ENVIRONMENT ACT PROPOSAL
LOCAL GOVERNMENT DISTRICT OF PINAWA
WASTEWATER STABILIZATION POND EXPANSION

Prepared for:

L.G.D. of Pinawa
Box 100
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Pinawa, Manitoba
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Project No: 101-15463-01
Old Project No: 10-023-00

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0.0 EXECUTIVE SUMMARY

Leading up to this Environment Act Proposal (EAP), GENIVAR undertook a study for the LGD of Pinawa wastewater treatment system. The Local Government District (LGD) of Pinawa carried out an emergency discharge of treated wastewater from the Pinawa sewage lagoon into the Winnipeg River in April 2011. GENIVAR was retained by the LGD of Pinawa to investigate and analyze conditions leading to the emergency discharge and propose preventive actions to avoid emergency discharges in the future.

The existing wastewater stabilization pond is located west of the Community of Pinawa and consists of one primary (treatment) cell and two secondary (storage) cells, receiving wastewater from a sewer system in the Community of Pinawa via a lift station and a forcemain. A sewer system in the Pioneer Bay Campground also discharges into the forcemain on a seasonal basis. The Pinawa wastewater treatment facility also receives wastewater from Relax Ridge Campground and septage from Awanipark Development. When the new Tim Hortons camp is operational, it will also contribute wastewater to the lagoon facility. Considering that the LGD of Pinawa anticipates continued growth and based on the organic and hydraulic loadings for the 20-year design period, expansion of the existing lagoon is required.

It is recommended to construct two new secondary cells west of the existing lagoon to match the growth and hydraulic capacity projections. The proposed new secondary cells will be constructed with a 1.0 m surface clay liner based on the recommendations of the Geotechnical Report. The new secondary cells will discharge to a ditch-type constructed wetland and eventually the Winnipeg River (along with the existing secondary cells). Major design appurtenances include a perimeter fence, valves, piping, rip rap and lagoon signage.

Upon approval from Manitoba Conservation and the issuance of an Environment licence, it is anticipated that the tender and construction will begin in 2014.

1.0 DEVELOPMENT INFORMATION

LGD of Pinawa – Wastewater Stabilization Pond Expansion
Name of development

LGD of Pinawa
Legal name of the proponent of the development

NE 5-14-12 EPM
Location of development

Contact Person for Proponent:

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2.0 DESCRIPTION OF DEVELOPMENT

2.1 LEGAL DESCRIPTION AND OWNERSHIP

The existing lagoon is located on areas of four quarter sections of land:

- NE 5-14-12 EPM
- SE 5-14-12 EPM
- NW 4-14-12 EPM
- SW 4-14-12 EPM

The government road allowance between sections 4 and 5 was closed by Plan No. 7854 WLTO. The Certificates of Title Nos. 2405515, 2029379, 2417780, 2415771 for the existing lagoon area are included in Appendix A. The Local Government District (LGD) of Pinawa is shown to be the registered owner of Parcels pertaining to the existing lagoon.

The new development is to be located to the west of the existing lagoon system in the NE 5-14-12 EPM, as shown in Figure 2.1. Specifically, the new development is located on Parcels A (Plan No. 9199 WLTO), B (Plan No. 9199 WLTO), and K (Plan No. 36515 WLTO) as well as an area of land south of Parcel K and west of Parcels A and B that is currently Crown land. These areas are shown on Plan No. 36515 WLTO. The LGD of Pinawa is shown to be the registered owner of Parcels "A", "B" and K and are currently in discussions with the Crown Lands and Property Agency regarding the acquisition of the aforementioned area of Crown land. The Certificates of Title Nos. 2405515, 2029379 and 2040154 for the proposed development area are included in Appendix A.

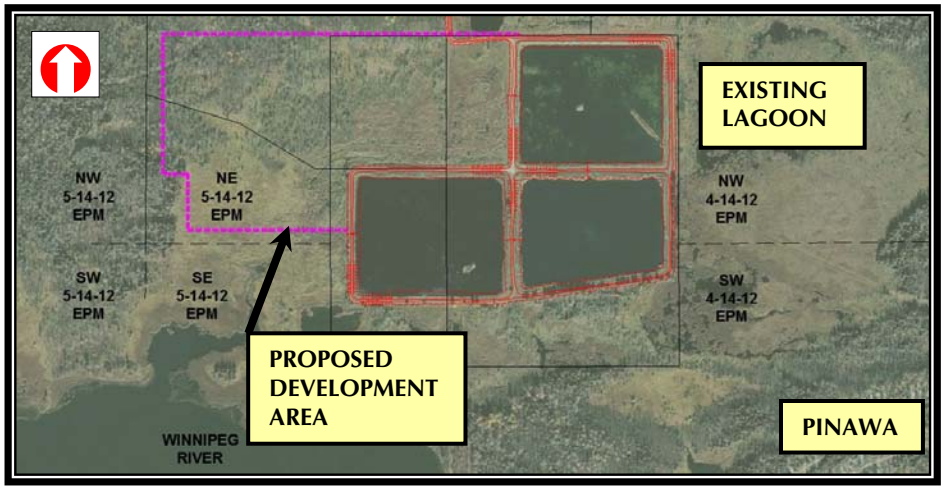

Figure 2.1: Location map of the existing and proposed development

2.2 MINERAL RIGHTS

The Crown Lands and Property Agency – Lands Branch was contacted to provide information on the mines and minerals and sand and gravel ownership of the lands in question. Table 2.1 below provides the details of ownership. Correspondence is included in Appendix E.

TABLE 2.1: EXISTING WASTEWATER STABILIZATION POND STORAGE CAPACITY

Certificate of Title	Mines and Minerals	Sand and Gravel
2415771	Crown	LGD of Pinawa
2417780	Crown	LGD of Pinawa
2029379	Crown	Crown
2405515	Crown	LGD of Pinawa
2040154	Crown	LGD of Pinawa

2.3 DESCRIPTION OF EXISTING LAND USE

The land intended for lagoon development is designated as "Industrial" and zoned "Waste Disposal-Industrial". As mentioned in Section 2.1, part of the development area is also Crown Land. These areas are a combination of low marsh land with scattered to less dense trees.

2.4 PREVIOUS STUDIES

2011 ***"Emergency Discharge, Pinawa Lagoon" Assessment Report prepared*** **by GENIVAR for the** ***LGD of Pinawa***

This report documents all existing wastewater sources and provides an assessment of the wastewater flow to the lagoon and emergency discharge analysis. The study concludes with recommendations on avoiding emergency discharges in the future.

