



Sewage 101 Report to Council

Consultations
Discussion
Communication
Proposals

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Introduction

It is recognized that a sewage treatment facility needs to be built to handle sewage waste for Lumsden. This new facility must reduce odour and meet Ministry of Environment Water Quality Guidelines. The facility will need to be of appropriate size for the community and expandable. Ultimately, a wastewater treatment plant for Lumsden must meet sustainability criteria: **economically sustainable** in capital and operating costs, **environmentally sustainable** minimizing environmental impact, using green technologies, minimizing the carbon footprint, maximizing aesthetics, **socially sustainable** providing jobs locally, reducing negative impacts on citizens who are affected by the current odour, consulting with and reducing impact on downstream users as appropriate.

AE 2007 Report

Associated Engineering prepared *Report on the Town of Lumsden Wastewater Management Strategy, 2007* which summarized the situation and gave careful consideration to the options available. The Executive Summary page ii states that:

Through a non-economic workshop exercise, the Town, in conjunction with Associated Engineering selected two options to retain for costing purposes:

- Option 2a – New Mechanical WWTF
- Option 3 – New Lagoon-based WWTF

The New Mechanical WWTF would be constructed near the existing lagoons. Wastewater collected and pumped from the Town would be received, treated and discharged directly into the Qu'Appelle River.

The New Lagoon-based WWTF would require upgrading of the existing lift station, construction of a force main, construction of a facultative treatment cell, construction of storage cells and a return gravity pipeline to the Qu'Appelle River.

In their report, Associated Engineering recommended Option 2a at a cost of 7.5 million dollars to be completed on a schedule which would have seen the mechanical plant in place and operating in March 2009.

At the time of the report the BOD loading rate was in excess of recommended standards and that is a major factor contributing to odour, the primary lagoon is undersized for the population of the town (page 2-2). "The facultative primary lagoon cell was found to have a loading rate of 44.0 kg/ha-d for the Town's 2005 population of 1 600 residents. This loading rate is approximately 1.5 times the primary lagoon cell rated capacity." (page 2-2)

A population growth rate of 1.5% was used to project the population of 2300 in 2030 which would have been the end life of the new treatment plant had it been constructed in 2005. Since the community is in a valley alongside a river, flooding must be considered. This report also addresses Currently, the lagoons are several meters below the 1:500 flood event water levels. (page 5-2)

Sewage 101 Findings

An ad hoc committee of the Town Council, Sewage 101, met and gathered the following information. Councillors Rhonda Phillips, Al Sulma, Doug Mader, and town employee Dave Cherney met to determine what was known and what information was needed. They gathered information from Ben Lichtenwald (Ministry of Environment), Bill Haywood and Michael Whalley (Associated Engineering), Leroy Starks (C3). Rhonda Phillips had conversations with Norm Henderson (Prairie Adaptation Research Collaborative), Thon Phommavong (Ministry of Environment), Dena McMartin (Engineering Faculty University of Regina), Iain Phillips (Saskatchewan Watershed Authority). Suggestions by other councillors were researched on the internet and discussed with above mentioned experts.

The Qu'Appelle River was identified by Ministry of Environment as having an impaired health rating and a higher stress potential according to the SaskWater report to the Town of Lumsden. The 2010 State of the Watershed report by the Saskatchewan Watershed Authority shows this area as stressed or even impacted according to aquatic benthic macroinvertebrate indicators and indicators of health grade. (Table 3)

The design of the wastewater treatment facility should integrate climate change and adaptation initiatives. Funding will be available for reduced carbon dioxide technology such as a sludge digester and there is GO GREEN FUNDING for new emerging technologies. This includes results based incentives and assistance. Such green technologies might include but are not restricted to effluent irrigation and greenhouses. Effluent discharge can be used for irrigation to create forests for recreation, visual screens, shelterbelts and tree nursery stock to be planted out in the community. Such an endeavour must keep in mind that multispecies afforestation reduces risk and there must be a plan to move an irrigation system every 10 years. Polishing, which is additional nutrient removal, can be done in a greenhouse. All water re-use options should be considered for wastewater in the community, but these are restricted by health standards. Garth Weideman with Ministry of Agriculture at Outlook will look at soil samples to determine if land would work for effluent irrigation. There are currently no greenhouse systems in Saskatchewan. A disposal option is needed for water after the greenhouse.

The location of a mechanical treatment plant needs careful consideration. There must be room for expansion on the property. A wastewater treatment plant can't be built within 300m of the community. Lagoons must be more than 600 m from residences so our current system is not in compliance. The facility needs to be above the 1:500 point for river flooding. Currently the dike in that area is not at 1:500 and there are some geotech concerns noted by AE engineers.

