HEADINGLEY WASTEWATER TREATMENT FACILITY
BIOSOLIDS OPTIONS REPORT

A REPORT TO THE RURAL MUNICIPALITY OF HEADINGLEY
MARCH 20, 2015

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Headingley Wastewater Facility Biosolids

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SUMMARY

Manitoba Conservation and Water Stewardship (MCWS) through the application of the Environment Act and Environment Act Licence 2869 RRR has required the Rural Municipality of Headingley (RM) to submit a report with a complete assessment of options for beneficial reuse of biosolids.

This report was commissioned by the RM to provide an assessment of the options available to the RM to comply with the requirements. The study examined the quantity and quality of biosolids produced at the RM together with the cost of operation. Changes to the existing treatment processes that generate and process biosolids were discussed but discarded as not feasible. The existing system and seven (7) options to handle biosolids were examined and high-level cost estimates for ranking of options were prepared.

Forty-three (43) tonnes of biosolids generated annually at the Headingley Wastewater Treatment Facility (HWWTF) are currently disposed to landfill. For comparison the City of Winnipeg landfilled close to 14,000 tonnes of biosolids in 2014. The quality of biosolids generated at the HWWTF is such that beneficial reuse by land application is certainly feasible and desirable. However, the requirement to store biosolids over the winter months results in the need for expensive storage infrastructure and additional operational attention as detailed in this report.

The RM's earlier request was to continue to landfill its biosolids until such time as Winnipeg develops its proposed biosolids processing and disposal system with the expectation that the RM biosolids could be integrated into that system. Additional municipalities from within the Capital Region currently dispose of treatment plant solids at the City's North End Water Pollution Control Centre (NEWPCC). The municipality's preferred approach is to still landfill their biosolids. If this is unacceptable to MCWS after reviewing the options presented herein, the next most suitable alternative from the RM's perspective is to land apply the biosolids in the summer months and continue to landfill the biosolids in the winter months.

1 INTRODUCTION

Every wastewater facility produces biosolids in its operation. The environmentally safe handling and disposal of biosolids is critical to the ongoing facility operation and reliable performance. To date, biosolids from the Headingley Wastewater Treatment Facility (HWWTF) have been disposed of at a landfill.

The purpose of this report is to respond to Clause 5 of the Environment Act Licence 2869RRR, which states:

> *The Licencee shall submit to the Director for approval, on or before June 30, 2013, a report containing a re-assessment of the options for treated waste solids and sewage sludge disposal which shall include the sampling results of waste solids and sewage sludge produced from the operation of the facility.*

The Rural Municipality of Headingly (RM) submitted an initial response to this clause. In reply, the Director of the Environmental Approvals Branch requested *"a report containing a complete assessment of options for beneficial re-use of biosolids by December 31, 2014."* The entire letter from the Director is reproduced in Appendix A.

The letter further states: *Options to be considered could include land application during the summer with winter landfilling as a temporary measure along with regular assessment and reporting of other options.*

The deadline for submittal of the report was subsequently extended to May 31, 2015.

BDM Projects Ltd. together with KOR Project Services submitted a proposal to prepare a biosolids options report on October 28, 2014 and was subsequently notified on November 13, 2014 that the proposal was accepted. A project start-up meeting was held at the RM offices on December 4, 2014.

Figure 1 on the next page shows the study approach. The basic premise of the study is to examine alternatives to the current operation that might be available to move from landfilling of biosolids to beneficial use. The RM has indicated that cost will be a major factor for them in evaluating alternatives.

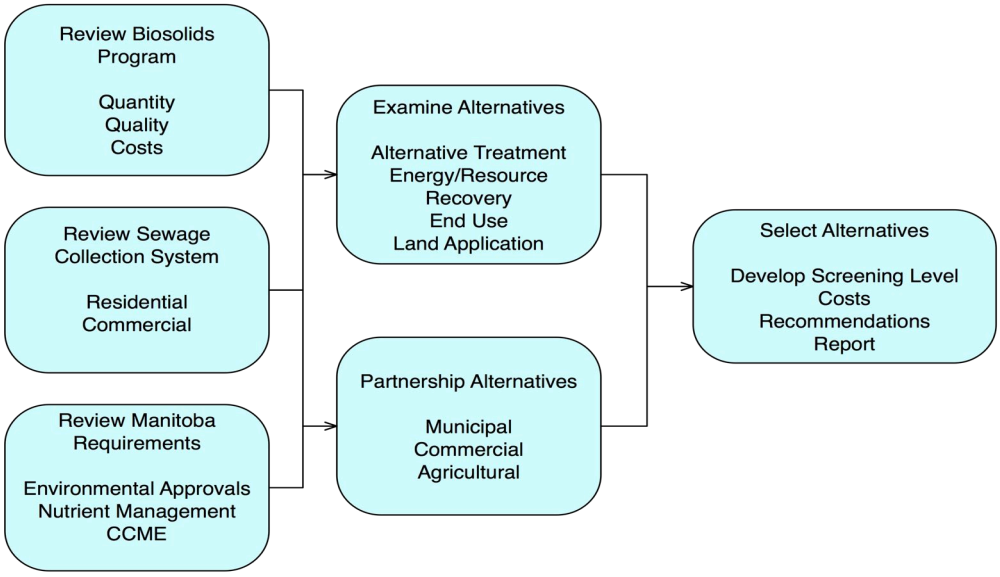

Figure 1 Study Approach

2 HEADINGLEY WASTEWATER SYSTEM

2.1 Collection System Description

The RM is serviced by using the septic tank effluent pumping (STEP) system that includes about 5400 m of 200, 250 and 300 mm diameter low-pressure sewers (LPS). The LPS system services about 74 commercial/industrial customers including the Women's Correctional Centre and about 905 dwelling units with a population of about 2605 (in 2011). A separate collection system services the Headingley Correctional Centre (HCC) for men. The HCC system consists of conventional gravity sewers that flow to a lift station that pumps wastewater to the HWWTF.

The LPS system operates without major issues. Typically, a $^{1}/_{3}$ or $^{1}/_{2}$ horsepower pump is used at each septic tank and typical operating pressure is less than 4 pounds per square inch (psi) with a maximum system pressure of about 19 psi. Currently there are about 40 housing starts per year on average with a peak of 75 and a low of 15 starts per year.

Two characteristics of the STEP – LPS system are that:

- The strength of the sewage reaching the plant is generally lower than a conventional gravity system because of the septic tank at each property serviced which separates and contains solids.
- There can be long retention times in the system leading to formation of significant amounts of hydrogen sulphide that must be dealt with at the treatment facility.

2.2 Wastewater Treatment Facility

The Headingley Wastewater Treatment Facility (HWWTF) receives sewage from the collection system described above. The plant was built under an agreement with the Manitoba Water Services Board. Penn-Co Construction in association with Stantec Consulting Ltd. were selected to construct the facility under a "Design-Build" arrangement including commissioning and operation over 120 days. The design year for the facility is 2030 with a projected population of 6700 people. The 2011 population of the RM was recorded as 3215.

The facility receives sewage from two sources:

1. The STEP – LPS collection system that services the RM.
2. The Headingley Correctional Centre (HCC).

As the STEP system by its nature removes primary solids in each on-site septic tank, there are no primary clarifiers at the facility. Since the flow from the HCC does not come from a STEP system, a 6mm opening spiral screen is used to provide preliminary treatment prior to secondary treatment.

Figure 2 below shows the flow schematic for the existing treatment facility. Secondary treatment is provided by sequencing batch reactors (SRB) with a cycle intended to provide biological nitrogen removal. Phosphorus reduction is provided by chemical phosphorus removal using aluminum sulphate (alum).

Waste activated sludge produced in the SBRs is aerobically digested with a retention time of 27.5 days at design flow. Digested sludge is dewatered by a centrifuge on an intermittent basis with the digesters providing the balancing storage. The dewatered sludge or biosolids are deposited in a roll-off bin for transport to a Class 1 landfill under the current operation.

The plant was commissioned in June of 2011. In 2013, the HCC system was connected.

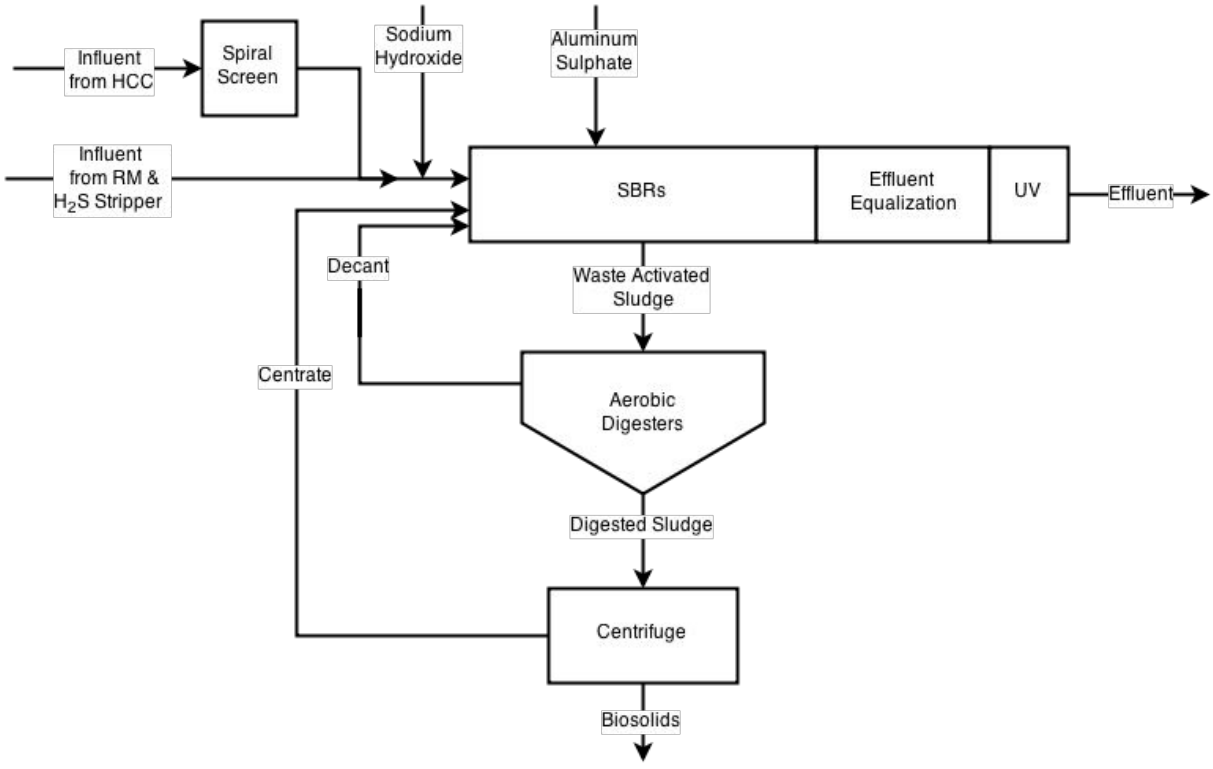

Figure 2 Headingley WWTF Flow Chart

Table 1 below shows the 2014 monitoring results as obtained from the records at the facility along with values submitted in the 2009 design brief[1]. As can be seen, the plant is operating well below its design capacity and is meeting effluent requirements. There is very limited data on the influent in terms of

[1] December 2009, Stantec Consulting Ltd., *Rural Municipality of Headingley Wastewater Treatment Plant Design Build Project – Design Brief (Rev 1)*

BOD_5, TN and TP. The limited values are consistent with what might be expected from the Headingley collection system.

