Appendix - P

Effluent Outfall Site Selection

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April 24, 2018 File No. 115157

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Attn: **Christine Furlong, P.Eng.**
Project Manager

Ref: **Town of Erin, Urban Centre Wastewater Servicing Class EA**
Effluent Outfall Site Selection, Technical Memorandum

Dear Ms. Furlong:

We are pleased to present our Technical Memorandum for the "Effluent Outfall Site Selection" for the Urban Centre Wastewater Servicing Schedule 'C' Municipal Class Environmental Assessment (EA).

This Technical Memorandum provides a review of the effluent outfall site alternatives for discharge of treated wastewater to the West Credit River and is based on the preferred general alternative solution identified in the Servicing and Settlement Master Plan (SSMP). The Technical Memorandum establishes and evaluates alternative sites for the effluent outfall as a component of Phase 3 and of the Municipal Class EA process.

Yours truly,

AINLEY & ASSOCIATES LIMITED

Joe Mullan, P.Eng.
Project Manager

TOWN OF ERIN

Town of Erin

Urban Centre Wastewater Servicing Class Environmental Assessment

Technical Memorandum Treated Effluent Outfall Site Selection

Final

April 2018

Ainley GROUP
CONSULTING ENGINEERS PLANNERS

Urban Centre Wastewater Servicing Class Environmental Assessment

Technical Memorandum
Treated Effluent Outfall Site Selection

Project No. 115157

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The Town of Erin

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Glossary of Terms

ACS	Assimilative Capacity Study: see assimilative capacity.
Ainley	Primary engineering consultant for the Class EA process.
Alternative Solution	A possible approach to fulfilling the goal and objective of the study or a component of the study.
Assimilative Capacity	The ability of receiving water (lake or river) to receive a treated effluent discharge without adverse effects on surface water quality, eco-system and aquatic life.
Benthic	Of, relating to, or occurring at the bottom of a body of water.
Build-out	Refers to a future date where all vacant and underdeveloped lots have been fully developed in accordance with the Town's Official Plan.
Class EA	Municipal Class Environmental Assessment, a planning process approved under the EA Act in Ontario for a class or group of municipal undertakings. The process must meet the requirements outlined in the "Municipal Class Environmental Assessment" document (Municipal Engineers Association, October 2000, as amended). The Class EA process involves evaluating the environmental effects of alternative solutions and design concepts to achieve a project objective and goal and includes mandatory requirements for public consultation.
CVC	Credit Valley Conservation Authority
Design Concept	A method of implementing an alternative solution(s).
Environmental Compliance Approval (ECA)	This approval covers emissions and discharges related to air, noise, waste or sewage.
Effluent	Liquid after treatment. Effluent refers to the liquid discharged from the WWTP to the receiving water.
ESR	Environmental Study Report, a report prepared at the culmination of Phase 4 of the Class EA process under a Schedule C planning process.
Evaluation Criteria	Criteria applied to assist in identifying the preferred solution(s).
Forcemain	A pressurized pipe used to convey pumped wastewater from a sewage pumping station.
Geotechnical Investigation	Study of the engineering behavior of earth materials such as soil properties, rock characteristics, natural slopes, earthworks and foundations, etc.
Gravity sewer	A pipe that relies on gravity to convey sewage.
HSEL	Hardy Stevenson and Associates Limited is the firm conducting the public consultation process for this Class EA.
Hydrogeological	Study of the distribution and movement of groundwater in soil or bedrock.
Master Plan	A comprehensive plan to guide long-term development in a particular area that is broad in scope. It focuses on the analysis of a system for the purpose of outlining a framework for use in future individual projects.
MOECC	Ministry of the Environment and Climate Change, the provincial agency responsible for water, wastewater and waste regulation and approvals, and environmental assessments in Ontario.
NPV	Net Present Value is the value in the present of a sum of money, in

	contrast to some future value it will have when it has been invested at compound interest.
O&M	Operation and maintenance
Open-cut Construction	Method of constructing a pipeline by open excavation of a trench, laying the pipe, and backfilling the excavation.
Peak Flow	An estimation of the maximum volume of wastewater generated over a single day. The peak day flow is calculated by multiplying the ADF by the Harmon Peaking Factor.
Preferred Alternative	The alternative solution which is the recommended course of action to meet the objective statement based on its performance under the selection criteria.
Sewage Pumping Station (SPS)	A facility containing pumps to convey sewage through a forcemain to a higher elevation.
PWQO	Provincial Water Quality Objectives (PWQO) are numerical criteria which serve as chemical and physical indicators representing a satisfactory level for surface waters (i.e. lakes and rivers). The PWQO are set at a level of water quality which is protective of all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure to the water.
ROW	Right-of-way applies to lands which have an access right for highways, roads, railways or utilities, such as wastewater conveyance pipes.
Screening Criteria	Criteria applied to identify the short-list of alternative solutions from the long-list of alternative solutions.
Service Life	The length of time that an infrastructure component is anticipated to remain in use assuming proper preventative maintenance.
Sewage	The liquid waste products of domestic, industrial, agricultural and manufacturing activities directed to the wastewater collection system.
Sewage Treatment Plant (STP)	A plant that treats urban wastewater to remove solids, contaminants and other undesirable materials before discharging the treated effluent back to the environment. Referred to in this Class EA as a Wastewater Treatment Plant.
SSMP	Servicing and Settlement Master Plan – the master plan for Erin which was conducted by B.M. Ross in 2014 and establishes the general preferred alternative solution for wastewater.
Terms of Reference (ToR)	The Terms of Reference define the purpose and structures of a project, committee, meeting, negotiation, or any similar collection of people who have agreed to work together to accomplish a shared goal.
Trenchless technology	Methods of installing a utility, such as a sewer, without excavating a trench, including directional drilling, microtunneling etc.
Triton	Town of Erin engineering consultant.
UCWS Class EA	Urban Centre Wastewater Servicing Class Environmental Assessment.
Wastewater	See Sewage.
Wastewater Treatment Plant (WWTP)	See Sewage Treatment Plant.

1.0 Purpose and Study Background

In 2014 the Town of Erin completed a Servicing and Settlement Master Plan (SSMP) to address servicing, planning and environmental issues within the urban areas of Erin Village and Hillsburgh. The aforementioned SSMP examined issues related to wastewater servicing and concluded that the preferred solution for both urban areas was a municipal wastewater collection system conveying wastewater to a single wastewater treatment plant located south east of Erin Village with treated effluent being discharged to the West Credit River.

In August of 2013, B. M. Ross concluded an Assimilative Capacity Study (ACS) establishing that a surface water discharge of treated effluent to the West Credit River was a viable alternative and suggested that the most suitable location for a WWTP outfall to the West Credit River would be situated between 10th Line and Winston Churchill Boulevard. It should be noted that the discharge from a WWTP was recommended to be located below Erin Village because of the greater assimilative capacity in this part of the river. The water quality records within this span of the river indicate lower contaminant concentrations than in other locations upstream. MOECC and CVC agreed with this approach. An update to the ACS during this Urban Centre Wastewater Servicing (UCWS) Class EA study has confirmed the viability of this location and has established effluent criteria that will permit both communities to be built out to full build out of the present OP. Whereas the SSMP recommended preferred alternative was a single treatment plant with a capacity of 2,610 m^3/d, servicing a population of 6,000 persons, this UCWS Class EA study has identified a recommended preferred alternative treatment plant with a capacity of 7,172 m^3/d servicing a population of 14,459 persons and the updated ACS confirmed this discharge capacity potential.

The Terms of Reference for this UCWS Class EA study require that alternative sites for the effluent discharge location be identified and evaluated and a recommended preferred site selected. The purpose of this memorandum is to identify alternative potential locations for the discharge of treated wastewater effluent to the West Credit River and to conduct a detailed evaluation to select the recommended preferred discharge site.

1.1. Related Documents and Projects

Several related studies were completed prior to the commencement of the UCWS Class EA study. During Phase 1 of the UCWS Class EA, each of these studies was reviewed for pertinent information related to this project. They are described in brief in the following subsections.

1.2. Zoning Bylaw

The Town of Erin's Zoning Bylaw (No. 07-67) provides detailed information to control the development of properties within the Town. The bylaw regulates many aspects of development, including the permitted uses of property, the location, size, and height of buildings, as well as parking and open space requirements.

1.3. Servicing and Settlement Master Plan (SSMP)

The SSMP was developed by B.M. Ross and Associates Limited (2014) with the goal to develop appropriate strategies for community planning and municipal servicing, consistent with current provincial, county and municipal planning policies. The SSMP process followed the Master Plan approach, specifically Approach 1, as defined in the Municipal Class Environmental Assessment (Class EA) document, dated October 2000 (as amended in 2007 and 2011).

2.0 General Review of Potential Outfall Locations

The potential location for an effluent outfall site to the West Credit River was reviewed during the 2014 SSMP and a rationale was established for the location between 10th Line and Winston Churchill Boulevard where the assimilative capacity of the West Credit River is maximised. The updated Assimilative Capacity Study (ACS) completed for this UCWS Class EA has confirmed the validity of this stretch of the river as being suitable for the discharge from a water quality point of view.

The Collection System Alternatives Technical Memorandum completed as part of this UCWS Class EA study identifies a preferred collection system that conveys all wastewater to a Sewage Pumping Station at the South end of Erin Village and a forcemain from that Sewage Pumping Station that pumps all wastewater along Wellington Road 52 towards 10th Line. Wastewater treatment and disposal is therefore recommended to be located in the area of 10th line and Winston Churchill Boulevard (WCB). Based on this, Figure 1 shows the area for the potential locations of the outfall.

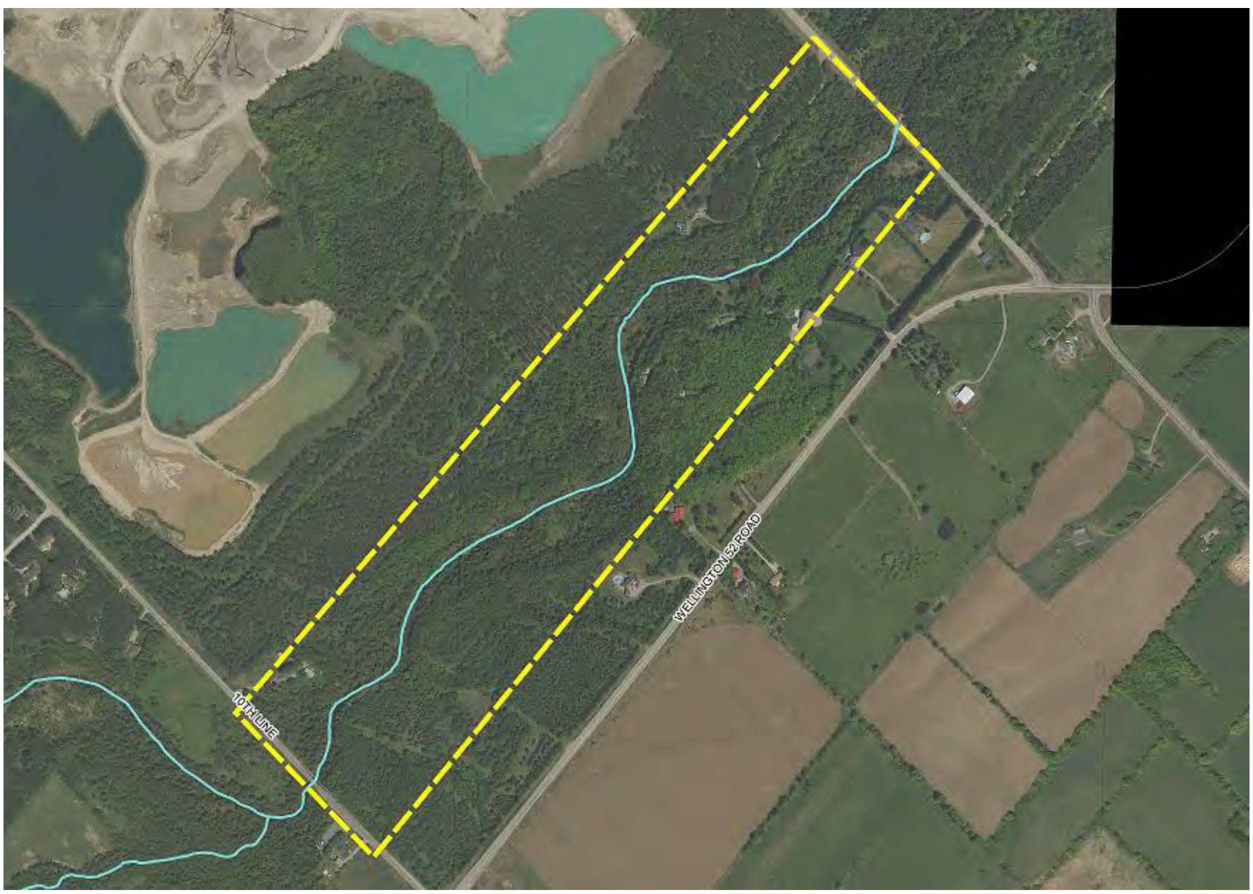

Figure 1 - Study Area for Potential Outfall Locations

As a first step in identification of alternative discharge locations, the following key aspects were considered:

- The need for permanent access to the discharge point to support collection of samples and maintain the discharge pipe and diffusers
- Minimising impacts to the natural environment during construction and operation
- Minimising impacts on the riverbed and banks
- Minimising the impacts on private property

The entire stretch of the river between 10th Line and Winston Churchill Boulevard is heavily wooded and privately owned. Locating an outfall anywhere along this stretch would require purchase of an easement from 10th Line to the potential discharge point from land owners (possibly several owners) and the removal of trees sufficient to create a permanent access road for construction of the pipeline and ongoing operation and maintenance activities. This would have a significant impact on the natural environment. In addition, the nature of the river along this stretch is such that there is no particular location that would present a natural outfall location.

3.0 Potential WWTP Discharge Outfall Sites

Based on the above, two locations were examined as potential discharge points.

- Where 10th Line crosses the West Credit River
- Where Winston Churchill Boulevard crosses the West Credit River

Both of these locations are fully accessible from public road allowances leading from the area of the proposed WWTP. A field review established that an outfall could be constructed within the public right of way on either side of the bridge on 10th Line and on the west side of Winston Churchill Boulevard. It is noted that the east side of Winston Churchill Boulevard is in Peel Region.

Three (3) alternative sites for the treated effluent outfall have been identified as follows:

- Alternative 1A 10th Line West Side
- Alternative 1B 10th Line East Side
- Alternative 2 Winston Churchill Boulevard West Side

In all three alternatives, the treated effluent will be discharged though the effluent pump station at the recommended WWTP site and conveyed through forcemains and gravity sewers to the discharge locations which are depicted in Figures 2 and 3.

A natural environment assessment was carried out along this stretch of the river including the above alternative sites, during June 2017 by Hutchinson Environmental Sciences Ltd (HESL). The HESL report forms part of the project documentation.

A Fluvial Geomorphological Assessment along this stretch of the river was carried out by Palmer Environmental Consulting Group Inc. This report is attached as an appendix to this Technical Memorandum.

A geotechnical field investigation along the routes of the proposed sewers/forcemains from the WWTP to the outfall alternative sites was carried out by GeoPro Limited, during October 2017 and this report also forms part of the project documentation.

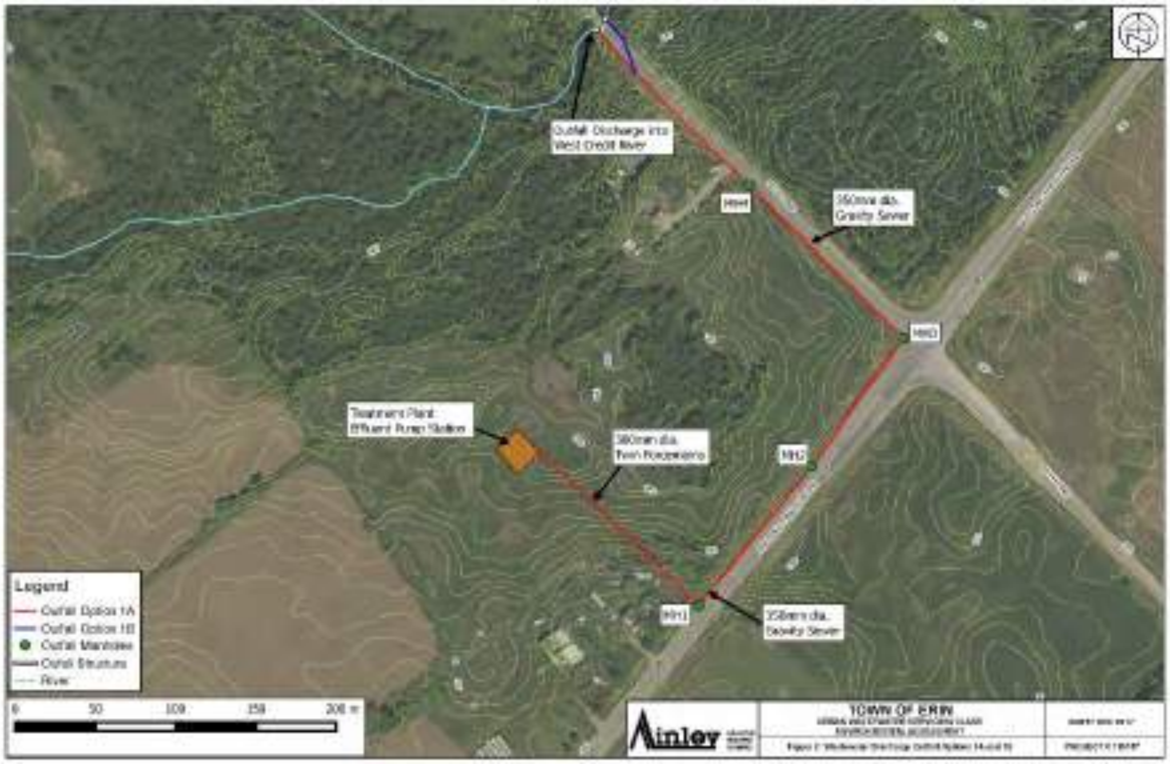

Figure 2 – Wastewater Effluent Discharge Outfall Alternatives 1A and 1B

Figure 3 – Wastewater Effluent Discharge Outfall Alternative 2

3.1. Description of Alternatives

3.1.1. Alternative 1A/1B –10th Line

Alternatives 1A and 1B will consist of gravity sewers that run East on Wellington Rd 52 from the proposed WWTP Site and then North on 10^{th} Line before discharging into the West Credit River. There is significant downwards slope on Wellington Rd 52 heading towards 10^{th} Line and from the intersection of 10^{th} Line North to the West Credit River bridge. As can be seen in Figure 4, there is enough room on the north shoulder of Wellington Rd 52 to place the discharge sewer within the shoulder and not in the road.

Figure 4 – Wellington Rd 52 facing West from 10th Line Intersection

The gravity discharge sewer will continue East on Wellington Rd 52 towards the intersection of Wellington Rd 52 and 10th Line. At the manhole within that intersection, the sewer will turn North on 10th Line. Figure 5 shows the view North down 10th Line from the Wellington Rd 52 / 10th Line intersection.

Figure 5 – 10th Line Facing North Towards West Credit River

There appears to be sufficient clearance from power lines to permit construction while retaining two-way traffic on 10th Line. As the sewer approaches the bridge over the West Credit River, there are two options for discharge: the West side of the bridge or the East side of the bridge. For Alternative 1A, the discharge is on the West side of the bridge.

It can be seen in Figure 6 that the road reduces to one lane over the bridge, however the sewer can still be constructed on the west side of the road allowance without affecting the bridge. The roadside barrier will need to be temporarily removed to allow construction of the sewer to the river. The CVC monitoring station will need to be protected during construction.

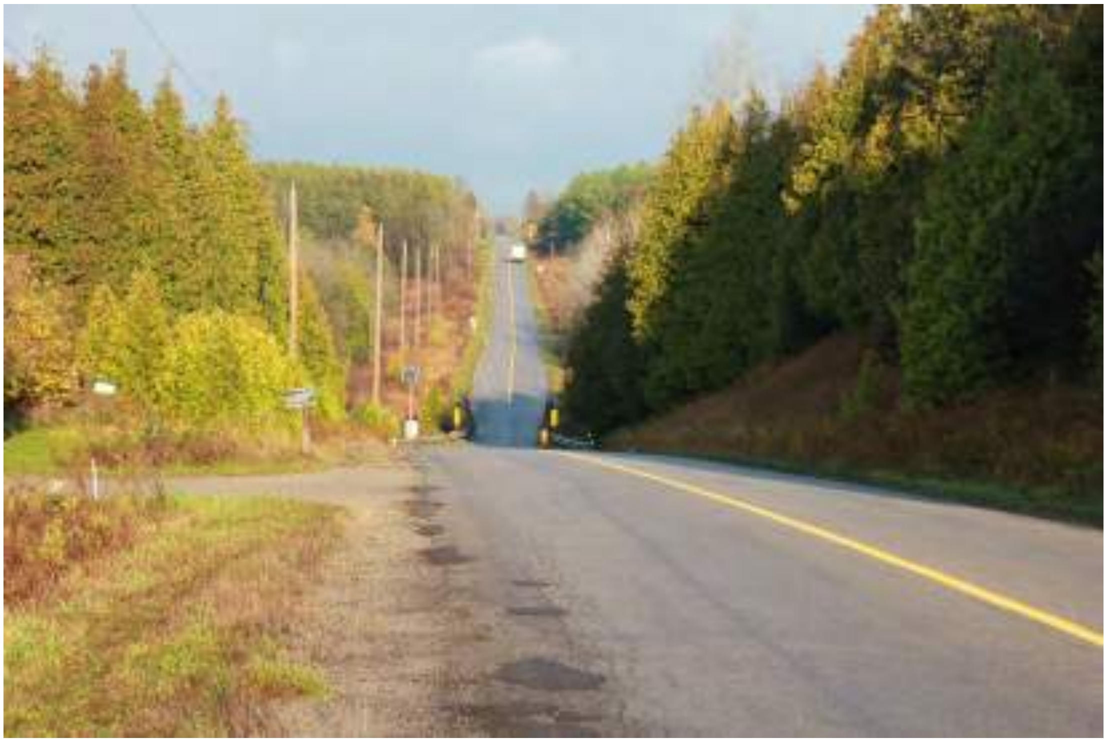

Figure 6 – 10th Line West Credit River Bridge (CVC monitoring station also pictured)

Figure 7 - Outfall Alternative 1A Discharge Location (Facing South)

In accordance with the recommendations in the Assimilative Capacity Study, the outfall will need to extend either along the bank for 5 metres with 15 equally spaced diffuser ports to disperse the effluent. Details of the diffuser will be developed during detailed design.

3.1.2. Alternative 1B –10th Line (East Side of bridge)

Alternative 1B is the same as Alternative 1A until the sewer nears the West Credit River bridge. At this point the discharge sewer will need to cross 10th Line and discharge into the river on the east side of the bridge. Figure 8 depicts the bridge area and the difference between Alternative 1A and 1B in more detail.

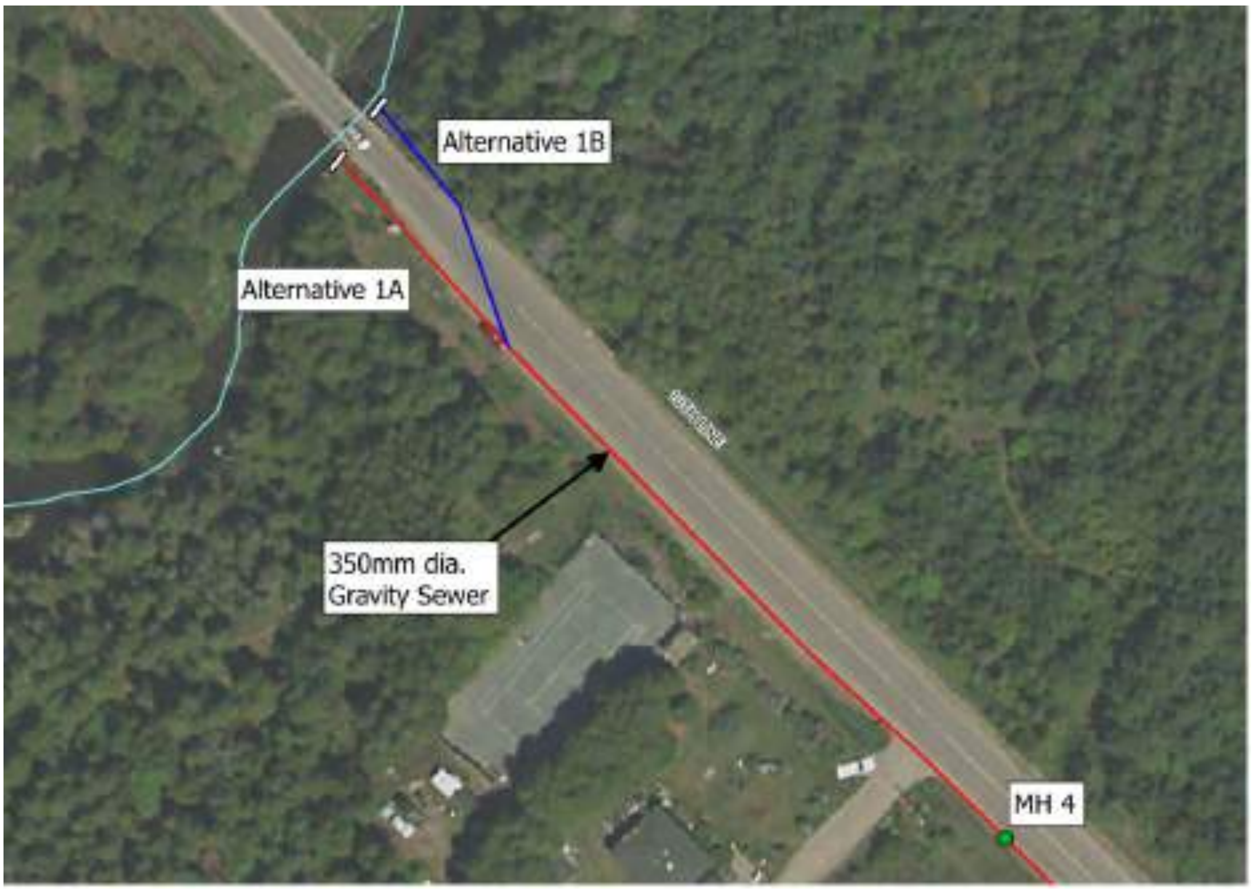

Figure 8 – 10th Line West Credit River Bridge for Alternatives 1A and 1B

The East side of 10th Line has a steep bank immediately off the shoulder making it difficult to construct the sewer. For this reason, Alternative 1B will need to cross the road at the point shown in Figure 8. Figure 9 shows the approximate outfall location for Alternative 1B.

Figure 9 - Alternative 1B Discharge Sewer Outfall Location (Facing South)

3.1.3. Alternative 2 –Winston Churchill (West Side of Bridge)

Alternative 2 will require a forcemain all the way from the WWTP site along Wellington Rd 52 to Winston Churchill Boulevard. This 1.6 km stretch of road slopes back towards 10th Line requiring the effluent to be pumped.

Figure 10 - Wellington Rd 52, From 10th Line Intersection Facing East

Figure 10 illustrates ample width of the shoulder available to place the forcemains with minimal impact on the existing road. The forcemains will follow the North shoulder of Wellington Rd 52 to a proposed manhole at the intersection with Winston Churchill Boulevard. From the intersection, a gravity sewer will convey effluent north, downhill along the west side of Winston Churchill Boulevard to the river. The sewer will require to be constructed down the west side of the road to remain in Wellington County. The road centreline represents the boundary between Wellington County and Peel Region.

Figure 11 - Winston Churchill Blvd Facing North from Wellington Rd 52 Intersection

Figure 11 also illustrates the narrowness of the shoulder and proximity to overhead power lines on the west side of the road. This will necessitate a lane closure of the road during construction. Due to the steepness of the road and height above the river, an energy dissipation manhole will be required to ensure an even velocity for dispersion into the river. The discharge will be as shown in Figure 12.

Figure 12 - Winston Churchill Blvd River Crossing and Alternative 2 Discharge

The same Alternative 1A/1B outfall structure will be used for the Alternative 2 discharge (Appendix A). Figures 13 and 14 show how the future sewer approaches the West Credit River.

Figure 13 - Facing North on Winston Churchill Blvd towards West Credit River

Figure 14 - West Side of Winston Churchill Blvd River Crossing

It can be seen in Figure 15 that the outfall will discharge directly before the opening of the culvert crossing.

Figure 15 - Alternative 2 Outfall Discharge Location

3.2. Impact Analysis of Alternatives

Cost Impacts

In order to compare the capital costs of the three (3) outfall sites, the following was considered:

- Costs of forcemain/sewer to convey treated effluent to each outfall site
- Costs for manholes/chambers for each outfall site
- Costs associated with any unique development features for each outfall site
- Costs for the actual outfall diffuser pipe.

Since all outfall scenarios require an effluent pumping station, this was not considered in the cost impact analysis. For the comparative analysis of the alternatives, costs were taken from the 10th Line/Wellington road intersection.

The peak flows for both Phases 1 and 2 of the WWTP were generated within our technical memorandum titled “Wastewater Treatment Technology Evaluation” and established as 11,779 m^3 /day (136.2 L/s) and 19,148 m^3 /day (221.6 L/s), respectively. These flows were used to size all discharge outfall alternatives. Unit costs were taken from the cost tables established in the “Collection System Alternatives Review”. Once the forcemains reach the road, Alternatives 1A/B and Alternative 2 were sized and costed differently as shown in the following sections. The costs were generated from Tables 1, 2 and 3 which provide prices for installation of sewer pipe, forcemain and manholes.

- All costs are presented in 2016 Canadian dollars.
- Net present value costs are based on 80 years of operation, maintenance, and component replacement. Capital costs are excluded.
- Inflation and escalation to account for actual expected prices at the time of tendering cannot be accounted for at this time.
- Life cycle costs have been estimated based on an inflation rate of 4%.

For alternatives 1A and 1B, the gravity sewer size was determined to be a 350 mm diameter sewer based on a full build out peak flow of 19,148 m^3 /day (221.6 L/s) for both alternatives 1A and 1B. Based on that pipe size, the number of manholes shown in Figure 2, and an approximate outfall structure cost of $30,000, the cost breakdown of these alternatives can be seen in Tables 1 and 2 below.

Table 1 – Alternative 1A Capital Cost

Alternative 1A (350mm Gravity Sewer)			
	Units	**Unit Cost**	**Cost**
350mm PVC Pipe	588 m	$ 560	$ 329,280
Manholes	4	$ 10,000	$ 40,000
Outfall Structure	1	$ 30,000	$ 30,000
		Total	**$ 399,280**

Table 2 – Alternative 1B Capital Cost

Alternative 1B (350mm Gravity Sewer)			
	Units	**Unit Cost**	**Cost**
350mm PVC Pipe	590 m	$ 560	$ 330,400
Manholes	4	$ 10,000	$ 40,000
Outfall Structure	1	$ 30,000	$ 30,000
Total			**$ 400,400**

For Alternative 2, twin 300 mm diameter forcemains are proposed for the full build out flows. One air/vacuum relief valve chamber will also be required along Wellington 52 at the high point. From the intersection of Winston Churchill Boulevard and Wellington Rd 52 a 300 mm gravity sewer is required down to the river. Using these pipe sizes, the one proposed air chamber, and four proposed manholes, the cost breakdown of this alternative is shown in Table 3:

Table 3 – Alternative 2 Capital Cost

Alternative 2 (Twin 300mm Forcemains + 300mm Gravity Sewer)			
	Units	**Unit Cost**	**Cost**
Twin 300mm PVC Pipe	1696 m	$ 800	$ 1,356,800
300mm Gravity Sewer	323 m	$ 520	$ 167,960
Manholes	4	$ 10,000	$ 40,000
Air Chambers	1	$ 12,000	$ 12,000
Outfall Structure	1	$ 40,000	$ 30,000
		Total	**$ 1,606,760**

The operation and maintenance costs for Alternative 1A/1B will involve routine maintenance of the short sewer section and energy costs for pumping from the WWTP to Wellington Road 52. Alternative 2 will involve a slightly higher cost for operation and maintenance of the forcemains, and a similar cost for the sewer section.

The design is based on twin 300 mm forcemains sufficient to accommodate full build out peak flow. Peak flow events are short duration, while most of the time the flow will be closer to average flow. Using twin 300 mm forcemains the velocity under peak flow will be 1.6 m/s whereas under average flow the velocity will be under 0.6 m/s requiring substantially less energy.

There will be added energy cost to pump effluent from the WWTP to the outfall location at Winston Churchill Blvd versus 10th Line. The preferred WWTP site will require an effluent pumping station so the effluent would be pumped from this location no matter where the discharge to the river is located. The capital cost of the effluent pumping station was included in the WWTP Treatment Process Selection Technical Memorandum. For WWTP Site 1 (Solmar) the effluent would be pumped to an elevation on Wellington Road 52 that is above the outfall pipe all the way to Winston Churchill Boulevard. Pumping along this outfall will require only 2.5 m of additional dynamic head under average flow condition. At full buildout, this results in an additional energy requirement of 76 KWh/day which represents $4,000/year energy cost. The 80 year NPV for this extra energy cost is $95,000.

The total lifecycle costs, including initial construction and 80 years of operational costs of each alternative are provided in Table 4.

Table 4 – Total 80-year Lifecycle Costs

Alternative	Estimated Lifecycle Cost
Site 1A (10^{th} Line West)	$895,300
Site 1B (10^{th} Line East	$ 896,400
Site 2 (WCB West)	$ 2,191,800

Environmental Impacts

The Assimilative Capacity Study (ACS) completed by HESL in 2017 outlines and delineates effluent limits and objectives sufficient to ensure that effluent is not directly toxic to the aquatic environment, and determines the characteristics of the mixing zone and water quality at the point of complete mixing downstream of the effluent outfall site. Water quality modelling results are compared to Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines to determine the potential for any impacts to aquatic biota. Water quality objectives and guidelines are protective of all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure to water (MOE 1994).

There is an additional requirement that the effluent stream, at the point of discharge, not be acutely lethal to aquatic life.

The size and shape of the effluent plume and water quality in the mixing zone was modelled using the CORMIX water quality model (as required by MOECC) and oxygen and temperature modelling of the discharge was modelled using the Qualk2K model (HESL 2017). The 10th Line was used as the modelled effluent outfall location, but the results can be conservatively applied at Winston Churchill Boulevard since there is approximately 15% more dilution potential at Winston Churchill Boulevard due to inputs of groundwater between the two locations.

The HESL (2017) ACS concluded the following with respect to parameters most relevant to aquatic life, including fisheries and sensitive Brook Trout habitat in the study area:

- For the Full Build Out summer low flow scenario, dissolved oxygen concentrations were predicted to decrease by 1.33 mg/L to a minimum concentration of 6.39 mg/L at a distance approximately 700 m downstream of the WWTP discharge location and then begin recovering. As such, dissolved oxygen concentrations were predicted to remain well above the PWQO of 5 mg/L for cold water biota at river temperatures of 20°C and 25°C.
- Given that the maximum summer water temperature for the WWTP effluent of 19°C proposed by BM Ross (2014) is below the 75th percentile West Credit River water temperature of 21.18°C, the input from the WWTP effluent will slightly cool the river temperatures downstream of the outfall.
- A total ammonia effluent limit of 2.1 mg/L or less would meet the requirement for non-lethality during the summer discharge period. The distance to meet the PWQO for un-ionized ammonia of 0.02 mg/L is 153 m from the outfall at full build out and through implementation of a multiport diffuser. The mixing zone does not occupy the complete width of the river and meets all MOECC requirements for mixing zones.

From an Environmental perspective, the potential effluent outfall locations at 10th Line and Winston Churchill Boulevard were evaluated through the following criteria characterizing aquatic ecology conditions: water temperature, dissolved oxygen, Brook Trout redds and benthic invertebrate biological metric results.

Water temperature and dissolved oxygen data were gathered from HESL (2017) and compared at each site. Water temperatures were cooler in the summer at Winston Churchill Boulevard, as measured as maximum water temperature and 75th percentiles, because groundwater upwellings are abundant in the study reach upstream of Winston Churchill Boulevard. Dissolved oxygen concentrations were slightly higher as well at Winston Churchill Boulevard because of upstream groundwater inputs (HESL 2017). These provide more resilience and potential for assimilation of effluent and any associated changes in temperature and oxygen demand.

Only three Brook Trout redds were observed in the potential mixing zone within 153 m of the 10th Line. Dissolved oxygen was modelled to decline slightly downstream of the outfall. More Brook Trout redds (39) were observed within the oxygen sag zone downstream of the 10th Line than downstream of Winston Churchill Blvd (15). The benthic invertebrate assemblage at the 10th Line contained a greater proportion and a more diverse assemblage of sensitive invertebrates.

Based on Environmental considerations, the preferred effluent outfall location to the West Credit River is Winston Churchill Boulevard because of the presence of more sensitive aquatic features and functions at the 10th Line and the density of Brook Trout redds downstream. Treated effluent discharged at the 10th Line would flow downstream through the sensitive study area to Winston Churchill Blvd. and beyond but an outfall location at Winston Churchill Blvd. would avoid the most sensitive area altogether, initial mixing would occur within the culvert where habitat has already been impacted and there is ~ 15% more assimilation flow (HESL 2017).

Agricultural Impacts

There are no agricultural impacts associated with construction at the sites.

Fluvial Geomorphological Impacts

Based on the results of the fluvial geomorphological assessment, all alternative sites would provide suitable effluent discharge locations. The study indicates that the discharge would not impact the stream bed or banks to any meaningful extent.

Archaeological Impacts

Construction of all the treated effluent outfall alternatives will be completed in public rights of way (road allowances) including the actual outfall locations at the West Credit River. As such, all of the disturbed lands are previously disturbed for construction of the road or bridge works. It is not anticipated that archaeological impacts will be significant for any of the alternatives.

Geotechnical Impacts

All of the construction of the treated effluent outfall alternatives will be completed in public rights of way (road allowances) including the actual outfall locations at the West Credit River. As such, all of the disturbed lands are previously disturbed for construction of the road or bridge works. It is not anticipated that archaeological impacts will be significant for any of the alternatives.

4.0 Evaluation Methodology

The evaluation methodology used to select the preferred treated effluent outfall site was established in a manner consistent with the principles of environmental assessment planning and decision-making as outlined in Municipal Class Environmental Assessment.

A decision model consistent with the principles of environmental assessment planning and decision making as outlined in Municipal Class Environmental Assessment manual was developed to select the preferred outfall site.

In developing the decision model, relevant and specific evaluation criteria were identified and compared distinguishing features between the sites. Whereas other components of the UCWS Class EA place a higher emphasis on Technical Criteria, for the outfall site selection evaluation, Environmental and Economic Criteria play a more important role.

Based on the above, the three (3) Alternative Sites (Site 1A, 1B, and 2) will be evaluated against the specific evaluation criteria described in the Table 4 below:

Table 5 – Outfall Alternatives Evaluation Criteria

Primary Criteria	Weight	Secondary Criteria	Weight
Social/Culture	10%	Impacts During Construction	30%
		Aesthetics (Appearance of discharge)	40%
		Effect on Residential Properties	10%
		Effect on Businesses/ Commercial Properties	10%
		Effect on Industrial Properties	10%
Technical	10%	Functionality and Performance	30%
		Suitability for Phasing	10%
		Constructability	30%
		Operation and Maintenance Impacts	30%
Environmental	60%	Effect on Surface Water/ Fisheries	50%
		Effect on Vegetation/ Wetlands	20%
		Effect on Groundwater	20%
		Effect on Habitat/ Wildlife	10%
Economic	20%	Capital Cost	100%

4.1. Screening Criteria Definitions

4.1.1. Social/Culture, Impacts During Construction

This criterion captures the level of disturbance to the community the proposed solution will have during the construction period. These effects include noise levels, vibration, odours, dust production, as well as the amount of time for which these disturbances will persist.

4.1.2. Social/Culture, Aesthetics (appearance of Discharge)

This criterion captures the level of impact from the visual appearance of the outfall and discharge to the river.

4.1.3. Social/Culture, Effect on Residential Properties

This criterion captures the level of impact that the outfall has on individual residential properties. Impacts considered include operation and maintenance activities.

4.1.4. Social/Culture, Effect on Commercial Properties

This criterion captures the level of impact that the outfall has on individual commercial properties. Impacts considered include operation and maintenance activities.

4.1.5. Social/Culture, Effect on Industrial Properties

This criterion captures the level of impact that the outfall has on individual industrial properties. Impacts considered include operation and maintenance activities.

4.1.6. Technical, Functionality and Performance

This criteria compares the methods of conveying the effluent to the outfall location (pumping or gravity) and the technical suitability of the sites to accept and mix the effluent into the river.

4.1.7. Technical, Suitability for Phasing

This criterion captures the ability to be expanded under a phased development plan. Outfall locations that allow flexibility in development to promote ease of expansion would have a higher score.

4.1.8. Constructability

This criterion captures the constructability of each alternative. This would include geotechnical aspects and hydrogeological aspects affecting structural design of the outfall.

4.1.9. Technical, Operational and Maintenance Impacts

This criterion captures the impacts of each site on the operability of the overall system. This would take into consideration, access to the outfall sites and level of effort required by operations staff to operate and maintain the outfall.

4.1.10. Environmental, Effect on Surface Water/ Fisheries

The criterion captures the impact that the establishment and operation of the outfall alternative has on the local surface waters both during construction and over the long term and in terms of impacts to water quality and fisheries. Minimizing contamination of the local surface water is rated favourably.

4.1.11. Environmental, Effect on Vegetation/ Wetlands

The criterion captures the impact that the establishment and operation of the system alternative has on the local vegetation and wetlands both during construction and over the long term. Minimizing negative impacts on the local vegetation and wetlands is rated favourably.

4.1.12. Environmental, Effect on Groundwater

The criterion captures the level of groundwater contamination associated with the establishment and operation. Minimizing contamination of the local groundwater is rated favourably.

4.1.13. Environmental, Effect on Habitat/ Wildlife

The criterion captures the impact that the establishment and operation of the system alternative has on the local habitat and wildlife both during construction and over the long term. Minimizing contamination of the local habitat and wildlife is rated favourably.

4.1.14. Economic

The criterion captures the estimated cost to construct the alternative and to operate and maintain the system on an annual basis.

4.2. Evaluation of Alternatives

4.2.1. Overview

As discussed in Section 3.0 above, the following three (3) alternatives for outfall were developed:

- Alternative 1A – 10th Line (West Side of Bridge)
- Alternative 1B – 10th Line (East Side of Bridge)
- Alternative 2 – Winston Churchill Blvd (West Side of Crossing)

A description and layout of these options can be found in Section 3.0.

4.2.2. Detailed Evaluation of Outfall Alternatives

The evaluation of each of the outfall alternatives, using the criteria and weightings listed in Table 4 is provided in Table 5.

Using the weighted percentages assigned to each category and criteria, each criteria is then scored from 1 to 5 with one having the most negative effect and 5 the least negative impact. The highest score therefore represents the preferred alternative.

Table 6 – Weighted Scoring of WWTP Outfall Site Alternatives

Primary Criteria		Secondary Criteria		Absolute Weight (WT)	Site 1A (10th Line West)		Site 1B (10th Line East)		Site 2 (Winston Churchill Blvd West)		Comments
Criteria	Weight	Criteria	Weight		Score	WT Score	Score	WT Score	Score	WT Score	
Social/Culture	10%	Impacts During Construction	50%	5	4	4	4	4	1	1	Site 2 has significant traffic impact on Wellington Road 52 and WCB
		Aesthetics (Appearance of discharge)	20%	2	3	1.2	3	1.2	4	1.6	All sites used by public but WCB discharge can be better hidden
		Effect on Residential Properties	10%	1	4	0.8	4	0.8	4	0.8	Little effect anticipated
		Effect on Businesses/ Commercial Properties	10%	1	5	1	5	1	5	1	Little effect anticipated
		Effect on Industrial Properties	10%	1	5	1	5	1	5	1	Little effect anticipated
Technical	10%	Functionality and Performance	50%	5	3	3	3	3	2	2	WCB better mixing and outfall location but higher energy use
		Suitability for Phasing	10%	1	2	0.4	2	0.4	2	0.4	Typically outfalls are sized for ultimate
		Constructability	30%	3	4	2.4	4	2.4	2	1.2	All relatively straight forward but WCB considerably longer and must be pumped
		Operation and Maintenance Impacts	10%	1	5	1	5	1	2	0.4	WCB more remote from plant and not so easy access for sampling
Environmental	60%	Effect on Surface Water/ Fisheries	70%	42	1	8.4	1	8.4	4	33.6	Discharge at 10th line has potential for substantially higher impact on fish
		Effect on Vegetation/ Wetlands	10%	6	4	4.8	4	4.8	4	4.8	Little effect anticipated
		Effect on Groundwater	10%	6	4	4.8	4	4.8	4	4.8	Small additional effect on local well at 10th Line
		Effect on Habitat/ Wildlife	10%	6	3	3.6	3	3.6	4	4.8	Slightly higher impact upstream of WCB
Economic	20%	Lifecycle Cost	100%	20	5	20	5	20	1	4	Site 2 has considerably higher capital cost and a higher operational cost
			TOTAL SCORE	100		56.4		56.4		61.4	

Based on the detailed evaluation of the alternatives, Alternative 2 returns the highest score and therefore offers the most benefit. The details of the scoring rationale are provided in Table 6.

Table 7 – Criteria Rating Rationale

Criteria	Site 1A (10th Line West)	Site 1B (10th Line East)	Site 2 (Winston Churchill Boulevard)
Social/ Culture - Impacts During Construction	▪ Open cut construction of sewer on Wellington 52 and 10th Line. Potential impact to one residence and small traffic impact	▪ As Site 1A	▪ Forcemain open cut construction along Wellington 52 shoulder and sewer down Winston Churchill Boulevard southbound lane. Potential impact on over 10 homes. ▪ Potential substantial traffic impact on Winston Churchill Boulevard and small impact on Wellington Road 52.
Social/ Culture - Aesthetics	▪ Outfall can be relatively well hidden beside bridge	▪ Outfall can be made slightly less visible than for Site 1A.	▪ Outfall can be well hidden from the road
Social/ Culture - Effect on Residential Properties	▪ Minimal long term impact on local properties	▪ Minimal long term impact on local properties	▪ Minimal long term impact on local properties
Social/ Culture - Effect on Businesses/ Commercial Properties	▪ Minimal long term impact on local businesses.	▪ Minimal long term impact on local businesses	▪ Minimal long term impact on local businesses
Social/ Culture - Effect on Industrial Properties	▪ Minimal long term impact on local businesses.	▪ Minimal long term impact on local businesses.	▪ Minimal long term impact on local businesses.
Technical – Functionality and Performance	▪ Requires pumping up to Wellington Road 52 then gravity to outfall. ▪ Reasonable access to outfall point for operation and maintenance. ▪ Enough space available within road property for outfall. ▪ Good location from geomorphological aspect ▪ Potential future bridge replacement/widening could affect outfall	▪ Requires pumping up to Wellington Road 52 then gravity to outfall. ▪ Reasonable access to outfall point for operation and maintenance. ▪ Enough space available within road property for outfall. ▪ Good location from geomorphological aspect ▪ Potential future bridge replacement/widening could affect outfall	▪ Requires pumping all the way to Winston Churchill Boulevard then gravity to outfall. ▪ Steep access to outfall point from river would require safe access construction. ▪ Good location for outfall for mixing. ▪ Good location from geomorphological aspect
Technical - Suitability for Phasing	▪ Typically outfalls are sized and constructed for full build out flows with port left closed off until needed. Likely full sized sewer would be build day one.	▪ Typically outfalls are sized and constructed for full build out flows with port left closed off until needed. Likely full sized sewer would be build day one.	▪ Typically outfalls are sized and constructed for full build out flows with port left closed off until needed. ▪ This alternative offers possibility to construct one forcemain at Phase 1 and add a second at Phase 2, however this does not provide redundancy during Phase 1 and overall results in higher capital cost.
Technical - Constructability	▪ Fairly easy to construct with few impacts.	▪ Fairly easy to construct with few impacts.	▪ Construction down Winston Churchill will have traffic and utility impacts. ▪ Steep bank between road and river will require energy dissipation before outfall.
Technical - Operation and Maintenance Impacts	▪ Easy access for maintenance	▪ Easy access for maintenance	▪ More remote access for maintenance and more difficult to get to river bank.
Environmental - Effect on Surface Water/ Fisheries	▪ Water temperature higher and oxygen levels lower than at Winston Churchill Boulevard ▪ Higher impact on Brook Trout and benthic invertebrates downstream of 10th Line than downstream of Winston Churchill Boulevard	▪ As Alternative 1A	▪ Water temperature lower and oxygen levels higher than at 10th Line ▪ Lower impact on Brook Trout and benthic invertebrates downstream of Winston Churchill Boulevard
Environmental - Effect on Vegetation/ Wetlands	▪ Little impact anticipated	▪ Little impact anticipated	▪ Little impact anticipated
Environmental - Effect on Groundwater	▪ Little impact anticipated	▪ Little impact anticipated	▪ Little impact anticipated
Environmental - Effect on Habitat/ Wildlife	▪ Little impact anticipated	▪ Little impact anticipated	▪ Little impact anticipated
Economic - Capital Cost	▪ Least cost alternative at $400,000	▪ Similar cost to 1A	▪ Capital Cost $1,600,000. ▪ Considerably more expensive alternative

5.0 Conceptual Outfall Design

The conceptual design of the outfall at the preferred location at Winston Churchill Boulevard is shown in Figure 16. The conceptual design shows the full extent of the outfall within the existing property line.

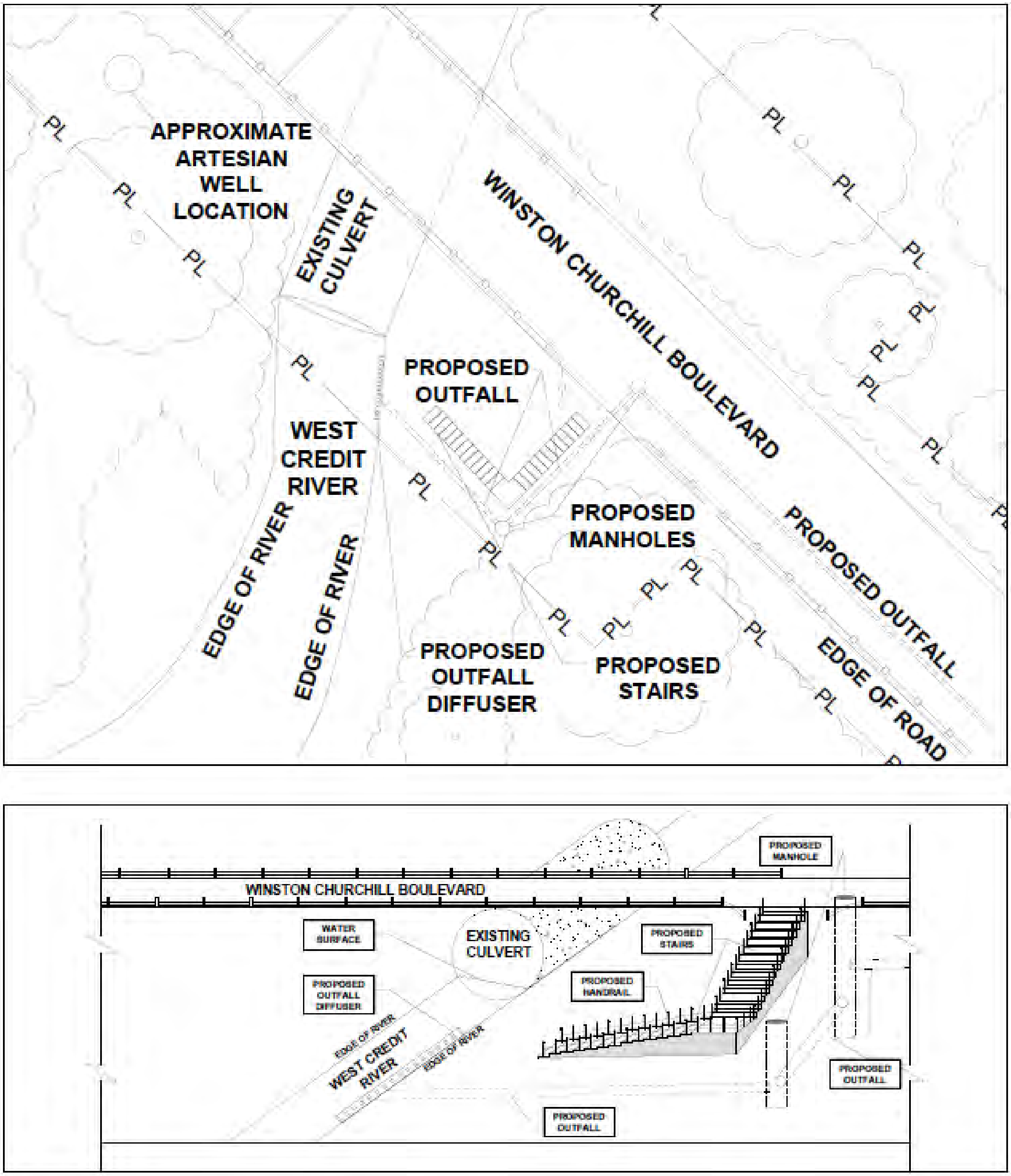

Figure 16 – Conceptual Outfall Design

6.0 Conclusions and Recommendations

- The 2014 Servicing and Settlement Master Plan (SSMP) identified a general area for a discharge of treated effluent to the West Credit River south east of Erin Village.
- The UCWS EA is a continuation of the Class EA process and aims to establish the preferred design alternative for the wastewater system servicing Erin Village and Hillsburgh.
- The updated Assimilative Capacity study completed for the UCWS Class EA study confirmed the suitability of the general effluent discharge area identified in the SSMP.
- The proposed treated water effluent Limits and Objectives for the discharge as outlined in the ACS confirm that all alternative outfall locations provide acceptable locations from a water quality perspective.
- Based on the above and a more detailed examination of the area, this UCWS Class EA study has refined the general area for the potential treated effluent outfall and selected three (3) sites within this area for more detailed evaluation.
- The three (3) alternatives effluent outfall sites are defined as follows:
  - Site 1A 10th Line West Side
  - Site 1B 10th Line East Side
  - Site 2 Winston Churchill Boulevard West Side
- The Outfall Alternatives were sized, conceptually designed and costed.
- In addition to the Assimilative Capacity Study, a Natural Environment Study, a Fluvial Geomorphological Study and Geotechnical study were undertaken for the river between 10th Line and downstream of Winston Churchill Boulevard and the outfall pipe routes from a potential WWTP site to assist with defining potential impacts.
- The team has compiled sufficient information on the environmental, geotechnical, archaeological and costing aspects of the sites to support an evaluation process aimed at selecting the preferred site.
- The evaluation criteria were established with the following weighting for the primary criteria:
  - Social/ Cultural Impacts – 10%
  - Technical Impacts – 10%
  - Environmental Impacts - 60%
  - Economic Impacts– 20%
- The evaluation criteria reflect the relative importance of the criteria on water quality and the potential impact on fisheries as well as cost
- The relative 80-year lifecycle costs, covering initial construction and 80 years of operational costs for each site are summarized as follows:

Alternative	Estimated Lifecycle Cost
Site 1A (10th Line West)	$895,300
Site 1B (10th Line East	$ 896,400
Site 2 (WCB West)	$ 2,191,800

- In addition, Alternative 2 will require additional pumping costs to pump the effluent to Winston Churchill Boulevard.
- Environmental impacts for Alternative 2 are summarized as follows:
  - Water temperature is lower and oxygen levels higher at Winston Churchill Boulevard
  - Lower impact on Brook Trout and benthic invertebrates
- Geotechnical impacts are summarized as follows:
  - Prevalent sand and gravel deposits in the area will not present major construction issues for outfall pipelines until close to the river where groundwater will affect construction. It is anticipated that dewatering will be required for the 100 m closest to the river. This applies to all alternatives.
- Archaeological impacts are not expected to be significant for any of the alternatives.
  - Since all of the works will take place in established road allowances, it is not anticipated that archaeological resources will be encountered.
- A Fluvial Geomorphological assessment confirmed that all potential outfall locations are suitable and will not cause erosion or affect the existing channel
- The results of the evaluation process indicate that, Alternative 2 (Winston Churchill Boulevard) has the highest score and is preferred over sites 1A and 1B.
- The primary reasons for this are:
  - The potential impact on Brook Trout and fisheries in the river reach downstream of 10th Line
  - Lower water temperature and higher oxygen levels at the Winston Churchill Boulevard location
  - Opportunity for improved mixing at Winston Churchill Boulevard location
- In examining the sensitivity of the scoring to changes in the criteria weightings, it should be noted that a 4% decrease in the Environmental weighting and corresponding 4% increase in the Economic weighting would result in Alternative 1A or 1B being the preferred Alternative. In this case the Environmental criteria has been rated highly because of the potential impact on brook trout which represents a valuable resource for the West Credit River. While the high quality effluent will protect river water quality and all of the fish species, there remains a risk to this sensitive and significant resource which cannot be mitigated.
- The recommended effluent limits are protective of all fish at all critical life stages and so meet the requirements for protection of aquatic habitat. Mitigation to be considered during design to achieve an even higher level of protection, in consideration of the resident population of Brook Trout are outlined below:
  - Any in-stream work should adhere to Fisheries and Oceans Canada's in-stream construction timing windows for spring (March 15 to July 15) and fall spawners (October 1 to May 31) to protect the sensitive life stages of spawning and rearing for resident species such as Rainbow and Brook Trout.
  - An Erosion and Sediment Control Plan should be developed to prevent runoff and solids from entering the river. A construction mitigation plan should be developed (CISEC Canada 2012)
- A monitoring plan should be developed in combination with the regulatory WWTP effluent monitoring to assess the response of the river to the effluent discharge. The monitoring plan will ultimately be

reviewed by CVC and regulated through the ECA and should include an assessment of fisheries, benthic invertebrates and aquatic habitat with sufficient effort to allow for natural variability to be controlled and allow for a sensitive determination of any impact.

Appendix A
Fluvial Geomorphological Assessment

PALMER
ENVIRONMENTAL
CONSULTING
GROUP INC.

Fluvial Geomorphological Assessment of West Credit River to Support Siting of a Proposed WWTP Discharge Location

Prepared for

Hutchinson Environmental Sciences Ltd.

November 16, 2017

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

374 Wellington Street West, Suite 3, Toronto, ON M5V 1E3 ***t*** *647-795-8153*

November 16, 2017

Deborah Sinclair
Hutchinson Environmental Sciences Ltd.
1-5 Chancery Lane
Bracebridge, ON
P1L 2E3

Dear Ms. Sinclair,

Re: Fluvial Geomorphological Assessment of West Credit River to Support Siting of a Proposed WWTP Discharge Location

Palmer Environmental Consulting Group Inc. is pleased to provide the results of our fluvial geomorphological assessment of West Credit River between 10th Line and Winston Churchill Boulevard, in the Town of Erin, in support of the overall Class Environmental Assessment for urban centre wastewater servicing.

The subject reach of West Credit River is an irregular-meandering, partly confined channel that has adopted a stable cross-sectional form and pool-riffle bed morphology. The proposed effluent discharge (0.083 m^3/s) will have negligible impact on erosion processes along West Credit River, and the two proposed discharge locations (10th Line and Winston Churchill Boulevard) are both morphologically stable.

Should you have any questions, please do not hesitate to contact Robin McKillop at 647-795-8153 (ext. 106) or robin@pecg.ca.

Yours truly,
Palmer Environmental Consulting Group Inc.

Robin McKillop, M.Sc., P.Geo., CISEC
Principal, Senior Fluvial Geomorphologist

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1 Introduction

Palmer Environmental Consulting Group Inc. (PECG) is pleased to provide Hutchinson Environmental Sciences Ltd. (HESL) with the results of our fluvial geomorphological assessment of West Credit River, between 10th Line and Winston Churchill Boulevard, in the Town of Erin (**Figure 1**). The fluvial geomorphological assessment will support the overall Class Environmental Assessment for urban centre wastewater servicing in the Town of Erin, which includes a proposed wastewater treatment plant (WWTP) along County Road 52. Effluent from the WWTP will discharge into West Credit River. A fluvial geomorphological assessment is required as a basis for evaluating the morphological implications of increased flow in West Credit River. As well, the assessment encompassed candidate discharge locations, with an emphasis on documenting and analyzing conditions in the areas most sensitive to increases in flow.

2 Methods

The fluvial geomorphology of West Credit River was assessed through a combination of desktop and field investigations. We reviewed a number of important background information sources for the study area, including Credit Valley Conservation's (CVC) 2005 and 2013 Watershed Report Cards, Management Plan Credit River Fisheries (2002), and Rising to the Challenge: A Handbook for Understanding and Protecting the Credit River Watershed (2009); 50 cm topographic contour data provided by HESL; and Ontario Geological Survey bedrock and surficial geology mapping (Ontario Geological Survey, 2014a,b). Orthophotography (2010) of the study area and Google Earth (2004, 2006, 2012, 2013, 2014, 2015, 2016) provided a basis for characterizing channel conditions in West Credit River.

Field reconnaissance and detailed data collection were completed on June 28, 2016 by PECG's Fluvial Geomorphologist during baseflow conditions without any significant antecedent precipitation. West Credit River was walked from ~400 m upstream of 10th Line to ~350 m downstream of Winston Churchill Boulevard to observe channel conditions, examine patterns and processes of local erosion, determine channel reach breaks, and ground truth aerial photograph-based interpretations. Furthermore, a Rapid Geomorphic Assessment (RGA; Ontario Ministry of the Environment, 2003) was completed along the study reach to document evidence of channel aggradation, degradation, widening and planimetric form adjustment. The RGA tool provides a useful checklist of evidence to consider, but its results are dependent on the presence or absence of a set number of specific features within a reach and thus must be interpreted carefully to ensure accuracy (McKillop, 2016).

Detailed data were collected at three sites in order to establish erosion thresholds: ~100 m downstream of 10th Line, ~100 m upstream of Winston Churchill Boulevard, and ~100 m downstream of Winston Churchill Boulevard (**Figure 1**). The three sites were deemed likely WWTP discharge locations through consultation with HESL (the proposed WWTP discharge locations were not determined at the time of the field work). Four to five cross-sections and a longitudinal profile were surveyed at each site according to CVC Fluvial

Geomorphic Guidelines (2015). The surveyed cross-sections were strategically positioned in representative morphological units (e.g. pools, riffles). Bankfull dimensions were based on field indicators defining the principal limit of scour, including abrupt changes in bank vegetation, material and steepness (Harrelson et al., 1994), which is assumed to represent the 'channel-forming discharge'. The grain size distribution of the alluvial material within each site was determined through modified Wolman (1954) pebbles counts.

