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GANGES SEWER LOCAL SERVICE COMMISSION

Notice of Meeting on **Thursday, March 9, 2017 at 1:00 pm**

Portlock Park Meeting Room, 145 Vesuvius Bay Road, Salt Spring Island, BC

Wayne McIntyre Gary Utter Rod Scotvold David Toynbee Mike de Carle

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AGENDA

1. **Approval of Agenda**

2. **Approval of Minutes – December 12, 2016**

3. **Delegations/Presentations**

   3.1 Ganges Wastewater Infrastructure Renewal Project - Solids Handling Options Analysis
   Sunny Mangat PEng, CPESC, MSc, MTech, PG Diploma
   Project Manager & Wastewater and Water Treatment Specialist
   Amec Foster Wheeler

4. **Chair and Director Reports**

5. **Reports**

   5.1 Ganges Wastewater Infrastructure Renewal Project – Solids Handling Options Analysis

   That the Ganges Sewer Local Services Commission:

   1) direct staff to proceed with solids handling upgrades to the Ganges Wastewater Treatment Plant with a membrane thickening process; and
   2) direct staff to include the membrane thickener and tank in the pre-purchase Request for Proposal (RFP) document.

6. **New Business**

   6.1 Combining Salt Spring Island Sewer and Liquid Waste Local Area Service Commissions (Ganges, Maliview and Liquid Waste)

7. **Outstanding Business**

8. **Adjournment**

To ensure quorum, advise Tracey Shaver 250 537 4448 if you cannot attend.

EXEC-1295039085-1293

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Minutes of the Regular Meeting of the Ganges Sewer Local Service Commission Held December 12, 2016 at the Portlock Park Meeting Room, 145 Vesuvius Bay Road, Salt Spring Island, BC

DRAFT

PRESENT: **Director:** Wayne McIntyre
Commission Members: Gary Utter, David Toynbee, Mike de Carle, Rod Scotvold (participated via telephone)
Staff: Karla Campbell, Senior Manager SSI Electoral Area; Keith Wahlstrom, Manager, Engineering SSI Electoral Area; Dan Robson, Manager, Saanich Peninsula and Gulf Islands Operations; Dale Puskas, Engineer 5 - Core Area, SPWWC, Small Sewer Systems; Malcolm Cowley, Manager, Regional Wastewater, Core Area, SPWWC, Small Sewers; Tracey Shaver, Recording Secretary

Chair Utter called the meeting to order at 1:05 pm.

1. Approval of Agenda

MOVED by Director McIntyre, **SECONDED** by Commissioner Toynbee,
That the Ganges Sewer Local Service Commission meeting agenda for December 12 , 2016 be approved and amended by adding in a new delegation under item 3.0.

CARRIED

2. Approval of Minutes – September 19, 2016

MOVED by Commissioner de Carle**, SECONDED** by Commissioner Toynbee**,**
That the Ganges Sewer Local Service Commission meeting minutes of September 19, 2016 be approved as submitted.

CARRIED

3. Delegations/Presentations

3.0 Ian Peace- Ganges Wastewater Renewal Project
Mr. Peace requested that the Commission consider broadening the scope of the Ganges Wastewater Infrastructure Renewal Project to include the following two concepts:

- Processing the outflow water to drinking water standards (new source of water)
- Expand the capacity if the sewer for additional connections (additional intake and output)

3.1 Amec Foster Wheeler-Ganges Wastewater Infrastructure Renewal Project
Sunny Mangat and Troy Dassos presented a comprehensive overview of the project process to date and the background information used to determine recommendations on the style of treatment facility and procurement methods best suited to the Ganges sewer project.

4. Chair and Director Reports

4.1 Chair report
No report

4.2 Director report

Director McIntyre briefly reported on the following:
- Waiting to hear from the Ministry regarding a referendum on Incorporation.
- CRD Board is meeting is this week, creating committee structures and reviewing service plans.

5. Reports

5.1 Ganges Wastewater Infrastructure Renewal Project – Progress Report Update

General discussion on the merits of the various treatment processes regarding suitability, operational costs and environmental needs.

MOVED by Commissioner Toynbee, **SECONDED** by Commissioner de Carle,
That the Ganges Sewer Local Services Commission:
1) direct staff to proceed with upgrades to the Ganges Wastewater Treatment Plant with a membrane bioreactor (MBR) process;
2) direct staff to proceed with the sludge handling options analysis based on the sludge produced from a MBR treatment process and present the options to the Commission for their consideration; and
3) recommend to the Electoral Area Services Committee to recommend to the CRD Board that staff be authorized to issue a Request for Proposal (RFP) to pre-purchase major equipment for Ganges WWTP upgrades and issue an Invitation to Tender (ITT) for the installation of equipment and associated works when the design is completed.

CARRIED

5.2 Ganges Wastewater Treatment Plant-Emergency Standby Generator Replacement

General discussion on need to replace the 35 yr old standby generator.

MOVED by Commissioner Toynbee, **SECONDED** by Commissioner de Carle,
That the Ganges Sewer Local Services Commission:
1) direct staff to proceed with preparing specifications and tender documents for the replacement of the emergency standby generator and automatic transfer switch at the Ganges Wastewater Treatment Plant;
2) authorize staff to issue a tender for the replacement generator when the tender documents are complete; and
3) approve up to $165,000 from the Ganges Sewer Capital Reserve Fund to replace the standby generator and automatic transfer switch.

CARRIED

6. New Business
No new business

7. Outstanding Business

7.1 Comparison of Ganges Sewer Rates in 2015 and 2016
General discussion on the history of the sewer plant and reasoning behind the rate structure.

Commissioners Toynbee and Utter to establish a subcommittee to review rate structure and provide an informational brief for rate payers. Subcommittee will also consider the potential of restructuring the rates to bring them more in line with current conditions.

8. Adjournment

MOVED by Commissioner de Carle, **SECONDED** by Commissioner Toynbee,
That the meeting be adjourned at 3:15 pm.

CARRIED

____
CHAIR

____
SENIOR MANAGER

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REPORT TO GANGES SEWER LOCAL SERVICE COMMISSION
MEETING OF THURSDAY, MARCH 9, 2017

Item 5.1

SUBJECT **GANGES WASTEWATER INFRASTRUCTURE RENEWAL PROJECT – SOLIDS HANDLING OPTIONS ANALYSIS**

ISSUE

To seek approval from the Ganges Sewer Commission (Commission) on the solids handling process for the Ganges Wastewater Treatment Plant (WWTP).

BACKGROUND

At the December 12, 2016 Commission meeting, the following motion was carried:

That the Ganges Sewer Local Services Commission:

1) *direct staff to proceed with upgrades to the Ganges Wastewater Treatment Plant with a membrane bioreactor (MBR) process;*
2) *direct staff to proceed with the sludge handling options analysis based on the sludge produced from a MBR treatment process and present the options to the Commission for their consideration; and*
3) *recommend to the Electoral Area Services Committee to recommend to the CRD Board that staff be authorized to issue a Request for Proposal (RFP) to pre-purchase major equipment for Ganges WWTP upgrades and issue an Invitation to Tender (ITT) for the installation of equipment and associated works when the design is completed.*

Since that time, the consultant, Amec Foster Wheeler (Amec), has completed their analysis on the solids handling options for Ganges WWTP. A draft copy of Amec's report is attached (**Attachment 1**) and Amec will be presenting the findings of their work at the March 9, 2017 Commission meeting.

Based on the initial work completed by Amec, it has been confirmed the solids handling process can be optimized to increase the solids content, make the system easier to maintain, and reduce operating costs. Amec considered four technologies in their analysis each with varying degrees of solids content as follows:

1. Membrane Thickening (capable of increasing solids content to at least 4%)
2. Rotary Drum Thickener (capable of increasing solids content to 7%)
3. Centrifuge (capable of increasing solids content to 17%); and
4. Filter Press (capable of increasing solids content to 28%, but requires pre-thickening to at least 3% before solids can be pressed)

Amec's report provides the advantages, disadvantages and full lifecycle cost analysis of each option. The primary advantage of increasing the solids content is that it will reduce the number of trucks to haul and dispose of the solids. However, once the solids content exceeds much above 7% they also become more difficult to manage and keep aerobic which increases the odour generation potential.

Therefore, options 2, 3, and 4 will require sophisticated odour control equipment to mitigate the odour risk and that equipment will need to be housed in a building which increases their capital and operating costs. In addition, even though higher solids content may theoretically require less trucks, in reality, trucks may be sent out more frequently anyway (only partially full) to minimize the potential for anaerobic conditions and odour problems at Ganges.

It should also be noted that once the solids content exceeds 7% it cannot be disposed at the Burgoyne Septage Facility, because it will plug up that equipment. Therefore, it would have to be hauled in a sealed bin directly to Hartland. The unit rate cost to haul and dispose solids at Hartland is approximately $229/m^3 versus $109/m^3 at Burgoyne. As a result, the most optimal solids handling solution for Ganges is one where solids content can be increased to a point where capital and operating costs can be minimized but the solids can still be disposed at Burgoyne. As noted in Amec's report the option with the lowest lifecycle cost is membrane thickening, but it is proposed that the process be automated to maximize solids content and minimize operation and maintenance.

Therefore, as noted in Alternative 1 below, staff are seeking direction from the Commission on confirming the solids handling process and to include some of this equipment in the pre-purchase contract that was previously approved by the Commission. The major equipment to be pre-purchased includes: the influent fine screen, MBR system (including cassettes, permeate pumps and cleaning tank), and sludge membrane thickener and tank all at an estimated cost of $1,040,000 including 30% contingency. The subsequent installation tender is estimated to be within the total remaining budget for this project. Contingency allowances are for unforeseen conditions such as market conditions, the Canadian dollar exchange rate, final selection variations, etc.