Table 1 Headingley WWTF 2014 Data

Headingley WWTF Monitoring - 2014[1]			Design Brief[2]	
Influent				
RM	675	m^3/d	1321	m^3/d
Correction Centre	311	m^3/d	388	m^3/d
Total	986	m^3/d	1709	m^3/d
Peak day	2665	m^3/d	5200	m^3/d
pH	8.2			
TSS			128	mg/L
BOD_5[3]	76	mg/L	307	mg/L
TN[3]	60.5	mg/L	36	mg/L
TP[3]	8.2	mg/L	9.8	mg/L
Alum solution	69.5	L/d	70	L/d
NaOH solution	28.8	L/d		
WAS flow	27	m^3/d	40	m^3/d
WAS SS	7800	mg/L		
Effluent				
Flow	967	m^3/d		
TSS	9.1	mg/L		
cBOD	<6	mg/L		
NH_3-N	0.8	mg/L		
NO(x)	2.6	mg/L		
TN	5.0	mg/L		
TP	0.5	mg/L		
Fecal Coliform (GM)	158	/100mL		
Digested Sludge Flow	3322	m^3/yr		
Biosolids	732.9	kg/d (wet)	2.1	m^3/d
	268000	kg/yr (wet)		
Moisture	83.8%			
	119	kg/d (dry)	264	kg/d (dry)
	43000	kg/yr (dry)		

[1]RM of Headingley Data 2014

[2]Stantec Consulting Ltd. December 2009

[3]Very limited data for influent BOD, TN, TP

3 EXISTING BIOSOLIDS PROGRAM

Biosolids currently produced at the facility are transported and disposed of at the Brady Road Resource Management Centre (BRRMC), a Class 1 landfill operated by the City of Winnipeg. This is the same landfill currently used to dispose of biosolids from the City of Winnipeg wastewater treatment facilities.

3.1 Biosolids Quantity

During 2014, a total of 268 tonnes of biosolids (43 dry tonnes) were picked up at the HWWTF and taken to the BRRMC.

Table 2 - Biosolids Quantity 2014

Biosolids Bin Pickup

Date	Net Weight kg	Date	Net Weight kg
14-01-06	4500	14-07-17	6350
14-01-10	5680	14-07-30	6870
14-01-17	4850	14-08-07	8150
14-01-27	4930	14-08-12	5620
14-01-31	5640	14-08-21	6190
14-02-18	4670	14-08-28	6470
14-02-28	6070	14-09-04	5560
14-03-10	4610	14-09-11	6930
14-03-17	5310	14-09-17	5970
14-03-24	6130	14-09-26	6850
14-03-31	5490	14-10-02	6610
14-04-07	5690	14-10-08	6660
14-04-16	5020	14-10-17	7170
14-04-22	5440	14-10-23	6990
14-04-24	4840	14-10-29	6850
14-04-30	5430	14-11-06	6770
14-05-05	5590	14-11-12	5170
14-05-12	4920	14-11-21	4540
14-05-15	5980	14-11-27	5050
14-05-23	5410	14-12-03	5130
14-06-04	5140	14-12-10	5130
14-06-11	4790	14-12-17	5030
14-07-04	4180	14-12-31	5130
14-07-10	6010		

Loads	47	
Total	267510	kg
No of Days	365	
Per day	733	kg
Per week	5130	kg
Moisture	83.8%	
Dry	43337	kg

December abnormal due to centrifuge problems. Loads highlighted in yellow added to simulate more normal operations

During the year, three samples were submitted to ALS Laboratory for analysis. The results for moisture content are as follows.

RM of Headingley Biosolids Moisture Content

Date Sampled	Units	09-Jan-2014	03-Apr-2014	01-May-2014	Average
% Moisture	%	83.1	84.1	84.1	83.8

At 83.8% moisture, the 268 tonnes of dewatered biosolids would be equal to 43 tonnes of dry solids; equivalent to a generation rate of 119 kg per 1000 m^3 treated which is reasonable for this facility. A comparison with Portage la Prairie and Winnipeg is shown below.

Biosolids Production Comparison

	Year	Ave. Flow m^3/d	Biosolids 1000 kg/yr	Production $kg/1000m^3$
Headingley	2014	991	43	119
Portage la Prairie	2013	15151	1060	192
Winnipeg	2014	277908	13687	135

3.2 Biosolids Quality

Biosolids quality is generally in reference to its suitability for land application without causing concerns with respect to pathways impacting plant, animal or human health. Biosolids contain organic matter, which adds to the suitability of soils for growing crops. It also contains macronutrients, micronutrients and metals.

The macronutrients that are in commercial fertilizers are also in biosolids. The key ones that most often are in commercial fertilizers are nitrogen, phosphorus, and potassium. Generally, biosolids contain less of these nutrients by weight compared to commercial fertilizers.

RM of Headingley Biosolids - Macronutrients

Date Sampled	Units	09-Jan-2014	03-Apr-2014	01-May-2014	Average
Total Organic Carbon	%	27.0	33.0	33.5	31.2
Available Ammonium-N	mg/kg	112	1150	1550	937
Total Organic Nitrogen	%	4.45	5.70	4.44	4.86
Total Kjeldahl Nitrogen	%	4.46	5.81	4.6	4.96
Available Nitrate-N	mg/kg	617			617
Phosphorus (P)	mg/kg	49900	46900	53300	50000
Available Phosphate-P	mg/kg	683	2180	1760	1540
Potassium (K)	mg/kg		3330	3180	3260
Sulfur (as SO4)	mg/kg		4090	2930	3510
Calcium (Ca)	mg/kg		490	581	540
Magnesium (Mg)	mg/kg		1860	1350	1610

These values are typical for biosolids with biological nitrogen removal and chemical phosphorous removal. For phosphorous, 50,000 mg/kg dry solids for 43 tonnes of dry solids per year, would equal a removal of 2150 kg/year. For an influent flow rate of 991 m^3/day, that would be a removal rate of 6 mg/L of P from the influent.

The phosphorous in the biosolids is not generally available for plants as it is either organically or chemically bound in the biosolids. The organically bound phosphorous is more weakly absorbed compared to the chemically bound phosphorus that is strongly absorbed. According to the laboratory results, the plant available phosphorus is 1540 mg/kg or 3% of the total phosphorus.

RM of Headingley Biosolids - Micronutrients

Date Sampled	Units	09-Jan-2014	03-Apr-2014	01-May-2014	Average
Boron (B)	mg/kg	31	28	25	28
Boron (B), Hot Water Ext.	mg/kg	10.6	15.6	6.6	10.9
Copper (Cu)	mg/kg	1090	1220	1350	1220
Iron (Fe)	mg/kg	10500	5350	5750	7200
Manganese (Mn)	mg/kg	84.8	86.6	91.5	87.6
Molybdenum (Mo)	mg/kg	29.0	26.3	34.5	29.9
Zinc (Zn)	mg/kg	640	649	693	661

Micronutrients are required for plant growth and can be supplied by biosolids. Limits on concentrations of copper, molybdenum and zinc are discussed under metals below.

RM of Headingley Biosolids - Metals

Date Sampled	Units	09-Jan-2014	03-Apr-2014	01-May-2014	Average
Aluminum (Al)	mg/kg	42100	29600	30100	33900
Antimony (Sb)	mg/kg	2.20	2.00	2.22	2.14
Arsenic (As)	mg/kg	5.27	4.12	4.09	4.49
Barium (Ba)	mg/kg	213	168	192	191
Beryllium (Be)	mg/kg	0.30	0.24	0.24	0.26
Bismuth (Bi)	mg/kg	9.06	7.32	7.9	8.1
Boron (B)	mg/kg	31	28	25	28
Cadmium (Cd)	mg/kg	2.58	0.793	0.848	1.41
Calcium (Ca)	mg/kg	13900	14000	13700	13900
Chromium (Cr)	mg/kg	27.8	18.1	17.1	21.0
Cobalt (Co)	mg/kg	2.21	1.7	2.09	2.0
Copper (Cu)	mg/kg	1090	1220	1350	1220
Iron (Fe)	mg/kg	10500	5350	5750	7200
Lead (Pb)	mg/kg	16.2	14.5	24.3	18.3
Magnesium (Mg)	mg/kg	7170	8630	8790	8200
Manganese (Mn)	mg/kg	84.8	86.6	91.5	87.6
Molybdenum (Mo)	mg/kg	29.0	26.3	34.5	29.9
Nickel (Ni)	mg/kg	20.1	15.3	34.9	23.4
Phosphorus (P)	mg/kg	49900	46900	53300	50030
Potassium (K)	mg/kg	7210	7720	8360	7760
Selenium (Se)	mg/kg	4.81	4.02	4.06	4
Silver (Ag)	mg/kg	1.26	0.82	0.83	1
Sodium (Na)	mg/kg	1330	1340	1310	1330
Strontium (Sr)	mg/kg	263	325	241	276
Thallium (Tl)	mg/kg	<0.10	<0.10	<0.10	<0.10
Tin (Sn)	mg/kg	16.7	14.7	36.8	22.7
Titanium (Ti)	mg/kg	61.9	39.3	48.5	49.9
Uranium (U)	mg/kg	13.9	9.13	9.38	10.80
Vanadium (V)	mg/kg	9.26	5.89	6.66	7.27
Zinc (Zn)	mg/kg	640	649	693	661

The aluminum concentration of 3.4% is consistent with the quantity of alum added to remove phosphorus.