2013 ***Geotechnical Report: "Proposed LGD of Pinawa WWSP Expansion"*** **prepared by GENIVAR for the** ***LGD of Pinawa***

This report provides a detailed geotechnical investigation of the proposed development site conducted by GENIVAR on March 13, 2013. The investigation included testhole drilling,

sample collection and laboratory testing. The report concluded that based on soil conditions, the proposed expansion should be constructed with a 1-meter surface clay liner.

3.0 EXISTING WASTEWATER STABILIZATION POND

3.1 DESCRIPTION

The existing wastewater stabilization pond is located west of the Community of Pinawa and consists of one primary cell and two secondary cells, receiving wastewater from a sewer system in the Community of Pinawa via a lift station and a forcemain. A sewer system in the Pioneer Bay Campground also discharges into the forcemain on a seasonal basis. The Pinawa wastewater treatment facility also services Relax Ridge Campground and Awanipark Development.

The existing LGD of Pinawa lagoon services the current population of the Community of Pinawa, approximately 1,450 people (630 houses), which are using the sewer system. In addition to the serviced residents, the system serves 17 bussed-in students. In calculating wastewater flow for the additional students, we use a ratio of 3:1 (3 bussed-in students are equivalent to 1 person in a dwelling), which totals 6 equivalent people.

The Pioneer Bay campground has 200 sites which are pumped directly into the piping system from May 10th to September 25th each year. The Relax Ridge campground has 85 sites serviced by holding tanks that are emptied approximately once per year; in addition, washroom and shower facilities at this campground have 3 holding tanks. Neither campground contributes to the lagoon during the storage period. There is a 34-site Awanipark Development with septic tanks, which are trucked to the lagoon.

The LGD of Pinawa is expecting a population increase of 300 residences and 60 condo units, and a construction of a 70-bed Pinawa Senior House (PCH) for a total population increase of approximately 950 people over the next 20-year period. Also, a new Tim Hortons Camp will contribute wastewater to the lagoon in the future.

The existing licence directing lagoon operation is Clean Environment Commission Order No. 230 VC, dated October 30, 1975 (Appendix B).

3.2 EXISTING CAPACITY

The existing LGD of Pinawa lagoon has one primary cell and two secondary cells that collectively function in the treatment and storage of the wastewater. Information regarding the actual dimensions of the existing LGD of Pinawa lagoon was obtained from the 2012 GENIVAR survey data. At an operating depth of 1.5 m, the primary cell has a total volume of 77,400 m^3 and a storage volume of 38,700 m^3 (Manitoba Conservation stipulates that only half of the total volume contributes to the hydraulic storage of the facility). The West secondary cell has a storage volume of 72,660 m^3, at an operating depth of 1.5 m and the North secondary cell has a storage volume of 71,215 m^3, at an operating depth of 1.5 m, if a 0.3 m dead storage is assumed for the bottom of the cells. The total storage provided by the three cells is **182,575 m^3**.

The storage capacities of the existing cells are listed in Table 3.1. All cells are detailed as having 5:1 interior and 3:1 exterior side slopes.

TABLE 3.1: EXISTING WASTEWATER STABILIZATION POND STORAGE CAPACITY

Type	Storage Volume [m^3]
Primary Cell	38,700
Secondary Cell (West)	72,660
Secondary Cell (North)	71,215
Total	**182,575**

According to the Manitoba Conservation guideline, a primary treatment cell requires one hectare of liquid surface area per 56 kg-BOD_5 daily loading. The existing primary cell has a surface area of approximately 5.6 hectares at a liquid level of 1.5 m and was designed for a daily organic loading of **313.6 kg-BOD_5**.

3.3 EFFLUENT QUALITY AND DISCHARGE ROUTE

To meet the requirements of the *Water Quality Standards, Objectives and Guidelines Regulation* under *The Water Protection Act (2011)*, the LGD of Pinawa will implement a nutrient reduction strategy consisting of trickle discharge. We propose to utilize the existing low marsh area by modifying and constructing a serpentine ditch within it. The lagoon would be trickle discharged during the spring and the fall periods. A sampling and monitoring program would be implemented with a duration of 10 years. During the program the treated lagoon effluent would be sampled and analyzed during the discharges to track and assess the phosphorus reduction in a ditch-type constructed wetland.

The *Water Quality Standards, Objectives and Guidelines Regulation* introduction on the Manitoba Government website discusses how small wastewater treatment facilities (serving less than 2,000 people or equivalent) have the option of implementing a demonstrated nutrient reduction strategy instead of the 1 mg/L phosphorus limit. While the population serviced by the Pinawa lagoon is less than 2,000 people we believe this sampling and monitoring program approach is an acceptable way to determine if this ditch-type constructed wetland will demonstrate a consistent phosphorus reduction below 1 mg/L, which could then continue to be used after the population exceeds 2,000 people.

The proposed secondary cells, including the existing cells, will discharge into the new serpentine discharge ditch that eventually flows into the Winnipeg River and follow the same route as the existing cells, as illustrated in Figure 3.1. From the discharge point into the new discharge ditch, the treated effluent will flow 2,000 metres before making its way into the natural wetland areas that drain into the Winnipeg River. The proposed lagoon facility is in the Lac du Bonnet Area Watershed (No. 96).

