#101, 10630-172 Street
Edmonton, AB T5S 1H8
Phone: 780-486-2000

a division of Englobe

County of Vermilion River
P.O. Box 69
4912 – 50 Avenue
Kitscoty, AB T0B 2P0

January 3, 2025
File: N:\5205\003\01\L35R3

Attention: Ben McPhee
General Manager – Public Works Operations

Dear Ben:

Re: County of Vermilion River Hamlet of Blackfoot Wastewater System Upgrades
Treated Effluent Disposal on SE12-50-02-4 – Executive Summary Review

1.0 INTRODUCTION

1.1 Background

MPE a division of Englobe (MPE) completed an analysis of the Hamlet of Blackfoot's (Hamlet's) wastewater flows in November 2023 which projected a 25-year daily sewage flow of 101 m^3/d. This projection was extrapolated using the recorded historical wastewater flows and a 2% annual growth rate. The projected flow rate mentioned above was maintained as a basis for further analysis as presented in this summary review and corresponding reports.

A copy of the November 2023 Projected Flows Memorandum can be found in **Appendix A.**

1.2 Field Investigations

In June 2024, MPE a division of Englobe (MPE), Environmental Management Consultants (EnviroMak), and Soil and Forestry (S&F) determined that disposal of treated effluent from the Hamlet's wastewater treatment facility would be feasible on SE12-50-02-4 either via an evaporation pond (Option A) or by treated effluent irrigation (Option B).

Further field investigations were completed, and include:

1. EnviroMak completed a field assessment and has provided a draft report entitled "Draft Environmental Screening and Delineation of Wetlands to Inform Evaluation of Feasibility of Blackfoot Wastewater Treatment Effluent Disposal in Parts of SE12-50-2-W4M." A copy of the report is provided separately.

2. Soils and Forestry completed the following:

    a. A field assessment and has provided a report entitled "Agricultural Feasibility Report" and includes the "Level II Land Irritability Classification Report".

    b. Addendum #1 Letter – Response to review comments by MPE and the County from October 8, 2024.

c. Addendum #2 Letter – Response to review comments by MPE and the County from October 9, 2024.

Copies of the above reports and amendments are provided separately.

The following provides a summary review of the outcomes of the above-referenced reports and presents a comparison of the two options.

2.0 OPTION A: EFFLUENT DISPOSAL VIA EVAPORATION POND

2.1 Regulatory Review

2.1.1 Water Act

A few wetlands would be impacted by the evaporative lagoon and therefore regulatory approval and/or permitting under the Alberta Water Act would be required. EnviroMak's preliminary review determined that the wetlands within the area are classified as either C or D. Classes range from A to D, with A being the highest valued wetlands and D being the lowest. For this report, the impacted wetlands are estimated as Class C, pending the final report from EnviroMak.

2.1.2 Alberta Environment and Parks

AEP Standards stipulate that wastewater systems with average daily design flows of less than 250 m^3/d only require one evaporation cell with provisions at the inlet to the cell for settlement. For systems with flows larger than 250 m^3/d, the evaporation cell shall be preceded by two anaerobic or two facultative cells.

The Hamlet of Blackfoot's wastewater design flow is 101 m^3/day, but the existing anaerobic and facultative cells would be maintained upstream of the proposed evaporation pond to provide preliminary treatment. This exceeds AEP requirements.

2.2 Proposed Upgrades

MPE updated the evaporation pond sizing memorandum which determined the evaporation pond size requirement of 166.4 ML and a footprint of approximately 20.25 ha. The pond water depth would be 0.83 m and side slopes of 5H:1V. The scope for an evaporative pond would include:

- Installation of interconnecting piping from the existing facultative lagoon cell to provide gravity flow to the evaporative lagoon.
- Construction of a 166.4 ML capacity pond including structures and piping.
- Removal of all existing infrastructure including homesteads, roads, and overhead powerlines.
- Construction of an access road.
- Removal/Decommission of abandoned oil wells within Footprint of the Evaporation Pond.

A copy of the memorandum is provided in **Appendix B.**

3.0 OPTION B: EFFLUENT DISPOSAL VIA IRRIGATION

3.1 Regulatory Review

3.1.1 Water Act

It is not anticipated that any wetlands would be impacted with this option. However, if it is determined that the wetlands need to be disturbed to allow for proper irrigation, regulatory approval and/or permitting under the Alberta Water Act would be required.

3.1.2 Alberta Environment and Parks

The minimum treatment requirement for treated wastewater irrigation is primary treatment (anaerobic cells in series or facultative cells) followed by at least seven months storage. The County completed sampling of their wastewater prior to discharge on April 02, 2024, while S&F did sampling on August 29, 2024. The lab results are summarized in Table 3.1 against the AEP standards and for treated effluent quality for wastewater irrigation.

Table 3.1 – Hamlet of Blackfoot Wastewater Characterization and AEP Treated Effluent Quality Standards for Wastewater Irrigation

Parameter	Results		Standard	Type of Sample	Comments
	2024/08/29	2024/04/02			
Total Coliform*	2100	-	<1000/100 mL	Grab	Geometric mean of weekly samples (if storage is provided as part of the treatment) or daily samples (if storage is not provided) in a calendar month.
Fecal Coliform*	610	-	<200/100 m	Grab	
(BOD)	6	6	<100 mg/L	Grab/Composite**	Samples collected twice annually prior to and on completion of a major application event.
(COD)	40	-	<150 mg/L	Grab/Composite**	
TSS	4	-	<100 mg/L	Grab/Composite**	
EC	1.79	0.249	<2.5 ds/m	Grab/Composite**	
SAR	3.5	1.1	<9	Grab/Composite**	
pH	7.85	7.66	6.5 – 9.5	Grab/Composite**	

* For golf courses and parks only.
** Grab sample would suffice if storage were provided; Composite sample is required if storage is not provided.

The isolated grab samples show that the lagoon's treated effluent meets AEP's requirements for all constituents except for Total and Fecal Coliform. As these were grab samples, they are not representative of the 30-day geometric mean of weekly samples. Nevertheless, fecal and total coliform are regulated only if the treated wastewater is used for golf courses or parks, which is not the case.

For irrigation on SE12 for the purpose of native pasture and forbs used to graze cattle, the Hamlet's wastewater would be considered environmentally acceptable and agriculturally beneficial.

Irrigation would be scheduled so that wastewater discharge does not occur 30 days prior to harvesting of crops or grazing by dairy cattle, or seven days prior to pasturing by other livestock.

3.2 Proposed Upgrades

It was determined that the minimum irrigation area required for disposal of 40,000 m^3 of treated effluent is approximately 16.4 ha. In addition, a major drawback of an irrigation system is that it can be in use during wet periods and potentially during periods when the effluent quality does not meet requirements. For this reason, additional emergency storage in addition to the annual storage should be considered.

Proposed upgrades for this option would include but not be limited to:

- Existing Lagoon upgrades include expanding the storage capacity to provide emergency storage during wet years or when effluent quality is not met. A 3-year storage capacity of 120 ML is to coincide with AEP's minimum evaporation storage pond size.
- Installation of an irrigation system which would include:
    - A supply pipeline from the lagoon to the SE12-50-15-4.
    - An irrigation pumping station, i.e., manhole equipped with a vertical turbine exterior rated pump.
    - Power supply to the pump station.
    - Irrigation piping and stationary volume gun systems.
        - Assuming a medium volume gun capable of up to 3.3 ha irrigation area. Approximately 5 station volume guns would be required.

4.0 OPTIONS COMPARISON

Two alternatives have been investigated for upgrading the Hamlet of Blackfoot's wastewater treatment system for wastewater disposal. These upgrades build on the existing infrastructure with modifications that meet the Hamlet's current and future needs and regulatory requirements.