A comparison of the quality of the Headingley biosolids versus Winnipeg and various criteria for land application to agricultural land is provided below. Manitoba does not regulate the contaminant level in biosolids, choosing instead to restrict the total build up of metals in agricultural soils.

Biosolids Metals Comparison		Headingley	Winnipeg 2013	Ontario Land Application	CAN/BNQ Dried or Alkaline	US EPA Exceptional Quality
Constituent	Units					
Arsenic (As)	mg/kg	4.49	4.6	170	41	41
Cadmium (Cd)	mg/kg	1.41	1.7	34	15	39
Chromium (Cr)	mg/kg	21.0	112	2800	1000	1200
Cobalt (Co)	mg/kg	2.0		340	150	
Copper (Cu)	mg/kg	1220	595	1700	1500	4300
Lead (Pb)	mg/kg	18.3		1100	300	840
Mercury (Hg)-Total	mg/kg	0.192	1.1	11	4	17
Molybdenum (Mo)	mg/kg	29.9	17.7	94	20	75
Nickel (Ni)	mg/kg	23.4	58.3	420	180	420
Selenium (Se)	mg/kg	4.30		34	25	36
Zinc (Zn)	mg/kg	661	1665	4200	1850	2800

As can be seen, the contaminant levels in the Headingley easily meet the USEPA criteria for "exceptional quality" biosolids. Compared to the data available for Winnipeg, the Headingley biosolids contains less chromium, mercury, nickel, and zinc, but contains more copper and molybdenum.

Headingley biosolids would not meet the molybdenum criteria under the CAN/BNQ standard for alkaline or dried municipal biosolids. The value for this parameter is the same as for agriculture fertilizers and is much lower than used elsewhere. Manitoba does not have a molybdenum criterion.

A study of biosolids by the USEPA[2] found that the medium concentration of molybdenum in biosolids was 11.4 mg/kg and the 90th percentile was 30.6 mg/kg. Common sources of significant molybdenum in wastewater include cooling towers where sodium molybdate is used in water treatment chemicals and automotive or metal shops as molybdenum is used in lubricants[3].

[2] USEPA 2009, *Targeted National Sewage Sludge Survey, Statistical Analysis Report.*
[3] King County Industrial Waste Program 2011, *Molybdenum Study*

3.3 Cost of Existing Program

In 2014, the cost of the biosolids pick up and disposal was $28,400 as follows.

Total Tonnes	268
Total Tonnes (dry)	43
Trips	47
Landfill Charges	$ 15,917
Trip Charges	$ 7,674
Bin Rental	$ 1,633
Fuel Surcharges	$ 1,826
GST	$ 1,352
Total	$ 28,402
Cost per tonne wet	$ 106
Cost per tonne dry	$ 661

4 MANITOBA REQUIREMENTS FOR BIOSOLIDS

Manitoba supports the Canada-wide Approach for the Management of Wastewater Biosolids[4], which encompasses four principles that promote recycling/recovery of nutrients, organic matter or energy in biosolids. The potential uses include energy production, compost and soil products, agricultural land and forestry applications, and land reclamation. Landfilling of municipal biosolids is discouraged under these policies.

Manitoba has adopted the Manitoba Water Quality Standards, Objectives, and Guidelines[5] by regulation[6]. A Tier 1 Standard requires *"Best practical technology for beneficial use of valuable resources such as nutrients, organic matter and energy contained within municipal biosolids and sludge."*

The CCME has also produced a guidance document[7] in support of its policies, which has been reviewed in the context of the HWWTF.

Provincial staff did confirm that land application is the preferred approach for handling of biosolids in Manitoba so that the nutrients in biosolids are recycled and green house gases associated with landfills are reduced. This would require storage over about five to six months as land application is prohibited on from November 10 to April 10. In recognition, the province has indicated that they would consider a proposal where land application is only done in the summer months as an interim step for the RM until the City of Winnipeg's plans are more definite.

The Manitoba requirements for wastewater biosolids are typically laid out in Environment Act licences. They include limits on heavy metals and nutrient application rates. In particular the Nutrient Management Regulation[8] can impact alternatives.

4.1 Requirements for Environment Act Licence

Biosolids application requires an Environment Act Licence. Biosolids application is considered a Class 2 development[9] under the Environment Act. The process for the RM to be granted a license include:

- Submission of an Environment Act Proposal (fee $7500)
- Public notice and review
- Technical screening

[4] CCME, October 11, 2012 *"Canada-Wide Approach for the Management of Wastewater Biosolids."*
[5] Manitoba Water Stewardship, Nov 28 2011, *Manitoba Water Quality Standards, Objectives and Guidelines*
[6] Regulation 196/2011 under the Water Protection Act
[7] CCME, 2012, "*Guidance Document For The Beneficial Use Of Municipal Biosolids, Municipal Sludge And Treated Septage"*
[8] MR 62/2008, Nutrient Management Regulation, Water Protection Act
[9] MR 164/88 Classes of Development Regulation (This regulation classifies biosolids application as a Class 1 development in error according to the Branch – who use the act to raise biosolids application to a Class 2 development.)

- Further information may be required
- Public hearing if public concerns warrant it
- Licensing Decision

4.2 Typical licence requirements

While many licences have been issued for biosolids removal from lagoons and one-time agricultural applications, relatively few licences are in place for biosolids from wastewater treatment facilities. Licences for Brandon, Portage La Prairie, and Gimli were reviewed and have similar requirements as listed below.

- Prior public notification
- Prior approval of the land to be used each year
- Application rates that do not exceed 10 to 15 dry tonnes per hectare, and plant available nitrogen not exceeding 100 kg per hectare.
- Immediate incorporation into the soil
- Specified separation distances from residences, waterways and groundwater wells
- No application to soils with pH less than 6.0, the level of nitrate nitrogen exceeds 100 kg/ha in the upper 60 cm, or where the available phosphorus exceeds 60 ug/g in the upper 15 cm.
- Land cannot be used as pasture for 3 years
- Only specific crops for 3 years following application
- Heavy metal restrictions to ensure cumulative weight per hectare does not exceed objectives
- Ongoing monitoring and reporting
- Annual report to MCWS on the program.

4.3 Land Application - Nitrogen

The Nutrient Management Regulation governs land application of nutrients from any source and is the basis of an environmental licence for biosolids application. Winter application of nutrients is not permitted between November 10 of any year and April 10 of the following year unless modified by the director. The regulation restricts nitrogen and phosphorus application according to water quality management zones N1 through N4 which are in turn related to soil classes according to the Soil Capability Classification for Agriculture by the Canada Land Inventory report published in 1972.

For good quality soil classes the allowable rate for nitrogen is such that at the end of the growing season there is no more than 157 kg/ha NO_3 as N in the top 0.6 m. An application rate of 10 t/ha (dry) of Headingley Biosolids would contribute about 500 kg/ha total nitrogen. As it is predominately organic nitrogen, about 20% or 100 kg/ha would be available for plants in the first year. Cereal crops in Manitoba might typically remove 70 kg/ha as shown in the table below.

Crop Removal Rates for N and P2O5 (Metric Units)[1,2].

Crop 2	Example Target Yield 3	Average Nutrient Removal Rate[4]		Average Nutrient Removal Rate[4]		
		N	P2O5	N	P2O5	As P
	t/ha	kg/t	kg/t	kg/ha	kg/ha	kg/ha
Spring Wheat	2.69	25.1	9.8	67.5	26.4	11.5
Winter Wheat	3.36	17.4	8.5	58.5	28.6	12.5
Barley	4.30	20.3	8.8	87.3	37.8	16.5
Oats	3.81	18.3	7.7	69.7	29.3	12.8
Rye	3.45	19.0	8.1	65.6	27.9	12.2
Grain Corn	6.27	17.4	7.9	109.1	49.5	21.6
Canola	1.96	38.7	20.8	75.9	40.8	17.8
Flax	1.50	38.1	11.6	57.2	17.4	7.6
Sunflowers	1.68	35.7	10.7	60.0	18.0	7.8
Alfalfa	11.2	29.0	6.9	324.8	77.3	33.7
Grass	6.7	17.1	5.0	114.6	33.5	14.6
Corn Silage	11.2	15.6	6.4	174.7	71.7	31.3
Barley Silage	10.1	17.2	5.9	173.7	59.6	26.0

[1]Adapted from "Detailed Instructions for Completing Nutrient Management Plans Municipal Wastewater Sludge or Biosolids, Manitoba Government

[2]Adapted from Nutrient Uptake and Removal by Field Crops, Western Canada, 2001.
Compiled by the Canadian Fertilizer Institute.

[3]Example target yields for Manitoba. Site specific and actual yields for any parcel of land will depend on the agriculture capability of the land.

[4]Nutrient removed in the harvested portion of the crop.

4.4 Land Application – Phosphorus

The Nutrient Management Regulation restricts application of phosphorus in some circumstances as well. Providing the soil test phosphorus level is less than 60 mg/kg, there is no restriction. The maximum application rate of two times the applicable phosphorus removal rate applies if the soil test phosphorus levels are greater than 60 mg/kg but less than 120 mg/kg.

Headingley biosolids contains similar amounts of phosphorus as nitrogen and so at an application rate of 10 t/ha (dry), 500 kg/ha of phosphorus would be applied. However much of the phosphorus is unavailable for plant uptake as it is combined with aluminum from the aluminum sulphate used to remove phosphorus from the wastewater. In fact only about 3% is available which would equate to 15 kg/ha. Cereal crops in Manitoba typically remove about 15 kg P/ha.

