MEMORANDUM

MORRISON HERSHFIELD

TO:	Michael Harney - Mayor	**FROM:**	Nedal Barbar/Chad Newton
	Rudolph Liebenberg -CAO	**PROJECT No.:**	180347100
RE:	Sandy Beach Existing Lagoon Summary & Recommended Upgrade Options	**DATE:**	11/17/2020

P:\2018\180347100-ENGINEERING STUDY SANDY BEACH\08. WORKING\MEMO - RECOMMENDED OPTIONS\MH MEMO -LAGOON IMPROVEMENT OPTIONS_17NOV2020.DOCX

Morrison Hershfield was retained by the Summer Village of Sandy Beach to evaluate the performance of the existing lagoon and propose recommended options for improvement. Background information was reviewed, and the lagoon currently exceeds its capacity.

This memorandum summarizes existing conditions and proposed options for improvement to the evaporation lagoon onsite.

Available Information

The following information was reviewed. No other data or reports were available.

- Project Binder supplied by the Summer Village
- Regional Lagoon Feasibility Study by Wardrop Alberta LTD, dated July 1990
- As-built drawings by Maxim Engineering, dated July 29, 1991
- Parts 3 and 4 of the *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems* (March 2013)

Existing System Conditions

The existing lagoon was constructed in Year 1991 and consists of three cells, a primary cell and two evaporation cells. Some of the berms are in need of repair and therefore the sewage level in lagoon will need to be lowered to accommodate the repairs.

Figure 1.0 shows a site plan of the area.

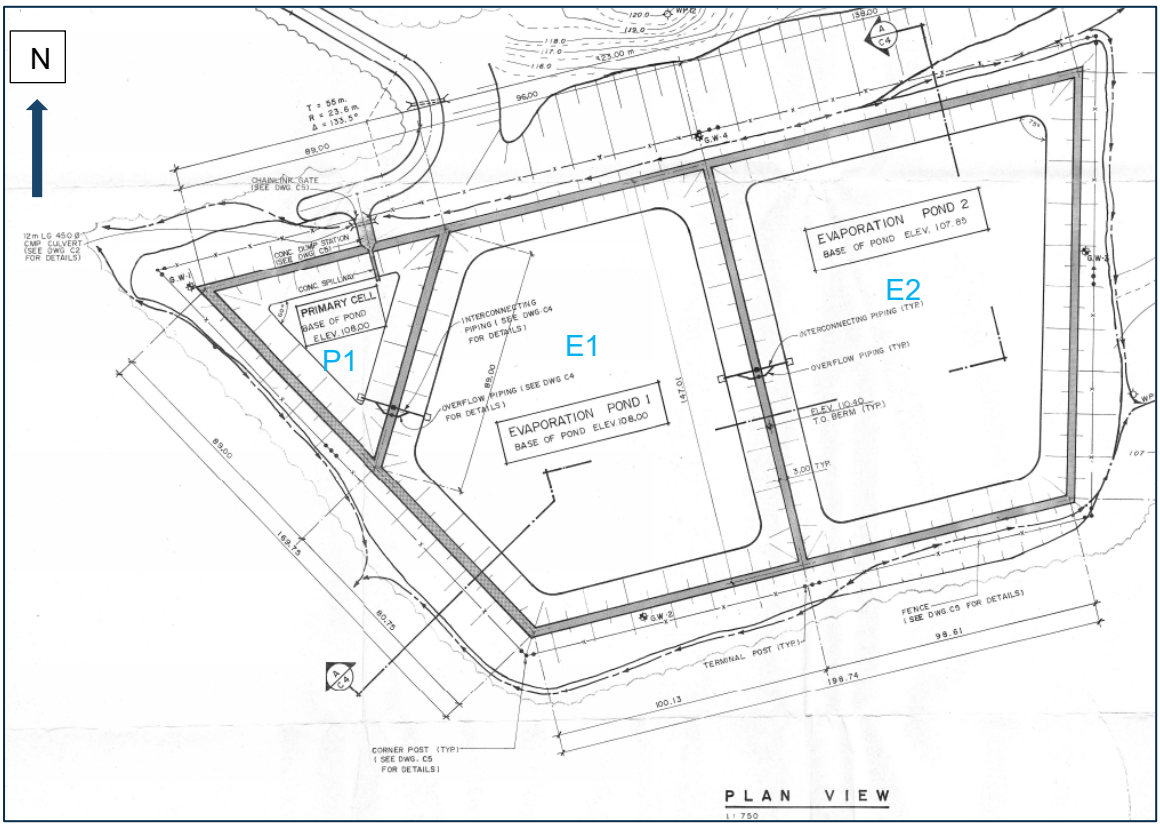

Figure 1.0

Table 1.0 shows the dimensions and volumes for all cells at maximum operation level but excludes freeboard. Original design included a Free Board (FB) of 0.9 m but currently the lagoon has a remaining freeboard of 0.1 m, therefore exceeding its capacity and occupying the freeboard area.