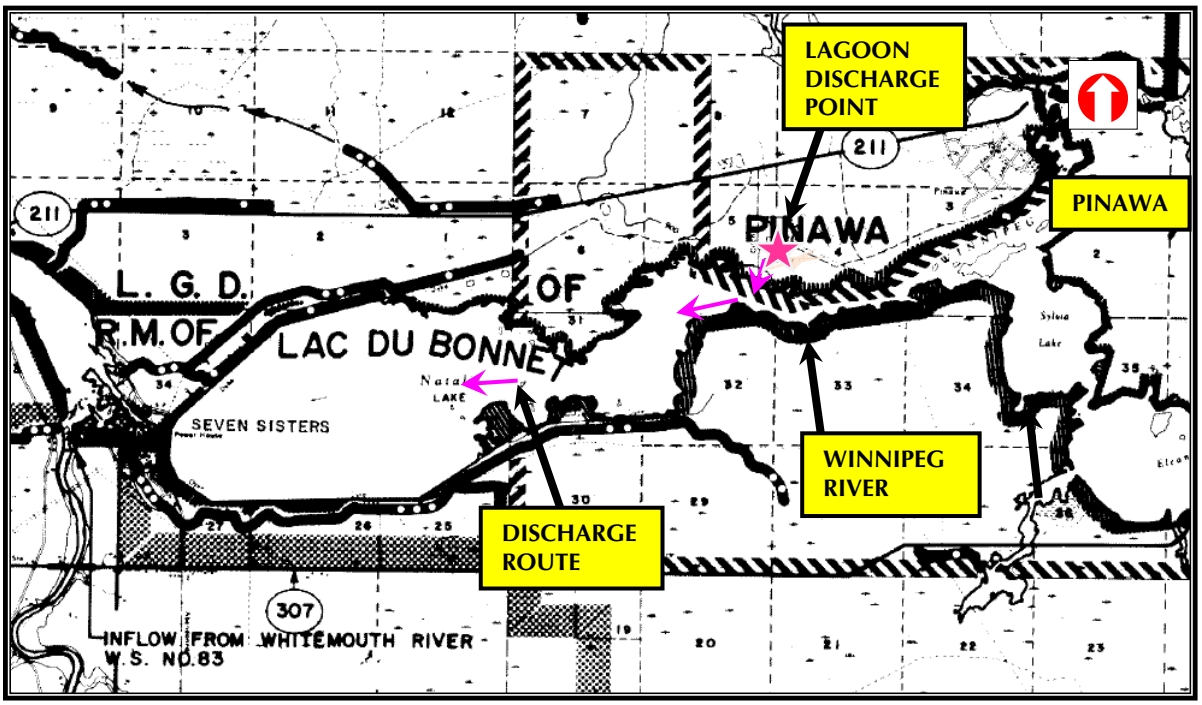

Figure 3.1: Effluent discharge route from the LGD of Pinawa lagoon

4.0 POPULATION SERVICED AND DESIGN LOADING

4.1 SOURCES OF WASTEWATER

The existing LGD of Pinawa lagoon services the current population of the Community of Pinawa of approximately 1,450 people (630 houses), which are using the sewer system. In addition to the serviced residents, the Community of Pinawa sewer system serves 17 bussed-in students. In calculating wastewater flow we use a ratio of 3:1 (3 bussed-in students are equivalent to 1 person in a dwelling), which totals 6 equivalent people. The Pioneer Bay campground has 200 sites, which are pumped directly into the piping system from May 10th to September 25th each year. The Relax Ridge campground has 88 holding tanks, which are emptied approximately once per year. Additionally, the Awanipark Development (34-sites) collects their wastewater in septic tanks and this septage is hauled to the lagoon. The LGD of Pinawa is expecting a population increase of 300 residences and 60 condo units, and a construction of a 70-bed Pinawa Senior House (PCH) to a total population of approximately 2,400 people (including bussed-in students) over the next 20-year period. Also, a new Tim Hortons Camp will contribute wastewater to the lagoon in the future. There are no significant industrial or high strength contributors.

Table 4.1 lists all of the existing and proposed wastewater sources to be serviced by the LGD of Pinawa lagoon.

TABLE 4.1: EXISTING AND PROPOSED WASTEWATER SOURCES

Wastewater Source	**Existing (2013)**	**Proposed (2033)**
Town of Pinawa (Sewer System), people	1,456	2,400
Pioneer Bay Campground (Sewer System): *Serviced Sites*	200	200
Relax Ridge Campground (Holding Tanks): *Sites* *Washrooms / Showers*	85 3	85 3
Awanipark Development (Septic Tanks)	34	34
Tim Hortons Camp	-	1

4.2 ASSESSMENT DETAILS

As typical, a 20-year projection is used to evaluate design populations and corresponding loadings from all contributing wastewater sources. Prior to the discussion of wastewater loading, the following approximations and assumptions are first outlined for the calculations used in assessing the wastewater loadings.

To calculate the organic loading to a treatment facility, it is assumed that the daily BOD_5 contribution for domestic wastewater collected via a piped system is 0.077 kg-BOD_5/person/day.

Septic tank emptying relies on certain assumptions to determine its loading effects. The following calculations outline the methodology used in estimating the septage loading. Presumably, each home has one septic tank. It is estimated that approximately 75% of the total number of septic tanks are emptied in any given year. Typically, peak septic tank emptying occurs within a 45-day period in the fall months. Essentially during this time period, the septic tank systems will contribute the highest volume and therefore the greatest BOD_5 loading to a treatment system. It is estimated that approximately 55% of tanks that are emptied during the year will be emptied into the facility during this peak period. It is estimated that approximately 20% of tanks that are emptied during the year will be emptied during the lagoon storage period. In general, the average volume discharged during a single septic tank emptying is 2,725 L (600 IG) and the average organic load contribution per tank is calculated to be 12 kg-BOD_5.

To calculate the organic loading to a treatment facility, it is assumed that the holding tanks are emptied on average once a year within a 45-day period in the fall months and each load is approximately 3,600 L. The wastewater strength for holding tanks is approximately 1.8 kg-BOD_5 /tank.

When analysing the campground loading, several assumptions were incorporated. The campgrounds are predominantly occupied between May 10th and September 25th of any year. For Pioneer Bay Campground, seasonal site residents are assumed to generate wastewater at

40 L/c/d at a strength of 250 mg-BOD_5/L at 2.3 persons per site with an average occupancy of 40%. For Relax Ridge Campground, the holding tanks are assumed to be emptied once per year and have a wastewater strength of 500 mg-BOD_5/L.

4.3 ORGANIC LOADING

Organic loading refers to the quantity of organic material present in the incoming wastewater and is measured as the five day Biochemical Oxygen Demand (BOD_5). The organic loading becomes the total mass of BOD_5 in kg/d in the wastewater discharged to the lagoon. The wastewater from the piped serviced area is consistent on a year-round basis and does not have a seasonal variation. However, the peak loading from the contributing facilities occurs within the fall months.

4.3.1 Town of Pinawa

On the basis of accepted practice, the daily BOD_5 production for domestic wastewater is 0.077 kg per person. Currently, the existing lagoon services 1,450 people (630 houses) which are using the sewer system. In addition to the serviced residents, the Community of Pinawa sewer system serves 17 bussed-in students. In calculating wastewater flow we use a ratio of 3:1 (3 bussed-in students are equivalent to 1 person in a dwelling), which totals 6 equivalent people. Therefore the total equivalent population is **1,456 people**.