ALTERNATIVES

Alternative 1

That the Ganges Sewer Local Services Commission:

1) direct staff to proceed with solids handling upgrades to the Ganges Wastewater Treatment Plant with a membrane thickening process; and
2) direct staff to include the membrane thickener and tank in the pre-purchase Request for Proposal (RFP) document.

Alternative 2

That the Ganges Sewer Local Service Commission request additional information to be provided at a subsequent meeting.

IMPLICATIONS

Alternative 1 – Proceeding with the membrane thickening process and pre-purchasing that equipment will enable Amec to complete the detailed design of the entire Ganges WWTP upgrades and allow the equipment to be manufactured and delivered to the site in a timely manner. Pre-purchasing of the major equipment by the CRD also avoids paying mark-up costs to a general contractor (if the contactor were to order the equipment). Knowing the exact specifications of the pre-purchased equipment also enables the consultant to complete his design with more certainty and less potential for changes during construction.

However, pre-purchasing equipment does require more staff effort to administer the pre-purchase contract and there is some risk in contract interface between the supplier and the general contractor, but that risk can be mitigated by utilizing good contract language. The benefits of saving time, saving mark-up costs, and having design certainty outweigh the slight risk associated with pre-purchasing the equipment.

Once the equipment proposals are evaluated and a recommended supplier is identified a staff report will be brought back to the Commission and CRD Board for approval to award the contract.

Alternative 2 – Staff can provide additional information at a subsequent meeting, but this will delay the advancement of the project, extend the overall project timeline and potentially increase the overall cost.

CONCLUSION

Many components of the Ganges wastewater system, including the solids handling equipment, have reached the end of their service life and are in need of renewal to avoid system failures and to minimize operational costs. The total cost of the renewal project, as approved by the electors in a referendum, is $3,900,000. The solids handling upgrades as proposed in this report is in accordance with the approved project plan.

RECOMMENDATION(S)

That the Ganges Sewer Local Services Commission:

1) direct staff to proceed with solids handling upgrades to the Ganges Wastewater Treatment Plant with a membrane thickening process; and
2) direct staff to include the membrane thickener and tank in the pre-purchase Request for Proposal (RFP) document.

Submitted by:	Malcolm Cowley, P.Eng., Manager, Wastewater Engineering & Planning
Concurrence:	Karla Campbell, Senior Manager, Salt Spring Island Administration
Concurrence:	Ian Jesney, P.Eng., Senior Manager, Infrastructure Engineering
Concurrence:	Ted Robbins, BSc, C.Tech., General Manager, Integrated Water Services

MC:ls

Attachments: Biosolids Management Options Analysis Report- March 3, 2017

Ganges Wastewater Infrastructure Renewal Project

Capital Regional District

BIOSOLIDS MANAGEMENT OPTIONS ANALYSIS REPORT

To:	Capital Regional District 479 Island Highway | Victoria, BC V9B 1H7
Date	March 3, 2017
From:	Amec Foster Wheeler Environment & Infrastructure A division of Amec Foster Wheeler Americas Limited

AMEC is now Amec Foster Wheeler

Amec Foster Wheeler (www.amecfw.com) designs, delivers and maintains strategic and complex assets for its customers across the global energy and related sectors. With 2013 annual revenues of over CAD$9.7 billion and over 40,000 employees in more than 50 countries, Amec Foster Wheeler operates across the whole of the oil and gas industry – from production through to refining, processing and distribution of derivative products – and in the mining, clean energy, power generation, pharmaceuticals, environment and infrastructure markets.

Amec Foster Wheeler Environment & Infrastructure is a leading environment and infrastructure, engineering, consulting and project management organization with more than 240 offices and over 8,200 employees worldwide. Our team of professionals provides a full range of services to clients in a wide range of sectors including government, industrial & commercial, water, transportation, minerals & metals, oil & gas clients and clean energy. Environment and Infrastructure's core competencies are in environmental assessments, health and environmental risk assessment, environmental geology (site investigation), remediation engineering, geotechnical engineering and testing, and water resource services.

We employ permanent staff in each region of Canada. Amec Foster Wheeler staff includes hydrogeologists, environmental, geological, civil, and geotechnical engineers, environmental scientists, and technician/technologist support personnel. Our specialists have provided consulting services to public and private sector clients in Canada since 1907. Each of our regional teams is supported by local offices and national Professional Practice Networks.

This proposal is submitted in confidence, solely for the Client's use in considering the use of Amec Foster Wheeler's services. It is understood that Client's receipt of this proposal constitutes agreement that its distribution shall be limited and controlled according to the same standards observed by Client in protecting its own confidential information. All copies of this proposal that are not retained in Client's confidential business records shall be destroyed upon the completion of review. No part of this document shall be divulged to Amec Foster Wheeler's competitors or any third parties without Amec Foster Wheeler's prior knowledge and written consent.

March 3, 2017

Capital Regional District

479 Island Highway

Victoria, BC V9B 1H7

ATTENTION: **Mr. Malcolm Cowley, P.Eng.**

REFERENCE: **Capital Regional District**
VT160009 - Ganges Wastewater Infrastructure Renewal Project – Biosolids Management Options Analysis Report

Dear Mr. Cowley,

Amec Foster Wheeler Environment & Infrastructure, a division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), is pleased to provide the Biosolids Management Options Analysis report related to the Ganges WWTP Infrastructure Renewal project.

This report has been prepared for the exclusive use of Capital Regional District. This report is based on, and limited by, the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. It has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.

Please feel free to contact Sunny Mangat at (604) 295-8902 for additional clarifications, if any required.

Respectfully submitted,

Amec Foster Wheeler Environment & Infrastructure

a division of Amec Foster Wheeler Americas Limited

Sunny Mangat, P.Eng.

Project Manager, Community Infrastructure Western Canada

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Distribution List

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	Yes	Capital Regional District

REVISION LOG

Revision #	Revised By	Date	Issue / Revision Description
1	SM	9/02/2016	Draft
2	SM	20/02/2017	Draft

AMEC FOSTER WHEELER SIGNATURES

Report Prepared By:

Author Name, Designation Title   Stamp

Report Reviewed By:

Reviewer Name, Designation Title   Stamp

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1.0 Introduction

The purpose of this report is to provide an analysis of biosolids processing options for the Ganges Wastewater Treatment Plant (WWTP). This report includes the background information related to historical biosolids handling and disposal practices for the Ganges WWTP, past studies on biosolids management analyses for the plant, design basis for the biosolids processing option analysis and estimated capital, Operating and Maintenance (O& M), and life cycle cost analysis.

1.1 Background

As illustrated in Figure 1, the Ganges WWTP currently generates two solid waste streams: 1) screenings; and 2) waste biosolids.

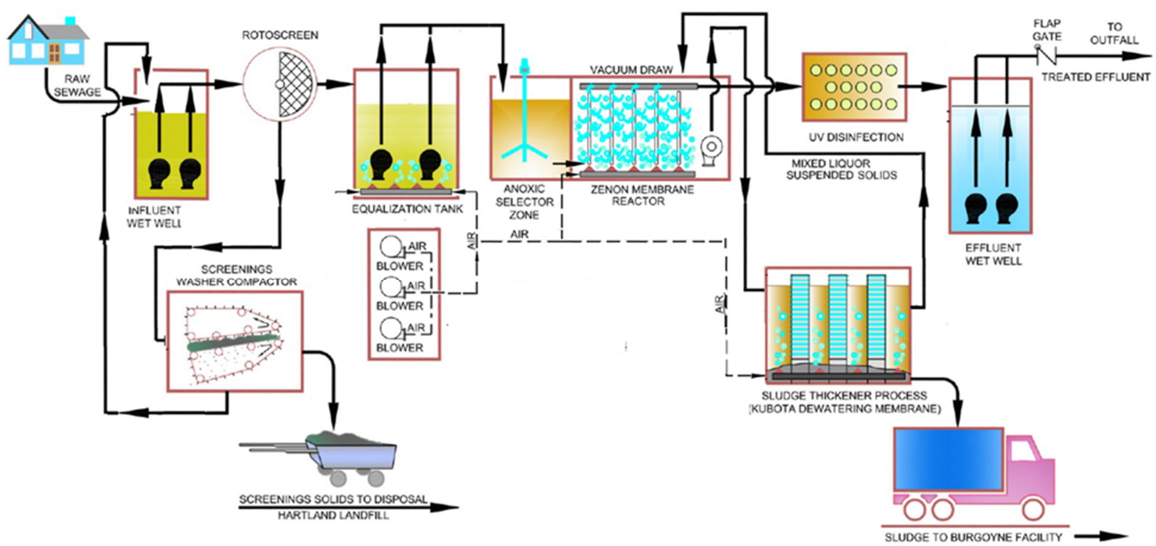

Figure 1-1 Existing Ganges WWTP Process Flow Diagram (Courtesy CRD)

Incoming wastewater is first passed through a 3 mm screen before being discharged into an aerated flow equalization basin, and the screened debris is collected in a trash bin and hauled by truck to the Burgoyne Septage Facility to be combined with screenings collected from that facility and the Maliview Estates wastewater treatment plant, and screenings are then transported to Hartland Landfill for disposal.

Mixed liquor from the bottom of the aerated membrane bioreactor (MBR) tank is pumped to the Kubota flat-sheet membrane sludge thickener, where the 8,000 to 10,000 mg/L mixed-liquor suspended solids (MLSS) concentration is increased to about 25,000 to 30,000 mg/L (2.5 to 3 percent solids content), and the thickened waste biosolids are then transferred to a tanker truck and hauled to the Burgoyne Bay septage receiving facility for disposal. The filtrate from the Kubota sludge thickener flows by gravity through a drain line back to the MBR for treatment.