Table 1.0: Existing Lagoon Cells

Lagoon Cell	Treatment Cell	Side Slopes (H:V)	Max. Operation Liquid Depth	Liquid Volume m^3	Liquid Surface Area m^2	0.9 m Depth Freeboard Volume m^3	Total Volume (includes FB) m^3
P1	Primary Cell	4:1	1.50	2,460	2,100	1,890	4,350
E1	Evaporation Cell	4:1	1.50	20,660	15,200	13,680	34,340
E2	Evaporation Cell	4:1	1.65	20,020	14,850	13,365	33,385
Total				**43,140**	**32,150**	**28,935**	**72,075**

The lagoons are designed to hold a liquid volume of approx. 43,140 m^3 (without the freeboard volume), however, the liquid is currently at approx. 68,860 m^3 with approximately 0.1 m of freeboard remaining. The total available volume in existing lagoon is 72,075 m^3, including the freeboard (28,935 m^3).

This indicates that the freeboard depth is currently at 0.8 m and 89% of the design freeboard is occupied as shown in Table 2.0 below:

Table 2.0: Existing Freeboard

	Depth (m)	Approx. Volume (m^3)	% of Total FB Volume
Design Freeboard	0.9	28,935	n/a
Occupied Freeboard	0.8	25,720	89%
Vacant Freeboard	0.1	3,215	11%

Approximately 25,720 m^3 of volume is in excess of the design capacity and needs to be relocated elsewhere through hauling, pumping, or a possible new lagoon cell in order to keep the existing lagoon running at its optimum operating capacity.

The *Regional Lagoon Feasibility Study* by Wardrop indicated that there will be a time in the design life of the lagoon where inflow will exceed evaporation. The lagoon level will continue to rise at that point until storage capacity is has been exceeded. The study stated a major discharge would be required to reduce the storage volume.

It appears this lagoon has passed that point and is currently reaching near the top of berm.

Existing Lagoon Limitations

At the time of design, the evaporation lagoon was designed based on a net evaporation rate of 180 mm/yr. This rate was confirmed to be near the calculated average based on available climate data from years 1980 to 2010. The existing cells were assessed to understand the sewage inflow limits. **Table 3.0** below shows that an influent of 15.9 m^3/day (5787 m^3/year) will evaporate from lagoon and not cause further increase in levels and will ensure the 0.9 m freeboard is available.

Table 3.0: Influent Limitations of Existing Lagoon

Influent Flow	**m3/day**	**15.9**
	m^3/year	5,787
Net Evaporation Rate	mm/yr	180
Primary Cells		
Influent	m^3/yr	5,787
Net Evaporative Water Loss in Lagoons	m^3/yr	378
Effluent to Evaporation Cell #1	m^3/yr	5,409
Evaporation Cell #1		
Influent from Primary Cell	m^3/yr	5,409
Net Evaporative Water Loss in Lagoons	m^3/yr	2,736
Effluent to Evaporation Cell #2	m^3/yr	2,673
Evaporation Cell #2		
Influent from Evap. Cell #1	m^3/yr	2,673
Net Evaporative Water Loss in Lagoons	m^3/yr	2,673
Excess Effluent	m^3/yr	-

Based on conversations with the Summer Village, there was approximately 10,500 m^3/year (28.7 m^3/day) being discharged into the lagoon, which is greater than the limit of 5787 m^3/year (15.9 m^3/day) available thru evaporation. Therefore, there is an excess of 4713 m^3 being dumped into the lagoon per year which explains why the freeboard is currently at 0.1 m versus 0.9 m. Based on the occupied freeboard volume of 25,720 m^3, **it may have taken an estimate of 6-7 years for lagoon freeboard to fill to that level based on the excess rate of 4713 m^3/year.**

It should also be noted that in 2009 it was recommended that a desludging of the lagoon should be completed. However, this recommendation was not completed, and the capacity of the lagoon was further reduced by the sludge volume.