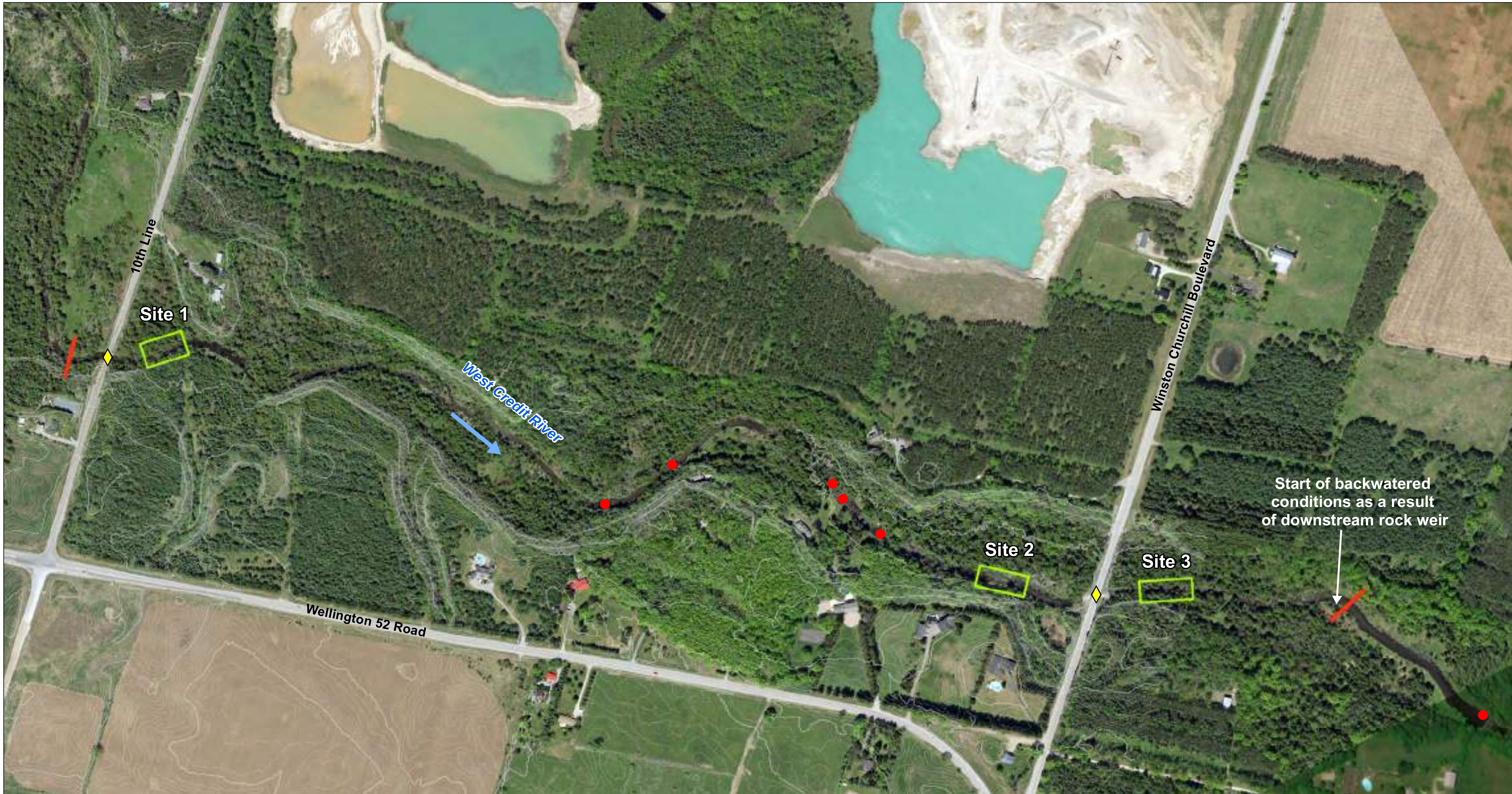
All bed erosion threshold and critical discharge analyses were completed based on a Shields (1936) approach as outlined by Church (2006), as it is a semi-empirical approach (as opposed to completely empirical) and is well-suited for gravel bed rivers. A bed erosion threshold is the hydraulic condition at which the channel bed is in a state of incipient motion, and the critical discharge is the flow that produces that threshold condition at a particular location along the channel. Iterative hydraulic simulations were completed to determine the flow at which the erosion threshold is exceeded (i.e. critical discharge).

3 Physical Setting and Historical Changes

The Credit River watershed is within the Regional Municipality of Peel, Regional Municipality of Halton, Wellington County, and Dufferin County. Major urban centers within the watershed include Caledon, Brampton and Mississauga. The entire watershed encompasses 871 km^2 and the main branch of Credit River is ~90 km long and contains over 1,500 km of tributaries (Credit Valley Conservation, 2002). The Niagara Escarpment, a major topographic feature, runs diagonally across the watershed. The headwaters of Credit River, including West Credit River, are located above the Niagara Escarpment. Streams above the Niagara Escarpment have remained in a relativity natural condition (Credit Valley Conservation, 2009).

The West Credit River subwatershed comprises hummocky moraines and drumlins (Guelph Drumlin Field) as well as glacial spillways, yielding undulating topography (Credit Valley Conservation, 2009). Within the study area, the West Credit River flows within a valley dominated by glaciofluvial deposits and the channel is underlain by modern alluvial deposits. Prominent fluvial terraces are present along the edges of the valleys (Ontario Geological Survey, 2014b). The coarse sands and gravels of the surficial material are highly permeable and support high infiltration rates. As such, baseflow in West Credit River is maintained from groundwater discharge. Maximum stream flow typically occurs in late winter or early spring as a result of snowmelt or rainfall on frozen ground, or a combination of both. High intensity summer storms also lead to high flow events. Stream monitoring conducted by CVC in 2003 suggests that watercourses within the West Credit River subwatershed are stable channels that are “In Regime” (Credit Valley Conservation, 2009).

Traditionally, agricultural (primarily beef cattle farming) has been a dominant land use in the upper Credit River watershed; however, there has been a significant decrease in the amount of land cultivated in recent decades. Deciduous forests and white cedar swamps are common atop the Niagara Escarpment and it is estimated that 60% of the upper watershed is forested (Credit Valley Conservation, 2009). Upstream of the study reach, land use is mostly natural areas and agricultural. Furthermore, the West Credit River catchment has many wetland complexes that moderate flood flows (Credit Valley Conservation, 2002).



Client: Hutchinson Environmental Services Limited
Project: Erin Waster Water Treatment Plant

PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DRAWN: B. Elder
DESIGNED: D. McParland
CHECKED: R. McKillop
PROJECT: 13183
DATE Jul 26, 2017

LEGEND

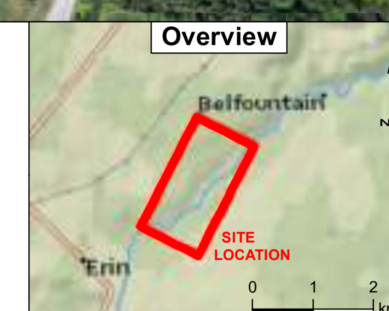
- Detailed Data Collection Site
- Anthropogenic Rock Weir
- Candidate Discharge Location
- Reach Break
- Flow Direction
- Contour (5 m Interval)
- Contour (1 m Interval)

DATA SOURCES: SWOOP Aerial imagery (2010) and topographic data provided by Hutchinson Environmental Services Limited. Roads, Additional basemap imagery ©ESRI, DigitalGlobe 2010. Inset backgorund - National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN (Content may not reflect National Geographic's current map policy).

COORDINATE SYSTEM:
NAD 1983 UTM ZONE 17N
SCALE: 1:5000

0 50 100 150 200 250
METRES

Overview



Study Area and Detailed Data Collection Sites

FIGURE 1

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4 Description of Channel Morphology

A description of channel morphology at the reach scale is provided in Section 4.1. Results of the site-scale detailed data collection, including the erosion threshold analyses, is documented in Section 4.2.

4.1 Reach Scale

A partly confined reach extending from ~50 m upstream of 10th Line to ~350 m downstream of Winston Churchill Boulevard was identified (**Figure 1**). Upstream of the reach, West Credit River is unconfined and low gradient and contains many large woody debris (LWD) jams. Downstream of the reach, the channel is significantly backwatered upstream of an anthropogenic rock weir. The identified reach exhibits a low-sinuosity, irregular meander pattern and is partly confined by prominent fluvial terraces and valley walls. The channel has a moderate gradient and, generally, has a defined pool-riffle bed morphology with pools located near the apices of meanders. The pool cross-sections tended to be asymmetric with larger depths along the outer bank, whereas riffles are typically symmetrical.

Bed material in the riffles is mostly coarse gravel and cobble derived from erosion of the underlying glaciofluvial materials. The coarser cobble particles are commonly covered in aquatic lichens and mosses, indicating they are rarely entrained (**Photo 1**). The bed material in the pools is dominated by gravel covered with a thin veneer of silts and sands. Bank materials are dominated by alluvial sands and silts. The channel banks are well-vegetated and have gentle slopes. Minimal bank and bed erosion was observed within the reach. The riparian vegetation, which is a mixture of herbaceous and mature forest, has locally been cleared near residential properties. Throughout the reach, fallen/leaning trees line the channel banks and many LWD jams are present (**Photo 2**). The jams locally perturb the energy gradient, cause local channel braiding/cutoffs, and store significant volumes of gravel (**Photo 3**). Furthermore, five anthropogenic rock weirs were observed adjacent to the residential properties (**Photo 4**). The rock weirs cause local channel impoundment but have minimal impact on channel morphology at the reach scale.

Overall, the study reach of West Credit River exhibits only minor departures from a state of dynamic equilibrium with an RGA Stability Index of 0.29 (**Table 1**). According to the RGA, aggradation and widening were the dominant modes of adjustment based on the following observations: embedded coarse material in riffles, siltation in pools, deposition in overbank zone, fallen/leaning trees, occurrence of large organic debris, exposed tree roots. Based on professional interpretation of reach-scale geomorphological form and processes, the channel lacked strong evidence of a dominant mode of channel adjustment and was in a state of dynamic equilibrium. Localized channel instabilities were, for the most part, caused by LWD jams.

Photo 1. Algae covered cobble

Photo 2. Fallen trees within the bankfull channel

Photo 3. Local channel splitting due to downstream LWD jam

Photo 4. Looking upstream at an anthropogenic rock weir

Table 1. Summary Results of Rapid Geomorphic Assessment (RGA) along West Credit River

Form/Process	Index
Evidence of Aggradation	0.43
Evidence of Degradation	0.00
Evidence of Widening	0.43
Evidence of Planimetric Form Adjustment	0.29
Stability Index	**0.29**
Classification	**Transitional or Stressed**

4.2 Site Scale

All three detailed data collection sites had similar bankfull channel dimensions (**Table 2**) and bankfull channel hydraulics (**Table 3**). The width to depth ratios are greater than 20 at all three sites, indicating the channel has good access to its floodplain (i.e. is not entrenched). Due to increases in cross-sectional area, the bankfull discharge increased in the downstream direction. All three sites have sub-critical flows conditions (Froude Number < 1) at bankfull conditions.

Table 2. Averaged bankfull channel dimensions

Measure	Site 1	Site 2	Site 3
Width (m)	11.62	13.25	13.25
Average Depth (m)	0.52	0.52	0.66
Maximum Depth (m)	0.71	0.65	0.88
Width:Average Depth	22.56	26.43	20.06
Cross-sectional Area (m^2)	6.02	6.80	8.83

Table 3. Averaged bankfull channel hydraulics

Measure	Site 1	Site 2	Site 3
Energy Gradient (m/m)	0.0028	0.0036	0.0025
Discharge (m^3/s)	6.23	9.51	10.49
Average Velocity (m/s)	1.03	1.38	1.18
Froude Number	0.46	0.62	0.46
Average Shear Stress (N/m^2)	13.82	24.84	15.85

Notes: Manning's 'n' assumed to be 0.035 for all-cross-sections for the full range of flows because the beds are level with water levels much deeper than the grains are in diameter and the channel had moderate sinuosity (Hicks and Mason, 1998)

All three sites had similar grain size distributions dominated by gravels (**Table 4**). The critical discharge was lowest at Site 2, likely because it had the steepest energy gradient that induces entrainment of the gravel bed material more readily than the other two sites (**Table 5**). The critical discharges ranged from 52 to 84% of bankfull discharge, indicating there are few sediment transport inducing events in a given year. The stable pool-riffle morphology and moss-covered cobble corroborate these critical values.

Table 4. Grain size distribution summary statistics

Measure	Site 1	Site 2	Site 3
D_{16}	5	9	5
D_{35}	13	18	16
D_{50}	22	26	24
D_{65}	35	34	35
D_{84}	58	70	90

Notes: D_x is the grain size than which X% of the substrate is finer

Table 5. Critical hydraulic conditions

Measure	Site 1	Site 2	Site 3
Critical Shear Stress (N/m^2)	16.02	18.81	17.16
Critical Discharge (m^3/s)	5.21	4.91	7.84
% of Bankfull Flow	84	52	75

Notes: Critical Shields parameter used to calculate erosion thresholds was 0.045 because the channel had stable gravel-cobble bedforms (Church, 2006)

5 Effluent Discharge Rate and Location

The following information regarding the effluent discharge rates and location was provided to PECG by HESL in February 2017:

- The proposed effluent discharge will be a constant 0.083 m^3/s
- The 7Q20 flow for the subject reach of West Credit River is 0.225 m^3/s
- The two candidate discharge locations are the 10th Line road crossing and the Winston Churchill Boulevard road crossing

The proposed effluent discharge of 0.083 m^3/s is 0.8% to 1.3% of the bankfull discharge and 1.1% to 1.7% of the critical discharge, based on channel measurements and erosion threshold analyses at three sites (see **Section 4.2**). Given that sediment transport occurs almost exclusively during moderate to high flow events, once a local erosion threshold has been exceeded, it follows that channel morphology (and the aquatic habitat it supports) is largely determined by moderate to high flows (Knighton, 1998). A relatively small increase in discharge at critical and bankfull conditions will have an unmeasurable and negligible impact on natural erosional processes along West Credit River. Furthermore, due to minimal anthropogenic disturbance and upstream urbanization, West Credit River has adopted a stable geomorphological form. Thus, there is little concern the effluent discharge will disrupt the existing dynamic equilibrium of West Credit River or exacerbate existing instabilities.

Detailed morphological data were collected immediately downstream of both candidate effluent discharge locations. Both locations are morphologically stable with no specific erosion concerns. Discharging the effluent at either location is appropriate from a fluvial geomorphological perspective. The outlet should be oriented in the downstream direction and situated on the downstream side of the chosen road crossing. The outlet will require energy dissipation measures regardless of the flow conditions in the channel. The flow dissipation can be as simple as a rip-rap splash pad, baffle features, and/or a drop-structure.

6 Summary and Conclusions

PECG completed a fluvial geomorphological assessment of West Credit River between 10th Line and Winston Churchill Boulevard, in the Town of Erin, as a basis for evaluating the morphological implications of increased flow in West Credit River from a proposed WWTP. The assessment included establishing erosion thresholds and documenting existing channel processes and areas of instability. The subject reach of West Credit River is an irregular-meandering, partly confined channel that has adopted a stable cross-sectional form and pool-riffle bed morphology. The proposed effluent discharge (0.083 m^3/s) will have negligible impact on erosion processes along West Credit River. The two proposed discharge locations (10th Line and Winston Churchill Boulevard) are morphologically stable with no existing erosion concerns. The outlet should be constructed in such a manner that flow is not directed towards the bed and/or bank, and some form of energy dissipation is utilized.

7 Certification

This report was prepared and reviewed by the undersigned:

Prepared by:

Dan McParland, M.Sc., P.Geo.
Fluvial Geomorphologist

Reviewed by:

Robin McKillop, M.Sc., P.Geo., CISEC
Principal, Senior Fluvial Geomorphologist

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Appendix - Q

Wastewater Treatment Plant Site Selection

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E-mail: brampton@ainleygroup.com

April 24, 2018 File No. 115157

Triton Engineering Services Limited
105 Queen Street West Unit 14
Fergus, ON N1M 1S6

Attn: **Christine Furlong, P.Eng.**
Project Manager

Ref: **Town of Erin, Urban Centre Wastewater Servicing Class EA**
Wastewater Treatment Plant Site Selection, Technical Memorandum

Dear Ms. Furlong:

We are pleased to present our Technical Memorandum for the "Wastewater Treatment Plant Site Selection" for the Urban Centre Wastewater Servicing Schedule 'C' Municipal Class Environmental Assessment (EA).

This Technical Memorandum provides a review of the Wastewater Treatment Plant (WWTP) Site Alternatives and is based on the preferred general alternative solution identified in the Servicing and Settlement Master Plan (SSMP). The Technical Memorandum establishes and evaluates alternative sites for the WWTP as a component of Phase 3 and of the Municipal Class EA process.

Yours truly,

AINLEY & ASSOCIATES LIMITED

Joe Mullan, P.Eng.
Project Manager

Town of Erin
Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Wastewater Treatment Plant Site Selection

FINAL

April 2018

Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Wastewater Treatment Plant Site Selection

Project No. 115157

Prepared for:
The Town of Erin

Prepared By:

Gary Scott, P.Eng.

Prepared By:

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Glossary of Terms

ACS	Assimilative Capacity Study: see assimilative capacity.
Ainley	Primary engineering consultant for the Class EA process.
Alternative Solution	A possible approach to fulfilling the goal and objective of the study or a component of the study.
Assimilative Capacity	The ability of receiving water (lake or river) to receive a treated effluent discharge without adverse effects on surface water quality, eco-system and aquatic life.
Build-out	Refers to a future date where all vacant and underdeveloped lots have been fully developed in accordance with the Town's Official Plan.
Class EA	Municipal Class Environmental Assessment, a planning process approved under the EA Act in Ontario for a class or group of municipal undertakings. The process must meet the requirements outlined in the "Municipal Class Environmental Assessment" document (Municipal Engineers Association, October 2000, as amended). The Class EA process involves evaluating the environmental effects of alternative solutions and design concepts to achieve a project objective and goal and includes mandatory requirements for public consultation.
CVC	Credit Valley Conservation Authority
Design Concept	A method of implementing an alternative solution(s).
EA Act	*Environmental Assessment Act*, R.S.O. 1990, c.E.18 (Ontario)
Effluent	Liquid after treatment. Effluent refers to the liquid discharged from the WWTP to the receiving water.
Environmental Protection Act (EPA)	
Equivalent Population	Equivalent Population represents Residential Population plus Institutional/ Commercial/Industrial wastewater flow sources expressed as the equivalent number of residents, while Residential Population represents the "actual" population exclusive of Institutional/ Commercial/ Industrial wastewater flows.
ESR	Environmental Study Report, a report prepared at the culmination of Phase 4 of the Class EA process under a Schedule C planning process.
Evaluation Criteria	Criteria applied to assist in identifying the preferred solution(s).
Forcemain	A pressurized pipe used to convey pumped wastewater from a sewage pumping station.
Geotechnical Investigation	Study of the engineering behavior of earth materials such as soil properties, rock characteristics, natural slopes, earthworks and foundations, etc.
Hydrogeological	Study of the distribution and movement of groundwater in soil or bedrock.
Master Plan	A comprehensive plan to guide long-term development in a particular area that is broad in scope. It focuses on the analysis of a system for the purpose of outlining a framework for use in future individual projects.
MOECC	Ministry of the Environment and Climate Change, the provincial agency

	responsible for water, wastewater and waste regulation and approvals, and environmental assessments in Ontario.
MNR	Ministry of Natural Resources, the provincial agency responsible for the promotion of healthy, sustainable ecosystems and the conservation of biodiversity in Ontario.
O&M	Operation and maintenance
Official Plan	
Preferred Alternative	The alternative solution which is the recommended course of action to meet the objective statement based on its performance under the selection criteria.
Private Treatment System	Lot-level or communal sewage treatment methods, such as septic systems or aerobic treatment systems, which remain in private ownership.
Sewage Pumping Station (SPS)	A facility containing pumps to convey sewage through a forcemain to a higher elevation.
Screening Criteria	Criteria applied to identify the short-list of alternative solutions from the long-list of alternative solutions.
Service Area	The area that will receive sewage servicing as a result of this study.
Service Life	The length of time that an infrastructure component is anticipated to remain in use assuming proper preventative maintenance.
Sewage	The liquid waste products of domestic, industrial, agricultural and manufacturing activities directed to the wastewater colleciton system.
Sewage Treatment Plant (STP)	A plant that treats urban wastewater to remove solids, contaminants and other undesirable materials before discharging the treated effluent back to the environment. Referred to in this Class EA as a Wastewater Treatment Plant.
SSMP	Servicing and Settlement Master Plan – the master plan for Erin which was conducted by B.M. Ross in 2014 and establishes the general preferred alternative solution for wastewater.
Study Area	The area under investigation in which construction may take place in order to provide servicing to the Service Area.
Terms of Reference (ToR)	
Triton	Town of Erin engineering consultant
UCWS Class EA	Urban Centre Wastewater Servicing Class Environmental Assessment
Wastewater	See Sewage
Wastewater Treatment Plant (WWTP)	See Sewage Treatment Plant.

1.0 Purpose and Study Background

In 2014 the Town of Erin completed a Servicing and Settlement Master Plan (SSMP) to address servicing, planning and environmental issues within the urban areas of Erin Village and Hillsburgh. The aforementioned SSMP examined issues related to wastewater servicing and concluded that the preferred solution for both urban areas was a municipal wastewater collection system conveying wastewater to a single wastewater treatment plant located south east of Erin Village with treated effluent being discharged to the West Credit River.

In August of 2013, B. M. Ross concluded an Assimilative Capacity Study (ACS) establishing that a surface water discharge of treated effluent to the West Credit River was a viable alternative and suggested that the most suitable location for a WWTP outfall to the West Credit River would be situated between 10th Line and Winston Churchill Boulevard. It should be noted that the discharge from a WWTP was recommended to be located below Erin Village because of the greater assimilative capacity in this part of the river. The water quality records within this span of the river indicate lower contaminant concentrations than in other locations upstream. MOECC and CVC agreed with this approach. An update to the ACS during this UCWS Class EA study has confirmed the viability of this location and has established effluent criteria that will permit both communities to be built out to full build out of the present OP. In keeping with the recommended discharge location, the SSMP identified a general area for the location of a WWTP along Wellington County Road 52 in the area of 10th Line. Whereas the SSMP recommended preferred alternative was a single treatment plant with a capacity of 2,610 m^3/d, servicing a population of 6,000 persons, this UCWS Class EA study has identified a recommended preferred alternative treatment plant with a capacity of 7,172 m^3/d servicing a residential population of 14,559 persons.

The Terms of Reference for this study require that alternative sites in this area be identified and evaluated and a recommended preferred site selected. The purpose of this memorandum is to identify alternative potential locations for the WWTP and conduct a detailed evaluation to select the recommended preferred WWTP site.

1.1 Related Documents and Projects

Several related studies were completed prior to the commencement of this UCWS Class EA Study and each of these studies was reviewed for pertinent information related to this project. They are described in brief in the following subsections.

1.2 Land Use Policies and Regulations

The following documents define the land use policies and regulations that control development within the Town of Erin.

- Provincial Policy Statement
- Greenbelt Plan
- Growth Plan for the Greater Golden Horseshoe
- County of Wellington Official Plan
- Town of Erin Official Plan
- The Town of Erin's Zoning Bylaw (No. 07-67)

The Provincial Policy Statement provides policy direction on matters of provincial interest related to land use planning and development. As a key part of Ontario's policy-led planning system, the Provincial Policy Statement sets the policy foundation for regulating the development and use of land. This document works in tandem with locally-generated land-use planning documents with a focus on developing communities that foster a healthy environment and economic growth over the long term.

The Greenbelt is a band of permanently protected land within Ontario. The goal of the Greenbelt Plan is to protect against the loss and fragmentation of the agricultural land base and support agriculture as the predominant land use. The plan gives permanent protection to the natural heritage and water resource systems that sustain ecological and human health and provides for a diverse range of economic and social activities associated with rural communities, agriculture, tourism, recreation and resource uses. In completing the wastewater infrastructure to service the existing communities and growth designated within the Town Official Plan, through a local solution, the project is in compliance with Section 4.2 of the Greenbelt Plan.

The Growth Plan for the Greater Golden Horseshoe is a long-term plan to manage growth, build complete communities, curb sprawl and protect the natural environment. The plan sets out a structure for the type and location of development, outlines the future infrastructure needs, defines protective measures for natural and cultural resources, and provides an overarching implementation plan to achieve the stated goals.

County of Wellington Official Plan is a legal document intended to give direction over the next 20 years, to the physical development of the County, its local municipalities and to the long term protection of County resources. The plan outlines a long-term vision for Wellington County's communities and resources.

Town of Erin Official Plan is a component of the overarching County of Wellington Official Plan and details the growth allocation for Erin, planning densities, and land uses.

The Town of Erin's Zoning Bylaw (No. 07-67) provides detailed information to control the development of properties within the Town. The bylaw regulates many aspects of development, including the permitted uses of property, the location, size, and height of buildings, as well as parking and open space requirements. WWTP's are not permitted in the Town zoning bylaw which means that a zoning bylaw amendment will be required before project implementation.

1.3 Servicing and Settlement Master Plan (SSMP)

The SSMP was developed by B.M. Ross and Associates Limited (2014) with the goal to develop appropriate strategies for community planning and municipal servicing, consistent with current provincial, county and municipal planning policies. The SSMP process followed the Master Plan approach, specifically Approach 1, as defined in the Municipal Class Environmental Assessment (Class EA) document, dated October 2000 (as amended in 2007 and 2011).

2.0 General Review of Potential WWTP Site Area

The potential location for a wastewater treatment facility was thoroughly reviewed during the 2014 SSMP and a clear rationale was established for the location along Wellington Road 52 between County Road 124 and Winston Churchill Boulevard where the assimilative capacity of the West Credit River is maximised. The location of the wastewater treatment plant identified during the SSMP was largely based on the service area, suggested wastewater collection system and the required discharge location.

The Collection System Alternatives Technical Memorandum completed as part of this UCWS Class EA study identifies a preferred collection system that conveys all wastewater to a Sewage Pumping Station at the South end of Erin Village and a forcemain from that Sewage Pumping Station that pumps all wastewater along Wellington Road 52 towards 10th Line. The Effluent Discharge Location Technical Memorandum also completed as part of this UCWS Class EA, examines three (3) potential locations for treated effluent discharge to the West Credit River. Two locations are examined at 10th Line and one at Winston Churchill Boulevard with the preferred discharge location being located at Winston Churchill Boulevard. Wastewater from all alternative WWTP sites will therefore have to be pumped from the WWTP site.

Based on the above considerations, the lands along Wellington Road 52 between Highway 124 and Winston Churchill Boulevard with direct access of Wellington Road 52, were examined for possible sites. The lands are characterized as mildly undulating with farmlands/aggregate extraction areas to the South and the McCullough Drive/Aspen Court subdivision/farmland/large homes to the North. Elevations along Wellington Road 52 are typically between 385m and 395m above sea level. The valley of the West Credit River and tributaries to the north of the road is generally 10-15 m below this elevation. Groundwater north of Wellington Road 52 flows north to the river valley. In addition, lands to the South of Wellington Road 52 along 10th Line were examined for a potential site. An area for a possible WWTP was therefore established as follows:

- The area South of the McCulloch Drive/Aspen Court and extending 200 m east of the subdivision was eliminated due to the potential impact on the residential area and the need to create a buffer zone to meet MOECC siting criteria;
- The area North of Wellington Road 52 between 10th Line and Winston Churchill Boulevard was eliminated as it consists of private residences and the area therefore does not meet the MOECC buffer siting criteria;
- The area South of Wellington Road 52 extending from 300 m east of 10th Line to Winston Churchill Boulevard was eliminated as it could impact several private residences along the South and North side of Wellington Road 52 and not meet the MOECC buffer siting criteria;
- All lands to the North of Wellington Road 52 within CVC protected areas, including the required buffer area, were eliminated due to the potential environmental impacts;
- Lands to the South of Wellington Road 52 along 10th Line were eliminated as they are currently being operated as an aggregate extraction area and are being used as an office and processing area.

Based on the above, Figure 1 shows the area for the potential locations of the WWTP. Per the Official Plan land use designations and the Growth Plan for the Greater Golden Horseshoe, the potential site area is designated Prime Agricultural, Secondary Agricultural, Greenlands and Core Greenlands.

Figure 1 - Study Area for the potential location of the WWTP

3.0 Identification of Potential WWTP Sites

Having established the potential area for a WWTP site, it was necessary to determine the size of the site required to meet the effluent limits established under the ACS for a plant with a capacity of 7,172 m^3/d. While the plant capacity may be revised following completion of the UCWS Class EA study in line with a new Town Official Plan, the capacity of 7,172 m^3/d is seen as an ultimate capacity and typically, for long term infrastructure investments involving land purchase, it is considered prudent to purchase sufficient lands for the ultimate capacity. In addition, since this capacity represents full build out of the population including existing areas and new growth areas, it is likely that the plant will be constructed in Phases. For the purpose of this UCWS Class EA study it has been assumed that the treatment plant will be built in two phases. Within the site area, it will be necessary to reserve sufficient lands to enable construction of future phases in a safe manner without affecting operations.

Based on this, a preliminary plant layout was developed to identify the site area required. For a conventional plant with tertiary treatment constructed in two phases, it is likely that the plant areas would require approximately 150 m by 150 m of space including all of the ancillary buildings and facilities required by MOECC. The layout of this plant is shown in Figure 2.

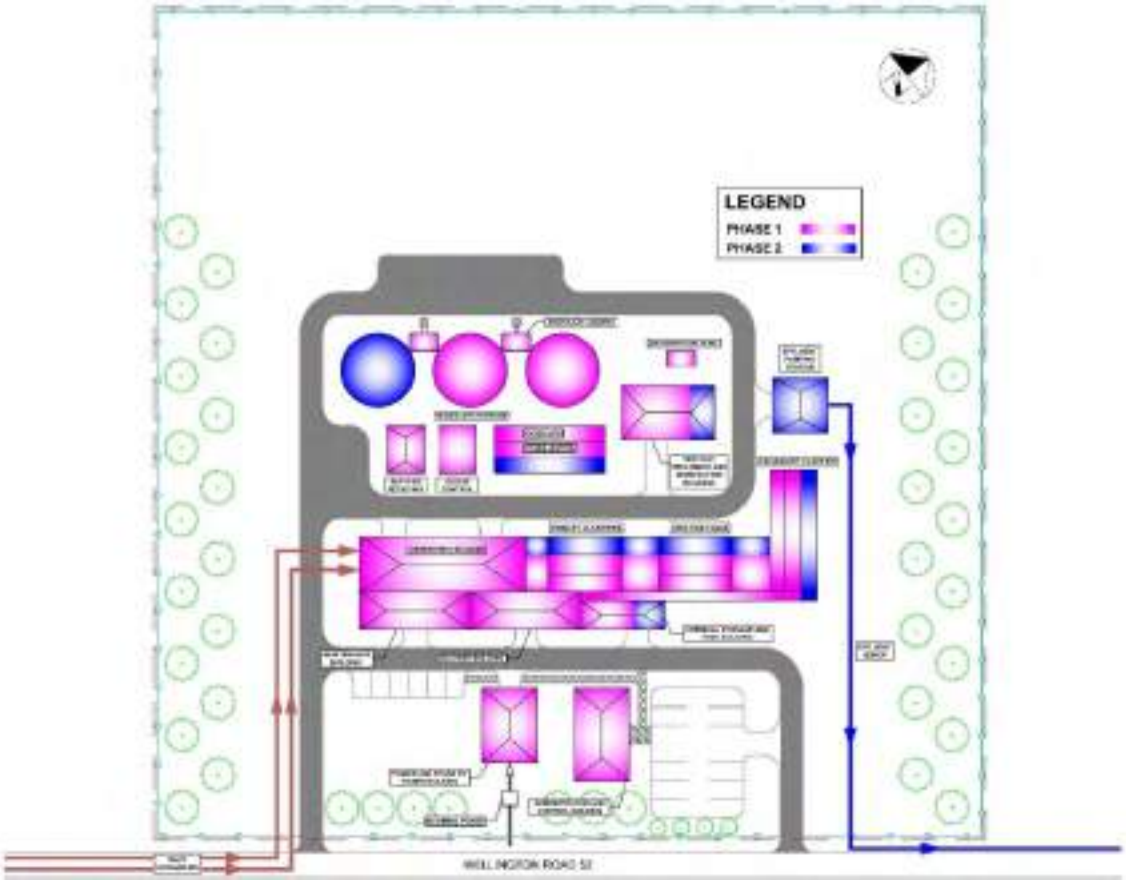

Figure 2 – WWTP Site Selection

Siting considerations for Sewage Works are outlined in Section 3.3 of the MOECC Design Guidelines for Sewage Works (2008). These considerations include:

- To be located as far as practical from any existing commercial or residential area or any area to be developed within the plant design life
- Should be separated from adjacent uses by a buffer zone
- To be above the 100 year flood event elevation
- To have a secure boundary with access to deal with emergencies
- The site should allow for:
  - Ease of construction
  - A phased approach
  - Maintaining operation during construction
  - Planning for future additions/expansions

MOECC also places limits on air and noise emissions governed by Section 9 of the Environmental Protection Act (EPA) and must demonstrate compliance at critical receptors (eg Residences)

Separation distances between Sewage Works and sensitive land use are specified in MOECC Guideline D2 “Compatibility between Sewage Treatment and sensitive land use” intended to mitigate the effects of odour and noise. Separation distances are measured between facility structures that could generate odour or noise and the property line of a sensitive land use. For treatment plants up to a capacity of 25,000 m^3/d MOECC guidelines suggest a buffer zone of 150 m and not less than 100 m.

Since the area identified for a WWTP is agricultural/aggregate extraction with few homes, it is suggested that a 5 Ha site with dimensions of 225 m by 225 m would be sufficient and would allow approximately 40 m between tanks and the property boundary of the site with the rest of the buffer zone provided by the agricultural lands and environmentally sensitive lands around the sites. While this rectangular area is used to identify the preferred areas for the WWTP, The actual site boundary would be established through discussions between the Town and the site owner at time of purchase.

Four (4) alternative sites for a WWTP have been identified for consideration and these are illustrated in Figure 3 and described below.

Figure 3 – Four Alternative Sites for WWTP

3.1. Alternative Sites

3.1.1 Alternative 1 – Solmar Site

Site 1 consists of an abandoned farmhouse and farm buildings and lands sloping down towards the West Credit River. Part of the site has been used to dispose of waste materials. Per Town of Erin Official Plan (Modified Schedule A-1), this site is located primarily in a Secondary Agricultural designation with a small portion designated as Greenlands and Core Greenlands. The site is also outside of the urban boundary and under the current Greenbelt Plan, it cannot be developed for residential or commercial use. The site is part of a 200 acre farm property owned by Solmar Development Corporation (Solmar).

A meeting was held between the project team and Solmar to discuss the potential for use of the site as a WWTP. During the meeting, Solmar indicated that they are willing to sell sufficient property to the Town for construction of a WWTP. In fact, Solmar indicated that they had originally purchased the land for use as a WWTP site to service their development lands to the North. They had planned a discharge of treated effluent to the West Credit River. Solmar expressed no preference for where the WWTP would be located on their property, however it was agreed any potential site would be as far as possible from the existing McCullough Drive/Aspen Court subdivision and out of CVC regulated lands. This is also mostly out of the area currently under cultivation. Solmar indicated that they had not conducted any studies on the site and agreed to permit access to the project team to conduct archaeological, environmental and geotechnical studies. An agreement was executed to this effect. The results of these studies are summarised below.

Figure 4 – Site 1 (Solmar)

Environmental Impacts

A natural environment assessment was carried out at sites 1 (Solmar) and 2A and 2B (HSC) during June 2017 by Hutchinson Environmental Sciences Ltd (HESL).

Two species at risk, Bobolink and Eastern Meadowlark, were detected during bird surveys of these three proposed WWTP sites. On June 1, 2017 both species were heard in the fields on sites 2A and 2B, and Eastern Meadowlark was also heard on site 1. On June 21, 2017 Bobolink and Eastern Meadowlark were only heard on Sites 2A and 2B. Site 1 appears less suitable as breeding habitat, since it is more overgrown, with scattered shrubs. The fact that an Eastern Meadowlark was heard in this field only on the first visit suggests that the species is likely not using this habitat for breeding.

Savannah Sparrow, an area sensitive species, was also recorded in the fields of all sites. Its breeding habitat is considered Significant Wildlife Habitat (Open Country Bird Breeding Habitat) because this type of habitat is declining across Ontario and North America (MNRF 2015). As such, development and site alteration are only permitted if there will be no negative impacts on the natural features or their ecological functions (MMAH 2014).

One locally rare and uncommon plant species was observed within Site 1 (Wild Geranium), while four rare and uncommon plant species were associated with the adjacent West Credit PSW complex: Yellow Sedge, Turtlehead, White Spruce, and Bristly Buttercup. The Wild Geranium can be transplanted at a location on site.

The HESL report forms part of the project documentation.

Heritage / Archaeological Impacts

A Cultural Heritage Resource Assessment was conducted by Archaeological & Cultural Heritage Services Inc. (ASI) as part of this project. A field review of the study area was undertaken by ASI on July, 19 2017. Based on the results of this assessment, no significant impacts to cultural heritage resources is anticipated as a result of the adoption of this site for the Wastewater Treatment Plant.

A Stage 1 Archaeological Assessment of the site was conducted by ASI including a field inspection on June 22, 2017. No excavation was conducted during this inspection which concluded that the site exhibited archaeological potential. As such, the site requires a Stage 2 Archaeological Assessment by test pits prior to any proposed construction on the property.

Both ASI reports form part of the project documentation.

Geotechnical Impacts

A geotechnical investigation was conducted by GeoPro Consulting Limited during October 2017. Four boreholes we completed to assess the suitability for construction of a WWTP. The results indicate that the site is underlain by sands and gravel deposits that provide an adequate foundation for all WWTP structures. Construction would not be impacted by groundwater or rock.

The GeoPro Consulting Limited Geotechnical Report forms part of the project documentation.

Agricultural Impacts

This site consists of an abandoned farmhouse and farm buildings and lands sloping down towards the West Credit River. Part of the site has been used to dispose of waste materials. The site is located in a secondary agricultural zone and therefore has agricultural potential. In total the property is 200 acres with the northwestern portion of the farm property currently being rented out for crop farming on three large fields; no livestock are present at the site. The WWTP could be constructed largely to the east of the cultivated area.

The site is bounded on the west by urban development, to the north by the West Credit River. The closest property to the south is an aggregate extraction site. There are no livestock barns on the lands and it is highly unlikely that any would ever be built given the proximity to the urban area. Given the land-use in the surrounding area, development on this site would have no impact on the farming in the surrounding area.

Overall, the agricultural impact of development at this site would be limited of the loss of 5 Ha of Secondary Agricultural designated land for crop farming though this part of the property is presently not farmed.

Cost Impacts

In order to compare the capital costs of the four (4) sites, the following was considered:

- Relative lengths of forcemain to convey wastewater to each site
- Estimated purchase cost of the site
- Costs associated with any unique development features for each site
- Costs to convey treated wastewater to the preferred outfall site.

As previously noted, all of the sites will require an inlet forcemain conveying wastewater from the collection system and an effluent pumping station to convey treated effluent to the preferred outfall site at Winston Churchill Boulevard. The inlet and outlet forcemains are the same diameter. To establish the cost of these inlet/outlet pipes relative to each site, the inlet cost was taken from a point to the west of site 1 and 2A and the outlet cost was taken to a point to the east of site 2C.

For site 1, the inlet forcemain location will be approximately the same as for site 2A (taken as zero). Outlet forcemain costs will be assumed to a common point beyond site 2C. For site 1 a cost has also been estimated to conduct necessary studies prior to purchase including and Environmental Site Assessment (ESA), Archaeological Stage 2 Study as well as clean up and demolition of the existing structures.

Table 1 - Site 1 Estimated Capital Cost

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Site Studies/Clean Up/Demolitions	$ 150,000
Inlet/Outlet Forcemains	$ 425,000
Total	**$ 785,000**

Table 2 - Advantages and Disadvantages of Site 1

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately adjacent Wellington Road 52. ▪ The elevations across the site are adequate to support design of gravity flow through the WWTP. ▪ The Owner is willing to sell the land to the Town for a WWTP. ▪ The site is mostly not presently farmed or used for any agricultural purpose. ▪ Topography will allow the main plant processes	▪ Use of this site will require cleanup of materials deposited on the site and this will likely require an Environmental Site Assessment Study prior to purchase. ▪ The use of this site will require a Stage 2 Archaeological Assessment prior to purchase. ▪ The Town may have to purchase more than 5 Ha as remaining lands may not be useful to the present Owner. ▪ An entrance permit onto Wellington Road 52

Advantages	Disadvantages
to be hidden from Wellington Road 52 and from the subdivision to the west. ▪ The distance between the nearest WWTP structure and the home on 10th Line exceeds 200 m which is greater than the MOECC buffer zone requirement. ▪ The distance between the nearest WWTP structure and the home east of the McCullough Drive/Aspen Court subdivision is over 290 m and also exceeds the MOECC buffer zone requirement.	will be necessary from the County. ▪ Will require a zoning bylaw amendment to permit WWTP use.

3.1.2 Alternative 2A, 2B and 2C –Halton Crushed Stone Sites

Site 2A consists of farmland on the south side of Wellington Road 52 generally opposite Site 1 and would be accessed off Wellington Road 52. Site 2B also consists of farmland at the south west corner of Wellington Road 52 and 10th Line. Site 2C consists of farmland at the south east corner of Wellington Road 52 and 10th Line. Site 2C was added for consideration after completion of the natural environment report, however, the area is similar to sites 2A and 2B and a previous environmental report (completed as part of the aggregate extraction application) covered all three sites. Per Town of Erin Official Plan (Modified Schedule A-1), these sites are located in a Prime Agricultural designation. The sites are also outside of the urban boundary and under the current Greenbelt Plan, as such, the sites cannot be developed for residential or commercial use. The sites are owned by Halton Crushed Stone (HCS), part of the Crupi Group, who have an application for extraction of sand and gravel covering all three sites, as an extension to their operation to the south of the sites.

A meeting was held between the project team and HCS to discuss the potential for use of these sites as a WWTP. During the meeting, HCS indicated that they are willing to sell sufficient property to the Town for construction of a WWTP subject to the following considerations:

- It is undesirable to HCS to sell a portion of their lands that have not been mined for the underlying aggregate resources. The lands represent an opportunity to maintain stable employment for many people. Should the Town wish to purchase the unmined lands, the value of the underlying resource would need to be taken into consideration.
- The identified sites have not been mined by HCS for their aggregate resources. The sites are within the extraction area for which HCS is in the process of obtaining approval for extraction. Based on current mining plans, it is possible the area would be actively mined for between 5 to 10 years depending on market conditions, however HCS could not confirm a schedule for extraction on the site.
- Depending on the timeline for a wastewater system, the lands could be fully mined before required by the Town, however this cannot be guaranteed by HCS.

HCS has completed extensive studies covering these sites including resource development plans, archaeological report, agricultural, natural environment report, hydrogeological report, noise report, planning report, and transportation brief. HCS made all of their reports available to the project team.

During the visit to the HCS facility the project team observed the mined and restored area. To mitigate the impact on habitat for species at risk, HCS have completed extensive restoration of mined areas. It is likely that similar mitigation would be required if these sites are developed as a WWTP. Mitigation would likely involve setting aside lands to compensate for loss of habitat.

The sites are part of an application by HCS to extend their present operation. Their application covers some 56.7 Ha for extraction involving the recovery of some 4 to 5 million tonnes of sand and gravel at a rate of some 725,600 tonnes per year. The area represents a key sand and gravel resource generating high quality granular A and B as well as stone and sand. It would appear that the sites are underlain by up to 5 m of extractable sand and gravel.

Based on the plan to extract some 4 to 5 million tonnes over 56.7 Ha, it is reasonable to assume that a 5 Ha site would be underlain by some 400,000 tonnes of extractable sand and gravel. The commercial value of this resource is estimated at $5/tonne (typical pick up cost for Granular B and sand in the GTA) which means that the resource under each of site 2A, 2B and 2C can be valued at $2,000,000.

Since purchase of these sites cannot be guaranteed to meet the project timeline if they have the aggregate resource extracted, for the purpose of comparing the sites it is assumed that the Town would have to purchase the sites before extraction and therefore have to pay the commercial value of the land. In addition, since there is an active application for approval of aggregate extraction in place, the assumption that they would be mined before use as a WWTP, implies approval of the mining application.

It can also be noted that following extraction the sites are left as basically flat sites just above the groundwater table which does not make them ideal for construction of a WWTP.

Since the timeline of the project cannot be fixed with certainty, a comparison has also been completed assuming that the aggregate has been removed prior to purchase.

Figure 5 – Site 2A (HCS)

Figure 6 – Site 2B (HCS)

Figure 7 – Site 2C (HCS)

The results of field studies are summarised below.

Environmental Impacts

A Level 1 and Level 2 Natural Environment Technical Report was completed in 2016 by WSP on behalf of Halton Crushed Stone as part of their application for sand and gravel extraction covering all three sites. This study identified three Provincially and Federally listed bird species at risk on the sites including the barn swallow, bobolink and eastern meadowlark. The report recommends progressive rehabilitation of habitat as the extraction proceeds to minimise the impact on these species.

A natural environment assessment was carried out at the sites during June 2017 by Hutchinson Environmental Sciences Ltd as part of the UCWS Class EA. Two species at risk, Bobolink and Eastern Meadowlark, were detected during bird surveys on sites 2A and 2B. On June 1, 2017 both species were heard in the fields on sites 2A and 2B. On June 21, 2017 Bobolink and Eastern Meadowlark were also heard on Sites 2A and 2B. Sites 2A and 2B represent potential breeding habitat for both Bobolink and Eastern Meadowlark. These species breed in grassland habitat, such as farm fields, uncut pastures and meadows. This also likely applies to site 2C.

Savannah Sparrow, an area sensitive species, was also recorded in the fields of all sites. Its breeding habitat is considered Significant Wildlife Habitat (Open Country Bird Breeding Habitat) because this type of habitat is declining across Ontario and North America (MNRF 2015). As such, development and site alteration are only permitted if there will be no negative impacts on the natural features or their ecological functions (MMAH 2014).

Heritage / Archaeological Impacts

The sites are all owned by an aggregate extraction company who is actively seeking approval to extract aggregates from the sites. Aggregate extraction is a significant local industry and a potential source of employment in the Town.

An Archaeological assessment was completed in 2002 on all three Halton Crushed Stone sites by Archaeologix Inc. on behalf of Dufferin Aggregates application to expand the aggregate extraction area. One area with significant mid-19th Century artifacts was located close to site 2C. Stage 2 and Stage 3 Assessments were conducted at this location and a recommendation for a Stage 4 assessment was made prior to aggregate extraction.

A Cultural Heritage Resource Assessment was conducted by Archaeological & Cultural Heritage Services Inc. (ASI) as part of this project. A field review of the study area of sites 2A and 2B was undertaken by ASI on July, 19 2017. Based on the results of this assessment, no significant impacts to cultural heritage resources is anticipated as a result of the adoption of sites 2A or 2B for the Wastewater Treatment Plant.

The ASI report forms part of the project documentation.

Geotechnical Impacts

The sites are underlain by sand and gravel which is being extracted to just above the water table. Prior to extraction it is anticipated that the soils would provide excellent foundation materials with little requirement for a “Permit to Take Water” for construction dewatering or for structures to counteract buoyancy forces. Following extraction of the aggregates it is likely that dewatering would be required during construction and structures would need to have increased weight to counteract buoyancy. Alternatively they could be constructed above the water table and the site refilled.

Agricultural Impacts

Currently the site consists partially of agricultural land with a single detached dwelling and a gravel quarry operation with all the necessary appurtenances. A portion of the site is currently zoned for aggregate extraction and the remainder is zoned for agriculture. The lands are relatively flat with a gradual slope towards the north end of the site. The subject lands are actively farmed with a mixture of rye, oat and hay; no livestock are present at the site. The lands are recognized as a Prime Agricultural area based on the County and Town Official Plans and within the Growth Plan for the Greater Golden Horseshoe. According to updated soils mapping from OMAFRA, the subject lands contain Class 1 soils (Caledon Fine Sandy Loam).

Soil drainage is identified as “Good” with a low potential for soil compaction. The topographic class is “Smooth very gently sloping” and the stoniness class is “Stonefree”. The existing pit is being progressively rehabilitated back to agricultural uses. The rehabilitated lands are actively farmed and managed as a hay field.

The site is bounded on the south and east by the rural area intermixed with woodlands. There are no livestock barns on the lands and it is highly unlikely that any would ever be built given the proximity to the urban area. Given the land-use in the surrounding area, development on this site may have a limited impact on the agricultural activities in the surrounding area. The proposed treatment facility would have regular truck traffic bringing septage to the site and could interfere with the movement of agricultural equipment. Given that the site is currently used for aggregate extraction, the impact of a WWTP would be substantially reduced in comparison to the current use.

The direct agricultural impact of development at this site would be limited of the loss of 5 Ha of Prime Agricultural designated land for crop farming.

Cost Impacts

Below, estimated capital costs and advantages/disadvantages are shown for each of the three Halton Crushed Stone sites both before and after resource extraction.

For site 2A, the inlet forcemain location will be approximately the same as for site 1. Table 3 shows the relative length of the inlet and outlet forcemains. The cost of land purchase is assumed to be the same as for site 1 based on agricultural use. It is assumed that the Town would also have to pay for the aggregate resource.

Table 3 - Site 2A Estimated Capital Cost Prior to Resource Extraction

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Value of Aggregate Resources	$ 2,000,000
Inlet/Outlet Forcemains*	$ 455,000
Total	**$ 2,665,000**

Table 4 - Advantages and Disadvantages of Site 2A

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately adjacent Wellington Road 52. ▪ The WWTP can be constructed more than 200 m from any residences.	▪ Site topography may not provide adequate space to support gravity flow through the WWTP as elevations drop off considerably to the west. ▪ The site is mainly at a high elevation and the site would be highly visible. ▪ Species at risk have been identified on the site and any development may require habitat compensation. ▪ Additional land purchase may be needed for habitat compensation. ▪ An entrance permit onto Wellington Road 52 will be necessary from the County. ▪ Would result in up to 5 Ha of prime agricultural lands being impacted. ▪ Will require a zoning bylaw amendment to permit construction of the WWTP.

Table 5 - Site 2A Estimated Capital Cost Following Resource Extraction

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Inlet/Outlet Forcemains	$ 455,000
Total	**$ 665,000**

It is assumed that in purchasing the lands for the WWTP site following resource extraction, HCS would have already provided rehabilitation compensation for the species at risk over their other lands.

It should also be noted that, following extraction, the flat site just above the groundwater table will add to the cost of construction both in terms of having to provide considerable dewatering within sand and gravel during construction and in additional structural weight (concrete) to offset the effects of buoyancy when constructing tanks below the groundwater table. Alternatively the facilities could be constructed above the water table on imported fill which would also add to cost.

Table 6 - Advantages and Disadvantages of Site 2A Following Resource Extraction

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately adjacent Wellington Road 52. ▪ The WWTP can be constructed more than 200 m from any residences. ▪ The plant could be hidden from view in the extracted area	▪ Site topography will be flat following aggregate extraction which does not support gravity flow through plant. ▪ Construction may be affected by the groundwater table which can add to costs for dewatering and structural work. ▪ HCS cannot provide a date when the

Advantages	Disadvantages
	resource extraction will be completed and so this alternative does not provide a valid solution at this time. ▪ Would result in up to 5 Ha of prime agricultural lands being impacted. ▪ Will require a zoning bylaw amendment to permit construction of the WWTP.

For site 2B, the inlet forcemain location will be longer than for site 1 and 2A, however the outlet forcemain would be shorter and effluent would still require pumping. The cost of land purchase is assumed to be the same as for site 1 based on agricultural use. It is assumed that the Town would also have to pay for the aggregate use.

Table 7 - Site 2B Estimated Capital Cost Prior to Resource Extraction

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Value of Aggregate Resources	$ 2,000,000
Inlet/Outlet Forcemains	$ 440,000
Total	**$ 2,650,000**

Table 8 - Advantages and Disadvantages of Site 2B Prior to Resource Extraction

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately with an access off 10th Line. ▪ The elevations across the site are adequate to support design of gravity flow through the WWTP. ▪ Topography will allow the main plant processes to be partly hidden from Wellington Road 52. ▪ The WWTP can be constructed more than 200 m from any residences and represents the site with the greatest buffer zone	▪ HCS may wish to mine 10th Line which could affect access or outlet forcemain design. ▪ Species at risk have been identified on the site. ▪ Additional land purchase may be needed for habitat compensation. ▪ Would result in up to 5 Ha of prime agricultural lands being impacted. ▪ Will require a zoning bylaw amendment to permit construction of the WWTP.

Table 9 - Site 2B Estimated Capital Cost Following Resource Extraction

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Inlet/Outlet Forcemains	$ 440,000
Total	**$ 650,000**

Table 10 - Advantages and Disadvantages of Site 2B Following Resource Extraction

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately with an access off either Wellington Road 52 or 10th Line. ▪ The plant could be hidden from view in the extracted area. ▪ The WWTP can be constructed more than 200 m from any residences and represents the site with the greatest buffer zone	▪ Site topography will be flat following aggregate extraction which does not support gravity flow through plant. ▪ Construction may be affected by the groundwater table which can add to costs for dewatering and structural work. ▪ HCS cannot provide a date when the resource extraction will be completed and so this alternative does not provide a valid solution at this time. ▪ Would result in up to 5 Ha of prime agricultural lands being impacted. ▪ Will require a zoning bylaw amendment to permit construction of the WWTP.

For site 2C, the inlet forcemain location will be longer than for site 1 and 2A/2B, however the outlet forcemain would be shorter and effluent would still require pumping. The cost of land purchase is assumed to be the same as for site 1 based on agricultural use. It is assumed that the Town would also have to pay for the aggregate use prior to extraction.

Table 11 - Site 2C Estimated Capital Cost Prior to Resource Extraction

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Value of Aggregate Resources	$ 2,000,000
Inlet/Outlet Forcemains	$ 460,000
Total	**$ 2,670,000**

Table 12 - Advantages and Disadvantages of Site 2C Prior to Resource Extraction

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately with an access off 10th Line. ▪ The elevations across the site are adequate to support design of gravity flow through the WWTP. ▪ The WWTP can be constructed more than 200 m from any residences and represents the site with the greatest buffer zone	▪ HCS may wish to mine 10th Line which could affect access or outlet forcemain design. ▪ Species at risk have been identified on the site ▪ Additional land purchase may be needed for habitat compensation. ▪ Topography and location make this a fairly visible site that will not allow the main plant processes to be hidden from Wellington Road 52 unless berms are constructed. ▪ An archaeological site has been identified close to this site. ▪ The site is closer to residences on Wellington

Advantages	Disadvantages
	Road 52 downwind of prevailing winds. ▪ Would result in up to 5 Ha of prime agricultural lands being impacted. ▪ Will require a zoning bylaw amendment to permit construction of the WWTP.

Table 13 - Site 2C Estimated Capital Cost Following Resource Extraction

Cost Component	Estimated Capital Cost
Land Purchase	$ 210,000
Inlet/Outlet Forcemains	$ 460,000
Total	**$ 670,000**

Table 14 - Advantages and Disadvantages of Site 2C Following Resource Extraction

Advantages	Disadvantages
▪ Sufficient space is available for the WWTP immediately with an access off 10th Line. ▪ The plant could be hidden from view in the extracted area. ▪ The WWTP can be constructed more than 200 m from any residences and represents the site with the greatest buffer zone	▪ HCS may wish to mine 10th Line which could affect access or outlet sewer design. ▪ Additional archaeological discoveries could delay the project and add to cost. ▪ Site topography will be flat following aggregate extraction which does not support gravity flow through plant. ▪ Construction may be affected by the groundwater table which can add to costs for dewatering and structural work. ▪ HCS cannot provide a date when the resource extraction will be completed and so this alternative does not provide a valid solution at this time. ▪ Would result in up to 5 Ha of prime agricultural lands being impacted. ▪ Will require a zoning bylaw amendment to permit construction of the WWTP.

4.0 Evaluation Methodology

The evaluation methodology used to select the preferred solution for the WWTP site was established in a manner consistent with the principles of environmental assessment planning and decision-making as outlined in Municipal Class Environmental Assessment.

A decision model consistent with the principles of environmental assessment planning and decision making as outlined in Municipal Class Environmental Assessment manual was developed to select the preferred site.

Since the sites are all in a similar area and have similar characteristics, specific evaluation criteria were identified and compared distinguishing features between the sites. Whereas other components of the UCWS Class EA place a higher emphasis on Technical Criteria, for the site selection evaluation, Environmental and Economic Criteria play a more important role.

Based on the above, the four (4) Alternative Sites (Site 1, 2A, 2B and 2C) will be evaluated against the specific evaluation criteria described in the Table 15 below:

Table 15 - WWTP Site Evaluation Criteria

Primary Criteria	Weight	Secondary Criteria	Weight
Social/Culture	15%	Impacts During Construction	20%
		Aesthetics	30%
		Effect on Residential Properties	30%
		Effect on Businesses/ Commercial Properties	10%
		Effect on Industrial Properties	10%
Technical	10%	Suitability of Elevation and Topography	50%
		Suitability for Phasing	20%
		Construction Impacts	20%
		Operation and Maintenance Impacts	10%
Economic	25%	Capital Cost	30%
Environmental	50%	Effect on Habitat/ Wildlife	30%
		Effect on Vegetation/ Wetlands	30%
		Effect on Groundwater	20%
		Effect on Surface Water/ Fisheries	20%

4.1. Screening Criteria Definitions

4.1.1 Social/Culture, Impacts During Construction

This criterion captures the level of disturbance to the community the proposed solution will have during the construction period. These effects include noise levels, vibration, odours, dust production, as well as the amount of time for which these disturbances will persist.

4.1.2 Social/Culture, Aesthetics

This criterion captures the level of impact from the visual appearance of the plant on local residents and traffic on Wellington Road 52.

4.1.3 Social/Culture, Effect on Residential Properties

This criterion captures the level of impact that establishing and maintaining a WWTP on the site, has on individual residential properties. Impacts considered include, traffic (septage receiving, chemicals and other deliveries as well as sludge haulage), lighting, odour and noise from the operating plant.

4.1.4 Social/Culture, Effect on Commercial Properties

This criterion captures the level of impact that establishing and maintaining a WWTP on the site, has on individual commercial properties. Impacts considered include, traffic (septage receiving, chemicals and other deliveries as well as sludge haulage), lighting, odour and noise from the operating plant.

4.1.5 Social/Culture, Effect on Industrial Properties

This criterion captures the level of impact that establishing and maintaining a WWTP on the site has on individual industrial properties. Impacts considered include, traffic (septage receiving, chemicals and other deliveries as well as sludge haulage), lighting, odour and noise from the operating plant.

4.1.6 Technical, Suitability of Elevation and Topography

Typically the flow through WWTP processes is by gravity. Wastewater will be pumped to the WWTP and effluent will be pumped to the West Credit River at Winston Churchill Boulevard. The elevation and topography of potential sites therefore impacts the suitability of the site.

4.1.7 Technical, Suitability for Phasing

This criterion captures the capacity of the WWTP to be expanded under a phased development plan. Sites that allow flexibility in WWTP development to promote ease of expansion would have a lower impact on expandability.

4.1.8 Technical, Construction Impacts

This criterion captures the constructability of the WWTP on the potential sites. This would include geotechnical aspects and hydrogeological aspects affecting structural design of the WWTP.

4.1.9 Technical, Operational and Maintenance Impacts

This criterion captures the impacts of each site on the operability of the WWTP. This would take into consideration, access to the site, ability to deal with weather events, prevailing winds, potential for flooding and level of effort required by operations staff to operate and maintain the system on the site.

4.1.10 Economic, Capital Cost

For upfront purchase of lands to construct the WWTP the main issue is capital cost. There is minimal ongoing cost associated with the WWTP site. Site comparison is presented on the basis of relative capital costs for each site. All sites will have a similar cost for earthworks, landscaping and plant development not included in the comparative analysis

4.1.11 Environmental, Effect on Habitat/ Wildlife

The criterion captures the impact that the establishment and operation of the site has on the local habitat and wildlife both during construction and over the long term. Minimizing negative impacts of the local habitat and wildlife is rated favourably.

4.1.12 Environmental, Effect on Vegetation/ Wetlands

The criterion captures the impact that the establishment and operation of the site has on the local vegetation and wetlands both during construction and over the long term. Minimizing negative impacts on the local vegetation and wetlands is rated favourably. Agricultural impacts are also captured under this category.

4.1.13 Environmental, Effect on Groundwater

The criterion captures the level of groundwater impacts associated with the site and proximity to source water protection zones. Minimizing contamination of the local groundwater is rated favourably.

4.1.14 Environmental, Effect on Surface Water/ Fisheries

The criterion captures the impact that the establishment and operation of the site has on the local surface waters both during construction and over the long term. Minimizing contamination of the local surface water is rated favourably.

5.0 Evaluation of Alternatives Sites

5.1. Detailed Evaluation of Site Alternatives

The evaluation of the four (4) potential WWTP sites, using the criteria and weightings listed in Table 15 was completed based on:

- The present site conditions prior to resource extraction. The evaluation is provided in Table 16.
- The site conditions following resource extraction. The evaluation is provided in Table 17.

Based on detailed evaluation of the alternatives, Site No 1 (Solmar) has the highest score prior to resource extraction and is identified as the preferred alternative based on present site conditions. Following resource extraction, Site 2B (HCS) has the highest score and is identified as the preferred alternative following resource extraction.

The details of the scoring and rationale have been provided in Table 18.

Table 16 – Evaluation Matrix for Short Listed Wastewater Treatment Plant Site Alternatives (Prior to Aggregate Extraction)

Primary Criteria		Secondary Criteria		Absolute Weight (WT)	Site 1 (Solmar)		Site 2A (HCS) Prior to Extraction		Site 2B (HCS) Prior to Extraction		Site 2C (HCS) Prior to Extraction		Comments Prior to Aggregate Extraction on Sites 2A, 2B, 2C
Criteria	Weight	Criteria	Weight		Score	WT Score	Score	WT Score	Score	WT Score	Score	WT Score	
Social/Culture	15%	Impacts During Construction	20%	3	5	3	5	3	4	2.4	4	2.4	Site 2B/2C may impact access to HCS operation
		Aesthetics	30%	4.5	5	4.5	1	0.9	4	3.6	3	2.7	Site 2A and 2C most visible. Site 1 can be completely hidden from view
		Effect on Residential Properties	30%	4.5	4	3.6	2	1.8	5	4.5	3	2.7	Buffer zone for Site 2B is greater so less effect
		Effect on Businesses/ Commercial Properties	10%	1.5	5	1.5	5	1.5	5	1.5	5	1.5	Minimal Effect from any alternative
		Effect on Industrial Properties	10%	1.5	5	1.5	2	0.6	2	0.6	2	0.6	Site 2A and 2B affect aggregate resource
Technical	10%	Suitability of Elevation and Topography	50%	5	5	5	4	4	5	5	4	4	All similar with good topography. All sites require effluent pumping
		Suitability for Phasing	20%	2	5	2	5	2	5	2	5	2	All sites good
		Construction Impacts	20%	2	4	1.6	4	1.6	4	1.6	4	1.6	All should have low impacts. All use same roads.
		Operation and Maintenance Impacts	10%	1	5	1	5	1	4.5	0.9	4.5	0.9	All similar good sites with access for deliveries and maintenance
Environmental	50%	Effect on Habitat/Wildlife	30%	15	4	12	3	9	3	9	3	9	All impact bird habitat and may require compensation
		Effect on Vegetation/Wetlands	30%	15	4	12	4	12	4	12	4	12	All impact agricultural lands. Site 1 impact rare species
		Effect on Groundwater	20%	10	4	8	4	8	3	6	3	6	May be a small effect on groundwater flow to River
		Effect on Surface Water/Fisheries	20%	10	5	10	5	10	5	10	5	10	Little effect anticipated
Economic	25%	Capital Cost	100%	25	5	25	2	10	2	10	2	10	Site 2A, 2B and 2C costs include land aggregate resource cost
			TOTAL SCORE	100		90.7		65.4		69.1		65.4	

Based on the above evaluation, Site 1 (Solmar) is the preferred site prior to aggregate extraction.