Table 4.1 on the following page compares these two options and includes a third option which is the original design intent of disposing the treated effluent to the Blackfoot creek. The major findings from the comparison table are as follows:

- Option A – An Evaporation Pond requires a storage capacity of approximately 166.4 ML and has the lowest capital cost and the lowest operational and maintenance costs.
- Option B – Irrigation would require a storage volume to allow for effluent storage beyond the one-year period in situations where there is a wet year and/or poor effluent quality. For this reason, a 3-year storage pond has been assumed. The stationary volume gun irrigation system would eliminate extensive operational requirements. The overall capital cost is estimated to be approximately $611,000 higher than option A. This option would incur the highest operational and maintenance costs.
- Option C – Forcemain to Blackfoot Creek is estimated to be about $110,000 higher than Option A The maintenance costs would be higher than Option A but lower the Option B.
- The overall 25-year net present value shows Option A (Evaporation Pond) to be the lowest cost option and Option B (Irrigation) to be the highest cost option. Option C (Forcemain Discharge to Blackfoot) is estimated to have a 25-year NPV of $830,000 higher than that of Option A.

Detailed Class D capital cost estimates can be found in **Appendix C.**

Estimated Net Present Values and Operation Costs are presented in **Appendix D**.

Table 4.1 - Summary Comparison of Treated Effluent Disposal Options				
		Option A - Evaporation Pond	**Option B - Irrigation**	**Option C - Forcemain to Blackfoot Creek**
Regulatory	**Water Act**	• Wet Land impact compensation is expected • Highest of all options	• Wet Land impact compensation is expected.	• Wet Land impact compensation is expected • Lowest of all options
	Alberta Environment & Parks	• Approval Ammendment needed.	• Approval Ammendment needed. • Irrigation Management Plan Needed	• Approval Ammendment needed.
Existing System Review	**Anaerobic Cells (2 x 500 m3)**	• Not required as design flow of 101 m3/d is < 250 m3/d	• Not required as design flow of 101 m3/d is < 250 m3/d	• Not required as design flow of 101 m3/d is < 250 m3/d
	Storage Cell (1 x 22,000 m3)	• Not required as design flow of 101 m3/d is < 250 m3/d	• Required • Upgrades needed as noted below	• Required • Upgrades needed as noted below
Proposed Upgrades	**Existing Anaerobic Cells**	• Maintain in operation for better quality • Consider Desludging	• Maintain in operation for better quality • Consider Desludging	• Maintain in operation for better quality • Consider Desludging
	Existing Facultative Cell	• Maintain in operation for better quality • Consider Desludging	• Upgrade to meet AEP standards and future capacity. • 60 Day Storage Capacity > 6,100 m3	• Upgrade to meet AEP standards and future capacity. • 60 Day Storage Capacity > 6,100 m3
	Additional Cell(s)	• New Evaporation pond • Sizing based on local meteorological conditions • AEP minimum size requirement for 3 year storage. • Calculated Storage Volume = 166,400 m3 • Water Depth = 0.83 m • 5H : 1V Slopes • ~21 ha area requirement • Heavy duty Synthetic Liner	• New Storage Pond • 12 Months Storage Capacity • Additional Emergency Storage for • Wet Years • Effluent Requirements are not met • Assumed 3 year storage • Calculated Storage Volume = 120,000 m3 • Water Depth ~ 0.83 m • 5H : 1V Slopes • ~20 ha area requirement • Heavy duty Synthetic Liner	• New Storage Pond • 12 Months Storage Capacity • Calculated Storage Volume = 40,000 m3 • Water Depth ~ 2.4 m • 5H : 1V Slopes • ~2 ha area requirement
	Pumping System	• Not Required	• Pump Station • Dual Pumping System Capable of ~ 25 L/s @ 105 m • 50 HP Pumps • Pump Station c/w electrical and mechanical • Power Service to Station • Stationary Irrigation System Consisting of • Required area ~ 16.4 ha • Medium Volume Gun Sprinklers • Capacity = ~ 25 L/s ea. (400 usgpm) • Area Coverage = ~ 3.3 ha ea. • No. of Station Guns needed = 5 • ~ 2 km of piping system • Bollards to protect guns	• Pump Station • Dual Pumping System Capable of ~ 22 L/s 50 m • 35 HP Pumps • Pump Station c/w electrical and mechanical • Power Service to Station • Forcemain • ~ 7 km of 10" Forcemain • Outfall at Blackfoot Creek
	Miscellaneous	• Access Road • Abandoned oil well rehabilitation • Abandoned Homestead Removal	• Access Road • Abandoned oil well rehabilitation • Abandoned Homestead Removal • Power Service	• Access Road • Abandoned oil well rehabilitation • Abandoned Homestead Removal • Power Service
Operation and Maintenance requirements		• Inspection of Cells and structures	• Inspection of Cells and structures • Running Pumping and Irrigation System • Flushing Piping Systems at start and end of Irrigation • Inspection of pump station and volume guns. • Repairs and replacement of pumping system components as needed • Repairs and replacement of irrigation volume gun system components including valves as needed	• Inspection of Cells and structures • Running pumping system • Inspection of pump station and outfall structure • Repairs and replacement of pumping system components as needed
Order of Magnitude Capital Cost		**$7,472,000.00**	**$8,083,000.00**	**$7,582,000.00**
NPV Estimate of Capital Cost		$7,621,000.00	$8,244,000.00	$7,733,000.00
NPV Estimate of O&M Cost		$475,000.00	$1,918,000.00	$1,197,000.00
NPV Estimate Total		**$8,096,000.00**	**$10,162,000.00**	**$8,930,000.00**
Unit Cost Estimate ($/m3)		$19.22 - $15.71	$23.26 - $21.05	$20.76 - $18.00

** Net Present Value (NPV) based on assumed 5% debenture rate*

5.0 CLOSURE

We thank you for the opportunity to be of service and to have prepared the report on your behalf and look forward to assisting you in implementing your plans for the future. If you have any inquiries regarding any of the submitted reports or if clarification is required, please contact Ryan Sharpe or the undersigned.

Yours truly,

MPE a division of Englobe

Ivan Kagoro, P.Eng.
Project Engineer

Appendix A

Wastewater Flows Projection Memorandum

a division of Englobe

#101, 10630-172 Street
Edmonton, AB T5S 1H8
Phone: 780-486-2000

an Englobe company

MEMORANDUM

To: **Roger Garnett**
County of Vermillion River

From: **Ryan Sharpe**

cc:

Re: **Blackfoot Wastewater System Upgrades**
Lagoon Storage Requirements

Date: **November 27, 2023, 2023**

File: **5205-003-03**

Pages: **4**

Email: **rgarnett@county24.com**

In follow up to our recent discussions, we herein provide additional information on the storage requirements for the projected 25 year wastewater flows. The storage requirements are based on providing capacity for 12 months of storage.

Projected Population

The projected populations were estimated by adopting a 25 year growth rates for the expected Hamlet growth, and adjusted for planning purposes. Based on discussions with the County, **growth rates of 1.5% and 2%** were adopted, which is a typical growth rate based on communities of similar size.

Table 1 presents the projected populations for the 25 year design horizon.

Table 1 – Population Projections

Year	Population (1.5% Annual Growth Rate)	Population (2% Annual Growth Rate)
2021	386	386
2025	410	418
2030	441	461
2035	475	509
2040	512	562
2045	552	621
2047	568	646

Projected Flows – Historical Data

Historical wastewater demands show that Blackfoot wastewater loading is only 156.4 Litres per capita per day (Lpcd). The projected flows are based on historical demands and the annual growth rates as outlined below. Table 2.1 outlines the flows established as the basis for the wastewater system upgrades.

Table 2.1 – Flow Projections

Year	ADD Wastewater 1.5% Annual Growth (m^3/day)	ADD Wastewater 2% Annual Growth (m^3/day)
2021	60	60
2025	64	65
2030	69	72
2035	74	80
2040	80	88
2045	86	97
2047	89	101

Water demand for the next 25 years was based on the annual lagoon discharge provided by the County, which is estimated to be between 18,000 m^3 and 22,000 m^3. The more conservative value of 22,000 m^3 will be used for this table.

Projected Flows – General Municipal Servicing Standards

The County of Vermilion River General Municipal Servicing Standards outline the sewage flow generation rates. Section E.2.1.1 states that the Average Sewage Flow for residential is 320 Lpcd. In Table 2.2, the average sewage generation rate is applied to the current and projected population.

Table 2.2 – Flow Projections

Year	ADD Wastewater 1.5% Annual Growth (m^3/day)	ADD Wastewater 2% Annual Growth (m^3/day)
2021	124	124
2025	131	134
2030	141	148
2035	152	163
2040	164	180
2045	177	199
2047	182	207

Section D.2.1 of the design standards has the Average Daily Demand for water consumption as 320 L/person/day and is outlined for the forecasted population in the table above.