Design Standards and Guidelines

According to Parts 3 of the *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems* (March 2013), Section 3.4.2.1 states the following for evaporation ponds:

- "For systems with average daily design flows of less than 250 m^3, the system may be designed with one evaporation cell. Provision must be made at the inlet to the cell for settlement and removal of sludge."

- "In no case shall an evaporation lagoon provide less than 3 years of storage capacity based on average daily design flows."

- "Evaporation cells shall not have a depth greater than 1.5 m."

One of the evaporation cells, Cell E2, is a little over the depth limit but still acceptable (1.65 m vs 1.5 m). The minimum volume required based on a 3-year storage capacity and a daily average sewage flow of 26 m^3/d (Year 2016) would be approximately 28,000 m^3. The current lagoon volume exceeds this amount, however, the design should consider the rate of evaporation in sizing the surface area of the lagoon.

Recommended Options for Improving Lagoon Operation

Based on the existing conditions onsite, we have proposed 4 options for improving the function of this existing lagoon. **All options will require desludging**. A discharge extension which has been requested by MH to Alberta Environment would be required to bring the sewage level down further so repairs can be made. All options are discussed below:

1. ***Option 1***: Discharge existing lagoon to a water level to allow repair to berms. Approval by Alberta Environment will be required prior to discharge. Restrict the capacity of the facility to 15.9 m^3/day (5,787 m^3/yr) and haul the rest 12.9 m^3/day (4713 m^3/yr) to another lagoon nearby. Long term hauling contract with Onoway or another facility would be required.

2. ***Option 2***: Upgrade the system to 30 m^3/day (10,950 m^3/yr) by constructing another evaporation cell with a total surface of area of approximately 29,000 m^2. A sketch of Option 2 is shown below in **Figure 2.0.**