Table 17 – Evaluation Matrix for Short Listed Wastewater Treatment Plant Site Alternatives (Following Aggregate Extraction)

Primary Criteria		Secondary Criteria		Absolute Weight (WT)	Site 1 (Solmar)		Site 2A (HCS) Following Extraction		Site 2B (HCS) Following Extraction		Site 2C (HCS) Following Extraction		Comments Following Aggregate Extraction on Sites 2A, 2B, 2C
Criteria	Weight	Criteria	Weight		Score	WT Score	Score	WT Score	Score	WT Score	Score	WT Score	
Social/Culture	15%	Impacts During Construction	20%	3	5	3	5	3	4.5	2.7	4.5	2.7	Site 2B/2C may impact access to HCS operation
		Aesthetics	30%	4.5	5	4.5	3	2.7	5	4.5	3	2.7	Site 2A and 2C most visible. Site 1 can be completely hidden from view
		Effect on Residential Properties	30%	4.5	4	3.6	2	1.8	5	4.5	3	2.7	Buffer zone for Site 2B is greater so less effect
		Effect on Businesses/ Commercial Properties	10%	1.5	5	1.5	5	1.5	5	1.5	5	1.5	Minimal Effect from any alternative
		Effect on Industrial Properties	10%	1.5	5	1.5	5	1.5	5	1.5	5	1.5	Assuming aggregates removed effect will be minimal
Technical	10%	Suitability of Elevation and Topography	50%	5	5	5	3	3	3	3	3	3	Aggregate removal causes groundwater and structural issues
		Suitability for Phasing	20%	2	5	2	5	2	5	2	5	2	All sites good
		Construction Impacts	20%	2	4	1.6	4	1.6	4	1.6	4	1.6	All should have low impacts. All use same roads.
		Operation and Maintenance Impacts	10%	1	5	1	5	1	4.5	0.9	4.5	0.9	All similar good sites with access for deliveries and maintenance
Environmental	50%	Effect on Habitat/Wildlife	30%	15	4	12	5	15	5	15	5	15	Assume bird habitat restored after aggregate extraction on 2A, 2B and 2C
		Effect on Vegetation/Wetlands	30%	15	4	12	5	15	5	15	5	15	All impact agricultural lands. Site 1 impact rare species
		Effect on Groundwater	20%	10	5	10	4	8	4	8	4	8	Effect on groundwater flow to River increased with aggregate extraction
		Effect on Surface Water/Fisheries	20%	10	5	10	5	10	5	10	5	10	Potential effect increased with aggregate extraction
Economic	25%	Capital Cost	100%	25	4	20	4	20	4	20	4	20	Little cost difference after aggregate extraction
TOTAL SCORE				100		87.7		86.1		90.2		86.6	

Based on the above evaluation, Site 2B (HCS) is the preferred site following aggregate extraction.

Table 18 – Criteria Rating Rationale

Criteria	Site 1 (Solmar)	Site 2A (HCS)	Site 2B (HCS)	Site 2C (HCS)
Social/ Culture - Impacts During Construction	▪ It is anticipated that the site is sufficiently remote from the existing community that the effects of dust, noise, will not impact the community to any great degree ▪ Traffic impact can be mitigated by specifying haul routes and likely can avoid urban areas ▪ Stage 2 Archaeological Study required	▪ Same as site 1 ▪ Similar impacts after aggregate extraction	▪ Same as site 1 ▪ Development of site 2B on 10th Line may impact access to HCS operations ▪ Similar impacts after aggregate extraction	▪ Same as site 1 ▪ Development of site 2C on 10th Line may impact access to HCS operations ▪ Similar impacts after aggregate extraction ▪ Potential for additional archaeological resources to be found
Social/ Culture - Aesthetics	▪ Due to the site sloping to the north it will be possible to minimize impact from Wellington Road 52 ▪ The subdivision to the west will likely be completely hidden from the WWTP	▪ The site is at the highest elevation in the area and it would likely be highly visible from Wellington Road 52 and from the subdivision to the west ▪ This site would have a significant aesthetic impact despite attempts to mitigate through landscaping and planting ▪ Following extraction the site would be less visible but still likely in view of road	▪ This site has the potential to have the least aesthetic impact on the area ▪ Natural topography can shield the WWTP from Wellington Road 52 and the subdivision to the west ▪ It would have a small aesthetic impact on homes to the east of 10th Line ▪ Following extraction would be even less visible	▪ The site is at the corner of Wellington Road 52 and 10th Line and visible from both roads and to homes to the east ▪ This site would have an aesthetic impact despite attempts to mitigate through landscaping and planting ▪ Following extraction the site would be less visible but still likely in view of roads
Social/ Culture - Effect on Residential	▪ This site could potentially impact the McCullough	▪ This site could potentially impact the McCullough	▪ This site would potentially have little impact on	▪ This site could potentially impact several homes to

Criteria	Site 1 (Solmar)	Site 2A (HCS)	Site 2B (HCS)	Site 2C (HCS)
Properties	Drive/Aspen Court subdivision and a single home on 10th Line ▪ Buffer distances exceed MOECC recommended distances and additional mitigation can be put in place to comply with noise and odour limitations ▪ Prevailing winds are away from the subdivision	Drive/Aspen Court subdivision ▪ Buffer distances exceed MOECC recommended distances and additional mitigation can be put in place to comply with noise and odour limitations ▪ Prevailing winds are away from the subdivision ▪ Aggregate extraction would not significantly change potential impacts	residential developments. ▪ Buffer distances exceed MOECC recommended distances and additional mitigation can be put in place to comply with noise and odour limitations. ▪ Prevailing winds are away from the subdivision ▪ Aggregate extraction would not significantly change potential impacts	the east ▪ Buffer distances exceed MOECC recommended distances and additional mitigation can be put in place to comply with noise and odour limitations ▪ Prevailing winds are generally in the direction of the homes on the south side of Wellington Road 52 ▪ Aggregate extraction would not significantly change potential impacts
Social/ Culture - Effect on Businesses/ Commercial Properties	▪ There are few commercial businesses within the area of the site and a WWTP on this site would have little impact on commercial properties	▪ Same as site 1	▪ Same as site 1	▪ Same as site 1
Social/ Culture - Effect on Industrial Properties	▪ There are no industrial businesses within the area of the site and a WWTP on this site would have little impact on industrial properties	▪ The site is zoned for aggregate extraction and development of this site prior to extraction, would negatively impact the commercial value of the site	▪ Same as 2A	▪ Same as 2A
Technical - Suitability of Elevation and Topography	▪ Site 1 is sufficiently above the river and flood level. ▪ Site 1 provides topography	▪ Site 2A is sufficiently above the river and flood level.	▪ Site 2B is sufficiently above the river and flood level. ▪ Site 2B provides topography	▪ Site 2C is sufficiently above the river and flood level. ▪ Site 2C provides

Criteria	Site 1 (Solmar)	Site 2A (HCS)	Site 2B (HCS)	Site 2C (HCS)
	sloping to the north sufficient to maintain gravity flow through all of the treatment processes while screening them from the road. ▪ Site will need to have debris cleaned from the site prior to construction.	▪ Site 2A provides topography sloping to the south sufficient to maintain gravity flow through all of the treatment processes ▪ Aggregate extraction would result in a flat site just above the groundwater table making it more costly to construct the plant	sloping to the south east sufficient to maintain gravity flow through all of the treatment processes while screening them from the road. ▪ Same as site 2A	topography sloping to the south east sufficient to maintain gravity flow through all of the treatment processes ▪ Same as site 2A
Technical - Suitability for Phasing	▪ Site supports phasing as shown in figure 2	▪ Site supports phasing as shown in figure 2	▪ Site supports phasing as shown in figure 2	▪ Site supports phasing as shown in figure 2
Technical - Construction Impacts	▪ Construction traffic flow to the site should not have a major impact on the community ▪ Site is sufficiently far from residential properties that dust and noise should not impact them ▪ The soils underlying the site form adequate foundation material and avoid added cost of dewatering and rock removal	▪ As site 1 ▪ Aggregate removal to just above the water table will add to the construction cost	▪ As site 1 ▪ Aggregate removal to just above the water table will add to the construction cost	▪ As site 1 ▪ Aggregate removal to just above the water table will add to the construction cost
Technical - Operation and Maintenance Impacts	▪ Site has good access for deliveries, maintenance and dealing with emergencies ▪ Sufficient space to	▪ As site 1 ▪ Aggregate removal will detract from site access	▪ As site 1	▪ As site 1 ▪ Aggregate removal will detract from site access

Criteria	Site 1 (Solmar)	Site 2A (HCS)	Site 2B (HCS)	Site 2C (HCS)
	accommodate all MOECC requirements ▪ The elevation and slope of the site should be able to deal with design weather events			
Economic - Capital Cost	▪ This site has the least capital cost prior to aggregate extraction ▪ The Owner of the site is willing to sell the site to meet the project schedule	▪ Sites 2A, 2B and 2C have a similar cost prior to extraction which is substantially higher than site 1 cost ▪ The Owner of the site is not willing to sell the site to meet the project schedule, however would be willing to sell the site after mining which would lower the capital cost ▪ Following aggregate extraction the site is likely less costly to purchase but more costly to develop	▪ Sites 2A, 2B and 2C have a similar cost prior to extraction which is substantially higher than site 1 cost ▪ The Owner of the site is not willing to sell the site to meet the project schedule, however would be willing to sell the site after mining which would lower the capital cost ▪ Following aggregate extraction the site is likely less costly to purchase but more costly to develop	▪ Sites 2A, 2B and 2C have a similar cost prior to extraction which is substantially higher than site 1 cost ▪ The Owner of the site is not willing to sell the site to meet the project schedule, however would be willing to sell the site after mining which would lower the capital cost ▪ Following aggregate extraction the site is likely less costly to purchase but more costly to develop
Environmental - Effect on Habitat/ Wildlife	▪ Each of the four proposed WWTP site locations contained sensitive features ▪ Two threatened bird species observed on site but not considered to be breeding on site ▪ Provides wildlife habitat for an area sensitive grassland	▪ Each of the four proposed WWTP site locations contained sensitive features ▪ Two threatened bird species observed on site and considered to be breeding on site ▪ Mitigation to protect	▪ Each of the four proposed WWTP site locations contained sensitive features ▪ Two threatened bird species observed on site and considered to be breeding on site ▪ Mitigation to protect threatened species must be	▪ Each of the four proposed WWTP site locations contained sensitive features ▪ Two threatened bird species observed on site and considered to be breeding on site ▪ Mitigation to protect

Criteria	Site 1 (Solmar)	Site 2A (HCS)	Site 2B (HCS)	Site 2C (HCS)
	species (Savannah Sparrow) ▪ Mitigation to protect threatened species must be implemented	threatened species must be implemented	implemented	threatened species must be implemented
Environmental - Effect on Vegetation/ Wetlands	▪ One rare and uncommon plant growing on site (Wild Geranium) can be replanted ▪ Four rare plant species in adjacent wetland	▪ Farmed grassland fields. No anticipated impact ▪ Loss of prime agricultural land	▪ Farmed grassland fields. No anticipated impact ▪ Loss of prime agricultural land	▪ Farmed grassland fields. No anticipated impact ▪ Loss of prime agricultural land
Environmental - Effect on groundwater	▪ Unlikely to affect groundwater flow and effects can be mitigated	▪ Unlikely to affect groundwater flow and effects can be mitigated	▪ Unlikely to affect groundwater flow and effects can be mitigated	▪ Unlikely to affect groundwater flow and effects can be mitigated
Environmental - Effect on Surface Water/Fisheries	▪ No anticipated impact	▪ No anticipated impact	▪ No anticipated impact	▪ No anticipated impact

6.0 Conclusion and Recommendations

- The 2014 Servicing and Settlement Master Plan (SSMP) identified a general area for the WWTP south east of Erin Village.
- The UCWS EA is a continuation of the Class EA process and aims to establish the preferred design alternative for the wastewater system servicing Erin Village and Hillsburgh.
- The updated Assimilative Capacity study completed for the UCWS Class EA study confirmed the suitability of the general WWTP site area identified in the SSMP.
- The Wastewater Collection System Alternatives Technical Memorandum confirmed that all wastewater can be conveyed to the area.
- The Outfall Alternatives Technical Memorandum confirms that Winston Churchill Boulevard is the preferred effluent discharge location from the WWTP requiring effluent to be pumped from all of the candidate sites to the outfall location.
- MOECC requirements for WWTP siting were examined and used to assist in defining potential sites.
- An assessment of site space requirements was conducted and a site area of 5 Hectares was identified sufficient for the plant facilities and a buffer zone in excess of MOECC requirements including the agricultural/Wetland areas around the site.
- Based on the above and a more detailed examination of the area, this UCWS Class EA study has refined the general area for the WWTP and selected four (4) sites within this area as being suitable for a WWTP site.
- The four (4) sites are defined as follows:
    - Site 1 Solmar site
    - Site 2A Halton Crushed Stone (HCS) site
    - Site 2B Halton Crushed Stone (HCS) site
    - Site 2C Halton Crushed Stone (HCS) site
- The project team met with the Owners of the sites and secured permission to conduct studies to support the decision making process. Studies completed by HCS were provided to the project team.
- As a result of these Owner meetings, Solmar (site 1) indicated that they would support sale of part of their land for a WWTP site and HCS (sites 2A, 2B and 2C) indicated that they would support the sale of their property only after the aggregate resources were mined and the site restored to agricultural use.
- The team compiled sufficient information on the environmental, geotechnical, archaeological and costing aspects of the sites to support an evaluation process aimed at selecting the preferred site.
- The evaluation criteria were established with the following weighting for the primary criteria:
    - Social/ Cultural Impacts – 15%
    - Technical Impacts – 10%
    - Economic Impacts– 25%
    - Environmental Impacts - 50%
- Environmental impacts are summarized as follows:

Each of the four proposed WWTP site locations contained sensitive features.

Several threatened species of birds were found on all sites. Bobolink and Eastern Meadowlark are threatened species under Ontario's Endangered Species Act. As such, certain provisions apply to development that will damage or destroy the habitat of these birds. No permit is required if the area to be developed is equal to or less than 30 hectares, but the following rules must be followed:

- The work and affected species must be registered with the MNRF before the work begins;
- A habitat management plan must be prepared and followed;
- Habitat for the affected species must be created or enhanced, and managed;
- A written undertaking must be submitted to MNRF indicating that any habitat created or enhanced will be managed over time;
- No activity likely to damage or destroy habitat, or kill, harm or harass individuals of the affected
- species will be carried out between May 1 and July 31;
- Reasonable steps will be taken to minimize adverse effects on the affected species (e.g., locating access routes outside of the birds' habitat);
- Records relating to the work and habitat must be prepared and maintained; and
- Sightings of rare species must be reported (and registration documents updated, as needed).

The WWTP site locations were evaluated based on presence of provincially and/or nationally designated SAR, sensitive bird species, and significant habitat. The screening criteria indicated that Site 1 (Solmar) is the preferred choice for the location of the WWTP site, based on the presence of two species at risk in suitable breeding habitat on the other sites (HCS). However, Site 1 does provide suitable breeding habitat for the area sensitive Savannah Sparrow, and thus qualifies as Significant Wildlife Habitat under the PPS. As such, development and site alteration are only permitted if there will be no negative impacts on the natural features or their ecological functions. Furthermore, Site 1 contained a rare and uncommon plant species (Wild Geranium), and is located next to the West Credit PSW Complex. Appropriate mitigation measures were therefore recommended to ensure no negative effects on species of conservation concern and important natural heritage features in the vicinity.

- Geotechnical impacts are summarized as follows:

  All sites are generally suitable for construction of a WWTP. Prior to aggregate extraction, the sites provide good foundation materials well above the groundwater table which will minimize the need to dewater excavations during construction. Following aggregate extraction, the HCS sites will be just above the water table which would require dewatering during excavation or otherwise importing materials and building all facilities above the water table.

- Archaeological impacts are summarized as follows:

  An archaeological investigation of Site 1 (Solmar) indicated the potential for archaeological resources to be found on site. A stage 2 investigation is recommended prior to site development.

  An archaeological investigation (Stage 1, 2 and 3) has been completed for Sites 2A, 2B and 2C (HCS). An archaeological site was located close to site 2C leaving the potential for additional resources to be located on Site 2C.

- The relative capital costs for each site are summarized as follows:

Alternative	Capital Cost Prior to Aggregate extraction	Capital Cost Following Aggregate extraction
Site 1 (Solmar)	$ 785,000	$ 785,000
Site 2A (HCS)	$ 2,665,000	$ 665,000
Site 2B (HCS)	$ 2,650,000	$ 650,000
Site 2C (HCS)	$ 2,670,000	$ 670,000

- The results of the evaluation process indicate that, **prior to aggregate extraction**, Site 1 has the highest score and is preferred over sites 2A, 2B or 2C.
- The primary reasons for this are:
  - The site owner is willing to sell the land to meet the project schedule
  - The high capital cost difference between Site 1 and Site 2A 2B and 2C which includes the resource cost for the aggregate extraction
  - The effect on the industrial sector of reducing the area for aggregate extraction
  - Aesthetics of developing a WWTP on site 2A
  - Less environmental impact on Site 1
- Based on the above, prior to aggregate extraction, it is recommended that Site 1 (Solmar) be carried forward as the preferred site for the WWTP.
- The results of the evaluation process **following aggregate extraction**, indicate that Site 2B has the highest score and is preferred over sites 1, 2A or 2C.
- The primary reasons for this are:
  - The site provides the best buffer from all nearby residences
  - The site can be hidden almost completely from view from all residences and Wellington Road 52
  - Less environmental impact following extraction assuming that HCS have mitigated the loss of habitat
- It is noted that all of the necessary studies
- It Based on the above, if aggregate extraction takes place prior to the Town requiring the site for the project then it is recommended that Site 2B (HCS) be carried forward as the preferred site for the WWTP.
- In carrying forward two treatment plant sites as possible locations for the WWTP through to the final ESR it is recognized that the municipality will need to prepare an Addendum to the ESR to make a final site selection and this addendum will need to fully explain the events that have occurred and the rationale for making the final location decision.

Appendix - R

Treatment Technology Alternatives

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April 24, 2018

File No. 115157

Triton Engineering Services Limited
105 Queen Street West Unit 14
Fergus, ON N1M 1S6

Attn: **Christine Furlong, P.Eng.**
Project Manager

Ref: **Town of Erin, Urban Centre Wastewater Servicing Class EA**
Treatment Technology Alternatives, Technical Memorandum

Dear Ms. Furlong:

We are pleased to present the Technical Memorandum for the "Treatment Technology Alternatives" for the Urban Centre Wastewater Servicing Schedule 'C' Municipal Class Environmental Assessment (EA).

This Technical Memorandum provides a review of the Treatment Technology Alternatives and includes those alternatives identified in the Servicing and Settlement Master Plan (SSMP). The Technical Memorandum establishes and evaluates alternative for the wastewater treatment system as a component of Phase 3 of the Municipal Class EA process. The recommended preferred Alternative is presented in the Technical Memorandum which will remain in draft until completion of the public review process.

Yours truly,

AINLEY & ASSOCIATES LIMITED

Joe Mullan, P.Eng.
Project Manager

TOWN OF ERIN

Town of Erin
Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Treatment Technology Alternatives

Final

April 2018

Ainley GROUP
CONSULTING ENGINEERS PLANNERS

Urban Centre Wastewater Servicing Class Environmental Assessment

Technical Memorandum
Treatment Technology Alternatives

Project No. 115157

Prepared for:
The Town of Erin

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Glossary of Terms

ACS	Assimilative Capacity Study
ADF	Average Daily Flow
ATAD	Autothermal Thermophilic Aerobic Digester
BAF	Biological Aerated Filters
BOD	Biological Oxygen Demand.
CAS	Conventional Activated Sludge.
BOD_5	Biochemical oxygen demand
CVC	Credit Valley Conservation Authority
DO	Dissolved Oxygen
ECA	Environmental Compliance Approval
HESL	Hutchinson Environmental Sciences Limited:
IFAS	Integrated Fixed-Film Activated Sludge:
MBBR	Moving Bed Bioreactors
MBR	Membrane Bioreactors
MLSS	Mixed Liquor Suspended Solids
MOECC	Ministry of the Environment and Climate Change
NPV	Net Present Value
O&M	Operation and maintenance:
PHF	Peak Hourly Flow
PWQO	Provincial Water Quality Objectives (PWQO).
RAS	Return Activated Sludge
RBC	Rotating Biological Contractor:
SBR	Sequencing Batch Reactor
SSMP	Servicing and Settlement Master Plan
TAN	Total Ammonia Nitrate:
TM	Technical Memorandum
TP	Total Phosphorous
TSS	Total Suspended Solids
UCWS Class EA	Urban Centre Wastewater Servicing Class Environmental Assessment
UV	Ultra-Violet
WAS	Waste Activated Sludge
WWTP	Waste Water Treatment Plant

1.0 Introduction

This Technical Memorandum has been prepared in support of the Town of Erin Urban Centre Wastewater Servicing Class Environmental Assessment (UCWS EA) to identify and evaluate alternative solutions for the treatment of wastewater generated by the existing population and projected growth within the urban areas of Erin Village and Hillsburgh. The UCWS EA follows a 2014 Servicing and Settlement Master Plan (SSMP), completed by B.M. Ross. The SSMP completed part of Phase 1 and Phase 2 of the Class EA process and recommended construction of a new municipal wastewater collection system and wastewater treatment plant (WWTP) to service both urban communities. The SSMP also recommended discharge of the treated effluent to the West Credit River between 10th Line and Winston Churchill Boulevard.

The UCWS EA commenced in 2016 and Phases 1 and 2 were completed during the fall of 2017 with the following results:

1.1 Assimilative Capacity Study (ACS)

In 2014, B.M Ross performed an assimilative capacity study (ACS) as part of the SSMP. During 2016, the ACS was updated by Hutchinson Environmental Sciences Ltd. (HESL) to include hydrodynamic modelling and additional data collected since the 2014 ACS was completed. The 2014 ACS determined that phosphorous loading to the West Credit River was the limiting factor to the amount of treated wastewater that could be discharged to the West Credit River. The updated, 2016 ACS confirmed this and also established WWTP effluent limits for the discharge to the West Credit River. The effluent limits and discharge flow rates recommended in the 2016 ACS have been accepted by the Ministry of the Environment and Climate Change (MOECC) and Credit Valley Conservation (CVC).

1.2 Service Area

The SSMP examined the existing septic systems throughout the urban areas of Erin Village and Hillsburgh. As part of the UCWS EA, during 2016, a more detailed assessment of these systems was undertaken and a service area covering the existing developed portions of the communities was defined.

1.3 Plant Capacity/Service Population

Based on the results of the ACS, the septic system survey, and discussions with Wellington County on potential new growth areas, it was established that a WWTP with an average capacity of 7,172 m^3/d at an effluent phosphorus concentration of 0.046 mg/L could service all of the existing urban areas, including an allowance for infill and intensification, as well as all of the areas zoned for development within the study area, as defined by Wellington County. This flow will allow a residential population of approximately 14,559 people. When industrial, commercial, and industrial growth is included, the equivalent population is 18,873.

2.0 Objectives

This technical memorandum (TM) presents the evaluation of treatment technology alternatives available for Erin's proposed wastewater treatment plant. The information presented in this TM constitutes a component of Phase 3 of the Class EA process, which involves examination of alternative methods of implementing the preferred solution(s) as determined in the previous phases of the Class EA. The new WWTP will be designed to service the existing community plus projected residential, commercial, and industrial growth in the study area. Additional technical memoranda will address other components of Phase 3 activities, including locations of the wastewater treatment plant and wastewater discharge to the West Credit River as well as collection system alternatives.

3.0 Design Basis

The basis of design for Erin's WWTP was developed using information from the following documents:

- The Assimilative Capacity Studies (2014 and 2016)
- Ainley technical memorandum entitled "System Capacity and Sewage Flows"
- Ainley technical memorandum entitled "Septic System Overview".

The projected sewage flow from the existing communities represents 40% of the full build out flow for the WWTP. To achieve full build out, it is envisaged that the wastewater treatment plant would be constructed in phases. For the purpose of this technology alternatives evaluation, it is assumed that the wastewater treatment plant will be constructed in two phases. It has also been assumed that the plant would be designed to have three process trains, each with a capacity equal to one third of the full build out capacity. Table 1 illustrates the capacity, timing, and allocation of flows between existing development and growth. The years selected as the "Forecasted Year of Construction" were selected to establish a life-cycle in order to perform the life-cycle cost analyses. It does not imply that the project will necessarily be constructed in those years.

Table 1 – Wastewater Treatment Plant Construction Phasing

Phase	Capacity (m^3/d)	Allocation to Existing Population	Allocation to Growth Population	Forecasted Year of Construction
Phase 1	4,780	60%	40%	2020 – 2022
Phase 2	2,390	0%	100%	2028 – 2030

Phase 1 would provide two thirds of the full build out flow and allowable discharge to the river. Phase 1 would also provide for 100% of the required capacity to service the existing community (2,844 m^3/d) as well as 45% of the total growth identified for full build out. Phase 1 allocation would be 60% to existing community and 40% to growth. Phase 2 (Full Buildout) would involve construction of one additional process train onto the Phase 1 plant to treat the maximum allowable flow that was established by the 2016 ACS. This would service all remaining growth.

For the purposes of this evaluation, it is assumed that Phase 1 will be designed to meet the effluent limits prescribed for the Full Buildout.

3.1 Population and Flows

Contributing wastewater flows were calculated as outlined in the "System Capacity and Sewage Flows" technical memorandum. Plant capacity is based on per capita residential flows for the existing urban areas with allowance for institutional, commercial, and industrial flows as well as allowances for infill and intensification in existing areas. Growth areas were established by Wellington County and flow was calculated for these areas as outlined in the "System Capacity and Sewage Flows" technical memorandum. Based on the above, a capacity of 7,172 m^3/d was established to service all of the existing and growth areas. To be able to discharge this volume of treated effluent to the West Credit River, the ACS established that the effluent concentration for total phosphorus would need to be 0.046 mg/L.

Based on the maximum allowable WWTP discharge flow of 7,172 m^3/d and the assumed per capita flow contributions, the number of residents that could be served is 14,559. Table 2 shows WWTP flow rates, population served, and percentage of the Full Buildout flow that each phase.

Table 2 – WWTP Phases of Construction and Population Served

	Phase 1	Phase 2 / Full Buildout
Total WWTP Capacity (Average Day Flow)	4,780 m^3/d	7, 172 m^3/d
Residential Population Served	8,864	14,559
Equivalent Population* Served	12,893	18,873

*Equivalent population captures contributions from commercial, institutional, and industrial sources.

3.2 Peaking Factor and Peak Flows

The Harmon Formula, as detailed in the Ministry of the Environment and Climate Change's "Design Guidelines for Sewage Works (2008)", was used to determine peaking factors and peak hourly flows for Phase 1 and Phase 2.

Table 3 below presents the peaking factors and peak hourly flows used for Phase 1 and Phase 2. It should be noted that the peak flows below include contributions from inflow and infiltration.

Table 3 – Peaking Factors and Design Flows

	Phase 1	Phase 2 / Full Buildout
Average Day Flow	4,780 m^3/d	7, 172 m^3/d
Harmon Peaking Factor	2.84	2.67
Peak Hourly Flow	11,779 m^3/d	19,148 m^3/d

Sewage Pumping Stations as well as specific unit processes will need to be designed for the peak instantaneous flows.

3.3 WWTP Influent Characteristics

The existing urban areas within the study area use private, on-site wastewater systems to manage wastewater. As such, there is no data available for the raw sewage/wastewater to be received at the new WWTP. Raw sewage characteristics used for the technology alternatives evaluation were derived from the Ministry of the Environment and Climate Change "Design Guidelines for Sewage Works (2008)", Page 8-9 and are listed in Table 4.

There are a number of rural residents who will be outside the recommended service area of the proposed wastewater collection system and will remain on septic systems. Hauled septage from these residents will be received and treated at the new WWTP.

Evaluation of the alternatives for management and treatment of septage is presented in Section 8 of this technical memorandum. The influent characteristics listed in Table 4 do not include contributions from septage. Influent characteristics that incorporate septage addition to the wastewater treatment system are presented in Section 8.3.

Table 4 – WWTP Influent Characteristics and Loading Rates

Influent Parameter	Typical Raw Sewage Concentrations (mg/L)	Loading (kg/d)	
		Phase 1	Phase 2 (Full Buildout)
Biological Oxygen Demand (BOD)	175	837	1,255
Total Suspended Solids (TSS)	175	837	1,255
Total Ammonia Nitrogen (TAN)	35	110	165
Total Kjeldhal Nitrogen	35	167	251
Total Phosphorous (TP)	7	33	50

Loadings are calculated based on average day flows for both Phase 1 and Phase 2.

3.4 WWTP Effluent Limits and Objectives

In addition to phosphorous limits, the ACS established effluent limits for other regulated parameters under Full Buildout flow. For the purposes of this technical memorandum, is has been assumed that the same treatment technology will be used for Phase 1 and Full Buildout. For this reason, the effluent limits associated with the Full Buildout flow were also used as the limits for Phase 1 flow and evaluation of treatment alternatives.

The ACS also found that dissolved oxygen (DO) levels in the West Credit River are well above the Provincial Water Quality Objective (PWQO) of 6 mg/L. HESL determined that an effluent DO concentration of 4 mg/L would maintain the oxygen levels in the river.

Table 5 presents the WWTP effluent limits for the regulated parameters for Erin's WWTP.

Table 5 – Erin WWTP Effluent Limits

Parameter	Effluent Concentration Limit (mg/L)
Carbonaceous Biological Oxygen Demand (cBOD5)	5 mg/L
Total Suspended Solids (TSS)	5 mg/L
Total Phosphorous (TP)	0.045 mg/L
Total Ammonia Nitrate (TAN)	0.6 mg/L (summer: May 15 to October 15) 2 mg/L (winter: October 16 to May 14)
Nitrate Nitrogen	5 mg/L
Minimum Dissolved Oxygen	4 mg/L
E. Coli.	100 cfu/100mL
pH	6.5 - 8.5

These effluent limits are stringent when compared against other wastewater treatment facilities in Ontario. This is due to the West Credit River's classification as a Policy 1 receiver. To achieve the required level of treatment, the Erin WWTP will need to be an Advanced Wastewater Treatment Facility, incorporating both secondary and tertiary treatment and include an add-on technology for re-oxygenation of the treated effluent.

Typically, the Environmental Compliance Approval (ECA) for municipal wastewater treatment facilities includes effluent or operational objectives in addition to the effluent limits. Effluent objectives are set as treatment goals for the WWTP as a guarantee that the limits will not be exceeded. The operational objectives proposed for Erin's WWTP are presented in Table 6.

Table 6 – Proposed WWTP Effluent / Operational Objectives

Parameter	Effluent Concentration Objective
Biological Oxygen Demand (BOD)	3 mg/L
Total Suspended Solids (TSS)	3 mg/L
Total Phosphorous (TP)	0.03 mg/L
Total Ammonia	0.3 mg/L (summer: May 15 to October 15) 1 mg/L (winter: October 16 to May 14)
Nitrate Nitrogen	4 mg/L
Minimum Dissolved Oxygen	5 mg/L
E. Coli.	100 cfu / 100mL

4.0 Evaluation Methodology

An evaluation methodology to identify a recommended treatment technology alternative for Erin's WWTP has been developed based on methodologies and guidelines outlined in the Municipal Class Environmental Assessment. This evaluation was performed on four distinct wastewater treatment processes, which are outlined below:

- Liquid Treatment
- Aeration of the Treated Effluent
- Sludge/Biosolids Treatment
- Septage Treatment/Management

Liquid Treatment refers to the process (treatment train) that treats the raw sewage to produce the liquid effluent that can be released to the West Credit River.

Aeration of the Treated Effluent refers to the process to be used to maintain dissolved oxygen levels in the treated effluent above 4 mg/L. This is included as a separate component, since, depending on what technologies are recommended for the liquid treatment train, a separate aeration step may not be required. For example, if the preferred liquid train treatment is a membrane bioreactor (MBR), the MBR's blowers could be sized to continuously maintain a minimum DO level of 4 mg/L in the aerobic stage and since there are no processes downstream of the MBR that remove oxygen or are hindered by elevated DO levels in the wastewater stream, the DO level would remain at 4 mg/L until discharge to the river. No additional aeration step would be required prior to discharge into the West Credit River.

Sludge/Biosolids Treatment refers to the system that will treat the residual solids component of the wastewater. Treatment can be to a level where the final product can be used or disposed of off-site, i.e. to agricultural land, or treatment can be to the minimum level required to allow trucking the sludge/biosolids to an off-site, privately owned, facility for final treatment and use and/or disposal.

Septage Treatment/Management refers to the alternatives available for receiving and treating septage such that it will meet the quality requirements for discharge to the environment. Septage requires both liquid and sludge/biosolids treatment.

Evaluation of each of the four (4) treatment processes involved two main steps:

- Identification of a long list of potential alternative solutions and the screening of this list down to a short list of viable alternatives.
- A detailed evaluation of the short-listed alternatives to identify a recommended preferred alternative.

To achieve this goal, the following steps were undertaken:

- Develop a set of long-list screening criteria to screen the long list of alternatives to a short list. This set of criteria is meant to capture features that are considered essential to the success of the WWTP servicing Erin and to establish viability of the alternative.
- Develop a set of short-list evaluation criteria to evaluate the short-listed alternatives. This set of criteria consists of primary and secondary criteria and weightings. These criteria provide a more in-depth analysis of the technologies, sufficient to identify the recommended technology.
- Generate a long list of technologies that could be used for the process being evaluated.
- Use the long-list screening criteria to reduce the long list to a short list.
- Develop design concepts (treatment trains) using the short-listed technologies.
- Perform detailed evaluations of each design concept, including a life-cycle cost analysis, using the short-list evaluation criteria.
- Identify the recommended alternative, based on the results of the detailed evaluation.

Separate sets of screening/evaluation criteria were used for each of the four (4) processes, since the objectives for each process are different.

4.1 Approach to Life-Cycle Cost Analysis

A life-cycle cost analysis was carried out on each short-listed alternative as part of the detailed evaluation. The analyses incorporated factors such as equipment costs, construction costs, annual operating and maintenance costs, and the Net Present Value (NPV) over the expected life of the facility.

Equipment and operating costs for each alternative were obtained from budgetary quotes, solicited from relevant equipment suppliers. Construction costs for common systems were estimated from data in Ainley's possession from projects of a similar nature and scope. Estimates for general contracting, site works, and yard piping were based on a percentage of equipment and building/tankage construction costs.

Actual costs associated with each alternative may be significantly affected by inflation and market conditions, however, changes in the conditions that affect these cost estimates would affect all alternatives proportionately, since the same assumptions and rationale were used to evaluate all alternatives. In this regard, the results of the comparative cost evaluation should remain the same.

The parameters and assumptions used in the life-cycle cost analyses are listed below.

- All costs are presented in 2017 Canadian dollars.
- Phase 1 construction projected to begin in 2020 and finish in 2022.
- Phase 2 construction is projected to begin in 2028 and finish in 2030.
- NPV costs are based on a 50-year life cycle for the facility.
- Major equipment replacements were incorporated at 30-year intervals.

- Electrical and I&C costs were factored into equipment installation costs.
- An estimated inflation rate of 2% was used
- An estimated interest rate of 5% was used.
- Electricity costs of 0.11/kWh was used.
- Land costs were included in the WWTP Site Evaluation Technical Memorandum
- The estimates related to site works, assume that there is no contaminated soil on the property.
- Cost estimates are net of taxes which apply to all alternatives.

5.0 Liquid Treatment

5.1 Overview of Liquid Treatment Train Processes

Treatment of the liquid component of wastewater involves several stages, typically starting with removal of grit and larger particles and ending with disinfection of the treated effluent just prior to release to the environment. The stages traditionally associated with treating the liquid train are described below.

Preliminary Treatment

Raw sewage arriving at the treatment plant by gravity or from a pumping station is first subjected to preliminary treatment which involves removal of larger objects and grit from the wastewater. Technologies used for preliminary treatment include various types of screens and grit removal systems. This process results in screenings and grit waste which is typically sent to a landfill.

Primary Treatment

Primary treatment is geared towards removal of particles that can be easily removed without the addition of chemicals or biological means. Typically, gravity settling technologies, such as clarification, are used for primary treatment. However, other technologies, such as filters, can be used. Some secondary treatment technologies do not require primary treatment. Primary treatment produces primary sludge, which is sent to the sludge treatment system.

Secondary Treatment

Once solids, grit, and settlables are removed from the wastewater, secondary treatment is implemented to reduce organics and other contaminants such as phosphorous, nitrogen, and ammonia. Technologies used for secondary treatment are usually biological in nature, such as aeration tanks, biological filters, and moving bed bioreactors. The biological sludge resulting from biological treatment is commonly referred to as “activated sludge” and is separated from the liquid via secondary clarification. Depending on the treatment technology used for in the secondary treatment stage, secondary sludge can either be recycled to the biological treatment step as return activated sludge (RAS) and/or sent to the sludge treatment system as waste activated sludge (WAS).

Tertiary Treatment

Where secondary treatment alone cannot meet a facility’s required effluent limits/objectives for particular parameters, it may be necessary to add a further treatment stage referred to as tertiary treatment. Tertiary treatment typically focuses on removal of parameters with low effluent limits, including phosphorous, nitrogen, and suspended solids.

Disinfection

Disinfection is performed to deactivate and/or kill pathogenic micro-organisms found in the liquid stream. Typically, E. coli is used as the indicator organism to measure the effectiveness of the disinfection process. Traditionally, chlorination has been used for disinfection, however, ultra-violet radiation and ozonation are becoming more common.

The effluent limit on nitrogen species for the Town of Erin is lower than most wastewater treatment facilities in Ontario. Typically, the MOE enforces a limit on total ammonia nitrogen (TAN). However, the West Credit River ACS, through the suggestion by the CVC, also recommends a limit on nitrate-nitrogen in to ensure that the nitrate-nitrogen loading to the river will be at a level that will not negatively impact the brook trout fishery in the river. Achieving the nitrate-nitrogen effluent limit requires a treatment process that can remove both ammonia and nitrate nitrogen.

In domestic wastewater, nitrogen generally exists as ammonia (NH_4). In order to remove nitrogen from the wastewater, a two-step process called nitrification/denitrification must take place. Nitrification is the conversion of ammonia to nitrite (NO_2) and then to nitrate (NO_3). Denitrification is the conversion of nitrate to nitrogen gas, which is released to the atmosphere.

The nitrification process requires the presence of oxygen (aerobic conditions) to convert ammonia to nitrite (NO_2) and nitrate (NO_3). The denitrification process, on the other hand, can only take place where the oxygen concentration is less than 0.5 mg/L (anoxic conditions). In the absence of free oxygen, denitrifying bacteria will use the oxygen in the nitrate molecules as they assimilate BOD. This process releases nitrogen in gaseous form.

The treatment alternative chosen for Erin will need to incorporate steps that will nitrify and denitrify the wastewater in order to achieve the treatment objectives for TAN and nitrate-nitrogen.

For the purposes of this evaluation process, preliminary treatment was not evaluated since the alternatives available will not be appreciably different in terms of environmental impact or cost.

5.2 Liquid Train Evaluation Criteria

5.2.1 Long-List Screening Criteria

The criteria selected for long-list screening of the liquid train alternatives are presented in Table 7.

Table 7 – Liquid Train Long-List Screening Criteria

Criteria	Description
Proven Reliability	Demonstrated track record of consistently meeting and/or exceeding the treatment objectives set forth for the UCWS EA.
Ease of Expansion to Buildout	Ability of the system to easily to expand to meet UCWS EA WWTP Full Buildout capacity.
Operation and Maintenance Complexity	Simplicity of operation and maintenance and level of staffing required.

Criteria	Description
Cost	Have value in terms of performance and/or operation and maintenance that are reflective of the capital costs.

Proven Reliability

In order to gain acceptance and approval by the Ministry of Environment and Climate Change (MOECC) in Ontario through the issuance of an Environmental Compliance Certificate (ECA), proponents must be able to demonstrate that a treatment process can achieve the required objectives on a consistent basis. In order for a technology to be carried forward for detailed analysis, the technology must therefore have a demonstrated history of being reliable and able to meet the performance requirements set out for the UCWS EA.

For primary and secondary treatment, MOECC typically prefers a minimum of three successfully operating plants of similar size and capacity, located in a similar climate and with comparable effluent criteria in order to be considered for implementation in Erin.

The effluent limit set for phosphorous will require best available technology to achieve the desired contaminant removal. There are several advanced treatment processes that have been proven successful at the proposed limits for phosphorus, however, operating plants under similar conditions as those proposed for Erin is limited. Tertiary treatment technologies that have been successfully proven in both operating plants and pilot studies to achieve the required phosphorous removal levels were considered in the long list.

Other factors taken into consideration include the technology's ability to adjust to changing influent conditions, such as high/low flows or fluctuations in sewage characteristics.

Ease of Expansion to Buildout

This criterion reviews how easily a technology can be expanded to match the facility's planned expansion from initial construction to Phase 2 / Full Buildout. Alternatives that require minimal component upgrades and financial investment were rated more favourably.

Operation / Maintenance Complexity

This criterion reviews how complex the technology/system is to operate and maintain. It also reviews the required operator skill level and staffing requirements. Technologies that were deemed very complex to operate or to have intensive maintenance schedules were excluded from the short list of alternatives, as are technologies that require highly skilled operators.

Cost

The cost criterion looks at capital cost, operation and maintenance costs, and the net present value of the alternative. Capital costs include purchase of equipment and its installation as well as the construction costs of tanks and buildings. Operation and maintenance aspects include costs related to utilities (electricity, gas, potable water), chemicals, etc. It should be noted that labour costs associated with the number of operators required were considered equivalent for all alternatives.

5.2.2 Short-List Evaluation Criteria

The criteria and weightings selected for the liquid train short-list evaluation are presented in Table 8 and descriptions of each follow.

Where warranted, weightings for some criteria were adjusted, to more accurately reflect the differing objectives in the process being evaluated. Where weightings were revised from those shown below, the revised weightings are listed in the report before the results of the analysis are presented.

Table 8 – Liquid Train Short-List Screening Criteria

Primary Criteria	Weight	Secondary Criteria	Weight
Social / Culture	15%	Aesthetic Impacts (plant appearance)	10%
		Traffic Impacts (during construction and operation)	10%
		Noise Impacts (during operation)	40%
		Odours Impacts (during operation)	40%
Technical	35%	Ability to Meet Regulatory Objectives	30%
		Technology / Process Robustness	30%
		Ease of Expansion and Phasing to Buildout	20%
		Energy Requirements	5%
		Operation & Maintenance Requirements (simplicity, operator skill level/quantity)	10%
		Site Requirements (plant footprint)	5%
Environmental	20%	Public Health and Safety	30%
		Sustainability	20%
		Climate Change Impacts / Greenhouse Gas Generation	20%
		Natural Environment Impacts	10%
		Waste Generation	20%
Economic	30%	Capital Cost	30%
		Operation and Maintenance Costs	40%
		Net Present Value	30%

Social/Culture

Aesthetic Impacts: Aesthetic impacts relate to the technology's or facility's physical appearance and how aesthetically pleasing it might be. Alternatives that are more likely to blend in with the rural agricultural setting scored higher in the evaluation.

Traffic Disruption/Truck Traffic: This criterion captures the level of traffic disruption that could exist during the facility's construction and day-to-day operation. Factors considered would be delivery of large amounts of concrete during construction, which would result in numerous concrete trucks travelling to the site. Pre-fabricated units have a lesser impact on the local traffic during construction. Traffic impacts during operation would include increased traffic due to such activities as frequent chemical deliveries. A higher score was given to technologies/systems that would minimize traffic disruptions.

Noise Impacts: This criterion relates to the amount of noise that would be generated during normal operation of the facility. Systems with numerous pieces of motorized equipment or that require continuous blower operation rather than intermittent blower operation would have higher noise emissions. Technologies with lower noise generation were scored higher.

Odours: The odours criterion relates to the likelihood for a technology to emit/generate odours during normal operation. For example, odours from systems housed in an enclosed space/building may be more easily controlled than odours from open tanks. Technologies that minimize odours were scored higher than those prone to emitting odours.

Technical

Ability to Meet Regulatory Objectives: The ability to meet regulatory objectives relates to a technology's ability to consistently achieve the effluent limits and objectives. The required phosphorous effluent limit for Erin is very low. Technologies with a demonstrated ability to consistently meet Erin's phosphorous effluent limits, in addition to the other regulated parameters, were scored higher.

Process Robustness: The robustness of a technology refers to its ability to cope with or adjust to changing operational demands and adverse events. Examples include the system's ability to cope with unexpected high flow events, variations in sewage strength, temperature variations, weather events, or utility interruptions. A higher score was applied to technologies/systems that are more flexible to operational fluctuations.

Ease of Expansion and Phasing to Buildout: The technology chosen for Erin must be able to expand relatively easily to grow with Erin's population. The technology will also need to be able to facilitate expansion under a phased development plan to meet the full buildout population. Processes or technologies which require minimal component upgrades as the system expands were rated more favourably.

Energy Requirements: The energy requirements for some technologies can be higher than others and would have a higher environmental and cost impact. Alternatives with lower energy requirements were scored higher in the evaluation.

Operation and Maintenance Requirements: This criterion captures the level of effort required by operations staff to operate and maintain the system as well as staffing requirements and operator skill level. Systems that require minimal operational intervention, standard operator skill level, and fewer staff were rated more favorably.

Site Requirements: Site requirements relate to the space that will be needed for the technology / system as compared to the space available for the treatment facility.

Environmental

Public Health and Safety: This criterion looks at the level of risks posed to the public, such as accidents, spills, fires, etc. Examples of these risks include high temperature/pressure operations or increased handling of hazardous chemicals.

Sustainability: This criterion captures a technology's ability to meet current needs for performance and protection of the environment in a way that will not negatively impact the environment in the future. It also includes the ability of the alternative to maintain its performance over the life of the facility.

Climate Change Impacts/Greenhouse Gas Generation: The criterion relates to how the technology might contribute to climate change. Factors such as greenhouse gas emissions are considered. Processes with lower impacts on climate change triggers were scored higher in the evaluation.

Impacts to the Natural Environment: This criterion captures impacts on the local flora and fauna during construction and operation. If construction associated with an alternative would require removal of a large number of trees or significant disturbances to local wildlife, it scored lower in the evaluation.

Waste Generation: This criterion reflects the amount of waste that an alternative would produce. Waste can be in the form of waste chemicals, filter media, replacement parts, etc.

Economic

Capital Cost: This criterion relates to the financial investment required to purchase and install the alternative. Factors such as equipment cost, installation costs, construction of ancillary infrastructure, and land costs were evaluated. Alternatives with lower capital costs were rated more favourably.

Operation and Maintenance Costs: This criterion captures the estimated cost to operate and maintain the system. Aspects considered include cost of utilities (electricity, gas, water), cost of chemicals, such as coagulants, and frequency of major equipment replacements.

Net Present Value: The Net Present Value analysis captures the present value of all costs associated with initial construction and operation and maintenance of the technology / system for the expected life span of the technology / system. The net present value analysis in this report uses a 50-year life cycle.

5.3 Screening of Long List of Liquid Train Treatment Technologies

The long list of technologies considered for the primary, secondary, tertiary, and disinfection treatment process of the liquid treatment train are listed, described, and evaluated in Table 9.

Table 9 – Evaluation of Long List of Liquid Train Treatment Technologies

No.	Technology	Description	Screening Criteria					Rationale
			Track Record	Ease of Expansion	O&M	Cost	Carry Forward	
Primary Treatment								
P1	Conventional Primary Clarifier	Conventional clarifier that employs gravity settling to remove settleable particles. A sludge collection system scrapes the settled solids from the bottom of the clarifier into sludge hoppers. A scum collection system scrapes scum from the top of the clarifier into a scum hopper.	✓	✓	✓	✓	**Yes**	▪ Well established technology ▪ Easily expanded ▪ Well established and understood O&M requirements ▪ Capital costs are comparable with other technologies
P2	Enhanced Primary Treatment	Technologies that would have higher solids removal compared to a conventional clarifier and needed to facilitate or enhance secondary treatment technologies. For example, use of filtration for high solids removal to pair with membranes in the secondary treatment or use of a clarification technology that also includes some nutrient removal in order to reduce loading on secondary treatment.	✓	✓	✓	✓	**Yes**	▪ These types of technologies are carried forward as they are needed to facilitate some of the secondary treatment technologies considered, such as membrane bioreactors.
Primary / Secondary Treatment								
S1	Modified Conventional Activated Sludge System (CAS)	The traditional CAS process involves primary settling via a standard clarifier, followed by aeration, and completed by secondary clarification. The CAS process is a flexible process that can be modified to denitrify by adding one or more anoxic tanks and/or perform phosphorous removal by dosing with coagulant at one or multiple locations in the process.	✓	✓	✓	✓	**Yes**	▪ The CAS is a well-established and extensively used technology ▪ Easily expandable ▪ Well established and understood O&M requirements ▪ Costs are comparable with other technologies
S2	Extended Aeration	The extended aeration process is similar to the CAS process, except the primary clarification step is removed. Preliminary treated sewage is fed directly to the aeration tank. The residence time is between a minimum of 15 hours compared to 6 hours in the CAS process. Aeration tank effluent flows to a secondary clarifier for solids separation.	X	✓	✓	✓	No	▪ Well- established technology, but not suitable for denitrification ▪ Easily expandable ▪ O&M requirements comparable with other technologies ▪ Costs are comparable with other technologies
S3	Sequencing Batch Reactor (SBR) for Biological Nutrient Removal	The SBR process performs BOD and nitrogen removal and settling in the same tank. The phases in the SBR process are fill, react, settle, decant, and idle. During the react stage, air is introduced into the reactor to facilitate biological growth. Primary treatment and secondary clarification are not required in an SBR system. SBRs can accommodate fluctuations in flows by either adjusting cycle times or via an equalization tank upstream of the SBR or a combination of both. SBRs can also achieve the advanced nutrient removal required for Erin.	✓	✓	✓	✓	**Yes**	▪ SBR is a well-established technology, especially for smaller plants ▪ Easily expandable due to the minimal number of tanks/reactors in the process ▪ O&M requirements comparable with other technologies ▪ Costs are low due to fewer reactors/tanks in the process
S4	Rotating Biological Contactors (RBC)	An RBC consists of a cylinder of plastic discs that are mounted on a rotating shaft. The cylinder is partially submerged in the wastewater and continuously rotated. Micro-organisms attach to and grow on the discs. Exposure to air when portions of the discs are out of the wastewater provides oxygen to the organisms and submergence	**X**	✓	**X**	✓	No	▪ Lack of operational flexibility to achieve advanced nutrient removal ▪ Easily expandable ▪ O&M difficulties in high flow periods where biomass tends to get washed off the discs

No.	Technology	Description	Screening Criteria: Track Record	Ease of Expansion	O&M	Cost	Carry Forward	Rationale
		causes the organisms to take up the nutrients in the wastewater. Nitrification and denitrification both occur on the RBC.						▪ Costs are comparable with other technologies
S5	Membrane Bioreactors (MBR)	An MBR is a modified CAS process with membranes submerged in the aeration tank or installed downstream of the aeration tank. The membranes combine microfiltration or ultrafiltration with a suspended growth process. The combination provides high nutrient and suspended solids removal. Secondary clarifiers and filtration are not required with an MBR system. Sewage temperature will affect an MBR's treatment capacity. MBRs also remove particulate phosphorous, so a tertiary stage may not be needed. Treatment capacity is affected at lower wastewater temperatures.	✓	✓	✓	✓	**Yes**	▪ MBR is a relatively newer technology, but now has a proven track record for advanced nutrient removal ▪ Relatively easy to expand by adding membrane cartridges and no secondary clarifier or tertiary system to expand ▪ O&M requirements higher than CAS system but offset by removal of clarifier and tertiary treatment in system ▪ Membranes require regular replacement at five to twelve year intervals, depending on the effectiveness of preliminary treatment. ▪ Costs are comparable with other technologies
S6	Moving Bed Bioreators (MBBR)	An MBBR uses plastic media, suspended in an aerated tank. Micro-organisms attach to and grow on the media. Nitrification takes place in an aerated tank and denitrification is achieved in a second, anoxic tank.	X	✓	✓	✓	No	▪ MBBR is a newer technology, but insufficient experience in achieving advanced nutrient removal ▪ Easily expanded by adding media to void space ▪ O&M requirements comparable with other technologies ▪ Costs are comparable with other technologies
S7	Integrated Fixed Film Activated Sludge (IFAS) Process with Chemical Addition for Phosphorous Removal	The IFAS process is a variation of an MBBR. IFAS combines the CAS system (suspended growth) with a biofilm on media system (attached growth). Plastic media is added to the aeration stage to provide surface area for micro-organisms to attach to and grow. The IFAS system achieves BOD removal and nitrification via the mix liquor suspended growth (MLSS) and denitrification via the biofilm on the media. Effluent from the IFAS goes to a clarifier to separate solids.	X	✓	X	✓	No	▪ Only one successful installation in Ontario. Insufficient experience in achieving advanced nutrient removal ▪ Easily expanded by adding more media to void space ▪ Operational difficulties associated with retaining media in tank without affecting hydraulics and foaming issues reported ▪ Costs are comparable with other technologies
S8	Two-Staged Biological Aerated Filters (BAF)	BAFs are usually up-flow filters that use granular or plastic media. BOD removal and nitrification would take place in an aerated BAF and denitrification would occur in a subsequent anoxic BAF. An external carbon source would be needed in the anoxic tank to feed the biomass. A clarifier is not needed downstream of a BAF.	X	✓	X	✓	No	▪ Lack of history in advanced nutrient removal ▪ Ease of expansion is comparable with other technologies ▪ O&M requirements are high ▪ Costs are comparable with other technologies
Tertiary Treatment								
T1	Tertiary Membrane Filters	Use of ultrafiltration membranes to remove phosphorous. Commonly used in drinking water systems. Membranes can remove phosphorous down to 0.02 mg/L. Sewage temperature will impact treatment capacity of tertiary membranes.	✓	✓	✓	✓	**Yes**	▪ Newer technology. Well applied for drinking water installations in Ontario ▪ Can be expanded by adding membrane cartridges ▪ Relatively complex O&M requirements, but acceptable due to its high performance ▪ Membranes require regular replacement at ten-year intervals. ▪ Expensive relative to other technologies, but acceptable due to its high performance and ability to meet effluent criteria with minimal chemical addition.

No.	Technology	Description	Screening Criteria					Rationale
			Track Record	Ease of Expansion	O&M	Cost	Carry Forward	
T2	Two-Stage Continuous Backwash Up-Flow Sand Filters (e.g. DynaSand)	Two stage filtration refers to up-flow filters that use sand as the filter media. Chemical addition is used to facilitate phosphorous removal. The majority of removal occurs in the first stage. The second stage is a polishing step.	✓	✓	✓	✓	**Yes**	▪ Shown effective in pilot test studies, with one full-scale installation in Ontario ▪ High chemical usage
T3	Cloth Disc Filters	Cloth disc filters consist of a cartridge of circular filters that are made of a specialized cloth material. Solids accumulate on both sides of the filters. When solids accumulation reaches the upper limit, a backwash cycle is initiated to clean the filters	X	✓	✓	✓	No	▪ No history of achieving the advanced level of phosphorous removal required.
T4	High Rate Clarification (e.g. ActiFlo)	High rate clarifiers employ flocculation then use of micro-sand and a polymer. Coagulant is added to the secondary treatment effluent after which polymer and micro-sand are introduced into the wastewater stream. The flocs are then settled out of the water using a lamella clarifier.	X	✓	✓	✓	No	▪ No history of achieving the advanced level of phosphorous removal required.
T5	Adsorptive Deep Bed Filtration (e.g. BluePro)	A deep bed filtration process where a hydrous ferric coating is continuously applied to the sand media. Phosphorous in the wastewater chemically binds with the coating on the sand particles. The sand is continuously washed to remove adsorbed phosphorous and then recycled to the filter, where it is recoated with the ferric coating and reused.	✓	✓	✓	✓	**Yes**	▪ A few full-scale Canadian installations and several US installations. Some systems achieve phosphorous removal as low as 0.02 mg/L.
Disinfection								
D1	Chlorination / De-chlorination	A chlorination / dichlorination system uses sodium hypochlorite to disinfect the wastewater. The chlorinated wastewater is sent through a contact chamber to provide the required contact time. Sodium bisulphite is added to the contact tank effluent to remove residual chlorine, which can be harmful to the environment if over dosing occurs.	✓	✓	✓	✓	**Yes**	▪ Well established technology ▪ Easily expanded ▪ Extensive experience with dosing systems needed. ▪ Costs are comparable with other technologies
D2	Ultra-Violet Radiation	Ultra-violet lamps are used to irradiate the wastewater with ultraviolet radiation which inactivates pathogens. No by-products are left in the wastewater.	✓	✓	✓	✓	**Yes**	▪ Newer but, now a well-proven technology ▪ Easily expandable ▪ Relatively simple operation and maintenance requirements ▪ Costs are comparable with other technologies
D3	Ozonation	An on-site ozone generator is used to generate ozone, which is then dosed into the wastewater. Ozone inactivates pathogens and quickly degrades, leaving no by-products in the wastewater.	✓	X	X	✓	No	▪ Newer but, a proven technology ▪ Not very easily expandable ▪ Ozone is very reactive and more hazardous than chlorination/dichlorination chemicals. ▪ Costs are higher than other technologies

5.3.1 Summary of Short-List Technologies

The technologies that were short-listed for detailed evaluation for the liquid train treatment are listed below.

Primary Treatment

- Conventional Primary Clarifier
- Advanced Primary Treatment

Secondary Treatment

- Modified Conventional Activated Sludge Process
- Sequencing Batch Reactor
- Membrane Bioreactor

Tertiary Treatment

- Tertiary Membrane Filtration (Ultrafiltration)
- Two-Stage Up-Flow Sand Filters
- Adsorptive Deep Bed Filtration

Disinfection Treatment

- Chlorination/De-Chlorination
- Ultraviolet Radiation

5.4 Detailed Description of Liquid Train Short Listed Technologies

5.4.1 Technology Alternatives for Primary Treatment

The short listed primary treatment technologies are not all applicable to all of the short listed secondary treatment technologies. As such, the detailed evaluation of the primary treatment technologies has been coupled together with the detailed evaluation of the secondary treatment alternatives in order to identify the best combination of primary-secondary treatment.

5.4.2 Technology Alternatives for Primary/Secondary Treatment

Alternative 1: Modified Conventional Activated Sludge Process (CAS)

Figure 1 shows a flow schematic of the modified CAS process. The primary treatment alternative that couples with the CAS process is a traditional primary clarifier. For advanced nutrient removal, the CAS system is modified to include an anoxic zone upstream of the aeration tank. The anoxic zone is used to facilitate denitrification.

Wastewater flows from the preliminary treatment system into the primary clarifier, where settleable solids are removed. Sludge and scum from the primary clarifier are directed to the sludge/solids treatment system.

From the primary clarifier, wastewater flows into the anoxic zone, where denitrification takes place. The denitrification step is positioned upstream of the nitrification step (aeration) because denitrifying bacteria require sufficient BOD (carbon source) in the wastewater to support their metabolic activity and the aeration step reduces BOD levels. Denitrifying bacteria are introduced into the anoxic zone via a recycled activated sludge (RAS) stream from the secondary clarifier and nitrates are introduced into the anoxic zone through a nitrified mixed liquor recycle stream from the aeration tank.

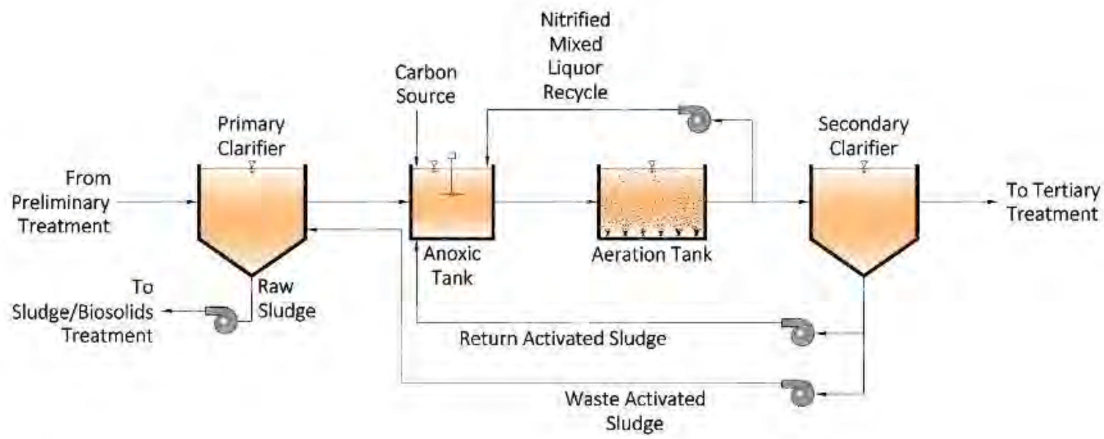

Figure 1 –Modified CAS Process Flow Schematic

In the anoxic zone, the denitrifying bacteria use the component of the nitrate molecule as an oxygen source for respiration and release nitrogen gas as a product.

The wastewater serves as a carbon source to the denitrifying bacteria. However, if BOD levels in the wastewater are not high enough, an external carbon source, such as methanol, would be required.

From the anoxic zone, wastewater flows to the aeration tank where BOD levels are reduced and ammonia and ammonium are converted to nitrate. Alternatives for aeration as applicable to all secondary treatment processes involve installation of high efficiency fine bubble diffusers systems and high efficiency blowers. If chemical phosphorous removal is included in this system, the coagulant can be added in the aeration tank and/or the anoxic tank.

The final step in the modified CAS process is removal of solids, which is typically done by a secondary/final clarifier. Sludge that is not recycled as RAS to the anoxic zone, is classified as waste activated sludge(WAS) and can be pumped directly to the sludge/biosolids treatment system or sent to the primary clarifier sludge hoppers for co-thickening before being sent to the sludge/biosolids treatment system.

Figure 2 shows a schematic of the biological stage of the modified CAS process. The anoxic zone and aeration tank could be constructed as a pair of independent channels for Phase 1, where one channel could serve as a by-pass to the other in the event that maintenance is required in one of the channels and it needs to be taken out of service.

A third channel would be constructed to accommodate Phase 2 flows. The plant layout shows the use of rectangular clarifiers, which were chosen based on the east of construction and expansion compared with circular clarifiers. However, circular clarifiers have equivalent benefits and are also viable. Selection of rectangular or circular clarifiers can be made during the design phase. Sufficient space has been identified for the WWTP site to support either alternative.