Historical Treated Water Consumption - Comparison

Historical treated water consumption from 2018 to 2022 is summarized in Table 3.

Year	Annual Treated Water Consumption (m^3)
2018	27,899
2019	24,626
2020	25,766
2021	31,606
2022	29,587

The average treated water consumption from 2018 to 2022 is 27,897 m^3. Based on a population of 386 in 2021, the per capita water consumption is 198 Lpcd. Assuming 80% of treated water results in wastewater, the wastewater loading is estimated at 158 lpcd which aligns with the historical wastewater flows of 156 Lpcd.

Lagoon Storage Requirements

The storage requirements for the proposed anerobic, facultative and storage cells are based on Alberta Environment and Protected Areas (AEPA) Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems (April 2012).

AEPA outlines anaerobic cells shall operate at a minimum depth of 3.0 m to a maximum of 3.5 m, with a sufficient bottom area for sludge accumulation and the capacity to hold the average daily flow for 2 days. Facultative cells operate at a maximum depth of 1.5 m and retain 60 days of influent wastewater based on the average daily flow. The storage cell capacity is based on a 12 month average daily flow and has a maximum operating depth of 3 m.

The storage requirements for a 2 day anerobic cell, 60 day facultative cell and 12 month storage cell for projected wastewater flows in 2047 based on historical data and using the General Municipal Design Standards are summarized in Table 4.

Table 4 – Anerobic, Facultative and Storage Cell Requirements

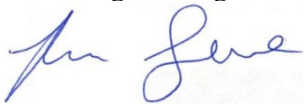
Design Method	Design Period (Years)	Per Capita Flows (Lpcd)	Anerobic Cell 2 Day Volume (m^3)	Facultative Cell 60 Day Volume (m^3)	Storage Cell 12 Month Volume (m^3)
Historical Data (1.5% Annual Growth)	25	156	178	5,340	32,400
Historical Data (2% Annual Growth)	**25**	**156**	**202**	**6,060**	**36,815**
Assumed (1.5% Annual Growth)	**10**	**240**	**218**	**6,540**	**39,785**
	25	240	272	8,160	49,640
General Municipal Servicing Standards (1.5% Annual Growth)	10	320	292	8,760	53,290
	25	320	364	10,920	66,400

The recommendation for the current lagoon is to construct the existing two smaller cells into anerobic cells, while transforming a portion of the existing 12 month storage cell into a facultative cell. The remaining portion of the storage cell will continue to be utilized as a 12 month storage cell, with a new storage cell constructed to encompass the remaining 12 month design volume. MPE further recommends that the historical data with 2% growth rate be utilized and the 12 month storage cell be constructed with a minimum volume of 36,815 cubic meters (part of which will be constructed in the existing storage cell).

If you have any questions or require additional information please call me at 780-509-4301.

Regards,

MPE Engineering Ltd.



Ryan Sharpe. P.Eng
Project Manager

Appendix B

Evaporation Pond Sizing

#101, 10630 - 172 Street
Edmonton, AB T5S 1H8
Phone: 780-786-2000
Fax: 780-486-9090

a division of Englobe

TECHNICAL MEMORANDUM 01
Hamlet of Blackfoot Wastewater Evaporation Lagoon

To:	Ben McPhee General Manager – Public Works County of Vermilion River	**From:**	Juliana Kaiber
		cc:	Ryan Sharpe, Ivan Kagoro
Re:	Hamlet of Blackfoot Wastewater System Upgrades – Phase 1	**Date:**	December 9, 2024
File:	N:\5205\003\03\Evaporation Pond	**Pages:**	7
Email:	gmpw@county24.com		

Rev. No.	Date	Revision Description	Prepared By	Reviewed By
0	June 10, 2024	For Review	JK	DS/RS/IK
1	December 9, 2024	Final	JK	DS/RS/IK

1.0 BACKGROUND

The County of Vermilion (County) retained MPE a division of Englobe (MPE) to evaluate the viability of implementing an evaporation lagoon as an alternative for wastewater disposal for the Hamlet of Blackfoot. The expected wastewater daily discharge to be disposed within the lagoon is 100 m^3/day.

2.0 STUDY AREA

The evaporation lagoon is intended to be located within parcel SE12 50-2-4, northeast of the Hamlet of Blackfoot, adjacent to Range Road 20. ***Figure 2.1*** indicates the location of the parcel in relation to the Hamlet of Blackfoot.

Figure 2.1: Evaporation Lagoon Location Plan

3.0 MODELLING APPROACH AND CLIMATE DATA

PCSWMM (version 7.3) was used for the computer modelling of the proposed evaporation lagoon. The evaluation of the required evaporation area was modelled considering continuous simulation of total precipitation and shallow lake evaporation timeseries as well as the expected wastewater daily discharge. Preliminary assumed geometric arrangement of the evaporation lagoon includes:

- Maximum acceptable depth of the lagoon was limited to 1.0 m.
- Sides slopes of 3H:1V.
- Minimum three years of storage capacity based on average daily design flows. Considering the expected wastewater discharge of 100 m^3/day, the minimum storage capacity is 109.8 ML.

The climate data timeseries used to perform the continuous simulation covers a period of 27 years (1982-2009) and includes:

- Total Precipitation: Lloydminster A (AB 3013961) is the closest station with a daily total precipitation (rainfall and snowfall) dataset. The accumulated annual precipitation over the analysis period is shown in ***Figure 3.1*** and ***Table 3.1***. The average precipitation for the 1982-2009 period is 401 mm.
- Shallow Lake Evaporation: Coronation and Cold Lake are the closest locations with shallow lake evaporation data available (Alberta Government, 2013), presenting a yearly average of 713 mm and 647 mm, respectively. The yearly average shallow lake evaporation for the Lloydminster region is approximately 685 mm (Morton's shallow lake evaporation map presented in Alberta Government, 2013). The Cold Lake dataset was adjusted considering the ratio between the shallow lake evaporation yearly averages for Lloydminster and Cold Lake, which is 1.06. The accumulated annual evapotranspiration adjusted to Lloydminster location is shown in ***Figure 3.2*** and in ***Table 3.1***. The average evapotranspiration for the period 1982-2009 is 677 mm.

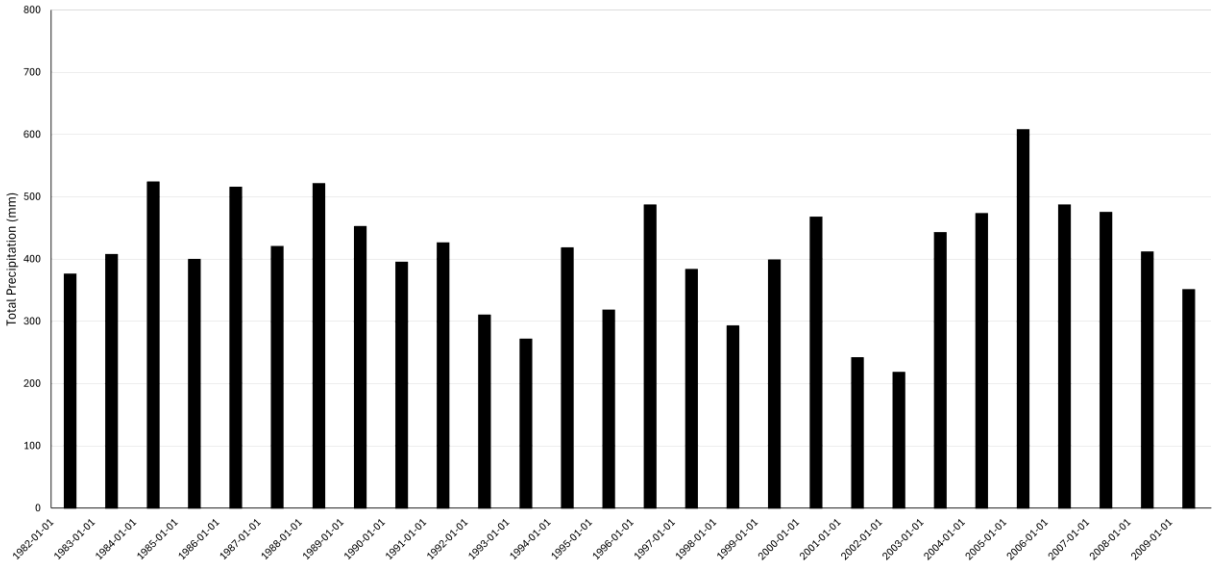


Figure 3.1: Accumulated Annual Precipitation (1982-2009) – Lloydminster A Station