The existing sludge thickening and processing system has experienced a number of operational problems including:

- the sludge thickener tank was retrofitted from an old fuel tank and the Kubota membranes were placed inside without any access to operate and maintain the membrane and aeration system;
- the aeration grid within the thickener tank is unable to distribute the air uniformly across the flat sheet membranes to prevent them from fouling;
- it is difficult to remove the thickened waste biosolids from the thickener tank, particularly if the solids content reaches 4 percent;
- the thickener requires manual operation and is a gravity driven operation;
- lack of provisions for back-pulsing the Kubota membranes and effective cleaning of the membranes and the whole system which reduces its efficiency and life expectancy; and
- the thickener mechanical equipment has reached the end of its design life.

Therefore, the existing system requires upgrading or replacement.

2.0 Screenings and Waste Biosolids Operational Data - Existing Components & Capacities

2.1 Screenings

Screenings are comprised of wastewater solids that are greater than 3 mm in size that are collected from the fine screen located just downstream of the influent pump station. The screenings go through a washer/compactor and are then collected in a bin and hauled to Burgoyne Bay Septage Facility approximately once every two months. The estimated weight of screenings is about 1 tonne per bin load so the annual weight of screenings is approximately six (6) metric tonnes.

Wastewater screening is extremely important for membrane bioreactors, in particular hollow-fibre ultrafiltration membrane processes, as material that is not screened can become entangled in the membranes, interfering with filtration and damaging the membranes. As a consequence, most MBR wastewater treatment processes incorporate 2 mm or even 1 mm screens to protect the membranes. The quantity of screenings material removed from the waste stream varies significantly depending size of screen opening. Coarse screenings typically consist of rags, sticks, leaves, food particles, bones, plastics and stones. Smaller screen openings (6 mm and under) can also remove cigarette butts, fecal matter and other organic matter. However, reducing the screening mesh size from 3 mm to 2 mm is expected to increase the total amount of annual screenings from 3 to 5 percent, depending on the prevalence of garburators within the collection system.

2.2 Sludge

Biological wastewater treatment involves growing bacterial on the biodegradable waste materials contained in the wastewater. The treatment process can only function properly with a maximum concentration of bacteria; consequently, to maintain an optimal bacteria population in the treatment process it is necessary to routinely remove and disposal of excess bacteria – referred to as waste biosolids or sludge. MBR processes are designed to retain all of the bacteria within the mixed liquor, so removal of excess bacteria involves pumping a known quantity of mixed liquor to the sludge thickener to remove excess water and reduce the volume for disposal. At the Ganges WWTP, the mixed liquor is pumped to the Kubota flat-sheet membrane tank to be thickened prior to being hauled to the Burgoyne Bay Septage Facility for disposal.

The Kubota flat-sheet membranes are characteristically resistant to fouling as a result of their layered structure and the use of an air scour system, and can thicken the 0.8 to 1 percent mixed liquor solids content to about 2 to 3% solids – reducing the volume for disposal by up to 75 percent.

The existing Kubota thickener does not have a permeate pump system in place, and liquid is drawn through the membrane using only a hydrostatic head and gravity. The thickener tank is filled to a preset level with mixed liquor from the MBR. Two days before the truck arrives to haul the thickened biosolids to the Burgoyne Bay septage facility for disposal, the permeate discharge valve at the downstream end of the Kubota membrane is opened and liquid is allowed to filter through the membrane. The filtered water is then discharged back to the west tank upstream of the MBR wastewater train. The biosolids retained in the tank are pumped into a septage hauling truck approximately every two days. The Ganges WWTP operators can increase the solids content of the thickened sludge to more than 3 percent solids, but have found that increasing the solids content beyond this makes it difficult to extract the thickened sludge due to the configuration of the old fuel tank. In addition, the aeration scour system is reported to not be working properly, and is a limiting factor in achieving optimal system performance. A better engineered system can potentially provide a higher thickened solids concentration which can be more easily extracted from the tank into a septage truck.

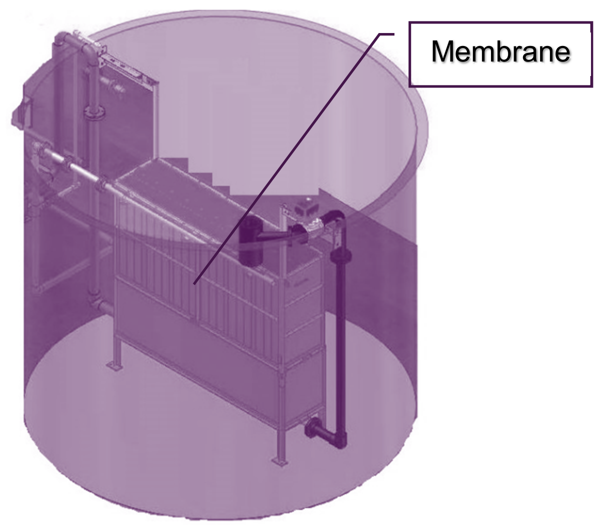

Figure 2-1 Diagrammatic Depiction of Membrane Thickener

Incorporating a permeate pumping system, improving the effectiveness of the air scour system, and incorporating an automated control system is expected to increase process reliability and achieve improved thickening performance.

A review of the historical influent flows and influent BOD and TSS concentrations indicates the average dry weather flow (ADWF) and average annual flows are very similar and have not changed over the period of 2014 – 2016, with the ADWF of about 450 m^3/d, and average BOD and TSS concentration of 350 mg/L. Taking into consideration the high MLSS and SRT associated with operating a MBR process, the estimated waste biomass generated is estimated to be approximately 93 kg/d or 34,000 kg/yr.

Table 2-1 summarizes the volume of waste biosolids received at the Burgoyne Bay septage facility from Ganges WWTP over the past three years, and the estimated percent solids content on the thickened waste biomass. The estimated solids content for 2014 is based on information provided by operations staff that until 2015, the Kubota thickener has been only able to thicken the waste biosolids to 2 percent solids content. The mass of waste biosolids generated in 2014 was estimated using the volume of waste biosolids received at the Burgoyne Bay septage facility and the assumed 2 percent (20,000 mg/L) thickened solids concentration. As the amount of waste biosolids produced is proportional to the BOD mass loading to the plant, which has not changed significantly in the past 10 years, the amount of waste biomass for 2015 and 2016 is assumed to be the same as for 2014. Consequently, the estimated solids content for 2015 and 2016 is calculated using the constant waste biomass and the reported volume of waste biomass received at Burgoyne Bay.

Table 2-1 Ganges WWTP Volumes and Estimated Percent Solids Generated from 2014 to 2016

Year	Total Flow Treated at Ganges WWTP		Volume of Biosolids Received at Burgoyne		Waste Biosolids	Estimated Solids Content
	(m^3)	(Igal)	(m^3)	(Igal)	(kg/year)	(%)
2014	163,544	35,974,630	1,805	397,045	34,000 (1)	2.0%
2015	156,873	34,507,220	1,159	254,944	34,000 (2)	2.9% (3)
2016	160,928	35,399,190	1,083	238,227	34,000 (2)	3.0% (3)

(1) Annual mass of waste biosolids noted for 2014 is based on the volume of thickened waste biosolids received at Burgoyne Bay in 2014 and an assumed 2 percent solids content.

(2) No change in ADWF or BOD and TSS loading loading for the past ten years, consequently the annual amount of waste biomass generated is expected to be constant.

(3) *Estimated solids content based on the constant amount of waste biosolids generated annually and the volume of biosolids received at Burgoyne Bay for the years indicated (i.e. 2015 and 2016).*

Table 2-2 summarizes the discharge fees for waste biosolids disposed of at Burgoyne Bay for the years 2012 through 2016. Again, using the assumption of a constant contributing population, organic loading and waste biosolids generation of 34 tonnes/yr, the volume of waste biosolids discharged at Burgoyne Bay is estimated using the discharge fees. The discharge fee from 2012 to 2014 was $83.60/m^3, $85.80/m^3 in 2015 and $90.20/m^3 in 2016. Assuming a truck capacity of 7.5 m^3/truck, the number of truckloads is estimated by dividing the annual discharge volume by the truck capacity. The cost per trip is estimated by dividing the annual truck hauling costs by the number of return truckload events. The representative values for use in this study are based on an average of the results for 2015 and 2016, both reflecting the outcome of optimizing the Kubota waste biosolids thickener performance to achieve a 3 percent solids content.

Table 2-2 Burgoyne Bay Biosolids Disposal Costs

Year	Burgoyne Bay Processing*						
	Discharge Fees	Dry Mass (1) (tonnes)	**Volume (2) (m^3)**	% Solids	Truckloads	Hauling Cost	Hauling Cost/Trip
2012	$138,972	34	1,662	2	216	$30,000	139
2013	$135,404	34	1,620	2	216	$29,200	135
2014	$150,933	34	1,805	2	241	$31,307	130
2015	$99,412	34	1,159	3 (3)	159	$23,902	150
2016	$97,688	34	1,083	3 (3)	156	$22,300	143
AVG (4)	**$ 98,550**	**34**	**1,121**	**3**	**158**	**$23,100**	**$147**

(1) Constant waste biomass of 34,000 kg/yr, as flows and BOD & TSS loading haven't changed during the period shown in the table.

(2) Volume estimated assuming discharge fee charged at Burgoyne Bay, based on Burgyone Bay Septage Disposal Facility Fee in Bylaw 4069 - Sewage treatment plant sludge.

(3) Ganges operations optimized Kuboda Thickener in 2015 resulting in an increase in solids content and a reduction in volume transported, number of truckloads, and discharge fees at Burgoyne Bay.

(4) Average based on 2015 and 2016 values reflecting the expectation that the most current operating conditions will prevail, including continuing to thicken to 3 percent solids content.

Hauling practice changes were implemented in February 2015 by plant operators resulting in increasing the percent solids from about 2 percent to 3 percent solids. Previously, four loads were being discharged from the WWTP to Burgoyne Bay. To fill the fourth load MBR contents were being filled to fill the load from 3.5 to 4 full loads. In 2015, this practice was stopped and 3 loads were extracted and disposed instead of four. This change in hauling practice is responsible for the reduction in disposal and trucking costs noted in Table 2-2 for 2015 and 2016, indicates operations efforts were successful.