5 ALTERNATIVES FOR BIOSOLIDS

5.1 Alternative or Additional Treatment

5.1.1 Anaerobic digestion with biogas recovery

Anaerobic digestion with biogas recovery is an alternative to the aerobic digestion that is now practiced at the HWWTF. The recovery and use of biogas associated with this treatment for heating would be in line with the CCME objective to recover energy. However, for a small installation such as the HWWTF, anaerobic digestion would be cost prohibitive, involving significant capital costs for heat exchangers and gas handling in accordance with the latest gas codes. There would still be a requirement to deal with biosolids from this process.

5.1.2 Struvite phosphorous recovery

Struvite phosphorous recovery is a fairly new process where struvite (magnesium ammonium phosphate) is precipitated from high phosphorus centrate. Struvite is a slow release fertilizer. It has been applied typically with anaerobic digestion where ammonium levels are high and only in larger plants. It is not applicable to the HWWTF. The City of Winnipeg has issued a request for proposal for a struvite recovery system to be located at the North End Water Pollution Control Centre.

5.1.3 High temperature drying, alkaline stabilization, composting and incineration

These processes can be used to provide biosolids that are reduced in volume (drying or incineration) which is an important consideration for storage or just easier to store (alkaline stabilization and composting). They are not really applicable to the HWWTF because they involve extensive capital and operating costs. They are normally considered in large operations only.

5.2 Energy Resource Recovery

Various possibilities have been used to recover the energy in biosolids. These include:

- Incinerator heat recovery
- Cement manufacture
- Biogas utilization
- Landfill gas utilization

While the first three are not applicable for Headingly due to high cost for small-scale facilities, landfill gas utilization is possible with the current landfill disposal. The Brady Road Resource Management Centre (BRRMC) is the current disposal location for Headingley biosolids. The BRRMC has a landfill gas system that recovers and flares landfill gas. Now that the gas quantities and quality has been proven, the City is in discussions to utilize the gas for space heating and electrical generation.

5.3 Land application

Land application on agricultural land to utilize organic matter, macronutrients and micronutrients is well accepted and is supported by environmental regulators as a good environmental practice. Biosolids contain pathogens and can result in odour complaints so care must be taken in handling, storage and land application of biosolids. Separation distances from ditches, watercourses and wells are required. Incorporation into the soil is important to improve acceptance and minimize nutrient loss or runoff.

In Manitoba, biosolids may be applied by liquid injection below the soil or by broadcast on to the surface with subsequent thorough tillage.

Variations on land application would be application to forestry lands, marginal land reclamation and landfill cover.

Application to agricultural land is the alternative that most matches the Province's stated objective to reuse the nutrients in HWWTF biosolids. For the HWWTF winter storage of biosolids would be necessary. Land application efforts would be relatively small involving only about 5 ha per year.

In a meeting with Manitoba Conservation and Water Stewardship, we asked about storage on agricultural land as is done with manures. The regulator would only permit this if a system of full containment of runoff with return to the plant was provided and if it was assured that odour would not be a problem.

In terms of land application for the HWWTF, three possibilities are worthy of consideration for land application:

- Summer application continuously only with landfill in the winter
- Six month storage on site with application in the spring and fall
- Six month storage off site with application in the spring and fall

5.4 Possible Partnerships

5.4.1 City of Winnipeg

We met with technical staff of the City of Winnipeg, Water and Waste Department to discuss current operation and future plans. The City is in a similar situation to the RM at present, albeit at a much larger scale. The City disposes of biosolids in the Brady Road Resource Management Centre (BRRMC). The Province of Manitoba would like to see a program that recycles the nutrients.

As of December 2014, the City is just commissioning a new pilot biosolids composting operation at BRRMC as permitted under the BRRMC Environmental licence. The project was designed with a capacity equal to twenty percent of Winnipeg's biosolids to provide an alternative outlet for biosolids. The composted biosolids will be used as cover at the landfill. The licence approves a two-year pilot study for Winnipeg biosolids. When we met with the City they confirmed earlier advice to the RM that they

Figure 3 – City of Winnipeg biosolids composting with wood chips

cannot accept the HWWTF biosolids in the composting pilot, as it would introduce another variable into the pilot study.

In the short term, the only option that they have that doesn't involve the pilot composting facility is landfilling which would not help the RM.

In addition they have issued a request for proposal for Supply and Delivery of a Struvite Recovery System that closed on November 27, 2014. The longer-term plan includes a thermal hydrolysis treatment step before the anaerobic digesters. This is expected to produce a low pathogen biosolids that is typically referred to as Class A biosolids. Class A biosolids can be more widely used but when used in agriculture still would require a nutrient management plan.

The biosolids composting facility is covered under the Brady Road Environmental Licence. The licence approves a two-year duration pilot study for biosolids generated from the City of Winnipeg's three water pollution control centres.

5.4.2 Disposal as Hauled Wastewater

The City of Winnipeg typically accepts hauled wastewater at its NEWPCC. In fact, many small treatment plants in East and West St. Paul regularly haul sludge to the NEWPCC. Even the HWWTF has used this option on a few limited occasions when the centrifuge has not been operating satisfactorily. The idea would be to suspend centrifuge dewatering and haul liquid biosolids in tanker type vehicles. The disadvantage of this is that the liquid volume is considerable compared to the biosolids post centrifuge. Another issue is that the City would have to reprocess the waste through its treatment plant. Perhaps arrangements could be made to deposit the material directly into a digester or even a holding tank since it has already gone through digestion. Of course, the final issue with this alternative is that the City currently deposits its biosolids in the landfill. However, the City plans to revert to land application in the future after developing additional biosolids processing steps.

5.4.3 Portage la Prairie

Portage la Prairie, like Headingley produces biosolids year round. Biosolids are stored on the treatment plant site. They store biosolids in a liquid form and use a contractor to inject the liquid biosolids into

agricultural land each spring and fall. They have indicated a willingness, subject to Council approval, to accept biosolids from the HWWTF at cost plus a margin to be determined.

5.4.4 Rural Municipality of Gimli

The RM of Gimli was contacted to learn more about their biosolids disposal methods.

Gimli's wastewater treatment plant is very similar to that of Headingley. Gimli has a sequencing batch reactor (SBR). Waste solids are further processed with aerobic digestion. Digested solids are dewatered also with a centrifuge to 20 to 25 % solids concentration.

The dewatered solids are stored in a holding pond near the plant for agricultural disposal during the period allowed by the nutrient management regulation. Gimli previously contracted out the spreading and incorporation of the biosolids but now undertakes that work in-house. They have acquired a manure spreader for that purpose.

Gimli was asked if they have capacity to accommodate the biosolids generated by Headingley. Operating staff advised that they would not as they are currently facing their own challenges managing Gimli's biosolids. The biosolids generated by Gimli stretch the capacity of the storage system that they have available so they are reluctant to accept any further quantities. Gimli is also currently exploring additional biosolids disposal options.

5.4.5 Manure Operation

An idea that came up early in the process was to partner with an existing manure operation. Many manure operations exist in Manitoba and typically include a manure storage lagoon and/or on land storage for the winter with application in the spring and fall. Such operations already have the nutrient management expertise to operate under the nutrient management regulation.

When we discussed this option with the Environmental Approvals staff at Manitoba Conservation and Water Stewardship we found that comingling of animal and human biosolids would not be permitted. There is a concern that it would lead to not knowing on which land which biosolids were applied and record keeping would be impossible.

5.4.6 Contract Operation

5.4.6.1 Lystek

Lystek International Inc. is an organic materials recovery firm with head office located in Cambridge, Ontario. Their mission is to provide solutions for the management and beneficial re-use of organic materials including biosolids. The technology uses an alkali (in this case potassium hydroxide) and steam to produce a Class A (low pathogen) liquid fertilizer, which is sold as a fertilizer and applied using conventional liquid injection equipment. They indicated that the fertilizer is a high-solids liquid called "Lystegro" and is registered with the Canadian Food Inspection Agency as a fertilizer and contains about 15% solids.

We inquired about potential applications of this technology for Headingley. Their smallest installation right now is for 10,000 to 15,000 persons so much larger than Headingley. They have just commissioned a system for North Battleford Saskatchewan. North Battleford's population is around 16,500 persons so again larger than Headingley. For North Battleford they used a 5 m^3 reactor, which is the smallest they have available. They indicated that their "standard" unit is 9 m^3.

The cost for North Battleford was $2.5 to 3 million, which included a biosolids storage lagoon that is lined and covered. According to Lystek, the next closest bid for North Battleford was almost double their cost at $6 million, which was for an option to produce pellets. Lystek advised that they were able to incorporate their reactor inside North Battleford's existing plant, therefore a new building was not required.

The deal that was made with North Battleford includes marketing and sales of the final product. They have done this in other locations and indicated that farmers are quite receptive to paying for the product. They indicated that it is about 40% cheaper than commercial fertilizer. Sales are shared 60-40 with 60% going to Lystek and 40% for the municipality. The deal includes a 5-year review clause where the % split can be reviewed or the municipality can take over the operation in its entirety if desired.

Their interest would be in developing a shared facility if there was sufficient interest from more municipalities such as Portage la Prairie.

5.4.6.2 Famers Edge

Farmers Edge is a Manitoba company of agronomists dedicated to help growers be more efficient users of nutrients. We met with a representative to discuss if there is any service that they might provide in partnership with Headingley.

Farmers Edge does agronomic consulting for both manure managers and for farmers. They do soil sampling and analysis, manure analysis, and the associated paperwork required under the Nutrient Management Regulation.

They seemed confident that the Headingley biosolids would provide a benefit and that farmers would even be willing to pay for biosolids. They thought that the biosolids could be stored on farm fields as occurs now with hog manure. Because, in the spring, it would be frozen and not available as a spring fertilizer, it would likely need to wait until the fall to be applied. However, they later advised that they also met with representatives of Manitoba Water Stewardship who told them that field storage of biosolids would not be permitted.