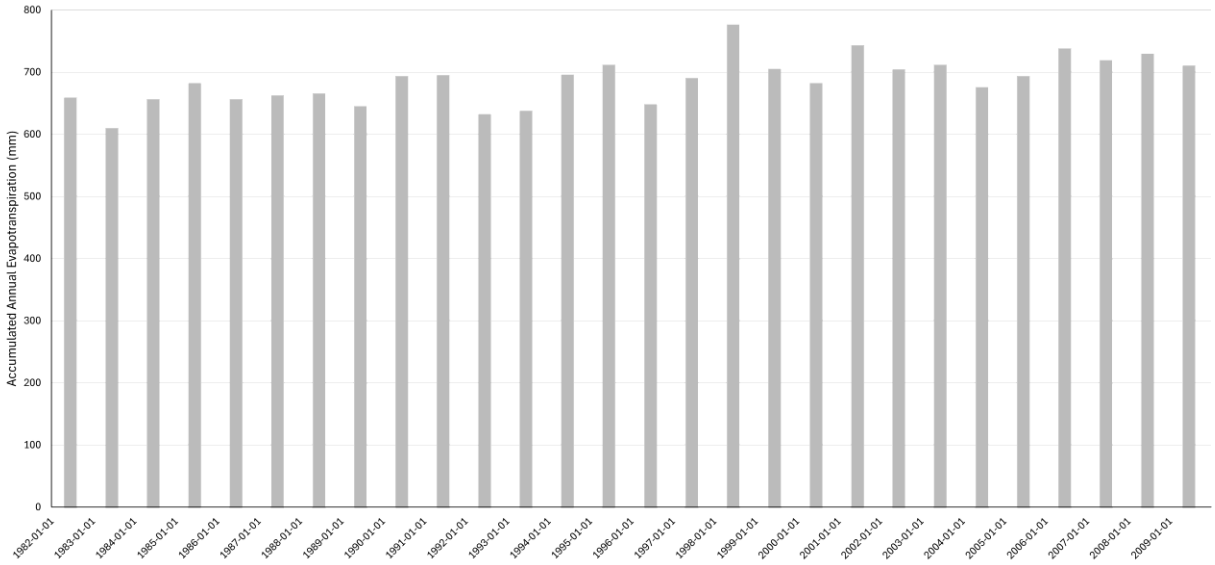


Figure 3.2: Accumulated Annual Evapotranspiration (1982-2009) – Cold Lake Station Adjusted to Lloydminster Location

Table 3.1: Accumulated Annual Precipitation and Evapotranspiration Adjusted to Lloydminster

Year	Precipitation (mm)	Evapotranspiration (mm) Adjusted to Lloydminster
1982	366	649
1983	398	600
1984	515	647
1985	390	672
1986	506	647
1987	411	653
1988	512	656
1989	443	635
1990	386	684
1991	417	685
1992	301	623
1993	262	628
1994	409	686
1995	309	702
1996	478	638
1997	374	681
1998	283	767
1999	389	696
2000	458	672
2001	232	734
2002	209	695
2003	433	702
2004	464	666
2005	599	684
2006	478	728
2007	466	709
2008	402	720
2009	342	701

The evaporation lagoon's general shape and volume must be established to account for the total wastewater influent volume and local meteorological conditions (total precipitation and evapotranspiration) and to accommodate climatological variability. For instance, a sequence of several years with higher levels of total precipitation and lower evapotranspiration. The continuous simulation water balance completed using PCSWMM accounts for total precipitation volume considering the evaporation lagoon footprint and the precipitation depth (mm). Similarly, the evapotranspiration volume is calculated considering the exposed water surface and the evapotranspiration depth (mm).

4.0 RESULTS

Table 4.1 summarizes the continuous simulation modelling results considering three evaporation lagoon footprint areas, including maximum depths modelled and associated maximum volumes as well as the total inflow volume and the estimated total evaporation volume over the simulation period (1982-2009). The minimum evaporation area of 18.5 ha is required to keep the evaporation lagoon depth limited to approximately 1 m.

Table 4.1: Evaporation Lagoon Sizing

Footprint Area at Depth of 1 m (ha)	Maximum Volume (ML)	Maximum Depth (m)	Total Inflow Volume (ML)	Evaporation Loss (%)	Estimated Total Evaporation Volume (ML)
18.5	184.4	1.01	3,240	97	3,143
18.9	179.8	0.96	3,290	98	3,224
20.25	166.4	0.83	3,430	99	3,361

Figure 4.1 to ***Figure 4.3*** show the variation of wastewater/stormwater depths accumulated within the evaporation lagoons over the period of analysis.