Under the current solids handling process, the costs to haul and dispose screenings and waste biosolids for the last three years are summarized in Table 2-3.

Table 2-3 Ganges WWTP solids disposal cost from 2014 to 2016

Year	Sludge Disposal Cost	Sludge Transport Cost	Screening Disposal Cost
2014	$150,933	$31,307	$646
2015	$99,412	$23,902	$1,255
2016	$97,688	$22,300	$410

Although not a significant cost component, there is a wide variation in annual screenings disposal cost between the three years shown in Table 2-2. Although the reason for this variation isn't apparent from a review of operating conditions during this period, the screenings from Ganges were not weighed and it is speculated the cost variation may be due to accounting procedures rather than changes in the process, operating conditions, or the quantity of screenings collected. CRD Operations intends to monitor the screening volumes more closely in the future.

Table 2-4 illustrates a breakdown of anticipated biosolids disposal costs at Hartland landfill. Assuming a 30 ft truck with a 10 tonne capacity bin, the tipping cost at Hartland for a 10 tonne load is $121 per tonne, with a return ferry fare of $140 and a 7-hour round trip based on current ferry schedules, resulting in a cost per trip of $2,295.

Table 2-4 Estimated Hartland Biosolids Disposal Costs Per Tonne

Hartland Disposal[1]			
Tipping Fee (1)	Return Ferry Charge (2)	Trucking Cost (3)	Hauling Cost per Trip (4)
$1,210	$140	$945	$2,295

(1) Hartland Landfill Tipping Fee of $121 is based on Bylaw 3881, and assumes a full bin weighing 10 tonnes. Waste biosolids with 7 to 30 percent solids content will have to be transported to Hartland Landfill for disposal.

(2) Return BC Ferries Fare based on a commercial rate of $3.85/ft + 2.9% Fuel Rebate, and assuming a 30 ft truck with a 10-tonne bin, plus $12.60 for driver.

(3) Trucking cost = assume 7-hour round trip (Travel time to ferry terminal and wait - 9 am to Ferry – 9:50 am Ferry – Return on 1:00 pm Ferry – 1:35 pm arrival – 2:00 Return – Time for drop at Hartland and travel time back to yard). Truck will need to be sealed with a cover to prevent odours. Note the timing will be greater than 7 hours in the event that the truck is unable to make it back to the ferry terminal in time for the return ferry.

(4) Sum of Tipping Fee + Ferry Charge + Trucking Cost

3.0 Design Criteria

3.1 Solids Loading

The scope of work is based on the assumption there will be no increase in the current permitted capacity of the WWTP (1,090 m^3/day). All following analysis in this report are based on the current loading conditions and the current permitted capacity of the WWTP.

3.2 Disposal Constraints

A maximum of 7% solids can be discharged at the Burgoyne Bay Septage Facility because it is still liquid enough that it will not plug up the septage equipment. Therefore, sludge above 7% solids concentration will require to be disposed at the Hartland Landfill site facility utilizing special equipment/bins to transport the solids to Hartland.

3.3 Holding Tank Size

Except for membrane thickener process, a holding tank is required to allow operators to routinely waste mixed liquor from the bioreactor to maintain the target sludge age, and then thicken or dewater the pre-process waste mixed liquor in a batch.

Table 3-1 illustrates the annual volume of 1% solids mixed liquor to be wasted (3,400 m^3/yr), as well as the weekly volume based on a 5-day operations work week. Where a thickener or dewater device is available to achieve the indicated solids content (ranging from 1% to 28%) Table 3-1 also indicates the adjusted weekly volume for disposal and the number of corresponding truckloads each week based on a transporting 7.5 m^3 and 10 m^3 per truckload for Burgoyne and Hartland respectively.

Table 3-1 Biosolids Volume Estimates for 1 to 28% Solids Content

	Waste Biomass Dry Mass (Tonne/yr)	Burgoyne Disposal								Hartland Disposal			
		1% Solids		3% Solids		4% Solids		7% Solids		17% Solids		28% Solids	
		Annual m^3 Volume	m^3/5 d Volume	Annual m^3 Volume	m^3/5 d Volume	Annual m^3 Volume	m^3/5d Volume	Annual m^3 Volume	m^3/5d Volume	Annual m^3 Volume	m^3/5d Volume	Annual m^3 Volume	m^3/5d Volume
Value	34	3400	65	1133	22	850	16	485	9	200	4	121	2
Truckloads	-	453	9	151	3	113	2	65	1	20	1[i]	12	1[i]

[i] Although 1 truckload could be hauled every 2 to 4 weeks, the number of truckloads would be set to once per week to minimize the potential for odour generation.

At 1% solids, the required holding tank volume is 65 m^3 for 5 days. Therefore, this would be the minimum pre-processed biosolids storage requirements.

3.4 Truck Size/Connections

The processed storage requirements as it relates to biosolids percent solids has been listed in Table 3.1. For the membrane thickening Option the processed solids will be extracted out of the tank with vacuum truck directly. Provisions will be provided in the tank to allow for extraction from different zones to avoid the sludge bridging issue. For all other Options, dedicated storage will be provided either in the form of fixed or roll off bin. For the fixed bin Option, progressive cavity type pumps will be installed with a minimum 100 mm diameter discharge pipe to allow filling of the hauling truck.

Hauling up to 7% solids to Burgoyne can be performed by septage trucks. Hauling solids greater than 7% to Hartland will require a truck that can pick up a roll-off bin. The bin will have to be watertight and air tight to prevent loss of liquid or the release of odours.

3.5 Odour Control

Odour control provisions will be required for all biosolids processing Options except for the existing membrane thickener Option. Higher solids concentrations may generate odors as a result of developing anaerobic conditions, particularly for high solids dewatering options that require extensive pre-processing storage volumes. Other options to control odour include odor masking, aerated liquid layer and continuous aeration as is provided for the existing membrane thickening process.

The odour control system requirement for the solids processing at Ganges would vary between different Options due to higher solids concentration and longer storage times which would likely create anaerobic conditions. The more intensive odours that are created will require more extensive odour control systems for mitigation.

4.0 Solids Processing Options

The quantity of screenings and grit collected (about 115 kg/wk), and the associated costs for transport and disposal at the Hartland Landfill, is not expected to change significantly as a result of the proposed upgrades to the Ganges WWTP. Minor increase in screening from change of 3 mm to 2 mm mesh size has been documented earlier in this report. Further evaluation of the screening and grit removal system is beyond the scope of this project.

Various options for biosolids handling have been presented in the following text.

4.1 Description of Process

4.1.1 Review of Thickening & Dewatering Technologies

The purpose of thickening and dewatering technologies is to remove excess water from waste biosolids. Often thickening technologies are used as a preliminary treatment method prior to dewatering, but may be sufficient in situations where only modest amounts of water removal are required or can be accommodated, such as at the Burgoyne Bay septage facility.

Technologies considered in this technical report include:

1A Membrane Thickening (e.g. Kubota or Toray membrane thickener is capable of increasing MLSS up to 4% solids).

1B Rotary Drum Thickener (e.g. IPEC Rotary Drum is capable of increasing MLSS up to 7% solids);

2A Centrifuge (e.g. Andritz's Centrifuge is capable of increasing MLSS up to 17% solids); and

2B Filter Press (e.g. Faure TitanFilter Press is capable of increasing MLSS up to 28% solids, depending on the type and amount of polymer used – but also requires the biosolids to first be thickened to 3% solids).

Tables 4-1 through 4-4 provide summary descriptions of advantages and disadvantages of the biosolids management options being considered.

Table 4-1 Advantages and Disadvantages of Membrane Thickeners

Advantages	Disadvantages
• Established technology requiring little operator intervention. • Operator familiarity with the process. • Minimal operator attention required (low labour cost) • Can function efficiently at reasonably low temperatures. • Energy requirements lower than for more efficient mechanical thickening or dewatering technologies. • Membrane costs are decreasing rapidly as the technology finds wider adoption. • Does not require special housing or enclosure to control odours	• Membranes are subject to fouling leading to reduced flux rates and membrane failure. • Membranes can be damaged by cross shear forces. • Lower percent solids and therefore higher sludge disposal volumes.

Table 4-2 Advantages and Disadvantages of Rotary Drum Thickeners

Advantages	Disadvantages
• Rotary Drum units are usually compact in size. • Can achieve solids concentrations of up to 7% solids. • System can be supplied as an enclosed unit with a vent stack for containment and treatment of odour and vapour releases. • Has a built-in spray backwashing system, controlled with programmable timers that can be optimized for each application	• Performance depends on upstream WWTP conditions – poor settling sludge will result in poor rotary drum performance • Will require building enclosure • Require odor control system • Chemical addition is generally required. • Continuous supply of water is required to wash the drums

Table 4-3 Advantages and Disadvantages of Centrifuges

Advantages	Disadvantages
• Same machine can be used for both thickening and dewatering • Is very flexible in meeting process requirements • Is not affected by grit • Compared to belt filter press and vacuum filter installations, is clean looking and has less potential for odour generation • Is excellent for dewatering hard-to-handle sludges, although sludge cake solids are only 10-15% for digested primary and WAS • Flexibility in producing different cake solids concentrations because of skimming ability	• Unit is not continuous feed and discharge • Requires special structural support, much more than a solid bowl centrifuge • Has a high ratio of capital cost to capacity • Discharge of wet sludge can occur if there is a machine malfunction or if the sludge is improperly conditioned • Provision should be made for noise control • Continuous automatic operation requires complex controls • Bowl requires washing once per shift

Table 4-4 Advantages and Disadvantages of Filter Presses

Advantages	Disadvantages
• High solids content cake • Can dewater hard-to-dewater sludges, although very high chemical conditioning dosages or thermal conditioning may be required • Very high solids capture	• Large quantities of inorganic conditioning chemicals are commonly used for filter presses • Polymer alone is generally not used for conditioning due to problems with cake release and blinding of filter media. Experimental work on polymer conditioning is continuing • High capital cost, especially for diaphragm filter presses • Labor cost may be high if sludge is poorly conditioned and if press is not automatic • Replacement of the media is both expensive and time consuming • Noise levels caused by feed pumps can be very high • Requires grinder or prescreening equipment on the feed • Acid washing requirements to remove calcified deposits caused by lime conditioning can be frequent and time consuming • Batch discharge after each cycle requires detailed consideration of ways of receiving and storing cake, or of converting it to a continuous stream for delivery to an incinerator

4.1.2 Waste Biosolids Storage

With the exception of the membrane thickening technology, all of the other technologies will require dedicated separate storage. For membrane thickening, similar to the existing configuration, integrated storage will be provided.