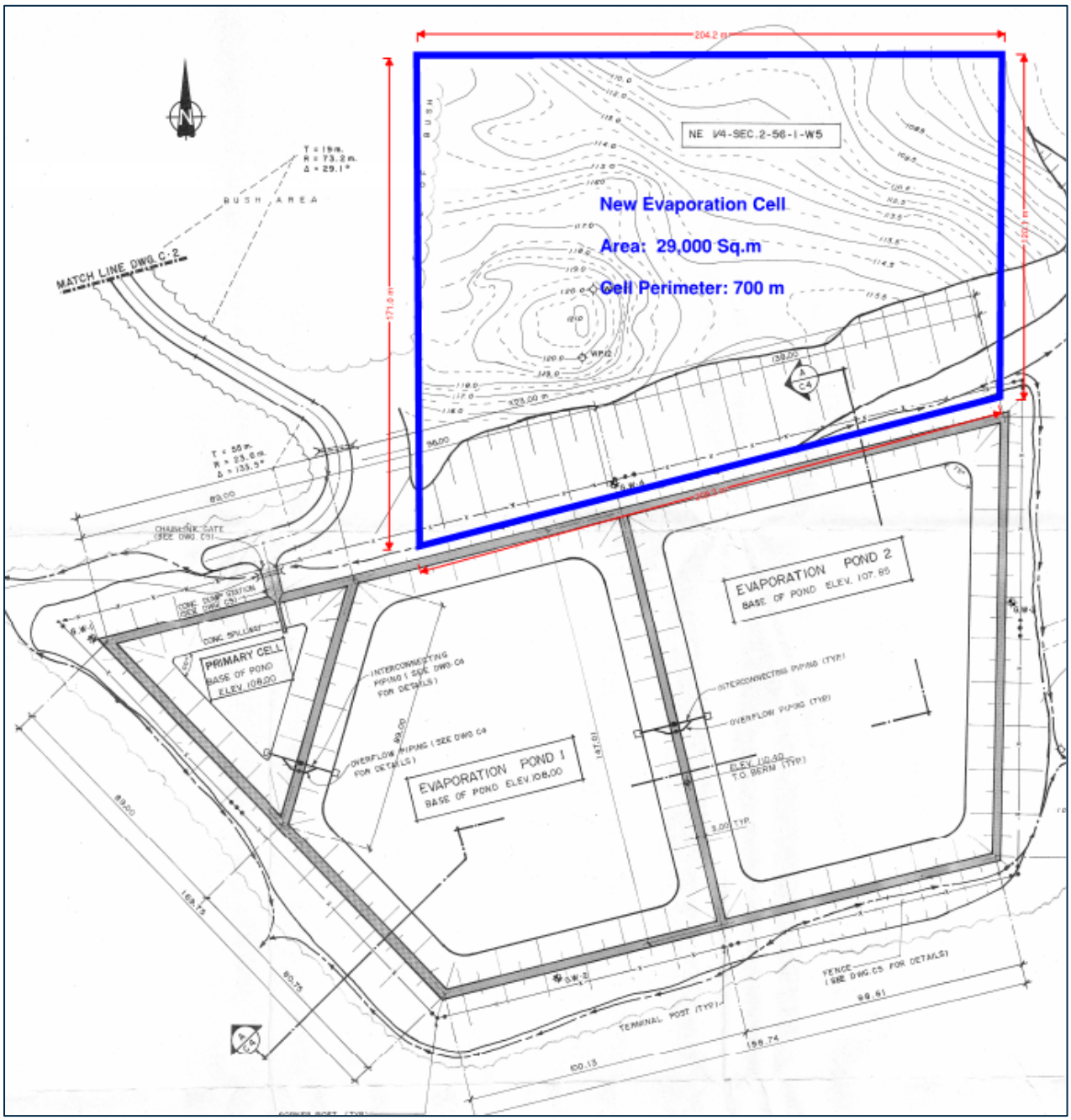

Figure 2.0

3. ***Option 3***: Construct a conventional lagoon that consists of a primary cell with a storage volume of 2,700 m^3 (includes freeboard) and storage cell with a volume of 13,000 m^3 (includes freeboard) based on the inflow of 28.7 m^3/day (10,500 m^3/year). The storage cell will need to be deeper at 3.0 m with an outlet that is directed to Bard Lake. This option is subject to approval by Alberta Environment and the First Nation Reserve neighboring Bard Lake. A sketch of Option 3 is shown below in **Figure 3.0**. Decommissioning of the existing evaporation pond may be required.