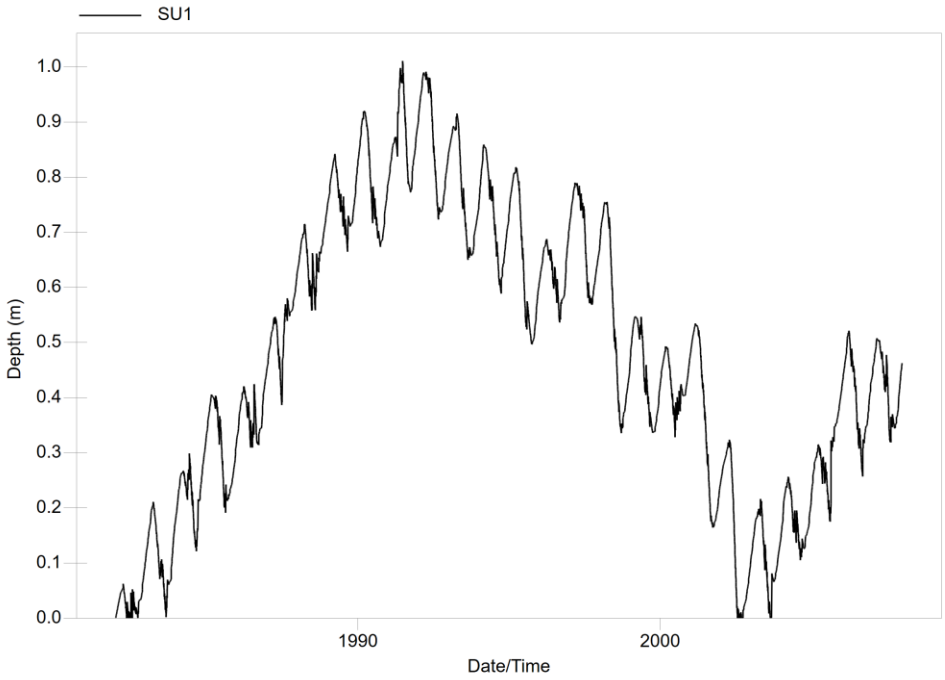


Figure 4.1: Evaporation Lagoon Depth – Footprint Lagoon Area 18.5 ha

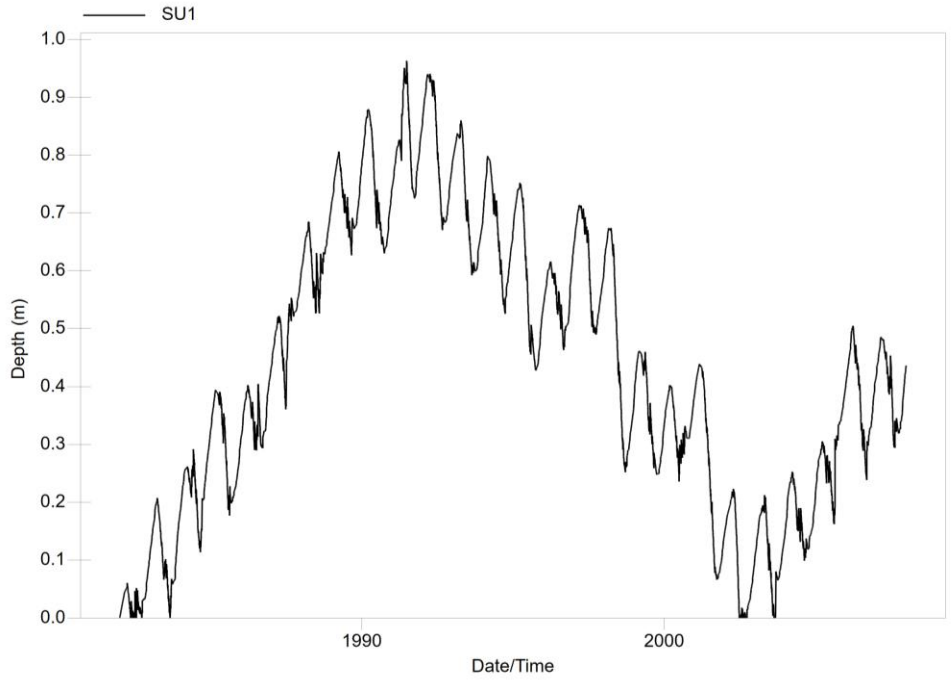


Figure 4.2: Evaporation Lagoon Depth – Footprint Lagoon Area 18.9 ha

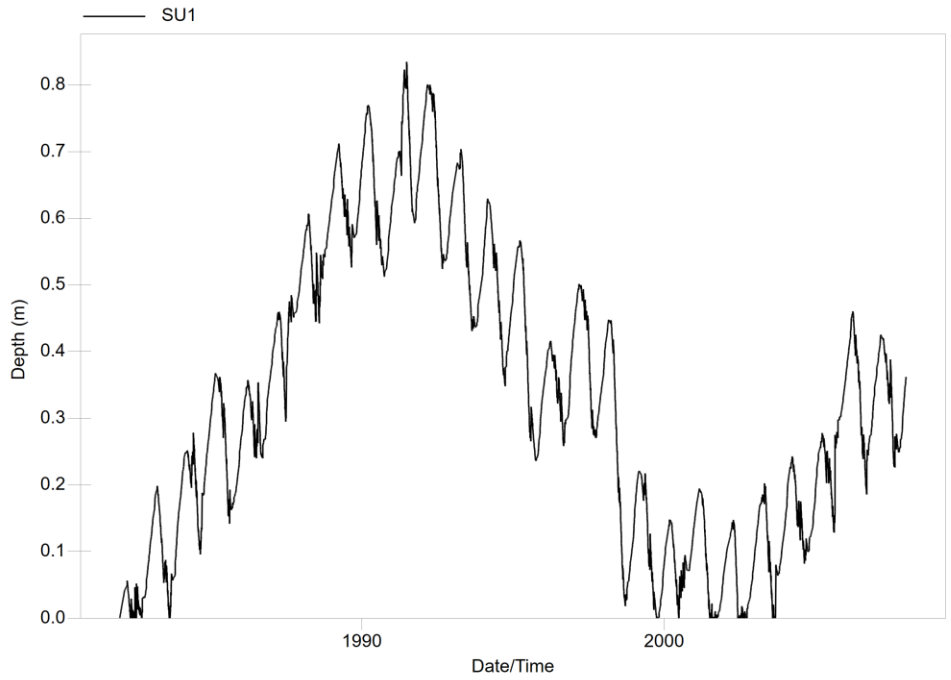


Figure 4.3: Evaporation Lagoon Depth – Footprint Lagoon Area 20.25 ha

5.0 CONCLUSIONS

The main results presented in this technical memorandum are as follows:

- Considering the wastewater discharge, shallow lake evaporation and total precipitation timeseries (1982-2009), 18.5 ha is the minimum evaporation area required to keep the evaporation lagoon depth limited to approximately 1 m.
- Slightly larger evaporation areas, such as 20.25 ha, might be adopted as a conservative design assumption.

The required size of the evaporation pond depends on the pond shape, surface grading and treatment details as well as the evaporation data being considered. Therefore, as the detailed design is completed, the final evaporation pond size could marginally differ from the area determined in this technical memorandum.

Evaporation rates are influenced by several factors such as sun and wind exposure, pond shape, size and surface materials and depth of water and edge effects. The sizing has been based on Morton's shallow lake evaporation rates, which generally assumes deeper water and a larger water body than the proposed pond. As the evaporation pond is likely to be staged over a period of time to account for the expected increase in annual volume, monitoring of the pond levels could enable a site-specific calibration of the evaporation rates for refinement of the pond size required.

6.0 CLOSURE

This technical memorandum has been prepared by MPE a division of Englobe under the authorization of the Hamlet of Blackfoot. The material in this technical memorandum represents the best judgment of MPE a division of Englobe given the available information. Any use that a third party makes of this technical memorandum, or reliance on or decisions made based upon it, is the third party's responsibility. MPE a division of Englobe accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions taken based upon this technical memorandum.

We trust that this memorandum provides sufficient information to support your next steps. Should you wish to discuss any part of this Technical Memorandum, please do not hesitate to contact the undersigned at 403-219-6322.

Yours truly,

MPE a division of Englobe

Prepared by:

Juliana Kaiber, Ph.D., E.I.T.
Design Engineer

Reviewed by:

PROFESSIONAL ENGINEER ALBERTA
DAVID SEELIGER
ID 138342

December 9, 2024

David Seeliger, P.Eng.
Project Engineer

PERMIT TO PRACTICE
MPE, a division of Englobe Corp.
Signature _____
APEGA ID 138342
Date December 9, 2024
PERMIT NUMBER: P 7841
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Corporate Permit

Appendix C

Class D Capital Cost Estimate

a division of Englobe

OPTION A - EVAPORATION LAGOON
CLASS D COST ESTIMATE (January 2025)

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST
	Miscellaneous Site Works				
1	Mobilization/Demobilization	1	L.S.	$ 249,800.00	$ 249,800.00
2	Clearing and Grubbing	1	L.S.	$ 65,000.00	$ 65,000.00
3	Topsoil Stripping/Stockpilling	32	ha	$ 11,500.00	$ 368,000.00
4	Finish Grading and Topsoil Replacement	32	ha	$ 11,500.00	$ 368,000.00
5	Locate/Protect Existing Utilities	1	L.S.	$ 35,000.00	$ 35,000.00
6	Access Road	1	L.S.	$ 80,000.00	$ 80,000.00
7	Seeding	5	Ha	$ 3,500.00	$ 17,500.00
8	Silt Fence	3000	m	$ 15.00	$ 45,000.00
9	Chain Link Fence	2000	m	$ 115.00	$ 230,000.00
10	Monitoring Wells	12	ea	$ 3,900.00	$ 46,800.00
				Subtotal - Site Works:	**$ 1,505,100.00**
	Evaporation Lagoon				
11	Excavation	104200	m^3	$ 9.00	$ 937,800.00
12	Berm Construction	15630	m^3	$ 11.00	$ 171,930.00
13	Clay Liner Construction	88570	m^3	$ 12.00	$ 1,062,840.00
14	Sand Bed	1800	m^3	$ 60.00	$ 108,000.00
15	Weeping Tile (S 150 HDPE DR 21)	3600	m	$ 235.00	$ 846,000.00
16	Geotextile	7200	m^2	$ 9.00	$ 64,800.00
17	RipRap	630	m^3	$ 275.00	$ 173,250.00
18	Existing Lagoon Care of Water	1	L.S.	$ 25,000.00	$ 25,000.00
19	Existing Lagoon Desludging	1	L.S.	$ 75,000.00	$ 75,000.00
20	Oil Wells Reclamation	3	ea.	$ 25,000.00	$ 75,000.00
				Subtotal - Lagoon:	**$ 3,539,620.00**
	Structures				
21	Level Control Vault (V-1)	1	L.S.	$ 75,000.00	$ 75,000.00
22	Manhole (MH2)	1	L.S.	$ 15,000.00	$ 15,000.00
23	Manhole (MH3U) and Equipment	1	L.S.	$ 39,500.00	$ 39,500.00
				Subtotal - Structures:	**$ 54,500.00**
	Underground Work				
24	200mm HDPE DR11	310	m	350.00	$ 108,500.00
25	200mm Gate Valves	3	ea	12,500.00	$ 37,500.00
				Subtotal - Lagoon Underground Work	**$ 146,000.00**
Subtotal					$ 5,245,000.00
CONTINGENCY (25%)					$ 1,311,000.00
ENGINEERING (10%)					$ 656,000.00
WETLAND REPLACEMENT FEES					$ 260,000.00
TOTAL					**$ 7,472,000.00**