The LGD of Pinawa is expecting a population increase of 300 residences and 60 condo units, and a construction of a 70-bed Pinawa Senior House (PCH) to a total population of approximately 2,400 people on the sewer system (including bussed-in students) over the next 20-year period.

With a current equivalent population of 1,456 (including bussed-in students) on the sewer system, the organic loading to the existing Pinawa lagoon is 112.1 kg-BOD_5/d. With the design population increase of 944, the organic loading is projected to increase to 184.8 kg-BOD_5/d.

4.3.2 Pioneer Bay Campground

The Pioneer Bay campground has 200 existing sites. The campground is assessed with the approximation that 100% of the sites are occupied by seasonal usage during the summer period only. Seasonal site residents are assumed to generate wastewater at 40 L/c/d at a strength of 250 mg-BOD_5/L at 2.3 persons per site with an average occupancy of 40%,

These 200 campground sites generate approximately 7,360 L/d during the summer period at a wastewater strength of 250 mg-BOD_5/L for an organic loading of 1.8 kg-BOD_5/d. This loading is projected to remain the same over the course of the 20-year design period (2033).

4.3.3 Relax Ridge Campground

The Relax Ridge campground has 85 seasonal sites with holding tanks and washroom / shower facilities with 3 holding tanks. It is assumed that the holding tanks are emptied on average one time a year within a 45-day period in the fall months and each tank is approximately 3,600 L. The organic loading attributed to holding tanks is approximately 1.8 kg-BOD_5 /tank based on a wastewater strength of 500 mg-BOD_5/L. For 2013, the organic loading attributed to these holding tanks totals 3.5 kg-BOD_5/d. This loading is projected to remain the same over the course of the 20-year design period (2033).

4.3.4 Awanipark Development

Based on methodology discussed in Section 4.2, 26 of the 34 septic tanks (75%) are emptied in any given year and approximately 14 of those 26 tanks (~55%) will be emptied into the lagoon facility during the 45-day peak period in the fall months. The wastewater strength of each tank is approximately 12 kg-BOD_5 for a current (2013) organic loading total of 3.7 kg-BOD_5/d. This loading is projected to remain the same over the course of the 20-year design period (2033).

4.3.5 Tim Hortons Camp

A new Tim Hortons Camp will contribute to the LGD of Pinawa lagoon in the future. It is estimated that the camp will generate approximately 15,000 L/d during the storage period at a wastewater strength of 250 mg-BOD_5/L for an organic loading of 3.8 kg-BOD_5/d.

4.3.6 Summary

A summary of the existing (2013) and proposed (2033) organic loading from each wastewater source is detailed in Table 4.2.

TABLE 4.2: SUMMARY OF THE ORGANIC LOADING TO THE LGD OF PINAWA LAGOON

Wastewater Source	Type	Wastewater Strength	Existing (2013)	Proposed (2033)
			[kg-BOD_5/d]	[kg-BOD_5/d]
Town of Pinawa	Forcemain	0.077 kg-BOD_5/person	112.1	184.8
Pioneer Bay Campground	Forcemain	250 mg-BOD_5/L	1.8	1.8
Relax Ridge Campground	Holding tank	1.8 kg-BOD_5/t	3.5	3.5
Awanipark Development	Septic tank	12 kg BOD_5/t/y	3.7	3.7
Tim Hortons Camp	Forcemain	250 mg-BOD_5/L	-	3.8
TOTAL			121.1	197.6

As stated in Section 3.2, the existing primary cell of the lagoon has an organic loading capacity of 313.6 kg-BOD_5/d. Therefore, the existing primary cell has adequate treatment capacity for the present and future loadings.

4.4 HYDRAULIC LOADING

Hydraulic loading refers to the volume of sewage flow to the lagoon. Wastewater facilities are presently designed for a 227-day storage period beginning November 1st and ending June 15th of the following year. Hydraulic loading over the 227-day storage period is used to calculate the volume of storage required in the lagoon facility.

4.4.1 Town of Pinawa

As a Town lift station pumps the majority of the flow to the Pinawa lagoon (exception is the wastewater from Pioneer Bay Campground), flow data was collected for the station and utilized in determining hydraulic loadings to the lagoon. Data was obtained from the LGD of Pinawa for the period of August 2009 to June 2013. As well, a drawdown test was performed in April 2012 to determine the flow rate of the pumps. Both pumps individually operate at a flow rate of 104 litres per second (L/s). In addition, water usage data from January 2010 to

August 2013 was analyzed. Figure 4.1 shows the 2010-2013 Pinawa lift station and water usage flow rates on a monthly basis.