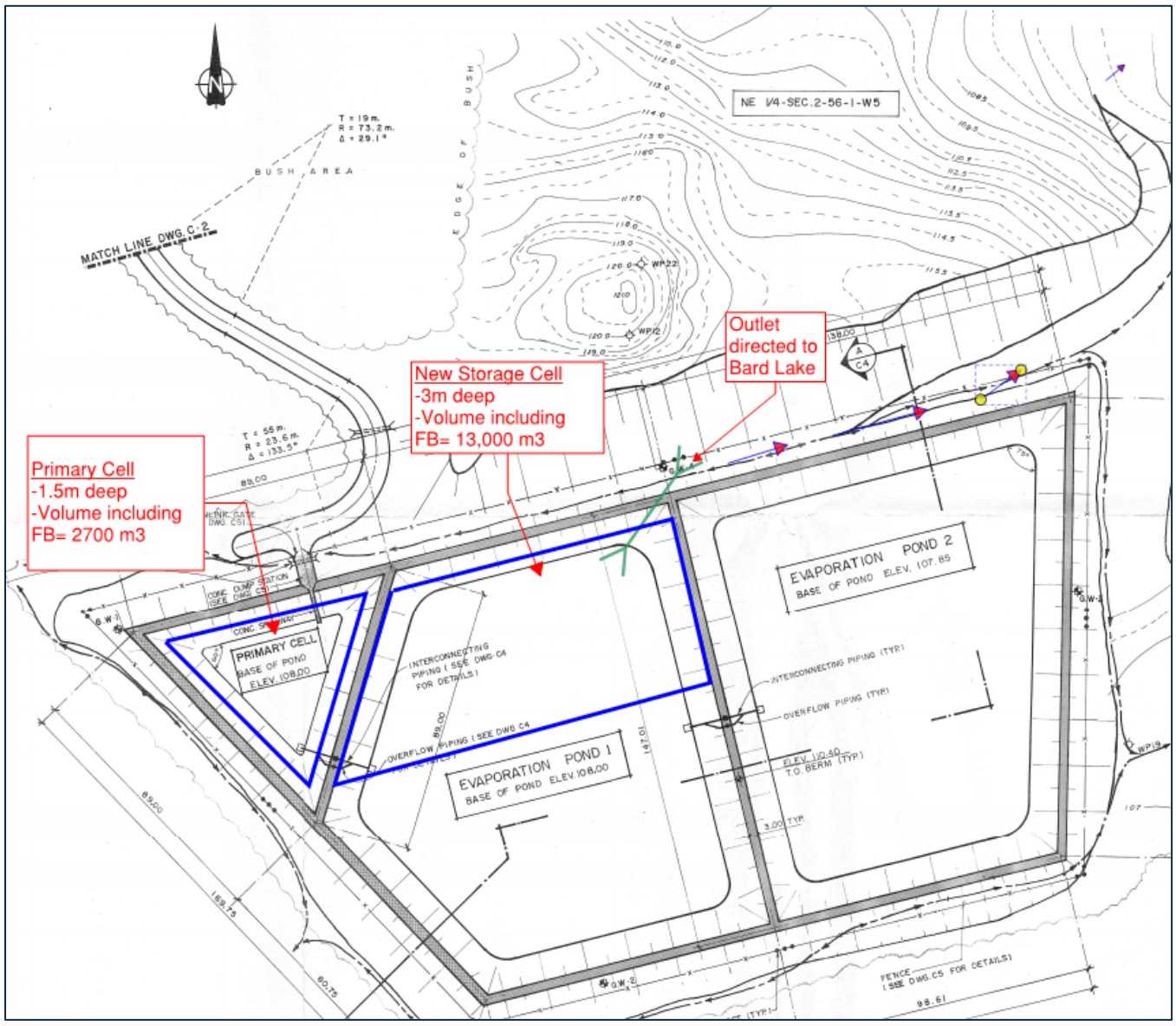

Figure 3.0

4. ***Option 4***: Leave Lagoon operational but not in operation. Discharge existing lagoon to a water level to allow repair to berms. Approval by Alberta Environment will be required prior to discharge. Monitoring and reporting will be required to maintain lagoon capacity levels as required by Alberta Environment. Redirect all sewage to another lagoon for a period of time until volume is available in the cells. Hauling contract with Onaway or another facility required.

Costs:

Costs for each option are shown below in Table 4.0. The additional cost for Option 4 is negligible as the only costs that occur are desludging and repair to eroded berms. **Desludging of all cells is required by all options, and have been included in cost estimate.** Berm repair was assumed to be within the freeboard depth of Evaporation Pond 2 only.

Table 4.0: Cost Estimates for Each Option

	Total Cost
Option 1 - Restrict Inflow to 15.9 m^3/day*	$ 252,000
Option 2 - Evaporation Cell	$ 2,531,000
Option 3 - Conventional Lagoon	$ 1,119,000
Option 4 – Haul to Another Lagoon Offsite*	$ 258,000

*Option 1 & 4 require an additional $4713/year and $10,500/year, respectively.

Detailed breakdown of this conceptual estimate is provided in **Appendix A**. Note that Option 1 and Option #4 would require an additional $4713 per year and $10,500 per year, respectively, for hauling to Onoway or another facility.

Note that the costs above are within ± 30% error. As design progresses, more accurate cost estimates can be provided.

Funding:

Research was completed on possible grants for water and wastewater systems in Alberta. The following are possible sources of funding for this project:

1. *Water for Life Program* – Provides cost-shared funding to regional commissions or groups of 2 or more municipalities and consists of 2 funding streams. One stream for new infrastructure and one for existing infrastructure.

2. *Alberta Municipal Water/Wastewater Partnership (AMWWP)* – Provides cost-shared funding to eligible municipalities to help build municipal facilities for water supply and treatment, and wastewater treatment and disposal.

Grant application are due yearly by Nov 30th, 2020. Engineering and repairs should be applicable.

Should you have any questions or concerns, please feel free to contact the Chad Newton or myself.

Yours truly,
Morrison Hershfield Limited

Chad Newton, MBA, PMP, Principal
PM Department Manager West,
Senior Project Manager

2020-11-18

Nedal Barbar, P.Eng
Project Engineer

Morrison Hershfield Limited
APEGA PERMIT TO PRACTICE P2277
Brian Fawson, P.Eng.
B Fawson
Nov 18, 2020

Attached: Appendix A: Cost Breakdown

Appendix A - Detailed Cost Breakdown for Each Option

Summary

	Total Cost
Option 1 - Restrict Flow to 15.9 m3/day	$ 252,134
Option 2 - Evaporation Cell	$ 2,531,313
Option 3 - Conventional Lagoon	$ 1,118,572
Option 4 - Haul to Another Lagoon	$ 257,921

Option - 1 (Restrict to 15.9 m3/day)