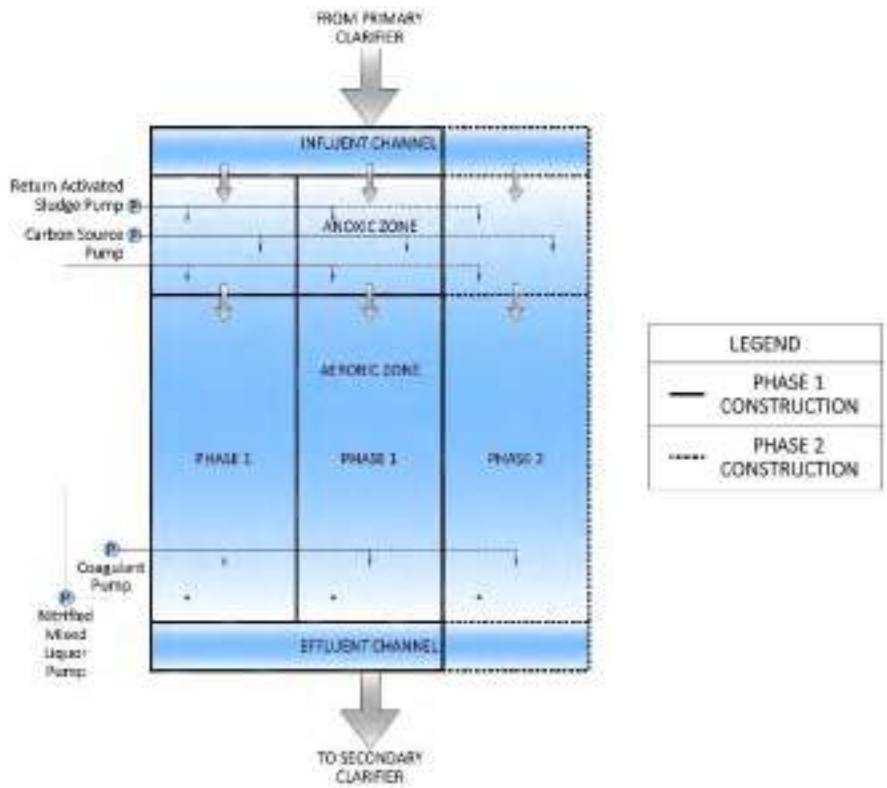

Figure 2 – Modified CAS Reactor Layout

Advantages and disadvantages of the modified CAS process are listed in 9 Table 10.

Table 10 – Advantages and Disadvantages of Modified CAS Process

Advantages	Disadvantages
▪ Well understood process and easy to operate ▪ Construction is straightforward. ▪ Lower aeration demand/costs when coupled with primary treatment. ▪ Relatively easy to expand if clarifiers and biological system constructed as rectangular tanks.	▪ System not very flexible for high flow events ▪ Tertiary treatment stage would be needed for the required advanced phosphorous removal. ▪ Requires large amount of chemical if phosphorous removal is required in the secondary treatment stage to facilitate advanced removal in the tertiary treatment stage.

Alternative 2: Sequencing Batch Reactor (SBR)

The SBR system uses a single tank/reactor as the anoxic tank, the aerobic tank, and the settling tank required for biological removal of nutrients from the wastewater. Primary clarification is not required in an SBR system. Wastewater flows from the preliminary treatment system directly to the SBR reactor. Figure 3 shows a flow schematic of a SBR system. All phases of the of treatment by the SBR occur in the reactor.

The SBR reactor is divided into two sections, a “pre-react” zone, where no aeration is provided and a main zone, which includes an aeration system. In general, there are four stages in the operation of an SBR, all of which occur in a single reactor. The typical stages are: fill, react, settle, decant, which are shown in Figure 3. There are several variations to the sequence and duration of each cycle, depending on the vendor.

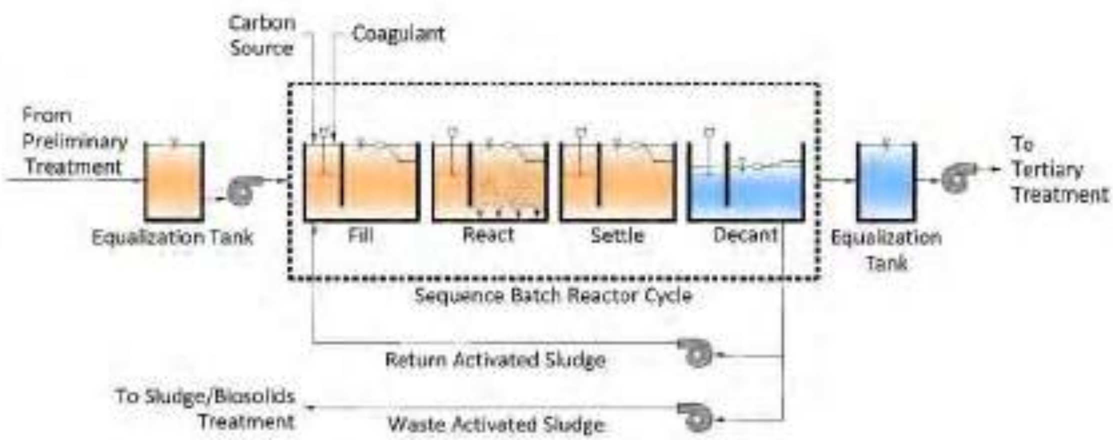

Figure 3 – Sequencing Batch Reactor Process Flow Schematic

During the fill stage, wastewater is introduced into the reactor into the pre-react zone along with a coagulant to precipitate phosphorous and a carbon source for the denitrifying bacteria, if needed.

The react phase occurs next where wastewater flows to the main zone and air is introduced into the reactor to support the micro- organisms that convert ammonia to nitrite and nitrate. Once the react phase is complete, the settle phase takes place, where the aeration system is de-activated and denitrification takes place. The settle phase also is a quiescent period that allows solids to settle to the bottom of the reactor. The final step is the decant phase in which the treated wastewater is decanted out of the SBR, via a decanter at the effluent end of the reactor.

Effluent from the SBR flows to an equalization tank designed to allow secondary effluent to be pumped to the tertiary treatment stage at an even flow rate.

The SBR includes two sets of pumps in the main zone. The pumps and their functions are described below:

- RAS Pumps: Pumps activated sludge from the main zone to the pre-react zone to keep the micro-organisms required to convert nitrates to nitrogen gas in the reactor.
- WAS Pumps: Pumps waste activated sludge from the main zone in the settle phase to the sludge/biosolids treatment system

In systems where the BOD levels in the SBR influent wastewater is not high enough to sustain the denitrifying micro-organisms, an external carbon, such as methanol, would be needed as supplemental carbon source.

To achieve the high level of phosphorous removal required for Erin, a coagulant is added in to the reactor to precipitate phosphorous and reduce loading to the tertiary treatment system.

Figure 4 shows the general layout of an SBR unit. As with Alternative 1 above, the SBR system would be constructed as three treatment trains. Phase 1 flow would be treated using two SBRs and a third would be added to treat Phase 2 flows.

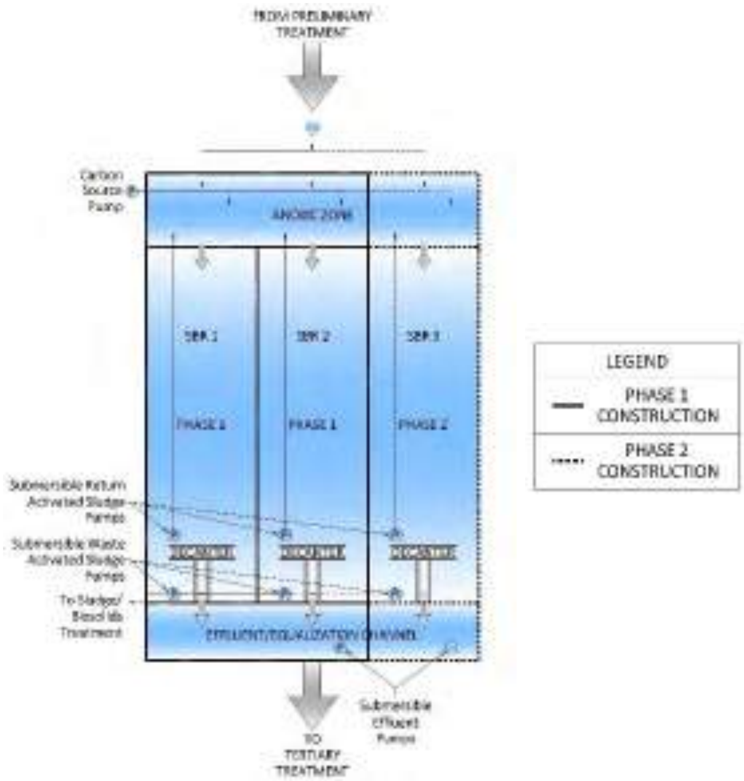

Figure 4 – Sequencing Batch Reactor Layout

Table 11 presents the advantages and disadvantages of the SBR treatment process.

Table 11 – Advantages and Disadvantages of the SBR Process

Advantages	Disadvantages
▪ Simple construction as reactors systems can come as prefabricated modules. ▪ Very resilient to extreme flow conditions by adjusting cycle times and/or adding an equalization tank upstream of the SBR. ▪ Relatively easy to expand. ▪ Small footprint as primary and final clarifiers not required.	▪ Operation is slightly more complex than CAS system. ▪ Tertiary treatment stage would be needed for the required advanced phosphorous removal. ▪ Equalization tank is required prior to downstream treatment processes. ▪ More frequent sludge wasting compared with CAS process.

Alternative 3: Membrane Biological Reactor (MBR)

A membrane bioreactor system combines the activated sludge process with a filtration process. Figure 5 presents a general flow schematic of an MBR system. Membranes used in an MBR system will be low-pressure microfiltration or ultrafiltration membranes. Through the filtration process and use of coagulants an MBR system can achieve the effluent limits, including phosphorous, without requiring a tertiary treatment step.

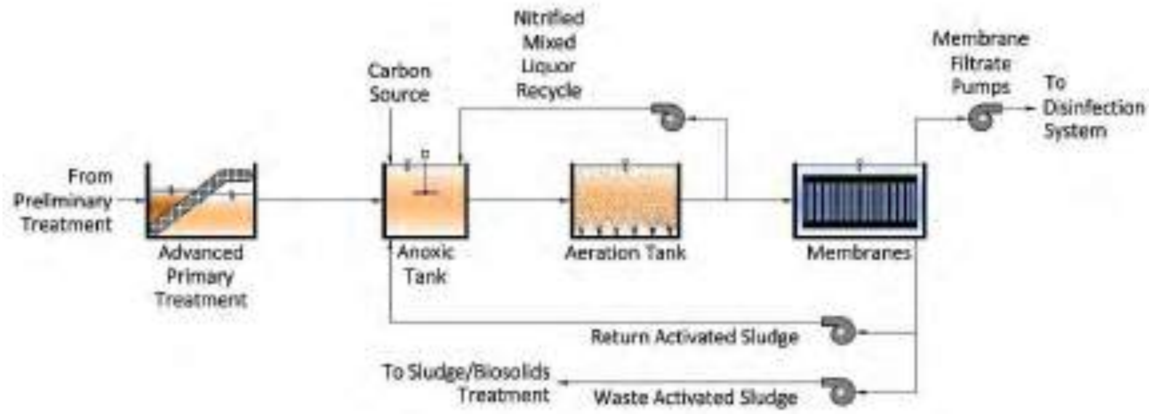

Figure 5 – Membrane Bioreactor Process Flow Schematic

For the MBR membranes to operate without excessive fouling and shutdowns for cleaning, an advanced primary clarification technology is needed for advanced solids and particle removal as compared with a traditional primary clarifier. A rotary belt filter (such as a Salsness filter) has been coupled with the MBR alternative because of its ability to remove fine particles, including hair, which is a common cause of excessive membrane fouling.

Wastewater from the preliminary treatment stage would flow to the belt filter which incorporates a rotating, polyethylene filter mesh/belt, which is partially submerged in the wastewater at approximately a 45-degree angle. As wastewater flows across the filter mesh particulates are collected on the mesh and carried upwards out of the liquid. A jet of compressed air is used to blow the screenings off the mesh and into a collection bin. The screenings can be disposed of at a landfill.

From the advanced primary treatment step, wastewater flows into the bioreactor, which consists of an anoxic zone and an aerobic zone. The anoxic zone is designed for denitrification and the aerobic zone is designed for nitrification and BOD reduction. A coagulant is added at the bioreactor step to facilitate phosphorous precipitation and removal by the membranes.

The MBR membranes can either be submerged in the aerobic zone of the biological reactor tank or housed in separate tanks downstream of the aerobic zone. This evaluation used membranes submerged in separate tanks. However, various vendor variations are available. Effluent from the biological reactor flows to the membrane tanks where pollutants are filtered out of the wastewater. Filtrate from the membranes is pumped to the disinfection system.

Filtration occurs in an aerobic environment and a continuous supply of air is required in the membrane tanks.

Figure 6 shows a general layout of the membrane biological reactor process.

Table 12 presents the advantages and disadvantages of the MBR treatment process.

Table 12 – Advantages and Disadvantages of the MBR Process

Advantages	Disadvantages
▪ The pore size of Ultrafiltration Membranes (MF) acts as an absolute barrier to suspended solids containing particulate phosphorus, bacteria and viruses, and large molecules. ▪ Tertiary treatment stage would not be needed to achieve the required advanced phosphorous removal. ▪ Smaller footprint than other technologies.	▪ Complex operation requiring advanced control systems. ▪ Aeration costs are higher than other technologies, due to aeration requirement in the bioreactor tank and the membrane tank. ▪ Membrane modules require replacement every 5 to 12 years, which is an added cost.

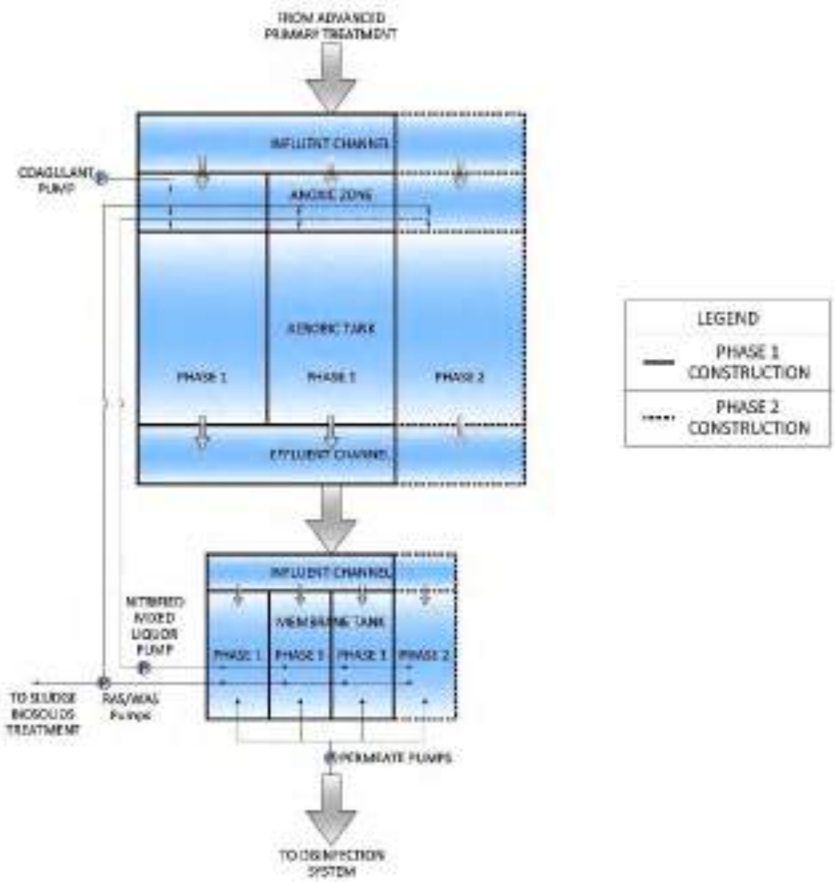

Figure 6 –Membrane Bioreactor Layout

5.4.3 Cost Comparison of Short Listed Primary/Secondary Treatment Alternatives

Table 13 summarizes the results of the life-cycle cost analyses for the three, short-listed primary/secondary treatment alternatives. Estimates have been rounded to the nearest thousand dollars. Details of the life-cycle cost analysis can be found in Appendix A.

An important factor in the cost of the membrane bioreactor system is the membrane replacement interval. The life cycle analysis includes replacement of the membrane modules at a ten-year frequency. There are examples of membranes having a lifespan greater than ten years, however, the more conservative approach was used in this evaluation.

Table 13 – Cost Estimates for Primary/Secondary Treatment Alternatives

	Modified Conventional Activated Sludge	Sequencing Batch Reactor	Membrane BioReactor
Capital Cost	$10,436,000	$11,749,000	$21,168,000
Annual Operation and Maintenance Cost	$3,251,000	$4,242,000	$6,850,000
Net Present Value	**$13,687,000**	**$15,991,000**	**$28,018,000**

5.4.4 Technology Alternatives for Tertiary Treatment

Alternative 1: Adsorptive Deep Bed Filtration

An adsorptive deep bed filter is configured and operated in a similar manner as a continuous up-flow sand filter. However, an adsorptive deep bed filter system applies a hydrous ferric oxide coating to the sand media. Phosphorous and other metals in the wastewater are chemically attracted to the coating and adsorb onto the coated sand particles.

An airlift transports media with the attached contaminants upwards into a washbox where the hydrous ferric oxide coating and contaminants are washed off. The used hydrous ferric oxide and contaminants flow out of the filter and the cleaned media settles back to the filter bed and is recoated with hydrous ferric oxide for another filter cycle.

It should be noted that this technology is primarily sold by one vendor.

Alternative 2: Two-Stage Continuous Up-Flow Sand Filtration

A continuous up-flow sand filter is a type of moving bed filter where the filter media (sand) is continuously cleaned, which avoids the need to shut down the unit for backwashing. Wastewater from the secondary treatment system enters the filter tank at the bottom and flows upwards through the filter bed. Suspended particles are filtered out of the wastewater stream. This technology as a single pass filter is successfully used at multiple locations throughout Ontario.

To achieve the advanced phosphorous removal required for Erin, two filters, connected in series, would be needed. Filtrate from the first unit is the influent to the second filter.

A coagulant is added to the wastewater, upstream of the first filter, to flocculate reactive phosphorous and facilitate its removal by the filter media.

It should be noted that this technology is primarily sold by two vendors.

Alternative 3: Tertiary Membranes

Membrane filtration uses pressure or vacuum to drive the wastewater through a permeable membrane to remove pollutants. Low-pressure membranes are categorized by the membrane pore size. Tertiary membrane systems typically use either microfiltration or ultrafiltration membranes. Microfiltration membranes have a pore size small enough to prevent the passage of bacteria and ultrafiltration membranes have a pore size small enough to prevent the passage of viruses. This evaluation was based on discussion with pressurized tertiary membranes vendors, however, implementation would involve bids from all types of membrane suppliers. These membranes are used in multiple drinking water treatment plants across Ontario and would produce a very high quality effluent.

Membranes can be installed in a dedicated tank where wastewater from the secondary treatment system is passed through the filter modules or, in the case of pressurized membranes, installed in a building and wastewater from the secondary treatment stage is pumped through the filter modules.

To prevent excessive fouling of the tertiary membranes a pre-filtration step is required upstream of the tertiary membranes to remove particulates that can clog the membranes. The pre-filter can be an automatic backwash type of filter and needs to be able to remove hair, which is a common cause of membrane fouling.

Cost Comparison of Short Listed Tertiary Treatment Alternatives

Table 14 summarizes the results of the life cycle-cost analysis of the three, short-listed tertiary treatment alternatives. Estimates have been rounded to the nearest thousand dollars. Details of the life-cycle cost analysis can be found in Appendix B.

It should be noted that pre-filters for the tertiary membranes have been include in the life-cycle costs of the tertiary membranes as well as filter module replacement at ten-year intervals.

Table 14 – Cost Estimates for Tertiary Treatment Alternatives

	Adsorptive Deep Bed Filtration	Two-Stage Up-Flow Sand Filtration	Tertiary Membranes
Capital Cost	$15,570,000	$9,795,000	$14,050,000
Annual Operation and Maintenance Cost	$6,037,000	$7,512,000	$5,082,000
Net Present Value	**$21,607,000**	**$17,307,000**	**$19,132,000**

5.4.5 Technology Alternatives for Disinfection

Alternative 1: Chlorination/De-Chlorination

A chlorination/de-chlorination disinfection system achieves disinfection by dosing the treated wastewater with a chlorine solution. Typically, a solution of chlorine gas or sodium hypochlorite is used as the chlorinating agent. Chlorine released into the receiving water stream negatively impacts all forms of life in the stream. For this reason, a de-chlorination process is needed to remove residual chlorine prior to discharge to the river. For the purposes of this evaluation, sodium hypochlorite was assumed as the disinfecting agent and sodium bisulphite was used as the de-chlorinating agent.

Treated wastewater from the tertiary treatment system would enter a chlorine contact tank, where chlorine would be metered into to wastewater at the contact tank's inlet channel. The contact tank would be designed to provide the required amount of contact time between the chlorine and wastewater to allow the disinfection process to take place.

Residual chlorine would be removed by adding a dechlorinating agent to the contact tank effluent channel. Sodium bisulphite is often used as the dechlorinating agent.

Advantages and disadvantages of the chlorination/de-chlorination alternative are listed in Table 15.

Table 15 – Advantages and Disadvantages of Chlorination/De-Chlorination

Advantages	Disadvantages
▪ Proven effective and historically, extensively used. ▪ Well understood process. ▪ Effectiveness is not affected by water characteristics, such as turbidity.	▪ Negatively impacts all forms of life in receiving water. ▪ Over-dosing with the dechlorination chemical can reduce the dissolved oxygen concentrations in the wastewater and lower effluent DO levels. ▪ Operation requires skilled operators with a good understanding of chlorination chemistry. ▪ Added risk to worker health and safety due to handling of liquid or gaseous chlorine. ▪ Requires a building to house chemical dosing and storage systems.

Alternative 2: UV Disinfection

Disinfection via UV radiation involves exposing micro-organisms in wastewater to UV light within the 200 to 300 nanometer wavelength range. This range is called the germicidal range because micro-organisms, such as bacteria, viruses, and protozoa, are deactivated and lose the ability to reproduce after exposure.

A UV disinfection system consists of a bank of UV radiation emitting tubes, which are submerged in the wastewater, usually a concrete channel. As the wastewater flows across the UV tubes, micro-organisms are exposed to the radiation and become deactivated.

Advantages and disadvantages of the UV disinfection alternative are listed in Table 16.

Table 16 – Advantages and Disadvantages of UV Disinfection

Advantages	Disadvantages
▪ Proven effective on multiple installations in Ontario ▪ Smaller footprint than chlorination ▪ Effective against a wide range of micro-organisms. ▪ Does not produce harmful by-products.	▪ Effectiveness depends on water quality, i.e. transmissivity and turbidity. ▪ Not very flexible to large variations in water quality. ▪ Requires building to house UV system.

Cost Comparison of Short Listed Disinfection Alternatives

Table 17 summarizes the results of the life-cycle cost analysis of the short-listed disinfection system alternatives. Estimates have been rounded to the nearest thousand dollars. Details of the life-cycle cost analysis can be found in Appendix C

Table 17 – Cost Estimate for Disinfection Alternatives

	Chlorination / De-Chlorination	UV Disinfection
Capital Cost	$1,761,000	$785,000
Annual Operation and Maintenance Cost	$873,000	$444,000
Net Present Value	**$2,634,000**	**$1,229,000**

5.5 Development of Alternatives for Liquid Treatment Train

There were three short-listed primary/secondary treatment technologies and three short-listed tertiary treatment technologies. Evaluating all possible combinations of the short-listed technologies would require detailed analyses of nine different liquid train treatment alternatives, however not all combinations are applicable.

To further narrow down the feasible alternatives, a preferred tertiary treatment technology was identified and paired with the applicable, short-listed primary/secondary treatment technologies to create overall liquid train treatment alternatives for detailed analysis. It is noted that the selection of the MBR technology for secondary treatment would preclude the need for tertiary treatment.

The alternative used for disinfection does not depend on or affect the alternatives for primary/secondary or tertiary treatment and was excluded from development of the liquid treatment train alternatives.

5.4.6 Detailed Evaluation of Tertiary Treatment Technologies

The weightings used for detailed analysis of the tertiary treatment alternatives were revised to more closely reflect the impacts related to the tertiary treatment system. At the point of tertiary treatment, the wastewater would be almost fully treated. Most of the solids and nutrients would be removed. Accordingly, it was decided that the Social/Cultural impacts of the tertiary treatment would not be as great as with the primary/secondary treatment and the weighting assigned to the Social/Culture criterion was reduced.

Weightings assigned to the Technical and Environmental criteria were increased to reflect the relative importance of these criteria for tertiary treatment.

Table 18 shows the criteria and weightings used to evaluate the tertiary treatment alternatives.

Table 18 – Tertiary Treatment Short-List Screening Criteria

Primary Criteria	Weight	Secondary Criteria	Weight
Social / Culture	5%	Aesthetic Impacts (plant appearance)	10%
		Traffic Impacts (during construction and operation)	10%
		Noise Impacts (during operation)	40%
		Odours Impacts (during operation)	40%
Technical	40%	Ability to Meet Regulatory Objectives	30%
		Technology / Process Robustness	30%
		Ease of Expansion and Phasing to Buildout	20%
		Energy Requirements	5%
		Operation & Maintenance Requirements (simplicity, operator skill level/quantity)	10%
		Site Requirements (plant footprint)	5%
Environmental	25%	Public Health and Safety	30%
		Sustainability	20%
		Climate Change Impacts / Greenhouse Gas Generation	20%
		Natural Environment Impacts	10%
		Waste Generation	20%
Economic	30%	Capital Cost	30%
		Operation and Maintenance Costs	40%
		Net Present Value	30%

Table 19 summarizes the results of the detailed evaluation of the tertiary treatment alternatives.

Table 19 – Detailed Evaluation of Tertiary Treatment Alternatives

PRIMARY CRITERIA		SECONDARY CRITERIA		ABSOLUTE WEIGHT (WT)	SHORT LISTED OPTIONS: Alternative 1 Adsorptive Deep-Bed Filtration		Alternative 2 2-Stage Up-Flow Sand Filtration		Alternative 3 Tertiary Membranes		COMMENTS
CRITERIA	WEIGHT	CRITERIA	WEIGHT		SCORE*	WT SCORE	SCORE*	WT SCORE	SCORE*	WT SCORE	
Social/Culture	5%	Aesthetic Impacts (plant apperance)	10	0.5	3	0.3	4.5	0.45	4	0.4	All equipment for the three Alternatives would be housed in a building. Aesthetic impacts would be related to the size of each building. Alternative 1 has the largest footprint (740m2), followed by Alternative 3 (336m2), then Alternative2(444m2).
		Traffic (during construction and operation)	10	0.5	3	0.3	3	0.3	4	0.4	Alternatives that have many components or require large tanks and/or buildings would create more traffic during construction. Alternatives that consume greater amounts of chemicals would result in the greater traffic during normal operation due to frequency of chemical deliveries. Alternative 1: # of units: 20 filters in Phase 1 , 8 filters in Ph2 and the most concrete. Highest chemical usage during operation at 977 kg/d. Alternative 2: 20 filters in Ph1, 10 filters in Ph2, moderate amount of concrete. Chemical consumption at 862 kg/d.
		Noise Impacts (during operation)	40	2	3	1.2	3	1.2	3.5	1.4	Alternatives 1 and 2 use air compressors. Alternative 3 uses blowers. Noise from blowers can be attenuated with silencers. Same level of noise attenuation not typically feasible for air compressors. Based on operator health and safety, the alternative with
		Odour Impacts (during operation)	40	2	3	1.2	3	1.2	3	1.2	No signifiant odours are expected during normal operation as the wastewater would be almost fully treated at this point of the tertiary treatment process.
Technical	40%	Ability to Meet Regulatory Objectives	30	12	4	9.6	3.5	8.4	3.5	8.4	Alternative 1: 4 installations meeting or exceeding Erin's TP Limit Alternative 2: 2 installations meeting Erin's TP limit Alternative 3: 2 installations meeting Erin's TP limit
		Technology/Process Robustness	30	12	3.5	8.4	4	9.6	3	7.2	Alternative 1: Performance could decreases with if TSS concentrations out of secondary stage too high. Alternative 2: Peformance not affected by exernal factors. Alternative 3: Could be subject to fouling if wastewater TS and TSS too high and peformance decreases at lower temperatures
		Ease of Expansion and Phasing to Buildout	20	8	3	4.8	3	4.8	4	6.4	Alternative 1: Requires a 40% increase in equipment and concrete tankage for to achieve Full Buildout capacity Alternative 2: Requires a 50% increase in equipment and concrete tankage to achieve Full Buildout capacity. Alternative 3: Requires 100% increase in equipment but no additional structures to achieve Full Buildout capacity. Construction of new structures considered more costly and complex than adding new additional pieces of equipment.
		Energy Requirements	5	2	3	1.2	4.5	1.8	3.5	1.4	Alternative 1: Highest energy requirement at 552 kWh/d. Alternative 2: Lowest energy requirement at 292 kWh/d. Alternative 3: Second highest energy requirement at 462 kWh/d.
		Operation & Maintenance Staffing Requirements (skill level/number)	10	4	4	3.2	4	3.2	3	2.4	More equipment could translate to more complex operations and would require increased maintenance. Alternative 1: System consists of filter, hydrous ferric oxide dosing pump skid, compressors Alternative 2: System consists of filters, coagulant dosing pump skid, compressors Alternative 3: System consists of numerous membranes modules, 5 chemical dosing pump skids, air compressors, membrane aeration blowers, backpulse system.
		Site Requirements (plant footprint)	5	2	3	1.2	4.5	1.8	4	1.6	Based on required buildling footprint
Environmental	25%	Public Health and Safety	30	7.5	3	4.5	3.5	5.25	4.5	6.75	1 the most
		Sustainability	20	5	3	3	3	3	3	3	Each Alternative is considered to have the same level of sustainability as they are all fairly new application for advanced phosphorous removal, without a long track record for perofrmance at this time.
		Greenhouse Gas Generation / Climate Change Impacts	20	5	3	3	3.5	3.5	3.5	3.5	required. Alternative 1 consumes the most energy and requires the most amount of tanks. Alternative 2 has the least energy consumption and less tankage than Alternative 1. Alternative 3 has the second highest energy consumption, but least tankage
		Natural Environment Impact	10	2.5	3	1.5	3	1.5	3	1.5	Since each technology would be housed in a dedicated building, each would have a similar level of impact on the natural environement (local flora and fauna).
		Waste Generation	20	5	3	3	3	3	4	4	Waste generated would be related to chemical usage and wasting. Alternative 1 has the highest chemical consumption and Alternative 3 the lowest.
Economic	30%	Capital Cost	30	9	2	3.6	4	7.2	2.5	4.5	Refer to NPV analysis spreadsheet
		Operation and Maintenance Costs	40	12	3.5	8.4	3	7.2	4.5	10.8	Refer to NPV analysis spreadsheet
		Net Present Value	30	9	2	3.6	3	5.4	2.5	4.5	Refer to NPV analysis spreadsheet
			TOTAL SCORE	100	62.0		68.8		69.4		

*Score is a number from 1 to 5

5.4.6.1 Preliminary Preferred Alternative for Tertiary Treatment

Based on the detailed evaluation of the short-listed tertiary treatment alternatives, tertiary membranes would be the preferred tertiary treatment alternative.

5.4.7 Liquid Treatment Train Alternatives

The alternatives developed for treatment of the liquid train, using tertiary membranes as the tertiary treatment technology, are:

- Modified Conventional Activated Sludge with Tertiary Membranes
- Sequencing Batch Reactor with Tertiary Membranes
- Membrane Bioreactor

Note that the membrane bioreactor option does not require a tertiary treatment step, since it is capable of achieving the required effluent limits, with appropriate coagulant dosing for phosphorous removal.

5.6 Evaluation of Liquid Treatment Train Alternatives

5.6.1. Cost Comparison of Liquid Train Treatment Alternatives

Table 20 summarizes the results of the life-cycle cost analysis of the three liquid treatment train alternatives, excluding disinfection, which is evaluated separately.

Table 20 – Cost Comparison of Liquid Treatment Train Alternatives

NPV	Modified Conventional Activated Sludge with Tertiary Membranes	Sequencing Batch Reactor with Tertiary Membranes	Membrane BioReactor
Capital Cost	$24,486,000	$25,799,000	$21,168,000
Annual Operation and Maintenance Cost	$8,333,000	$9,324,000	$6,850,000
Net Present Value	**$32,819,000**	**$35,123,000**	**$28,018,000**

5.6.2. Detailed Evaluation of Liquid Train Treatment Alternatives

The evaluation criteria and weightings used to evaluate the liquid treatment train alternatives were those presented in section 5.2.2.

Table 21 presents the detailed analysis of the liquid treatment train alternatives.

Table 21 – Detailed Evaluation of Liquid Treatment Train Alternatives

PRIMARY CRITERIA		SECONDARY CRITERIA		ABSOLUTE WEIGHT (WT)	SHORT LISTED ALTERNATIVES						COMMENTS
					Alternative 1 Modified CAS with Tertiary Filters		Alternative 2 SBR with Tertiary Filters		Alternative 3 MBR		
CRITERIA	WEIGHT	CRITERIA	WEIGHT		SCORE*	WT SCORE	SCORE*	WT SCORE	SCORE*	WT SCORE	
Social/Culture	5%	Aesthetic Impacts (plant apperance)	10	0.5	3	0.3	3.5	0.35	4	0.4	CAS would greatest visual impact since it has the most tanks. SBR has only one tank and MBR would likelybe housed in a building.
		Traffic (during construction and operation)	30	1.5	3	0.9	3.5	1.05	4	1.2	CAS would have the highest construction traffic to increased tankage (concrete trucks) and equipment required for each tank/process and the lowest operation traffic due to chemical deliveries. MBR would have the least construction traffic as it has the least tankage and does not require a tertiary building like the other two alternatives. MBR will have more frequent chemical deliveries during normal operation.
		Noise Impacts (during operation)	30	1.5	4	1.2	4	1.2	3.5	1.05	Noise impacts would be limited to effects on worker health and safety and be due largely to blower operation. SBR would have the least noise emissions since the blower runs intermittently. MBR has two sets of blowers that operate continuously and CAS has one set of blowers that run continuously.
		Odour Impacts (during operation)	30	1.5	3	0.9	3.5	1.05	4	1.2	A higher potential for fugitive odours exist where there are open tanks. CAS has the most open tankage, followed by SBR, and MBR has the least.
Technical	40%	Ability to Meet Regulatory Objectives	30	12	5	12	5	12	4.5	10.8	All the alternatives are considered to have the same ability to meet regulatory objectives as they are all capable of meeting the advanced treatment required for Erin. MBR is slighly less sustainable.
		Technology/Process Robustness	30	12	4	9.6	5	12	2	4.8	The SBR alternative is considered the most robust since its operating cycles can be adjusted to respond to changes in flows or increases in wastewater strength, such as those from septage addition. The MBR alternative is considered the least robust as it only has one process.
		Ease of Expansion and Phasing to Buildout	10	4	3	2.4	4	3.2	4.5	3.6	The CAS alternative would involve the greatest amount of new construction due to the number of tanks to be expanded plus tertiary treatment expansion. The SBR alternative would require expansion of one tank plus the tertiary treatment. MBR would require expansion of two tanks, with a total footprint less than SBR expansion, but no expansion of a tertiary system and would be the least complex to expand to full buildout.
		Energy Requirements	15	6	5	6	4.5	5.4	5	6	The CAS alternative has approximately 1435 kWh/d energy requirement. The SBR alternative has approximately 1820 kWh/d energy requirement. The MBR alternative has approximately 1432 kWh/d energy requirement.
		Operation & Maintenance Staffing Requirements (skill level/number)	10	4	3	2.4	4	3.2	4	3.2	The CAS alternative has the most process units and resulting operation and maintainance requirements. The SBR alternative has the SBR and tertiary proces. The MBR alternative has the advanced fine filter for primary treatment, biological/aeration reactor, and the membrane reactor.
		Site Requirements (plant footprint)	5	2	3	1.2	4	1.6	4.5	1.8	The CAS alternative requires the greatest amount of land. The MBR option requires the least, since its tankage footprint is less than the SBR alternative and it does not require a tertiary treatment system/building.
Environmental	15%	Public Health	10	1.5	5	1.5	4.5	1.35	2	0.6	The risk to public health would be related to failure of the treatment systems, resulting in an environmental spill. MBR failure would have the most negative impact on public health and safety since the plant would lose both secondary and tertiary treatment. The CAS alternative would have the lowest impact since the increased number of tanks would provide more buffering than the single tank SBR.
		Sustainability	20	3	3.5	2.1	4	2.4	3.5	2.1	The SBR alternative is considered to be the most sustainable since it can most consistantly meet the effluent requiements. MBRs may also be approved as a disinfection system in the future, which would make the plant more efficient by removing the disinfection process. Since the SBR alternative is more flexible to fluctuating influent conditions than the CAS alternative, it is considered better in terms of long term sustainability.
		Greenhouse Gas Generation / Climate Change Impacts	20	3	3.5	2.1	3	1.8	4	2.4	For this high level evaluation, alternatives were scored based on energy usage and amount of tankage/construction required. The SBR alternative consumes the most energy. The CAS and MBR alternatives have approximately equal energy requirements. The CAS alternative has the highest amount of tankage/construction. SBR has more tankage footprint than the MBR alternative.
		Natural Environment Impact	10	1.5	3.5	1.05	4	1.2	4.5	1.35	The alternative with the largest footprint would result in the greatest impact to the natural environment, due to clearing of trees and other site works. The CAS alternative has the largest footprint, followed by the SBR alternative, and MBR has the smallest footprint.
		Waste Generation	40	6	4	4.8	4	4.8	4.5	5.4	Waste generated would be related to chemical usage and biological efficiency. The MBR alternative has approximately 10% less chemical consumption than CAS and SBR alternatives, which have approximately the same level of chemical usage.
Economic	40%	Capital Cost	40	16	4	12.8	4	12.8	5	16	Refer to NPV spreadsheets.
		Operation and Maintenance Costs	40	16	4	12.8	3.5	11.2	5	16	Refer to NPV spreadsheets.
		Net Present Value	20	8	4	6.4	3.5	5.6	5	8	Refer to NPV spreadsheets.
			TOTAL SCORE	100	80.5		82.2		85.9		

*Score is a number from 1 to 5

5.6.3. Preliminary Preferred Alternative for Liquid Treatment Train

Based on the detailed evaluation of the short-listed liquid treatment train alternatives, the preferred alternative is the Membrane Bioreactor system, which will perform secondary and tertiary treatment.

5.6.4. Detailed Evaluation of Disinfection Alternatives

The evaluation criteria and weightings used for evaluating disinfection alternatives were those presented in section 5. Results of the evaluation are presented in Table 22.

Table 22 - Detailed Evaluation of Disinfection System Alternatives

PRIMARY CRITERIA		SECONDARY CRITERIA		ABSOLUTE WEIGHT (WT)	SHORT LISTED ALTERNATIVES				COMMENTS
					Alternative 1 Chlorination / DeChlorination		Alternative 2 UV Disinfection		
CRITERIA	WEIGHT	CRITERIA	WEIGHT		SCORE*	WT SCORE	SCORE*	WT SCORE	
Social/Culture	15%	Aesthetic Impacts (plant apperance)	10	1.5	3	0.9	4.5	1.35	A chlorination system will require a contact tank and a building to house the chemical storage tanks and dosing systems. The UV system does not require as large a building and its contact tank is smaller than chlorination.
		Traffic (during construction and operation)	10	1.5	3	0.9	4.5	1.35	The chlorination alternative has more structures and tankage to construct than the UV alternative. Chlorination requires chemical deliveries during normal operation and UV does not.
		Noise Impacts (during operation)	40	6	3	3.6	3	3.6	Noise impacts are comparable
		Odour Impacts (during operation)	40	6	3	3.6	4	4.8	The chlorination alternative has a higher potential for odour impacts in the event of accidental high chlorine dosing or chemical spills.
Technical	35%	Ability to Meet Regulatory Objectives	30	10.5	4	8.4	4	8.4	Both are comparable.
		Technology/Process Robustness	30	10.5	4	8.4	3	6.3	The UV alternative is more responsive to fluctuations in system parameters, whereas, there is a 30 minute delay between the time a chlorination dose is changed and the the effect can be seen (react time in contact tank).
		Ease of Expansion and Phasing to Buildout	20	7	3	4.2	4	5.6	The chlorination alterative would be more complex and costly to expand, due to the need for increased tankage and chemical storage. For the UV system, additional lamp modules would be needed. The contact tank is small enough that it can be constructed for Phase 2 flow in Phase 1.
		Energy Requirements	5	1.75	5	1.75	3	1.05	The chlorination alternative requires the least energy at 12 kWh/d and the UV alternative requires 77 kWh/d.
		Operation & Maintenance Staffing Requirements (skill level/number)	10	3.5	3	2.1	4.5	3.15	The chlorination alternative requires more skilled operations staff and more maintenance attention than the UV alternative because it has more equipment and involves fairly complex chemistry.
		Site Requirements (plant footprint)	5	1.75	3	1.05	4	1.4	The chlorination alternative had a larger footprint.
Environmental	20%	Public Health and Safety	30	6	3	3.6	4.5	5.4	The chlorination system is considered to pose a greater risk to public health and safety due to the potential for accidental release of chlorine into the river if the de-chlorination system were to fail. In the natural environment, chlorine has been shown to produce by-products that are carcinogenic.
		Sustainability	20	4	3	2.4	4	3.2	The UV alternative is considered more sustainable since it does not use chemicals and is effective against micro-organisms that are resistant to chlorine.
		Greenhouse Gas Generation / Climate Change Impacts	20	4	3	2.4	3.5	2.8	The UV system uses 80% more energy than the chlorination system. However, the chemical deliveries required for chlorination/de-chlorination would generate comparable levels of greenhouse gases.
		Natural Environment Impact	10	2	3	1.2	4	1.6	The chlorination alternative has a larger footprint and would disrupt more of the natural environment.
		Waste Generation	20	4	3	2.4	4	3.2	The de-chlorination alternative could discharge excess sodium bisulphite to the effluent re-oxygenation system, which would negatively affect performance of the effluent re-oxygenation system. The UV alternative does not generate wastes.
Economic	30%	Capital Cost	30	9	3	5.4	5	9	Refer to NPV analysis
		Operation and Maintenance Costs	40	12	3	7.2	4.5	10.8	Refer to NPV analysis
		Net Present Value	30	9	3	5.4	5	9	Refer to NPV analysis
			TOTAL SCORE	100	64.9		82.0		

*Score is a number from 1 to 5

5.6.5. Preliminary Preferred Alternative for the Disinfection System

Based on the detailed evaluation of the short-listed disinfection system alternatives, the preferred alternative is UV disinfection.

5.7 Re-Oxygenation of Treated Effluent

5.7.1 Objectives and Overview

Dissolved oxygen levels in the treated effluent must be a minimum of 4 mg/L to comply with the effluent limits. In order to achieve this, it will be necessary to include a re-oxygenation step just prior to discharge to the West Credit River to elevate the DO levels.

The re-oxygenation capacity required will vary depending on how much oxygen the liquid treatment train strips from the wastewater. However, for the purposes of this evaluation, it was assumed that the DO level in the treated wastewater will be approximately 2 mg/L, which is the minimum required DO level in the aerobic/biological stage and none of the short-listed secondary treatment alternatives or tertiary alternatives involve an anoxic or anaerobic step following the aerobic stage that will remove oxygen from the treated wastewater.

5.7.2 Effluent Re-Oxygenation Technology Selection

Several alternatives to re-oxygenate the treated effluent were considered. The alternatives were:

- Coarse Bubble Aeration
- Fine Bubble Aeration
- Side Stream Dissolved Gas System
- Natural aeration via engineered waterfall from the WWTP to discharge point

Natural aeration was eliminated as it is not possible to readily calculate the amount of re-oxygenation that can be achieved using this method, which means there is no accurate way of sizing or pricing such a system. It also eliminates the ability to control the process and guarantee that the effluent limit is met.

The side stream dissolved gas system involves taking a side stream of the treated effluent, dissolving oxygen gas into the side stream and returning it to the main flow. The oxygen content in the side stream becomes distributed throughout the main flow and raises the DO levels. This alternative requires approximately 68 kg/day of oxygen. This is a large enough amount that an on-site oxygen storage facility would be needed. Additionally, the risks associated with handling oxygen gas make this alternative unattractive from an operator safety perspective and it was also eliminated from the evaluation.

Discussions with suppliers who have experience with effluent re-oxygenation systems revealed that fine bubble aeration is preferred over coarse bubble aeration, since fine bubble is a more efficient and cost-effective option. While fine bubble diffusers are more costly and have a shorter lifespan than coarse bubble diffusers, they have the lowest lifecycle cost due to the increased efficiency. For this re-oxygenation process, the treated wastewater will have less than 5 mg/L suspended solids and it is anticipated that this will greatly extend the life of the diffusers. In addition, fine bubble diffusers are recommended for the secondary treatment process and this selection provides the opportunity to streamline equipment selection.

The air required for re-oxygenation could be supplied from dedicated blowers or by increasing the capacity of the blowers used in the secondary treatment process. Preliminary sizing for dedicated blowers showed that the required blower capacity was likely smaller than any available on the market. It was decided that it would be more practical and less costly to increase the size of the secondary treatment blowers to include the oxygen demand of the re-oxygenation process rather than using dedicated blowers.

Fine bubble aeration, using upsized secondary treatment blowers, was selected as the preferred alternative for re-oxygenating the effluent.

Table 23 presents the results of the life-cycle analysis for this process. Estimates have been rounded to the nearest thousand dollars. Details of the life-cycle cost analysis can be found in Appendix D.

Table 23 – Life-Cycle Costs of Effluent Re-Oxygenation

	Effluent Re-Oxygenation Costs
Capital Cost	$86,000
Annual Operation and Maintenance Cost	$11,000
Net Present Value	**$97,000**

5.8 Preliminary Preferred Alternative for the Liquid Treatment Train

Based on the results of the detailed analyses of the alternatives for the liquid treatment processes, the preferred alternatives are:

- Primary, Secondary Treatment, and Tertiary – Membrane Bioreactor (MBR)
- Disinfection – UV Radiation (UV)
- Effluent Re-Oxygenation – Fine Bubble Diffusers, using upsized secondary treatment blowers

Figure 7 presents the flow schematic for the preliminary preferred alternative for the liquid treatment train.

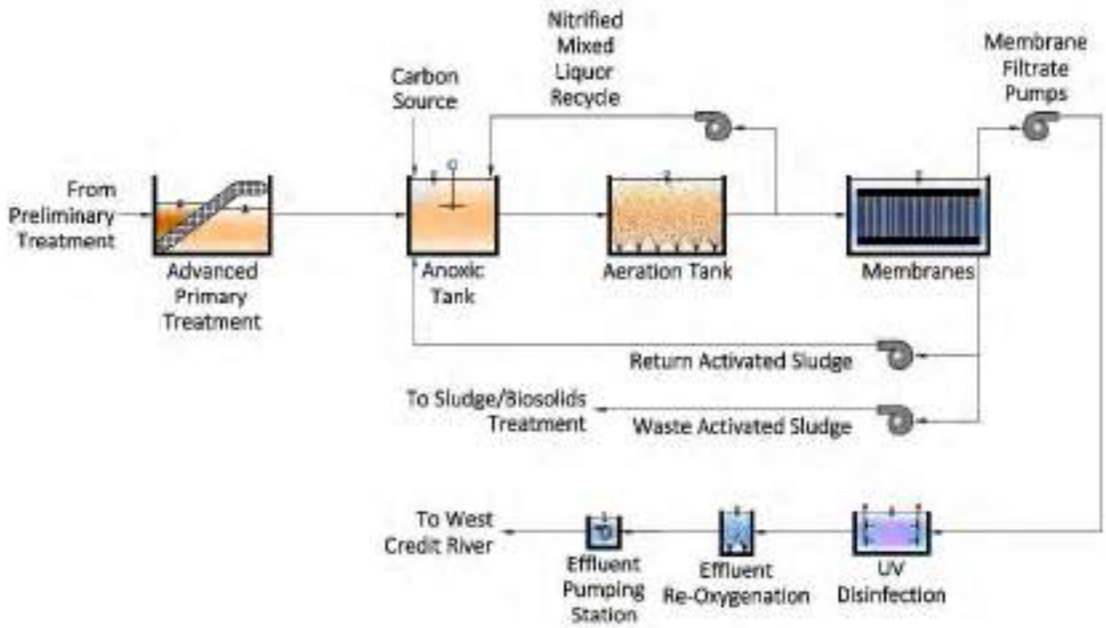

Figure 7 – Preferred Liquid Treatment Train Process Flow Schematic

6.0 Sludge/Biosolids Treatment and Management

6.1 Objectives and Overview

The objective of the sludge/biosolids component of the evaluation is to develop alternatives for treating and managing the sludge/biosolids generated at the WWTP.

Sludge/biosolids refers to the solids component in the wastewater. For the purposes of this assessment, sludge refers to wastewater solids that have not been stabilized and biosolids refers to wastewater solids that have been stabilized and are suitable for removal from the WWTP. Sludge does not include grit or solids that have been removed during preliminary treatment, as these solids are typically hauled off site for disposal at a landfill.

Sludge is progressively removed from the liquid stream during primary, secondary, and tertiary treatment. The quantity of sludge removed and/or generated in each process depends on the process itself. For example, processes that add coagulants to the liquid system will generate more sludge than processes that do not use coagulants.

Sludge from the WWTP is collected and can either be stabilized on site or hauled off-site for treatment by a biosolids management contractor. Sludge that is stabilized on site would be hauled off-site for use and/or disposal. If the sludge/biosolids were to be managed by a contractor, the contractor would choose the treatment and disposal methods.

Biosolids is a nutrient-rich product of the wastewater treatment process, with many options available for recovering and using the nutrients in a beneficial way, often termed as “beneficial reuse”. Biosolids can be treated by various methods to produce products that can be used agriculturally, commercially marketed, or used as an energy source. Some of the possible end-use options for biosolids include:

- Applied to agricultural land as fertilizer;
- Used as a soil amendment, such as with compost;
- Commercially marketable fertilizer;
- Incinerated for heat and the ash used in the cement industry.

6.2 Sludge/Biosolids Train Evaluation Methodology

Several factors were considered when developing a management strategy for the sludge/biosolids generated. Factors considered included:

- Whether or not to stabilize the sludge on site or have unstabilized sludge hauled off-site for treatment and disposal at another facility,
- What on-site stabilization technology to use, and
- To what level should the biosolids be processed for beneficial re-use and/or commercial marketing.

6.2.1 Alternatives Related to Hauling Unstabilized Sludge Off-Site

Alternatives involving management /disposal of unstabilized sludge involve performing no on-site sludge stabilization. Unstabilized sludge would be hauled off-site for either disposal or treatment by another party.

The alternatives considered for management of unstabilized sludge were:

- Disposal at a landfill, licensed to accept unstabilized sludge;
- Treatment at another municipal facility, and
- Treatment/disposal by an independent, Biosolids Management Contractor.

All alternatives involving disposing or hauling unstabilized sludge off site were considered not sustainable as they carry a high degree of risk due to dependence on the receiving facility. Specifically, if the receiving facility were unable to accept Erin's unstabilized sludge, Erin would have no alternate means of disposing of the unstabilized sludge. The ability to expand Erin's plant would hinge on whether or not the off-site receiving facility has spare capacity to accept additional sludge. Alternatives related to hauling unstabilized sludge off-site were eliminated from the evaluation.

6.2.2 Alternatives Related to On-Site Sludge Stabilization

Unlike unstabilized sludge, stabilized sludge can be readily land applied to suitable agricultural lands. There are numerous contractors that offer land application services. End-use options related to stabilized sludge do not carry the same risk of dependence on a third part as alternatives related to unstabilized sludge.

Due to the flexibility associated with stabilizing the plant's sludge on site, it was decided that this alternative would serve the Town well and a long-list/short-list evaluation, as described previously in Section 4, was performed for sludge stabilization technologies. The evaluation and its results are presented in Section 7.3.

6.2.3 Alternatives Related to Revenue Generation from Biosolids

Biosolids can be processed to a level where they are suitable for commercial marketing and generate revenue. Typically, additional treatment systems are required after the sludge stabilization stage to produce a biosolids end-product of quality that matches the regulations as a commercially marketable product.

There are two options available for generating a marketable biosolids product. The first option consists of constructing an on-site treatment system then independently marketing the biosolids product. The second option is to retain the services of an independent Biosolids Management Contractor that would haul the stabilized sludge from the wastewater plant to their facility for treatment, after which the Contractor would market the biosolids product and return a portion of the revenue to the Town. The first alternative would require the capital expenditure of constructing a biosolids processing system, but would have the benefit that 100% of the revenue would go to the Town. The second alternative would not require the Town to finance the construction and operation of the biosolid treatment system. However, only a portion of the revenues would come back to the Town.

In either case, the amount of revenue generation possible depends on market conditions at the time of production and the amount of biosolids product available for marketing. It is difficult at this time to accurately predict what market conditions will be following Phase 1 construction. Also, the amount of sludge/biosolids generated by the plant depends on the characteristics of the raw wastewater and the treatment technologies implemented at the wastewater treatment plant.

Due to the degree of uncertainty this stage of the project with the major variables required to assess the cost benefits of producing a commercially marketable biosolids product, a long-list/short-list evaluation was not performed for revenue generation options. Instead, it is recommended that this evaluation be conducted after Phase 1 is operating and when the sludge production and quality will be known.

Section 7.4 presents an overview of the technologies available for processing biosolids to a level of commercial marketability and discusses the advantages and disadvantages of each.

Limiting the solution to generating stabilized sludge until marketability of the biosolids can be accurately assessed will provide the Town with a sufficiently secure solution for Phase 1 and incorporates a conservative approach to the cost estimate for the whole plant.

6.3 Evaluation of On-Site Sludge Stabilization Technologies

The methodology used to evaluate the technologies available for on-site sludge stabilization was a modified version of that used for the liquid train evaluation. A long-list set of screening criteria, specific to sludge/biosolids, was developed and used to short list the technology alternatives. This approach was used because the objectives for sludge/biosolids management vary from those associated with the liquid train. For example, the ability for beneficial reuse is a criterion that is specific to sludge/biosolids and is not relevant to the liquid treatment process.

6.3.1 Long-List Screening Criteria

The criteria selected for screening the long list of sludge stabilization technologies are presented in Table 24 and descriptions of each criterion follow.

Table 24 - Sludge Stabilization Short-List Screening Criteria

Criteria	Description
Regulatory Compliance	Ability to meet current and anticipated future regulations for processing and end-use / disposal.
Proven Reliability and Sustainability	Demonstrated successful projects of similar size and high level of flexibility to variations in sludge/biosolids quality and adverse weather conditions.
Staging / Phasing	Ability to easily expand to meet Erin WWTP's Full Buildout capacity.
Cost	Have value in terms of performance and/or operation and maintenance that are reflective of the capital costs.
Resource Recovery / Revenue Generation	Ability for end product to be used beneficially (e.g. land application) or to generate revenue (e.g. sold commercially as compost or fertilizer)

Regulatory Compliance

In order for an alternative to be carried forward for detailed analysis, the alternative must be one that produces a final product that meets the current and anticipated regulations for the intended use of the end product. For example, processes that produce compost must be able to adhere to the stringent metals content as prescribed by the Guidelines for the Production of Compost in Ontario, if the compost is to be commercially marketed in Ontario.

Proven Reliability and Sustainability

The preferred alternative must have a demonstrated history of reliably processing biosolids from a facility or facilities of a similar scale. The preferred alternative must be sustainable and be able to provide year-round treatment and/or storage, where required.

Staging/Phasing

The staging / phasing criterion reviews how easily an alternative can be expanded to match the planned expansion of the facility. Alternatives that require minimal component upgrades and financial investment were rated more favourably.

Cost

The cost criterion looks at the capital cost of the alternative and the costs associated with its operation and maintenance. Capital costs involve all initial construction costs including equipment purchase and installation. Operation and maintenance aspects include costs related to utilities (electricity, gas, potable water), chemicals, and the level of effort required for regular maintenance of the equipment.

Beneficial Use / Revenue Generation

This criterion relates to whether or not the final product produced by the alternative can be beneficially reused and/or commercially marketed. Alternatives that do not provide nutrient recovery or revenue generation from biosolids are excluded from the short-list.

6.3.2 Short-List Screening Criteria

The short-list screening criteria applied to the sludge stabilization technology alternatives were those used for the liquid train evaluation as they were considered relevant to both processes. Refer to section 4 for a list of the criteria and their descriptions.

6.3.3 Short-Listing of Sludge Stabilization Alternatives

The long list of alternatives considered for sludge stabilization technologies and the rationale used for short-listing are presented in Table 25.

Table 25 – Evaluation of Long List of Sludge Stabilization Technology Alternatives

No.	Technology	Description	Screening Criteria						Rationale
			Regulatory Compliance	Proven Reliability & Sustainability	Staging / Phasing	Cost	Resource / Recovery / Revenue Generation	Carry Forward	
Primary Treatment									

1	Anaerobic Digestion	▪ This alternative involves stabilizing by anaerobic digestion. The digester is heated to a temperature between 35°C to 38°C and bacteria break down the organic matter in the sludge. The process produces methane gas as a by-product, which can be converted to heat and/or energy.
		▪ The biosolids produced is suitable for land application only. A local contractor would be retained for the services of land application.
		▪ The solids content of biosolids from an anaerobic digester is typically lower than 2%. Thickening from 2% to 4% would reduce haulage costs by 50%. This alternative includes a biosolids thickening system.
		▪ Regulations require that the facility include a means to store biosolids during the winter months when land application is not feasible. At least 240 days of storage is mandated, unless alternate methods of disposing of the biosolids are in place.
			✓	✓	✓	X	✓	No	▪ Anaerobic digestion not economically sound for smaller plants.
									  ▪ Digesters need specialized components, such as gas-tight covers
									  ▪ Needs heating, mixing, gas collection systems
									  ▪ Equipment needs to be designed for service in an explosive environment due to the presence of methane
									▪ Digester performance severely hindered if operated improperly
									▪ Requires fairly knowledgeable operators

2	Aerobic Digestion	▪ This alternative involves stabilizing the sludge using aerobic digestion. Micro-organisms consume the organics in the presence of oxygen. ▪ Generally considered unsuitable for primary sludge because of higher oxygen demand and larger amount of biomass produced ▪ The biosolids produced is suitable for land application only. A local contractor would be retained for the services of land application. ▪ This alternative also includes an on-site biosolids thickening system and 240 days of on-site biosolids storage.	✓	✓	✓	✓	✓	**Yes**	▪ Commonly used and well understood technology, especially for small plants ▪ Expansion is straightforward ▪ Capital costs are not high, but operating costs can be due to requirement for aeration ▪ Digested product can be land-applied in Ontario
3	Alkaline Stabilization	▪ This alternative involves stabilizing the sludge through the addition of alkaline material (typically lime) to raise and maintain the pH at 12 to destroy the pathogens. ▪ The biosolids produced is suitable for land application and unrestricted use as a fertilizer product. A local contractor would be retained for the services of land application. ▪ This alternative also includes an on-site biosolids thickening system and 240 days of on-site biosolids storage.	✓	X	✓	X	✓	No	▪ Potential for significant odour generation if system not operated properly ▪ Higher haulage costs due to lime addition ▪ Product has lower nitrogen content than other stabilization processes – may be less desirable as fertilizer

No.	Technology	Description	Screening Criteria						Rationale
			Regulatory Compliance	Proven Reliability & Sustainability	Staging / Phasing	Cost	Resource / Recovery / Revenue Generation	Carry Forward	
		▪ Regular importing of lime to the WWTP would be needed. ▪ Process produces 15% to 50% more material to be hauled off-side, due to the addition of lime.							
4	Stabilization with Autothermal Thermophillic Aerobic Digestion (ATAD)	▪ This alternative involves stabilizing the sludge using an auto-thermal aerobic digester (ATAD), which uses the heat generated by the digestion process to keep the digester temperature between 55°C and 65°C. No external heat source is required. ▪ The required hydraulic retention time is between 6 and 10 days as compared with 15 to 30 days for anaerobic or traditional aerobic digestion. ▪ The volatile solids destruction is higher than traditional aerobic and anaerobic digestion, which means less biosolids to haul off site. ▪ A sludge thickening system would be needed upstream of the ATAD, since the ATAD feed has to be above 3%. ▪ The biosolids produced is suitable for land application and unrestricted use as a fertilizer product. A local contractor would be retained for the services of land application. ▪ This alternative includes 240 days of on-site biosolids storage.	✓	✓	✓	✓	✓	**Yes**	▪ Well understood technology with several installations in Ontario ▪ No external heating system required ▪ Short hydraulic retention time results in smaller digester and lower construction costs ▪ Digested product can be land-applied in Ontario
5	Thermal Drying	▪ This alternative involves heating the sludge either through direct or indirect heating to reduce the pathogen level and evaporate water. Dryer types include rotary dryers, fluidized beds, hollow-flight dryers, and steam dryers. ▪ A sludge thickening system would be needed upstream of the dryer, since a thickened sludge removes water thereby reducing the amount of heat needed for drying. ▪ A biosolids cooling technology is needed prior to and during storage to prevent ignition of the dried product ▪ The biosolids produced is suitable for land application and unrestricted use as a fertilizer product. A local contractor would be retained for the services of land application.	✓	X	✓	X	✓	No	▪ Produces high quality product and reduces volume of biosolids to be hauled off site ▪ High capital costs ▪ Increased operational hazard due to risk of fires ▪ System is relatively complex and requires skilled operators

6.3.4 Summary of Short-Listed Sludge/Biosolids Alternatives

The on-site sludge stabilization technologies that were short-listed for detailed evaluation were:

- Aerobic Digestion
- Auto-Thermal Thermophilic Aerobic Digestion (ATAD)

6.3.5 Detailed Description of Short Listed Sludge Stabilization Alternatives

Alternative 1: Aerobic Digestion

Figure 8 shows a flow schematic of the process steps associated with the aerobic digestion alternative. Sludge and scum from the liquid train are directed to the aerobic digester, which is equipped with an aeration and mixing systems.

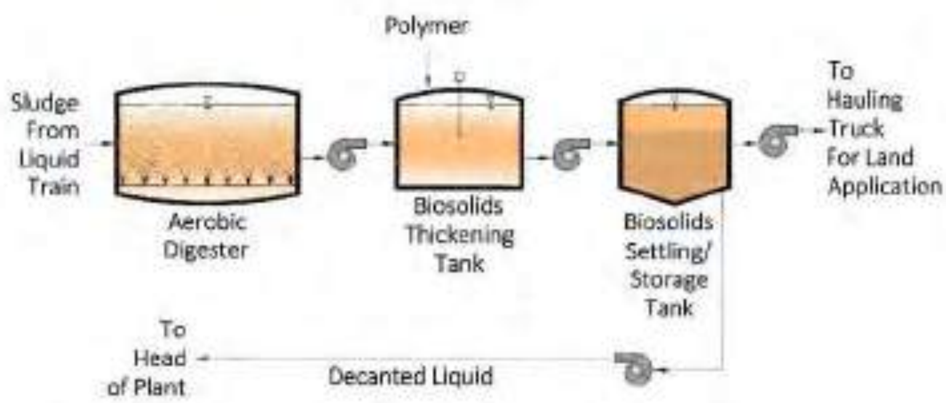

Figure 8 – Conventional Aerobic Digester Process Flow Schematic

Stabilized sludge is pumped from the digester to the biosolids thickening tank at approximately 1.5% solids. Polymer is added to the thickening tank, which is equipped with a mixing system to allow the polymer to react with the biosolids. From the thickening tank, the biosolids is pumped to the biosolids settling tanks.

The biosolids settling tank provide quiescence for settling and will be equipped with decanting systems to facilitate gravity thickening. Decanted liquid from the biosolids settling tank will be pumped to the head of the plant and thickened biosolids will be pumped to the biosolids storage tanks.

During summer months, thickened biosolids is pumped from the biosolids storage tanks then to the haulage trucks and hauled off-site for land application.