5.4.6.3 Assiniboine Injections

We met with Assiniboine Injections at the HWWTF. Assiniboine Injections is a firm located in Notre Dame, MB that specializes in land application of biosolids. They have won numerous contracts including at Portage la Prairie and Brandon to land apply biosolids. They would be interested in assisting Headingley in biosolids management and provided some high level cost estimates to use in the analysis of options.

5.4.7 Prairie Landfill

The BFI Prairie Green Landfill was contacted with respect to their compost operation and whether Headingley Biosolids might be recycled as compost through that operation. The District Manager indicated that the Environment Licence outlined what materials are permitted and he believed the clause would not permit the landfill to incorporate biosolids into the operation.

6 SELECTED OPTIONS FOR COST ESTIMATES

6.1 Disposal at City of Winnipeg as Hauled Wastewater

The City of Winnipeg accepts hauled wastewater from other small wastewater plants in the capital region.

The current rate charged by the City is a base fee of $8.70 per kilolitre for household waste and an additional $7.90 per kilolitre for non-household hauled wastewater for a total fee of $16.60 per kilolitre. The HWWTF produces about 3322 kilolitres of digested biosolids per year that is currently dewatered using the centrifuge. The City's disposal charge would work out to about $56,000 per year. This would be about one 30-kilolitre truckload every three days. The NEWPCC receives about 20 such loads per day presently. About 16 come from the SEWPCC and 4 from the WEWPCC over a 24-hour per day operation. The City pays its contractor about $5.00 per kilolitre to transport the wastewater in 30 kilolitre loads. In the attached cost estimate, a rate of $7.50 for the additional distance and a lower annual volume was used. In addition, additional pumping capacity and a truck loading facility would have to be constructed on site to fill a truck in about 10 to 20 minutes.

This alternative has a net present value of about 4 times the current costs. It would result in double treating of an already treated sludge where the biosolids still end up being landfilled. This alternative does not make sense under current conditions when the City's biosolids are landfilled but may make sense in a future operation where the City's biosolids are beneficially utilized.

6.2 Haul Liquid Biosolids to Portage la Prairie

This alternative involves hauling liquid biosolids at 5 percent solids to Portage la Prairie. Five percent was chosen as being similar to the existing Portage la Prairie biosolids concentration. At that concentration, the biosolids would be easily incorporated into their system that involves storage in tanks and subsurface injection onto agricultural land spring and fall. To prepare a 5% biosolids, a mixing tank will be required to be placed under the centrifuge (where the bin is currently located) to receive dewatered biosolids and to mix in digested biosolids as a liquid in an arrangement as shown in Figure 4. Costs for this tank have been included in estimates for this option.

In addition a liquid storage tank would be required to provide for storage between tanker truck trips to Portage la Prairie. A 60 m^3 tank is envisaged which is twice the capacity of a typical tanker truck. About 860 m^3 of biosolids would be transported over the year, or about 30 tanker-truck loads.

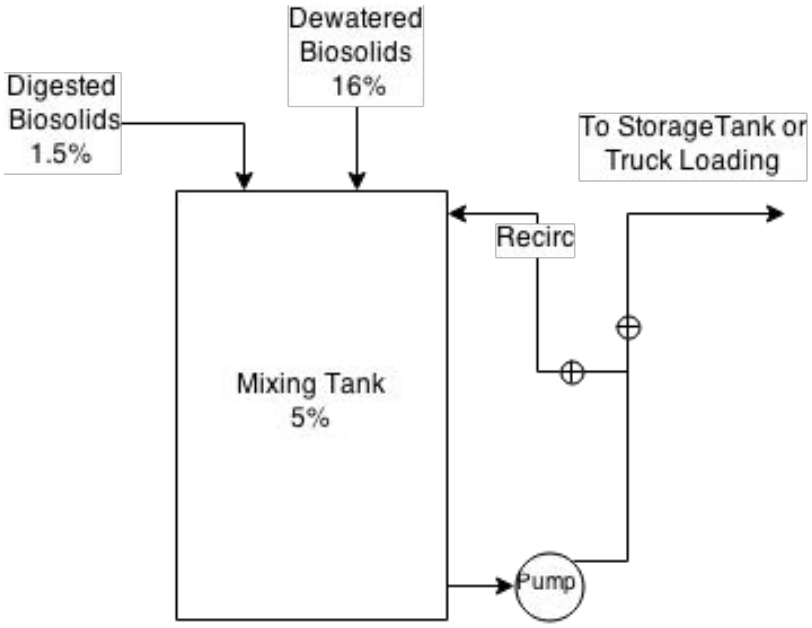

Figure 4 - Mixing Arrangement

6.3 Store Liquid Biosolids on site – Inject Spring and Fall

Another option would be to store the biosolids in tanks that would be installed at grade and removal of the biosolids twice per year with subsurface injection similar to the Portage la Prairie arrangement. To allow the solids to flow into and out of the tanks, the biosolids would need to be at about 5% solids as compared to the current 17% solids. As this is similar to the requirement for hauling to Portage la Prairie, a mixing tank would be required. The disadvantage is that with a lower solids content there is a greater quantity to store as the biosolids are contain more water. For Headingley, tank suppliers were contacted for an idea of pricing and tank sizes available. For current biosolids generated, and assuming 5% solids were achieved, three tanks each 150,000 litres would be required. Allowing for future growth in flow at the plant to the design capacity, an additional 2 tanks for a total of five 150,000-litre tanks are estimated to be required. A conceptual layout is shown on Figure 5. Tank venting and odour control would be required. For cost estimating purposes, tanks that were 4.6 metres (15 feet) in diameter and 9 metres (30 feet) high were used. A typical tank is shown in Figure 6. A biofilter is included for odour control in cost estimates developed for this option. The liquid biosolids held in the tanks would still be drawn down twice per year and land applied. As the biosolids are at 5%, subsurface injection of the biosolids would be used.

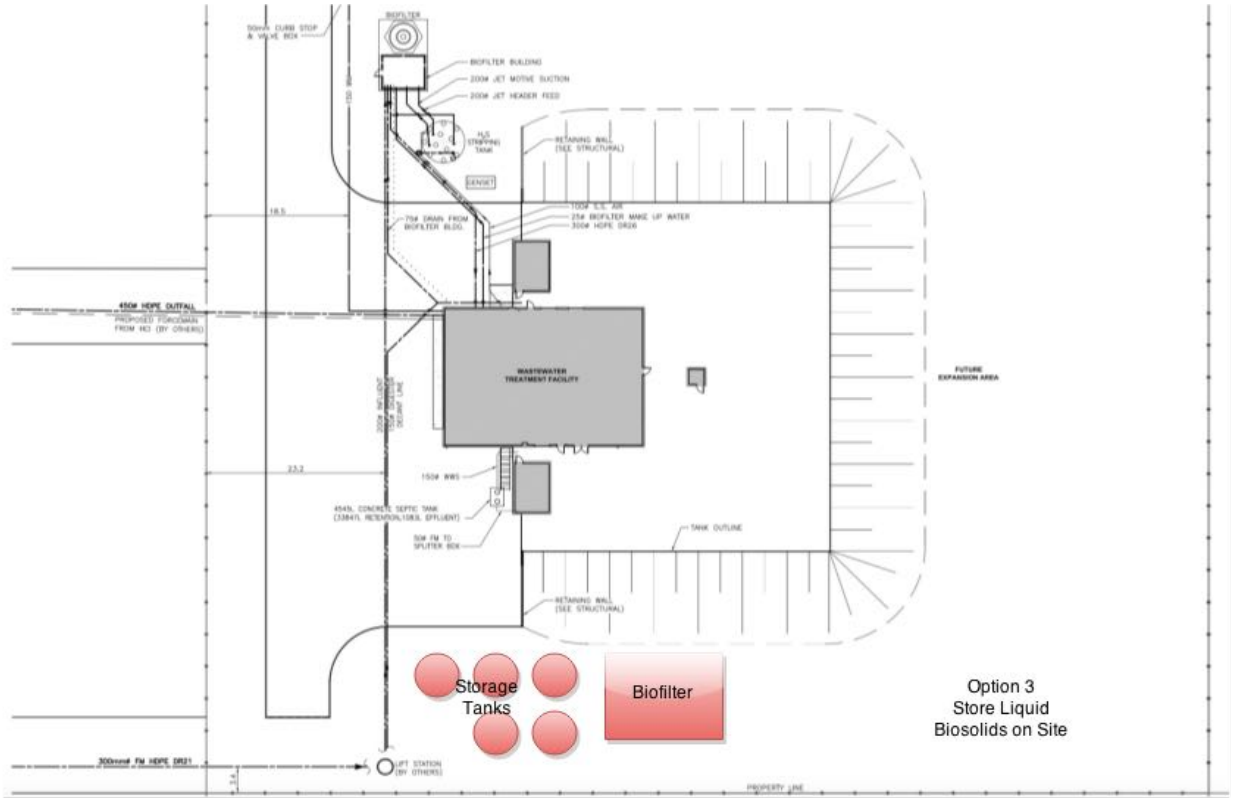

Figure 5 - Option 3 - Storage Tanks

Figure 6 - 150,000 litre storage tank

6.4 Cake Storage on Site – Land Application Spring and Fall

This alternative involves the construction of a building on the existing HWWTF site. A tour of the compost facility recently completed at the Winnipeg BRRMC was undertaken. At that site a fabric covered building enclosure as pictured below in Figure 7 was constructed for purposes of receiving and mixing biosolids. This same building system would be suitable for storage of dewatered biosolids over the winter months until land spreading is permitted in the spring. A total storage period of 5-6 months would be required. It is estimated that a building 21.5 metres (70 feet) by 15.25 metres (50 feet) would be suitable for current biosolids quantities and future quantities when the HWWTF reaches full capacity. The building could be built east of the existing HWWTF between the existing treatment basins and the

fence line. A large overhead door will be provided to allow equipment to enter to load and unload biosolids.

Odour emanating from the facility during loading and unloading of biosolids is a concern. Ventilation and odour control will therefore be required. A large outside biofilter similar to the one at Brady Road is used for costing. Liquid will be collected inside the building enclosure and directed to the nearby lift station. A conceptual facility layout is shown on Figure 8.