OPTION B - IRRIGATION
CLASS D COST ESTIMATE (January 2025)

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST
	Miscellaneous Site Works				
1	Mobilization/Demobilization	1	L.S.	$ 534,400.00	$ 534,400.00
2	Clearing and Grubbing	1	L.S.	$ 15,600.00	$ 15,600.00
3	Topsoil Stripping/Stockpilling	3.5	ha	$ 12,000.00	$ 42,000.00
4	Finish Grading and Topsoil Replacement	4.5	ha	$ 12,000.00	$ 54,000.00
5	Locate/Protect Existing Utilities	1	L.S.	$ 7,800.00	$ 7,800.00
6	Access Upgrade	1	L.S.	$ 50,000.00	$ 50,000.00
7	Seeding	3	Ha	$ 3,500.00	$ 10,500.00
8	Silt Fence	700	m	$ 16.00	$ 11,200.00
9	Chain Link Fence	600	m	$ 125.00	$ 75,000.00
10	Monitoring Wells	4	ea	$ 3,900.00	$ 15,600.00
				Subtotal - Site Works:	**$ 816,100.00**
	Lagoon				
11	Common Excavation	78200	m^3	$ 9.00	$ 703,800.00
12	Berm Construction	11800	m^3	$ 11.00	$ 129,800.00
13	Liner Construction	66500	m^3	$ 12.00	$ 798,000.00
14	300mm Sand Bed (Supply and Install)	1400	m^3	$ 60.00	$ 84,000.00
15	Weeping Tile (S 150 HDPE DR 21)	2700	m	$ 235.00	$ 634,500.00
16	Geotextile	5400	m^2	$ 9.00	$ 48,600.00
17	RipRap	480	m^3	$ 275.00	$ 132,000.00
18	Existing Lagoon Care of Water	1	L.S.	$ 25,000.00	$ 25,000.00
19	Existing Lagoon Desludging	1	L.S.	$ 75,000.00	$ 75,000.00
20	Existing Lagoon Berm Construction	1	L.S.	$ 25,000.00	$ 25,000.00
				Subtotal - Lagoon:	**$ 2,655,700.00**
	Irrigation System				
21	Pump Station Strucure	1	L.S.	$ 550,000.00	$ 550,000.00
22	Pump Supply and Install	1	L.S.	$ 150,000.00	$ 150,000.00
23	Mechnical Piping and Valving	1	L.S.	$ 95,000.00	$ 95,000.00
24	Electrical, Instrumetnation and Controls	1	L.S.	$ 125,000.00	$ 125,000.00
25	Travelling Volume Gun Sprinklers c/w controls	1	L.S.	$ 250,000.00	$ 250,000.00
26	Piping System for Sprinklers c/w valves, solenoids, cleanouts etc.	2000	m	$ 500.00	$ 1,000,000.00
27	Power Supply	1	L.S.	$ 25,000.00	$ 25,000.00
				Subtotal - Irrigation System:	**$ 2,195,000.00**
	Structures				
28	Level Control Vault (V-1)	1	L.S.	$ 75,000.00	$ 75,000.00
29	Manhole (MH2)	1	L.S.	$ 15,000.00	$ 15,000.00
30	Manhole (MH3)	1	L.S.	$ 15,000.00	$ 15,000.00
31	Manhole (MH4U) and Equipment	1	L.S.	$ 39,500.00	$ 39,500.00
				Subtotal - Structures:	**$ 144,500.00**
	Underground Work				
32	200mm HDPE DR11	120	m	350.00	$ 42,000.00
33	200mm Gate Valves	2	ea	12,500.00	$ 25,000.00
				Subtotal - Lagoon Underground Work	**$ 67,000.00**
Subtotal					$ 5,878,000.00
CONTINGENCY (25%)					$ 1,470,000.00
ENGINEERING (10%)					$ 735,000.00
TOTAL					**$ 8,083,000.00**

MPE Engineering Ltd.

OPTION C - PUMP STATION AND FORCEMAIN TO BLACKFOOT CREEK
CLASS D COST ESTIMATE (January 2025)

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST
	Miscellaneous Site Works				
1	Mobilization/Demobilization	1	L.S.	$ 262,600.00	$ 262,600.00
2	Clearing and Grubbing	1	L.S.	$ 15,600.00	$ 15,600.00
3	Topsoil Stripping/Stockpilling	3.3	ha	$ 11,500.00	$ 37,950.00
4	Finish Grading and Topsoil Replacement	4.5	ha	$ 11,500.00	$ 51,750.00
5	Locate/Protect Existing Utilities	1	L.S.	$ 7,800.00	$ 7,800.00
6	Access Upgrade	1	L.S.	$ 50,000.00	$ 50,000.00
6	Seeding	3	Ha	$ 3,500.00	$ 10,500.00
6	Silt Fence	700	m	$ 15.60	$ 10,920.00
6	Chain Link Fence	600	m	$ 125.00	$ 75,000.00
6	Monitoring Wells	4	ea	$ 3,900.00	$ 15,600.00
				Subtotal - Site Works:	**$ 537,720.00**
	Lagoon				
7	Common Excavation	21100	m^3	$ 15.00	$ 316,500.00
8	Backfilling/Compaction	10200	m^3	$ 25.00	$ 255,000.00
9	Borrow Clay Material (Excavate and Haul)	10900	m^3	$ 25.00	$ 272,500.00
10	300mm Sand Bed (Supply and Install)	4000	m^3	$ 50.00	$ 200,000.00
11	Weeping Tile (S 150 HDPE DR 21)	330	m	$ 200.00	$ 66,000.00
12	Geotextile	730	m^2	$ 17.00	$ 12,410.00
13	RipRap	130	m^3	$ 230.00	$ 29,900.00
10	Existing Lagoon Care of Water	1	L.S.	$ 25,000.00	$ 25,000.00
11	Existing Lagoon Desludging	1	L.S.	$ 75,000.00	$ 75,000.00
12	Existing Lagoon Berm Construction	1	L.S.	$ 95,000.00	$ 95,000.00
				Subtotal - Lagoon:	**$ 1,347,310.00**
	Pump Station and Forcemain				
13	Pump Station Strucure	1	L.S.	$ 550,000.00	$ 550,000.00
14	Pump Supply and Install	1	L.S.	$ 100,000.00	$ 100,000.00
15	Mechnical Piping and Valving	1	L.S.	$ 175,000.00	$ 175,000.00
16	Electrical, Instrumetnation and Controls	1	L.S.	$ 225,000.00	$ 225,000.00
17	Supply and Install 250mm HDPE DR11 Discharge Forcemain	7000	m	$ 260.00	$ 1,820,000.00
18	Supply and Install Pigging Stations	2	ea.	$ 20,000.00	$ 40,000.00
19	Tie into Existing Forcemain	1	L.S.	$ 24,000.00	$ 24,000.00
20	Abandon Existing Forcemain Downstream of Connection	1	L.S.	$ 5,000.00	$ 5,000.00
21	Supply and Install Air Release Valve	4	ea.	$ 25,000.00	$ 100,000.00
22	Supply and Install Blow Off	2	ea.	$ 22,500.00	$ 45,000.00
23	Supply and Install Isolation Valve	3	ea.	$ 19,500.00	$ 58,500.00
24	Unsuitable Foundation (Washed Rock)	100	m^3	$ 200.00	$ 20,000.00
25	Pipeline Markers	1	L.S.	$ 16,000.00	$ 16,000.00
26	Care of Water	1	L.S.	$ 27,000.00	$ 27,000.00
27	Tracer Wire and Junction Boxes	1	L.S.	$ 11,500.00	$ 11,500.00
28	Allowance for Utility Crossings	1	L.S.	$ 27,000.00	$ 27,000.00
29	Traffic Control and Accommodation	1	L.S.	$ 15,000.00	$ 15,000.00
30	Erosion and Sedimentation Control	1	L.S.	$ 25,000.00	$ 25,000.00
31	Clearing and Grubbing	1	L.S.	$ 20,000.00	$ 20,000.00
32	Topsoil Stripping and Replacement	1000	m^2	$ 10.00	$ 10,000.00
33	Grass Seeding	1000	m^2	$ 3.50	$ 3,500.00
34	Pipeline Pigging	1	L.S.	$ 26,500.00	$ 26,500.00
35	Flushing, Pressure Testing, and Disinfection	1	L.S.	$ 16,500.00	$ 16,500.00
36	Highway Crossing - 18" Crossing	1	L.S.	$ 66,100.00	$ 66,100.00
37	Outfall Structure	1	L.S.	$ 33,000.00	$ 33,000.00
38	Power Supply	1	L.S.	$ 25,000.00	$ 25,000.00
				Subtotal - Pump Station & Forcemain:	**$ 3,484,600.00**
	Structures				
39	Level Control Vault (V-1)	1	L.S.	$ 75,000.00	$ 75,000.00
40	Manhole (MH2)	1	L.S.	$ 15,000.00	$ 15,000.00
41	Manhole (MH3)	1	L.S.	$ 15,000.00	$ 15,000.00
42	Manhole (MH4U) and Equipment	1	L.S.	$ 39,500.00	$ 39,500.00
				Subtotal - Structures:	**$ 144,500.00**
Subtotal					$ 5,514,000.00
CONTINGENCY (25%)					$ 1,379,000.00
ENGINEERING (10%)					$ 689,000.00
TOTAL					**$ 7,582,000.00**