This alternative involves land applying of the biosolids as a liquid product rather than a biosolids cake, so the biosolids will need to be thickened to no more than 6%, as pumping of biosolids beyond this concentration, using traditional sludge pumps, becomes problematic. It is anticipated that thickening via polymer addition and gravity settling will achieve the desired solids concentration.

Advantages and disadvantage of this alternative are presented in Table 26.

Table 26 – Advantages and Disadvantages of the Aerobic Digestion Alternative

Advantages	Disadvantages
▪ Requires simplest thickening system. ▪ Least amount of process equipment required. ▪ Biosolids produced is relatively odour-free. ▪ Well understood technology.	▪ Higher operation costs due to requirement of aeration. ▪ Degree of stabilization is weather dependent, with lower levels seen in the colder months.

Alternative 2: Auto-Thermal Thermophilic Aerobic Digestion (ATAD)

Figure 9 presents a flow schematic of the steps associated with the ATAD alternative. Unlike Alternative 1, sludge and scum cannot be pumped directly to the ATAD. It needs to be thickened to approximately 5% solids.

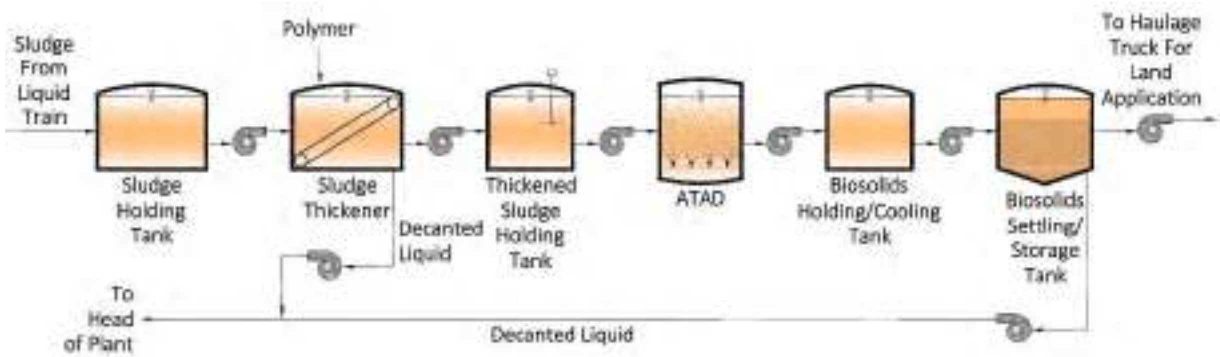

Figure 9 – ATAD Process Flow Schematic

From the liquid train, sludge and scum are pumped to an equalization tank then to a mechanical thickener. Polymer is added to the mechanical thickening process to improve thickening. Since sludge fed to the ATAD must be at a prescribed solids concentration, mechanical thickening is incorporated in this alternative to ensure that the required solids concentration can be achieved in a reasonable length of time.

Thickened sludge is then pumped to the ATAD for stabilization. The ATAD unit can be a single stage or double stage digestion system. A single stage process achieves sludge stabilization and the product is suitable for land application. If followed by a second stage, the second stage pasteurizes the biosolids to a quality level where the biosolids can be used as fertilizer without restrictions, as compared to land application only with the single stage ATAD. However, the pasteurized end-product has a lower nitrogen content, potentially making them a less desirable product in areas where high ammonia nitrogen fertilizer is desired.

From the ATAD, biosolids are transferred to biosolids holding/cooling tank, where excess heat from the stabilization process is removed to avoid possible over-heating.

Biosolids from the holding/cooling tank are pumped to the biosolids storage tanks, which provide the required 240 days of storage.

Advantages and disadvantage of this alternative are presented in Table 27.

Table 27 – Advantages and Disadvantages of the ATAD Alternative

Advantages	Disadvantages
▪ Smaller digester size due to shorter retention times. ▪ Degree of stabilization is not weather dependent. ▪ Can produce a pasteurized biosolids product if second stage used.	▪ Higher capital costs due to requirement for mechanical thickening system. ▪ Slightly more complex operation. ▪ Biosolids product have higher odour than conventional aerobic digestion – odour control system may be needed.

6.3.6 Cost Comparison of Short Listed Sludge Stabilization Alternatives

Table 28 summarizes the results of the life-cycle costs analysis for the sludge stabilization alternatives. Details of the life-cycle cost analysis can be found in Appendix E.

Table 28– Cost Estimates for Sludge Stabilization Alternatives

	Conventional Aerobic Digestion	Autothermal Thermophilic Aerobic Digestion (ATAD)
Capital Cost	$8,540,000	$11,091,000
Annual Operation and Maintenance Cost	$2,340,000	$1,529,000
Net Present Value	**$10,880,000**	**$12,620,000**

6.3.7 Sludge Stabilization Alternatives Detailed Evaluation

The criteria and weightings used to evaluate the sludge stabilization alternatives were those presented in section 5.2.2. Results of the evaluation are presented in Table 29.

Table 29 – Detailed Evaluation of Sludge Stabilization Alternatives

PRIMARY CRITERIA		SECONDARY CRITERIA		ABSOLUTE WEIGHT (WT)	SHORT LISTED ALTERNATIVES				COMMENTS
					Alternative 1 Aerobic Digestion		Alternative 2 ATAD		
CRITERIA	WEIGHT	CRITERIA	WEIGHT		SCORE*	WT SCORE	SCORE*	WT SCORE	
Social/Culture	15%	Aesthetic Impacts (plant apperance)	10	1.5	5	1.5	3.5	1.05	The ATAD system has a higher visual impact due to the extra tankage associated with thickening of the sludge prior to digestion. ATAD has 5 major steps and conventional aerobic disgestion has 3 major steps.
		Traffic (during construction and operation)	10	1.5	4.5	1.35	5	1.5	The ATAD sysetm would have more traffic during construction due to the higher concrete requiement. Traffic during operation would be comparable. The ATAD has a higher solids destruction ratio that would result in less sludge being hauled from site during normal operation.
		Noise Impacts (during operation)	40	6	5	6	4	4.8	ATAD has more equipment than aerobic digestion and likely higher noise emissions.
		Odour Impacts (during operation)	40	6	5	6	4	4.8	The additional processing of sludge required by the ATAD system results in a higher potential for fugitive odour emissions and ATAD biosolids are inherently more odourous.
Technical	35%	Ability to Meet Regulatory Objectives	30	10.5	3	6.3	5	10.5	Since ATAD pasteurizes as well as stabilizes sludge, it achieves a higher standard of biosolids than aerobic digestion and is more likely to be able to comply if regulations become more stringent.
		Technology/Process Robustness	30	10.5	4	8.4	5	10.5	The ATAD process has more buffering ability due to the additional sludge storage tanks, i.e. sludge with strong characteristics would be slightly diluted in the two sludge storage tanks before entering the ATAD, whereas sludge enters the aerobic disgester directly from the liquid train.
		Ease of Expansion and Phasing to Buildout	20	7	5	7	3	4.2	The aerobic digestion process would be easier to expand since it has less equipment
		Energy Requirements	5	1.75	3	1.05	5	1.75	The aerobic digestion process requires more energy (1064 kWh/d) than the ATAD process (522 kWh/d) due to the fine bubble diffuser system in the aerobic digester.
		Operation & Maintenance Staffing Requirements (skill level/number)	10	3.5	5	3.5	3.5	2.45	The ATAD system has more equipment to operate and maintain and an ATAD unit is more complex to operate than an aerobic digester.
		Site Requirements (plant footprint)	5	1.75	5	1.75	4	1.4	The ATAD system has more equipment and requires more land.
Environmental	20%	Public Health and Safety	30	6	4	4.8	5	6	Public health and safety factors would be related to the amount off-site trucking of biosolids. The ATAD system produces a thicker biosolids due to the mechanical thickening process and would result in less sludge being transported from the site.
		Sustainability	20	4	3	2.4	5	4	The ATAD unit is more sustainable since it produces a product that can be used without restrictions, whereas biosolids from a conventional aerobic digester can only be land applied. ATAD would be able to comply if more stringent regulations were implemented in the future.
		Greenhouse Gas Generation / Climate Change Impacts	20	4	3	2.4	5	4	For this high level evaluation, alternatives were scored based on energy usage and amount of tankage/construction required. Conventional aerobic digestion woud have a greater impact on climate change due to the significantly higher energy usage, even though it requires less construction.
		Natural Environment Impact	10	2	5	2	4	1.6	The ATAD system would have a the greater impact on the natural environment due to the larger footprint required.
		Waste Generation	20	4	3	2.4	3	2.4	Waste generation would be similar for the two systems
Economic	30%	Capital Cost	30	9	4	7.2	3.5	6.3	Refer to NPV analysis spreadsheet
		Operation and Maintenance Costs	40	12	3	7.2	4	9.6	Refer to NPV analysis spreadsheet
		Net Present Value	30	9	5	9	4	7.2	Refer to NPV analysis spreadsheet
			TOTAL SCORE	100	80.3		84.1		

*Score is a number from 1 to 5

6.3.8 Preliminary Preferred Alternative for Sludge Stabilization

Based on the detailed evaluation of the short-listed sludge stabilization alternatives, stabilization by auto-thermal thermophilic digestion (ATAD) and land application of liquid biosolids would be the preferred alternative.

6.4 Options for Revenue Generation

The amount of revenue generation that is possible from commercial marketing biosolids produced at the wastewater treatment facility is dependent on the following parameters:

- Quantity of the biosolids.
- Characteristics of the biosolids (nutrient profile).
- Market value of the biosolids end-product at the time of marketing
- The life-cycle costs associated with the technology used to produce the biosolids product.

Once Phase 1 of the Erin WWTP is in operation, the first three variables listed above will be known and a life-cycle analysis will be feasible to determine if revenue can be generated.

Commercially marketable biosolids are either fertilizers or soil amendments, such as compost. There are several viable technologies that produce a biosolids product that can be marketed in Ontario. The following is a description of a few of these technologies, along with the advantages and disadvantages of each.

6.4.1 Thermal Drying

Thermal drying involves heating the biosolids to further reduce its pathogen levels, reduce its water content to almost zero, and achieve the quality required for commercial marketing. The end-product is a pelletized fertilizer which is approved for unrestricted use. The fertilizer pellets can be sold for residential use, such as direct application to lawns or gardens. The can also be directly applied in public areas, used as agricultural amendments, or mixed with other ingredients prior to application.

Heating can be either direct heating or indirect. Technologies used for thermal drying include rotary dryers, fluidized beds, hollow-flight dryers, and steam dryers. This option would require incorporating a thickening system upstream of the thermal dryer to reduce the water content from approximately 96% to 75%, thus reducing the amount of energy required to dry the biosolids.

In addition, a cooling system will be needed to prevent ignition of the dried pellets when they are being stored.

Table 30 presents the advantages and disadvantages of thermal drying.

Table 30 – Advantages and Disadvantages of Thermal Drying

Advantages	Disadvantages
▪ Fertilizer product is high in nutrients, such as nitrogen and phosphorous – increased value as fertilizer ▪ Product easily packed for marketing. ▪ Small footprint compared with other technologies. ▪ Achieves the highest volume reduction (pellets are at least 90% solids) – reduced trucking traffic. ▪ Does not require the addition of chemicals or other agents – reduced traffic to facility.	▪ Higher energy consumption. ▪ High capital cost. ▪ Dust generated in drying process creates an explosion hazard. ▪ Systems are complex and require skilled operations staff. ▪ Potential for odours.

6.4.2 Solar Drying

Solar drying also involves stabilization of the biosolids with heat. However, solar drying uses the sun's energy as the heat source. Stabilized sludge is spread across the floor of drying greenhouses, where the heat of the sun stabilizes and dries the biosolids. The greenhouses are equipped with a mechanical system to mix and turn the biosolids bed while gradually moving biosolids from the inlet end of the greenhouse to the discharge end. The end-product is a pelletized fertilizer which is approved for unrestricted use.

A thickening system will be needed upstream of the solar dryer to reduce the water content in the biosolids. A pellet cooling system may not be required with this technology since the heat applied for drying is significantly less than with traditional thermal drying technologies.

Since the heat applied is low compared to traditional thermal drying technologies, the process takes longer and, thus requires a large footprint to expose all of the biosolids to the sun.

This technology would incorporate supplemental heating to provide heat during the winter months where there is reduced levels of sunlight and the ambient temperature is low.

Table 31 presents the advantages and disadvantages of solar drying.

Table 31 – Advantages and Disadvantages of Solar Drying

Advantages	Disadvantages
▪ Reduced energy costs compared to traditional thermal drying methods. ▪ Fertilizer product is high in nutrients, such as nitrogen and phosphorous – increased value as fertilizer ▪ Product easily packed for marketing. ▪ Does not require the addition of chemicals or other agents – reduced traffic to facility.	▪ Large footprint. ▪ Requires supplemental heating for periods of low-sunshine ▪ Potential for fugitive odours

6.4.3 On-Site Composting

Composting is a process in which organic material undergoes biological degradation, generating a stabilized end product. The composting process naturally heats the material by microbial decomposition to temperatures of 50 to 65°C. At this temperature range, pasteurization of the biosolids will take place.

Typically, bulking agents are added to the biosolids to improve the structural integrity of the mixture. Bulking agents can be wood chips, straw, or sawdust. Other organic composting materials are possible, such as food scraps, yard trimmings, and paper products. The choice of bulking agent is dictated by the type of composting used.

There are three major types of composting: aerated windrow composting, aerated static pile composting, and in-vessel composting. Aerated windrow composting and aerated static pile involve making piles or windrows of the material to be composted and aerating it to support the micro-organisms that decompose the material. In windrow composting the composting piles are mixed, whereas in aerated static pile composting the compost piles are not mixed.

The mixing in windrow composting tends to release odours. To control fugitive odours, windrows can be covered with a semi-permeable geotextile material, which allows the passage of oxygen molecules but prevents passage of larger molecules, including odorous compounds.

In-vessel composting is performed within an enclosed container (tank, silo, concrete lined trench, etc.). The vessel includes mixing to keep the material aerated. In-vessel composting is versatile in that it can accept almost any type of organic waste (meat, animal manure, biosolids, food scraps). Other advantages include less potential for nuisance odours, smaller footprint than other composting methods, and faster processing times.

Table 32 presents the advantages and disadvantages of on-site composting.

Table 32 – Advantages and Disadvantages of On-Site Composting

Advantages	Disadvantages
▪ Reduced energy costs compared to other stabilization methods. ▪ High level of flexibility, robustness, and lower labour costs possible with in-vessel composting method. ▪ Compost product marketable, especially to local residents.	▪ Large footprint. ▪ Precipitation can slow down the degradation process of organics due to excessive moisture and evaporative cooling (except for in-vessel) ▪ High potential for fugitive odours (except for in-vessel). ▪ Windrow and static pile are labour intensive.

6.4.4 Retain Services of a Biosolids Management Contractor

Currently, there are two companies in Ontario that provide biosolids management services, including commercial marketing of the biosolids end-product. The two companies are Lystek International and Walker Industries. Both companies use alkaline stabilization to produce a commercially marketable fertilizer product.

The option of retaining the services of a biosolids management contractor means that the contractor would use their privately-owned stabilization system and then market the end-product through their marketing network. A portion of the revenue generated from sales would be returned to the Town.

Both contractors can process either unstabilized or stabilized sludge in their systems and can include haulage of the sludge/biosolids from the Town's wastewater treatment facility to their processing plant in their services. These contractors require that the hauled sludge/biosolids be at a minimum solids concentration between 15% and 20%.

The Town would have to construct a biosolids thickening facility to achieve the higher solids concentration required for haulage.

The amount of revenue generation possible with this option will depend on market conditions at the time of production, sludge/biosolids quality, sludge/biosolids quantity produced. The Town may need to issue a call for proposals for potential contractors to assess which contractor can offer the greater value.

Table 33 presents the advantages and disadvantages of on-site composting.

Table 33 – Advantages and Disadvantages of Biosolids Management Contractor

Advantages	Disadvantages
▪ Town would not have to finance construction and operation of a biosolids processing facility. ▪ Town would not to have manage marketing of biosolids end-product.	▪ Town would not receive 100% of profits from biosolids product sales. ▪ Town would be relying on a third-party.

6.4.5 Recommendations

It is recommended that a Biosolids Options Study be performed after Phase 1 is in operation to assess the profitability of moving towards marketing the biosolids produced by the Town's wastewater treatment facility. Sludge quantity and quality will be known once Phase 1 is in operation. Assessments that may affect Phase 2 can be performed with the more accurate information gained from Phase 1 operations.

It may be of value to consider implementing a county-wide biosolids processing facility and benefiting from the economies of scale that such a system could provide.

7.0 Septage Management

7.1 Objectives and Overview

Current residents who are outside the recommended service area of the proposed wastewater collection system will remain on septic systems. To provide service to these residents, Erin's WWTP will include a septage receiving and management system.

Treatment of septage is challenging because septage is significantly stronger than domestic sewage. The MOECC cites that BOD and total phosphorous levels in septage are on average thirty-six times higher than in domestic sewage. Other parameters can be as high as seventy times higher.

For wastewater treatment plants with larger flows, septage can be added to the main treatment process without negatively impacting the performance of the plant, as the dilution by the large plant flow buffers loadings from septage. However, for smaller treatment facilities, such as Erin's, addition of even small amounts of septage to the main treatment process could result in overloading of the treatment processes.

Where septage is added to the main treatment process, the rate of addition has to be carefully controlled to respond to instantaneous plant flows in order to prevent system overload.

7.2 Septage Flows

There are an estimated 2,500 existing, rural residents who will remain on septic systems. The estimated growth rate of this rural population is 0.5% per year. Over this next twenty years, the number of residents using septic systems will increase to approximately 2,762.

The estimated septage flow for the existing rural residents is 2,500 m^3/year, projected to increase to 2,762 m3/year by the year 2038.

Septage flows to the treatment facility and population served are presented in Table 34.

Table 34 – Estimated Septage Flow to Erin WWTP

	2018	2038
Number of Rural Residents Using Septic Systems	2,500	2,762
Annual Septage Flow to the WWTP (m^3 / year)	2,500	2,762
Estimated Daily Flow to the WWTP ($m^{3/}$d)	9	10

The above flow rates were used in evaluating feasible alternatives for septage management and it was assumed that the plant will accept septage only from residents of the Town of Erin.

Since the projected increase in septage flow for the next 20 years is less than 1 m^3/d, it would be practical and cost effective to design the septage receiving and management system in Phase 1 to accommodate 2018 flows.

7.3 Septage Characteristics

The septage characteristics used in the evaluation of septage management alternatives for Erin were the suggested design values as cited in the MOE Design Guidelines for Sewage Works, Chapter 9 (Co-Treatment of Septage and Landfill Leachate at Sewage Treatment Plants), and are listed in Table 35.

It should be noted that characteristics of septage received at the WWTP may vary widely, since septage haulers collect septage and waste from differing sources in addition to septic tanks, including construction and temporary toilets for special events. Once Erin's WWTP starts to receive septage, the septage can be tested to determine its specific characteristics and the septage management system can be adjusted accordingly.

Table 35 – Raw Septage Characteristics

Raw Septage Parameter	MOE Suggested Design Value (mg/L)
Biological Oxygen Demand (BOD)	7000
Total Suspended Solids (TSS)	15,000
Total Kjeldahl Nitrogen (TKN)	700
Total Ammonia Nitrogen (TAN)	150
Total Phosphorous (TP)	250
Alkalinity	1000

7.4 Overview of Septage Management Approaches

Three approaches were considered for management and treatment of septage at the wastewater treatment facility. The approaches are:

- Co-Treatment
- Pre-Treatment Followed by Co-Treatment
- Separate Treatment

Co-Treatment

Co-Treatment is the addition of raw septage to the WWTP's treatment process. Raw septage can be treated as either part of the plant's liquid or solid treatment system. This approach requires either careful monitoring or metering of the septage addition rate to ensure that the plant does not become overloaded or suffer system shock or designing the main treatment plant to be capable of treating the expected septage flows. Co-treatment is typically used in larger wastewater treatment facilities.

Pre-Treatment Followed by Co-Treatment

Pre-treatment followed by co-treatment involves partially treating the raw septage to reduce its strength prior to adding it to the main plant. This reduces the loading to the plant and has the added benefit of allowing the plant to accept and treat more septage. This approach is typically used in smaller wastewater treatment facilities.

Separate Treatment

Separate treatment involves treating the septage via a dedicated system to a level that matches the WWTP's effluent characteristics. This approach is not widely used since it tends to add significant capital cost to the plant or require a large amount of land, in the case of treatment via lagoons.

The alternatives considered in the evaluation of septage management were chosen based on the preferred technology alternative for the main treatment plant. If the preferred alternative for the treatment plant is changed then evaluation of the septage management alternatives may need to be revisited.

7.5 Septage Management Evaluation Criteria

7.5.1 Long-List Screening Criteria

The criteria selected for the long-list screening of the septage management alternatives are presented in Table 36.

Table 36 – Septage Management Long-List Screening Criteria

Criteria	Description
Proven Reliability	Demonstrated track record of consistently meeting treatment objectives for septage.
Potential for Upset to Main Plant Process	The likelihood that this process would lead to an upset in the main plant's ability to meet effluent limits.
Site Requirements (footprint)	Amount of land required for the technology.
Potential for Odours	Likelihood of the alternative to generate odours at an unacceptable level during normal operation.
Cost	Have value in terms of performance and/or operation and maintenance that are reflective of the capital costs.

Proven Reliability

In order for an alternative to be carried forward for detailed analysis, the alternative must be one that achieves the required level of treatment for that particular alternative. For example, an alternative that would treat the septage independently from the plant would need to have a proven history of achieving the removal rates set out for the plant. However, an alternative that involves partially treating the septage before adding it to the main plant would only need to achieve a certain, prescribed level of treatment.

Potential for Upset to the Main Plant Process

This criterion reviews the impact that the septage management alternative might have on the main treatment process. Alternatives that treat the septage independently from the main plant would score higher as they would not contribute to the plant loadings. Alternatives that either add raw septage or partially treated septage to the plant would be scored according to the impact on the main plant process in the event of a septage system upset.

Site Requirements

Site requirements relate to the space that will be needed for the alternative as compared to the space available at the site for this system.

Cost

This cost criterion looks at the capital cost of the alternative and the costs associated with its operation and maintenance. Capital costs include equipment purchase and installation. Operation and maintenance aspects include costs related to utilities (electricity, gas, potable water), chemicals, and the level of effort required for regular maintenance of the equipment.

7.5.2 Short-List Screening Criteria

The criteria selected as the septage management short-list criteria are presented in Table 37. Descriptions of each criterion can be found in section 5.2.2.

Table 37 – Septage Management Short-List Screening Criteria

Primary Criteria	Weight	Secondary Criteria	Weight
Social / Culture	10%	Aesthetic Impacts (plant appearance)	10%
		Traffic Impacts (during construction and operation)	10%
		Noise Impacts (during operation)	40%
		Odours Impacts (during operation)	40%
Technical	40%	Ability to Meet Treatment Objectives and Robustness	30%
		Potential for Upset to Main Plant Process	40%
		Energy Requirements	10%
		Operation & Maintenance Requirements (simplicity, operator skill level/quantity)	10%
		Site Requirements (plant footprint)	10%
Environmental	20%	Public Health and Safety	35%
		Sustainability	25%
		Climate Change Impacts / Greenhouse Gas Generation	25%
		Natural Environment Impacts	15%
Economic	30%	Capital Cost	30%
		Operation and Maintenance Costs	40%
		Net Present Value	30%

7.6 Evaluation of Septage Management Alternatives

7.6.1 Short-Listing of Sludge Stabilization Alternatives

The long list of alternatives considered for septage management and the rationale used for short-listing are presented in Table 38.

Table 38 – Evaluation of Long List of Septage Management Technologies

No.	Technology	Description	Screening Criteria: Track Record	Potential for Plant Upset	Site Require-ments	Potential for Odours	Cost	Carry Forward	Rationale
1	Direct Co-Treatment in Main Treatment Plant Process	Raw septage would be received at a septage receiving/storage station and pumped to the main plant for treatment as part of the liquid treatment train. The flow of septage to the treatment plant would need to be controlled to prevent shock loading or overloading of plant treatment systems.	✓	✓	✓	✓	✓	**Yes**	▪ This a common practice in Ontario for septage management ▪ Has the highest potential for plant upset if not managed properly. ▪ Low foot print as only a septage receiving station would be needed ▪ Low potential for odours if receiving tanks are covered. ▪ Lower cost compared to other alternatives as only the septage receiving/storage station would be required
2	Stabilization Pond / Lagoon	This is a separate treatment alternative that would involve constructing a treatment lagoon/pond system at the site to receive and treat raw septage. Treated septage would then be disposed of off-site via land application.	X	✓	X	X	✓	No	▪ Ability to achieve advanced TAN removal is questionable ▪ No possibility of plant upset, since septage would be treated independently ▪ Requires larger amount of land ▪ High potential for odours as lagoon would be open to atmosphere ▪ Costs are comparable with other alternatives
3	Pre-Treat Raw Septage by Dewatering with GeoTube Followed by Co-Treatment	Raw septage would be received at a septage receiving station from where it would be pumped into permeable tubes (GeoTubes) for dewatering. Filtrate from the GeoTubes would be collected and pumped into the plant for co-treatment. The filtrate would be significantly weaker than raw septage, reducing the risk of plant overload and potentially increasing the facility's septage treatment capacity. The dewatered septage solids would be disposed of off-site via land application.	✓	✓	✓	✓	✓	**Yes**	▪ Dewatering as a pre-treatment is a common practice ▪ Low potential for plant upset ▪ Land requirements can be met ▪ Odour control incorporated into system ▪ Costs are comparable with other alternatives
4	Design Preferred Main Plant's MBR System to Include Septage Treatment	This alternative involves increasing the plant's treatment capacity to process the increased loading from septage. Raw septage would be received at a septage receiving station then pumped to the plant for treatment. The flow of septage to the treatment plant would need to be controlled to prevent shock loading or overloading of the plant's treatment systems, in the event that the septage characteristics are stronger than the design values.	✓	✓	✓	✓	✓	**Yes**	▪ MBR is a proven technology ▪ Some potential for plant upset if septage characteristic are significantly stronger than system is designed to treat ▪ MBR biological reactor tank size will increase slightly ▪ Costs are comparable with other alternatives.
5	Separate Treatment via Dedicated Treatment Process	This alternative involves incorporating a separate treatment system at the wastewater facility to treat the raw septage to meet the plant's effluent limits.	X	✓	✓	✓	X	No	▪ All technologies investigated are emerging without a track record for advanced nutrient removal from septage. Required phosphorous removal is challenging. ▪ No possibility of plant upset, since septage would be treated independently ▪ Land requirements can be met ▪ The systems considered were enclosed. Odour control systems can be included for the enclosure. ▪ Capital costs are high compared with other alternatives.

7.6.2 Summary of Short-Listed Septage Management Alternatives

The septage management alternatives that were short-listed for detailed evaluation were:

- Direct Co-Treatment of Raw Septage
- Design Main Plant's MBR process to Include Septage Treatment
- Pre-Treat Raw Septage by Dewatering with GeoTube Followed by Co-Treatment

7.6.3 Detailed Description of Short Listed Sludge Stabilization Alternatives

Alternative 1: Direct Co-Treatment of Raw Septage

Alternative 1 involves receiving raw septage at a septage receiving station and pumping it to the main plant for treatment as part of the liquid train. The septage receiving station would be a common system for all septage management alternatives considered and would include a bar screen and a septage holding tank. The bar screen would be designed to remove larger objects, rags, and other items that would be difficult to pump. The septage holding tank would store raw septage and submersible raw septage pumps would pump septage to the head of the main plant for co-treatment at an even, metered flow rate.

Raw septage would be introduced to the plant at the headworks area to allow mixing with the domestic sewage prior to the biological treatment stage. Since septage is significantly stronger than domestic sewage, the rate at which raw septage is pumped to the plant will need to carefully controlled to prevent shock-loading or overloading the plant's treatment processes.

Using the septage characteristics listed in section 8.3, at the plant's Phase 1 average flow of 4,780 m^3/d, raw septage could be added to the plant at approximately 6 L/min before the plant's influent characteristics would rise above the average range for domestic sewage. Additionally, the septage pumping rate would need to be modulated to mirror fluctuations in plant's instantaneous flow rate. Raw septage flow to the plant would need to be kept below 0.19% of the plant's instantaneous flow in order to prevent system overload.

A septage addition rate of 6 L/min equates to adding 9 m^3 (one small haulage truck) over a 24-hour period. It is proposed that two septage holding tanks be provided (standby and backup) and each tank sized to contain two day's worth of septage.

Advantages and disadvantage of this alternative are presented in Table 39.

Table 39 – Advantages and Disadvantages of Direct Co-Treatment

Advantages	Disadvantages
▪ Least costly alternative ▪ Small footprint, since only the septage receiving station and holding tank would be required	▪ Highest potential for upset to main plant process ▪ Requires frequent operator involvement to analyze septage characteristics and determine acceptable transfer rate to main plant. ▪ Difficult to plan for variability of septage arrival at the WWTP. ▪ No potential to expand for revenue generation.

Alternative 2: Design Main Plant's MBR to Include Septage Treatment

Alternative 2 involves designing the plant's preferred secondary treatment technology (membrane bioreactor) to accommodate the increased loading from septage. The increase in design capacity would be to a level where the MBR could achieve the required treatment up to the point where addition of septage would drive the plant's influent characteristics above the average range for domestic sewage.

Raw septage would be received at the septage receiving station, stored in a septage holding tank, and pumped to the plant for treatment when the tank is full. The flow of septage to the treatment plant would need to be controlled to prevent shock loading or overloading of the plant's treatment system.

Using the septage characteristics in section 8.3, it is estimated that this alternative could accommodate a septage addition rate up to 0.42% of the plant's instantaneous flow. At the plant's Phase 1 average flow rate of 4,780 m^3/d, this septage addition rate equates to 14 L/min.

Advantages and disadvantage of this alternative are presented in Table 40.

Table 40 – Advantages and Disadvantages of Increasing the Capacity of the Main Plant

Advantages	Disadvantages
▪ Minimizes potential for plant upset compared to direct co-treatment ▪ Slight increase in bioreactor size	▪ Potential for upset fairly high ▪ No potential to expand to achieve revenue generation, if desired.

Alternative 3: Pre-Treat Raw Septage by Dewatering with GeoTube Followed by Co-Treatment

Alternative 3 involves pre-treating the raw septage using a permeable membrane tube (Geotube) dewatering system and pumping the dewatering filtrate to the head of the main plant for co-treatment. The solids component of the dewatering operation would become stabilized in the Geotube and the stabilized product would be suitable for land application.

Pre-treatment decreases the strength of the raw septage, thus reducing the potential for shock-loading or overloading of the main plant and potentially increasing the plant's septage treatment capacity.

As with alternative 1, raw septage would be received at the septage receiving station and stored in the septage holding tank. Submersible pumps would pump the raw septage into the Geotube for dewatering on a batch basis for each tube. The Geotubes would be installed on an engineered laydown area, which would incorporate trenches to collect the filtrate and direct it to a filtrate holding tank, from where the filtrate would be pumped to the head of the plant.

This system also incorporates an odour control system which would draw air from the septage bar screen and holding tank when septage is being delivered, pumped into the Geotube, or mixed within the holding tank and treat the odourous air to prevent emission of fugitive odours.

The rate at which filtrate is pumped to the plant would need to be monitored to ensure that the characteristics of the raw sewage do not increase beyond the average range for domestic wastewater. Using the septage characteristics proposed is section 8.3, it is estimated that Geotube filtrate could be added to the plant at a maximum of 2.8% of the plant's instantaneous flow. At the Phase 1 average plant flow rate of 4,780 m^3/d, the maximum filtrate addition translates to approximately 92 L/min.

The Geotube® technology was selected for this alternative because it has been successfully used at the Eganville WWTP in Eganville, ON for the past seven years and the supplier was able to provide data on the characteristics of the filtrate and the dewatered solids, which were needed to determine the level of treatment possible with this system and the maximum allowable rate of filtrate addition to the main plant.

Additionally, this alternative produces a biosolids end-product that can be land-applied as opposed to disposed of at a landfill, which is the typical disposal method for dewatered septage solids. This feature of this alternative is in keeping with the potential for resource recovery criterion used in the solids treatment train evaluation for Erin's WWTP. If instances occur where the characteristics of the Geotube solids do not permit them to be land applied, those solids can be disposed of at a landfill.

Advantages and disadvantage of this alternative are presented in Table 41.

Table 41 - Advantages and Disadvantages of Pre-Treatment with Geotubes®

Advantages	Disadvantages
▪ Minimizes potential for plant upset ▪ Produces a biosolids product that can be disposed of by land application ▪ Low operator involvement ▪ Can accommodate fluctuations in septage characteristics ▪ Easily expanded to accommodate septage from neighbouring communities (revenue generation potential)	▪ Higher capital cost ▪ Larger footprint than other alternatives

7.6.4 Cost Comparison of Short Listed Septage Management Alternatives

Table 42 presents the life cycle costs associated with the septage management alternatives evaluated. Estimates have been rounded to the nearest thousand dollars. Details of the analysis can be found in Appendix F.

Table 42 – Cost Estimates of Septage Management Alternatives

	Alternative 1 Direct Co-Treatment	Alternative 2 Design MBR to Treat Septage	Alternative 3 Pre-Treat with Geotube®
Capital Cost	$498,000	$504,000	$853,000
Annual Operation and Maintenance Cost	$38,000	$49,000	$243,000
Net Present Value	**$536,000**	**$553,000**	**$1,096,000**

7.6.5 Detailed Evaluation of Short Listed Septage Management Alternatives

The weightings used in the evaluation of septage management alternatives were tailored for this system and are presented in Table 43.

Table 43 – Septage Management Short-List Screening Criteria

Primary Criteria	Weight	Secondary Criteria	Weight
Social / Culture	10%	Aesthetic Impacts (plant appearance)	10%
		Traffic Impacts (during construction and operation)	10%
		Noise Impacts (during operation)	40%
		Odours Impacts (during operation)	40%
Technical	40%	Ability to Meet Regulatory Objectives	30%
		Technology / Process Robustness	30%
		Ease of Expansion and Phasing to Buildout	20%
		Energy Requirements	5%
		Operation & Maintenance Requirements (simplicity, operator skill level/quantity)	10%
		Site Requirements (plant footprint)	5%
Environmental	25%	Public Health and Safety	30%
		Sustainability	20%
		Climate Change Impacts / Greenhouse Gas Generation	20%
		Natural Environment Impacts	10%
		Waste Generation	20%
Economic	25%	Capital Cost	30%
		Operation and Maintenance Costs	40%
		Net Present Value	30%

Table 44 summarizes the results of the detailed evaluation of the septage management alternatives.

Table 44 – Detailed Evaluation of Septage Management Alternatives

PRIMARY CRITERIA		SECONDARY CRITERIA		ABSOLUTE WEIGHT (WT)	SHORT LISTED ALTERNATIVES						COMMENTS
					Alternative 1 Direct Co-Treatment		Alternative 2 Design MBR to Treat Septage		Alternative 3 Dewater with GeoTube & Co-Treat Filtrate		
CRITERIA	WEIGHT	CRITERIA	WEIGHT		SCORE*	WT SCORE	SCORE*	WT SCORE	SCORE*	WT SCORE	
Social/Culture	10%	Aesthetic Impacts (plant apperance)	10	1	4	0.8	4	0.8	3	0.6	Geotube has the most external components and would be more visable than other alternatives.
		Traffic (during construction and operation)	10	1	4	0.8	4	0.8	3.5	0.7	Geotube would have greater traffic during construction as it has more components than the other alternatives.
		Noise Impacts (during operation)	40	4	3	2.4	3	2.4	3	2.4	No significant difference.
		Odour Impacts (during operation)	40	4	4	3.2	4	3.2	3.5	2.8	Geotubes are installed outdoors and has potential for odour impacts, although no odour issues have been reported in previous installations.
Technical	40%	Ability to Meet Treatment Objectives & Robustness	30	12	2	4.8	3	7.2	4.5	10.8	Alternative 1 is the least flexible/robust. Alternative 2 is more robust than Alternative 1 because the MBR would be sized to accommodate the increased loading. Alternative 3 is considered the most robust because it's performance is not significantly affected by the septage characteristics or volume.
		Potential for Upset to Main Plant Process	30	12	2	4.8	3	7.2	4.5	10.8	Since the Geotube filtrate is significantly weaker than raw septage, this option has much less potential for system upset.
		Energy Requirements	10	4	4	3.2	3	2.4	3.5	2.8	Alternative 1: 35 kWh/d Alternative 2: 43 kWh/d Alternative 3: 39 kWh/d
		Operation & Maintenance Staffing Requirements (skill level/number)	15	6	4	4.8	4	4.8	4	4.8	No significant difference.
		Site Requirements (plant footprint)	15	6	4	4.8	4	4.8	3	3.6	Alternative 1 require the same amount of land. Alternative 2 requires slightly more land. Alternative 3 requirest the additional area for the Geotubes®.
Environmental	25%	Public Health and Safety	35	8.75	2.5	4.4	3	5.3	4.5	7.9	Public health and safety would be impacted if the main plant were unable to achieve its effluent limits, which may result from overloading by septage addition. Dewatering has very little chance of overloading the plant and the other alternatives have a high potential for plant upset.
		Sustainability	25	6.25	2	2.5	2.5	3.1	4	5.0	Alternative 1 and 2 are considered less sustainable than Alternative 3 since the amount of septage that can be added to the plant is limited and cannot be increased if needed and treatment capacity is would be affected by septage characteristics.
		Greenhouse Gas Generation / Climate Change Impacts	25	6.25	3.5	4.4	3.5	4.4	3	3.8	Energy consumption is comparable, however, Alterantive 3 would involve more construction due to the laydown area, which would lead to greater climate change impacts.
		Natural Environment Impact	15	3.75	4	3.0	4	3.0	3.5	2.6	Alternative 3 would have the greatest impact as it requires more land to be cleared for construction.
Economic	25%	Capital Cost	30	7.5	4	6.0	3.5	5.3	2.5	3.8	Refer to NPV analysis
		Operation and Maintenance Costs	40	10	4.5	9.0	4	8.0	2	4.0	Refer to NPV analysis
		Net Present Value	30	7.5	4	6.0	3.5	5.3	2	3.0	Refer to NPV analysis
			TOTAL SCORE	100	64.9		67.9		69.3		

*Score is a number from 1 to 5

7.6.6 Preliminary Preferred Alternative for Septage Management

Based on the results of the detailed evaluation of the septage management alternatives, pre-treatment with Geotube followed by co-treatment of the dewatering filtrate from the Geotubes is the preferred alternative.

8.0 Preliminary WWTP Preferred Design Concept

The results of the technologies alternative evaluation show that the MBR technology is the preferred alternative for the liquid train. The MBR technology can meet tertiary treatment requirements so a separate tertiary treatment process would not be required.

To prevent excessive membrane fouling during the operation of the MBR, an advanced primary treatment technology is needed to remove particles, including hair, that typically clog membrane filters. A rotary belt filter was coupled with the MBR alternative in this evaluation.

UV radiation was the preferred alternative for disinfection. A fine bubble aeration system that uses increased capacity from the MBR blowers was selected as the preferred alternative to elevate DO levels in the treated wastewater prior to discharge to the river.

On-site stabilization of sludge via an ATAD system, with land application of liquid biosolids was selected as the preferred alternative for Phase 1. It is recommended that the Town evaluate the potential for revenue generation through marketing of biosolids once Phase 1 is in operation and the nature and quantity of biosolids produced at the plant is known.

The wastewater treatment facility will incorporate a septage receiving and management/treatment system. The preferred alternative for septage management is dewatering by a dewatering membrane technology, such as GeoTubes® and treating the dewatering filtrate in the main plant.

Figure 10 shows the flow schematic of the preferred alternative for the liquid treatment train, including the septage receiving and treatment system.

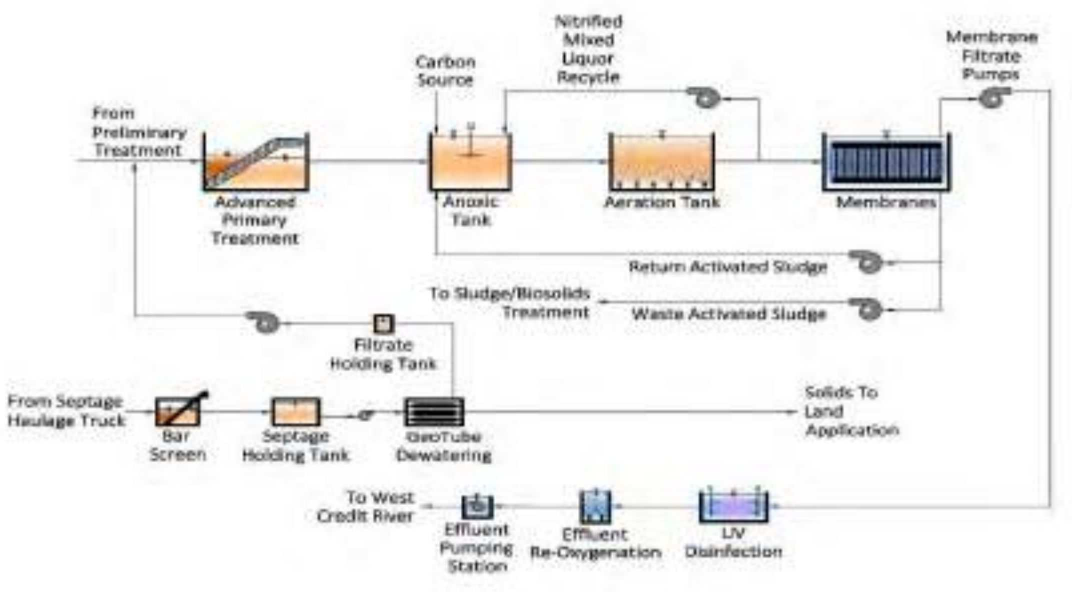

Figure 10 – Preferred Liquid Treatment Train Process Flow Schematic

Figure 11 shows the preferred alternative for the sludge/biosolids treatment train.

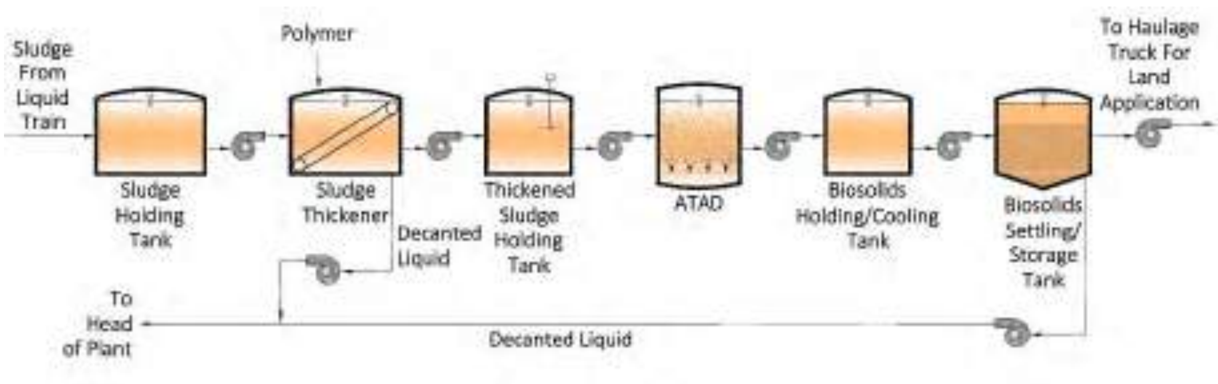

Figure 11 – Preferred Solids Treatment Train Process Flow Schematic

8.1 WWTP Site Plan

Figure 12 presents a conceptual plant layout, which is based on the preliminary preferred treatment alternatives. The plant layout includes common facilities such as the administration building, standby power, odour control, and the effluent pumping station.

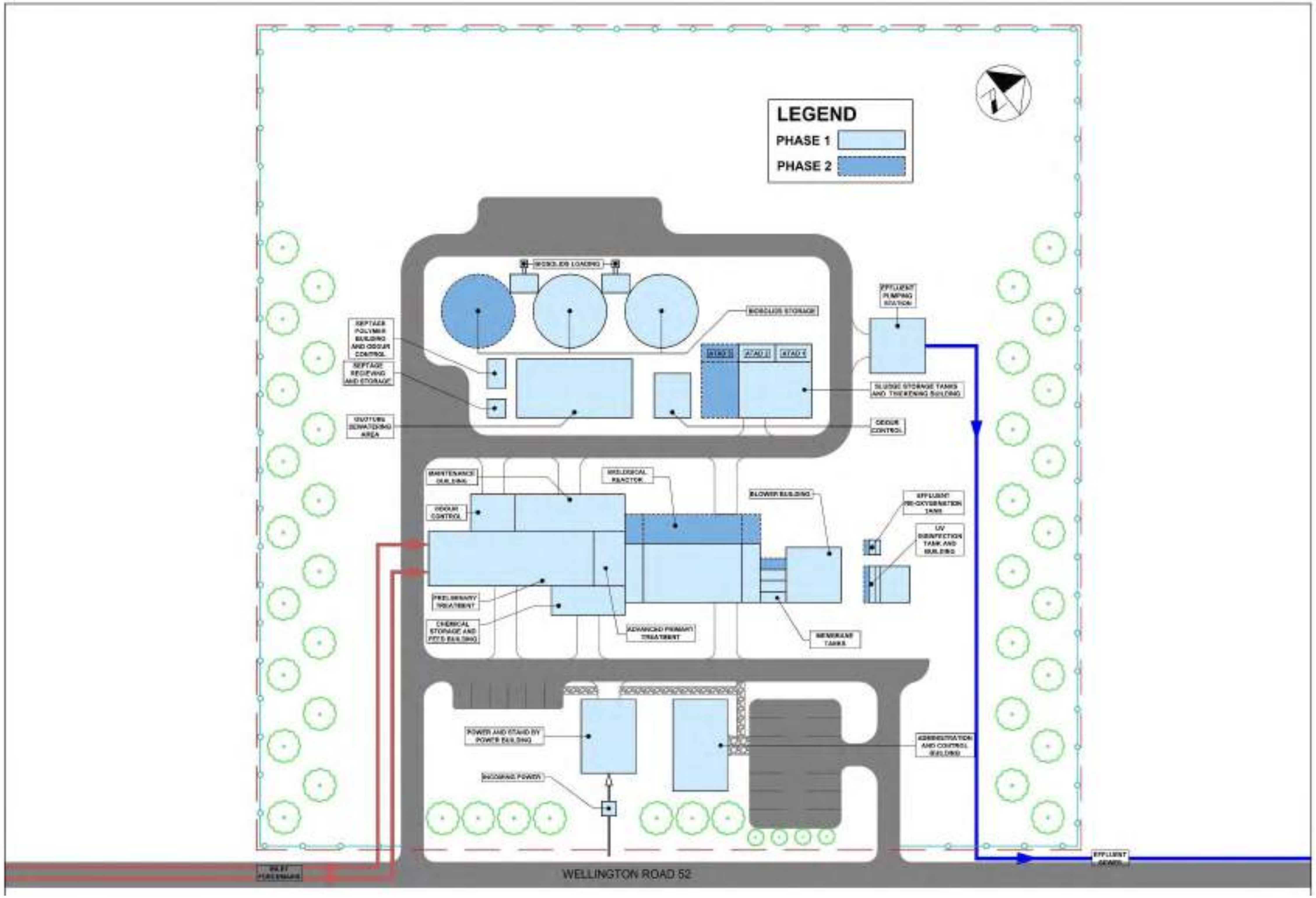

Figure 12 – Conceptual Site Layout of Preliminary Preferred Alternatives

8.2 Capital Costs of WWTP Construction

Based on the preliminary preferred alternatives, an estimate of the construction costs for the treatment plant was generated. The estimate incorporates factors such as equipment costs, tankage and building construction costs, site works, standby power, land acquisition, and engineering fees and permits.

A breakdown of the cost estimate is presented in Table 45.

Table 45 – Estimated Capital Construction of Erin WWTP

	PHASE 1 CAPITAL COST ESTIMATE (2017 Dollars)	PHASE 2 CAPITAL COST ESTIIMATE (2017 Dollars)	FULL BUILDOUT CAPITAL COST ESTIMATE (2017 Dollars)
Preliminary Treatment / Headworks	$ 2,220,000	$ 1,092,000	$ 3,312,000
Primary/Secondary Treatment	$ 17,121,480	$ 7,665,000	$ 24,786,480
Tertiary Treatment (not needed with MBR)	$ -	$ -	$ -
UV Disinfection	$ 611,000	$ 148,000	$ 759,000
Effluent Re-Oxygenation	$ 69,000	$ 31,000	$ 100,000
Effluent Pumping	$ 1,800,000	$ 900,000	$ 2,700,000
Biosolids Treatment	$ 9,555,000	$ 4,163,000	$ 13,718,000
Septage Management	$ 1,315,000	$ -	$ 1,315,000
Odour Control	$ 2,187,000	$ 1,312,000	$ 3,499,000
Standby Power	$ 1,200,000	$ 600,000	$ 1,800,000
Administration and Maintenance Buildings	$ 960,000	$ -	$ 960,000
Site Works	$ 5,514,020	$ 2,133,000	$ 7,647,020
Land Acquisition	$ 785,000	$ -	$ 785,000
TOTAL COSTS:	**$ 43,337,500**	**$ 18,044,000**	**$ 61,381,500**

9.0 Conclusions and Recommendations

- The 2014 Servicing and Settlement Master Plan (SSMP) identified that a new wastewater collection system and treatment plant would be required to service the existing and expected growth population of Erin Village and Hillsburgh.
- The UCWS EA is a continuation of the Class EA process and includes establishment of the preferred treatment alternatives for the proposed new wastewater treatment plant.
- The updated Assimilative Capacity study completed for the UCWS Class EA study established the West Credit River as the receiving body for treated effluent from the wastewater treatment plant. The West Credit River is classified as a Policy 1 receiver.
- The updated ACS also established treatment effluent limits for pollutants that pose a threat to the river's ecosystem.
- It is proposed that construction of the wastewater treatment plant proceed in two phases. Phase 1 would service the existing population with some allotment for future growth and Phase 2 (Full Buildout) would be an expansion of Phase 1 to service the total population growth for the Town.
- This UCWS Class EA study evaluated technology alternatives for the primary, secondary, tertiary, disinfection, and sludge treatment stages of the wastewater treatment plant.
- The ACS included a minimum limit for dissolved oxygen in the plant's treated effluent. Alternatives for re-oxygenating the treated effluent, following disinfection, were also evaluated.
- The WWTP is to include a septage receiving and management system, to accept and treat septage from residents who will be outside the recommended service area of the proposed new collection system. Septage management alternatives were included in this evaluation.
- Life-cycle cost analysis were performed for each treatment stage considered in the evaluation. Life cycle analysis included equipment costs, building and tankage construction costs, operating cost associated with energy and chemical consumption, and a net present value analysis.
- The preferred treatment technologies for the wastewater treatment plant are summarized below:

Treatment Stage	Preferred Alternative
Primary Treatment	Advanced Primary Treatment (e.g. Rotary Belt Filter)
Secondary and Tertiary Treatment	Membrane Bioreactor
Disinfection	UV Radiation
Effluent Re-Oxygenation	Fine Bubble Aeration (using up-sized secondary treatment blowers)
Sludge Treatment / Management	Sludge Stabilization via Autothermal Thermophilic Aerobic Digestion (ATAD) and Land Application of Stabilized Biosolids
Septage Management	Pre-Treatment with GeoTubes Followed by Co-Treatment at the Main Plant and Land Application of Stabilized, Dewatered Biosolids

- It is recommended that the Town evaluate the potential for revenue generation through marketing of biosolids once Phase 1 is in operation and the nature and quantity of biosolids are known as well as market conditions at the time of production, as these factors are difficult to accurately assess at this time.
- Sensitivity analyses were performed on the detailed evaluation of each of the systems to assess how sensitive the results were to the weightings. For all but the septage management system, the evaluation results remained unchanged when the weightings were varied by 5% between pairs of criteria.
- For the septage management evaluation, a 5% increase in the environmental criterion with a 5% increase in the economic criterion results in the alternative of increasing the MBR capacity to directly co-treat septage without pre-treatment becoming the preferred septage alternative.
- The estimated total capital construction costs for Phase 1, including ancillary facilities, such as the administration building, siteworks, and yard piping, and standby power is $43,052,500 (2017 dollars)
- The estimated total capital construction costs for Phase 2/Full Buildout is $18,044,000 (2017 dollars)
- The estimated total cost for the wastewater treatment plant to Full Buildout is $61,096,500 (2017 dollars).
- Based on a conceptual plant layout, the proposed sites for the WWTP would both be large enough to accommodate the preliminary preferred treatment alternatives.

Appendix A

Life Cycle Cost Evaluation of Primary / Secondary Treatment Alternatives

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering and Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	Phase 1					Phase 2 (Full Buildout)				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Primary Clarifiers										
Sludge and Scum Removal Mechanism (including drives)	2	$ 36,667	$ 73,334	60%	$ 117,334	1	$ 36,667	$ 36,667	60%	$ 58,667
Weirs and Scum Baffles	2	$ 6,845	$ 13,690	60%	$ 21,904	1	$ 6,845	$ 6,845	60%	$ 10,952
Scum pumps	2	$ 17,908	$ 35,816	60%	$ 57,306	1	$ 17,908	$ 17,908	60%	$ 28,653
Raw Sludge Pumps	2	$ 9,050	$ 18,100	60%	$ 28,960	1	$ 9,050	$ 9,050	60%	$ 14,480
Conventional Activated Sludge Tank										$ -
Blowers	2	$ 31,554	$ 63,108	60%	$ 100,973	2	$ 31,554	$ 63,108	60%	$ 100,973
Aeration piping, valves, and diffusers	1	$ 266,400	$ 266,400	60%	$ 426,240	1	$ 133,200	$ 133,200	60%	$ 213,120
Secondary Clarifiers										
Sludge and Scum Removal Mechanism (including drives)	2	$ 44,000	$ 88,000	60%	$ 140,800	1	$ 44,000	$ 44,000	60%	$ 70,400
Weirs and Baffles	2	$ 7,524	$ 15,048	60%	$ 24,077	1	$ 7,524	$ 7,524	60%	$ 12,038
Scum pumps	2	$ 17,908	$ 35,816	60%	$ 57,306	1	$ 17,908	$ 17,908	60%	$ 28,653
RAS Pumps	2	$ 12,099	$ 24,198	60%	$ 38,717	1	$ 12,099	$ 12,099	60%	$ 19,358
WAS Pumps	2	$ 9,120	$ 18,240	60%	$ 29,184	1	$ 9,120	$ 9,120	60%	$ 14,592
Chemical Dosing										$ -
Chemical Storage Tanks	2	$ 22,200	$ 44,400	60%	$ 71,040	1	$ 22,200	$ 22,200	60%	$ 35,520
Day Tanks	1	$ 3,700	$ 3,700	60%	$ 5,920	1	$ 3,700	$ 3,700	60%	$ 5,920
Dosing Pumps	2	$ 2,200	$ 4,400	60%	$ 7,040	1	$ 2,200	$ 2,200	60%	$ 3,520
Chemical Transfer Pumps	2	$ 2,600	$ 5,200	60%	$ 8,320	1	$ 2,600	$ 2,600	60%	$ 4,160
Total Equipment Cost					$ 1,135,120					$ 621,006
CONSTRUCTION										
General			10%		$ 430,064			10%		$ 220,377
Site Work			15%		$ 645,096			15%		$ 330,565
Yard Piping			10%		$ 430,064			10%		$ 220,377
Primary Clarifier	1	$ 480,592	$ 480,592	10%	$ 528,651	1	$ 240,296	$ 240,296	10%	$ 264,326
Aeration Tanks	1	$ 834,048	$ 834,048	10%	$ 917,453	1	$ 417,024	$ 417,024	10%	$ 458,726
Secondary Clarifier	1	$ 708,628	$ 708,628	10%	$ 779,491	1	$ 354,314	$ 354,314	10%	$ 389,745
Blower/ RAS/ WAS Building	1	$ 854,478	$ 854,478	10%	$ 939,926	1	$ 427,239	$ 427,239	10%	$ 469,963
Total Construction Cost					$ 4,670,745					$ 2,354,079
Engineering & Contingency (25%)					$ 1,451,466					$ 743,771
Total Capital Cost					$ 7,257,331					$ 3,718,856

OPERATIONAL COST	Phase 1				Phase 2			
	Rating	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Clarifier Mechanisms	36	kWh/d	$ 0.11	$ 1,426.13	53	kWh/d	$ 0.11	$ 2,139.19
Blower Operation	832	kWh/d	$ 0.11	$ 33,404.80	1248	kWh/d	$ 0.11	$ 50,107.20
WAS Pumps	8	kWh/d	$ 0.11	$ 321.20	12	kWh/d	$ 0.11	$ 481.80
RAS Pumps	85	kWh/d	$ 0.11	$ 3,412.75	128	kWh/d	$ 0.11	$ 5,119.13
Raw Sludge Pumps	12	kWh/d	$ 0.11	$ 481.80	18	kWh/d	$ 0.11	$ 722.70
Total Power Cost				$ 39,047				$ 58,570
Chemical Consumption								
Alum	33	kg/d	$ 4.00	$ 48,180.00	50	kg/d	$ 4.00	$ 72,270.00
Total Chemical Cost				$ 48,180				$ 72,270
Total Operational Costs				$ 87,227				$ 130,840

NPV CALCULATION	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
CAPITAL COSTS											
Equipment	$ 2,195,158			$ 425,670	$ 567,560	$ 425,670					
Construction Costs	$ 8,781,029			$ 1,751,529	$ 2,335,372	$ 1,751,529					
Major Equipment Replacement Cost	$ 4,390,316										
Total Capital Cost in 2017 Dollars	$ 15,366,503			$ 2,177,199	$ 2,902,932	$ 2,177,199	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 10,436,312	$ -	$ -	$ 2,054,565	$ 2,661,151	$ 1,938,839	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS											
Power Consumption Cost	$ 4,295,135						$ 39,047	$ 39,047	$ 39,047	$ 39,047	$ 39,047
Chemical Consumption Cost	$ 5,299,800						$ 48,180	$ 48,180	$ 48,180	$ 48,180	$ 48,180
Total Operational Cost in 2017 Dollars	$ 9,594,935						$ 87,227	$ 87,227	$ 87,227	$ 87,227	$ 87,227
Total Operational Cost NPV	$ 3,250,606			$ -	$ -	$ -	$ 75,458	$ 73,302	$ 71,207	$ 69,173	$ 67,197
Current Year Sub-total	$ 24,961,438			$ 2,177,199	$ 2,902,932	$ 2,177,199	$ 87,227	$ 87,227	$ 87,227	$ 87,227	$ 87,227
Inflation Adjusted	$ 50,058,347			$ 2,265,158	$ 3,080,615	$ 2,356,671	$ 96,305	$ 98,231	$ 100,196	$ 102,200	$ 104,244
NPV	**$ 13,686,918**			$ 2,054,565	$ 2,661,151	$ 1,938,839	$ 75,458	$ 73,302	$ 71,207	$ 69,173	$ 67,197

NPV CALCULATION	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
CAPITAL COSTS										
Equipment	$ 232,877	$ 310,503	$ 232,877							
Construction Costs	$ 882,779	$1,177,039	$ 882,779							
Major Equipment Replacement Cost										
Total Capital Cost in 2017 Dollars	$ 1,115,657	$1,487,543	$ 1,115,657	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 834,909	$1,081,407	$ 787,882	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS										
Power Consumption Cost	$ 39,047	$ 39,047	$ 39,047	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570
Chemical Consumption Cost	$ 48,180	$ 48,180	$ 48,180	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
Total Operational Cost in 2017 Dollars	$ 87,227	$ 87,227	$ 87,227	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840
Total Operational Cost NPV	$ 65,277	$ 63,412	$ 61,600	$ 89,760	$ 87,195	$ 84,704	$ 82,284	$ 79,933	$ 77,649	$ 75,431
Current Year Sub-total	$ 1,202,884	$1,574,769	$ 1,202,884	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840
Inflation Adjusted	$ 1,466,308	$1,958,028	$ 1,525,547	$ 169,256	$ 172,641	$ 176,093	$ 179,615	$ 183,208	$ 186,872	$ 190,609
NPV	$ 900,186	$1,144,818	$ 849,482	$ 89,760	$ 87,195	$ 84,704	$ 82,284	$ 79,933	$ 77,649	$ 75,431

AINLEY: 115157
MODIFIED CONVENTIONAL ACTIVATED SLUDGE PROCESS

2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
														$ 1,418,900								$ 776,258							
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,418,900	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 776,258	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 529,568	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 229,754	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570
$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840
$ 73,275	$ 71,182	$ 69,148	$ 67,172	$ 65,253	$ 63,389	$ 61,578	$ 59,818	$ 58,109	$ 56,449	$ 54,836	$ 53,269	$ 51,747	$ 50,269	$ 48,833	$ 47,437	$ 46,082	$ 44,765	$ 43,486	$ 42,244	$ 41,037	$ 39,865	$ 38,726	$ 37,619	$ 36,544	$ 35,500	$ 34,486	$ 33,501	$ 32,543	$ 31,614
$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 1,549,740	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 907,098	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840
$ 194,421	$ 198,310	$ 202,276	$ 206,322	$ 210,448	$ 214,657	$ 218,950	$ 223,329	$ 227,796	$ 232,352	$ 236,999	$ 241,739	$ 246,573	$ 251,505	$ 3,038,538	$ 261,666	$ 266,899	$ 272,237	$ 277,682	$ 283,235	$ 288,900	$ 294,678	$ 2,083,826	$ 306,583	$ 312,715	$ 318,969	$ 325,348	$ 331,855	$ 338,492	$ 345,262
$ 73,275	$ 71,182	$ 69,148	$ 67,172	$ 65,253	$ 63,389	$ 61,578	$ 59,818	$ 58,109	$ 56,449	$ 54,836	$ 53,269	$ 51,747	$ 50,269	$ 578,400	$ 47,437	$ 46,082	$ 44,765	$ 43,486	$ 42,244	$ 41,037	$ 39,865	$ 268,479	$ 37,619	$ 36,544	$ 35,500	$ 34,486	$ 33,501	$ 32,543	$ 31,614

AINLEY: 115157
MODIFIED CONVENTIONAL ACTIVATED SLUDGE PROCESS

2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097
														$ 1,418,900								$ 776,258							
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,418,900	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 776,258	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 221,946	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 96,292	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570	$ 58,570
$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840
$ 30,710	$ 29,833	$ 28,981	$ 28,152	$ 27,348	$ 26,567	$ 25,808	$ 25,070	$ 24,354	$ 23,658	$ 22,982	$ 22,326	$ 21,688	$ 21,068	$ 20,466	$ 19,881	$ 19,313	$ 18,762	$ 18,226	$ 17,705	$ 17,199	$ 16,708	$ 16,230	$ 15,766	$ 15,316	$ 14,878	$ 14,453	$ 14,040	$ 13,639	$ 13,250
$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 1,549,740	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 907,098	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840	$ 130,840
$ 352,167	$ 359,211	$ 366,395	$ 373,723	$ 381,197	$ 388,821	$ 396,598	$ 404,530	$ 412,620	$ 420,873	$ 429,290	$ 437,876	$ 446,633	$ 455,566	$ 5,503,891	$ 473,971	$ 483,450	$ 493,119	$ 502,982	$ 513,041	$ 523,302	$ 533,768	$ 3,774,562	$ 555,333	$ 566,439	$ 577,768	$ 589,323	$ 601,110	$ 613,132	$ 625,395
$ 30,710	$ 29,833	$ 28,981	$ 28,152	$ 27,348	$ 26,567	$ 25,808	$ 25,070	$ 24,354	$ 23,658	$ 22,982	$ 22,326	$ 21,688	$ 21,068	$ 242,412	$ 19,881	$ 19,313	$ 18,762	$ 18,226	$ 17,705	$ 17,199	$ 16,708	$ 112,522	$ 15,766	$ 15,316	$ 14,878	$ 14,453	$ 14,040	$ 13,639	$ 13,250