Figure 7 Biosolids Storage Building

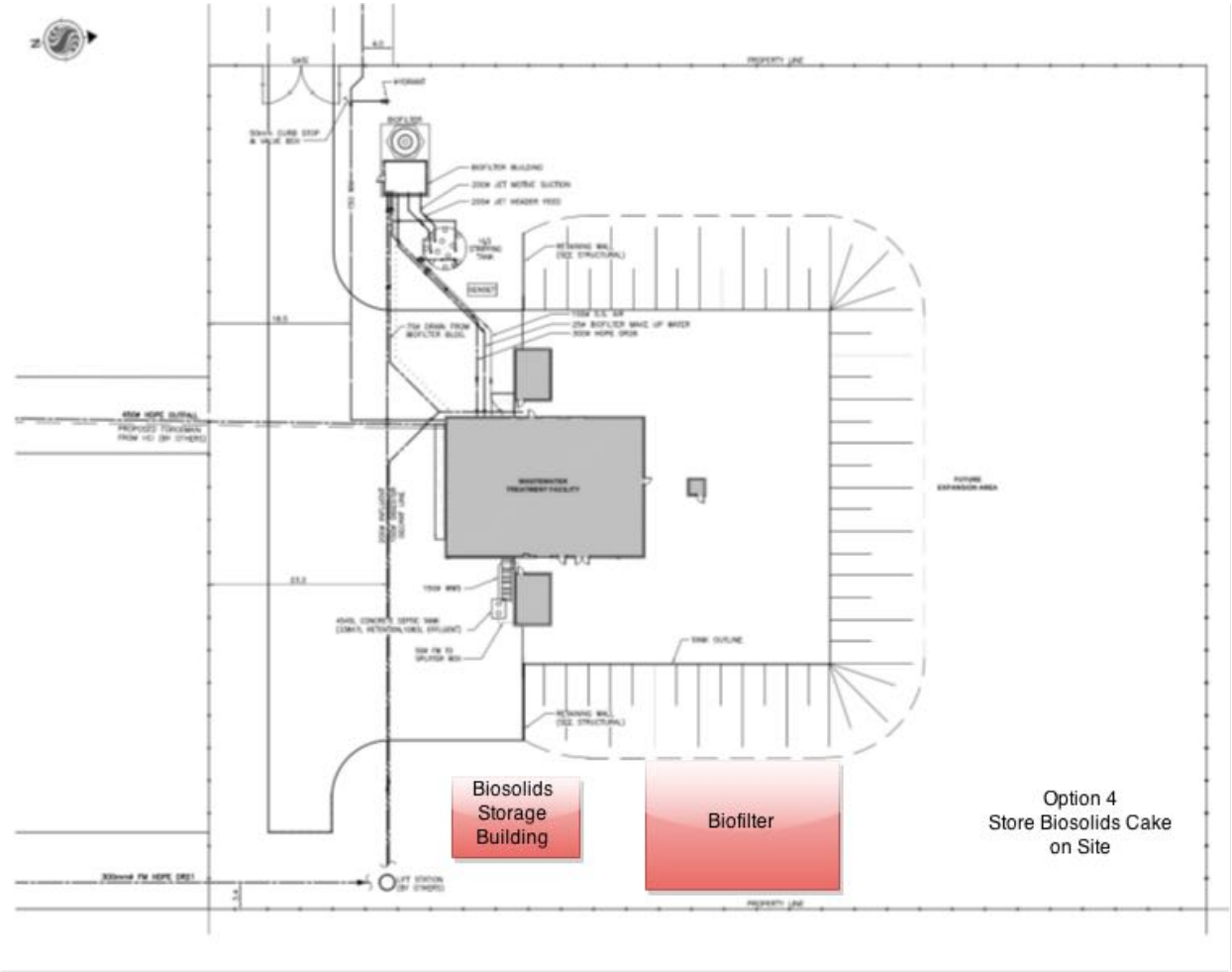

Figure 8 - Option 4 - Cake Storage

6.5 Store 5% Biosolids at off site Storage Lagoon

This alternative involves the construction of an earthen holding or storage pond that will permit storage of liquid biosolids at 1.5-5% solids at a location to be selected away from the HWWTF. The size would permit storage for about 6 months to one year depending on percent solids concentration of biosolids transported from the HWWTF. A site would need to be located that would be remote from development and individual residences or businesses.

The storage pond would occupy an area of about 0.64 hectares (1.6 acres) measured from the outside toe of the containment berms. Area at the liquid surface would be about 0.26 hectares (0.64 acres). Allowing for site access, and creating a buffer zone around the storage pond, property acquisition of 4.0 hectares (10 acres) has been included in development of option costs.

It is expected that the pond would need to be lined therefore a double walled high density polyethylene (HDPE) liner has been allowed in developing cost estimates. In addition a floating HDPE cover would be provided that would keep rainfall and snowmelt from entering the storage pond contents. Drainage of

snowmelt and rainwater would be part of the design. A pumping facility would be required at the storage pond site that would permit filling and dewatering of the pond.

6.6 Cake Storage by Assiniboine Injections off site

Discussions with Assiniboine Injections were undertaken to determine their processes and costs for spreading of liquid and dewatered biosolids from the HWWTF. During those discussions Assiniboine Injections proposed an option that would essentially amount to contracting out of biosolids disposal. Assiniboine Injections would leave a truck at the HWWTF and haul dewatered biosolids away twice per month to a storage facility that Assiniboine Injections would develop. Based on haulage distances allowed, we assume that the storage facility would be located in the vicinity of their business headquarters at Notre Dame De Lourdes. In addition, Assiniboine Injections would locate farmland and arrange for disposal. Assiniboine Injections noted that there would be an additional cost to Headingley for development of a storage enclosure but that cost was not disclosed at this time. For purposes of developing costs for this option, we have assumed that the storage facility cost would be of similar magnitude to the fabric covered building described in option #4. In order to make an investment into the infrastructure required for this option, Assiniboine Injections further indicated that a minimum contract length of 5 years would be necessary.

6.7 Summer Land Application with Winter Landfilling

The regulator mentioned this alternative as something that might be approved in the interim while the City of Winnipeg develops a system. It would involve no changes to the plant. During the summer, biosolids would be land applied. Land would be rented for this purpose.

During the winter, biosolids would be disposed of at a Class 1 landfill, as is the case presently.

The assumption in this approach is that the RM could eventually be a partner with the City of Winnipeg in its biosolids solution.

6.8 Continue Existing Program – Landfill Year Round

This alternative would be to continue the existing program of landfilling of biosolids. This alternative does not require any additional storage on site. Hauling biosolids offsite was the original design intention when the plant was built in 2011.

The RM proposed this in its earlier submission to the regulator. It is the lowest cost of all the alternatives. With the small amount of biosolids from this plant as compared to Winnipeg, Brandon and Portage, the municipality sees this as a practical approach.

7 COST ESTIMATES

7.1 Notes on Cost Estimates

The cost estimates herein are provided to have some idea of the relative costs of alternatives available to the RM. The estimates provided herein would be considered at best to be Class 5 estimates using the Association for the Advancement of Cost Engineering (AACE). According to the AACE, the primary characteristic of a Class 5 estimate is that level of project definition is 0-2% of a fully defined project with complete drawings and specifications. Class 5 estimates are used for concept screening, not for budget or authorization. Final costs can range from -20% to -50% lower to 30% to 100% higher than Class 5 estimates when the Class 5 estimate includes a contingency of 30 to 50%.

Our experience is that typically estimates continue to rise as the design process proceeds. Invariably, questions are raised about how this or that would be accommodated and the answers to those questions typically result in scope and design changes that increase the cost. It is on this basis that we provide cost estimates for the options.

7.2 Cost Estimates

Cost estimates were developed for each of the eight selected options described in Section 6. Capital cost estimates included a 30% contingency and 20% for soft costs such as engineering. Overall, our experience is that capital costs most often increase during subsequent design phases so that the reader is cautioned to consider additional allowances for cost increases.

Operating costs were calculated for year one again with a 30% contingency and a 3% per annum increase for growth and a 2% increase for inflation. A 20-year net present value was also calculated using a discount rate of 5%. The results are summarized in the table below. Appendix B contains details of the cost included for each option.

Costs presented assume that the RM will bear 100% of the project capital costs. There has been no allowance made for funding assistance as may become available from senior levels of government.

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option	Description	Year 1 Capital	Year 1 Operating	20 Year NPV
1	Haul Liquid to City of Winnipeg NEWPCC	$ 390,000	$ 104,100	$ 2,483,400
2	Haul Liquid to Portage la Prairie	$ 880,000	$ 55,900	$ 2,004,100
3	Store Liquid Biosolids at 5% on Site, Inject Spring and Fall	$ 3,150,000	$ 55,900	$ 5,015,400
4	Cake Storage on site - Land Application Spring and Fall	$ 3,070,000	$ 25,200	$ 3,576,800
5	5% storage lagoon off site - Land Application Spring and Fall	$ 3,270,000	$ 74,100	$ 4,760,100
6	Cake Storage by Assiniboine Injections off site	$ -	$ 237,200	$ 4,770,000
7	Summer Spreading and Winter Landfill	$ -	$ 60,000	$ 1,206,600
8	Continue Existing Program - Landfill year round	$ -	$ 29,800	$ 599,400

Notes:
Does not include environmental licencing process cost
Includes 30% contingency and 20% engineering on capital costs
Includes 30% contingency on operating costs*
*5% on existing truck to landfill options

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Appendix B includes a page for each alternative with a breakdown of costs.

The current system costs about $29,800 annually with a 20 year NPV of $599,400.

8 GREEN HOUSE GASES

In discussions of options with Manitoba Conservation and Water Stewardship, the subject of green house gas generation from the various options was discussed.

The CCME has developed a Biosolids Emissions Assessment Model[10] for use to examine the relative potential green house gas (GHG) emissions from a range of biosolids management scenarios. The CCME has made the spreadsheet model available for use. The model allows municipalities to compare potential emissions from alternative schemes. The model reports results in terms of annual emissions in tonnes of CO_2 equivalents (CO_2eq), by converting other green house gas emissions such as methane (CH_4) or nitrous oxide (N_2O) to there equivalent in terms of CO_2.