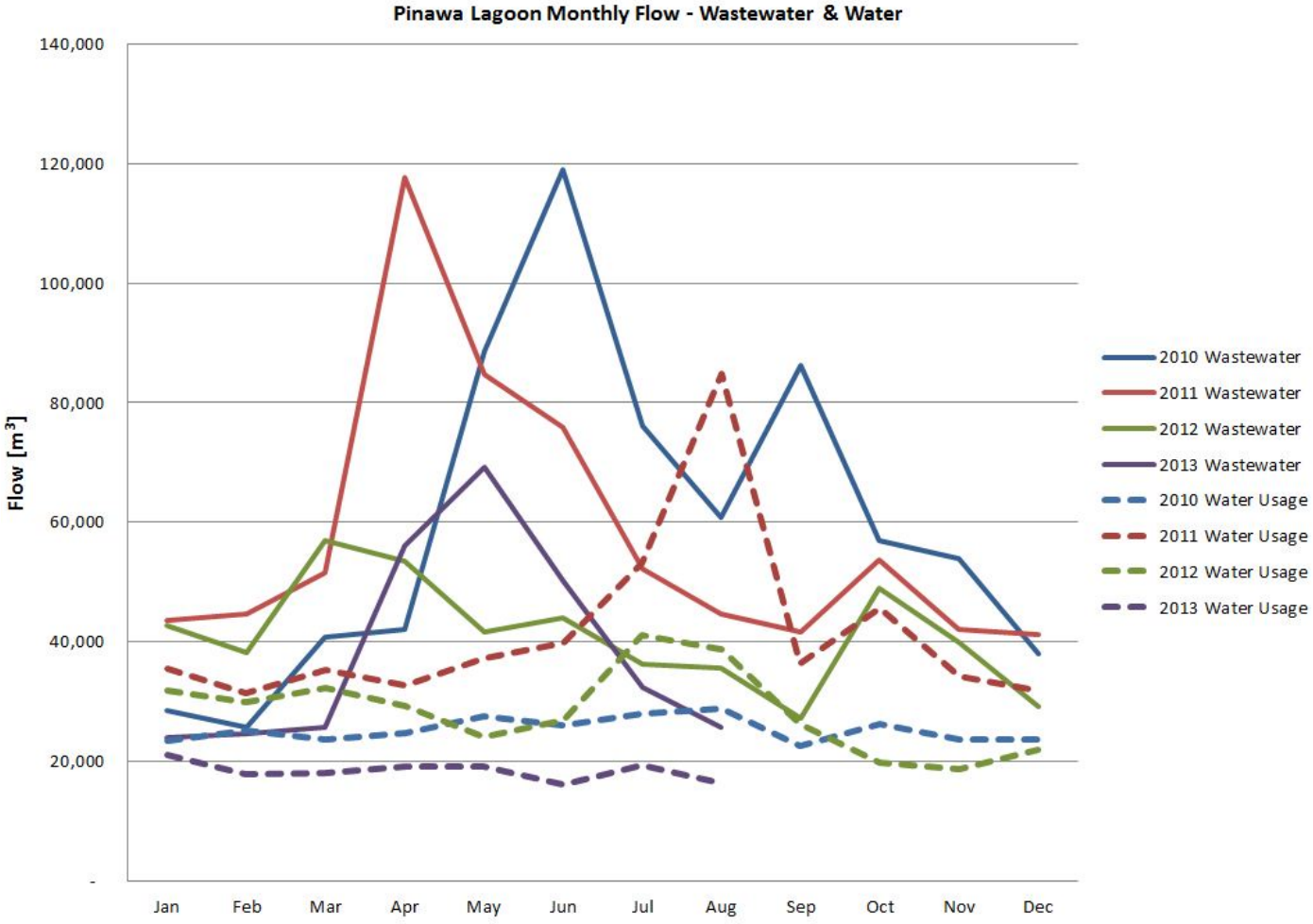

Figure 4.1: 2010-2013 Pinawa lift station and water usage flow rates on a monthly basis.

In 2012, the Town of Pinawa introduced a meter installation program to reduce water usage by changing habits, leaking fixtures and changeover to more water efficient fixtures and appliances. Over the fall period (September to December 2012), all residential meters were installed. As a result, water usage is being tracked and has been dropping. It is expected that water usage will continue to decrease somewhat over the next few years. During the course of meter installation and tracking of water usage, it was discovered that a business within Pinawa had constant flow coolers, which were using approximately 28,000 cubic metres of water per year or approximately 50 litres per capita per day (Lpcd). They have since had a condenser installed in late January 2013 to eliminate that flow. A recreation facility within Pinawa has a

constant flow compressor which also uses considerable water and there is potential there for additional water savings. As well, there are 7 houses running bleed taps during winter to prevent freezing. The Town of Pinawa Public Works is looking at options to eliminate or reduce this flow.

Table 4.3 shows the monthly lift station 2009-2010 and 2011-2013 flows for the storage period (November 1st - June 15th). In light of the efforts made by Town of Pinawa to reduce flows and their continuing work on storm sewer separation, we have dismissed the lift station data from the 2010-2011 storage period which was an extreme infiltration year (in the order of 479,000 m^3).

Table 4.3: PINAWA LIFT STATION MONTHLY FLOWS FOR 2009, 2010, 2011-2013 OVER THE 227-DAY LAGOON STORAGE PERIOD

Month	2009-2010 Flow [m^3]	2011-2012 Flow [m^3]	2012-2013 Flow [m^3]
November	36,309	41,937	39,814
December	31,375	41,274	29,106
January	28,541	42,674	24,014
February	25,579	38,200	24,553
March	40,840	56,875	25,755
April	42,068	53,547	56,100
May	88,677	41,659	69,148
June (1st – 15th)	64,801	17,922	27,436
Total	**358,190**	**334,088**	**295,926**
Lpcd	**1,084**	**1,010**	**895**

The existing LGD of Pinawa lagoon licence stipulates a 196-day storage period. However, a new licence will extend the storage period to 227-days. Based on the above table, the average (227-day) flow rate was **997 Lpcd**, including infiltration. This average rate is significantly higher than the typical range of 250-300 litres per capita per day (Lpcd) which accounts for normal usage and moderate infiltration. We anticipate that the infiltration component of this wastewater will continue to drop over the years as various improvements are performed on the

existing infrastructure and the water usage continues to decline. For design of the new storage cell, we will use **800 Lpcd** as a design wastewater generation.

With a current population of 1,456 (including bussed-in students) on the sewer system and based on the average 2009-2010 and 2011-2013 storage period flow data, the hydraulic loading to the existing Pinawa lagoon is (1,456 p x **997 Lpcd** x 196 d =) 284,520 m^3. With a new licence requirement of 227-day storage period and reduced infiltration, the hydraulic (2033) loading for the existing population is projected to be (1,456 p x **800 Lpcd** x 227 d =) 264,410 m^3.

The LGD of Pinawa is expecting a population increase of 300 residences and 60 condo units, and a construction of a 70-bed Pinawa Senior House (PCH) to a total population of approximately 2,400 people on the sewer system (including bussed-in students) by the year 2033.

When calculating the hydraulic loading from the new 300 residences and 60 condo units, it is assumed that the new piped system will have minimal infiltration. These new developments were attributed a wastewater generation of 350 Lpcd. In 2033, the total hydraulic loading is (874 p x 350 Lpcd x 227 d =) 69,440 m^3.

When calculating flow from the 70-bed PCH, it is assumed that the daily flow per bed (Lpb) would be approximately 200 L with the total hydraulic loading of (70 b x 200 Lpb x 227 d =) 3,178 m^3 by the year 2033.

4.4.2 Pioneer Bay Campground

The Pioneer Bay campground has 200 existing sites. The campground is assessed with the approximation that 100% of the sites are occupied by seasonal usage, all during the summer period only with no contribution during the storage period.