AINLEY: 115157
MODIFIED CONVENTIONAL ACTIVATED SLUDGE PROCESS

2098
$ -
$ -
$ 58,570
$ 72,270
$ 130,840
$ 12,871
$ 130,840
$ 637,903
$ 12,871

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
SEQUENCING BATCH REACTOR PROCESS

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering and Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	Phase 1					Phase 2				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Sequencing Batch Reactor										
Packaged SBR System, including:	1	$ 730,700	$ 730,700	60%	$ 1,169,120	1	$ 404,000	$ 404,000	60%	$ 646,400
Blowers										
Decanting system										
Mixers										
Aeration piping, valves, and diffusers										
RAS & WAS Pumps										
Decanter Air Compressor										
Equalization Pumps	2	$ 30,120	$ 60,240	60%	$ 96,384	1	$ 30,120	$ 30,120	60%	$ 48,192
Chemical Dosing										$ -
Chemical Storage Tanks	2	$ 22,200	$ 44,400	60%	$ 71,040	1	$ 22,200	$ 22,200	60%	$ 35,520
Day Tanks	1	$ 3,700	$ 3,700	60%	$ 5,920	1	$ 3,700	$ 3,700	60%	$ 5,920
Dosing Pumps (alum and carbon source)	4	$ 3,000	$ 12,000	60%	$ 19,200	2	$ 3,000	$ 6,000	60%	$ 9,600
Total Equipment Cost					$ 1,361,664					$ 745,632
CONSTRUCTION										
General			10%		$ 478,051	$ 1		10%		$ 249,254
Site Work (15% of Construction Costs)			15%		$ 717,076			15%		$ 373,881
Yard Piping (10% of Construction Costs)			10%		$ 478,051			10%		$ 249,254
SBR Tanks and Equalization Tanks	1	$ 2,494,652	$ 2,494,652	10%	$ 2,744,117	$ 1	$ 1,247,326	$ 1,247,326	10%	$ 1,372,059
Blower/ RAS/ WAS Building	1	$ 613,386	$ 613,386	10%	$ 674,725	$ 1	$ 340,770	$ 340,770	10%	$ 374,847
Total Construction Cost					$ 5,092,019					$ 2,619,294
Engineering & Contingency (25%)					$ 1,613,421					$ 841,231
Total Capital Cost					$ 8,067,104					$ 4,206,157

OPERATIONAL COST	Phase 1				Phase 2			
	Rating	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Blower Operation	1000	kWh/d	$ 0.11	$ 40,150.00	2000	kWh/d	$ 0.11	$ 80,300.00
WAS Pumps	6.5	kWh/d	$ 0.11	$ 260.98	10	kWh/d	$ 0.11	$ 391.46
RAS Pumps	75	kWh/d	$ 0.11	$ 3,011.25	112.5	kWh/d	$ 0.11	$ 4,516.88
Mixers	264	kWh/d	$ 0.11	$ 10,599.60	396	kWh/d	$ 0.11	$ 15,899.40
Air Compressor	12	kWh/d	$ 0.11	$ 481.80	18	kWh/d	$ 0.11	$ 722.70
Total Power Cost				$ 54,504				$ 101,830
Chemical Consumption								
Alum	33	kg/d	$ 4.00	$ 48,180	49.5	kg/d	$ 4.00	$ 72,270
Total Chemical Cost				$ 48,180				$ 72,270
Total Operational Costs				$ 102,684				$ 174,100

NPV CALCULATION	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
CAPITAL COSTS											
Equipment	$ 2,634,120			$ 510,624	$ 680,832	$ 510,624					
Construction Costs	$ 9,639,141			$ 1,909,507	$ 2,546,009	$ 1,909,507					
Major Equipment Replacement Cost	$ 5,268,240										
Total Capital Cost in 2017 Dollars	$ 17,541,501			$ 2,420,131	$ 3,226,841	$ 2,420,131	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 11,748,589	$ -	$ -	$ 2,283,813	$ 2,958,082	$ 2,155,174	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS											
Power Consumption Cost	$ 7,360,499						$ 54,504	$ 54,504	$ 54,504	$ 54,504	$ 54,504
Chemical Consumption Cost	$ 5,299,800						$ 48,180	$ 48,180	$ 48,180	$ 48,180	$ 48,180
Total Operational Cost in 2017 Dollars	$ 12,660,299						$ 102,684	$ 102,684	$ 102,684	$ 102,684	$ 102,684
Total Operational Cost NPV	$ 4,241,504			$ -	$ -	$ -	$ 88,829	$ 86,291	$ 83,826	$ 81,431	$ 79,104
Current Year Sub-total	$ 30,201,799			$ 2,420,131	$ 3,226,841	$ 2,420,131	$ 102,684	$ 102,684	$ 102,684	$ 102,684	$ 102,684
Inflation Adjusted	$ 62,195,758			$ 2,517,904	$ 3,424,350	$ 2,619,628	$ 113,371	$ 115,638	$ 117,951	$ 120,310	$ 122,716
NPV	**$ 15,990,093**			$ 2,283,813	$ 2,958,082	$ 2,155,174	$ 88,829	$ 86,291	$ 83,826	$ 81,431	$ 79,104

NPV CALCULATION	2028	2029	2030	2031	2032	2033	2034	2035	2036
CAPITAL COSTS									
Equipment	$ 279,612	$ 372,816	$ 279,612						
Construction Costs	$ 982,235	$1,309,647	$ 982,235						
Major Equipment Replacement Cost									
Total Capital Cost in 2017 Dollars	$ 1,261,847	$1,682,463	$ 1,261,847	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 944,312	$1,223,109	$ 891,122	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS									
Power Consumption Cost	$ 54,504	$ 54,504	$ 54,504	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830
Chemical Consumption Cost	$ 48,180	$ 48,180	$ 48,180	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
Total Operational Cost in 2017 Dollars	$ 102,684	$ 102,684	$ 102,684	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
Total Operational Cost NPV	$ 76,844	$ 74,648	$ 72,516	$ 119,438	$ 116,025	$ 112,710	$ 109,490	$ 106,362	$ 103,323
Current Year Sub-total	$ 1,364,531	$1,785,147	$ 1,364,531	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
Inflation Adjusted	$ 1,663,355	$2,219,605	$ 1,730,555	$ 225,217	$ 229,722	$ 234,316	$ 239,003	$ 243,783	$ 248,658
NPV	$ 1,021,156	$1,297,757	$ 963,638	$ 119,438	$ 116,025	$ 112,710	$ 109,490	$ 106,362	$ 103,323

AINLEY: 115157
SEQUENCING BATCH REACTOR PROCESS

2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830
$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
$ 100,371	$ 97,503	$ 94,717	$ 92,011	$ 89,382	$ 86,828	$ 84,347	$ 81,937	$ 79,596	$ 77,322	$ 75,113	$ 72,967	$ 70,882	$ 68,857	$ 66,890
$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
$ 253,631	$ 258,704	$ 263,878	$ 269,156	$ 274,539	$ 280,030	$ 285,630	$ 291,343	$ 297,170	$ 303,113	$ 309,175	$ 315,359	$ 321,666	$ 328,099	$ 334,661
$ 100,371	$ 97,503	$ 94,717	$ 92,011	$ 89,382	$ 86,828	$ 84,347	$ 81,937	$ 79,596	$ 77,322	$ 75,113	$ 72,967	$ 70,882	$ 68,857	$ 66,890

2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066
$ 1,702,080								$ 932,040						
$ 1,702,080	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 932,040	$ -	$ -	$ -	$ -	$ -	$ -
$ 635,257	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 275,862	$ -	$ -	$ -	$ -	$ -	$ -
$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830
$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
$ 64,978	$ 63,122	$ 61,318	$ 59,567	$ 57,865	$ 56,211	$ 54,605	$ 53,045	$ 51,530	$ 50,057	$ 48,627	$ 47,238	$ 45,888	$ 44,577	$ 43,303
$ 1,876,180	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 1,106,140	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
$ 3,678,582	$ 348,182	$ 355,145	$ 362,248	$ 369,493	$ 376,883	$ 384,421	$ 392,109	$ 2,541,075	$ 407,950	$ 416,109	$ 424,431	$ 432,920	$ 441,579	$ 450,410
$ 700,236	$ 63,122	$ 61,318	$ 59,567	$ 57,865	$ 56,211	$ 54,605	$ 53,045	$ 327,391	$ 50,057	$ 48,627	$ 47,238	$ 45,888	$ 44,577	$ 43,303

AINLEY: 115157
SEQUENCING BATCH REACTOR PROCESS

2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096
															$ 1,702,080								$ 932,040						
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,702,080	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 932,040	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 266,242	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 115,616	$ -	$ -	$ -	$ -	$ -	$ -
$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830	$ 101,830
$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270	$ 72,270
$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
$ 42,066	$ 40,864	$ 39,697	$ 38,563	$ 37,461	$ 36,390	$ 35,351	$ 34,341	$ 33,360	$ 32,406	$ 31,480	$ 30,581	$ 29,707	$ 28,859	$ 28,034	$ 27,233	$ 26,455	$ 25,699	$ 24,965	$ 24,252	$ 23,559	$ 22,886	$ 22,232	$ 21,596	$ 20,979	$ 20,380	$ 19,798	$ 19,232	$ 18,683	$ 18,149
$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 1,876,180	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 1,106,140	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100	$ 174,100
$ 459,418	$ 468,607	$ 477,979	$ 487,538	$ 497,289	$ 507,235	$ 517,380	$ 527,727	$ 538,282	$ 549,047	$ 560,028	$ 571,229	$ 582,653	$ 594,307	$ 606,193	$ 6,663,242	$ 630,683	$ 643,297	$ 656,162	$ 669,286	$ 682,671	$ 696,325	$ 710,251	$ 4,602,806	$ 738,945	$ 753,724	$ 768,799	$ 784,175	$ 799,858	$ 815,856
$ 42,066	$ 40,864	$ 39,697	$ 38,563	$ 37,461	$ 36,390	$ 35,351	$ 34,341	$ 33,360	$ 32,406	$ 31,480	$ 30,581	$ 29,707	$ 28,859	$ 28,034	$ 293,475	$ 26,455	$ 25,699	$ 24,965	$ 24,252	$ 23,559	$ 22,886	$ 22,232	$ 137,212	$ 20,979	$ 20,380	$ 19,798	$ 19,232	$ 18,683	$ 18,149

AINLEY: 115157
SEQUENCING BATCH REACTOR PROCESS

2097	2098
$ -	$ -
$ -	$ -
$ 101,830	$ 101,830
$ 72,270	$ 72,270
$ 174,100	$ 174,100
$ 17,630	$ 17,127
$ 174,100	$ 174,100
$ 832,173	$ 848,816
$ 17,630	$ 17,127

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
MEMBRANE BIOREACTOR

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering and Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	Phase 1					Phase 2				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Advance Primary Treatment System										
Primary Fine Filter	2	$ 425,000	$ 850,000	60%	$ 1,360,000	1	$ 425,000	$ 425,000	60%	$ 680,000
Membrane Bioreactor										$ -
Packaged Membrane System, including:	3	$ 527,100	$ 1,581,300	60%	$ 2,530,080	1	$ 527,100	$ 527,100	60%	$ 843,360
Membranes and Cartridges										$ -
Aeration Tank Blowers										$ -
Membrane Tank Blowers										$ -
Permeate Pumps										$ -
Air Compressors										$ -
RAS Pumps										$ -
Aeration piping, valves, and diffusers										$ -
										$ -
Chemical Dosing										$ -
Chemical Storage Tanks	2	$ 22,200	$ 44,400	60%	$ 71,040	1	$ 11,100	$ 11,100	60%	$ 17,760
Day Tanks	2	$ 3,700	$ 7,400	60%	$ 11,840	1	$ 1,850	$ 1,850	60%	$ 2,960
Dosing Pumps (included in Membrane Package)										
Total Equipment Cost					$ 3,972,960					$ 1,544,080
CONSTRUCTION										
General			10%		$ 845,504	$ 1		10%		$ 378,512
Site Work			15%		$ 1,268,255			15%		$ 567,768
Yard Piping			10%		$ 845,504			10%		$ 378,512
Bioreactor (AerationTank)	1	$ 1,687,200	$ 1,687,200	10%	$ 1,855,920	1	$ 843,600	$ 843,600	10%	$ 927,960
MembraneTanks	1	$ 1,287,014	$ 1,287,014	10%	$ 1,415,716	1	$ 643,507	$ 643,507	10%	$ 707,858
Blower Building (Blower, RAS & Permeate Pumps, Compressors)	1	$ 630,000	$ 630,000	10%	$ 693,000	1	$ 315,000	$ 315,000	10%	$ 346,500
Primary Filter Building (Cost to Increase size of Headworks Building)	1	$ 470,400	$ 470,400	10%	$ 517,440	1	$ 235,200	$ 235,200	10%	$ 258,720
Total Construction Cost					$ 7,441,338					$ 3,565,829
Engineering & Contingency (25%)					$ 2,853,575					$ 1,277,477
Total Capital Cost					$ 14,267,873					$ 6,387,386

OPERATIONAL COST	Phase 1				Phase 2			
	Rating	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Primary Fine Filter	175	kWh/d	$ 0.11	$ 7,026.25	88	kWh/d	$ 0.11	353320%
Aeration Tank Blowers	613	kWh/d	$ 0.11	$ 24,611.95	919	kWh/d	$ 0.11	$ 36,897.85
Membrane Tank Blowers	208	kWh/d	$ 0.11	$ 8,351.20	312	kWh/d	$ 0.11	$ 12,526.80
Permeate Pumps	53	kWh/d	$ 0.11	$ 2,127.95	26	kWh/d	$ 0.11	$ 1,043.90
RAS Pumps	379	kWh/d	$ 0.11	$ 15,216.85	569	kWh/d	$ 0.11	$ 22,845.35
Air Compressors	3	kWh/d	$ 0.11	$ 120.45	4	kWh/d	$ 0.11	$ 160.60
Total Power Cost				$ 57,455				$ 77,008
Chemical Consumption								
NaOCl	21	kg/d	$ 0.60	$ 4,599.00	$ 31	kg/d	$ 0.60	$ 6,789.00
Citric Acid	17	kg/d	$ 1	$ 8,067	$ 26	kg/d	$ 1	$ 12,337
Alum	358	kg/d	$ 4	$ 522,680	$ 6	kg/d	$ 4	$ 8,760
Total Chemical Cost				$ 535,346				$ 27,886
Total Operational Cost				$ 592,800				$ 104,894

NPV CALCULATION	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
CAPITAL COSTS												
Equipment	$ 6,896,300			$ 1,489,860	$ 1,986,480	$ 1,489,860						$ 579,030
Construction Costs	$ 13,758,959			$ 2,790,502	$ 3,720,669	$ 2,790,502						$ 1,337,186
Major Equipment Replacement Cost	$ 13,792,600											
Total Capital Cost in 2017 Dollars	$ 34,447,859			$ 4,280,362	$ 5,707,149	$ 4,280,362	$ -	$ -	$ -	$ -	$ -	$ 1,916,216
Total Capital Cost NPV	$ 21,168,471	$ -	$ -	$ 4,039,264	$ 5,231,809	$ 3,811,746	$ -	$ -	$ -	$ -	$ -	$ 1,434,013
OPERATIONAL COSTS												
Power Consumption Cost	$ 5,696,161						$ 57,455	$ 57,455	$ 57,455	$ 57,455	$ 57,455	$ 57,455
Chemical Consumption Cost	$ 6,179,012						$ 535,346	$ 535,346	$ 535,346	$ 535,346	$ 535,346	$ 535,346
Membrane Replacement Cost (1/10 years)	$ 2,812,000											
Total Operational Cost in 2017 Dollars	$ 14,687,173			$ -	$ -	$ -	$ 592,800	$ 592,800	$ 592,800	$ 592,800	$ 592,800	$ 592,800
Total Operational Cost NPV	$ 6,850,236			$ -	$ -	$ -	$ 512,817	$ 498,165	$ 483,932	$ 470,105	$ 456,674	$ 443,626
Current Year Sub-total	$ 49,135,032			$ 4,280,362	$ 5,707,149	$ 4,280,362	$ 592,800	$ 592,800	$ 592,800	$ 592,800	$ 592,800	$ 2,509,016
Inflation Adjusted	$ 94,796,031			$ 4,453,289	$ 6,056,472	$ 4,633,201	$ 654,499	$ 667,589	$ 680,941	$ 694,560	$ 708,451	$ 3,058,477
NPV	**$ 28,018,707**			$ 4,039,264	$ 5,231,809	$ 3,811,746	$ 512,817	$ 498,165	$ 483,932	$ 470,105	$ 456,674	$1,877,639

NPV CALCULATION	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
CAPITAL COSTS										
Equipment	$ 772,040	$ 579,030								
Construction Costs	$ 1,782,915	$ 1,337,186								
Major Equipment Replacement Cost										
Total Capital Cost in 2017 Dollars	$ 2,554,955	$ 1,916,216	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 1,857,389	$ 1,353,240	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS										
Power Consumption Cost	$ 57,455	$ 57,455	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008
Chemical Consumption Cost	$ 535,346	$ 535,346	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886
Membrane Replacement Cost (1/10 years)				$ 348,000						
Total Operational Cost in 2017 Dollars	$ 592,800	$ 592,800	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894
Total Operational Cost NPV	$ 430,951	$ 418,638	$ 71,960	$ 301,820	$ 67,907	$ 65,966	$ 64,082	$ 62,251	$ 60,472	$ 58,744
Current Year Sub-total	$ 3,147,755	$ 2,509,016	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894
Inflation Adjusted	$ 3,913,837	$ 3,182,039	$ 135,691	$ 597,584	$ 141,173	$ 143,997	$ 146,877	$ 149,814	$ 152,810	$ 155,867
NPV	$ 2,288,340	$ 1,771,878	$ 71,960	$ 301,820	$ 67,907	$ 65,966	$ 64,082	$ 62,251	$ 60,472	$ 58,744

AINLEY: 115157
MEMBRANE BIOREACTOR

2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
													$ 4,966,200
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,966,200
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,853,505
$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008
$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886
	$ 268,000		$ 348,000								$ 268,000		
$ 104,894	$ 372,894	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 372,894	$ 104,894	$ 104,894
$ 57,066	$ 197,072	$ 53,852	$ 225,869	$ 50,818	$ 49,366	$ 47,956	$ 46,586	$ 45,255	$ 43,962	$ 42,706	$ 147,480	$ 40,300	$ 39,149
$ 104,894	$ 372,894	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 372,894	$ 104,894	$ 5,071,094
$ 158,984	$ 576,486	$ 165,407	$ 728,451	$ 172,089	$ 175,531	$ 179,042	$ 182,622	$ 186,275	$ 190,000	$ 193,800	$ 702,733	$ 201,630	$ 9,942,772
$ 57,066	$ 197,072	$ 53,852	$ 225,869	$ 50,818	$ 49,366	$ 47,956	$ 46,586	$ 45,255	$ 43,962	$ 42,706	$ 147,480	$ 40,300	$ 1,892,654

2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
							$ 1,930,100							
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,930,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 571,263	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008
$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886
									$ 348,000					
$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894
$ 38,030	$ 36,944	$ 35,888	$ 34,863	$ 33,867	$ 32,899	$ 31,959	$ 31,046	$ 30,159	$ 126,495	$ 28,460	$ 27,647	$ 26,857	$ 26,090	$ 25,344
$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 2,034,994	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894
$ 209,776	$ 213,971	$ 218,251	$ 222,616	$ 227,068	$ 231,609	$ 236,242	$ 4,674,878	$ 245,786	$ 1,082,440	$ 255,716	$ 260,830	$ 266,046	$ 271,367	$ 276,795
$ 38,030	$ 36,944	$ 35,888	$ 34,863	$ 33,867	$ 32,899	$ 31,959	$ 602,310	$ 30,159	$ 126,495	$ 28,460	$ 27,647	$ 26,857	$ 26,090	$ 25,344

AINLEY
MEMBRANE BIORE

2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082
														$ 4,966,200
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,966,200
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 776,819
$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008
$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886
		$ 268,000		$ 348,000								$ 268,000		
$ 104,894	$ 104,894	$ 372,894	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 372,894	$ 104,894	$ 104,894
$ 24,620	$ 23,917	$ 82,594	$ 22,570	$ 94,664	$ 21,298	$ 20,690	$ 20,099	$ 19,525	$ 18,967	$ 18,425	$ 17,898	$ 61,810	$ 16,890	$ 16,408
$ 104,894	$ 104,894	$ 372,894	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 372,894	$ 104,894	$ 5,071,094
$ 282,331	$ 287,977	$ 1,044,225	$ 299,612	$ 1,319,488	$ 311,716	$ 317,950	$ 324,309	$ 330,795	$ 337,411	$ 344,159	$ 351,043	$ 1,272,904	$ 365,225	$ 18,009,955
$ 24,620	$ 23,917	$ 82,594	$ 22,570	$ 94,664	$ 21,298	$ 20,690	$ 20,099	$ 19,525	$ 18,967	$ 18,425	$ 17,898	$ 61,810	$ 16,890	$ 793,227

2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
							$ 1,930,100								
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,930,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 239,421	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008	$ 77,008
$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886	$ 27,886
									$ 348,000						
$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894
$ 15,939	$ 15,483	$ 15,041	$ 14,611	$ 14,194	$ 13,788	$ 13,394	$ 13,012	$ 12,640	$ 53,015	$ 11,928	$ 11,587	$ 11,256	$ 10,934	$ 10,622	$ 10,319
$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 2,034,994	$ 104,894	$ 452,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894	$ 104,894
$ 379,980	$ 387,579	$ 395,331	$ 403,238	$ 411,302	$ 419,528	$ 427,919	$ 8,467,894	$ 445,207	$ 1,960,690	$ 463,193	$ 472,457	$ 481,906	$ 491,544	$ 501,375	$ 511,403
$ 15,939	$ 15,483	$ 15,041	$ 14,611	$ 14,194	$ 13,788	$ 13,394	$ 252,433	$ 12,640	$ 53,015	$ 11,928	$ 11,587	$ 11,256	$ 10,934	$ 10,622	$ 10,319

: 115157
EACTOR

Appendix B
Life Cycle Cost Evaluation of Tertiary Treatment Alternatives

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
ADSORPTIVE DEEP BED FILTERS (BluePro)

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	**Phase 1**					**Phase 2**				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
Ultra-Filtration Package										
Filtration System										
Air Compressors (sized for Phase 2)	1	$ 1,700,000	$ 1,700,000	60%	$ 2,720,000	1	$ 625,000	$ 625,000	60%	$ 1,000,000
Media										
Instrumentation and control										
Chemical Dosing (Ferric Oxide)										$ -
Chemical Storage Tanks	7	$ 115,000	$ 805,000	60%	$ 1,288,000	6	$ 115,000	$ 690,000	60%	$ 1,104,000
Chemical Day Tanks	2	$ 3,700	$ 7,400	60%	$ 11,840	2	$ 3,700	$ 7,400	60%	$ 11,840
Dosing System skids (Part of Filtration Package)										
Total Equipment Cost					$ 4,019,840					$ 2,115,840
CONSTRUCTION										
General		10%			$ 539,933		10%			$ 280,558
Site Work		15%			$ 809,899		15%			$ 420,837
Yard Piping		10%			$ 539,933		10%			$ 280,558
Tertiary Treatment Building & Filter Structure	1	$ 1,254,078	$ 1,254,078	10%	$ 1,379,486	1	$ 627,039	$ 627,039	10%	$ 689,743
Total Construction Cost					$ 3,269,250					$ 1,671,697
Engineering & Contingency (25%)					$ 1,822,272					$ 946,884
Total Capital Cost					$ 9,111,362					$ 4,734,421

OPERATIONAL COST	**Phase 1**				**Phase 2**			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Compressor Operation	528	kWh/d	$ 0.11	$ 21,199	$ 792	kWh/d	$ 0.11	$ 31,799
Dosing Pumps	24	kWh/d	$ 0.11	$ 964	$ 36	kWh/d	$ 0.11	$ 1,445
Total Power Cost				$ 22,163				$ 33,244
Chemical Consumption								
Hydrous Ferric Oxide	977	kg/d	$ 0.39	$ 140,700	$ 1,465	kg/d	$ 0.39	$ 208,534.02
Total Chemical Cost				$ 140,700				$ 208,534
Total Operational Cost				$ 162,862				$ 241,778

NPV CALCULATION	**Total**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
CAPITAL COSTS																	
Equipment	$ 7,669,600			$ 1,507,440	$ 2,009,920	$ 1,507,440						$ 793,440	$ 1,057,920	$ 793,440			
Construction Costs	$ 6,176,183			$ 1,225,969	$ 1,634,625	$ 1,225,969						$ 626,886	$ 835,848	$ 626,886			
Major Equipment Replacement Cost	$ 15,339,200																
Total Capital Cost in 2017 Dollars	$ 29,184,983			$ 2,733,409	$ 3,644,545	$ 2,733,409	$ -	$ -	$ -	$ -	$ -	$ 1,420,326	$ 1,893,768	$ 1,420,326	$ -	$ -	$ -
Total Capital Cost NPV	$ 15,569,506	$ -	$ -	$ 2,579,445	$ 3,340,996	$ 2,434,154	$ -	$ -	$ -	$ -	$ -	$ 1,062,911	$ 1,376,723	$ 1,003,041	$ -	$ -	$ -
OPERATIONAL COSTS																	
Power Consumption Cost	$ 2,437,908						$ 22,163	$ 22,163	$ 22,163	$ 22,163	$ 22,163	$ 22,163	$ 22,163	$ 22,163	$ 33,244	$ 33,244	$ 33,244
Chemical Consumption Cost	$ 15,305,910						$ 140,700	$ 140,700	$ 140,700	$ 140,700	$ 140,700	$ 140,700	$ 140,700	$ 140,700	$ 208,534	$ 208,534	$ 208,534
Air Lift Pump Replacement Cost (1/5 years)	$ 60,000										$ 2,500			-		$ 2,500	
Total Operational Cost in 2014 Dollars	$ 17,803,818			$ -	$ -	$ -	$ 162,862	$ 162,862	$ 162,862	$ 162,862	$ 165,362	$ 162,862	$ 162,862	$ 162,862	$ 241,778	$ 244,278	$ 241,778
Total Operational Cost NPV	$ 6,037,154			$ -	$ -	$ -	$ 140,888	$ 136,863	$ 132,953	$ 129,154	$ 127,390	$ 121,879	$ 118,397	$ 115,014	$ 165,866	$ 162,793	$ 156,524
Current Year Sub-total	$ 46,988,802			$ 2,733,409	$ 3,644,545	$ 2,733,409	$ 162,862	$ 162,862	$ 162,862	$ 162,862	$ 165,362	$ 1,583,189	$ 2,056,631	$ 1,583,189	$ 241,778	$ 244,278	$ 241,778
Inflation Adjusted	$ 106,515,117			$ 2,843,838	$ 3,867,620	$ 2,958,729	$ 179,813	$ 183,410	$ 187,078	$ 190,819	$ 197,623	$ 1,929,898	$ 2,557,162	$ 2,007,866	$ 312,766	$ 322,320	$ 325,402
NPV	**$ 21,606,660**			$ 2,579,445	$ 3,340,996	$ 2,434,154	$ 140,888	$ 136,863	$ 132,953	$ 129,154	$ 127,390	$ 1,184,790	$ 1,495,120	$ 1,118,055	$ 165,866	$ 162,793	$ 156,524

Notes:
Equipment and Construction costs spread out over a 3-year construction period in 30%-40%-30% split for both Phases

AINLEY: 115157
ADSORPTIVE DEEP BED FILTERS (BluePro)

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244
$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534
	$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500		$ 2,500
$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278
$ 152,052	$ 149,235	$ 143,487	$ 140,829	$ 135,405	$ 131,536	$ 129,099	$ 124,127	$ 121,828	$ 117,136	$ 113,789	$ 111,681	$ 107,380	$ 105,390
$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278
$ 331,910	$ 342,048	$ 345,319	$ 355,867	$ 359,270	$ 366,455	$ 377,649	$ 381,260	$ 392,906	$ 396,663	$ 404,596	$ 416,955	$ 420,942	$ 433,800
$ 152,052	$ 149,235	$ 143,487	$ 140,829	$ 135,405	$ 131,536	$ 129,099	$ 124,127	$ 121,828	$ 117,136	$ 113,789	$ 111,681	$ 107,380	$ 105,390

2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
				$ 5,024,800								$ 2,644,800
$ -	$ -	$ -	$ -	$ 5,024,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,644,800
$ -	$ -	$ -	$ -	$ 1,875,376	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 782,798
$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244
$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534
		$ 2,500					$ 2,500		$ 2,500			
$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 241,778
$ 101,331	$ 98,436	$ 96,612	$ 92,892	$ 90,237	$ 87,659	$ 85,155	$ 83,577	$ 80,358	$ 78,869	$ 75,832	$ 73,665	$ 71,561
$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 5,266,578	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 2,886,578
$ 437,948	$ 446,707	$ 460,352	$ 464,754	$ 10,326,054	$ 483,530	$ 493,200	$ 508,266	$ 513,126	$ 528,800	$ 533,856	$ 544,533	$ 6,631,176
$ 101,331	$ 98,436	$ 96,612	$ 92,892	$ 1,965,614	$ 87,659	$ 85,155	$ 83,577	$ 80,358	$ 78,869	$ 75,832	$ 73,665	$ 854,358

AINLEY: 115157
ADSORPTIVE DEEP BED FILTERS (BluePro)

2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085
																					$ 5,024,800			
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,024,800	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 785,986	$ -	$ -	$ -
$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244
$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534
	$ 2,500			$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500					$ 2,500
$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 241,778	$ 241,778	$ 244,278
$ 69,516	$ 68,228	$ 65,600	$ 63,726	$ 62,545	$ 60,137	$ 59,022	$ 56,749	$ 55,128	$ 54,107	$ 52,023	$ 51,059	$ 49,093	$ 47,690	$ 46,806	$ 45,004	$ 44,170	$ 42,469	$ 41,255	$ 40,491	$ 38,932	$ 37,819	$ 36,739	$ 35,689	$ 35,028
$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 5,266,578	$ 241,778	$ 241,778	$ 244,278
$ 566,532	$ 583,838	$ 589,420	$ 601,208	$ 619,573	$ 625,497	$ 644,604	$ 650,767	$ 663,783	$ 684,059	$ 690,600	$ 711,695	$ 718,500	$ 732,870	$ 755,257	$ 762,478	$ 785,769	$ 793,282	$ 809,147	$ 833,864	$ 841,837	#########	$ 875,847	$ 893,364	$ 920,654
$ 69,516	$ 68,228	$ 65,600	$ 63,726	$ 62,545	$ 60,137	$ 59,022	$ 56,749	$ 55,128	$ 54,107	$ 52,023	$ 51,059	$ 49,093	$ 47,690	$ 46,806	$ 45,004	$ 44,170	$ 42,469	$ 41,255	$ 40,491	$ 38,932	$ 823,805	$ 36,739	$ 35,689	$ 35,028

AINLEY: 115157
ADSORPTIVE DEEP BED FILTERS (BluePro)

2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
				$ 2,644,800								
$ -	$ -	$ -	$ -	$ 2,644,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ 328,077	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244	$ 33,244
$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534	$ 208,534
	$ 2,500					$ 2,500			$ 2,500		$ 2,500	
$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778
$ 33,679	$ 33,055	$ 31,782	$ 30,874	$ 29,992	$ 29,135	$ 28,595	$ 27,494	$ 26,708	$ 26,213	$ 25,204	$ 24,737	$ 23,784
$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 2,886,578	$ 241,778	$ 244,278	$ 241,778	$ 241,778	$ 244,278	$ 241,778	$ 244,278	$ 241,778
$ 929,456	$ 957,848	$ 967,006	$ 986,346	#########	$ 1,026,195	$ 1,057,542	$ 1,067,653	$ 1,089,006	$ 1,122,272	$ 1,133,002	$ 1,167,611	$ 1,178,775
$ 33,679	$ 33,055	$ 31,782	$ 30,874	$ 358,069	$ 29,135	$ 28,595	$ 27,494	$ 26,708	$ 26,213	$ 25,204	$ 24,737	$ 23,784

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
TWO-STAGE UPFLOW SAND FILTERS (DynaSand)

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	Phase 1					Phase 2				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Upflow Sand Filter										
Filtration System										
3 Air Lift Pumps and Compressors	1	$ 659,537	$ 659,537	60%	$ 1,055,258	1	$ 659,537	$ 659,537	60%	$ 1,055,258
Process valves and piping										
Instrumentation and control	1	$ 12,124	$ 12,124	60%	$ 19,398	1	$ 12,124	$ 12,124	60%	$ 19,398
Chemical Dosing										$ -
Chemical Storage Tanks	6	$ 115,000	$ 690,000	60%	$ 1,104,000	5	$ 115,000	$ 575,000	60%	$ 920,000
Chemical Day Tanks	2	$ 3,700	$ 7,400	60%	$ 11,840	2	$ 3,700	$ 7,400	60%	$ 11,840
Dosing Pump skids	1	$ 15,000	$ 15,000	60%	$ 24,000	1	$ 15,000	$ 15,000	60%	$ 24,000
Total Equipment Cost					$ 2,214,497					$ 2,030,497
CONSTRUCTION										
General		10%			$ 313,415		10%			$ 47,167
Site Work		15%			$ 470,123		15%			$ 70,750
Yard Piping		10%			$ 313,415		10%			$ 47,167
Tertiary Treatment Building & Filter Structure	1	$ 836,052	$ 836,052	10%	$ 919,657	1	$ 418,026	$ 418,026	10%	$ 459,829
Total Construction Cost					$ 2,016,611					$ 624,913
Engineering & Contingency (25%)					$ 1,057,777					$ 663,852
Total Capital Cost					$ 5,288,885					$ 3,319,262

OPERATIONAL COST	Phase 1				Phase 2			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Compressor/ Airlift Pumps Operation	268	kWh/d	$ 0.11	$ 10,778	403	kWh/d	$ 0.11	$ 16,168
Dosing Pumps	24	kWh/d	$ 0.11	$ 964	36	kWh/d	$ 0.11	$ 1,445
Total Power Cost				$ 11,742				$ 17,613
Chemical Consumption								
Ferric Chloride	862	kg/d	$ 0.59	$ 186,851	1293	kg/d	$ 0.59	$ 280,276
Total Chemical Cost				$ 186,851				$ 280,276
Total Operational Cost				$ 198,593				$ 297,889

NPV Calculation	Total	2018	2019	2020	2021	2022	2023	2024	2025
CAPITAL COSTS									
Equipment	$ 5,306,241			$ 830,436	$ 1,107,248	$ 830,436			
Construction Costs	$ 3,301,905			$ 756,229	$ 1,008,306	$ 756,229			
Major Equipment Replacement Cost	$ 10,612,483								
Total Capital Cost in 2014 Dollars	$ 19,220,629			$ 1,586,665	$ 2,115,554	$ 1,586,665	$ -	$ -	$ -
Total Capital Cost NPV	$ 9,795,421	$ -	$ -	$ 1,497,294	$ 1,939,352	$ 1,412,957	$ -	$ -	$ -
OPERATIONAL COSTS									
Power Consumption Cost	$ 1,591,034						$ 11,742	$ 11,742	$ 11,742
Chemical Consumption Cost	$ 20,553,588						$ 186,851	$ 186,851	$ 186,851
Air Lift Pump Replacement Cost (1/5 years)	$ 60,000								
Total Operational Cost in 2014 Dollars	$ 22,204,622			$ -	$ -	$ -	$ 198,593	$ 198,593	$ 198,593
Total Operational Cost NPV	$ 7,511,670			$ -	$ -	$ -	$ 171,798	$ 166,889	$ 162,121
Current Year Sub-total	$ 41,425,251			$ 1,586,665	$ 2,115,554	$ 1,586,665	$ 198,593	$ 198,593	$ 198,593
Inflation Adjusted	$ 99,041,440			$ 1,650,767	$ 2,245,043	$ 1,717,458	$ 219,262	$ 223,648	$ 228,121
NPV	**$ 17,307,091**			$ 1,497,294	$ 1,939,352	$ 1,412,957	$ 171,798	$ 166,889	$ 162,121

NPV Calculation	2026	2027	2028	2029	2030	2031	2032
CAPITAL COSTS							
Equipment			$ 761,436	$ 1,015,248	$ 761,436		
Construction Costs			$ 234,342	$ 312,456	$ 234,342		
Major Equipment Replacement Cost							
Total Capital Cost in 2014 Dollars	$ -	$ -	$ 995,778	$ 1,327,705	$ 995,778	$ -	$ -
Total Capital Cost NPV	$ -	$ -	$ 745,198	$ 965,208	$ 703,223	$ -	$ -
OPERATIONAL COSTS							
Power Consumption Cost	$ 11,742	$ 11,742	$ 11,742	$ 11,742	$ 11,742	$ 22,016	$ 22,016
Chemical Consumption Cost	$ 186,851	$ 186,851	$ 186,851	$ 186,851	$ 186,851	$ 280,276	$ 280,276
Air Lift Pump Replacement Cost (1/5 years)		$ 2,500			-		$ 2,500
Total Operational Cost in 2014 Dollars	$ 198,593	$ 201,093	$ 198,593	$ 198,593	$ 198,593	$ 302,292	$ 304,792
Total Operational Cost NPV	$ 157,489	$ 154,915	$ 148,618	$ 144,372	$ 140,247	$ 207,381	$ 203,122
Current Year Sub-total	$ 198,593	$ 201,093	$ 1,194,371	$ 1,526,297	$ 1,194,371	$ 302,292	$ 304,792
Inflation Adjusted	$ 232,683	$ 240,324	$ 1,455,932	$ 1,897,759	$ 1,514,751	$ 391,047	$ 402,167
NPV	$ 157,489	$ 154,915	$ 893,816	$ 1,109,580	$ 843,470	$ 207,381	$ 203,122

Notes:
Equipment and Construction costs spread out over a 3-year construction period in 30%-40%-30% split for both Phases

2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059
																			$ 2,768,121							
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,768,121	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,033,129	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016
$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276
		$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500					$ 2,500		$ 2,500		
$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292
$ 195,700	$ 190,108	$ 186,204	$ 179,400	$ 175,716	$ 169,295	$ 164,458	$ 161,081	$ 155,195	$ 152,007	$ 146,453	$ 142,269	$ 139,347	$ 134,255	$ 131,498	$ 126,693	$ 123,073	$ 120,546	$ 116,141	$ 112,823	$ 109,599	$ 106,468	$ 104,281	$ 100,471	$ 98,407	$ 94,812	$ 92,103
$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 3,070,413	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292
$ 406,846	$ 414,983	$ 426,783	$ 431,748	$ 444,025	$ 449,191	$ 458,174	$ 471,203	$ 476,685	$ 490,239	$ 495,943	$ 505,861	$ 520,246	$ 526,298	$ 541,264	$ 547,561	$ 558,512	$ 574,394	$ 581,076	$ 6,020,085	$ 604,551	$ 616,642	$ 634,177	$ 641,555	$ 659,798	$ 667,474	$ 680,823
$ 195,700	$ 190,108	$ 186,204	$ 179,400	$ 175,716	$ 169,295	$ 164,458	$ 161,081	$ 155,195	$ 152,007	$ 146,453	$ 142,269	$ 139,347	$ 134,255	$ 131,498	$ 126,693	$ 123,073	$ 120,546	$ 116,141	$ 1,145,952	$ 109,599	$ 106,468	$ 104,281	$ 100,471	$ 98,407	$ 94,812	$ 92,103

2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084
$ 2,538,121																						$ 2,768,121		
$ 2,538,121	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,768,121	$ -	$ -
$ 751,223	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 432,993	$ -	$ -
$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016
$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276
		$ 2,500			$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500		$ 2,500			$ 2,500				
$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 302,292	$ 302,292
$ 89,471	$ 86,915	$ 85,130	$ 82,019	$ 79,676	$ 78,040	$ 75,188	$ 73,644	$ 70,953	$ 68,926	$ 67,510	$ 65,043	$ 63,708	$ 61,380	$ 59,626	$ 58,401	$ 56,268	$ 55,112	$ 53,098	$ 51,581	$ 50,522	$ 48,676	$ 47,285	$ 45,934	$ 44,622
$ 2,840,413	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 3,070,413	$ 302,292	$ 302,292
$ 6,525,123	$ 708,328	$ 728,470	$ 736,945	$ 751,684	$ 773,058	$ 782,052	$ 804,290	$ 813,646	$ 829,919	$ 853,519	$ 863,448	$ 888,001	$ 898,331	$ 916,298	$ 942,354	$ 953,317	$ 980,425	$ 991,831	$ 1,011,667	$ 1,040,434	$ 1,052,538	#########	$ 1,095,061	$ 1,116,962
$ 840,694	$ 86,915	$ 85,130	$ 82,019	$ 79,676	$ 78,040	$ 75,188	$ 73,644	$ 70,953	$ 68,926	$ 67,510	$ 65,043	$ 63,708	$ 61,380	$ 59,626	$ 58,401	$ 56,268	$ 55,112	$ 53,098	$ 51,581	$ 50,522	$ 48,676	$ 480,278	$ 45,934	$ 44,622

AINLEY: 115157
TWO-STAGE UPFLOW SAND FILTERS (DynaSand)

2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
					$ 2,538,121								
$ -	$ -	$ -	$ -	$ -	$ 2,538,121	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ 314,844	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016	$ 22,016
$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276	$ 280,276
$ 2,500		$ 2,500					$ 2,500			$ 2,500		$ 2,500	
$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292
$ 43,705	$ 42,108	$ 41,243	$ 39,736	$ 38,601	$ 37,498	$ 36,427	$ 35,679	$ 34,375	$ 33,393	$ 32,707	$ 31,512	$ 30,865	$ 29,737
$ 304,792	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 2,840,413	$ 302,292	$ 304,792	$ 302,292	$ 302,292	$ 304,792	$ 302,292	$ 304,792	$ 302,292
$ 1,148,724	$ 1,162,088	$ 1,195,132	$ 1,209,036	$ 1,233,217	#########	$ 1,283,039	$ 1,319,522	$ 1,334,873	$ 1,361,571	$ 1,400,288	$ 1,416,578	$ 1,456,859	$ 1,473,808
$ 43,705	$ 42,108	$ 41,243	$ 39,736	$ 38,601	$ 352,342	$ 36,427	$ 35,679	$ 34,375	$ 33,393	$ 32,707	$ 31,512	$ 30,865	$ 29,737

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
TERTIARY MEMBRANES

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

10%
15%
10%

CAPITAL COST	Phase 1					Phase 2				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Pre-Filters	2	$ 150,000	$ 300,000	60%	$ 480,000	$ 1	$ 150,000	$ 150,000	60%	$ 240,000
Tertiary Membrane Package										
UF System										
Instrumentation and control	1	$ 1,438,500	$ 1,438,500	60%	$ 2,301,600	1	$ 1,438,500	$ 1,438,500	60%	$ 2,301,600
Process valves and piping										
Chemical Dosing										
Chemical Storage Tanks	3	$ 115,000	$ 345,000	60%	$ 552,000	2	$ 115,000	$ 230,000	60%	$ 368,000
Dosing Pump skids *(Part of Tertiary Membrane Package)*										
Total Equipment Cost					$ 3,333,600					$ 2,909,600
CONSTRUCTION										
General		10%			$ 435,924		10%			$ 290,960
Site Work		15%			$ 653,886		15%			$ 436,440
Yard Piping		10%			$ 435,924		10%			$ 290,960
Tertiary Treatment Building (Sized for Phase 2 in Phase 1)	1	$ 932,400	$ 932,400	10%	$ 1,025,640	0	$ -	$ -		$ -
Total Construction Cost					$ 2,551,374					$ 1,018,360
Engineering & Contingency (25%)					$ 1,471,244					$ 981,990
Total Capital Cost					$ 7,356,218					$ 4,909,950

OPERATIONAL COST	Phase 1				Phase 2			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Feed Pumps	318	kWh/d	$ 0.11	$ 12,788	478	kWh/d	$ 0.11	$ 19,182
Membrane Blowers	77	kWh/d	$ 0.11	$ 3,100	116	kWh/d	$ 0.11	$ 4,650
Air Compressors	8	kWh/d	$ 0.11	$ 319	12	kWh/d	$ 0.11	$ 478
Backpulse and CIP Pumps	38	kWh/d	$ 0.11	$ 1,539	57	kWh/d	$ 0.11	$ 2,309
CIP Heater	21	kWh/d	$ 0.11	$ 827	31	kWh/d	$ 0.11	$ 1,241
Total Power Cost				$ 18,573				$ 27,859
Chemical Consumption								
Sodium Hypochlorite	21	L/d	$ 0.50	$ 3,785	31	L/d	$ 0.50	$ 5,677
Citric Acid	3	kg/d	$ 1.50	$ 1,637	4	kg/d	$ 1.50	$ 2,455
Sodium Bisulphite	6	kg/d	$ 1.00	$ 2,187	9	kg/d	$ 1.00	$ 3,280
Sodium Hydroxide	2	kg/d	$ 0.55	$ 351	3	kg/d	$ 0.55	$ 527
Ferric Chloride	358	kg/d	$ 0.59	$ 77,095	537	kg/d	$ 0.59	$ 115,643
Total Chemical Cost				$ 85,055				$ 127,582
Total Operational Cost				$ 103,627				$ 155,441

NPV CALCULATION	Total	2018	2019	2020	2021	2022	2023	2024	2025
CAPITAL COSTS									
Equipment	$ 7,804,000			$ 1,250,100	$ 1,666,800	$ 1,250,100			
Construction Costs	$ 4,462,168			$ 956,765	$ 1,275,687	$ 956,765			
Major Equipment Replacement Cost (@ 30 years)	$ 15,608,000								
Total Capital Cost in 2014 Dollars	$ 27,874,168			$ 2,206,865	$ 2,942,487	$ 2,206,865	$ -	$ -	$ -
Total Capital Cost NPV	$ 14,050,193	$ -	$ -	$ 2,082,560	$ 2,697,411	$ 1,965,257	$ -	$ -	$ -
OPERATIONAL COSTS									
Power Consumption Cost	$ 2,098,694			$ 18,573	$ 18,573	$ 18,573	$ 18,573	$ 18,573	$ 18,573
Chemical Consumption Cost	$ 9,611,188			$ 85,055	$ 85,055	$ 85,055	$ 85,055	$ 85,055	$ 85,055
Membrane Replacement Cost (1/10 years)	$ 2,732,400					-			
Total Operational Cost in 2014 Dollars	$ 14,442,282			$ 103,627	$ 103,627	$ 103,627	$ 103,627	$ 103,627	$ 103,627
Total Operational Cost NPV	$ 5,082,491			$ 97,790	$ 94,996	$ 92,282	$ 89,645	$ 87,084	$ 84,596
Current Year Sub-total	$ 42,316,449			$ 2,310,493	$ 3,046,114	$ 2,310,493	$ 103,627	$ 103,627	$ 103,627
Inflation Adjusted	$ 97,020,810			$ 2,403,836	$ 3,232,561	$ 2,500,951	$ 114,413	$ 116,701	$ 119,035
NPV	**$ 19,132,684**			$ 2,180,350	$ 2,792,408	$ 2,057,539	$ 89,645	$ 87,084	$ 84,596

NPV CALCULATION	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
CAPITAL COSTS											
Equipment			$ 1,091,100	$ 1,454,800	$ 1,091,100						
Construction Costs			$ 381,885	$ 509,180	$ 381,885						
Major Equipment Replacement Cost (@ 30 years)											
Total Capital Cost in 2014 Dollars	$ -	$ -	$ 1,472,985	$ 1,963,980	$ 1,472,985	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ -	$ -	$ 1,102,318	$ 1,427,765	$ 1,040,229	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS											
Power Consumption Cost	$ 18,573	$ 18,573	$ 18,573	$ 18,573	$ 18,573	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859
Chemical Consumption Cost	$ 85,055	$ 85,055	$ 85,055	$ 85,055	$ 85,055	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582
Membrane Replacement Cost (1/10 years)					-		$ 303,600				
Total Operational Cost in 2014 Dollars	$ 103,627	$ 103,627	$ 103,627	$ 103,627	$ 103,627	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441
Total Operational Cost NPV	$ 82,179	$ 79,831	$ 77,550	$ 75,334	$ 73,182	$ 106,637	$ 305,917	$ 100,630	$ 97,755	$ 94,962	$ 92,249
Current Year Sub-total	$ 103,627	$ 103,627	$ 1,576,612	$ 2,067,607	$ 1,576,612	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441
Inflation Adjusted	$ 121,416	$ 123,844	$ 1,921,882	$ 2,570,810	$ 1,999,526	$ 201,079	$ 605,695	$ 209,203	$ 213,387	$ 217,655	$ 222,008
NPV	$ 82,179	$ 79,831	$ 1,179,869	$ 1,503,099	$ 1,113,411	$ 106,637	$ 305,917	$ 100,630	$ 97,755	$ 94,962	$ 92,249

Notes:
Equipment and Construction costs spread out over a 3-year construction period in 30%-40%-30% split for both Phases

AINLEY: 115157
TERTIARY MEMBRANES

2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
															$ 4,167,000								$ 3,637,000							
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,167,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,637,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,555,225	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,076,465	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859
$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582
			$ 303,600		$ 303,600								$ 303,600												$ 303,600					
$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441
$ 89,613	$ 87,053	$ 84,566	$ 242,600	$ 79,802	$ 228,935	$ 75,307	$ 73,156	$ 71,066	$ 69,035	$ 67,063	$ 65,147	$ 63,285	$ 181,551	$ 59,721	$ 58,014	$ 56,357	$ 54,747	$ 53,182	$ 51,663	$ 50,187	$ 48,753	$ 47,360	$ 46,007	$ 44,692	$ 128,212	$ 42,175	$ 40,970	$ 39,799	$ 38,662	$ 37,558
$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 4,322,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 3,792,441	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441
$ 226,448	$ 230,977	$ 235,597	$ 709,668	$ 245,115	$ 738,338	$ 255,017	$ 260,118	$ 265,320	$ 270,626	$ 276,039	$ 281,560	$ 287,191	$ 865,081	$ 298,793	$ 8,474,906	$ 310,865	$ 317,082	$ 323,424	$ 329,892	$ 336,490	$ 343,220	$ 350,084	$ 8,712,164	$ 364,227	$ 1,097,132	$ 378,942	$ 386,521	$ 394,252	$ 402,137	$ 410,179
$ 89,613	$ 87,053	$ 84,566	$ 242,600	$ 79,802	$ 228,935	$ 75,307	$ 73,156	$ 71,066	$ 69,035	$ 67,063	$ 65,147	$ 63,285	$ 181,551	$ 59,721	$ 1,613,239	$ 56,357	$ 54,747	$ 53,182	$ 51,663	$ 50,187	$ 48,753	$ 47,360	$ 1,122,472	$ 44,692	$ 128,212	$ 42,175	$ 40,970	$ 39,799	$ 38,662	$ 37,558

AINLEY: 115157
TERTIARY MEMBRANES

2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859
$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582
		$ 303,600		$ 303,600								$ 303,600	
$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441
$ 36,485	$ 35,442	$ 101,676	$ 33,446	$ 95,949	$ 31,562	$ 30,660	$ 29,784	$ 28,933	$ 28,107	$ 27,303	$ 26,523	$ 76,090	$ 25,029
$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441
$ 418,383	$ 426,751	$ 1,285,465	$ 443,991	$ 1,337,398	$ 461,929	$ 471,167	$ 480,590	$ 490,202	$ 500,006	$ 510,006	$ 520,207	$ 1,566,975	$ 541,223
$ 36,485	$ 35,442	$ 101,676	$ 33,446	$ 95,949	$ 31,562	$ 30,660	$ 29,784	$ 28,933	$ 28,107	$ 27,303	$ 26,523	$ 76,090	$ 25,029

2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095
$ 4,167,000								$ 3,637,000					
$ 4,167,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,637,000	$ -	$ -	$ -	$ -	$ -
$ 651,807	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 451,155	$ -	$ -	$ -	$ -	$ -
$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859	$ 27,859
$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582	$ 127,582
										$ 303,600			
$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441
$ 24,314	$ 23,620	$ 22,945	$ 22,289	$ 21,652	$ 21,034	$ 20,433	$ 19,849	$ 19,282	$ 18,731	$ 53,735	$ 17,676	$ 17,171	$ 16,680
$ 4,322,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 155,441	$ 3,792,441	$ 155,441	$ 459,041	$ 155,441	$ 155,441	$ 155,441
$ 15,351,120	$ 563,088	$ 574,350	$ 585,837	$ 597,554	$ 609,505	$ 621,695	$ 634,129	$ 15,780,879	$ 659,748	$ 1,987,303	$ 686,401	$ 700,129	$ 714,132
$ 676,122	$ 23,620	$ 22,945	$ 22,289	$ 21,652	$ 21,034	$ 20,433	$ 19,849	$ 470,437	$ 18,731	$ 53,735	$ 17,676	$ 17,171	$ 16,680

AINLEY: 115157
TERTIARY MEMBRANES

2096	2097	2098
$ -	$ -	$ -
$ -	$ -	$ -
$ 27,859	$ 27,859	$ 27,859
$ 127,582	$ 127,582	$ 127,582
$ 155,441	$ 155,441	$ 155,441
$ 16,204	$ 15,741	$ 15,291
$ 155,441	$ 155,441	$ 155,441
$ 728,415	$ 742,983	$ 757,843
$ 16,204	$ 15,741	$ 15,291

Appendix C

Life Cycle Cost Evaluation of Disinfection System Alternatives

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
Chlorination/De-Chlorination

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	Phase 1					Phase 2				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Chemical Dosing System										
Chemical Storage Tanks	4.00	$ 30,000	$ 120,000	60%	$ 192,000	2.00	$ 30,000	$ 60,000	60%	$ 96,000
Dosing Pump skids (designed for Phase 2 flow in Phase 1)	2.00	$ 20,000	$ 40,000	60%	$ 64,000	0.00				
Total Equipment Cost					$ 256,000					$ 96,000
CONSTRUCTION										
General			10%		$ 73,149			10%		$ 33,379
Site Work			15%		$ 109,724			15%		$ 50,068
Yard Piping			10%		$ 73,149			10%		$ 33,379
Disinfection Building	1.00	$336,000	$ 336,000	10%	$ 369,600	1.00	$168,000	$ 168,000	10%	$ 184,800
Chlorine Contact Tank	1.00	$ 96,263.89	$ 96,264	10%	$ 105,890	1.00	$ 48,172.22	$ 48,172	10%	$ 52,989
Total Construciton Cost					$ 731,512					$ 354,616
Engineering & Contingency (25%)					$ 246,878					$ 112,654
Total Capital Cost					$ 1,234,390					$ 563,270

OPERATIONAL COST	Phase 1				Phase 2			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating/ Number	Units	Unit Cost	Yearly Cost
SYSTEM								
Power Consumption								
Chlorination Pump	6	kWh/d	$ 0.11	$ 241	9	kWh/d	$ 0.11	$ 361
De-Chlorination Pump	6	kWh/d	$ 0.11	$ 241	9	kWh/d	$ 0.11	$ 361
Total Power Cost				$ 482				$ 723
Chemical Consumption								
Sodium Hypochlorite	80	L/d	$ 0.50	$ 14,523	119	L/d	$ 0.50	$ 21,784
Sodium Bisulphite	18	Kg/d	$ 1.00	$ 6,703	28	Kg/d	$ 1.00	$ 10,055
Total Chemical Cost				$ 21,226				$ 31,839
Total Operational Cost				$ 21,708				$ 32,562

NPV Calculation	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
CAPITAL COSTS															
Equipment	$ 440,000			$ 96,000	$ 128,000	$ 96,000						$ 36,000	$ 48,000	$ 36,000	
Construction Costs	$ 1,357,660			$ 274,317	$ 365,756	$ 274,317						$ 132,981	$ 177,308	$ 132,981	
Major Equipment Replacement Cost	$ 880,000														
Total Capital Cost in 2018 Dollars	$ 2,677,660	$ -	$ -	$ 370,317	$ 493,756	$ 370,317	$ -	$ -	$ -	$ -	$ -	$ 168,981	$ 225,308	$ 168,981	$ -
Capital Costs Total NPV	$ 1,761,340	$ -	$ -	$ 349,458	$ 452,632	$ 329,775	$ -	$ -	$ -	$ -	$ -	$ 126,458	$ 163,793	$ 119,335	$ -
OPERATIONAL COSTS															
Chemical Consumption Cost	$ 2,398,526			$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 21,226	$ 31,839
Total Operational Cost in 2018 Dollars	$ 2,466,580	$ -	$ -	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 32,742
Operational Costs Total NPV	$ 873,499	$ -	$ -	$ 20,599	$ 20,010	$ 19,438	$ 18,883	$ 18,343	$ 17,819	$ 17,310	$ 16,816	$ 16,335	$ 15,869	$ 15,415	$ 22,462
Current Year Sub-total	$ 5,144,239	$ -	$ -	$ 392,145	$ 515,584	$ 392,145	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 21,828	$ 190,809	$ 247,136	$ 190,809	$ 32,742
Inflation Adjusted	$ 10,849,276	$ -	$ -	$ 407,988	$ 547,142	$ 424,470	$ 24,100	$ 24,582	$ 25,074	$ 25,575	$ 26,087	$ 232,595	$ 307,283	$ 241,992	$ 42,356
NPV	**$ 2,634,839**	$ -	$ -	$ 370,057	$ 472,642	$ 349,213	$ 18,883	$ 18,343	$ 17,819	$ 17,310	$ 16,816	$ 142,793	$ 179,662	$ 134,750	$ 22,462

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 21,820	$ 21,197	$ 20,591	$ 20,003	$ 19,431	$ 18,876	$ 18,337	$ 17,813	$ 17,304	$ 16,810	$ 16,329	$ 15,863	$ 15,410	$ 14,969
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 43,203	$ 44,067	$ 44,948	$ 45,847	$ 46,764	$ 47,699	$ 48,653	$ 49,626	$ 50,619	$ 51,631	$ 52,664	$ 53,717	$ 54,791	$ 55,887
$ 21,820	$ 21,197	$ 20,591	$ 20,003	$ 19,431	$ 18,876	$ 18,337	$ 17,813	$ 17,304	$ 16,810	$ 16,329	$ 15,863	$ 15,410	$ 14,969

2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059
						$ 320,000							
$ -	$ -	$ -	$ -	$ -	$ -	$ 320,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ 119,432	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 14,542	$ 14,126	$ 13,723	$ 13,330	$ 12,950	$ 12,580	$ 12,220	$ 11,871	$ 11,532	$ 11,202	$ 10,882	$ 10,571	$ 10,269	$ 9,976
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 352,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 57,005	$ 58,145	$ 59,308	$ 60,494	$ 61,704	$ 62,938	$ 691,613	$ 65,481	$ 66,790	$ 68,126	$ 69,489	$ 70,879	$ 72,296	$ 73,742
$ 14,542	$ 14,126	$ 13,723	$ 13,330	$ 12,950	$ 12,580	$ 131,652	$ 11,871	$ 11,532	$ 11,202	$ 10,882	$ 10,571	$ 10,269	$ 9,976

AINLEY: 115157
Chlorination/De-Chlorination

2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072
$ 120,000												
$ 120,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 35,517	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 9,691	$ 9,414	$ 9,145	$ 8,884	$ 8,630	$ 8,383	$ 8,144	$ 7,911	$ 7,685	$ 7,466	$ 7,252	$ 7,045	$ 6,844
$ 152,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 350,886	$ 76,721	$ 78,256	$ 79,821	$ 81,417	$ 83,045	$ 84,706	$ 86,401	$ 88,129	$ 89,891	$ 91,689	$ 93,523	$ 95,393
$ 45,208	$ 9,414	$ 9,145	$ 8,884	$ 8,630	$ 8,383	$ 8,144	$ 7,911	$ 7,685	$ 7,466	$ 7,252	$ 7,045	$ 6,844

2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085
									$ 320,000			
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 320,000	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,055	$ -	$ -	$ -
$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 6,648	$ 6,458	$ 6,274	$ 6,095	$ 5,920	$ 5,751	$ 5,587	$ 5,427	$ 5,272	$ 5,122	$ 4,975	$ 4,833	$ 4,695
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 352,742	$ 32,742	$ 32,742	$ 32,742
$ 97,301	$ 99,247	$ 101,232	$ 103,257	$ 105,322	$ 107,428	$ 109,577	$ 111,768	$ 114,004	$ 1,252,762	$ 118,609	$ 120,982	$ 123,401
$ 6,648	$ 6,458	$ 6,274	$ 6,095	$ 5,920	$ 5,751	$ 5,587	$ 5,427	$ 5,272	$ 55,176	$ 4,975	$ 4,833	$ 4,695

AINLEY: 115157
Chlorination/De-Chlorination

2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
				$ 120,000								
$ -	$ -	$ -	$ -	$ 120,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ 14,886	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839	$ 31,839
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 4,561	$ 4,431	$ 4,304	$ 4,181	$ 4,062	$ 3,945	$ 3,833	$ 3,723	$ 3,617	$ 3,514	$ 3,413	$ 3,316	$ 3,221
$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 152,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742	$ 32,742
$ 125,869	$ 128,387	$ 130,954	$ 133,573	$ 635,582	$ 138,970	$ 141,749	$ 144,584	$ 147,476	$ 150,425	$ 153,434	$ 156,503	$ 159,633
$ 4,561	$ 4,431	$ 4,304	$ 4,181	$ 18,947	$ 3,945	$ 3,833	$ 3,723	$ 3,617	$ 3,514	$ 3,413	$ 3,316	$ 3,221

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
UV Disinfection

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	**Phase 1**					**Phase 2**				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
UV3000Plus bank										
banks *modules per bank* *ALC* *baffles*	1.00	$ 162,144	$ 162,144	60%	$ 259,430	$ 4	$ 7,500	$ 30,000	60%	$ 48,000
lamps per module	48.00	$ 372	$ 17,856	60%	$ 28,570	32.00	$ 372	$ 11,904	60%	$ 19,046
Transformer (sized for Phase 2 in Phase 1)	1.00	$ 3,000	$ 3,000	60%	$ 4,800	0.00				
Total Equipment Cost					$ 292,800					$ 67,046
CONSTRUCTION										
General			10%		$ 30,169			10%		$ 7,297
Site Work			15%		$ 45,254			15%		$ 10,946
Yard Piping			10%		$ 30,169			10%		$ 7,297
UV Contact Tank	1.00	$ 8,082.56	$ 8,083	10%	$ 8,891	1.00	$ 5,388.38	$ 5,388	10%	$ 5,927
Total Construciton Cost					$ 114,483					$ 31,468
Engineering & Contingency (20%)					$ 101,821					$ 24,629
Total Capital Cost					$ 509,103					$ 123,143

OPERATIONAL COST	**Phase 1**				**Phase 2**			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating/ Number	Units	Unit Cost	Yearly Cost
SYSTEM								
Power Consumption								
Overall Power Consumption	77	kWh/d	$ 0.12	$ 3,364	115	kWh/d	$ 0.12	$ 5,046
Total Power Cost				$ 3,364				$ 5,046
Total Operational Cost				$ 3,364				$ 5,046