It is assumed that WAS will be pumped on daily basis. For membrane thickening process, biosolids will be discharged to the thickening tank directly and biosolids will be thickened continuously. For other technologies, intermediate storage will be provided until a sufficient quantity of mixed liquor has been accumulated to thicken or dewater it to meet a single truck hauling capacity of 7.5 m^3.

The sludge storage tanks will need to be aerated to prevent odour generation, until a sufficient volume is accumulated to process the solids. A dedicated processed biosolids storage bin, complete with bin cover and odor control provisions, will be required.

For pre-thickening or thickened/dewatered waste biomass storage, it is assumed that the decommissioned RBC tankage and clarifier can be utilized for this purpose. The existing mechanism in the clarifier can be removed and a pump can be installed adjacent to the clarifier with suction piping extending into the clarifier bottom area from the side wall. Biosolids will be pumped over to the new thickening or dewatering process area, assumed to be near the existing membrane solids thickening tank. From preliminary assessment, existing clarifier and RBC tankage have sufficient storage volume to serve this purpose.

4.2 Proposed Layout of Equipment

The footprint requirements accounts for the size of building to house the equipment and all ancillary items associated with each solids processing option including odour control equipment. A building is required for all of the solids processing options except for the membrane sludge thickener system. This is because the equipment for those options including the odour control equipment is required to be protected from the weather. Conversely, because the membrane sludge thickener membrane is enclosed inside a tank, it does not require odour control equipment and a building enclosure.

The approximate footprint requirements for each option has been summarized and presented in Table 4-5.

Table 4-5 Footprint Requirements of Solids Processing Options

Option	Approximate Footprint Area (m^2)
1A – Membrane Thickener(i)	16(i)
1B – Rotary Drum	50(ii)
2A – Centrifuge	75(iii)
2B – Filter Press	100(iv)

(i) No building envisioned for this option. Allows for tank, permeate pump and ancillary equipment
(ii) Allows for building to house equipment including polymer, rotary drum, odour control, pumps, etc.
(iii) Allows for building to house equipment including polymer, centrifuge, odour control, pumps, and a roll-off bin.
(iv) Allows for building to house equipment including thickener, polymer, filter press, odour control, pumps, and a roll-off bin.

5.0 Cost Analysis

5.1 Business Case Analysis

As previously described, an estimated average of 3,400 m^3/yr of waste mixed liquor with 1% solids, representing 34 tonnes of dry solids, is removed from the Ganges WWTP and thickened to 2-3% solids content, and then trucked in 7.5 m^3 batches for disposal at the Burgoyne Bay septage facility. Increasing the solids content from 3% to 7% (the maximum that can be disposed of at Burgoyne Bay), would reduce the estimated current volume for disposal from 1,133 m^3 (151 truckloads per year) to 485 m^3 (65 truckloads per year), while concurrently reducing the disposal costs from $122,200 to $50,000. If the membrane thickening is optimized further this operating cost gap between two analyzed thickening options (1A and 1B) can be further reduced, as depicted in Table 5.1.

In contrast, the Hartland Landfill can accept higher solids content for disposal. Transporting and disposing biosolids with a solids content of higher than 7 percent to the Hartland Landfill at a cost of $121/tonne discharge fee and a transport cost of $1,185/10 m^3 is shown in Table 5-1.

Table 5-1 Technology Alternatives –Biosolids Transport and Disposal Costs

Option No.	Technology	Disposal Site	Vol (m^3/y)	Weight (tonnes)	Number of 10-tonne trucks required per year	Sludge Disposal and Hauling Cost ($/unit)	Total Disposal. Cost ($/y)
1A	Membrane Thickener (4%)	Burgoyne	850	881	-	$109.80/m^3	$93,330
1B	Rotary Drum Thickener (7%)	Burgoyne	485	516	-	$109.80/m^3	$53,260
2A	Centrifuge (17%)	Hartland	200	231	24	$2,295/truck	$55,080
2B	Filter Press (28%)	Hartland	121	151	16	$2,295/truck	$36,720

*Refer to Appendix C for further details

Table 5-2 illustrates the capital costs for the technologies described in Section 4.

Following have been the some of the key cost estimation assumptions:

- Includes building and odor control cost for all except for the membrane Option.
- Includes soft cost of engineering, administration and operations support during construction/commissioning.
- All options where a building is required for odor control and equipment housing, a pre-engineered, metal clad building has been assumed.
- For dewatering and thickening (except membrane thickening), it is assumed that solids storage with aeration or sealed bin would be required.

- It should be noted that a capital cost estimate at this level of design is considered to have an accuracy of minus or minus 20 to 30%. Local conditions, commodity price changes and specific requirements identified during detailed design can significantly affect the final cost. The maintenance costs are based on a 20 year lifecycle which includes annual maintenance as well as equipment replacement for obsolescence and wear.

Table 5-2 Technology Alternatives – Biosolids Management Capital Cost Analysis

Item #	Option	Equipment Supply Cost	Odor Control	Ancilliary System	Building/Slab Cost	Contingency @ 30%	Engineering @ 15%	Administration @ 5%	Operations	Total Cost
1A	MEMBRANE THICKENER	$225,000	$-	$25,000	$10,000	$78,000	$50,700	$16,900	$20,200	$425,800
1B	ROTARY DRUM THICKENER	$230,500	$270,000	$100,000	$270,000	$261,200	$169,800	$56,600	$43,200	$1,401,300
2A	CENTRIFUGE	$568,000	$270,000	$100,000	$405,000	$402,900	$261,900	$87,300	$63,400	$2,158,500
2B	FILTER PRESS	$633,900	$306,000	$100,000	$540,000	$474,000	$308,100	$102,700	$95,100	$2,559,800

*Refer to Appendix C for detailed costing and data utilized for the cost estimation

Based on a truck capacity of 7.5 m^3/d to Burgoyne Bay and 10 m^3/trip to Hartland, the frequency of truck disposal ranges from once every 3 days (Option 1A), to once a month (Option 2B). While the treatment process can tolerate sludge wasting once every three days, biosolids wasting every 18 days would result in wide mixed liquor biosolids variations and concurrent process problems. Ideally, wasting should be done continuously, or on a daily basis and for this assessment it is assumed that the solids wasting will be continuous and same for all studied options. However, the storage requirements of the processed solids on the back end of each technology varies. For instance, either a bin will be installed in a covered area (to manage odors) or dedicated aerated storage for thickened sludge would be required to prevent the potential anaerobic conditions and therefore odour generation.

The existing abandoned RBC clarifier has an approximate volume of 52 m^3, representing only 4 days of storage for 1 percent solids content MLSS. If thickened to 4 % solids, the volume represents just under 12 days of storage. For all Options (except membrane thickening), the existing clarifier modification is used to store processed solids.

Once the solids percentage exceeds much above 7 percent, it becomes difficult to manage and keep aerobic, and should be removed from the site as it is dewatered. Consequently, any plans to dewater the biosolids to a solids concentration suitable to minimize trucking and disposal costs to Hartland will need to address the potential for the dewater biosolids to go anaerobic and generate odours. The time required to dewater the biosolids also has to be taken into consideration. For this assessment work, an aerated biosolids storage tank is envisioned. The existing abandoned clarifier with modifications has been considered as an option. Considering all the above mentioned criteria, capital cost for each Option has been presented in Table 5-2 above.

Operational and maintenance cost associated with each of the analyzed option has been presented in Table 5-3. For cost estimation, the weight takes into consideration the additional mass contributed by the biosolids, which doesn't affect the volume trucked or costs at Burgoyne Bay, but does affect the tipping fee at Hartland, which is based on weight and not volume.

Table 5-3 Technology Options –O & M Costs

No	Technology	Sludge Disposal	Annual Maintenance Cost	Building Operational Cost	Labour Cost	Annual Power Cost	Chemical and Activated Carbon Cost	Total
1A	Membrane Thickener (4%)	$93,330	$5,000	$-	$10,400	$450	$-	$109,180
1B	Rotary Drum Thickener (7%)	$53,260	$15,000	$1,500	$36,400	$2,640	$20,240	$129,040
2A	Centrifuge (17%)	$55,080	$9,000	$1,500	$52,000	$5,300	$21,990	$144,870
2B	Filter Press (28%)	$36,720	$15,000	$2,000	$52,000	$5,840	$21,460	$133,020

*See Appendix C for more details on costing.

Considering the above costs, life cycle cost analysis for a 20 year cycle has been presented in the following Table 5-4 for each studied option.

Table 5-4 Life Cycle Cost Analysis of All Biosolids Management Options

Option No.	Technology	Life Cycle Cost (20 yrs)
1 (A)	Membrane Thickener (4%)	$2,508,500
1 (B)	Rotary Drum Thickener (7%)	$3,422,800
2 (A)	Centrifuge (17%)	$4,428,000
2 (B)	Filter Press (28%)	$4,643,700

*See Appendix C for more details on NPV Analysis

Following are the Life Cycle Cost analysis assumptions:

- Estimate are based on Twenty year duration
- The discount rate used is 5%
- The inflation rate used is 2%

Based on the analysis completed, the life cycle cost for the existing membrane thickening operation is lowest whereas the remaining other Option are comparable. The capital investment for the replacement of the existing membranes is also the lowest cost Option and is recommended for further consideration.