Treatment of sewage so that effluent from the wastewater treatment facility can be discharged, needs to address three chemical criteria: biochemical oxygen demand (BOD), total nitrogen (N) and total phosphorus (P). The standards will be more stringent if the effluent is to be discharged into the river than if it is used for effluent irrigation. The degree of infiltration and contact with the groundwater will need to be taken into consideration when the irrigation is in the bottom of the valley because of the groundwater communication with the Qu'Appelle River. There are now national standards that will need to be met. These are designed to protect fish and fish habitat. They are: BOD \leq 25 mg/L,

suspended solids ≤ 25 mg/L, residual chlorine ≤ 0.02 mg/L and ammonia ≤ 1.25 mg/L (N at 15°C). The criteria that Lumsden must meet have been communicated in writing by Sask. Ministry of Environment and they recognize the sensitivity of the Qu'Appelle River in the area. The anticipated effluent discharge criteria for Lumsden 2011, communicated on May 11 2004, are as follows: TSS 25 mg/L, BOD 25 mg/L, total phosphorus 1 mg/L, NH₃N 4mg/L summer and 6 mg/L winter, TKN 12 mg/L (Total Kjeldahl Nitrogen - sum of organic nitrogen), total Coliform 1000 and Fecal Coliform 100. The document notes that these criteria may change however it should be noted that the new federal criteria have lower levels for nitrogen compounds and that will take precedence. In the past, the permit to operate the sewage lagoons in Lumsden set the BOD at 30 kg/ha-d. At this time the BOD loading is 44 kg/ha-d and therefore needs to be reduced because aerobic bacteria cannot keep up with this demand, anaerobic bacteria take over and there is a subsequent odour problem in the community quite separate from the problems related to effluent discharge. The following data table compares water quality from June 14, 2010, when there was a large dilution factor from rain and infiltration, with the probable targets. Once the effluent is in the secondary cell it is meeting target criteria for BOD and TSS. Nitrogen and phosphorus need to be reduced.

Data Table: Comparison of Current Wastewater to Future Targets			
Parameter	Target	Primary Cell	Secondary Cell
BOD (mg/L)	≤ 25	20.4	5.1
TKN (mg/L)*	12	26.1	20.2
Total phosphorus (mg/L)	1	4.91	5.04
Total Coliform (org. /100ml)	1000	25600	1019
TSS (mg/L)	≤ 25	45	6

*Note: We do not have current data for ammonia nitrogen.

3° Plant Options

There are a variety of mechanical system options also referred to a tertiary sewage treatment or a 3° plant. Activated Sludge is an older technology and as such has been around for a long time. It is tried and proven. Bacteria on a solid surface breakdown wastes (organic compounds) and remove ammonia (nitrogen compounds) as well as phosphorus. Dead bacteria are taken off as sludge. The next batch has to be re-inoculated. The footprint is larger than the newer systems but less expensive (about 80% of a membrane reactor).

One highly recommended consideration is mechanical treatment that uses biological nutrient removal (BNR). In this case, biofilms of bacteria and protists take nitrogen and phosphorus out of waste water -

dead organisms are used as fertilizer. The process is 100% biological, no chemicals are added. It is a common system that can be built to any size. The technology used needs nationally recognized 3rd party verification so in selection of companies to build a plant, they have to have ETV certification. It should be noted that different companies have different prices for the same thing. Some BNR reactors have attached growth systems such as greenhouses for polishing of effluent.

Research was done into two companies whose names were put forward. EcoLibra (www.ecolibrasystems.com) is a Saskatoon company with pilot plant in Aberdeen that looks promising but they have no big scale operation and scaling up the processes could be a factor. XOgen (www.xogen.ca), a southern Ontario company has a system that looks interesting but is not in operation stage of testing yet.

Membrane filtration is another treatment option. The membranes clean well. The facility has a small footprint because it does not require a large building. A membrane BioReactor acts like a filter which leaves solids behind the membrane. Such membrane systems can handle more concentrated solids than activated sludge system.

Rotating Biological Contact (RBC) are attached growth systems that provide surfaces for bacteria. Suspended discs rotate and are oxygenated when out of the water - process of nitrification takes place ($\text{NH}_4 \rightarrow \text{NO}_3$). There is a single proprietor, may be savings but could be associated with some risk. Original concept has been improved on, the new technology looks promising.

Sequencing Batch Removal (SBR) system has aeration and sludge settlement both occurring in the same tank. It carries out the functions of equalization aeration and sedimentation in a time sequence rather than in the conventional space sequence of continuous-flow systems.

Biofilter has a media suspended in solution with bacteria attached to it. Wastewater comes up through a bed and is cleaned by these biologically activated filters.