NPV Calculation	**Total**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
CAPITAL COSTS															
Equipment	$ 449,808			$ 109,800	$ 146,400	$ 109,800						$ 25,142	$ 33,523	$ 25,142	
Construction Costs	$ 182,438			$ 42,931	$ 57,241	$ 42,931						$ 11,800	$ 15,734	$ 11,800	
Major Equipment Replacement Cost	$ 899,616														
Total Capital Cost in 2018 Dollars	$ 1,531,862	$ -	$ -	$ 152,731	$ 203,641	$ 152,731	$ -	$ -	$ -	$ -	$ -	$ 36,943	$ 49,257	$ 36,943	$ -
Capital Costs Total NPV	$ 785,414	$ -	$ -	$ 144,128	$ 186,680	$ 136,010	$ -	$ -	$ -	$ -	$ -	$ 27,646	$ 35,809	$ 26,089	$ -
OPERATIONAL COSTS															
Power Consumption Cost	$ 370,022						$ 3,364	$ 3,364	$ 3,364	$ 3,364	$ 3,364	$ 3,364	$ 3,364	$ 3,364	$ 5,046
Lamp Replacement Cost (18/year)	$ 964,224						$ 6,696	$ 6,696	$ 6,696	$ 6,696	$ 6,696	$ 6,696	$ 6,696	$ 6,696	$ 13,392
Total Operational Cost in 2018 Dollars	$ 1,334,246	$ -	$ -	$ -	$ -	$ -	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 18,438
Operational Costs Total NPV	$ 444,083	$ -	$ -	$ -	$ -	$ -	$ 8,703	$ 8,454	$ 8,212	$ 7,978	$ 7,750	$ 7,528	$ 7,313	$ 7,104	$ 12,649
Current Year Sub-total	$ 2,866,109	$ -	$ -	$ 152,731	$ 203,641	$ 152,731	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 10,060	$ 47,003	$ 59,317	$ 47,003	$ 18,438
Inflation Adjusted	$ 6,739,448	$ -	$ -	$ 158,901	$ 216,106	$ 165,321	$ 11,107	$ 11,329	$ 11,556	$ 11,787	$ 12,022	$ 57,296	$ 73,753	$ 59,611	$ 23,851
NPV	**$ 1,229,497**	$ -	$ -	$ 144,128	$ 186,680	$ 136,010	$ 8,703	$ 8,454	$ 8,212	$ 7,978	$ 7,750	$ 35,175	$ 43,122	$ 33,194	$ 12,649

AINLEY: 115157
UV Disinfection

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058
																				$ 366,000						
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 366,000	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 136,600	$ -	$ -	$ -	$ -	$ -	$ -
$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046
$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392
$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438
$ 12,287	$ 11,936	$ 11,595	$ 11,264	$ 10,942	$ 10,630	$ 10,326	$ 10,031	$ 9,744	$ 9,466	$ 9,195	$ 8,933	$ 8,677	$ 8,429	$ 8,189	$ 7,955	$ 7,727	$ 7,507	$ 7,292	$ 7,084	$ 6,881	$ 6,685	$ 6,494	$ 6,308	$ 6,128	$ 5,953	$ 5,783
$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 384,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438
$ 24,328	$ 24,815	$ 25,311	$ 25,817	$ 26,334	$ 26,860	$ 27,398	$ 27,945	$ 28,504	$ 29,074	$ 29,656	$ 30,249	$ 30,854	$ 31,471	$ 32,101	$ 32,743	$ 33,397	$ 34,065	$ 34,747	$ 35,442	$ 753,758	$ 36,873	$ 37,611	$ 38,363	$ 39,130	$ 39,913	$ 40,711
$ 12,287	$ 11,936	$ 11,595	$ 11,264	$ 10,942	$ 10,630	$ 10,326	$ 10,031	$ 9,744	$ 9,466	$ 9,195	$ 8,933	$ 8,677	$ 8,429	$ 8,189	$ 7,955	$ 7,727	$ 7,507	$ 7,292	$ 7,084	$ 143,481	$ 6,685	$ 6,494	$ 6,308	$ 6,128	$ 5,953	$ 5,783

AINLEY: 115157
UV Disinfection

2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085
	$ 83,808																						$ 366,000			
$ -	$ 83,808	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 366,000	$ -	$ -	$ -
$ -	$ 24,805	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 57,250	$ -	$ -	$ -
$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046
$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392
$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438
$ 5,618	$ 5,457	$ 5,301	$ 5,150	$ 5,003	$ 4,860	$ 4,721	$ 4,586	$ 4,455	$ 4,328	$ 4,204	$ 4,084	$ 3,967	$ 3,854	$ 3,744	$ 3,637	$ 3,533	$ 3,432	$ 3,334	$ 3,239	$ 3,146	$ 3,056	$ 2,969	$ 2,884	$ 2,802	$ 2,722	$ 2,644
$ 18,438	$ 102,246	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 384,438	$ 18,438	$ 18,438	$ 18,438
$ 41,526	$ 234,884	$ 43,203	$ 44,067	$ 44,949	$ 45,848	$ 46,764	$ 47,700	$ 48,654	$ 49,627	$ 50,619	$ 51,632	$ 52,664	$ 53,718	$ 54,792	$ 55,888	$ 57,006	$ 58,146	$ 59,309	$ 60,495	$ 61,705	$ 62,939	$ 64,198	$ 1,365,328	$ 66,791	$ 68,127	$ 69,490
$ 5,618	$ 30,262	$ 5,301	$ 5,150	$ 5,003	$ 4,860	$ 4,721	$ 4,586	$ 4,455	$ 4,328	$ 4,204	$ 4,084	$ 3,967	$ 3,854	$ 3,744	$ 3,637	$ 3,533	$ 3,432	$ 3,334	$ 3,239	$ 3,146	$ 3,056	$ 2,969	$ 60,134	$ 2,802	$ 2,722	$ 2,644

AINLEY: 115157
UV Disinfection

2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
				$ 83,808								
$ -	$ -	$ -	$ -	$ 83,808	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ 10,396	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046	$ 5,046
$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392	$ 13,392
$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438
$ 2,568	$ 2,495	$ 2,424	$ 2,354	$ 2,287	$ 2,222	$ 2,158	$ 2,097	$ 2,037	$ 1,979	$ 1,922	$ 1,867	$ 1,814
$ 18,438	$ 18,438	$ 18,438	$ 18,438	$102,246	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438	$ 18,438
$ 70,879	$ 72,297	$ 73,743	$ 75,218	$425,459	$ 78,257	$ 79,822	$ 81,418	$ 83,046	$ 84,707	$ 86,402	$ 88,130	$ 89,892
$ 2,568	$ 2,495	$ 2,424	$ 2,354	$ 12,683	$ 2,222	$ 2,158	$ 2,097	$ 2,037	$ 1,979	$ 1,922	$ 1,867	$ 1,814

Appendix D

Life Cycle Cost Evaluation of Effluent Re-Oxygenation Alternatives

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
EFFLUENT RE-OXYGENATION

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	Phase 1					Phase 2				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Aeration Diffusers and Piping	1	$ 10,000	$ 10,000	50%	$ 15,000	1	$ 5,000	$ 5,000	50%	$ 7,500
(note: seondary treatment blowers will also supply air to this system)										
Chemical Dosing (not required)										$ -
	5		$ -	50%	$ -	5	$ -	$ -	50%	$ -
Total Equipment Cost					$ 15,000					$ 7,500
CONSTRUCTION										
General		10%			$ 3,414		10%			$ 1,516
Site Work		15%			$ 5,121		15%			$ 2,273
Yard Piping		10%			$ 3,414		10%			$ 1,516
Re-Oxygenation Tank	1	$ 17,400	$ 17,400	10%	$ 19,140	1	$ 6,960	$ 6,960	10%	$ 7,656
Total Construction Cost					$ 31,089					$ 12,961
Engineering & Contingency (25%)					$ 11,522					$ 5,115
Total Capital Cost					$ 57,611					$ 25,576

OPERATIONAL COST	Phase 1				Phase 2			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Blower (capacity added to aeration blowers)	8	kWh/d	$ 0.11	$ 301	$ 11	kWh/d	$ 0.11	$ 452
Total Power Cost				$ 301				$ 452
Chemical Consumption (not required)								
Total Chemical Cost				$ -				$ -
Total Operational Cost				$ 301				$ 452

NPV CALCULATION	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
CAPITAL COSTS																		
Equipment	$ 29,063			$ 5,625	$ 7,500	$ 5,625						$ 3,750	$ 3,750	$ 2,813				
Construction Costs	$ 55,062			$ 11,658	$ 15,545	$ 11,658						$ 4,860	$ 6,480	$ 4,860				
Major Equipment Replacement Cost	$ 28,125																	
Total Capital Cost in 2017 Dollars	$ 112,250			$ 17,283	$ 23,045	$ 17,283	$ -	$ -	$ -	$ -	$ -	$ 8,610	$ 10,230	$ 7,673	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 85,994	$ -	$ -	$ 16,310	$ 21,125	$ 15,391	$ -	$ -	$ -	$ -	$ -	$ 6,444	$ 7,437	$ 5,419	$ -	$ -	$ -	$ -
OPERATIONAL COSTS																		
Power Consumption Cost	$ 33,124						$ 301	$ 301	$ 301	$ 301	$ 301	$ 301	$ 301	$ 301	$ 452	$ 452	$ 452	$ 452
Total Operational Cost in 2017 Dollars	$ 33,124			$ -	$ -	$ -	$ 301	$ 301	$ 301	$ 301	$ 301	$ 301	$ 301	$ 301	$ 452	$ 452	$ 452	$ 452
Total Operational Cost NPV	$ 11,222			$ -	$ -	$ -	$ 260	$ 253	$ 246	$ 239	$ 232	$ 225	$ 219	$ 213	$ 310	$ 301	$ 292	$ 284
Current Year Sub-total	$ 173,498			$ 17,283	$ 23,045	$ 17,283	$ 301	$ 301	$ 301	$ 301	$ 301	$ 8,911	$ 10,531	$ 7,974	$ 452	$ 452	$ 452	$ 452
Inflation Adjusted	$ 343,941			$ 17,982	$ 24,455	$ 18,708	$ 332	$ 339	$ 346	$ 353	$ 360	$ 10,863	$ 13,095	$ 10,113	$ 584	$ 596	$ 608	$ 620
NPV	**$ 97,216**			$ 16,310	$ 21,125	$ 15,391	$ 260	$ 253	$ 246	$ 239	$ 232	$ 6,669	$ 7,656	$ 5,631	$ 310	$ 301	$ 292	$ 284

Notes:
Equipment and Construction costs spread out over a 3-year construction period in 30%-40%-30% split for both Phases

AINLEY: 115157
EFFLUENT RE-OXYGENATION

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059
																	$ 18,750							
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,750	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,998	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 276	$ 268	$ 260	$ 253	$ 246	$ 239	$ 232	$ 225	$ 219	$ 213	$ 207	$ 201	$ 195	$ 189	$ 184	$ 179	$ 174	$ 169	$ 164	$ 159	$ 155	$ 150	$ 146	$ 142	$ 138
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 19,202	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 632	$ 645	$ 658	$ 671	$ 685	$ 698	$ 712	$ 727	$ 741	$ 756	$ 771	$ 786	$ 802	$ 818	$ 835	$ 851	$ 868	$ 37,648	$ 903	$ 921	$ 940	$ 959	$ 978	$ 997	$ 1,017
$ 276	$ 268	$ 260	$ 253	$ 246	$ 239	$ 232	$ 225	$ 219	$ 213	$ 207	$ 201	$ 195	$ 189	$ 184	$ 179	$ 174	$ 7,167	$ 164	$ 159	$ 155	$ 150	$ 146	$ 142	$ 138

2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073
$ 9,375													
$ 9,375	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 2,775	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 134	$ 130	$ 126	$ 123	$ 119	$ 116	$ 112	$ 109	$ 106	$ 103	$ 100	$ 97	$ 94	$ 92
$ 9,827	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 22,574	$ 1,058	$ 1,080	$ 1,101	$ 1,123	$ 1,146	$ 1,169	$ 1,192	$ 1,216	$ 1,240	$ 1,265	$ 1,290	$ 1,316	$ 1,342
$ 2,908	$ 130	$ 126	$ 123	$ 119	$ 116	$ 112	$ 109	$ 106	$ 103	$ 100	$ 97	$ 94	$ 92

2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087
								$ 18,750					
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,750	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,933	$ -	$ -	$ -	$ -	$ -
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 89	$ 87	$ 84	$ 82	$ 79	$ 77	$ 75	$ 73	$ 71	$ 69	$ 67	$ 65	$ 63	$ 61
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 19,202	$ 452	$ 452	$ 452	$ 452	$ 452
$ 1,369	$ 1,397	$ 1,424	$ 1,453	$ 1,482	$ 1,512	$ 1,542	$ 1,573	$ 68,195	$ 1,636	$ 1,669	$ 1,702	$ 1,736	$ 1,771
$ 89	$ 87	$ 84	$ 82	$ 79	$ 77	$ 75	$ 73	$ 3,004	$ 69	$ 67	$ 65	$ 63	$ 61

AINLEY: 115157
EFFLUENT RE-OXYGENATION

2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
		$ 9,375								
$ -	$ -	$ 9,375	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ 1,163	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 59	$ 58	$ 56	$ 54	$ 53	$ 51	$ 50	$ 48	$ 47	$ 46	$ 44
$ 452	$ 452	$ 9,827	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452	$ 452
$ 1,807	$ 1,843	$ 40,890	$ 1,917	$ 1,955	$ 1,995	$ 2,034	$ 2,075	$ 2,117	$ 2,159	$ 2,202
$ 59	$ 58	$ 1,219	$ 54	$ 53	$ 51	$ 50	$ 48	$ 47	$ 46	$ 44

Appendix E
Life Cycle Cost Evaluation of Sludge Stabilization Alternatives

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
AEROBIC DIGESTION SYSTEM

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering and Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	**Phase 1**					**Phase 2**				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
Aerobic Digester										
Diffusers and Aeration Piping	2	$ 70,000	$ 140,000	60%	$ 224,000	1	$ 70,000	$ 70,000	60%	$ 112,000
Biosolis Thickening Tank Mixing System	1	$ 165,750	$ 165,750	60%	$ 265,200	1	$ 82,875	$ 82,875	60%	$ 132,600
Biosolids Transfer and Truck Loading Pumps	6	$ 26,250	$ 157,500	60%	$ 252,000	3	$ 37,000	$ 111,000	60%	$ 177,600
Total Equipment Cost					$ 741,200					$ 422,200
CONSTRUCTION										
General			10%		$ 409,602			10%		$ 103,248
Site Work			15%		$ 614,403			15%		$ 154,872
Yard Piping			10%		$ 409,602			10%		$ 103,248
Aerobic Digester	2	$ 499,833	$ 999,666	10%	$ 1,099,633	1	$ 249,917	$ 249,917	10%	$ 274,908
Biosolids Thickening Tanks	1	$ 527,250	$ 527,250	10%	$ 579,975	1	$ 263,625	$ 263,625	10%	$ 289,988
Biosolids Settling/Storage Tanks	2	$ 527,250	$ 1,054,500	10%	$ 1,159,950	1	$ 263,625	$ 263,625	10%	$ 289,988
Biosolids Building (fully built in Phase 1)	1	$ 428,460	$ 428,460	10%	$ 471,306	0			10%	
Biosolids Truck Loading Pump Buidling (fully built in Phase 1)	1	$ 39,960	$ 39,960	10%	$ 43,956	0			10%	$ -
Total Construction Cost					$ 4,788,426					$ 1,216,252
Engineering & Contingency (25%)					$ 1,382,407					$ 409,613
Total Capital Cost					$ 6,912,033					$ 2,048,065

OPERATIONAL COST	**Phase 1**				**Phase 2**			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
Digester Aeration	1032	kWh/d	$ 0.11	$ 41,434.80	1548	kWh/d	$ 0.11	$ 62,152.20
Biosolids Thickening Tank Mixing System	16	kWh/d	$ 0.11	$ 642.40	24	kWh/d	$ 0.11	$ 963.60
Biosolids Transfer and Truck Loading Pumps	16	kWh/d	$ 0.11	$ 642.40	24	kWh/d	$ 0.11	$ 963.60
Total Power Cost				$ 42,720				$ 64,079
Chemical Consumption								
Polymer	11	kg/d	$ 5.00	$ 20,075.00	17	kg/d	$ 5.00	$ 30,112.50
Total Chemical Cost				$ 20,075				$ 30,113
Total Operational Costs								

NPV CALCULATION	**Total**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
CAPITAL COSTS																		
Equipment	$ 1,454,250			$ 277,950	$ 370,600	$ 277,950						$ 158,325	$ 211,100	$ 158,325				
Construction Costs	$ 7,505,848			$ 1,795,660	$ 2,394,213	$ 1,795,660						$ 456,095	$ 608,126	$ 456,095				
Major Equipment Replacement Cost	$ 2,908,500																	
Total Capital Cost in 2014 Dollars	$ 11,868,598			$ 2,073,610	$ 2,764,813	$ 2,073,610	$ -	$ -	$ -	$ -	$ -	$ 614,420	$ 819,226	$ 614,420	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 8,539,588	$ -	$ -	$ 1,956,811	$ 2,534,536	$ 1,846,590	$ -	$ -	$ -	$ -	$ -	$ 459,805	$ 595,557	$ 433,906	$ -	$ -	$ -	$ -
OPERATIONAL COSTS																		
Power Consumption Cost	$ 4,699,156						$ 42,720	$ 42,720	$ 42,720	$ 42,720	$ 42,720	$ 42,720	$ 42,720	$ 42,720	$ 64,079	$ 64,079	$ 64,079	$ 64,079
Chemical Consumption Cost	$ 2,208,250						$ 20,075	$ 20,075	$ 20,075	$ 20,075	$ 20,075	$ 20,075	$ 20,075	$ 20,075	$ 30,113	$ 30,113	$ 30,113	$ 30,113
Total Operational Cost in 2014 Dollars	$ 6,907,406						$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 94,192	$ 94,192	$ 94,192	$ 94,192
Total Operational Cost NPV	$ 2,340,116			$ -	$ -	$ -	$ 54,322	$ 52,770	$ 51,262	$ 49,798	$ 48,375	$ 46,993	$ 45,650	$ 44,346	$ 64,618	$ 62,772	$ 60,978	$ 59,236
Current Year Sub-total	$ 18,776,004			$ 2,073,610	$ 2,764,813	$ 2,073,610	$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 62,795	$ 677,214	$ 882,021	$ 677,214	$ 94,192	$ 94,192	$ 94,192	$ 94,192
Inflation Adjusted	$ 36,321,484			$ 2,157,384	$ 2,934,042	$ 2,244,542	$ 69,330	$ 70,717	$ 72,131	$ 73,574	$ 75,045	$ 825,520	$1,096,682	$ 858,871	$ 121,847	$ 124,284	$ 126,770	$ 129,305
NPV	**$ 10,879,703**			$ 1,956,811	$ 2,534,536	$ 1,846,590	$ 54,322	$ 52,770	$ 51,262	$ 49,798	$ 48,375	$ 506,798	$ 641,207	$ 478,252	$ 64,618	$ 62,772	$ 60,978	$ 59,236

AINLEY: 115157
AEROBIC DIGESTION SYSTEM

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
																	$ 926,500								$ 527,750
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 926,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 527,750
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 345,792	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 156,201
$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079
$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192
$ 57,544	$ 55,900	$ 54,303	$ 52,751	$ 51,244	$ 49,780	$ 48,357	$ 46,976	$ 45,634	$ 44,330	$ 43,063	$ 41,833	$ 40,638	$ 39,477	$ 38,349	$ 37,253	$ 36,189	$ 35,155	$ 34,150	$ 33,175	$ 32,227	$ 31,306	$ 30,411	$ 29,543	$ 28,699	$ 27,879
$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 1,020,692	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 621,942
$ 131,891	$ 134,529	$ 137,220	$ 139,964	$ 142,763	$ 145,619	$ 148,531	$ 151,502	$ 154,532	$ 157,622	$ 160,775	$ 163,990	$ 167,270	$ 170,616	$ 174,028	$ 177,508	$ 181,059	$ 2,001,246	$ 188,373	$ 192,141	$ 195,984	$ 199,903	$ 203,901	$ 207,979	$ 212,139	$ 1,428,753
$ 57,544	$ 55,900	$ 54,303	$ 52,751	$ 51,244	$ 49,780	$ 48,357	$ 46,976	$ 45,634	$ 44,330	$ 43,063	$ 41,833	$ 40,638	$ 39,477	$ 38,349	$ 37,253	$ 36,189	$ 380,947	$ 34,150	$ 33,175	$ 32,227	$ 31,306	$ 30,411	$ 29,543	$ 28,699	$ 184,080

AINLEY: 115157
AEROBIC DIGESTION SYSTEM

2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085
																					$ 926,500			
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 926,500	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 144,924	$ -	$ -	$ -
$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079
$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192
$ 27,082	$ 26,308	$ 25,557	$ 24,826	$ 24,117	$ 23,428	$ 22,759	$ 22,108	$ 21,477	$ 20,863	$ 20,267	$ 19,688	$ 19,125	$ 18,579	$ 18,048	$ 17,533	$ 17,032	$ 16,545	$ 16,072	$ 15,613	$ 15,167	$ 14,734	$ 14,313	$ 13,904	$ 13,506
$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	########	$ 94,192	$ 94,192	$ 94,192
$ 220,709	$ 225,124	$ 229,626	$ 234,219	$ 238,903	$ 243,681	$ 248,555	$ 253,526	$ 258,596	$ 263,768	$ 269,044	$ 274,424	$ 279,913	$ 285,511	$ 291,221	$ 297,046	$ 302,987	$ 309,047	$ 315,227	$ 321,532	$ 327,963	########	$ 341,212	$ 348,037	$ 354,997
$ 27,082	$ 26,308	$ 25,557	$ 24,826	$ 24,117	$ 23,428	$ 22,759	$ 22,108	$ 21,477	$ 20,863	$ 20,267	$ 19,688	$ 19,125	$ 18,579	$ 18,048	$ 17,533	$ 17,032	$ 16,545	$ 16,072	$ 15,613	$ 15,167	$ 159,658	$ 14,313	$ 13,904	$ 13,506

2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
				$ 527,750								
$ -	$ -	$ -	$ -	$ 527,750	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ 65,465	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079	$ 64,079
$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192
$ 13,121	$ 12,746	$ 12,382	$ 12,028	$ 11,684	$ 11,350	$ 11,026	$ 10,711	$ 10,405	$ 10,108	$ 9,819	$ 9,538	$ 9,266
$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 621,942	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192	$ 94,192
$ 362,097	$ 369,339	$ 376,726	$ 384,261	########	$ 399,785	$ 407,780	$ 415,936	$ 424,255	$ 432,740	$ 441,395	$ 450,222	$ 459,227
$ 13,121	$ 12,746	$ 12,382	$ 12,028	$ 77,149	$ 11,350	$ 11,026	$ 10,711	$ 10,405	$ 10,108	$ 9,819	$ 9,538	$ 9,266

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
ATAD SYSTEM

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering and Contingency	25%
Year to Begin Construction	2020
Estimated Phase 1 Construction Complete	2022
Estimated Phase 2 Construction Complete	2030

CAPITAL COST	**Phase 1**					**Phase 2**				
	Units	Unit Cost	Cost	Installation	Total	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT										
ATAD										
Aeration/Mixing System	2	$ 84,015	$ 168,030	50%	$ 252,045	1	$ 84,015	$ 84,015	50%	$ 126,023
Sludge Thickener	2	$ 185,000	$ 370,000	60%	$ 592,000	1	$ 185,000	$ 185,000	60%	$ 296,000
Sludge and Thickened Sludge Holding Tanks Mixing System	2	$ 165,750	$ 331,500	60%	$ 530,400	2	$ 165,750	$ 331,500	60%	$ 530,400
Sludge and Biosolids Transfer and Loading Pumps	10	$ 26,250	$ 262,500	60%	$ 420,000	5	$ 26,250	$ 131,250	60%	$ 210,000
Total Equipment Cost					$ 1,794,445					$ 1,162,423
CONSTRUCTION										
General			10%		$ 471,845			10%		$ 205,567
Site Work			15%		$ 707,767			15%		$ 308,351
Yard Piping			10%		$ 471,845			10%		$ 205,567
ATAD Tanks	2	$ 574,092	$ 1,148,184	10%	$ 1,263,002	1	$ 287,046	$ 287,046	10%	$ 315,751
Sludge Holding Tanks	1	$ 262,500	$ 262,500	10%	$ 288,750	1	$ 131,250	$ 131,250	10%	$ 144,375
Thickened Sludge Holding Tank	1	$ 262,500	$ 262,500	10%	$ 288,750	1	$ 131,250	$ 131,250	10%	$ 144,375
Biosolids Settling/Storage Tanks	2	$ 262,500	$ 525,000	10%	$ 577,500	2	$ 131,250	$ 262,500	10%	$ 288,750
Thickening Building (built for Full Buildout in Phase 1)	1	$ 460,000	$ 460,000	10%	$ 506,000	0		$ -	10%	$ -
Total Construction Cost					$ 4,575,459					$ 1,612,736
Engineering & Contingency (25%)					$ 1,592,476					$ 693,790
Total Equipment Cost					$ 7,962,380					$ 3,468,948

OPERATIONAL COST	**Phase 1**				**Phase 2**			
	Rating/ Number	Units	Unit Cost	Yearly Cost	Rating	Units	Unit Cost	Total Cost
SYSTEM								
Power Consumption								
ATAD Aeration and Mixing (Aspirators)	360	kWh/d	$ 0.11	$ 14,454.00	540	kWh/d	$ 0.11	$ 21,681.00
Sludge and Thickened Sludge Tanks Mixing	105	kWh/d	$ 0.11	$ 4,215.75	158	kWh/d	$ 0.11	$ 6,323.63
Thickeners (inc feed and discharge pumps)	16	kWh/d	$ 0.11	$ 642.40	24	kWh/d	$ 0.11	$ 963.60
Thickened Sludge and Biosolids Transfer and Loading Pumps	41	kWh/d	$ 0.11	$ 1,646.15	62	kWh/d	$ 0.11	$ 2,469.23
Total Power Cost				$ 20,958				$ 31,437
Chemical Consumption								
Polymer	11	kg/d	$ 5.00	$ 20,075	17	kg/d	$ 5.00	$ 30,113
Total Chemical Cost				$ 20,075				$ 30,113
Total Operational Costs								

NPV CALCULATION	**Total**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
CAPITAL COSTS										
Equipment	$ 3,696,084			$ 672,917	$ 897,223	$ 672,917				
Construction Costs	$ 7,735,244			$ 1,715,797	$ 2,287,729	$ 1,715,797				
Major Equipment Replacement Cost	$ 7,392,169									
Total Capital Cost in 2014 Dollars	$ 18,823,497			$ 2,388,714	$ 3,184,952	$ 2,388,714	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 11,090,744	$ -	$ -	$ 2,254,166	$ 2,919,682	$ 2,127,197	$ -	$ -	$ -	$ -
OPERATIONAL COSTS										
Power Consumption Cost	$ 2,305,413						$ 20,958	$ 20,958	$ 20,958	$ 20,958
Chemical Consumption Cost	$ 2,208,250						$ 20,075	$ 20,075	$ 20,075	$ 20,075
Total Operational Cost in 2014 Dollars	$ 4,513,663			$ -	$ -	$ -	$ 41,033	$ 41,033	$ 41,033	$ 41,033
Total Operational Cost NPV	$ 1,529,155			$ -	$ -	$ -	$ 35,497	$ 34,483	$ 33,498	$ 32,540
Current Year Sub-total	$ 23,337,160			$ 2,388,714	$ 3,184,952	$ 2,388,714	$ 41,033	$ 41,033	$ 41,033	$ 41,033
Inflation Adjusted	$ 46,224,772			$ 2,485,218	$ 3,379,897	$ 2,585,621	$ 45,304	$ 46,210	$ 47,134	$ 48,077
NPV	**$ 13,151,003**			$ 2,254,166	$ 2,919,682	$ 2,127,197	$ 35,497	$ 34,483	$ 33,498	$ 32,540

NPV CALCULATION	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
CAPITAL COSTS									
Equipment		$ 435,908	$ 581,211	$ 435,908					
Construction Costs		$ 604,776	$ 806,368	$ 604,776					
Major Equipment Replacement Cost									
Total Capital Cost in 2014 Dollars	$ -	$ 1,040,685	$1,387,579	$ 1,040,685	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ -	$ 778,803	$1,008,736	$ 734,936	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS									
Power Consumption Cost	$ 20,958	$ 20,958	$ 20,958	$ 20,958	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437
Chemical Consumption Cost	$ 20,075	$ 20,075	$ 20,075	$ 20,075	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
Total Operational Cost in 2014 Dollars	$ 41,033	$ 41,033	$ 41,033	$ 41,033	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550
Total Operational Cost NPV	$ 31,611	$ 30,708	$ 29,830	$ 28,978	$ 42,225	$ 41,019	$ 39,847	$ 38,708	$ 37,602
Current Year Sub-total	$ 41,033	$ 1,081,718	$1,428,613	$ 1,081,718	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550
Inflation Adjusted	$ 49,039	$ 1,318,608	$1,776,300	$ 1,371,880	$ 79,621	$ 81,214	$ 82,838	$ 84,495	$ 86,185
NPV	$ 31,611	$ 809,511	$1,038,566	$ 763,914	$ 42,225	$ 41,019	$ 39,847	$ 38,708	$ 37,602

AINLEY: 115157
ATAD SYSTEM

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
																$ 2,243,056								$ 1,453,028			
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,243,056	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,453,028	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 837,163	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 430,062	$ -	$ -	$ -
$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437
$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550
$ 36,528	$ 35,484	$ 34,470	$ 33,485	$ 32,529	$ 31,599	$ 30,696	$ 29,819	$ 28,967	$ 28,140	$ 27,336	$ 26,555	$ 25,796	$ 25,059	$ 24,343	$ 23,648	$ 22,972	$ 22,316	$ 21,678	$ 21,059	$ 20,457	$ 19,872	$ 19,305	$ 18,753	$ 18,217	$ 17,697	$ 17,191	$ 16,700
$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 2,304,606	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 1,514,578	$ 61,550	$ 61,550	$ 61,550
$ 87,908	$ 89,667	$ 91,460	$ 93,289	$ 95,155	$ 97,058	$ 98,999	$ 100,979	$ 102,999	$ 105,059	$ 107,160	$ 109,303	$ 111,489	$ 113,719	$ 115,993	$ 118,313	$ 4,518,586	$ 123,093	$ 125,555	$ 128,066	$ 130,627	$ 133,240	$ 135,905	$ 138,623	$ 3,479,356	$ 144,223	$ 147,108	$ 150,050
$ 36,528	$ 35,484	$ 34,470	$ 33,485	$ 32,529	$ 31,599	$ 30,696	$ 29,819	$ 28,967	$ 28,140	$ 27,336	$ 26,555	$ 25,796	$ 25,059	$ 24,343	$ 23,648	$ 860,135	$ 22,316	$ 21,678	$ 21,059	$ 20,457	$ 19,872	$ 19,305	$ 18,753	$ 448,279	$ 17,697	$ 17,191	$ 16,700

AINLEY: 115157
ATAD SYSTEM

2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091
																		$ 2,243,056								$ 1,453,028	
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,243,056	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,453,028	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 350,862	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 180,242	$ -
$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437
$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550
$ 16,223	$ 15,759	$ 15,309	$ 14,872	$ 14,447	$ 14,034	$ 13,633	$ 13,244	$ 12,865	$ 12,498	$ 12,141	$ 11,794	$ 11,457	$ 11,129	$ 10,811	$ 10,502	$ 10,202	$ 9,911	$ 9,628	$ 9,353	$ 9,085	$ 8,826	$ 8,574	$ 8,329	$ 8,091	$ 7,860	$ 7,635	$ 7,417
$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 2,304,606	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 1,514,578	$ 61,550
$ 153,051	$ 156,112	$ 159,234	$ 162,419	$ 165,667	$ 168,980	$ 172,360	$ 175,807	$ 179,323	$ 182,910	$ 186,568	$ 190,299	$ 194,105	$ 197,988	$ 201,947	$ 205,986	$ 210,106	$ 214,308	$ 8,184,793	$ 222,966	$ 227,425	$ 231,974	$ 236,613	$ 241,346	$ 246,173	$ 251,096	$ 6,302,372	$ 261,240
$ 16,223	$ 15,759	$ 15,309	$ 14,872	$ 14,447	$ 14,034	$ 13,633	$ 13,244	$ 12,865	$ 12,498	$ 12,141	$ 11,794	$ 11,457	$ 11,129	$ 10,811	$ 10,502	$ 10,202	$ 9,911	$ 360,489	$ 9,353	$ 9,085	$ 8,826	$ 8,574	$ 8,329	$ 8,091	$ 7,860	$ 187,877	$ 7,417

AINLEY: 115157
ATAD SYSTEM

2092	2093	2094	2095	2096	2097	2098
$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437	$ 31,437
$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113	$ 30,113
$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550
$ 7,205	$ 6,999	$ 6,799	$ 6,605	$ 6,416	$ 6,233	$ 6,055
$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550	$ 61,550
$ 266,465	$ 271,794	$ 277,230	$ 282,775	$ 288,430	$ 294,199	$ 300,083
$ 7,205	$ 6,999	$ 6,799	$ 6,605	$ 6,416	$ 6,233	$ 6,055

Appendix F

Life Cycle Cost Evaluation of Septage Management Alternatives

Add the septage in controlled quantities to the treatment plant

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
DIRECT CO-TREATMENT OF SEPTAGE

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Construction Complete	2022

CAPITAL COST	Buildout				
	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT					
Septage Receiving Station					
Bar Screen	1.00	$ 100,000	$ 100,000	60%	$ 160,000
Septage Pumps	2.00	$ 10,000	$ 20,000	60%	$ 32,000
Total Equipment Cost					$ 192,000
CONSTRUCTION					
General			10%		$ 23,985
Site Work			15%		$ 35,978
Yard Piping			10%		$ 23,985
Septage Holding Tank (45 m3 AT $2900 per m2)	1.00	$ 43,500.00	$ 43,500	10%	$ 47,850
Total Construction Cost					$ 131,798
Engineering & Contingency (25%)					$ 80,949
Total Capital Cost					$ 404,747

OPERATIONAL COST	Buildout			
	Rating/ Number	Units	Unit Cost	Yearly Cost
SYSTEM				
Power Consumption				
Septage pumps	35	kWh/d	$ 0.11	$ 1,422
Total Power Cost				$ 1,422
Total Operational Costs				$ 1,422

NPV Calculation	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
CAPITAL COSTS													
Equipment	$ 240,000			$ 72,000	$ 96,000	$ 72,000							
Construction Costs	$ 164,747			$ 49,424	$ 65,899	$ 49,424							
Major Equipment Replacement Cost (@ 30 years)	$ 480,000												
Total Capital Cost in 2018 Dollars	$ 884,747	$ -	$ -	$ 121,424	$ 161,899	$ 121,424	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost NPV	$ 498,244	$ -	$ -	$ 114,585	$ 148,414	$ 108,131	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS													
Chemical Consumption Cost	$ -												
Power Consumption Cost	$ 108,083						$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
Total Operational Cost in 2018 Dollars	$ 108,083	$ -	$ -	$ -	$ -	$ -	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
Total Operational Costs NPV	$ 38,303	$ -	$ -	$ -	$ -	$ -	$ 1,230	$ 1,195	$ 1,161	$ 1,128	$ 1,096	$ 1,064	$ 1,034
Current Year Sub-total	$ 992,830	$ -	$ -	$ 121,424	$ 161,899	$ 121,424	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
Inflation Adjusted	$ 2,027,596	$ -	$ -	$ 126,330	$ 171,808	$ 131,433	$ 1,570	$ 1,602	$ 1,634	$ 1,666	$ 1,700	$ 1,734	$ 1,768
NPV	**$ 536,547**	$ -	$ -	$ 114,585	$ 148,414	$ 108,131	$ 1,230	$ 1,195	$ 1,161	$ 1,128	$ 1,096	$ 1,064	$ 1,034

AINLEY: 115157
DIRECT CO-TREATMENT OF SEPTAGE

2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
																						$ 240,000
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 240,000
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 89,574
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 1,004	$ 976	$ 948	$ 921	$ 894	$ 869	$ 844	$ 820	$ 796	$ 774	$ 752	$ 730	$ 709	$ 689	$ 669	$ 650	$ 632	$ 614	$ 596	$ 579	$ 562	$ 546	$ 531
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 241,422
$ 1,804	$ 1,840	$ 1,876	$ 1,914	$ 1,952	$ 1,991	$ 2,031	$ 2,072	$ 2,113	$ 2,155	$ 2,199	$ 2,243	$ 2,287	$ 2,333	$ 2,380	$ 2,427	$ 2,476	$ 2,526	$ 2,576	$ 2,628	$ 2,680	$ 2,734	$ 473,351
$ 1,004	$ 976	$ 948	$ 921	$ 894	$ 869	$ 844	$ 820	$ 796	$ 774	$ 752	$ 730	$ 709	$ 689	$ 669	$ 650	$ 632	$ 614	$ 596	$ 579	$ 562	$ 546	$ 90,105

AINLEY: 115157
DIRECT CO-TREATMENT OF SEPTAGE

2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 516	$ 501	$ 487	$ 473	$ 459	$ 446	$ 433	$ 421	$ 409	$ 397	$ 386	$ 375	$ 364	$ 354	$ 344	$ 334	$ 324	$ 315	$ 306	$ 297	$ 289	$ 281	$ 272	$ 265	$ 257	$ 250	$ 243
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 2,844	$ 2,901	$ 2,959	$ 3,018	$ 3,079	$ 3,140	$ 3,203	$ 3,267	$ 3,332	$ 3,399	$ 3,467	$ 3,536	$ 3,607	$ 3,679	$ 3,753	$ 3,828	$ 3,904	$ 3,982	$ 4,062	$ 4,143	$ 4,226	$ 4,311	$ 4,397	$ 4,485	$ 4,575	$ 4,666	$ 4,759
$ 516	$ 501	$ 487	$ 473	$ 459	$ 446	$ 433	$ 421	$ 409	$ 397	$ 386	$ 375	$ 364	$ 354	$ 344	$ 334	$ 324	$ 315	$ 306	$ 297	$ 289	$ 281	$ 272	$ 265	$ 257	$ 250	$ 243

2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
		$ 240,000																
$ -	$ -	$ 240,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ 37,541	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 236	$ 229	$ 222	$ 216	$ 210	$ 204	$ 198	$ 192	$ 187	$ 182	$ 176	$ 171	$ 166	$ 162	$ 157	$ 153	$ 148	$ 144	$ 140
$ 1,422	$ 1,422	$ 241,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422	$ 1,422
$ 4,855	$ 4,952	$ 857,409	$ 5,152	$ 5,255	$ 5,360	$ 5,467	$ 5,576	$ 5,688	$ 5,802	$ 5,918	$ 6,036	$ 6,157	$ 6,280	$ 6,406	$ 6,534	$ 6,664	$ 6,798	$ 6,934
$ 236	$ 229	$ 37,764	$ 216	$ 210	$ 204	$ 198	$ 192	$ 187	$ 182	$ 176	$ 171	$ 166	$ 162	$ 157	$ 153	$ 148	$ 144	$ 140

Increase the Sequencing Batch Reactor (SBR) size so it can treat the septage

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
CO-TREATMENT WITH MBR

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Construction Complete	2022

CAPITAL COST	Buildout				
	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT					
Septage Receiving Station					
Bar Screen	1.00	$ 100,000	$ 100,000	60%	$ 160,000
Septage Pumps	2.00	$ 10,000	$ 20,000	60%	$ 32,000
Chemical Dosing					
Chemical Storage Tanks	2	$ 133	$ 266	60%	$ 426
Day Tanks	1	$ 22	$ 22	60%	$ 36
Dosing Pumps (alum and carbon source)	4	$ 18	$ 72	60%	$ 115
Total Equipment Cost					$ 192,577
CONSTRUCTION					
General			10%		$ 25,156
Site Work			15%		$ 37,734
Yard Piping			10%		$ 25,156
Septage Holding Tank	1.00	$ 43,500	$ 43,500	10%	$ 47,850
Increase is Biological Reactor Tankage	1.00	$ 10,122	$ 10,122	10%	$ 11,134
Total Construction Cost					$ 135,896
Engineering & Contingency (25%)					$ 82,118
Total Capital Cost					$ 410,592

OPERATIONAL COST	Buildout			
	Rating/ Number	Units	Unit Cost	Yearly Cost
SYSTEM				
Power Consumption				
Septage pumps	35	kWh/d	$ 0.11	$ 1,422
Primary Fine Filter	1.1	kWh/d	$ 0.11	$ 42
Aeration Tank Blowers	3.7	kWh/d	$ 0.11	$ 148
Membrane Tank Blowers	1.2	kWh/d	$ 0.11	$ 50
Permeate Pumps	0.3	kWh/d	$ 0.11	$ 13
RAS Pumps	2.3	kWh/d	$ 0.11	$ 91
Air Compressors	0.02	kWh/d	$ 0.11	$ 1
Total Power Cost				$ 1,767
Chemical Consumption				
Alum	0.198	kg/d	$ 0.55	$ 40
Total Chemical Cost				$ 40
Total Operational Cost				$ 1,807

$ -

0.01

NPV Calculation	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL COSTS										
Equipment	$ 240,721			$ 72,216	$ 96,288	$ 72,216				
Construction Costs	$ 169,871			$ 50,961	$ 67,948	$ 50,961				
Major Equipment Replacement Cost	$ 481,442									
Total Capital Cost in 2017 Dollars	$ 892,034	$ -	$ -	$ 123,178	$ 164,237	$ 123,178	$ -	$ -	$ -	$ -
Capital Costs Total NPV	$ 503,986	$ -	$ -	$ 116,239	$ 150,558	$ 109,692	$ -	$ -	$ -	$ -
OPERATIONAL COSTS										
Chemical Consumption Cost	$ 3,021						$ 40	$ 40	$ 40	$ 40
Power Consumption Cost	$ 134,282						$ 1,767	$ 1,767	$ 1,767	$ 1,767
Total Operational Cost in 2017 Dollars	$ 137,303	$ -	$ -	$ -	$ -	$ -	$ 1,807	$ 1,807	$ 1,807	$ 1,807
Operational Costs Total NPV	$ 48,658	$ -	$ -	$ -	$ -	$ -	$ 1,563	$ 1,518	$ 1,475	$ 1,433
Current Year Sub-total	$ 1,029,337	$ -	$ -	$ 123,178	$ 164,237	$ 123,178	$ 1,807	$ 1,807	$ 1,807	$ 1,807
Inflation Adjusted	$ 2,112,149	$ -	$ -	$ 128,154	$ 174,289	$ 133,331	$ 1,995	$ 2,035	$ 2,075	$ 2,117
NPV	**$ 552,644**	$ -	$ -	$ 116,239	$ 150,558	$ 109,692	$ 1,563	$ 1,518	$ 1,475	$ 1,433

NPV Calculation	2027	2028	2029	2030	2031	2032	2033	2034	2035
CAPITAL COSTS									
Equipment									
Construction Costs									
Major Equipment Replacement Cost									
Total Capital Cost in 2017 Dollars	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital Costs Total NPV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS									
Chemical Consumption Cost	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
Power Consumption Cost	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767
Total Operational Cost in 2017 Dollars	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
Operational Costs Total NPV	$ 1,392	$ 1,352	$ 1,313	$ 1,276	$ 1,239	$ 1,204	$ 1,170	$ 1,136	$ 1,104
Current Year Sub-total	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
Inflation Adjusted	$ 2,159	$ 2,202	$ 2,246	$ 2,291	$ 2,337	$ 2,384	$ 2,431	$ 2,480	$ 2,530
NPV	$ 1,392	$ 1,352	$ 1,313	$ 1,276	$ 1,239	$ 1,204	$ 1,170	$ 1,136	$ 1,104

AINLEY: 115157
CO-TREATMENT WITH MBR

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767
$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
$ 1,072	$ 1,042	$ 1,012	$ 983	$ 955	$ 928	$ 901	$ 875	$ 850	$ 826	$ 802	$ 779	$ 757	$ 736	$ 715	$ 694
$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
$ 2,580	$ 2,632	$ 2,685	$ 2,738	$ 2,793	$ 2,849	$ 2,906	$ 2,964	$ 3,023	$ 3,084	$ 3,145	$ 3,208	$ 3,272	$ 3,338	$ 3,405	$ 3,473
$ 1,072	$ 1,042	$ 1,012	$ 983	$ 955	$ 928	$ 901	$ 875	$ 850	$ 826	$ 802	$ 779	$ 757	$ 736	$ 715	$ 694

2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
$ 240,721															
$ 240,721	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 89,843	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767
$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
$ 674	$ 655	$ 636	$ 618	$ 600	$ 583	$ 567	$ 550	$ 535	$ 519	$ 505	$ 490	$ 476	$ 463	$ 449	$ 437
$ 242,528	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
$ 475,518	$ 3,613	$ 3,685	$ 3,759	$ 3,834	$ 3,911	$ 3,989	$ 4,069	$ 4,150	$ 4,233	$ 4,318	$ 4,404	$ 4,492	$ 4,582	$ 4,674	$ 4,767
$ 90,517	$ 655	$ 636	$ 618	$ 600	$ 583	$ 567	$ 550	$ 535	$ 519	$ 505	$ 490	$ 476	$ 463	$ 449	$ 437

AINLEY: 115157
CO-TREATMENT WITH MBR

2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098
														$ 240,721																
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 240,721	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 37,654	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767	$ 1,767
$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
$ 424	$ 412	$ 400	$ 389	$ 378	$ 367	$ 356	$ 346	$ 336	$ 327	$ 317	$ 308	$ 299	$ 291	$ 283	$ 275	$ 267	$ 259	$ 252	$ 244	$ 237	$ 231	$ 224	$ 218	$ 211	$ 205	$ 200	$ 194	$ 188	$ 183	$ 178
$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 242,528	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807	$ 1,807
$ 4,863	$ 4,960	$ 5,059	$ 5,160	$ 5,264	$ 5,369	$ 5,476	$ 5,586	$ 5,697	$ 5,811	$ 5,928	$ 6,046	$ 6,167	$ 6,290	$ 861,336	$ 6,545	$ 6,675	$ 6,809	$ 6,945	$ 7,084	$ 7,226	$ 7,370	$ 7,518	$ 7,668	$ 7,821	$ 7,978	$ 8,137	$ 8,300	$ 8,466	$ 8,635	$ 8,808
$ 424	$ 412	$ 400	$ 389	$ 378	$ 367	$ 356	$ 346	$ 336	$ 327	$ 317	$ 308	$ 299	$ 291	$ 37,937	$ 275	$ 267	$ 259	$ 252	$ 244	$ 237	$ 231	$ 224	$ 218	$ 211	$ 205	$ 200	$ 194	$ 188	$ 183	$ 178

Use a Geotube dewatering system to remove the liquid part of the septage and treat only the liquid part, which is weaker at the main plant.

ERIN CLASS EA: PHASE 3
WWTP TECHNOLOGY EVALUATION
LIFE CYCLE ANALYSIS

AINLEY: 115157
GeoTube Dewatering and CoTreatment of Filtrate

Economic Factors	
Discount Rate (Interest):	5%
Inflation Rate	2%
Engineering & Contingency	25%
Year to Begin Construction	2020
Estimated Construction Complete	2022

CAPITAL COST	Buildout				
	Units	Unit Cost	Cost	Installation	Total
EQUIPMENT					
Septage Receiving Station					
Bar Screen	1.00	$ 100,000	$ 100,000	60%	$ 160,000
Laydown Area					
Geosynthetic Pad					
liner	1.00	$ 4,036.70	$ 4,037	10%	$ 4,440
non-woven fabric					
GeoTube System					
GeoTube Units	2.00	$4,099	$ 8,197	10%	$ 9,017
Geotube Filtration Fabric Rolls	4.00	$959	$ 3,836	10%	$ 4,220
Filtrate Pumps	2.00	$5,000	$ 10,000	10%	$ 11,000
Chemical Dosing - Polymer Activation System					
Polymer injection system					
PLC Controls and Mag Flow Meter	1.00	$ 100,000	$ 100,000	60%	$ 160,000
Blending/Flocking System					
Septage Pumps					
Total Equipment Cost					$ 348,677
CONSTRUCTION					
General			10%		$ 40,202.67
Site Work			15%		$ 60,304.00
Yard Piping			10%		$ 40,202.67
Septage Holding Tank	1.00	$ 43,500.00	$ 43,500	10%	$ 47,850
Filtrate Holding Tank	1.00	$5,000	$ 5,000	10%	$ 5,500
Total Construction Cost					$ 194,059
Engineering & Contingency (25%)					$ 135,684
Total Capital Cost					$ 678,420

OPERATIONAL COST	Buildout			
	Rating/ Number	Units	Unit Cost	Yearly Cost
SYSTEM				
Power Consumption				
Septage pumps	35	kWh/d	$ 0.11	$ 1,422
Filtrate Pumps	4	kWh/d	$ 0.11	$ 161
Total Power Cost				$ 1,583
Chemical Consumption				
Polymer	1	Tote/yr	$ 6,587.00	$ 6,587
Total Chemical Cost				$ 6,587
Total Operational Cost				$ 8,170

NPV Calculation	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL COSTS										
Equipment	$ 435,846			$ 130,754	$ 174,338	$ 130,754				
Construction Costs	$ 242,574			$ 72,772	$ 97,030	$ 72,772				
Major Equipment Replacement Cost	$ 871,692									
Total Capital Cost in 2018 Dollars	$ 1,550,112	$ -	$ -	$ 203,526	$ 271,368	$ 203,526	$ -	$ -	$ -	$ -
Capital Costs Total NPV	$ 852,916	$ -	$ -	$ 192,062	$ 248,766	$ 181,244	$ -	$ -	$ -	$ -
OPERATIONAL COSTS										
Chemical Consumption Cost	$ 520,373			$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587
Power Consumption Cost	$ 125,037			$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583
Total Operational Cost in 2018 Dollars	$ 645,410	$ -	$ -	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
Operational Costs Total NPV	$ 242,510	$ -	$ -	$ 7,710	$ 7,489	$ 7,275	$ 7,067	$ 6,866	$ 6,669	$ 6,479
Current Year Sub-total	$ 2,195,521	$ -	$ -	$ 211,696	$ 279,538	$ 211,696	$ 8,170	$ 8,170	$ 8,170	$ 8,170
Inflation Adjusted	$ 4,728,881	$ -	$ -	$ 220,248	$ 296,648	$ 229,146	$ 9,020	$ 9,200	$ 9,384	$ 9,572
NPV	**$ 1,095,426**	$ -	$ -	$ 199,772	$ 256,255	$ 188,519	$ 7,067	$ 6,866	$ 6,669	$ 6,479

NPV Calculation	2027	2028	2029	2030	2031	2032	2033	2034
CAPITAL COSTS								
Equipment								
Construction Costs								
Major Equipment Replacement Cost								
Total Capital Cost in 2018 Dollars	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital Costs Total NPV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPERATIONAL COSTS								
Chemical Consumption Cost	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587
Power Consumption Cost	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583
Total Operational Cost in 2018 Dollars	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
Operational Costs Total NPV	$ 6,294	$ 6,114	$ 5,939	$ 5,770	$ 5,605	$ 5,445	$ 5,289	$ 5,138
Current Year Sub-total	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
Inflation Adjusted	$ 9,764	$ 9,959	$ 10,158	$ 10,361	$ 10,568	$ 10,780	$ 10,995	$ 11,215
NPV	$ 6,294	$ 6,114	$ 5,939	$ 5,770	$ 5,605	$ 5,445	$ 5,289	$ 5,138

AINLEY: 115157
GeoTube Dewatering and CoTreatment of Filtrate

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587
$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583
$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
$ 4,991	$ 4,848	$ 4,710	$ 4,575	$ 4,445	$ 4,318	$ 4,194	$ 4,074	$ 3,958	$ 3,845	$ 3,735	$ 3,628	$ 3,525	$ 3,424	$ 3,326	$ 3,231
$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
$ 11,440	$ 11,668	$ 11,902	$ 12,140	$ 12,383	$ 12,630	$ 12,883	$ 13,141	$ 13,403	$ 13,671	$ 13,945	$ 14,224	$ 14,508	$ 14,798	$ 15,094	$ 15,396
$ 4,991	$ 4,848	$ 4,710	$ 4,575	$ 4,445	$ 4,318	$ 4,194	$ 4,074	$ 3,958	$ 3,845	$ 3,735	$ 3,628	$ 3,525	$ 3,424	$ 3,326	$ 3,231

2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
	$ 435,846													
$ -	$ 435,846	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ 162,668	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587
$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583
$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
$ 3,139	$ 3,049	$ 2,962	$ 2,877	$ 2,795	$ 2,715	$ 2,638	$ 2,562	$ 2,489	$ 2,418	$ 2,349	$ 2,282	$ 2,217	$ 2,153	$ 2,092
$ 8,170	$ 444,016	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
$ 15,704	$ 870,571	$ 16,339	$ 16,665	$ 16,999	$ 17,339	$ 17,685	$ 18,039	$ 18,400	$ 18,768	$ 19,143	$ 19,526	$ 19,917	$ 20,315	$ 20,721
$ 3,139	$ 165,717	$ 2,962	$ 2,877	$ 2,795	$ 2,715	$ 2,638	$ 2,562	$ 2,489	$ 2,418	$ 2,349	$ 2,282	$ 2,217	$ 2,153	$ 2,092

2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097
																$ 435,846															
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 435,846	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 68,176	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587	$ 6,587
$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583	$ 1,583
$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
$ 2,032	$ 1,974	$ 1,918	$ 1,863	$ 1,810	$ 1,758	$ 1,708	$ 1,659	$ 1,611	$ 1,565	$ 1,521	$ 1,477	$ 1,435	$ 1,394	$ 1,354	$ 1,316	$ 1,278	$ 1,241	$ 1,206	$ 1,171	$ 1,138	$ 1,105	$ 1,074	$ 1,043	$ 1,013	$ 984	$ 956	$ 929	$ 902	$ 877	$ 852	$ 827
$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 444,016	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170	$ 8,170
$ 21,136	$ 21,558	$ 21,990	$ 22,429	$ 22,878	$ 23,336	$ 23,802	$ 24,278	$ 24,764	$ 25,259	$ 25,764	$ 26,280	$ 26,805	$ 27,341	$ 27,888	$ 28,446	$ 1,576,918	$ 29,595	$ 30,187	$ 30,791	$ 31,407	$ 32,035	$ 32,675	$ 33,329	$ 33,995	$ 34,675	$ 35,369	$ 36,076	$ 36,798	$ 37,534	$ 38,284	$ 39,050
$ 2,032	$ 1,974	$ 1,918	$ 1,863	$ 1,810	$ 1,758	$ 1,708	$ 1,659	$ 1,611	$ 1,565	$ 1,521	$ 1,477	$ 1,435	$ 1,394	$ 1,354	$ 1,316	$ 69,453	$ 1,241	$ 1,206	$ 1,171	$ 1,138	$ 1,105	$ 1,074	$ 1,043	$ 1,013	$ 984	$ 956	$ 929	$ 902	$ 877	$ 852	$ 827

AINLEY: 115157
GeoTube Dewatering and CoTreatment of Filtrate

2098
$ -
$ -
$ 6,587
$ 1,583
$ 8,170
$ 804
$ 8,170
$ 39,831
$ 804

Appendix - S

Spills Risk Management

Town of Erin
Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Spills Risk Management

April 2018

Urban Centre Wastewater Servicing Class Environmental Assessment

Technical Memorandum
Spills Risk Management

Project No. 115157

Prepared for:
The Town of Erin

Prepared By:

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Simon Glass, B.A.Sc

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Table of Contents

1.0 System Overview

The recommended alternative wastewater system for Erin and Hillsburgh will consist of local and trunk sewers, sewage pumping stations and forcemains, a wastewater treatment plant and an outfall extending to the West Credit River. The wastewater system will extend from the North end of Hillsburgh through to south of Erin Village. As outlined in the Natural Environment Report, a considerable portion of the lands in Hillsburgh and Erin are environmentally sensitive. The West Credit River with tributaries and wetland areas also extend from the north end of Hillsburgh through Erin Village. The proposed infrastructure can experience malfunctions from time to time resulting in the potential for a wastewater spill to the river system.

The wastewater collection system will be completely separate from the stormwater system and will not be connected to roof down pipes or sump pumps. None the less, the flow capacity of the system will include an allowance for inflow and infiltration which is often the cause of spills. As the system ages, there will be opportunities for groundwater and storm water to enter the sanitary sewers. The sanitary sewage system, including pipes and sewage pumping stations, will also be designed for peak flows of 2.7 times the design capacity in accordance with Ministry of Environment and Climate Change (MOECC) design guidelines using the Harmon Peaking Factor. It is noted that all system pipes and pumping station wet wells will be sized and built for their ultimate capacity which will not be reached until full build out and this provides additional storage capacity in the sewer system over the short term. Critical unit processes in the wastewater treatment plant will also be designed for peak flows as per MOECC guidelines. While the plant will undergo a phased construction, each phase will be designed for peak flow. As such, it is unlikely that flows in the system will exceed the system capacity.

Due to the sensitivity of the local environment, overflow pipes from sewage pumping stations or overflow chambers that would permit by-passes or spills of untreated or partially treated wastewater to the natural environment throughout the system are not recommended. Ideally, all flows will be contained in the system until discharge of the treated effluent to the river. However, the trade-off with no overflow outlets to the environment and retaining sewage in the collection system is that the potential for flooding basements in areas serviced by pumping stations increases. This makes design and management of the system more important in order to ensure that sufficient system storage is provided for all flow scenarios.

The effluent disinfection system, in the recommended sewage treatment alternative evaluation, is UV which eliminates the risk of a spill to the river for chlorination and dechlorination chemicals.

2.0 Spills Risks

While the system will be designed to minimize the risk of overflows or spills to the natural environment, or back-ups into private properties, there does still exist some degree of risk. Overflows could potentially arise from:

- Main Breaks
- Main Blockages
- Capacity Exceedances from Infiltration and Inflow during storm events
- Equipment Failure

- Power Failure
- Control/Communications System failure
- Upgrade and expansion projects

2.1 Dealing with Potential Main Breaks

The highest risk of spills from wastewater pipe systems is from forcemain breaks as the pressure from pumps can result in spills to the surface similar to what is visible during watermain breaks. The recommended collection system alternative is based on using twin forcemains from sewage pumping stations except the smallest local stations. Leaks in manholes and sewers are more likely to allow groundwater into the system rather than causing a spill. Other measures to be considered in the design to minimize the risk of spills from main breaks include:

- Quality control during all aspects of construction including on development lands
- Use of heat welded polyethylene pipe for all forcemains
- Use of line valves for isolation of forcemain sections
- Use of pump pressure control to indicate leaks, send alarms and stop pump operation
- Implementing a preventative maintenance program including regular inspections using CCTV

2.2 Dealing with Potential for Main Blockages

Spills from wastewater pipe systems can also result from blockages of the sewer or pump intakes. This can be caused by illegal discharges of grease or large items. The recommended collection system alternative is based on using minimum sized sewers of 200 mm and non-clog sewage pumps. In addition, the entire system will be monitored using a computer control system that will alarm on pump failure or rising liquid levels in the pumping stations. Under normal conditions sewage collection systems operate continuously without blockages. Permitted discharges are defined within a sewer use by-law. Measures to be considered to minimize the risk of spills from blockages include:

- Implementation of a sewer use by-law that prevents discharge of materials likely to block the sewers or damage pumps
- Education leaflets on sewer use aimed at eliminating illegal discharges
- Regular inspections of industrial, commercial and school properties to prevent illegal discharges
- Careful hydraulic design of all elements to prevent sedimentation and deposits/build ups in the system
- Implementing a preventative maintenance program including regular inspections using closed circuit television (CCTV)

2.3 Dealing with Potential for Capacity Exceedances

Overflow events can occur when the volume of water entering the collection system exceeds the capacity of the sewers, pumping stations, or the treatment facility. In such events, the excess sewage can be by-passed through overflow discharges (typically to surface waters) or collected within holding tanks. Without overflows or peak flow storage, excess sewage can also back-up within the collection system ultimately leading to basement flooding.

As noted above, the preferred alternative will be isolated from extraneous flows entering the system and consideration will be given to not allowing overflows out of the system. The system will be designed to contain flow events within collection system capacity, pumping station capacity and treatment capacity.

The potential for capacity exceedances will be greater as the collection system ages. The connection of roof downspouts, sump pump discharges, and stormwater catch basins to the sanitary system are common examples of past practices that have been discontinued and must be prevented. Deteriorated systems can experience flow peaks over 5 times the average flow. This must be prevented through maintenance and inspections. Newer systems and systems without the improper connections would exhibit peak flows as low as 2 times the average flow.

Fully eliminating all sources of system inflow and infiltration is not feasible; however, best practices can significantly reduce the scale of the issue. In a system without improper connections, extraneous flow will still enter the collection system through manhole covers, loose joints, or breaks caused by roots. The sewer use by-law, that is enforced, should address the issue of illegal connections.

Another source of extraneous flows in new collection systems is improper installation of sewer mains and laterals. In order to ensure new installations are completed correctly, testing of installed sewers should include flow monitoring before connections and CCTV inspections. Contractors should be required to repair all deficiencies identified through the monitoring program. Other inflow and infiltration minimizing measures, such as leak-free manhole lids in low-lying areas, should also be adopted.

Often, the installation of sewer laterals on private property can be a significant source of infiltration to the municipal collection system. It is recommended that the Town Building Department only allow the use of pipe materials that are typically specified for use on the municipal side of the collection system. Most municipalities require the use of DR 28 PVC pipe with gasketed joints.

As the system ages, the potential or risk of high flows exceeding the peak capacity of the wastewater treatment plant or pumping stations will increase. This can be managed by increasing storage throughout the system either by constructing additional wet wells at pumping station sites or storage tanks at critical locations such as the last pumping station before the wastewater treatment plant. The volume of storage necessary to manage peak flow events would need to be determined through focused risk assessments to determine the best location for the storage. In establishing sites for sewage pump stations and the treatment plant, provision should be made for the future construction of additional wet well capacity or storage tanks. Risk assessment would include risks associated with system back up and the potential for basement flooding. In the future, if the risk of basement flooding cannot be mitigated using increased storage or system capacity increases, it may be necessary to construct overflows from pumping stations to the river.