6.0 Proposed Solids Management System Upgrade

The least cost option of the four options analyzed above has been advanced for the preliminary design. Following are the conceptual design consideration that will be pursued further during the detailed design.

- Remove existing tankage and associated components and replace with a new steel tank, similar location as the existing. The new steel tank would be complete with a grating platform at the 11-ft level and full diameter handrailing. Also there will be a sealed access hatch at grade level to access the tank internals if required for maintenance.

- Tank will be complete with a crane system to remove membrane modules to allow for easy maintenance of equipment underneath.

- There will be two flat plate membrane units with integral coarse-bubble aeration bases and slide-out guide rails.

- The base flux rate would be 0.1 $m^3/m^2/d$. The designed maximum week flux rate would be minimum 0.4 $m^3/m^2/d$ with peak flux rate of 0.6 during warmer temperatures. Each membrane unit would be 140 m^2 of membrane surface area. At a 0.1 $m^3/m^2/d$ flux rate, the permeate production will be 14 m^3/d; with both modules in operation, this unit will make about 28 m^3 of permeate per day. Each membrane unit requires 70 scfm of scouring air.

- The unit could operate in a gravity mode (i.e., no permeate pump); if this is preferred. A higher tank would be required for the gravity run system as a minimum of 1-m water depth would be required. We recommend using a permeate pump for better control of the permeate flow and to limit the chances of a higher than recommended flux rate.

- A submersible pump would be installed in the MBR reactor tank. This pump will be controlled by a level switch in the thickener tank. As the level in the thickener goes down, the transfer pump will start and fill the thickener tank up the “stop” level. The thickener runs continuously and as the liquid level draws down, the transfer pump will add more MLSS from the MBR to the thickener.

- The designed thickness would be 4 percent solids concentration. The system can be optimized to provide solids concentration of up to 5 percent.

The process unit, as presented in Figure 6-1, will consist of:

- Fabricated steel tank, approx. 12-ft dia x 12-ft high. It will be designed to sit on a compacted gravel pad. The tank top opening will be fully covered with fiberglass grating and a full diameter handrail will be installed. An access ladder (with cage) would also be installed. Interior coating will be coal-tar epoxy with an industrial epoxy exterior finish

- Two (2), Toray model TRM140-100S membrane modules, each c/w slide-out guide rails to permit the entire membrane assembly to be easily removed; the aeration base would remain in the tank.

- Quick-disconnect permeate piping through the tank wall.

- Individual aeration downcomers, each with separate rotometer-type air-flow meters (note, thermal-mass air-flow meters are optional)

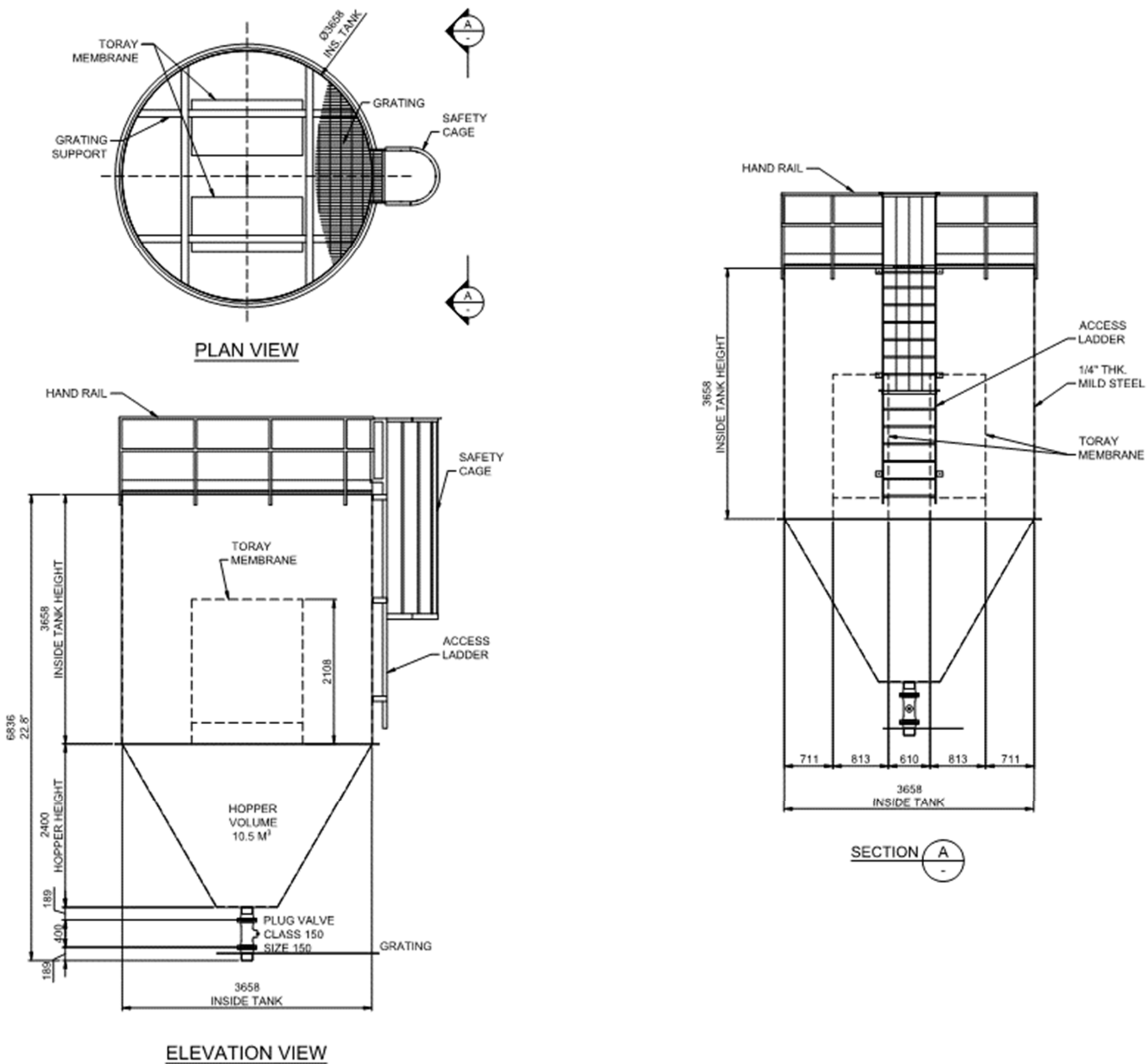

Figure 6-1 Replacement Biosolids Thickening System

- Skid-mounted permeate pump.

- Install a new flowmeter to measure the discharge flow through the permeate pumps and a new turbidity meter to monitor the integrity of the membranes;
- It is also recommended that the membrane thickening equipment noted above be pre-purchased with the main process train membrane system.

7.0 Conclusion and Recommendations

Based on the foregoing, the following is a summary of the recommended improvements:

- Existing sludge processing system has experienced some operational problems and require upgrade or replacement.
- Four Options have been reviewed for new solids processing system at the Ganges WWTP and include two solids dewatering and two thickening Options.
- Based on the business case analysis, it is determined that existing membrane thickening technology is the favorable Option. A complete replacement of the existing system is expected to have the least capital and life cycle cost of the all four studied options therefore it is the recommended Option.
- It is also recommended that the membrane thickener equipment be pre-purchased with the main process train membrane system.

Appendix A: Past Reports

CRD
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REPORT TO GANGES SEWER LOCAL SERVICE COMMISSION
MEETING OF THURSDAY, JANUARY 8, 2015

SUBJECT **SLUDGE DISPOSAL OPTIONS FOR GANGES SEWER PROJECT**

ISSUE

To review alternative options for sludge disposal for the Ganges Sewer Project to determine the lowest cost option from a lifecycle perspective.

BACKGROUND

Currently, the wastewater entering the Ganges Wastewater Treatment Plant (WWTP) is screened to remove organic matter and grit larger than 3mm prior to entering the membrane bioreactor (MBR), which is where the influent is biologically treated. The sludge from the secondary treatment process is directed to the Kubota flat sheet membrane for thickening prior to disposal. The Kubota membranes dewater the sludge to approximate 2-3% solids content. The filtrate from the sludge thickening flows back to the MBR via gravity for further treatment. The current process for the Ganges WWTP is illustrated in Figure 1. The thickened sludge is then hauled to the Burgoyne septage receiving facility for disposal. Annually, the Ganges WWTP disposes of 1,599 m^3 of sludge (351,770 igal, approximately one 1,200 igal truck every 2 days)[1] costing an average of $137,190/year[2] for disposal. Currently, the Burgoyne septage receiving facility charges are $85.788/m^3 ($0.39/igal).

Recently, operations staff have noticed breakthrough of total suspended solids during sludge thickening indicating that the sludge thickening membrane is not functioning as designed and requires replacement.

As is standard practice, a thorough evaluation of the current technologies available and space requirements will be conducted prior to proceeding with detailed design. In addition, a lifecycle cost analysis will be used to determine the most economic and effective process, based upon: operation, maintenance and capital costs.

In 2011, Stantec was retained and produced an Asset Condition Evaluation and Engineering Study report. The report had made the following statement:

"Next to labour cost, the most expensive item is sludge hauling and disposal with an annual cost of $128,000. The flat plate membrane system used for sludge thickening produces sludge with a solids content of 2% to 3%. Any improvement in the efficiency of sludge thickening could have a significant impact on reducing the cost of sludge hauling and disposing. In light of the high cost of sludge thickening, this should only be considered when the plant reaches capacity and is expanded in 2022. If carried out, this would reduce the sludge disposal cost by 50%."