Associated Engineering provided examples of operating systems. Field B.C. had a Membrane BioReactor built by Associated Engineering that met National Park Standards (0.15 mg/L as opposed to 1.0 mg/L phosphorus). Footprint of the plant was very small. Building was very aesthetically appealing. Cost was \$4 million, likely to come down as the technology is used more but this could be offset by increase in construction costs. This plant is operated by remote control from Lake Louise with the operator going out once a day. Effluent of this quality is discharged into a river in the National Park system. Town of Field has 1200 residents but flow rate is similar to Lumsden. Lesser Slave Lake has a SBR system at \$4 million for the plant, \$6 million overall. This facility discharges into a wetland with a path around the outside. Denare Beach built a SBR system at \$3.5 million for a plant that handles 500 m³/ day. Camrose AB, has an RBC. It discharges into a very small river so quality had to be excellent. This is a larger community than Lumsden

Biosolids produced by these plants have to be managed. With a mechanical plant, both biosolids (waste bacteria) and debris that needs to be taken off the front need to be removed every day. Production is about 10% or approximately 4 m³ per day. Odour and materials handling is a problem if put directly in a

land fill because it is difficult to cover. Option 1: Anaerobic Digestion: produces methane (CH₄) which can be used in a cogeneration system to produce electricity or heat. This may be less attractive for small communities because there may not be enough waste. Augmenting the system may be an option to consider. Lethbridge uses sludge produced methane mixed with natural gas to generate electricity for the sewage treatment plant. Regina burns sludge produced methane to heat their plant. Option 2: Aerobic Digestion: reduces the biomass but it is still pathogenic so use is restricted. Option 3: Composting: generates heat which kills pathogens. Class A biosolids are produced from composting and can be used in gardening, production of food crops, golf courses, fields or as cover for landfills. Composting requires a fairly large amount of land. We would need to know where the sludge would be taken and make that part of the design for the treatment plant. One option would be a community compost associated with the land fill which is in close proximity to the current sewage lagoons.

After tertiary treatment, effluent needs to be dealt with. If it is discharged into the river, there is a duty to consult with First Nations. Saskatchewan Ministry of the Environment will need lead time to facilitate consultations. If the effluent is treated to a very high standard, discharge could improve the quality of the water in the Qu'Appelle River. If the effluent is not discharged into the river, there may actually be a reduction in water in the river because usually there is exfiltrate from our current lagoons as this is how they were designed to operate.

Discharge options other than the river include evaporation and irrigation. Operational costs for evaporative lagoons are less. Lagoons can be smaller if discharging every summer by irrigating land. The Town would need to own the land for control reasons and provide irrigation pivot equipment. Operation and irrigation would be done by a farmer or other contractor. The right quality of land and monitoring of soil are required. In the sewage treatment process, reduction of BOD (biochemical oxygen demand) and TSS (total suspended solids) are required. In some instances, nutrients can be left in as they act as a fertilizer. This option is best suited for land on top of the valley but might be modified and used in the flood plain. Effluent irrigation could be used for trees, hay crops, cereal crops, parks, or a tree nursery. These plants would be used to polish treated effluent in the valley bottom. About 160 acres of land would be needed. There is a concern regarding the amount of salt being put in the soil when this process is used. There is a tree irrigation pilot test at Outlook in addition to others in the province. Wood harvested from trees grown in this way can be used as wood chips and in biogas generators.

Discharge of effluent into the wetland or oxbow area to the east would enhance the wetland and exfiltrate into the groundwater and subsequently the river. Plants in the wetland would polish the effluent, reducing nutrients even further than what would be done by the 3^o plant. Wetlands do not seem to do much for treatment of untreated sewage because wetlands only grow and take up nutrients in the warm months of the year.

Some options still require follow up. It was suggested that we investigate what is being done at Dundurn because it has a massive regional treatment centre where the sewage is transferred 10 to 15 miles. We could still look at what Vernon, B.C. is doing. We did not access expertise at the Uof R,

Sustainable Communities Group. Further research could also be done to investigate what is done in Australia. They use the term "water recycling" which is different water uses.

Facultative Lagoon

A new lagoon system is considered in both the Associated Engineering report and the report prepared by Sask Water. Such a lagoon would be out of the valley either north or south of Lumsden. This system would involve purchasing land. The sewage would have to be pumped up out of the valley. Effluent would not need to be treated to as high a standard as treating along side the Qu'Appelle River. The effluent could be used to irrigate hay land or poplar stands in the summer and only stored in the winter months making the lagoons smaller. A safe guard against high water events involves a line back down to the Qu'Appelle River in the design for the south of town. Significant soil and aquifer analysis would need to be done if such a system was located north of town. This option was rejected by the group because of cost and the fact that it would still produce an odour.