Item	Unit	Qty	Unit Rate	Cost
Additonal Delta Hauling Costs	m3	4,713	$ 1.00	$ 4,713
(additonal cost to haul to Onoway vs Current Lagoon)				
Sludge Removal and Disposal	LS	1	$136,627	$ 136,627
Repair to Berms (assumed just freeboard area of berm)	m^3	3187	$20	$ 63,748
Pumping between Cells	LS	1	$33,846	$ 33,846
Sewage Sampling	LS	1	$4,400	$ 4,400.00
Enviromental Sampling for Sewage Disposal on Agricultural Land	LS	1	$8,800	$ 8,800.00
			Sub Total	*$ 252,134*
Total Cost				**$ 252,134**

* assumed current rate to orginal lagoon is ~$4/m3
* new rate assumption $5/m3
* these costs would be either abosorbed by municpality or past directly onto residents

Option - 4 (Haul to Another Lagoon Offsite)

Item	Unit	Qty	Unit Rate	Cost
Additonal Delta Hauling Costs	m3	10,500	$ 1.00	$ 10,500
(additonal cost to haul to Onoway vs Current Lagoon)				
Sludge Removal and Disposal	LS	1	$136,627	$ 136,627
Repair to Berms (assumed just freeboard area of berm)	m^3	3187	$20	$ 63,748
Pumping between Cells	LS	1	$33,846	$ 33,846
Sewage Sampling	LS	1	$4,400	$ 4,400.00
Enviromental Sampling for Sewage Disposal on Agricultural Land	LS	1	$8,800	$ 8,800.00
			Sub Total	*$ 257,921*
Total Cost				**$ 257,921**

* assumed current rate to orginal lagoon is ~$4/m3
* new rate assumption $5/m3
* these costs would be either abosorbed by municpality or past directly onto residents

Option -3 (Conventional Lagoon)

Item	Unit	Qty	Unit Rate	Cost
New Storage and Primary Cell				
Topsoil and subsoil Stripping 1m deep	m^3	7405	$5	$ 37,026
Topsoil Placement (150mm depth)	m^2	7405	$1.5	$ 11,108
Pond Storage Excavation	m^3	6500	$10	$ 65,000
Clay Bottom Placement (1.0m Thick)	m^3	7405	$20	$ 148,105
Wave protection on side slopes (250mm Thick)	m^2	594	$65	$ 38,610
Containment Berms	m^3	12882	$20	$ 257,645
Hydroseed	m^2	7405	$1.0	$ 7,405
Sludge Removal and Disposal	LS	1	$136,627	$ 136,627
Pumping between Cells	LS	1	$33,846	$ 33,846
Sewage Sampling	LS	1	$4,400	$ 4,400.00
Enviromental Sampling for Sewage Disposal on Agricultural Land	LS	1	$8,800	$ 8,800.00
Control/Overflow Manhole or Chamber	each	1	$35,000	$ 35,000
Splash Pad	LS	2	$10,000	$ 20,000
Outlet Pipe	LS	1	$25,000	$ 25,000
			Sub Total	*$ 828,572*
Mob/Demob/Insurances	10%			$ 82,857
Contingencies and Engineering	25%			$ 207,143
Total Cost				**$ 1,118,572**

Option - 2 (New Evaporation Cell)

Item	Unit	Qty	Unit Rate	Cost
New Evaporation Cell				
Topsoil and subsoil Stripping 1m deep	m^3	29000	$5	$ 145,000
Topsoil Placement (150mm depth)	m^2	29000	$1.5	$ 43,500
Pond Storage Excavation	m^3	40000	$10	$ 400,000
Clay Bottom Placement (1.0m Thick)	m^3	29000	$20	$ 580,000
Wave protection on side slopes (250mm Thick)	m^2	480	$65	$ 31,200
Containment Berms	m^3	14969	$20	$ 299,376
Hydroseed	m^2	29000	$1.0	$ 29,000
Sludge Removal and Disposal	LS	1	$136,627	$ 136,627
Repair to Berms (assumed just freeboard area of berm)	m^3	3187	$20	$ 63,748
Pumping between Cells	LS	1	$33,846	$ 33,846
Sewage Sampling	LS	1	$4,400	$ 4,400.00
Enviromental Sampling for Sewage Disposal on Agricultural Land	LS	1	$8,800	$ 8,800.00
Control/Overflow Manhole or Chamber	each	1	$35,000	$ 35,000
Splash Pad	LS	2	$10,000	$ 20,000
Install Fence	m	495	$90	$ 44,550