In discussions with Stantec regarding clarification to the above statement, Stantec has reinforced that considerable capital costs would be required to incorporate another sludge

[1] Average of 2012 & 2013 operational information
[2] Average disposal cost at Burgoyne Bay.

thickening technology, and as such, the Burgoyne facility will experience a corresponding reduction in revenue due to the reduced sludge volume.

The Commission has raised concerns that there may be other more cost effective methods for sludge thickening considering the high costs of disposal at Burgoyne and on Stantec's comment in their report. This report will conduct a preliminary lifecycle analysis of two options for sludge disposal.

Current - Membrane Sludge Thickening Capital & Waste Disposal Costs:

To replace the current membrane sludge thickening process a new membrane and a new tank is required. The Class D cost estimate for both is **$500,000**[3].

The current average annual operating costs for sludge hauling and disposal are comprised of the following:

Annual Average Sludge Disposal	$137,190
Budgeted Sludge Hauling[4]	$ 30,000
Total	$167,190

The tipping fee at Burgoyne or negotiated hauling rate is subject to change.

The total operation costs are estimated to be **$167,190**, excluding BC Hydro costs.

Proposed - Fournier Filter Press Thickening Capital & Waste Disposal Costs:

Typically, a pilot study of the proposed process technology is carried out to determine the process efficiency, chemical dosing rate, evaluate overall process performance, and determine order of magnitude operating and maintenance costs. A pilot study is usually a scaled down operation of the proposed process. Since a pilot has not been conducted, the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) operational data for its Fournier Filter Press is used for the basis of comparison. Operational costs are pro-rated based on the volume or weight of sludge produced, the SPWWTP's filter press efficiency for dewatering are assumed to be the same as the sludge produced at Ganges. Past operational experience with GE membrane bioreactor's (MBR), and confirmed through discussions with GE ZENON representatives have indicated that most filter presses require fiber supplicants and/or additional polymer as MBR sludge is typically low in fibre and hard to retain on the filter.

As part of the Fournier filter process a chemical polymer is added to the wastewater sludge, which increases the solids retention on the filter element to avoid solids breakthrough into the effluent. The end products from the sludge are a biosolid, which is discharged into a bin for disposal, and an filtrate which is recycled back into the wastewater stream for UV disinfection prior to discharge via the outfall. The Fournier filter process is illustrated in Figure 2.

[3] 2015 Schedule G for the Ganges Sewer Local Service
[4] 2014 Ganges Sewer Local Service Operating Budget, subject to hauling contract renewal

To accommodate a Fournier Filter Press at Ganges, infrastructure is required for the following facilities and equipment:

- Building an enclosure for the filter press, disposal bin and chemical dosing room,
- Odour control, for the purposes of this evaluation a carbon filter with grease filter will be assumed to be sufficient, and
- Chemical polymer dosing pump, mechanical piping, mixer, etc.

A building is required for the new mechanical equipment, chemical storage, odour containment and treatment, and dry storage of biosolids. It is advantageous to construct a single building to house the entire process as it will simplify odour control and satisfy all the above requirements. We received the enclosure option presented by Waste 'n Watertech, but it does not address odour control for the biosolids, does not house the biosolid bin(s) to ensure rainwater does not re-wet the biosolids and does not house the separate polymer chemical room. For these reasons a building was chosen to house the Fournier Filter Press and associated equipment.

The estimated capital cost (Class D) of this option is $1,420,000. The breakdown of the estimated capital costs is in Appendix A. The cost of electricity has not been included and is not required for this type of evaluation, but will be more than the current sludge thickening process.

To determine the operational costs for a filter press, the following annual costs are required:

- Sludge volume & weight,
- Polymer requirement,
- Carbon requirement,
- Tipping fee at Hartland Landfill,
- Hauling of cake, and
- Additional operations and maintenance for additional equipment.

The methodology for determining the costs and the operational cost estimate are in Appendix B. The Class D estimate for the Sludge Filter Press is **$220,000**, excluding BC Hydro costs. A summary breakdown comprises of the following:

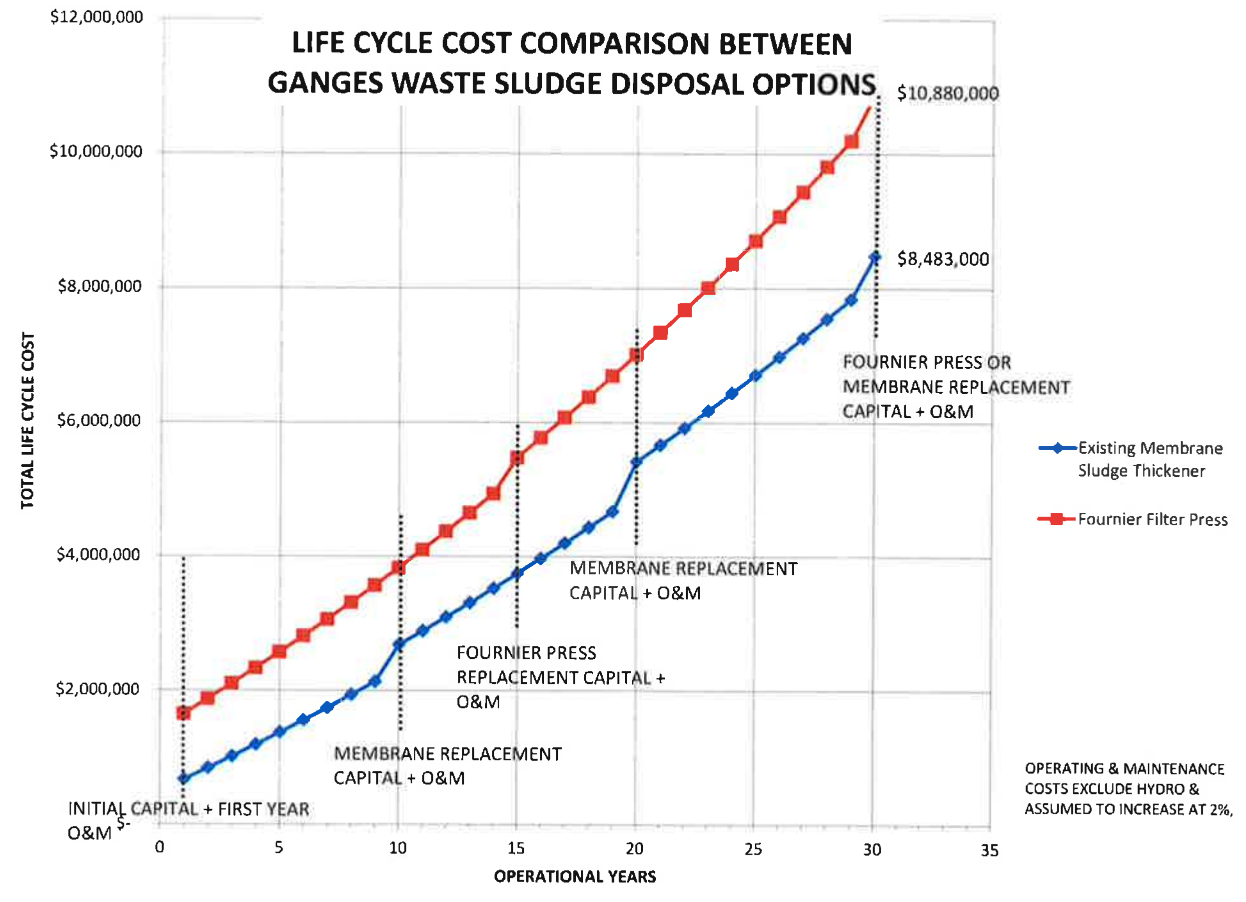
Annual Average Sludge Disposal	$79,000
Annual Average Sludge Hauling	$78,000
Production Costs	$63,000
Total	$220,000

In addition to the costs associated with the addition of a Fournier Filter Press, the location of the Fournier Filter Press building may be difficult to site. The zoning has not been investigated, but conceptual massing of the most likely location is in Figure 3. Issues with the location are its proximity to the influent pump station and ensuring truck access to the screen and MBR.

15 Year Lifecycle Cost Comparison

To properly compare the two options, the total lifecycle cost of each technology is considered for the Fournier Filter Press, which has the longer life expectancy of 15 years, and the membrane sludge thickening which has a life expectancy of 10 years. Operational costs for both scenarios are assumed to increase at a rate of 2% annually. Capital costs for both the membranes and filter press are incurred at the beginning of the analysis and at their expected replacement year. The 15-year lifecycle costs are illustrated in Figure 4 below:

Figure 4 15 year Lifecycle Cost Comparison



Raw data can be found in Appendix C.

This comparison is only order of magnitude and likely does not capture all costs. An in depth investigation is required to capture majority of the costs and address issues such as total lifecycle operation and maintenance costs such as building maintenance, heating and ventilation requirements and electrical costs.

In addition to the lifecycle cost comparison, a net present value comparison over 30 years was conducted to determine the total investment required for both options. A 30 year period was chosen as it resulted ended on a year in which both option's equipment would need to be replaced, and a discount rate of 5% based on the an estimated average loan interest rate was utilized. The net present values calculated over 30 years are:

Option	Net Present Value (2014)
Existing Membrane Sludge Thickening	(-)$4,934,000
Fournier Filter Press	(-)$6,703,000

From the net present value comparison, it is apparent that the existing membrane sludge thickening option incurs the least amount of cost.

The improvement of the water removal from the sludge will have undesired impact decrease in the capacity of the MBR, with an increased filtrate volume returned to the MBR in the order of 3 m^3/d. The increase in filtrate from the dewatered sludge is returned back to the MBR tank so that it is properly filtered and passes through the UV equipment. Disinfection is currently a requirement of discharge so this process will remain. The amount of filtrate returned has a direct impact on the capacity of the Ganges WWTP, effectively reducing it by the amount of filtrate returned to the MBR. This will need to be accounted for when evaluating the processes, but is not part of this report.