Appendix D

NPV & O&M Costs

Blackfoot - Wastewater Treatment System
Present Worth Analysis - Option A: Evaporation Pond

Capital Cost: $7,472,000
Funding Rate: 0.00%
Debenture Rate 5.000%

COST COMPONENTS		PRESENT WORTH	YEAR 0	1	2	3	5	10	15	20	25	25 Year
			2025	2026	2027	2028	2030	2035	2040	2045	2050	Total
1 Aerated Lagoon - Continuous Discharge												
DEBENTURE PERIOD:												
Term: 25 years												
CAPITAL COSTS ($):												
Captial Cost	$7,472,000											
Eligible Grants	$0											
Total	$7,472,000	$7,621,000	**$530,157**	**$530,157**	**$530,157**	**$530,157**	**$530,157**	**$530,157**	**$530,157**	**$530,157**	**$530,157**	$13,784,076
ANNUAL OPERATION & MAINTENANCE COSTS ($/yr):												
Operation, Maintenance, and Labour		$475,000	$24,144	$24,870	$25,618	$26,388	$27,998	$32,468	$37,652	$43,664	$50,638	$931,690
Total		$475,000	**$24,144**	**$24,870**	**$25,618**	**$26,388**	**$27,998**	**$32,468**	**$37,652**	**$43,664**	**$50,638**	$931,690
NET PRESENT WORTH:												
(Capital Cost + Annual Operation & Maintenance Costs):		**$8,096,000**	**$554,301**	**$555,027**	**$555,774**	**$556,545**	**$558,155**	**$562,625**	**$567,809**	**$573,821**	**$580,795**	$14,715,766
UNIT COST:												
Annual Production (m3)			28,835	29,123	29,415	29,709	30,306	31,852	33,477	35,184	36,979	
Capital Cost ($/m3)			$18.39	$18.20	$18.02	$17.85	$17.49	$16.64	$15.84	$15.07	$14.34	
O&M Cost ($/m3)			$0.84	$0.85	$0.87	$0.89	$0.92	$1.02	$1.12	$1.24	$1.37	
Total Cost ($/m3)			**$19.22**	**$19.06**	**$18.89**	**$18.73**	**$18.42**	**$17.66**	**$16.96**	**$16.31**	**$15.71**	

Blackfoot - Wastewater Treatment System
O&M Costs - Option A - Evaporation Pond

Assumptions

General:

Power Cost:	0.12	$/kW hr		
Inflation:	3	%		
Operations Annual Cost:	$24,000		200 $/hr	120 hrs
Life Cycle:	25	years		
Maintenance Allowance Unit Cost:	0.005	$/m3		

Projected Operational Costs

Year		2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Projected Sewage Production	**Unit**										
Total	ADF (m^3/day)	79	80	81	81	82	83	87	92	96	101
Wastewater Treatment System Power Consumption											
Total Avg Day Cost	($)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg Day Unit Cost	($/$m^3$)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Operations Cost											
Operation Unit Cost	($/$m^3$)	0.83	0.85	0.87	0.88	0.90	0.92	1.01	1.12	1.23	1.36
Operations Avg Day Cost	($/day)	65.75	67.73	69.76	71.85	74.01	76.23	88.37	102.44	118.76	137.67
Total Avg Day Cost	($)	65.75	67.73	69.76	71.85	74.01	76.23	88.37	102.44	118.76	137.67
Avg Day Unit Cost	($/$m^3$)	0.83	0.85	0.87	0.88	0.90	0.92	1.01	1.12	1.23	1.36
Maintenance											
General Maintenance Allowance	($/day)	0.40	0.41	0.43	0.44	0.46	0.48	0.59	0.71	0.87	1.06
Total Avg Day Cost	($)	0.40	0.41	0.43	0.44	0.46	0.48	0.59	0.71	0.87	1.06
Avg Day Unit Cost	($/$m^3$)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total Operation & Maintenance Costs											
Total Avg Day Cost	($)	66.15	68.14	70.19	72.30	74.47	76.71	88.95	103.16	119.63	138.73
Avg Day Unit Cost	($/$m^3$)	0.84	0.85	0.87	0.89	0.91	0.92	1.02	1.12	1.24	1.37

Blackfoot - Wastewater Treatment System
Present Worth Analysis - Option B: Irrigation

Capital Cost: $8,083,000
Funding Rate: 0.00%
Debenture Rate 5.000%

COST COMPONENTS		PRESENT WORTH	YEAR 0	1	2	3	5	10	15	20	25	25 Year
			2012	2013	2014	2015	2017	2022	2027	2032	2037	Total
2 Regional Wastewater Pipeline												
DEBENTURE PERIOD:												
Term: 25 years												
CAPITAL COSTS ($):												
Water for Life Eligible Capital Cost	$8,083,000											
Non-Eligible Costs	$0											
Total Capital Costs	$8,083,000											
Eligible Grants	$0											
Total	$8,083,000	$8,244,000	**$573,509**	**$573,509**	**$573,509**	**$573,509**	**$573,509**	**$573,509**	**$573,509**	**$573,509**	**$573,509**	$14,911,227
ANNUAL OPERATION & MAINTENANCE COSTS ($/yr):												
Operation, Maintenance, and Labour		$1,918,000	$97,282	$100,219	$103,244	$106,361	$112,881	$130,988	$152,006	$176,406	$204,733	$3,761,039
Total		$1,918,000	**$97,282**	**$100,219**	**$103,244**	**$106,361**	**$112,881**	**$130,988**	**$152,006**	**$176,406**	**$204,733**	$3,761,039
NET PRESENT WORTH:												
(Capital Cost + Annual Operation & Maintenance Costs):		**$10,162,000**	**$670,791**	**$673,727**	**$676,753**	**$679,870**	**$686,390**	**$704,496**	**$725,515**	**$749,915**	**$778,242**	$18,672,265
UNIT COST:												
Annual Production (m3)			28,835	29,123	29,415	29,709	30,306	31,852	33,477	35,184	36,979	
Capital Cost ($/m3)			$19.89	$19.69	$19.50	$19.30	$18.92	$18.01	$17.13	$16.30	$15.51	
O&M Cost ($/m3)			$3.37	$3.44	$3.51	$3.58	$3.72	$4.11	$4.54	$5.01	$5.54	
Total Cost ($/m3)			**$23.26**	**$23.13**	**$23.01**	**$22.88**	**$22.65**	**$22.12**	**$21.67**	**$21.31**	**$21.05**	

Blackfoot - Wastewater Treatment System
O&M Costs - Option B - Irrigation

Assumptions

General:

Power Cost:	0.12	$/kW hr			
Inflation:	3	%			
Operations Annual Cost:	$72,000		200	$/hr	360 hrs
Labour Annual Cost:	$2,500				
Life Cycle:	25	years			
Equipement Replacement Cost:	$50,000	$			
# of replacements	7				
frequency of replacement	1.5				
Maintenance Allowance Unit Cost:	0.02	$/m3			