Discussions

The information gathered pertains largely to environmental sustainability. A technology needs to be identified that reduces the environmental impact of wastewater effluent from the town of Lumsden. It is recognized that the treatment of this wastewater can no longer cause odour problems and continuing with a lagoon type system would not address this air quality problem. Therefore, a design needs to be sought which includes mechanical treatment to a very high standard. The new treatment facility needs to reduce BOD by more than 50% and more importantly, it needs to address nitrogen contamination.

The social impact and sustainability of decisions relating to wastewater treatment need to be given careful consideration. As long as the current lagoon system operates the potential for odour in the community exists. High odour events are having a significant impact on the community; some people don't like the smell and others make jokes about Lumsden being a smelly town. Any impact on the Qu'Appelle River by sewage from Lumsden or other sources in the area has a negative impact on downstream users. A decisions to do nothing in the short term has a social impact.

Perhaps there is something the community can do to help. If every effort is made to reduce the amount of effluent going to the lagoons, we may be able to reduce the odour problem. This could be done through a concerted campaign to have residents and particularly institutions implement any wastewater reduction strategies not currently being used. Examples of actions that could be taken are installation of low flow toilets, short showers, and installation of water saving clothes washing machines.

The population contributing sewage needs to be understood in the design of a new facility. The calculations for the AE 2007 report were based on a 1.5% growth rate projection however more recent data sets the growth rate of the town at 4% per year. At this rate of growth, Lumsden will reach the 2030 population projection of 2300 residents in 2020 and, if development continues at the current rate, the population of Lumsden will actually be in excess of 3500 when 2030 arrives. Population growth should also take into consideration growth in the R.M. that might ultimately access the wastewater treatment system. As costs for water and disposing of sewage rise, citizens and entrepreneurs may well

develop and access opportunities to reduce waste water leaving homes and other facilities in the community. Therefore, there is a risk of overbuilding the facility. It would probably be wise to call for a design for a facility that would accommodate 3000 residents.

The economic sustainability is a concern because there will likely be increased operating costs with a new treatment system and the construction costs. The requirement of the community to pay off the Drinking Water Treatment Plant before taking on the costs of a new sewage treatment facility puts the date for construction of such a facility at 2014. The cost of a sewage treatment facility is not known. We have seen a high of \$13 million from SaskWater, \$7.5 million estimate from the AE 2007 report and more current findings that are lower. Lumsden produces about 400 m3 of sewage per day. The Denare Beach plant noted earlier handles 500 m3/day and cost \$3.5 million.

Communication

Residents of Lumsden want to know what is happening regarding a new sewage treatment facility. It is the recommendation of Mr. Zerff (Town Administrator) that the electronic sign and website be used to keep people updated. A special section of the Web Site would give information on committee meetings, goals, any overall steps in the process, estimated costs, impact on sewage charge and technical information.

Proposed Process

1. Address acute problem of too much BOD and subsequent odour. Launch a communications campaign in the community to reduce amount of waste water being sent to lagoons.
2. Examine the non economic option analysis as outlined in the Associated Engineering document on pages 5-14 to 5-18. Set values for the factor weightings and rankings.
3. Inform stakeholders that we have been consulting and communicating and that we have a summary of the consultations. Invite stakeholders to an informational meeting where findings and decisions to be made can be discussed. Invite input. Stakeholders would not only include the community residents but also developers and Ministry of Environment personnel. Obtain feedback on the non economic option analysis.
4. Refine "Criteria" to be sent out in the request for design proposal based on the stakeholders meeting.
5. Work with Sask Water to develop a Request for Proposal document which would solicit input on a concept design for a sewage treatment plant.
6. Select the design that best meets the criteria set out in the Request for Proposals document. Award for a detailed design to be completed by the company whose design was selected.
7. Use an estimated or working cost from the designer to complete grant applications and search for additional sources of funding. Negotiate for special grants relating to the unique circumstances.
8. Consult with downstream First Nations and Watershed Groups.
9. Tender for construction.

Preliminary Criteria

Request for Proposals: Design of a Wastewater Treatment Facility for the Town of Lumsden.

- Mechanical waste water treatment for a population of 3000
- No odour in the community
- Discharge water quality exceeding the new 2010 standards
- Identify optional integration of green technologies with associated capital and operating costs (+/-) so decisions can be made on inclusion initially or in the future.
- Location meeting the setbacks from residential areas according to Ministry of Environment criteria
- Design that would withstand a 1:500 flood event
- Consideration for effluent irrigation in summer
- Cost estimates for:
 - construction of the facility
 - timing of expenditures from initiation of the project
 - operating the facility annually
 - manpower requirements
- Schedule showing time required for each stage of the project, independent of dates
- Consideration of integration with the land fill particularly relating to composting