4.4.3 Relax Ridge Campground

The Relax Ridge campground has 85 seasonal sites with holding tanks and washroom / shower facilities with 3 holding tanks. The campground is assessed with the approximation that 100%

of the sites are occupied by seasonal usage, all during the summer period only with no contribution during the storage period.

4.4.4 Awanipark Development

Based on methodology discussed in Section 4.2, 26 of the 34 septic tanks (75%) are emptied in any given year and approximately 5 of those 26 tanks (~20%) will be emptied into the lagoon facility during the storage period in the fall months and each load is approximately 2,725 L. For 2013, the hydraulic loading attributed to these septic tanks totals 14 m^3. This loading is projected to remain the same over the course of the 20-year design period (2033).

4.4.5 Tim Hortons Camp

A new Tim Hortons Camp will contribute to the LGD of Pinawa lagoon in the future. It is estimated that the camp will generate approximately 15,000 L/d during the storage period with the total 2033 hydraulic loading of (15,000 L/d x 227 d =) 3,405 m^3.

4.4.6 Summary

A summary of the existing and proposed hydraulic loading from each wastewater source during the storage period is detailed in Table 4.4.

TABLE 4.4: SUMMARY OF THE HYDRAULIC LOADING TO THE LGD OF PINAWA LAGOON DURING THE 227-DAY LAGOON STORAGE PERIOD

Wastewater Source	Type	Present (2013) [m^3]	Proposed (2033) [m^3]
Town of Pinawa – existing population	Forcemain	284,520	264,410
Town of Pinawa – new residences/condos		-	69,440
Town of Pinawa – PCH		-	3,178
Pioneer Bay Campground	Forcemain	0	0
Relax Ridge Campground	Holding Tank	0	0
Awanipark Development	Septic Tank	14	14
Tim Hortons Camp	Forcemain	-	3,405
TOTAL		284,534	340,447

As stated in Section 3.2, the existing storage capacity of the LGD of Pinawa lagoon is 182,575 m^3. Concluding from the information in Table 4.4, **the proposed design should provide a minimum storage of 340,447 m^3**. Therefore, the existing lagoon does not have adequate storage capacity for the present and future loadings and requires expansion.

5.0 PROPOSED DEVELOPMENT

Considering that the hydraulic loading section concludes that the existing lagoon is not capable of servicing the present and future wastewater generation, construction of two new secondary cells is proposed.

5.1 SITE CONDITIONS

On March 13, 2013, GENIVAR conducted a geotechnical investigation at the proposed development area during which a drill rig was used to drill a total of 10 testholes (TH1 to TH10) between 2.3 m and 6.1 m depths below grade. The complete Geotechnical Report is included in Appendix C.

5.1.1 Local Topography

The proposed expansion site is located on a fairly rugged area known as Precambrian Drift Plain. This area occurs along the eastern side of Lac du Bonnet area. Surficial deposits are composed of glacio-lacustrine deposits of silty and clayey material deposited on lake floors. The topography of Precambrian is very rugged, hummocky and characterised by numerous rock outcrops and peat bogs interspersed with small lacustrine clay areas. The proposed expansion site is developed on lacustrine clay over glacial till and followed by granitic bedrock, that range from about 2.7 m to 19.8 m in thickness overlying igneous and metamorphic rock of the Precambrian period.

5.1.2 Soil Conditions

The general soil profile reveals a topsoil/peat moss layer of about 250 mm to 750 mm underlain by high plasticity olive-grey clay that turns to a till-like structure with traces of fine gravel which extended to the depth explored at 6.1 m below grade. The exception to this soil profile is at testhole, TH1 where a suspected boulder/bedrock was encountered at 2.3m depth.

Sloughing conditions should be expected at a depth where the clay layer became sandy with traces of fine gravel, about 3.3 m to 5.5 m below grade. In addition, surface seepage beneath the topsoil/peat moss should be expected as some water ponding on the low areas was noted

during our investigation. A detailed description of the soil profile is presented in the attached logs, Appendix B (Geotechnical Report).

5.1.3 Groundwater

Ground Water Pollution Hazard Maps indicate that the subject area is not in a groundwater pollution hazard area. There are no well logs in the proposed development area. There is a groundwater report prepared by the Planning Branch of the Water Resources Division on this area. Based on the well logs of the nearest available and groundwater availability maps, groundwater bearing formations or aquifers are formed by surficial deposit (extensive sand and gravel or lenses of sand and gravel) and the Precambrian bedrock aquifer. In the vicinity of our proposed site, the aquifers in this area are the sand and gravel lenses and the granitic bedrock with fractures. The depth of the aquifer based on the well logs (depth of perforations) in this area range from 3.2 m to 155 m below grade. In addition, any sand and gravel deposits, which are laid down directly on the carbonate rock, are hydraulically connected to the fractures and included in the bedrock aquifer. The yield usually is minor to adequate (about 0.013 to 0.9 litres per second). Water quality in the bedrock aquifer ranges from poor to excellent potable water.

Based on the drainage map of the area, groundwater flow at the site is immediately towards the south with the flow eventually heading to Winnipeg River.

5.1.4 Site Investigation

As classified during our field investigation, the clay layer beneath the topsoil/peat moss layer is highly plastic to at least 3 m below grade. Hydraulic conductivity of the in-situ clay beneath the topsoil at depths of 1.5 m (TH2) and 3 m (TH6) as well as Atterberg limits were tested.

The clay material of the upper 1.5 m to 3 m depths is a CH material based on hydraulic conductivity, Atterberg limit and particle size analysis tests. The actual hydraulic conductivity of the sampled material is 2.9×10^{-8} cm/sec (TH2) and 7.4×10^{-8} cm/sec (TH6). The higher result of TH6 is due to trace of till inclusions in the sample. Both of these samples met the Manitoba Conservation's Environmental guidelines for lagoon's soil liners, 1.0×10^{-7} cm/sec.

5.2 SUMMARY OF PROPOSED DEVELOPMENT

As identified previously, the existing LGD of Pinawa lagoon is hydraulically undersized and requires expansion in order to provide adequate storage for the existing and proposed loadings for a 20-year design period (2033).

The proposed development consists of the construction of two new secondary cells, as illustrated in the design drawings (Appendix D). The expansion work is to be completed while the facility remains in operation.