The model does not use direct measurements but rather applies average values of green house gas emissions from the literature to the quantities that are inputted. At best, it provides a rough comparison of the emissions that might be expected. For example, if the input includes transportation distances and number of loads, the model uses literature values for truck fuel mileage to calculate litres of fuel used and emissions per litre burned. In terms of Headingley, the model results would favour land application over landfilling as there is a green house gas credit for displacing nitrogen fertilizer in land application and a high emission factor associated with methane production.

The table below summaries the results of applying the model to the 8 options.

Biosolids Emissions Assessment Model (BEAM)						
		Green House Gas Emissions (Tonnes of CO2 Equivalent)				
Option		Dewatering /Storage	Transportation	Land Application	Landfill	Total
1	NEWPCC	1	6	-	108	115
2	Portage	50	6	-10	-	46
3	Liquid on Site	50	1	-10	-	41
4	Cake on Site	50	1	-10	-	41
5	Lagoon	50	4	-10	-	44
6	Cake off Site	50	3	-10	-	43
7	Summer/Winter	24	3	-5	54	76
8	Existing	24	3	-	108	135

Examining the model results, it is concluded that:

- Centrifuge dewatering at the plant generates about 24 tonnes associated with electricity and polymer use.

[10] CCME 2009 *"Biosolids Emissions Assessment Model User's Guide"*

- Year round storage of generates another 26 tonnes
- Transportation is less than 6 for any option
- Landfill of a full year's biosolids generates 108 tonnes
- Land application of a full year's biosolids results in a credit of 10 tonnes.

Using this model, the existing system (Option 8) would have the highest GHG emissions. Option 7, winter landfilling and summer land application, would just about cut them in half because the landfill amount is half. Options with full land application of biosolids would have about one-third the emissions of the current system.

While the differences may seem significant, the absolute numbers are small. An often-used comparison is the green house gas emissions that might be expected from a typical passenger vehicle. A typical passenger vehicle emits about 4.7 tonnes CO_2eq per year[11]. Using this value, the existing program would have the equivalent emissions that might be expected from 29 vehicles, which is a small number compared to the number of vehicles used in Manitoba.

Maybe of more relevance is the comparison between Headingley and the City of Winnipeg. The City of Winnipeg currently landfills about 14,000 tonnes of biosolids annual. This is 325 times as much as Headingley and would be expected to generate 325 times the GHG.

[11] USEPA Office of Transportation and Air Quality, May 2014 *Greenhouse Gas Emissions from a Typical Passenger Vehicle.*

9 PREFERRED BIOSOLIDS PLAN

The least cost alternative is simply to continue landfilling of the biosolids from the HWWTF at an annual cost of $29,800 in 2015. This alternative provides for a simple operation consistent with a small facility. Headingley's current practice of disposal to landfill should be regarded in the context of other adjoining municipalities that are currently hauling waste solids to the City's NEWPCC for processing. These solids are also ending up at Brady and will continue until Winnipeg develops their new disposal system. The 43 dry tonnes per year is 0.3% of the nearly 14,000 dry tonnes per year from the City of Winnipeg that is also landfilled and will continue to be landfilled for 5 years or more as Winnipeg develops its own system. The City has indicated that it would not be possible to participate in the biosolids composting pilot project at Brady Road.

Landfilling does not achieve a provincial goal to recycle the nutrients, especially phosphorus in the biosolids. At the same time, much of the phosphorous in the HWWTF biosolids is tied up with aluminum and would not be available to field crops. Without significant redesign and reconfiguration of the entire HWWTF, biological phosphorous reduction or phosphorus recovery is not possible for the facility. The municipality prefers landfilling as the most reasonable interim approach with the longer-term vision to tie into Winnipeg's system. It would make sense for the Province to encourage Winnipeg to develop a system that accommodates regional biosolids with cost recovery. Headingley had asked Manitoba Conservation and Water Stewardship to continue this practice. MCWS asked for a review of alternatives to this practice.

If continued landfilling on an interim basis is not acceptable, the next alternative for Headingley would be land application during the summer with winter landfilling again as an interim measure in anticipation of partnering with a City of Winnipeg solution. MCWS indicated that this might be an alternative in their letter in Appendix A. Although this alternative is about double the cost of the current operation, it does move somewhat to achieving the goal to use the biosolids in a beneficial way. To permit land application as biosolids are generated and avoid storage costs during the summer growing season, it would be necessary not to grow any crops on the land used in that summer. It would also be necessary for the municipality to develop or engage expertise in land application for a very small benefit relative to biosolids generated in Winnipeg. For Headingley, if the preferred plan of continuing to landfill biosolids is not acceptable, this becomes the preferred plan.

The other alternatives examined in the report are relatively very expensive and would add hundreds of dollars to every customer. The reason for the high cost of these alternatives is winter storage of biosolids either as a liquid or as biosolids cake. It would be an imprudent use of the RM's financial resources to develop a stand-alone system when a more economical solution is likely to become available when Winnipeg implements their final biosolids disposal option. Given the relatively small benefit of these alternatives in terms of nutrient reuse compared to Winnipeg, they are not recommended.

APPENDIX A

LETTER FROM PROVINCE OF MANITOBA AUG 12 2014

Manitoba
Conservation and Water Stewardship
Environmental Stewardship Division
Environmental Approvals Branch
123 Main Street, Suite 160, Winnipeg Manitoba R3C 1A5
T 204 945-8321 F 204-945-5229
www.gov.mb.ca/conservation/eal

RECEIVED AUG 19 2014

File: 5366.00

August 12, 2014

Chris Fulsher
Chief Administrative Officer
Rural Municipality of Headingley
1 – 126 Bridge Road.
Headingley MB R4H 1G9

Dear Mr. Fulsher:

Re: Rural Municipality of Headingley Sewage Treatment Plant - Environment Act Licence No. 2869 RRR

Receipt of the May 5, 2014 submission regarding the Rural Municipality (R.M.) of Headingley's Sewage Treatment Plant waste solids and sludge disposal (biosolids) reassessment report is acknowledged. The submission of this report is pursuant to Clause 5 of the subject licence.

In the report, it is indicated that all the options for disposal (other than composting) involve a substantial capital investment which the R.M. believes does not have an equivalent benefit to the environment. The R.M. indicated that land application is an option, but stated that winter storage and resulting odour problems would be difficult to manage; however, options for winter storage were not explored. The report provides no documentation that the R.M. explored any other options than composting at the City of Winnipeg's pilot project for beneficial reuse of biosolids. Therefore, the submitted report does not meet the intent of Clause 5 and is deemed incomplete.

The R.M. requests permission to continue the current practice of landfilling and to amend the licence accordingly. Disposal of biosolids to a landfill is not consistent with the standard for beneficial reuse of biosolids pursuant to the *Manitoba Water Quality Standards, Objectives and Guidelines* nor is it consistent with the *Canada-Wide Approach for the Management of Wastewater Biosolids*. The document did not present analytical results that indicate there is no value of the material as a soil amendment. You are required to submit a report containing a complete assessment of options for beneficial re-use of biosolids by December 31, 2014. Options to be considered could include land application during the summer with winter landfilling as a temporary measure, along with regular assessment and reporting of other options.

If you have any questions, please contact Mr. Rafiqul Chowdhury. P.Eng., at (204) 945-2614 or by e-mail at Rafiqul.Chowdhury@gov.mb.ca.

Yours truly,

Tracey Braun

Tracey Braun, M.Sc.
Director

c. Don Labossiere, Director, Environmental Compliance and Enforcement
Donna Smiley, Provincial Manager, Environmental Compliance and Enforcement

APPENDIX B

COST ESTIMATES

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option	Description	Year 1 Capital	Year 1 Operating	20 Year NPV
1	Haul Liquid to City of Winnipeg NEWPCC	$ 390,000	$ 104,100	$ 2,483,400
2	Haul Liquid to Portage la Prairie	$ 880,000	$ 55,900	$ 2,004,100
3	Store Liquid Biosolids at 5% on Site, Inject Spring and Fall	$ 3,150,000	$ 55,900	$ 5,015,400
4	Cake Storage on site - Land Application Spring and Fall	$ 3,070,000	$ 25,200	$ 3,576,800
5	5% storage lagoon off site - Land Application Spring and Fall	$ 3,270,000	$ 74,100	$ 4,760,100
6	Cake Storage by Assiniboine Injections off site	$ -	$ 237,200	$ 4,770,000
7	Summer Spreading and Winter Landfill	$ -	$ 60,000	$ 1,206,600
8	Continue Existing Program - Landfill year round	$ -	$ 29,800	$ 599,400

Notes:
Does not include environmental licencing process cost
Includes 30% contingency and 20% engineering on capital costs
Includes 30% contingency on operating costs*
*5% on existing truck to landfill options

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option 1 *Haul Liquid to City of Winnipeg NEWPCC*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
Pumping and tanker truck loading station	1	$ 390,000	$ 390,000
$250,000 plus 30% plus 20%			

Annual Operating Costs

	Amount	Year	Amount	Present Value
Amounts include Contingency of 30%	Amount	1	$ 104,100	$ 104,100
Based on 3322 kilolitres in year 1		2	$ 109,400	$ 104,200
City charges of $16.60 per kilolitre in year 1	$ 71,689	3	$ 114,900	$ 104,200
Transport charges of $7.50 per kilolitre in year 1	$ 32,390	4	$ 120,700	$ 104,300
Total (rounded)	$ 104,100	5	$ 126,800	$ 104,300
		6	$ 133,200	$ 104,400
		7	$ 140,000	$ 104,500
		8	$ 147,100	$ 104,500
		9	$ 154,500	$ 104,600
		10	$ 162,300	$ 104,600
		11	$ 170,500	$ 104,700
		12	$ 179,200	$ 104,800
		13	$ 188,200	$ 104,800
		14	$ 197,800	$ 104,900
		15	$ 207,800	$ 105,000
		16	$ 218,300	$ 105,000
		17	$ 229,300	$ 105,000
		18	$ 240,900	$ 105,100
		19	$ 253,100	$ 105,200
		20	$ 265,900	$ 105,200