Irrigation Pumping:

Pump Head Required:	100	m
Pump & Motor Combined Efficieny:	79	%

Projected Operational Costs

Year		2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Projected Sewage Production	**Unit**										
Total	ADF (m^3/day)	79	80	81	81	82	83	87	92	96	101
Wastewater Treatment System Power Consumption											
Irrigation Pump Operation Projected Run Time	(hr)	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.1
Irrigation Pump Operation Projected Flow Rate	(l/sec)	25	25	25	25	25	25	25	25	25	25
Irrigation Pump Operation Power Consumption	(kW hr)	27	28	28	28	28	29	30	32	33	35
Irrigation Pump Operation Cost	($)	3.27	3.40	3.54	3.68	3.83	3.98	4.85	5.91	7.20	8.78
Total Avg Day Cost	($)	3.27	3.40	3.54	3.68	3.83	3.98	4.85	5.91	7.20	8.78
Avg Day Unit Cost	($/$m^3$)	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.09
Operations Cost											
Operation Unit Cost	($/$m^3$)	2.50	2.55	2.60	2.65	2.70	2.75	3.04	3.35	3.70	4.08
Operations Avg Day Cost	($/day)	197.26	203.18	209.27	215.55	222.02	228.68	265.10	307.33	356.27	413.02
Labour Unit Cost	($/$m^3$)	0.09	0.09	0.09	0.09	0.09	0.10	0.11	0.12	0.13	0.14
Labour Avg Day Cost	($/day)	6.85	7.05	7.27	7.48	7.71	7.94	9.20	10.67	12.37	14.34
Total Avg Day Cost	($)	204.11	210.23	216.54	223.04	229.73	236.62	274.31	318.00	368.64	427.36
Avg Day Unit Cost	($/$m^3$)	2.58	2.63	2.69	2.74	2.79	2.85	3.14	3.47	3.82	4.22
Maintenance											
Equipement Replacement	($/day)	57.53	59.26	61.04	62.87	64.76	66.70	77.32	89.64	103.91	120.46
General Maintenance Allowance	($/day)	1.58	1.64	1.71	1.78	1.85	1.93	2.35	2.86	3.48	4.24
Total Avg Day Cost	($)	59.11	60.90	62.75	64.65	66.61	68.62	79.67	92.49	107.40	124.71
Avg Day Unit Cost	($/$m^3$)	0.75	0.76	0.78	0.79	0.81	0.83	0.91	1.01	1.11	1.23
Total Operation & Maintenance Costs											
Total Avg Day Cost	($)	266.53	274.57	282.86	291.40	300.20	309.26	358.87	416.45	483.30	560.91
Avg Day Unit Cost	($/$m^3$)	3.37	3.44	3.51	3.58	3.65	3.72	4.11	4.54	5.01	5.54

Blackfoot - Wastewater Treatment System
Present Worth Analysis - Option C: Pump Station and Forcemain

Capital Cost: $7,582,000
Funding Rate: 0.00%
Debenture Rate 5.000%

COST COMPONENTS		PRESENT WORTH	YEAR 0	1	2	3	5	10	15	20	25	25 Year
			2012	2013	2014	2015	2017	2022	2027	2032	2037	Total
2 Regional Wastewater Pipeline												
DEBENTURE PERIOD:												
Term: 25 years												
CAPITAL COSTS ($):												
Total Capital Costs	$7,582,000											
Total	$7,582,000	$7,733,000	**$537,962**	**$537,962**	**$537,962**	**$537,962**	**$537,962**	**$537,962**	**$537,962**	**$537,962**	**$537,962**	$13,987,000
ANNUAL OPERATION & MAINTENANCE COSTS ($/yr):												
Operation, Maintenance, and Labour		$1,197,000	$60,685	$62,518	$64,406	$66,351	$70,420	$81,721	$94,840	$110,071	$127,755	$2,346,581
Total		$1,197,000	**$60,685**	**$62,518**	**$64,406**	**$66,351**	**$70,420**	**$81,721**	**$94,840**	**$110,071**	**$127,755**	$2,346,581
NET PRESENT WORTH:												
(Capital Cost + Annual Operation & Maintenance Costs):		**$8,930,000**	**$598,647**	**$600,480**	**$602,368**	**$604,313**	**$608,382**	**$619,683**	**$632,802**	**$648,033**	**$665,717**	$16,333,581
UNIT COST:												
Annual Production (m3)			28,835	29,123	29,415	29,709	30,306	31,852	33,477	35,184	36,979	
Capital Cost ($/m3)			$18.66	$18.47	$18.29	$18.11	$17.75	$16.89	$16.07	$15.29	$14.55	
O&M Cost ($/m3)			$2.10	$2.15	$2.19	$2.23	$2.32	$2.57	$2.83	$3.13	$3.45	
Total Cost ($/m3)			**$20.76**	**$20.62**	**$20.48**	**$20.34**	**$20.07**	**$19.46**	**$18.90**	**$18.42**	**$18.00**	

Blackfoot - Wastewater Treatment System
O&M Costs - Option C - Pump Station and Forcemain

Assumptions

General:

Power Cost:	0.12	$/kW hr			
Inflation:	3	%			
Operations Annual Cost:	$57,600		200	$/hr	288 hrs
Labour Annual Cost:	$500				
Life Cycle:	25	years			
Replacement Cost:	$35,000	$			
Number of replacements:	1				
frequency of replacement:	1				
Maintenance Allowance Unit Cost:	0.02	$/m3			
Annual Building Electricity Consumption	100	kWh			

Effluent Pumping:

Regional LS Flow:	25	l/sec
Pump Head Required:	50	m
Pump & Motor Combined Efficieny:	79	%

Projected Operational Costs

Year		2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Projected Sewage Production	**Unit**										
Total	ADF (m^3/day)	79	80	81	81	82	83	87	92	96	101
Wastewater Treatment System Power Consumption											
Effluent Pump Operation Projected Run Time	(hr)	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.1
Effluent Pump Operation Projected Flow Rate	(l/sec)	25	25	25	25	25	25	25	25	25	25
Effluent Pump Operation Power Consumption	(kW hr)	14	14	14	14	14	14	15	16	17	17
Effluent Pump Operation Cost	($)	1.63	1.70	1.77	1.84	1.91	1.99	2.43	2.96	3.60	4.39
Total Avg Day Cost	($)	1.63	1.70	1.77	1.84	1.91	1.99	2.43	2.96	3.60	4.39
Avg Day Unit Cost	($/$m^3$)	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04
Operations Cost											
Operation Unit Cost	($/$m^3$)	2.00	2.04	2.08	2.12	2.16	2.20	2.43	2.68	2.96	3.26
Operations Avg Day Cost	($/day)	157.81	162.54	167.42	172.44	177.61	182.94	212.08	245.86	285.02	330.42
Labour Unit Cost	($/$m^3$)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
Labour Avg Day Cost	($/day)	1.37	1.41	1.45	1.50	1.54	1.59	1.84	2.13	2.47	2.87
Total Avg Day Cost	($)	159.18	163.95	168.87	173.94	179.16	184.53	213.92	247.99	287.49	333.28
Avg Day Unit Cost	($/$m^3$)	2.01	2.05	2.10	2.14	2.18	2.22	2.45	2.70	2.98	3.29
Maintenance											
Replacement	($/day)	3.84	3.95	4.07	4.19	4.32	4.45	5.15	5.98	6.93	8.03
General Maintenance Allowance	($/day)	1.58	1.64	1.71	1.78	1.85	1.93	2.35	2.86	3.48	4.24
Total Avg Day Cost	($)	5.42	5.59	5.78	5.97	6.17	6.37	7.50	8.83	10.41	12.27
Avg Day Unit Cost	($/$m^3$)	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.10	0.11	0.12
Total Operation & Maintenance Costs											
Total Avg Day Cost	($)	166.26	171.28	176.46	181.78	187.28	192.93	223.89	259.84	301.56	350.01
Avg Day Unit Cost	($/$m^3$)	2.10	2.15	2.19	2.23	2.28	2.32	2.57	2.83	3.13	3.45