5.2.1 New Secondary Cell #3 and #4

Secondary cell #3 and #4 will be constructed as illustrated in the design drawings (Appendix D). The secondary cells are designed with a surface clay liner having a permeability of $1x10^{-7}$ cm/s or less. Based on the 2033 projected loadings, the cells are designed to provide an influent wastewater storage of 227 days amounting to (79,815 + 83,475 =) 163,290 m^3, bringing the total lagoon storage to (182,575 + 163,290 =) **345,865 m^3**. The cells will be constructed with 4:1 interior side slopes and 4:1 exterior side slopes and will have a normal operating depth of 1.5 metres with a minimum 1.0 metre freeboard. Table 5.2 provides the details for the preliminary design specifications for the new secondary cells.

TABLE 5.1: PRELIMINARY DESIGN SPECIFICATIONS FOR THE NEW SECONDARY CELLS

Parameter	New Secondary Cell #3	New Secondary Cell #4
Cell bottom	218.7 m x 300.7 m	218.7 m x 287.2 m
Liquid surface (at 1.5 m depth)	230.7 m x 312.7 m	230.7 m x 299.2 m
Top of dyke (inside to inside)	238.7 m x 320.7 m	238.7 m x 307.2 m
Operating depth	1.5 m	1.5 m
Freeboard height	1.0 m	1.0 m
Interior side slope	4:1	4:1
Exterior side slope	4:1	4:1
Total volume (at 1.5 m depth)	98,841 m^3	103,390 m^3
Dead storage volume (at 0.3 m depth)	19,026 m^3	19,915 m^3
Storage volume (at 1.5 m depth)	79,815 m^3	83,475 m^3
Liner system	1.0 m clay liner	1.0 m clay liner

5.2.2 Construction Details

According to the subsurface profiles in the 2013 Geotechnical Report, the depth of topsoil/peat moss in the proposed area was approximately 250 mm - 750 mm. Organic soil from the lagoon area will be stockpiled and reapplied at the end of construction on the applicable disturbed areas and on the dykes as shown in the drawings.

For lagoon construction, Manitoba Conservation's Environmental guidelines require that the proposed dykes and bottom of the proposed cells be provided with a layer consisting of at least one metre of soil having a permeability of less than $1x10^{-7}$ cm/s. The proposed expansion location consists where such clay is present. The olive-grey clay at 1.5 m and 3.0 m depths were tested and achieved a hydraulic conductivity test result of less than $1.0x10^{-7}$ cm/s, thus meeting the guidelines.

The new secondary cells will be constructed as detailed in the drawings. The interior and exterior side slopes of the constructed cell will be 4:1. The proposed secondary cell will have a 1.5 metre operating depth with a minimum 1.0 metre freeboard. The dykes will be constructed with in-situ material in 150 mm lifts compacted to 95% Standard Proctor density. The moisture content of the material should be minus two percent to plus 3 percent of optimum moisture as determined by the Standard Proctor test. Any unsuitable material such as course gravel and boulders should be removed. The top of the dykes will be 3.0 m wide to permit vehicle access to all points of the lagoon. The 1.0 m surface clay liners of the new secondary cells will be tested and the results of the testing will be reported to Manitoba Conservation.

A perimeter drainage ditch will be constructed around the new secondary cell if required. A serpentine ditch-type constructed wetland will be located as shown on the drawings. For disturbed areas where sediment or erosion control is deemed necessary, the contractor will be required to employ appropriate measures.

The interior dykes will be armoured with rip rap to prevent wave erosion. Rip rap is also proposed for the inlet and outlet areas of the inter-cell and discharge piping. All inter-cell and discharge piping and valves will be located as shown on the design drawings.

6.0 ENVIRONMENTAL IMPACTS

6.1 ODOUR CONSIDERATIONS

It is expected that the expanded facility will operate without causing any significant odour problems. The existing primary cell is designed for the flows with a 56 kg-BOD_5/ha/d loading. With the 2033 projected wastewater loading of 197.6 kg-BOD_5/d, the cell will only be operating at (197.6 / 313.6 =) 63% of its capacity. The only time of the year that some minor odours may be present is during the spring while the ice thaws. During the winter, ice cover largely prevents free oxygen from entering the water. This condition leads to the production of hydrogen sulphide gas (H_2S) during the winter by bacteria that do not require free oxygen. These accumulated gases dissipate quickly into the atmosphere when the ice breaks and the pond returns to a non-odorous condition.

The closest residence to the lagoon is located more than 1,000 metres away, which meets the Manitoba Conservation minimum setback distance of 300 metres.

6.2 LAND IMPACT

The land intended for lagoon development is designated as "Industrial" and zoned "Waste Disposal-Industrial". As mentioned in Section 2.1, part of the development area is also Crown Land. These areas are a combination of low marsh land with scattered to less dense trees. The areas with trees and bush will require clearing.

6.3 SURFACE WATER

From the discharge point into a serpentine ditch-type constructed wetland, the treated effluent will flow through this wetland and then meander through additional low marshy areas before reaching the Winnipeg River. The distance of the route from the discharge point of the proposed cells to the end of the constructed ditch is approximately 2,000 metres. Perimeter ditching will be constructed to provide positive drainage for surface water around the lagoon if required.

The Town of Pinawa and the proposed lagoon facility are in the Lac du Bonnet Area Watershed (No. 96). Figure 3.1 illustrates this discharge route in the specified watershed.

The water licensing branch of Manitoba Water Stewardship was consulted to provide a list of water users along the drainage route. It was reported that there are no water users along the drainage route (Appendix E).

6.3.1 Fuel Storage on Site

The proposed facility does not require the onsite storage of gasoline or diesel fuel. During construction and upgrading, the contractor will be required to ensure that all equipment is properly maintained to prevent leaks and spills of fuel and motor fluids. Refuelling of equipment will not be within 100 metres of a water body, stream or wetland.

6.4 GROUNDWATER

There are no well logs in the proposed development area. There is a groundwater report prepared by the Planning Branch of the Water Resources Division on this area. Based on the well logs of the nearest available and groundwater availability maps, groundwater bearing formations or aquifers are formed by surficial deposit (extensive sand and gravel or lenses of sand and gravel) and the Precambrian bedrock aquifer. In the vicinity of our proposed site, the aquifers in this area are the sand and gravel lenses and the granitic bedrock with fractures. The depth of the aquifer based on the well logs (depth of perforations) in this area range from 3.2 m to 155 m below grade. In addition, any sand and gravel deposits, which are laid down directly on the carbonate rock, are hydraulically connected to the fractures and included in the bedrock aquifer. The yield usually is minor to adequate (about 0.013 to 0.9 litres per second). Water quality in the bedrock aquifer ranges from poor to excellent potable water.