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 2,483,400

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option 2 *Haul Liquid to Portage la Prairie*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
60 kl tank and foundation	1	$ 380,000	$ 380,000
Internal mixing tank, piping, pumps, controls, truck loading	1	$ 500,000	$ 500,000

Annual Operating Costs

	Amount	Year	Amount	
Amounts include Contingency of 30%		1	$ 55,900	$ 55,900
Based on 860 kilolitres in year 1		2	$ 58,700	$ 55,900
Transport charges of $20.00 per kilolitre in year 1	$ 22,360	3	$ 61,700	$ 56,000
Portage charges of $600 per dry tonne, 43 dry tonnes in year 1	$ 33,540	4	$ 64,800	$ 56,000
Total (rounded)	$ 55,900	5	$ 68,100	$ 56,000
		6	$ 71,500	$ 56,000
		7	$ 75,200	$ 56,100
		8	$ 79,000	$ 56,100
		9	$ 83,000	$ 56,200
		10	$ 87,200	$ 56,200
		11	$ 91,600	$ 56,200
		12	$ 96,200	$ 56,200
		13	$ 101,100	$ 56,300
		14	$ 106,200	$ 56,300
		15	$ 111,600	$ 56,400
		16	$ 117,200	$ 56,400
		17	$ 123,100	$ 56,400
		18	$ 129,400	$ 56,500
		19	$ 135,900	$ 56,500
		20	$ 142,800	$ 56,500

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 2,004,100

Headingley Wastewater Treatment Facility
Biosolids Options Report Option
Cost Summary

Option 3 *Store Liquid Biosolids at 5% on Site, Inject Spring and Fall*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
First 3 storage tanks	1	$ 2,300,000	$ 2,300,000
Last 2 storage tanks with inflation	10	$ 1,150,000	$ 741,300
Biofilter (18 m by 18 m)	1	$ 850,000	$ 850,000

Annual Operating Costs

	Amount
Amounts include Contingency of 30%	
Based on Injection 43 dry tonnes	
times $1000 per tonne versus PLP pays $400 for	$ 55,900
much large quantity	

Year	Amount	Present Value
1	$ 55,900	$ 55,900
2	$ 58,700	$ 55,900
3	$ 61,700	$ 56,000
4	$ 64,800	$ 56,000
5	$ 68,100	$ 56,000
6	$ 71,500	$ 56,000
7	$ 75,200	$ 56,100
8	$ 79,000	$ 56,100
9	$ 83,000	$ 56,200
10	$ 87,200	$ 56,200
11	$ 91,600	$ 56,200
12	$ 96,200	$ 56,200
13	$ 101,100	$ 56,300
14	$ 106,200	$ 56,300
15	$ 111,600	$ 56,400
16	$ 117,200	$ 56,400
17	$ 123,100	$ 56,400
18	$ 129,400	$ 56,500
19	$ 135,900	$ 56,500
20	$ 142,800	$ 56,500

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 5,015,400

Headingley Wastewater Treatment Facility
Biosolids Options Report Option
Cost Summary

Option 4 *Cake Storage on site < Land Application Spring and Fall*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
Storage building, Civil Works	1	$ 1,600,000	$ 1,600,000
Biofilter (26 m by 26 m)	1	$ 1,470,000	$ 1,470,000

Annual Operating Costs

		Year	Amount	
Amounts include Contingency of 30%	Amount	1	$ 25,200	$ 25,200
Year 1 268 cake tonnes @$21 per tonne	$ 7,316	2	$ 26,500	$ 25,200
Mob/Demob $4000	$ 5,200	3	$ 27,800	$ 25,200
22 Semi loads at $260	$ 7,436	4	$ 29,200	$ 25,200
Testing and reporting [$4000	$ 5,200	5	$ 30,700	$ 25,300
Total (rounded)	$ 25,200	6	$ 32,300	$ 25,300
		7	$ 33,900	$ 25,300
		8	$ 35,600	$ 25,300
		9	$ 37,400	$ 25,300
		10	$ 39,300	$ 25,300
		11	$ 41,300	$ 25,400
		12	$ 43,400	$ 25,400
		13	$ 45,600	$ 25,400
		14	$ 47,900	$ 25,400
		15	$ 50,300	$ 25,400
		16	$ 52,800	$ 25,400
		17	$ 55,500	$ 25,400
		18	$ 58,300	$ 25,400
		19	$ 61,300	$ 25,500
		20	$ 64,400	$ 25,500

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 3,576,800

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option 5 — *5% storage lagoon off site / Land Application Spring and Fall*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
Lagoon site development	1	$ 3,170,000	$ 3,170,000
Land = 4 ha	1	$ 100,000	$ 100,000

Annual Operating Costs		Year	Amount	
Amounts include Contingency of 30%	Amount	1	$ 74,100	$ 74,100
Haul from plant to lagoon @ 10 per kl = 1000 kl	$ 13,000	2	$ 77,800	$ 74,100
Haul and inject $1000 per dry tonne	$ 55,900	3	$ 81,800	$ 74,200
Testing and reporting = $4000	$ 5,200	4	$ 85,900	$ 74,200
Total (rounded)	$ 74,100	5	$ 90,300	$ 74,300
		6	$ 94,800	$ 74,300
		7	$ 99,600	$ 74,300
		8	$ 104,700	$ 74,400
		9	$ 110,000	$ 74,500
		10	$ 115,500	$ 74,500
		11	$ 121,400	$ 74,500
		12	$ 127,500	$ 74,500
		13	$ 134,000	$ 74,600
		14	$ 140,800	$ 74,700
		15	$ 147,900	$ 74,700
		16	$ 155,400	$ 74,800
		17	$ 163,200	$ 74,800
		18	$ 171,500	$ 74,800
		19	$ 180,200	$ 74,900
		20	$ 189,300	$ 74,900

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 4,760,100

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option 6 *Cake Storage by Assiniboine Injections off site*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
No capital	1	$ 6	$ 6

Annual Operating Costs		Year	Amount	
Amounts include Contingency of 30%	Amount	1	$ 237,200	$ 237,200
		2	$ 249,200	$ 237,300
24 trips at $450 per trip	$ 14,040	3	$ 261,800	$ 237,500
268 tonnes		4	$ 275,100	$ 237,600
Spreading 2 times per year at $21 per cake tonne	$ 7,316	5	$ 289,000	$ 237,800
Mob and demob $2000 per year	$ 2,600	6	$ 303,600	$ 237,900
10% of $1.6 million building (no biofilter assumed)	$ 208,000	7	$ 319,000	$ 238,000
Testing and reporting 6 $4000	$ 5,200	8	$ 335,100	$ 238,100
Total (rounded)	$ 237,200	9	$ 352,100	$ 238,300
		10	$ 369,900	$ 238,400
		11	$ 388,600	$ 238,600
		12	$ 408,200	$ 238,700
		13	$ 428,900	$ 238,800
		14	$ 450,600	$ 239,000
		15	$ 473,400	$ 239,100
		16	$ 497,400	$ 239,300
		17	$ 522,500	$ 239,400
		18	$ 549,000	$ 239,500
		19	$ 576,800	$ 239,700
		20	$ 605,900	$ 239,800

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 4,770,000

Headingley Wastewater Treatment Facility
Biosolids Options Report
Option Cost Summary

Option 7 *Summer Spreading and Winter Landfill*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
No Capital costs	1		$ -

Annual Operating Costs

		Amount	Year		Amount		
Amounts include Contingency of 30%		Amount	1	$	60,000	$	60,000
Year 1 based on 1/2 of existing costs for winter	$	14,900	2	$	63,000	$	60,000
Summer spreading at $21 per cake tonne 134 MT	$	3,658	3	$	66,200	$	60,000
11 loads times $260 per tonne	$	3,718	4	$	69,600	$	60,100
11 times $2000 mob/demob	$	28,600	5	$	73,100	$	60,100
Land rental 3 ha @ $1000/ha	$	3,900	6	$	76,800	$	60,200
Testing and reporting 6 $4000	$	5,200	7	$	80,700	$	60,200
Total (rounded)	$	60,000	8	$	84,800	$	60,300
			9	$	89,100	$	60,300
			10	$	93,600	$	60,300
			11	$	98,300	$	60,300
			12	$	103,300	$	60,400
			13	$	108,500	$	60,400
			14	$	114,000	$	60,500
			15	$	119,700	$	60,500
			16	$	125,800	$	60,500
			17	$	132,200	$	60,600
			18	$	138,900	$	60,600
			19	$	145,900	$	60,600
			20	$	153,300	$	60,700

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 1,206,600

Headingley Wastewater Treatment Facility
Biosolids Options Report Option
Cost Summary

Option 8 *Continue Existing Program 1 Landfill year round*

Summary of Costs

Capital Costs

Item	Year	Amount	Present Value
No capital costs	1	$ 6	$ 6

Annual Operating Costs

		Amount	Year	Amount	
Amounts include Contingency of 5%		Amount	1	$ 29,800	$ 29,800
Based on existing cost of $28,400 per year now	$	29,820	2	$ 31,300	$ 29,800
Total (rounded)	$	29,800	3	$ 32,900	$ 29,800
			4	$ 34,600	$ 29,900
			5	$ 36,300	$ 29,900
			6	$ 38,100	$ 29,900
			7	$ 40,100	$ 29,900
			8	$ 42,100	$ 29,900
			9	$ 44,200	$ 29,900
			10	$ 46,500	$ 30,000
			11	$ 48,800	$ 30,000
			12	$ 51,300	$ 30,000
			13	$ 53,900	$ 30,000
			14	$ 56,600	$ 30,000
			15	$ 59,500	$ 30,100
			16	$ 62,500	$ 30,100
			17	$ 65,600	$ 30,100
			18	$ 69,000	$ 30,100
			19	$ 72,500	$ 30,100
			20	$ 76,100	$ 30,100

Present Value Calculation Assumptions	
Growth in Sewage Flows	3%
Inflation	2%
Discount	5%

Total Present Value $ 599,400