The suggested approach to establish the need for peak flow storage is as follows:

- Monitor daily wastewater flow averages and peaks at the treatment facility and track the scale and frequency of peak flow events

- Compare peak flow events to peak flow capacity in the collection system and treatment facility
- Quantify the risk (probability and consequence) of overflow events occurring
- Where the quantified risk is determined to be unacceptable:
  - First:
    - Identify I/I sources through wastewater flow monitoring of the collection system
    - Enact inflow and infiltration reduction measures (pipe relining/ replacement, manhole rehabilitation, etc.)
    - Quantify the impact of inflow and infiltration reduction measures
  - Second:
    - Conduct risk analysis of overflow in each collection area
    - Establish peak flow retention within collection areas where risk exceeds acceptable levels

2.4 Dealing with Potential for Equipment or Pump Failure

Equipment or pump failure also have the potential to result in overflows or spills from wastewater systems. Pumps are a critical component in wastewater systems and are used to convey wastewater from pump stations to the treatment plant. A large number of pump systems also exist in treatment plants to operate many of the processes and finally to convey effluent to the river. Their failure can lead to a rapid build-up of wastewater with the potential for a spill. Likewise, the failure of chemical feed pumps, screens, air blowers, UV systems and other equipment in the treatment plant can result in process failures. The Ministry of Environment and Climate Change (MOECC) provides design guidelines for pumping stations and treatment plant design in Ontario that requires the use of dual or standby equipment for all pumping stations and treatment systems. The use of dual pumps and multiple treatment trains minimize the risk of pump or equipment failure resulting in a spill or discharge of partially treated wastewater. Measures that should be considered in the design and operation of the system to minimize the risk of spills from pump or equipment failure include:

- Installation of a minimum of dual systems for all pumps and equipment at sewage pumping stations and the treatment plant sufficient to ensure continuous operation of all systems
- Design for plant operational flexibility such that pump systems can have multiple duties
- Conduct a risk assessment and develop a contingency and response plan to deal with equipment failures
- Implement a Maintenance Management System (MMS) that prevents equipment failure
- Adopt a proactive approach to fixing any piece of equipment that is out of operation.
- Develop a contingency plan to by-pass pumping stations
- Maintain an inventory of critical spare parts on site

2.5 Dealing with Potential for Power Failure

Wastewater systems must have a continuous and reliable supply of power for the safe operation of the system. The preferred treatment plant alternative has a wide range of equipment, instruments and control devices that require continuous and stable power. Treatment plants and pumping stations are built in strict compliance with electrical codes that ensure all electrical systems are safe and reliable. Measures that should be considered in the design and operation of the system to minimize the risk of spills from power failure include:

- Negotiate multiple power feeds to sewage pumping stations and treatment plant with the power authority
- Consider using twin power transformers to ensure a more robust supply
- Install standby power with automatic transfer from the prime power source sufficient to maintain the entire facility in operation during prime power failure
- Select a fuel supply for standby power based on the security of the supply (gas or diesel)
- Protect all electrical systems against the threat of lightning strikes

2.6 Dealing with Potential for Control/Communication Failure

Continuous operation of the wastewater system will rely on the System Control and Data Acquisition (SCADA) System. This is the system that will automatically control the operation of all equipment throughout the system 24 hours a day. It automatically starts and stops equipment as necessary and provides alarms to the operators in the event of any failure. Typically, operators can remotely investigate any issues with the operation and either remotely start a standby system, or go to the facility and take manual control of the particular system. The control system consists of sensing instruments, controllers and computers using control software customized for the particular system operation.

A system wide communications system that allows all facilities to be interconnected to the control system must also be robust and secure to support system reliability.

SCADA systems improve the reliability of the operation and greatly reduce the response time needed to deal with operational issues. Measures that should be considered in the design and operation of the system to minimize the risk of spills resulting from a control/communications system failure include:

- Design the SCADA system with dual controllers and computers
- Ensure protection and back up of all sensitive controls and computer networks using Un-interruptible Power Supply (UPS)
- Develop a contingency plan for manual operation in the event of control system failure
- Regularly maintain all sensing instruments

2.7 Upgrade and Expansion Projects

Upgrade and expansion projects can often be a source of planned bypasses if systems require to be taken out of operation to facilitate installation of new or replacement equipment. Measures that should be considered in the design to eliminate the need for bypassing during construction include:

- Conceptually design full build-out of the plant during the first phase and develop a constructability plan for all phases that eliminates the need to remove units from operation during future construction phases.
- Ensure sufficient isolation valves are constructed in the first phase.
- Provide for connection to future expansions during Phase 1.
- Provide for the replacement of all equipment while maintaining system capacity.

Appendix - T

Scope of Environmental Management Plan

Town of Erin
Urban Centre Wastewater Servicing
Class Environmental Assessment

Scope of Environmental Management Plan

April 2018

Urban Centre Wastewater Servicing
Class Environmental Assessment

Technical Memorandum
Scope of Environmental Management Plan

Project No. 115157

Prepared for:
The Town of Erin

Prepared By:

Melvin Van Os, E.I.T

Reviewed By:

Gary Scott, M.Sc., P.Eng.

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1.0 Wastewater System Overview

The recommended alternative wastewater system for Erin Village and Hillsburgh will consist of local and trunk sewers, sewage pumping stations and forcemains, a wastewater treatment plant and an outfall extending to the West Credit River. The wastewater system will extend from the North end of Hillsburgh through to south of Erin Village. As outlined in the Natural Environment Report, a considerable portion of the lands in Hillsburgh and Erin Village are environmentally sensitive. The West Credit River with tributaries and wetland areas also extend from the north end of Hillsburgh through Erin Village. Pipelines will mostly be on existing rights of way as well as the Elora Cataract Trail. Sewage Pumping Stations will be on public and private lands with several close to sensitive environmental features. The Wastewater Treatment Plant will be located in open lands with several sensitive features. The project is likely to generate a wide range of construction activities throughout a sensitive environmental landscape and could potentially impact surface waters, groundwater, trees within woodlots and along existing streets as well as wildlife, vegetation and fish.

To support the Class Environmental Assessment process, a Natural Environment Assessment and Geotechnical study were undertaken for the project area primarily to assist with establishment and evaluation of alternative solutions.

To support construction, a more detailed assessment will be required on each facility site and along all of the streets and routes for pipelines. This more detailed assessment will delineate all potential environmental impacts and will outline necessary mitigations to eliminate negative impacts.

It is recommended that all of the necessary studies be undertaken at an early stage in the design of the wastewater system to ensure that potential impacts are taken into consideration in the siting and timing of the works so as to avoid conflicts with natural environment hazards during construction.

This Technical Memorandum sets out to define the scope of an Environmental Management Plan that captures all of the necessary studies and mitigations necessary to support construction. The scope was developed based on work undertaken for previous similar projects as well as comments received from statutory authorities during the Class EA process. When completed, the Environmental Management Plan will provide guidance to designers and contractors to minimize potential impacts to the environment.

During construction of the works, it is recommended that, in addition to construction inspectors on site, all construction work be monitored by an environmental inspector responsible for making sure that works are carried out in accordance with the Environmental Management Plan.

It is anticipated that the Environmental Management Plan will be submitted in support of permits required by Credit Valley Conservation. The scope of an Environmental Management Plan will be developed and agreed with CVC and any other relevant agencies prior to commencement of project implementation.

2.0 Suggested Scope of Environmental Management Plan (EMP)

The following outlines a suggested scope for the EMP:

2.1 Regulatory Approvals, Authorization and Permits

The project will have to comply with all relevant environmental legislation, regulations, permits, approvals and exemptions at a federal, provincial and municipal level. The EMP should identify all of the anticipated permits, approvals and exemptions relevant to this project. Approvals include:

Federal Regulatory Approvals

Federal Regulatory approvals include but are not limited to the following:

- Fisheries Act
- Migratory Birds Convention Act
- Species at risk Act

Provincial Regulatory Approvals

Provincial Regulatory approvals include but are not limited to the following:

- Conservation Authorities Act
- Endangered Species Act
- Municipal Act
- Trees Act

2.2 Project Implementation

Timing

The EMP should identify the anticipated timeline, from tendering and contract reward to the various phases of construction. Regulatory requirements should be considered when establishing a timeline. All timing restraints so to minimize the impact on the environment as well as the community should all be identified and built in to construction contracts.

Construction Impacts

All necessary studies including geotechnical, hydrogeological and environmental will need to be carried out as necessary to identify construction methods necessary to mitigate any potential impacts on the natural environment. The following will need to be determined through necessary studies and assessments.

Extent of Disturbance

- Ground composition for all excavated areas so as to identify any potential contamination, soil conditions and groundwater conditions sufficient to develop construction methods that mitigate any impacts.

Erosion and Sediment Controls.

- Construction methodologies that require erosion and sediment control and their timing.
- Location of erosion and sediment control.
- Erosion and sediment control plan approvals.
- Inspection requirements

Dewatering

- Hydrological assessments to determine the locations of ground water control.

- Analysis of local surface water to determine quality.
- Construction methods that require dewatering and the timeline thereof.
- Zone of influence – the lateral extent of ground water drawdown and its severity.
- Inspection requirements.
- Dewatering parameters such as:
    - Steady state ground water inflow rate.
    - Excess inflow rate from groundwater storage and precipitation.
    - Total pumping rate allowance.
    - MOECC permit to take water requirements.
    - Discharge location and monitoring.
        - Requirements for discharge into a storm sewer.
        - Requirements for discharge into a creek.
        - On site discharge treatment facilities.
        - Analysis of water chemistry parameters: Cobalt, Aluminum, iron and TSS.
        - Frequency of monitoring.
        - Monitoring equipment.
        - Turbidity of discharge.
        - Contingency plan if discharge does not meet requirements.
        - Restoration of treatment facilities.

Soil Management

- Storage and reuse of any disturbed soils.
- Development of a soil management plan.

2.3 Natural Heritage Existing Conditions Information

A detailed Natural Heritage assessment of existing conditions of all areas that may be affected by construction should be carried out as follows:

Vegetation and Vegetation Communities

Identify features that would be considered candidate Life Science Area of Natural and Scientific Interest (LS-ANSI), Provincially Significant Wetlands (PSW) or other provincially significant features.

The methodology used for determining geographical extent, composition, structure and function of all vegetation communities should be described as well as methods and software used for conducting a tree inventory. The significance of the timing of the survey should also be defined.

The vegetation and vegetation communities will need to be classified within the study area. The following information is gathered:

- Zoning and associated semi-natural/natural vegetation.
- Topography and the corresponding wetlands and uplands.
- LS-ANSI, PSW and other areas of significance.
- Plant species and forest types.
- Previously disturbed areas and the effect the disturbance had on the vegetation.

Information collected in the tree inventory is to be compiled into an arborist report. Details of the arborist report include:

- Information collected in tree inventory such as, total number of trees, species identification, breast height, diameter at breast height, tree condition, canopy structure, crown vigour and other general comments.
- Location and ownership of the trees
- Significance of the timeline of tree capture
- Location of large trees
- Location of smaller trees
- Trees regulated under the Endangered Species Act.

Significant areas to be impacted by construction should be recognized and opportunities to avoid or minimize vegetation removal in these areas should be discussed. Disturbance limits, protection measures and restoration requirements should also be established in consultation with the relevant agencies.

Fish and Fish Habitat

Fish habitat communities within the study area have previously been identified. The EMP will focus on the potential for disturbance during any in water work including any pipe crossings or construction of the effluent outfall structure.

Surveys should be conducted at the sites of any potential impacts on fish and fish habitat including areas for discharge from dewatering activities as well as in water work and the following defined:

- Identify species that could be affected
- Define potential impacts from construction activities
- Suggest mitigations and timing limitations for construction activities

Wildlife and Wildlife Habitat

Wildlife habitat communities within the area of any construction activities will need to be fully defined as follows:

- List significance wildlife species
- Define potential impacts from construction activities
- Suggest mitigations and timing limitations for construction activities

2.4 Environmental Protection and Mitigation Plan

Describe the environmental protection measures that will be implemented during construction to avoid or mitigate adverse environmental effects and identify entities responsible for the implementation. For each of the following, identity any adverse activity; the anticipated effect of that activity; environmental protection and mitigation measures to compensate for the adverse effects of that activity; and the relevant regulatory requirements concerning the activity.

- Vegetation and Vegetation Communities
- Fish and Fish Habitat
- Wildlife and Wildlife Habitat
- Designated Natural Areas

2.5 Regulatory Approvals, Authorizations and Permits

The EMP will present in tabular format, the permits approvals and exemptions required for the project.

2.6 Environmental Inspection/Monitoring Measures

The EMP will describe the environmental inspection and monitoring measures to be implemented pre-construction, during construction and post-construction. The following should be defined:

- Powers and Functions of the Environmental Inspector
- Reporting Requirements
- Type, Elements and Frequency of Environmental Inspection/Monitoring

2.7 Contingency and Emergency Response Measures

The EMP will describe the measures that the contractor and owner will be required to follow during construction operation and maintenance in response to emergencies and unforeseen events. Contingency measures should be provided for events such as but not limited to:

- Fuel and Hazardous Material Spills Response
- Failure of Erosion and Sedimentation Control Measures
- Tunneling failure
- Encounters with species at risk
- Spills response during commissioning and operation of the wastewater system

Appendix - U

Opinion of Costs

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April 24, 2018 File No. 115157

Triton Engineering Services Limited
105 Queen Street West Unit 14
Fergus, ON N1M 1S6

Attn: **Christine Furlong, P.Eng.**
Project Manager

Ref: **Town of Erin, Urban Centre Wastewater Servicing Class EA**
Erin Wastewater Capital Cost Summary Report

Dear Ms. Furlong:

We are pleased to present our Report outlining "Wastewater System Capital Costs" for the Urban Centre Wastewater Servicing Schedule 'C' Municipal Class Environmental Assessment (EA).

This Report provides an outline of the capital cost estimates for the preferred alternative sanitary system components. The estimated capital cost for all system aspects are presented along with discussion of potential cost sharing opportunities. The cost estimates for servicing the existing community and the potential full buildout community are presented for comparison.

Should you have any questions or require clarifications, please contact the undersigned.

Yours truly,

AINLEY & ASSOCIATES LIMITED

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Joe Mullan, P.Eng.
Project Manager

Town of Erin

Urban Centre Wastewater Servicing
Class Environmental Assessment

Erin Wastewater System
Capital Cost Summary Report

April 2018

Urban Centre Wastewater Servicing Class Environmental Assessment

Wastewater Capital Cost Summary Report

Project No. 115157

Prepared for:
The Town of Erin

Prepared By:

Simon Glass P.Eng.

Reviewed By:

Gary Scott, M.Sc., P.Eng.

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Executive Summary

- The Urban Centre Wastewater Servicing Class EA (UCWS EA) identified the opportunity to service a higher population than assumed in the Servicing & Settlement Master Plan (SSMP), an increase from a service residential population of 6,000 to 14,559.
- Costing has been completed on the basis of servicing to this higher population level.
- Connected properties will have to pay for 3 separate cost components:
  - **Municipal System Capital Cost**
    - Identifies the cost to construct the entire wastewater system up to the street line/property line outside each property.
    - Financed by the Town and paid for by all connected properties.
    - Payment options will be offered by the Town including upfront payment or loans over a number of years.
    - Eligible for a government grant.
  - **Private Property Connection Cost**
    - The cost to connect the system from the street into each property.
    - Paid for directly by the property owner at time of connection.
    - Not eligible for a government grant.
  - **System Operating Cost**
    - Paid for through monthly billing to serviced properties through user rates similar to water rates.
- This capital cost report addresses the Municipal System Capital Cost and the Private Property Connection Cost which together account for the full cost to build the wastewater collection and treatment system and connect all of the properties.

Municipal System Capital Cost

- System Capital Costs presented herein were all developed in a series of independent memoranda covering each aspect of the system including:
  - Collection system,
  - Wastewater treatment plant (WWTP), and
  - Treated effluent outfall.
- System Capital Costs presented herein were developed on the basis of servicing the existing community including infill and intensification as well as all new growth potential.
- The updated System Capital Cost estimate is based on the more accurate design solution from the UCWS EA including:
    - A refined service area.
    - A comprehensive collection system design solution.
    - A treatment plant design solution capable of meeting stringent effluent requirements for discharge to the West Credit River.
    - Selected outfall location.

- The System Capital Cost of constructing a system for the larger service population including all of the designated development lands shown in the Town's Official Plan is approximately $118.2 million.

- A summary of the System Capital Costs for each system component for the full build-out scenario is provided in Table E1.

Table E1 – System Capital Cost

System Component	Estimated Cost (2017 CAD$)
Collection System	$ 55,211,000
Treatment System	$ 61,381,500
Outfall	$ 1,606,760
Total	**$ 118,199,260**

- The share of system capital cost between existing residents and new development is an important consideration.
- In order to identify the system capital cost sharing between the existing communities and new developments an Official Plan (OP) review process will need to be completed and system capacity will need to be allocated based on the OP objectives.
- For all aspects of the system shared between the existing community and development, it is recommended that system capital cost sharing is based on capacity/flow proportioning between the existing communities and developers.
- It is recognised that system capital cost sharing will also depend on project financing and implementation.
- Based on a review of the preferred alternative identified in this Class EA study, it is likely that the Town share of the system capital cost will be between $50 million and $60 million, representing 40% to 50% of the total cost.
- This will leave the balance of the $118.2 million between $58 million and $68 million to be paid by developers representing 50% to 58% of the total cost.
- The Town's share of the larger system will be less than if a smaller system was built by the Town to service the existing areas with only modest growth.
- The Town's share of the cost may depend on:
    - The extent sharing necessary for the collection system to service all the planned growth areas.
    - Whether the first phase is primarily to support the existing community.
    - Whether the first phase is primarily aimed at servicing new developments.
- The actual capital cost share between the Town and developers can only be established after allocation of capacity across the system and when planning approvals and financing is in place.
- The capital cost will be shared between each property in the existing communities plus any infill or additional units added within the communities which could be up to a total of 2,670 lots.

- Although the Town's share of the cost would be between $50 and $60 million, the Town has no means to finance this amount. In fact, the Town can only finance approximately $15 to $18 million. The balance of the funding will have to come from government grants or other funding sources.
- The project cannot proceed without government grants
- Based on a Town net cost of $18 million and anticipating servicing 2672 lots in the existing communities including infill and intensification, this means that the average municipal capital cost component for each property would be $7,500.
- Based on this, the Town could finance between 33% and 40% of their $50 to $60 million share of the project cost, with the balance of between 60% and 67% of the cost coming from a government grant or other funding sources.
- Typically government grants only pay for infrastructure that service the existing community. Infrastructure required for growth is paid for by benefitting new development.

Private Property Connection Cost

- In addition to the system capital costs defined above, each property will need to connect to the system.
    - Costs to connect each private property to the municipal system at the property line will be the responsibility of the property owners.
    - A range of connection costs were developed for both the piping and landscaping required for connecting private properties to the system and make the existing septic tank safe.
        - Piping costs range from $3,200 – $14,700, with the typical lot paying $4,500.
        - Landscaping costs range from $600 - $5,500, with the typical lot paying $1,500.
        - On average most properties can expect to pay between $4,000 and $8,000 with the average cost being approximately $6,000 to connect to the system.

Overall Capital Cost for Connected Properties

- Connected properties will have to pay their share of the **Municipal System Capital Cost** which will be approximately $7,500 on average with industrial/commercial properties paying more than this depending on their wastewater flow.
- Connected properties will have to pay their own **Private Property Connection Cost** to connect to the sewer in the street with most properties costing between $4,000 and $8,000.
- So each property would have to pay for the $7,500 system construction cost and $4,000 to $8,000 connection cost. A total of $11,500 to $15,500.

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1.0 Introduction

This Technical Memorandum has been prepared as a summary report for the capital cost estimates for all components of the Wastewater System recommended preferred alternative. The information provided is in support of the Town of Erin Urban Centre Wastewater Servicing Environmental Assessment (UCWS EA).

Properties within Erin Village and Hillsburgh are currently serviced by individual private septic systems. The Servicing and Settlement Master Plan (SSMP), completed by B.M. Ross in 2014, selected a municipal wastewater collection system for both communities as the preferred general alternative solution to deal with issues related to the private systems and growth. The SSMP completed part of Phase 1 and part of Phase 2 of the Class Environmental Assessment process and the Town is now engaged in completing these two phases and moving on to complete Phase 3 and Phase 4 of the Class EA process.

The UCWS EA has identified the opportunity to service a higher population than was assumed in the SSMP and the costing has been completed on the basis of servicing to this higher population level. The estimated capital costs presented herein were all developed in a series of independent memoranda covering each aspect of the system, i.e. the collection system, wastewater treatment facility, and treated effluent outfall. Costs presented were developed on the basis of servicing the existing community including infill and intensification as well as all new growth potential.

2.0 Objectives

The objectives of this report are as follows:

- Provide a clear outline of the estimated capital costs for all system components
- Compare the capital costs of establishing a system for the existing community and for the full build out
- Define the cost sharing opportunities between the existing community and development

3.0 Capital Cost Overview

Within the SSMP, a capital cost estimate was generated based on 2014 prices, to service the existing communities with a small allowance for growth to service an equivalent population of 6,000 persons. The capital cost estimate identified in the SSMP was $58.0 million. Inflating this to 2017 prices would give a present day cost of $63.4 million.

The UCWS EA has identified the opportunity to expand the residential population to 14,599. The UCWS EA also refined the service area, completed development of a more comprehensive collection system design solution and also identified a treatment plant design solution to meet the stringent effluent requirements needed to meet the MOECC effluent limits for discharge to the West Credit River as well as selecting an outfall location. The capital cost to service this larger population is therefore based on a more accurate design solution than was used in the SSMP.

In order to compare the capital cost of servicing the existing communities based on the more accurate design solution from the UCWS EA with the SSMP cost, the team has identified an updated cost to service the existing communities alone using the latest design solution while also allowing for infill and intensification within the existing built boundary. The updated cost, determined through the UCWS EA, to service the existing communities would be $72.4 million which would need to be paid for by the existing property owners including infill and intensification.

The capital cost of constructing a system for a larger service population including all of the designated development lands shown in the Town's Official Plan would be substantially higher at $118,200,000. These capital cost scenarios are summarised in Table 1. All project costs include both engineering and construction costs as well as a 15% contingency.

Table 1- Capital Cost Comparison

Cost Scenario	Estimated Capital Cost ($2017)
SSMP – Existing Communities Only	63,400,000*
UCWS EA – Existing Communities Only	72,400,000
UCWS EA – Full Build-Out Including new Developments	118,200,000

*Inflated to $2017 at 3%/year

The local sewers needed within each new development area are not included in the above full build out costs, as these costs are 100% the responsibility of the developers. It is important to note that there is a considerable scale effect from constructing the larger system with the cost per unit reducing with an increased service population.

4.0 UCWS EA Full Build-Out Capital Cost

Capital cost estimates have been developed for each component of the wastewater system. The following sections summarise the capital cost estimates for the collection system, treatment system, and outfall. A summary of the capital costs for each system component is provided in Table 2.

Table 2 – Full Build-Out System, Capital Cost Summary

System Component	Estimated Cost (2017 CAD$)	
Collection System	$	55,211,000
Treatment System	$	61,381,500
Outfall	$	1,606,760
Total	**$**	**118,199,260**

4.1 Collection System Capital Cost

The estimated capital costs for the proposed blended gravity/ low pressure sewer system are outlined in Table 3. The capital costs presented in Table 3 are based on servicing the full build out population.

Table 3 – Blended System Capital Cost Summary

System	Estimated Cost (2017 CAD$)
Trunk and Local Gravity Sewers	$ 23,072,000
Pressure Sewers	$ 1,008,000
Manhole Installation	$ 2,884,000
Grinder Pump Stations	$ 504,000
Sewage Pumping Stations	$ 16,534,000
Forcemains	$ 9,429,000
Approvals	$ 500,000
Portable Generator	$ 150,000
Land Acquisition	$ 500,000
Utility Relocations	$ 630,000
Total Capital Cost	**$ 55,211,000**

The collection system costs identified in this section include all costs for sewers in the streets up to the lot line at each property. They do not include the connection costs on private property to connect to the existing sewage pipe that currently outlets to the septic tank. This connection cost estimate is outlined in section 6 below.
No phasing of the collection system has been identified as there are many implementation scenarios depending on which areas are serviced first.

4.2 Wastewater Treatment Plant Capital Cost

Based on the recommended preferred alternative, an estimate of the construction costs for the treatment plant was generated. The estimate incorporates factors such as equipment costs, tankage and building construction costs, site works, standby power, land acquisition, engineering fees and permits.

The capital cost estimates are presented in Table 4 based on servicing the full build out population.

Table 4 – Estimated Capital Construction of Erin WWTP

Component	Full Buildout Capital Cost Estimate (2017 Dollars)
Preliminary Treatment/ Headworks	$ 3,312,000
Primary/ Secondary /Tertiary Treatment	$ 24,786,480
UV Disinfection	$ 759,000
Effluent Pumping	$ 2,700,000

Component	Full Buildout Capital Cost Estimate (2017 Dollars)	
Effluent Re-Oxygenation	$	100,000
Biosolids Treatment	$	13,718,000
Septage Management	$	1,315,000
Odour Control	$	3,499,000
Standby Power	$	1,800,000
Administration and Maintenance Buildings	$	960,000
Site Works	$	7,647,020
Land Acquisition	$	785,000
Total Capital Costs:	**$**	**61,381,500**

4.3 Outfall Capital Cost

The preferred outfall location is at Winston Churchill Boulevard. The capital cost estimate includes the cost of the pie and appurtenances to convey the effluent from outside the treatment plant site to the West Credit River at Winston Churchill Boulevard. The cost for effluent pumping equipment and pipe on the WWTP site is included in the treatment plant cost.

The cost estimate breakdown is provided in Table 5.

Table 5 – Outfall Capital Cost Estimate, Full Buildout Scenario

Alternative 2 (Twin 300mm Forcemains + 300mm Gravity Sewer)					
	Units	Unit Cost		Cost	
Twin 300mm Forcemain	1696 m	$	800	$	1,356,800
300mm Gravity Sewer	323 m	$	520	$	167,960
Manholes	4	$	10,000	$	40,000
Air Chambers	1	$	12,000	$	12,000
Outfall Structure	1	$	30,000	$	30,000
			Total	**$**	**1,606,760**

5.0 Capital Cost Sharing Opportunities

The summary of costs presented in Table 2 provides an outline of the capital cost to service the existing community as well as costs associated with constructing the system to allow for new development including oversizing gravity sewers and pumping stations to allow for increased flow from the development areas.

In order to identify the cost sharing between the existing communities and new developments, it will be necessary to:

- Complete the Official Plan (OP) Review process including allocation of required growth from Wellington County

- Based on the updated OP, allocate capacity to the existing community and to infill and intensification in accordance with the OP objectives
- Based on the updated OP, allocate capacity to each development area in accordance with the OP objectives for residential density, commercial, industrial and institutional developments
- After completing allocation of sewage capacity in accordance with the OP objectives, revise the collection system design to meet the flow capacity requirements of all areas.

It is recommended that, cost sharing will be based on:

- Allocation of collection system costs based on capacity/flow proportioning between the existing communities and developers for all trunk sewers, pumping stations and forcemains
- Allocation of treatment plant costs based on capacity/flow proportioning between the existing communities and developers
- Allocation of outfall costs based on capacity/flow proportioning between the existing communities and developers

It is recognised that cost sharing will also depend on project financing and implementation.

Implementation planning will depend on:

- Financing limits of the Town and the ability to secure funding from the Province and the Federal Government
- Varying schedules and approvals for all of the developers

Implementation scenarios might include:

1. A first phase primarily driven by the Town if funding is in place prior to the developments being approved. In this case, the Town costs may be slightly higher as the developers may not be in a position to finance a share of the initial phase.

2. A first phase wherein both the Town (with upper government funding in place) and developers are able to jointly fund the first phase with the developers being in a better position to cost share and to provide front end financing. In this case, the Town share would likely be reduced.

3. A first phase wherein the developers are the prime drivers and would finance and front end the development of the trunk sewer system and treatment plant. In this case the Town share maybe further reduced compared to scenario 2 above.

Based on a review of the preferred alternative identified in this Class EA study, it is likely that the Town share will be approximately $60 million if the first phase is primarily to support the existing community and approximately $50 million if the first phase is primarily aimed at servicing new developments.

The actual cost share can only be established after allocation of capacity across the system and when planning approvals and financing are in place.

Although the Town's share of the cost would be between $50 and $60 million, the Town has no means to finance this amount. In fact, the Town can only finance approximately $15 to $18 million. The balance of the funding will have to come from government grants or other funding sources. Based on a Town net cost of $18 million and anticipating servicing 2672 lots in the existing communities including infill and intensification, this means that the average capital cost for each property would be $7,500 for the construction on public streets.

Based on this, the Town could finance between 33% and 40% of their $50 to $60 million share of the project cost, with the balance of between 60% and 67% of the cost coming from a government grant or other funding sources.

6.0 Connection Costs on Private Property

The total system cost will include the municipal capital cost, identified in section 4 above, to the lot line of each property. Costs to connect from the municipal property line to the building on each private property will be the responsibility of the property owners and these costs have been estimated by the project team based on a survey existing properties in the community.

In order to develop an accurate assessment of connection costs throughout Erin Village and Hillsburgh, a street-by-street survey was conducted to assess the level of difficulty to connect homes to a collection system. Constructability aspects considered included the amount of landscaping which would be required to connect, the distance from the existing septic system to the street, tree and shrub removals/ replacement, and any driveway, curb and/or sidewalk repairs which would be necessary.

Each property was assessed for connection difficulty and rated on a five point scale for piping cost and for landscaping cost with 5 being the most difficult construction rating. The connection difficulty ratings for landscaping and piping are independent and are not inherently linked. For example, a property could receive a landscaping rating of 5 with a plumbing rating of 1.

The costs associated with each piping rating are summarized in Table 6. For the piping ratings a capital cost for both "gravity based systems" and "pressure based systems" are provided.

Table 6 – Service Connection Costing for Piping

Piping Rating	Unit	Gravity Based System Cost	Pressure System Cost
1 – Simple Connection	15-20m of sanitary lateral	$ 3,700	$ 3,200
2 – Through Driveway	15-20m of sanitary lateral	$ 4,200	$ 3,600
3 – Long Distance	21-30m of sanitary lateral	$ 4,700	$ 4,000
4 – Long Distance, Through Driveway	21-30m of sanitary lateral	$ 5,100	$ 3,400
5 – Difficult connection requiring internal plumbing or large commercial connection	15-20m of sanitary lateral	$ 14,700	$ 5,000

The frequencies of the connection ratings assigned to the existing community are displayed in Figure 1.

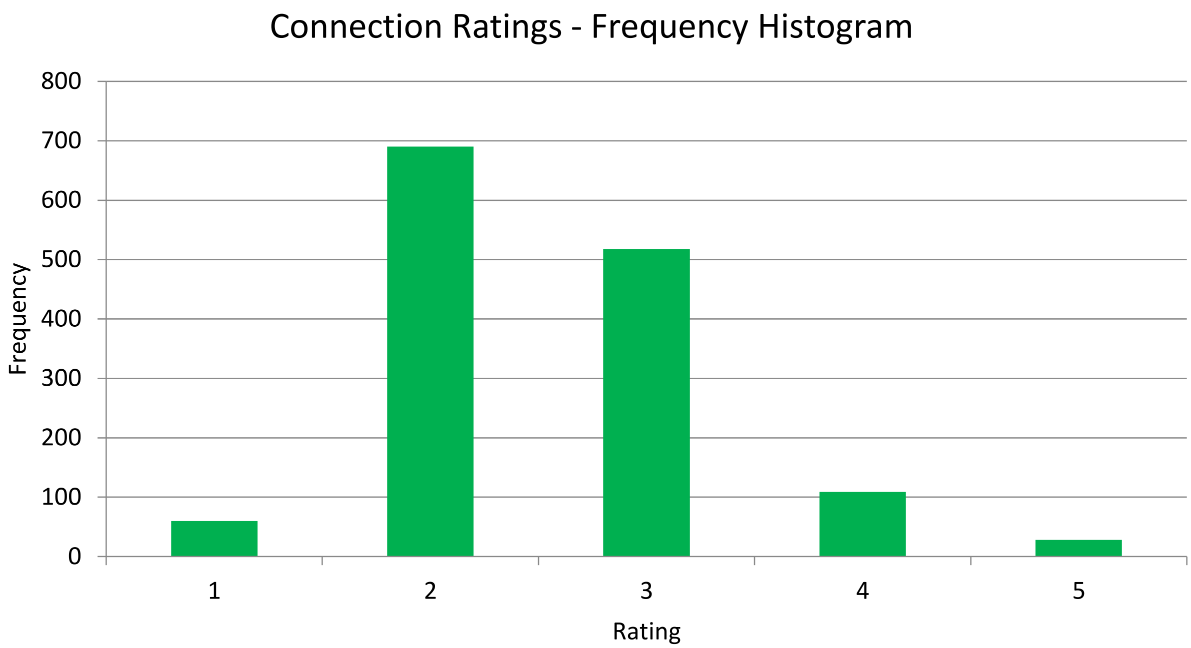


Figure 1 – Connection Rating Histogram

The costs associated with each landscaping rating are summarized in Table 7.

Table 7 – Service Connection Costing for Landscaping

Landscaping Rating	Unit	Gravity Based System Cost
1 – Minor Grass Replacement	30 m^2 – Sod and Topsoil	$ 600
2 – Major Grass Replacement	60 m^2 – Sod and Topsoil	$ 1,000
3 – Shrub/Garden Impacts	30 m^2 – Sod and Topsoil Shrub/Hedge Replacement	$ 1,300
4 – Single Tree Replacement	30 m^2 – Sod and Topsoil Tree Removal/Replacement	$ 3,000
5 – Multiple Tree Replacements	30 m^2 – Sod and Topsoil Multiple Tree Removal/Replacement	$ 5,500

The frequencies of the landscaping ratings assigned to the existing community are displayed in Figure 2.

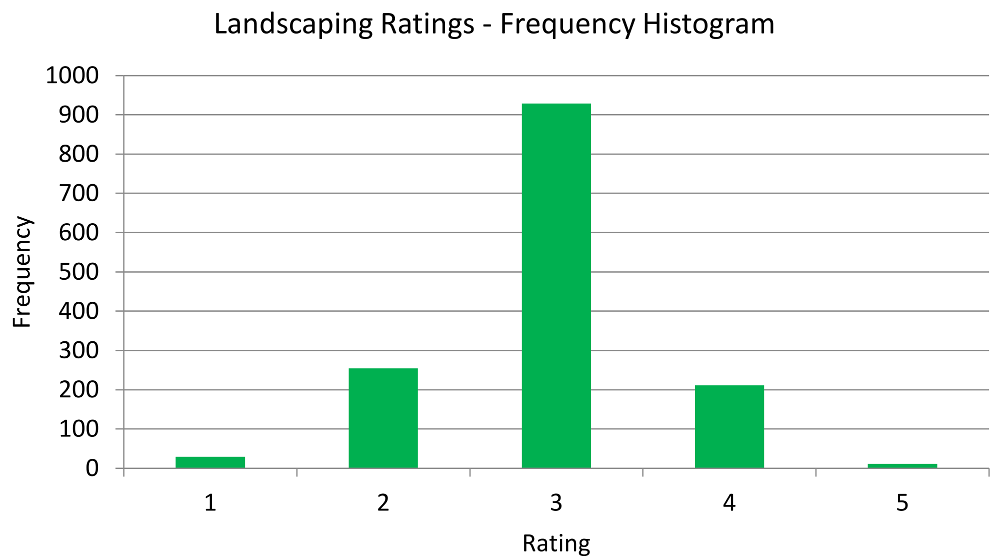


Figure 2 – Landscaping Rating Histogram

Watson & Associates ECONOMISTS LTD.

Plaza Three
101-2000 Argentia Rd.
Mississauga, Ontario
Canada L5N 1V9
Phone: (905) 272-3600
Fax: (905) 272-3602
e-mail: info@watson-econ.ca

Memorandum

To:	Gary Scott and Joe Mullan, Ainley Consulting Christine Furlong, Triton Engineering	Fax	☐
From:	Gary Scandlan	Courier	☐
Date:	March 31, 2018	Mail	☐
Re:	Financial Assessment of Town of Erin Urban Centre Wastewater Class EA	e-mail	☐

1. Study Purpose

In 2014, the Town of Erin completed a Servicing and Settlement Master Plan (SSMP) to address servicing, planning, and environmental issues within the Town. The study area for the SSMP included Erin Village and Hillsburgh as well as a portion of the surrounding rural lands. The SSMP considered servicing and planning alternatives for wastewater and identified a preferred wastewater servicing strategy for existing and future development in the study area. The SSMP was conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA), which is an approved process under Ontario's Environmental Assessment Act. The SSMP addressed Phase 1 & components of Phase 2 of the Class EA planning process.

Through the Urban Centre Wastewater Servicing Class EA (UCWS Class EA) the Town is now continuing with a review of Phase 2 and completing Phases 3 & 4 of the Class EA Planning Process to determine the preferred design alternative for wastewater collection for the existing urban areas of Erin Village and Hillsburgh, and to accommodate future growth. The Town has retained Ainley Consulting Engineers to undertake this work.

The aforementioned SSMP concluded that the preferred solution for both communities is a municipal wastewater collection system conveying sewage to a single wastewater treatment plant located south east of Erin Village with treated effluent being discharged to the West Credit River. In total, the treatment plant would service a population of 6,000. In completing Phase 2 activities within the UCWS Class EA, the preferred solution, remains as established under the SSMP, however, the serviced population has been increased to 14,559 persons to account for growth in accordance with the Town's Official Plan (OP).

The UCWS Class EA outlines a wastewater servicing plan for a population of 14,559, sufficient to service both existing communities and full buildout growth to meet the development potential of future development lands identified in the present OP. The present community has 1,800 residential/commercial/industrial units along with the potential to provide for 872 infill/intensification units (a total of 2,672 equivalent units).

As part of the SSMP process, Watson & Associates Economists Ltd. were retained to undertake a financial evaluation of the servicing plan. Watson has been retained again to consider the following matters related to the servicing of these communities with a draft wastewater solution, as follows:

- The method and impact of financing for the servicing costs and the implications on the Town's finances
- A breakdown of the costs by growth capital costs to be funded by developers, existing resident costs to be funded by properties receiving the wastewater servicing, and property connection costs
- Identify the potential cost impact on households and businesses
- Identification of capital financing methods available to the Town based upon the nature of the costs, past policies of the municipality, and the perspective of Council
- Municipal debt load capacity limits and potential grant funding needs

2. Summary of Capital Costs

The study team have undertaken a number of Public Information Centres regarding the servicing solution for the Erin and Hillsburgh communities. At the February 2, 2018 meeting, the design alternatives and draft servicing approach were presented. In support of Ainley's draft recommendations, the following reports have been prepared and were presented for public review and comment:

1. Natural Environment Report
2. Outfall Alternatives Technical Memorandum
    - Selects preferred site for discharge to West Credit River
3. Wastewater Treatment Plant (WWTP) Site Selection Technical Memorandum
    - Selects preferred site for WWTP
4. Collection System Alternatives Technical Memorandum

- Identifies preferred Collection System

5. Pump Stations and Forcemains Routing Alternatives Technical Memorandum

   - Identifies preferred Forcemain routing between Hillsburgh and Erin

6. Wastewater Treatment Technology Evaluation Technical Memorandum

   - Identifies preferred treatment system

7. Other Reports including Cultural Heritage Assessment Report, Stage 1 Archeological Assessment Report & Geotechnical/ Hydrogeological Report

The draft servicing plan provides for an identified capital costs of $118 million (2017$) to service both the existing and future properties (14,559 residential population), as follows:

System Component	Capital Cost (2017$ rounded)
Collection System	$55,211,000
Treatment System	$61,381,500
Outfall	$1,607,760
Total System Costs	**$118,119,260**

The above costs provide for servicing to the property line of existing homes and businesses. These properties would have to extend the services from the property line into the home. These costs are expected to be approximately $6,000 per home (note that costs will vary depending upon the distances from the home to the property line, location of the connection to the house, potential repairs to lawns/gardens/driveways, etc.). This matter is discussed in more detail within the Ainley Group Report.

3. Allocation of Capital Cost Benefit

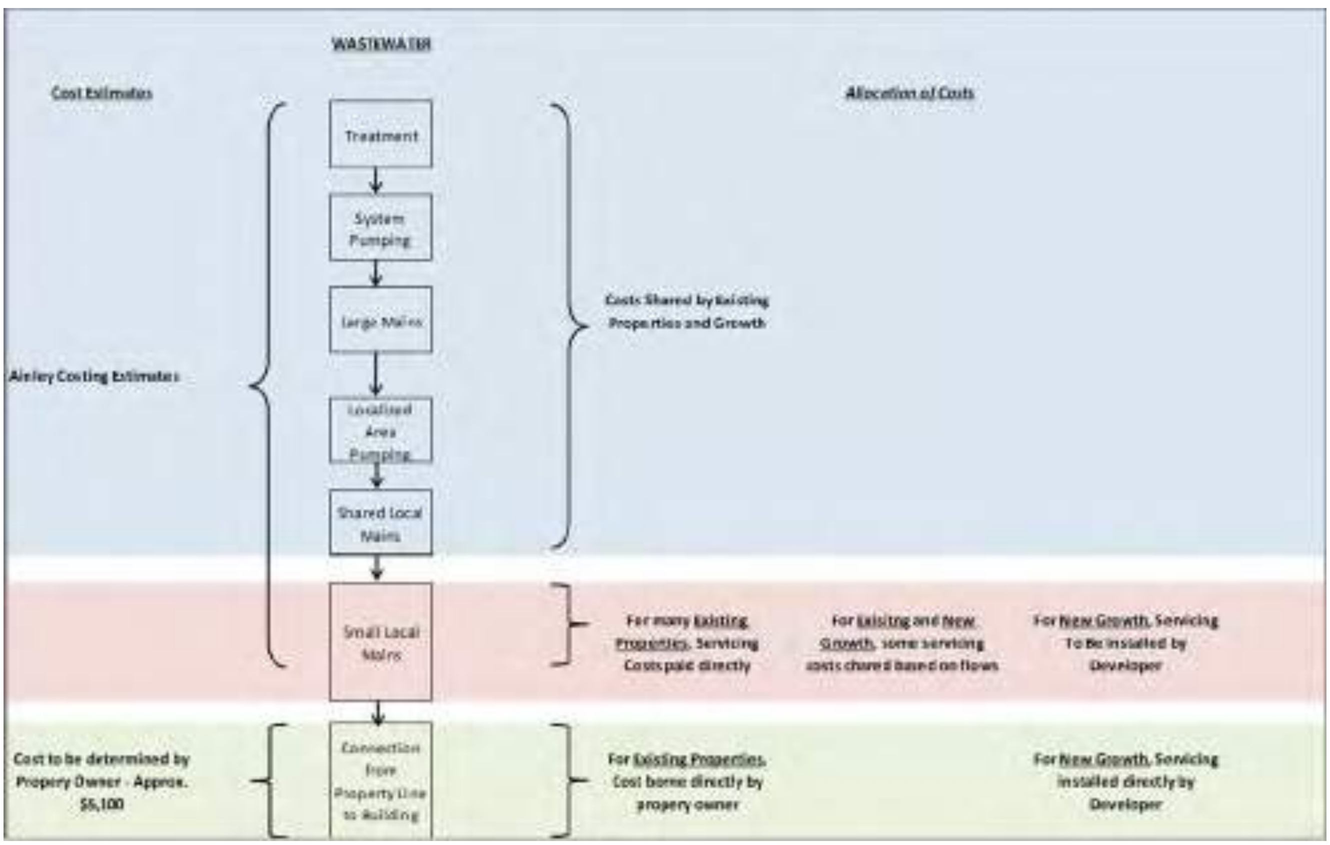
As noted the above costs are identified to service both the existing and future developable properties. The benefit of the servicing will be allocated between the exiting properties and the developable properties. At this time, a high-level allocation estimate was considered by Ainley and preliminary allocations are as follows (note that this estimate will need to be further considered in subsequent studies as servicing plans and infrastructure locations are established):

- Existing Community Costs - $50-$60 million
- Future Development Costs - $58-$68 million

Allocation of costs components to benefitting properties will be considered based on the following schematic where:

- Most of the broader system will be shared by both existing and future development
- Localized mains will be constructed by the Town for existing properties
- Localized mains for future development will be constructed by developing landowners
- Costs to connect the house to the servicing located at the property line to be borne by existing property owners
- Costs to connect the new houses to the servicing located at the property line to be borne by developing landowners

Capital Costs – Allocation of Costs



4. Summary of Capital Cost Financing Alternatives

4.1 Overview

Historically, the powers which Ontario municipalities have had to raise alternative revenues to taxation to fund capital services have been restrictive. While other provinces may allow certain approaches to funding, others may restrict these approaches. An often acknowledge document in the municipal realm is a 2006 document provided by the Canadian Council of Provincial/Federal Environment Ministers which provided a detailed overview of potential funding mechanisms. Some of the methods described therein would be a direct revenue to the municipality (e.g. grants, capital charges to properties) whereas others are cashflow methods (e.g. debt and 3P agreements). An overview of the alternatives provided therein is presented below along with the potential alternatives (highlighted) which are applicable in Ontario.

A	***Alternatives***	**Revenue**	**Cashflow**
	Sponsorships	X	
	Innovative Transportation Revenues & Incentives	X	
	Government Service Partnerships	X	
	Strategic Budget Allocations	X	
	Utility Models	X	
B	***Bank***		
	Bonds		X
	Loans		X
	Revolving Loans/Provincial State		X
	Trust Funds	X	
	Securitizations Funds	X	
C	***P3***		
	Public Private Partnerships		X
D	***PUBLIC***		
	Transfer Payments	X	
	Grants	X	
	Contributions		
	Taxation/Rates	X	
E	***User Based***		
	Special District Financing	X	
	Development Charges	X	
	Special Levies		

The methods of capital cost recovery available to municipalities are provided as follows:

RECOVERY METHODS

- Development Charges Act, 1997, as amended
- Municipal Act
  - Rates
  - Sewer Area Capital Charges
  - Local Improvements
- Grants

4.2 Development Charges Act, 1997, as Amended

Development charges (DCs) are fees collected from new development, most often at the time a building permit is issued. The Development Charges Act gives authority to municipalities' DC By-laws for financing costs resulting from new growth.

Municipalities use these fees to help pay for the cost of infrastructure required to provide municipal services to new development, such as water, wastewater, roads, community centres and fire and police facilities. Fees are payable to both the Town and County levels of government, and the Boards of Education. Provincial Law limits the types of infrastructure costs development charges can fund. Most municipalities in Ontario use development charges to ensure that the cost of providing infrastructure to service new development is not borne by existing residents and businesses in the form of higher property taxes.

The Act allows for development to assist in cash flowing major projects in order to relieve the municipality of significant debt burdens. These types of agreements are based upon an agreement between a developer or group of developers. While a municipality cannot mandate an agreement, it may be necessary if the municipality cannot cash flow the project(s) themselves.

In certain instances, developers have assisted municipalities by also providing added contributions over and above the DC amount in order to assist funding the non-growth share. Bill 73 has made provisions that this may not be mandated but, once again may assist in instances where the projects are unaffordable.

4.3 Municipal Act, 2001

4.3.1Part XII of the Municipal Act

Part XII of the Municipal Act, 2001 provides municipalities with broad powers to impose various types of capital and operating fees and charges. These powers include imposing fees or charges for services or activities provided or done by or on behalf of it.

Restrictions are provided to ensure that the form of the charge is not akin to a poll tax. Any charges not paid under this authority may be added to the tax roll and collected in a like manner. The fees and charges imposed under this part are not appealable to the O.M.B.

The legislations also permit municipalities to impose charges, by by-law, on owners or occupants of land who would or might derive benefit from the construction of sewage (storm and sanitary) or water works being authorized (in a Specific Benefit Area). For a by-law imposed under this section:

- A variety of different means could be used to establish the rate and recovery of the capital costs that could be imposed by a number of methods at the discretion of Council (i.e. lot size, frontage, number of benefiting properties, single detached equivalent, etc.). For example, dividing the costs by the number of units would provide for a cost per unit for the infrastructure costs;
- Rates could be imposed in respect to costs of major capital works, even though an immediate benefit was not enjoyed;
- Non-abutting owners could be charged;
- Recovery can be authorized against existing works, where a new water or sewer main was added to such works, "notwithstanding that the capital costs of existing works has in whole or in part been paid;"
- Charges on individual parcels could be deferred;
- Exemptions could be established;

Based on allocating the capital costs on a unit equivalent basis, the cost per property would be in the $20,000 - $25,000 range. The Municipal Act would allow the municipality to offer long term loans to property owners to allow for this cost to be paid off over 10, 15 or 20 years. Loan rates through Infrastructure Ontario are presently in the 3.5% - 4% range. In addition to these capital costs, the property owner would also have to provide the connection from the house to the property line (approx. $6,000). This connection cost is specific to the homeowner and cannot be included in the municipal loan amount.

4.4 Local Improvement Regulation

Prior to 2001, local improvements were allowed under its own legislation (i.e. Local Improvement Act). With the reform of the Municipal Act in 2001, the Local Improvement Act was repealed and brought into the Municipal Act by regulation. The regulation presently provides:

- A variety of different types of works may be undertaken, such as watermain, storm and sanitary sewer projects, supply of electrical light, bridge construction, sidewalks, road widening, and paving.

- Council may pass a by-law for undertaking such work on petition of a majority of benefiting taxpayers, on a 2/3 vote of Council, and on sanitary grounds, based on the recommendation of the Minister of Health. The by-law may go to the O.M.B., who might hold hearings and alter the by-law, particularly if there were objections.

- The entire cost of a work may be assessed only upon the lots abutting directly on the work, according to the extent of their respective frontages, using an equal special rate per metre of frontage.

4.5 Grant Funding Availability

4.5.1 Federal Infrastructure Funding

Phase 1 (April 1, 2016 – March 31, 2018)

Funding was provided by the Government of Canada to expressly help municipalities with repair and rehabilitation projects. Funding was mainly provided through the Clean Water and Wastewater Fund (CWWF) and Public Transit Infrastructure Fund (PTIF) in Federal Phase 1 projects. The CWWF was announced in Ontario on September 15, 2016. The Fund is $1.1 billion for water, wastewater, and storm water systems in Ontario. The federal government provided $569 million and Ontario and municipal governments provided $275 million each.

Over 1,300 water, wastewater, and storm water projects have been approved in Ontario through the CWWF. In Ontario, PTIF accounted for nearly $1.5 billion of the national total of $3.4 billion. The program was allocated by ridership numbers from the Canadian Urban Transit Association. AMO understands that $1 billion of Ontario's share has been approved.

Phase 2: Next Steps

The federal government announced Phase 2 of its infrastructure funding plan with a total of $180 billion spent over 11 years. In addition to the balance of funding for previous Green, Social, and Public Transit Infrastructure Funds ($20 billion each, including Phase 1), the government has added $10.1 billion for Trade and Transportation Infrastructure and $2 billion for Rural and Northern. This funding must be implemented by agreements with each province and territory. Negotiations are ongoing and funding is designed to start flowing after the 2018 Budget, ramping up in the out years.

In Phase 2, Ontario will be eligible for $11.8 billion including $8.3 billion for transit, $2.8 billion for green infrastructure, $407 million for community, culture and recreation and $250 million for rural and northern communities.

Federal Gas Tax

The Federal Gas Tax is a permanent source of funding provided up front, twice-a-year, to provinces and territories, who in turn flow this funding to their municipalities to support local infrastructure priorities. Municipalities can pool, bank and borrow against this funding, providing significant financial flexibility. Every year, the Federal Gas Tax provides over $2 billion and supports approximately 2,500 projects in communities across Canada. Each municipality selects how best to direct the funds with the flexibility provided to make strategic investments across 18 different project categories, which include bother water and wastewater servicing.

Ontario Government

The Province has taken steps to increase municipal infrastructure funding. The Ontario Community Infrastructure Fund (OCIF) was increased in 2016 with formula-based support growing to $200 million, and application funding growing to $100 million annually by 2018-19. As well, $15 million annually will go to the new Connecting Links program to help pay for the construction and repair costs of municipal roads that connect communities to provincial highways. This is on top of the Building Ontario Up investment of $130 billion in public infrastructure over 10 years starting in 2015.

Summary of Future Grant Funding

The Town has been in discussions with the senior levels of government relevant to servicing these communities. Generally, commitments towards specific initiatives is not granted until the project has proceeded through the environmental and the public processes. Presently, no funding guarantees have been given however the initiatives have received positive feedback.

4.6 Debt Financing

Although it increases the overall cost to the taxpayer, debt issuance is used by municipalities to assist in cash flowing large capital expenditures. The use of debt may be used to loan existing property owners the funds to repay the capital charge over time.

The Ministry of Municipal Affairs regulates the level of debt incurred by Ontario municipalities, through its powers established under the Municipal Act. Ontario Regulations 403/02 provides the current rules respecting municipal debt and financial obligations. Through the rules established under these regulations, a municipality's debt capacity is capped at a level where no more than 25% of the municipality's own purpose revenue may be allotted for servicing the debt (i.e. debt charges). Hence, proper management of capital spending and the level of debt issued annually, must be monitored and evaluated over the longer-term period.

Presently, based on 20-year debt at prevailing interest rates, the municipality has a maximum debt limit of approximately $24 million. Note that this amount is the maximum available for all services and fully utilizing it for one particular service would then limit the potential capital funding for other projects and services. Preserving some capacity for other servicing needs (e.g. water supply), the Town realistically may only make $15-$18 million available for this project.

4.7 Private/Public Partnership Agreements (3P's)

In 1993, the Province of Ontario passed legislation to amend the Municipal Act to allow municipalities to privatize municipal services (prior to which they needed special legislation). To date, there have been limited attempts at the full privatization of services however, there has been aspects of private initiatives present in many municipalities. Private contracts can range from simple construction contracts to full design/build/operate/finance contracts. Below is a summary of the more common forms of agreements.

Model	Construction	Operations	Capital Investment or Financing	Ownership at End of Contract Term
Operating Maintain Manage (OMM)	N/A	Private	Public	Public
Lease		Private	Public	Public
Lease Develop Operate (LDO)		Private	Private	Public
Design Build Operate (DBO)	Private	Private	Public	Public
Design-Build-Finance-Transfer (DBFT)	Private	Public	Private	Public
Design-Build-Finance-Maintain (DBFM)	Private	Operate	Private	Public
Design-Build-Finance-Operate (DBFO)	Private	Private	Private	Public
Build-Own-Operate (BOO)	Private	Private	Private	Private
Build-Own-Operate-Transfer (BOOT)	Public	Private	Private	Public

Cost/benefit of the various forms of contracts are dependent upon the service being provided, the form of contract and the alternative methods in structuring the agreement. Generally, the borrowing costs for the private sector are higher than the borrowing costs available to municipalities however, there can be other aspects of the contract which can reduce other cost components and enhance the competitiveness of the contract. Note however, that this form of capital financing is assessed in the same way debt financing is considered for debt capacity purposes, hence this form of agreement does not mitigate the provinces maximum limits on incurring long term liabilities.

4.8 Municipal Services Corporation (MSC)

A municipality may create a municipal services corporation for the purpose of providing a system, service or thing that the municipality itself could provide such as water or wastewater services. The service, system or thing must be within the municipality's sphere of jurisdiction under section 11 of the *Municipal Act, 2001*. To date, there is limited use of this legislative authority in Ontario.

Municipal services corporations may be established under the Business Corporations Act or the Corporations Act. The Corporations Act likely would be used if the municipal services corporation was going to be a not-for-profit organization. Before creating a MSC a municipality must prepare a business case and consult the public.

There are limitations and potential impacts which need to be considered prior to proceed to set up a MSC. Some of the considerations are provided below:

- MSC normally have a higher costs of borrowing (i.e. loans)
- Transferring an existing municipal service to a MSC can reduce a municipality's debt capacity however for a new service, it may provide for additional borrowing ability
- MSC's may not be eligible for certain grants and subsidies
- As a MSC is a Business Corporation, they do not have to same powers as a municipality hence there may be limitations in exercising certain authorities

4.9 Financial Observations for Erin

The options available to Erin for financing capital infrastructure are somewhat limited. Based on the above discussions:

- Town needs to pursue Federal/Provincial grants to reduce the overall impact onto property owners;
- Grants are also needed to be able to remain within the Town's debt capacity limits;
- Municipal Act (Part 12) charges for existing properties would be the primary basis for recovery. Distributing the capital cost on a single detached equivalent may be most equitable approach to distributing cost amongst existing properties;
- For growth related costs, developing landowners would need to pay their charges by upfront financing to offset the debt burden to the Town;
- Some level of financial assistance by developing landowners may assist in achieving financial affordability of the overall project;
- Staging of the works could be considered, as the Wastewater Treatment Plant and Collection System could be constructed in stages.

5. Operating Costs for the Wastewater System

Upon completion of the Wastewater system, operating costs would be incurred to collect and treat the wastewater. Most municipalities recover these funds via a wastewater rate similar to the rate structure imposed for the municipal water system.

Wastewater rates typically include a fixed/basic charge (monthly/bi-monthly) and a usage rate linked to the household water use. Often for wastewater, these rates are typically slightly higher than water rates. Wastewater rates will likely reduce as new customers are added.

The SSMP identified an average cost per household of $422 per year to operate the system based on a 6,000 population. However, this did not include system capital cost recovery. Generally, a new system is predominantly operations-related and has minimal capital-related costs. However, some level reserve fund contribution may be made towards the long-term lifecycle of the system or for contingency purposes.

A sampling of wastewater operating costs was undertaken for a number of municipalities in the general area of the Town. The costs per customer for the direct operating costs (net of capital financing and reserve transfers) are as follows:

Operating Costs Per Customer (2018)

Municipality	Operating costs (net of Capital and Reserve transfers)	Number of Customers	Operating Costs per Customer
Centre Wellington	3,156,300	6,742	468
Guelph-Eramosa	955,019	1,639	583
Wellington North	1,319,800	3,231	408
Orangeville	3,747,100	10,067	372
Average			458

Based on other local municipalities with similar size, it is anticipated that the annual operating costs per customer range from $400 to $500 per year.

6. Conclusion

Based on the analysis provided above, the magnitude of the capital cost is outside the Town's financial affordability without external funding. The capital costs total over $118 million and the Town has a maximum debt capacity of approximately $24 million. However, considering the other capital need of the Town, only about $15-$20 million may be made available.

For this project to proceed, the growth-related portion of the costs ($58-$68 million) must be upfront financed by developing landowners. The Development Charges Act provides for various forms of cashflow agreements (i.e. front-ending agreements, prepayment agreements) which would allow for the municipality to facilitate the growth component of the works.

For the portion of the cost which benefits existing properties ($50-$60 million), the municipality must receive external funding of approximately ($35-$45 million). This funding would be required from either federal/provincial grant and/or contributions from the developing landowners. Applying this funding would reduce the cost from $20,000-$25,000 per unit to approximately $7,500. Each property will also be responsible for connecting to the sewer with most properties costing $4,000 to $8,000. A total of $11,500 to $15,500.

A final alternative which could be considered if no external funding is available, is to stage the construction of the service. The first stage may allow for the growth component of the infrastructure (which services development lands) to proceed and be funded by the developing landowners. The second stage (and possibly subsequent stages) could then allow for portions of the existing community to be serviced. This approach would allow the Town to manage its debt capacity limit and service existing properties as it is financially feasible.

Appendix - V

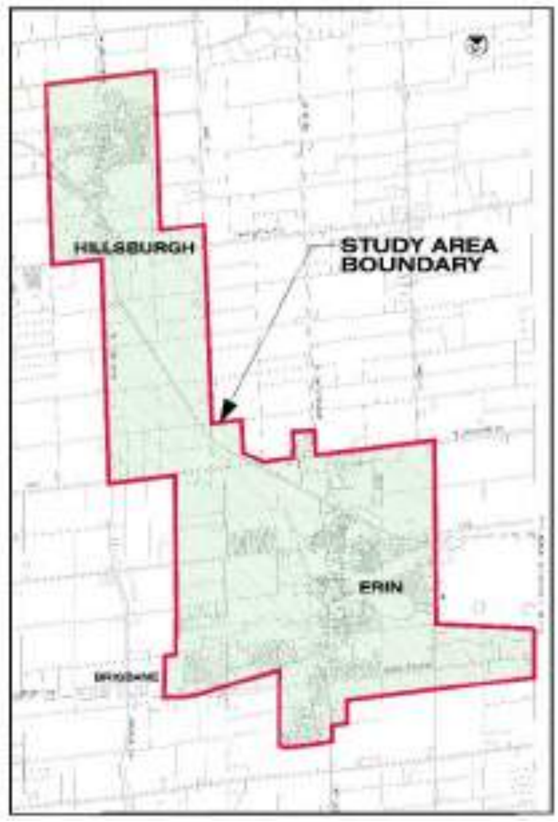
Notice of Completion

CORPORATION OF THE TOWN OF ERIN

Urban Centre Wastewater Servicing
Class Environmental Assessment
Notice of Completion of Environmental Study Report

In 2014, the Town of Erin completed a Servicing and Settlement Master Plan (SSMP) to address servicing, planning and environmental issues within the Town. The study area for the SSMP included Erin Village and Hillsburgh as well as a portion of the surrounding rural lands. The SSMP was conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA), which is an approved process under Ontario's Environmental Assessment Act and addressed Phase 1 & components of Phase 2 of the Class EA planning process.

The Urban Centre Wastewater Servicing Class Environmental Assessment (UCWS EA) is a continuation of the study, closing out Phase 2 of the study and initiating Phases 3 & 4 of the planning process to determine the preferred design alternative for wastewater collection, treatment and disposal. Through the completion of this Class EA, it has been determined that there is potential to grow the community to a residential population of approximately 14,600 people. The UCWS EA has therefore proceeded with planning for the community on this basis.



The Class Environmental Assessment process has followed the planning and design process for Schedule 'C' projects as described in the Municipal Class Environmental Assessment Document (October 2000 as amended in 2007, 2011 & 2015), published by the Municipal Engineer's Association. The Environmental Study Report has been completed and, by this Notice, is being placed in the public record for review and comment. Subject to comments received as a result of this Notice and the receipt of necessary approvals, the Town intends to proceed to seek funding for the implementation of the project. The total estimated cost of the project is $118,200,000 to be shared between the Town and Developers.

The Environmental Study Report will be available on Monday; May 14, 2018 on the Town website at www.erin.ca/town-hall/wastewater-ea along with hard copies being available at the following three locations:

1. Corporation of the Town of Erin Municipal Office
   5684 Trafalgar Road
   Hillsburgh, ON, N0B 1Z0

2. Erin Community Centre/Centre 2000 (Library)
   Boland Drive,
   Erin, ON, N0B 1T0

3. Hillsburgh Library
   98B Trafalgar Road PO Box 490
   Hillsburgh, ON, N0B 1Z0

If you have any outstanding concerns about this project, please address them to the following individuals:

Lisa Campion
Deputy Clerk
Corporation of the Town of Erin
5684 Trafalgar Road
Hillsburgh, ON N0B 1Z0
Email: Lisa.Campion@erin.ca

Joe Mullan, P. Eng.
Ainley & Associates Limited
195 County Court Boulevard,
Brampton, ON, L6W 4P7
Telephone: (905) 452-5172.
Email: erin.urban.classea@ainleygroup.com

If concerns regarding this project cannot be resolved in discussion with the Town, the individual with the concern may request that the Minister of the Environment and Climate Change (MOECC) to order a change in the project status and require a higher level of assessment under an individual Environmental Assessment process (referred to as a Part II Order). Detailed reasons must be provided with the request and the request must be sent to each of the following:

Ministry of the Environment and
Climate Change
77 Wellesley Street, West
11th Floor, Ferguson Block
Toronto, ON, M7A 2T5

Ministry of the Environment and
Climate Change
Environmental Approvals Branch
135 St. Clair Avenue West,
1st Floor, Toronto, ON, M4V 1P5

Lisa Campion
Deputy Clerk
Corporation of the Town of Erin
5684 Trafalgar Road
Hillsburgh, ON N0B 1Z0

If there is no request received by June 13, 2018 the Town will proceed to seek funding for the design and construction of the wastewater system as presented in the Environmental Study Report.

Please note that all personal information included in a Part II Order submission - such as name, address, telephone number and property location - is collected, maintained and disclosed by the Ministry of the Environment and Climate Change for the purpose of transparency and consultation. The information is collected under the authority of the Environmental Assessment Act or is collected and maintained for the purpose of creating a record that is available to the general public as described in s.37 of the Freedom of Information and Protection of Privacy Act. Personal information you submit will become part of a public record that is available to the general public unless you request that your personal information remain confidential. For more information, please contact the Ministry's Freedom of Information and Privacy Coordinator at 416-327-1434.

This notice issued May 3, 2018.