Based on the drainage map of the area, groundwater flow at the site is immediately towards the south with the flow eventually heading to Winnipeg River.

The design of the new lagoon complies with Manitoba Conservation guidelines and will therefore sufficiently contain the influent wastewater. The treated effluent intended for discharge will comply with the parameters listed in the new Environment Act Licence.

6.5 SPECIES IMPACT

A file search with the Biodiversity Conservation Wildlife and Ecosystem Protection Branch of Manitoba Conservation resulted in one historic occurrence found near the development site. Table 6-1 documents the species. Correspondence is included in Appendix E.

TABLE 6.1: RARE OR ENDANGERED SPECIES

Provincial Scientific Name	Provincial Common Name	Rank
Yellow Rail	Coturnicops noveboracensis	S3S4, SARA: Special Concern COSEWIC: Special Concern

Data developed by the Manitoba Conservation Data Centre; Wildlife and Ecosystem Protection Branch, MB Conservation

6.6 FISHERIES

From the discharge of the serpentine ditch-type constructed wetland, the treated effluent will meander through low marshy areas and eventually flow into the Winnipeg River (Figure 3.1). According to Fisheries and Oceans Canada (DFO) the designated drains from the lagoon are classified as type E habitat (indirect fish habitat), but it becomes type A habitat (complex habitat, indicators present) in the Winnipeg River. Correspondence is included in Appendix E.

In order to protect any potential fish in the critical springtime spawning season, when effluent un-ionized ammonia tends to be high, the lagoon has been designed to the 227-day storage period. The lagoon will discharge after June 15th and will allow for significant conversion of toxic un-ionized ammonia into relatively benign nitrates.

6.6.1 Fisheries Act Information

As noted from Fisheries and Oceans Canada (DFO), the deposit of deleterious substances into water frequented by fish is prohibited under the *Fisheries Act*. In addition, according to subsection 35(1) of the *Fisheries Act*, "no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat."

6.7 FORESTRY

The construction of the lagoon will require the clearing of approximately 10 ha of scattered to less dense trees and shrubs.

6.8 HERITAGE RESOURCES

In a letter dated November 6, 2012 from the Historic Resources Branch (Appendix E), it was stated that the potential to impact significant heritage resources is low, and therefore, the Historic Resources Brach has no concerns with the project.

6.9 SOCIO-ECONOMIC IMPACTS

The lagoon construction will result in a short-term boost to the construction industry in the area.

6.10 PUBLIC INVOLVEMENT

Comments from concerned members of the public will be solicited as part of Manitoba Conservation review prior to issuing a licence.

7.0 MANAGEMENT PRACTICE

The new wastewater treatment facility is specifically designed to provide wastewater treatment and storage capacity for the existing infrastructure and proposed developments. The proposed LGD of Pinawa lagoon is designed to treat wastewater up to an average loading of 313.6 kg-BOD_5/d and store the treated effluent for 227 days. The facility will normally discharge in spring soon after June 15th, and again in fall prior to October 31st. Treated effluent will be discharged from the isolated secondary cell(s). After the new development, the lagoon will consist of one primary and four secondary cells.

Manitoba Conservation generally requires treated effluent to have total suspended solids <25 mg/L, BOD_5 < 25 mg/L, fecal coliform MPN of <200 organisms/100 mL, total coliform MPN <1500 organisms/100 mL, and chlorine <0.02 mg/L and some nutrients removal requirements. The proposed facility will meet the new licence requirements.

7.1 DISCHARGE PROCEDURE

1) Manipulate the valve to isolate one, two or all of the secondary storage cells two weeks before collecting the BOD_5, bacteriological, and any other samples required in the new Environment Act Licence.

2) Sample the isolated secondary cell(s). Allow at least one week to analyze the sample(s), plus shipment time.

3) If the total coliform MPN index does not exceed 1500 organisms per 100 mL, the faecal coliform MPN index does not exceed 200 per 100 mL of sample, and the BOD_5 does not exceed 25 mg/L, then the bacteriological and BOD_5 component of the testing is satisfied. Further discharge parameters may be instituted in the new Environment Act Licence that should be satisfied prior to discharge.

4) While discharging, the valve(s) between the primary cell and the secondary cell(s) remain closed to prevent the primary cell from simultaneously discharging effluent into the discharging secondary cell(s).

5) Once the secondary cell(s) are discharged, close the discharge valve(s), and reopen the valve(s) between the primary cell and the secondary cell(s). This will allow the water

levels in the cells to equalize. In many cases a sufficient amount of treated effluent is discharged from the secondary cell(s) using this procedure to permit operation until the next scheduled discharge period. However, it may be necessary to discharge additional treated effluent to have enough storage for the wastewater flows in the following operational season.

6) If further discharging is necessary, repeat the isolation, testing and discharge process.

7.2 RECORD KEEPING AND INSPECTION ROUTINE

A record book, organized in five sections, should be maintained:

1) Daily Records – Water consumption and lift station pumping records should be collected and retained for future estimation of flows to the wastewater treatment facility. Septic hauling records (dates and volumes) from the individual haulers trucking to the lagoon should also be collected and retained.
2) Weekly Records - The weekly summer inspection would consist of recording the following: the water level, presence of odours and their source, and presence of floating objects (removal). The summer maintenance should also include grass cutting on the dykes, if necessary, elimination of emergent vegetation, extermination of burrowing animals, repair of the dykes and rip rap if damaged by wind erosion and wave action, repair of the fence and gate.
3) Periodic Winter Inspection is confined to inspecting for frozen piping, checking if the water level in the cells is as it should be.
4) Discharge Records - The records should contain all treated effluent quality analyses, dates of discharge, discharge procedure followed, water levels and other pertinent data.
5) Monitoring Program – If acceptable, a sampling and monitoring program would be implemented with a duration of 10 years. During the program the treated lagoon effluent would be sampled and analyzed during the discharges to track and assess the phosphorus reduction in the ditch-type constructed wetland.

8.0 SCHEDULE

It is anticipated that the Environmental Act Licence process will be finalized by spring of 2014 and construction will begin in the summer of 2014.

9.0 FUNDING

The LGD of Pinawa has an agreement with Manitoba Water Services Board for cost sharing on the project.

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