Additionally, the sludge produced from the Fournier filter presses cannot currently be handled by the Burgoyne septage receiving facility. Sludge produced with this method will have to be hauled to the Hartland Landfill for disposal. This will result in higher hauling costs and reduced revenue for the Burgoyne facility.

ALTERNATIVES

That the Ganges Sewer Local Service Commission:

1. Receive this staff report for information and review options at the preliminary design stage as initially envisioned for this project.

2. a) Receive this staff report for information and direct CRD staff to evaluate sludge thickening technologies before proceeding with replacing the sludge thickening membranes.

   b) Approve a budget of $35,000, funded from the capital reserves, for the evaluation work.

IMPLICATIONS

Alternative 1 – By proceeding as originally intended the project will not be delayed. The staff will select the lowest capital, operating, maintenance and lifecycle cost for the project.

Alternative 2 – By proceeding with the review the overall project will be delayed, potentially resulting in compliancy issues and/or equipment repairs or failures.

CONCLUSION

The existing sludge thickening membrane has provided 10 years of reliable and effective operation but it is at its end of serviceable life. The cost comparison between the current technology and a Fournier Filter Press is more complicated than just comparing disposal and hauling costs, a holistic approach for comparison is required. An in depth evaluation of available options will be carried out as part of preliminary design, as is standard engineering practice. The lowest capital, maintenance, operating and lifecycle option will be presented to the commission for consideration.

RECOMMENDATION

That the Ganges Sewer Local Service Commission receive this staff report for information and review options at the preliminary design stage as initially envisioned for this project.

Dale Puskas, P.Eng. Project Engineer Infrastructure Engineering and Operations	Craig Gottfred, P.Eng. Manager, Wastewater Engineering and Planning Infrastructure Engineering and Operations
Peter Sparanese, P.Eng. Senior Manager, Infrastructure Engineering and Operations Concurrence	Ted Robbins, BSc, C.Tech. General Manager, Integrated Water Services Concurrence

Attachments:

Figures 1, 2 and 3
Appendix A – Fournier Filter Press Capital Estimate
Appendix B – Ganges Fournier Filter Press Operational Cost Methodology and Estimate
Appendix C – Lifecycle Cost Raw Data

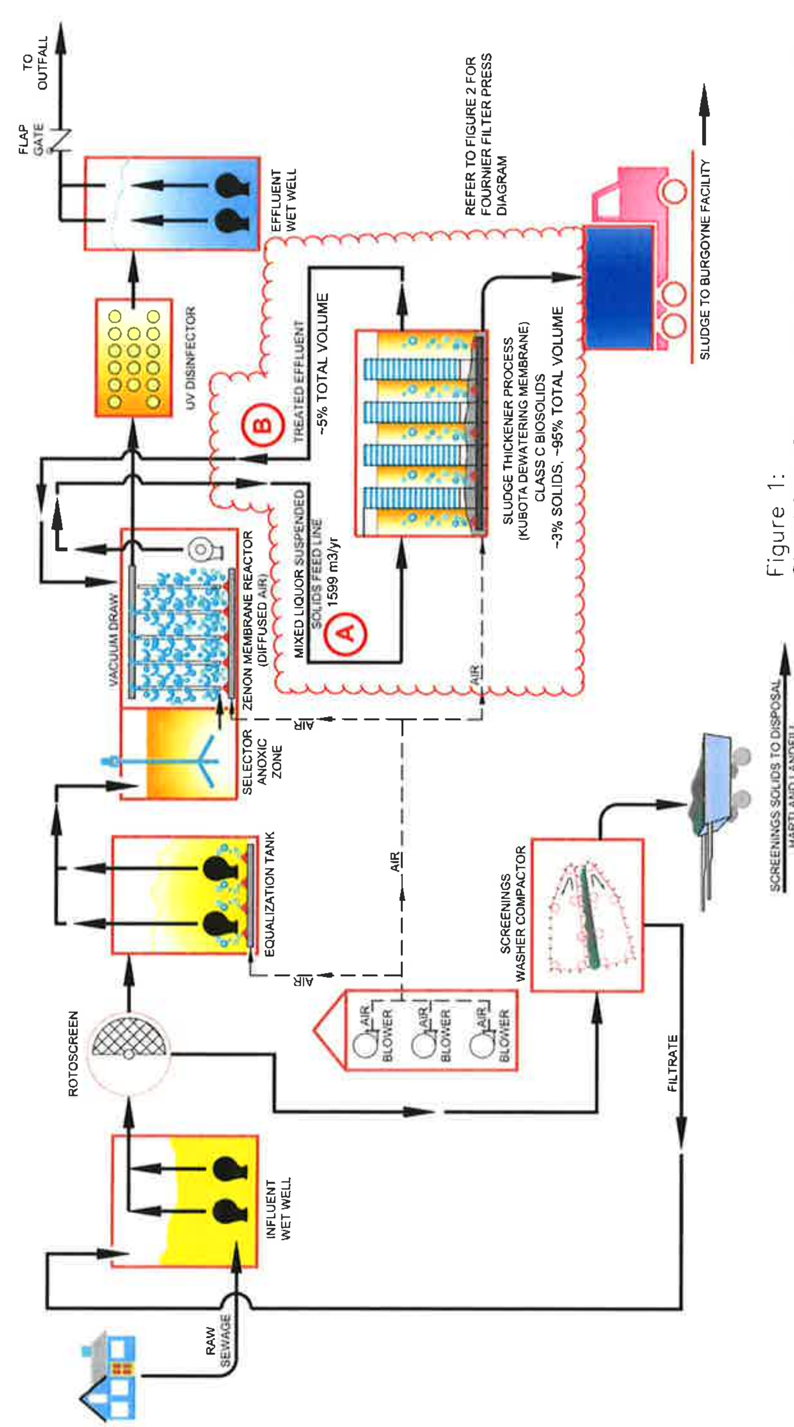


Figure 1:
Simplified Ganges Wastewater Treatment Plant Process

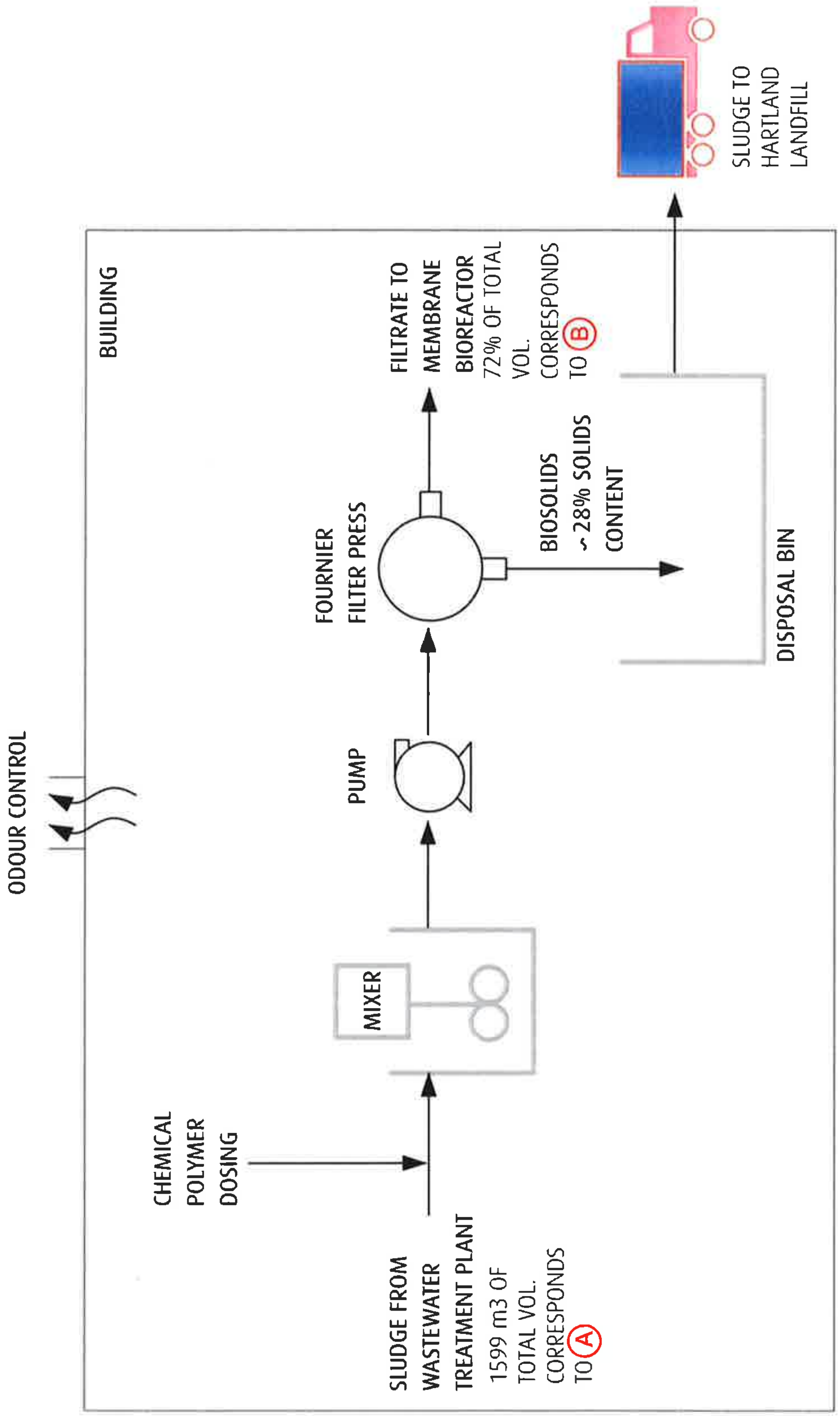


Figure 2: Typical Fournier Filter Press Process

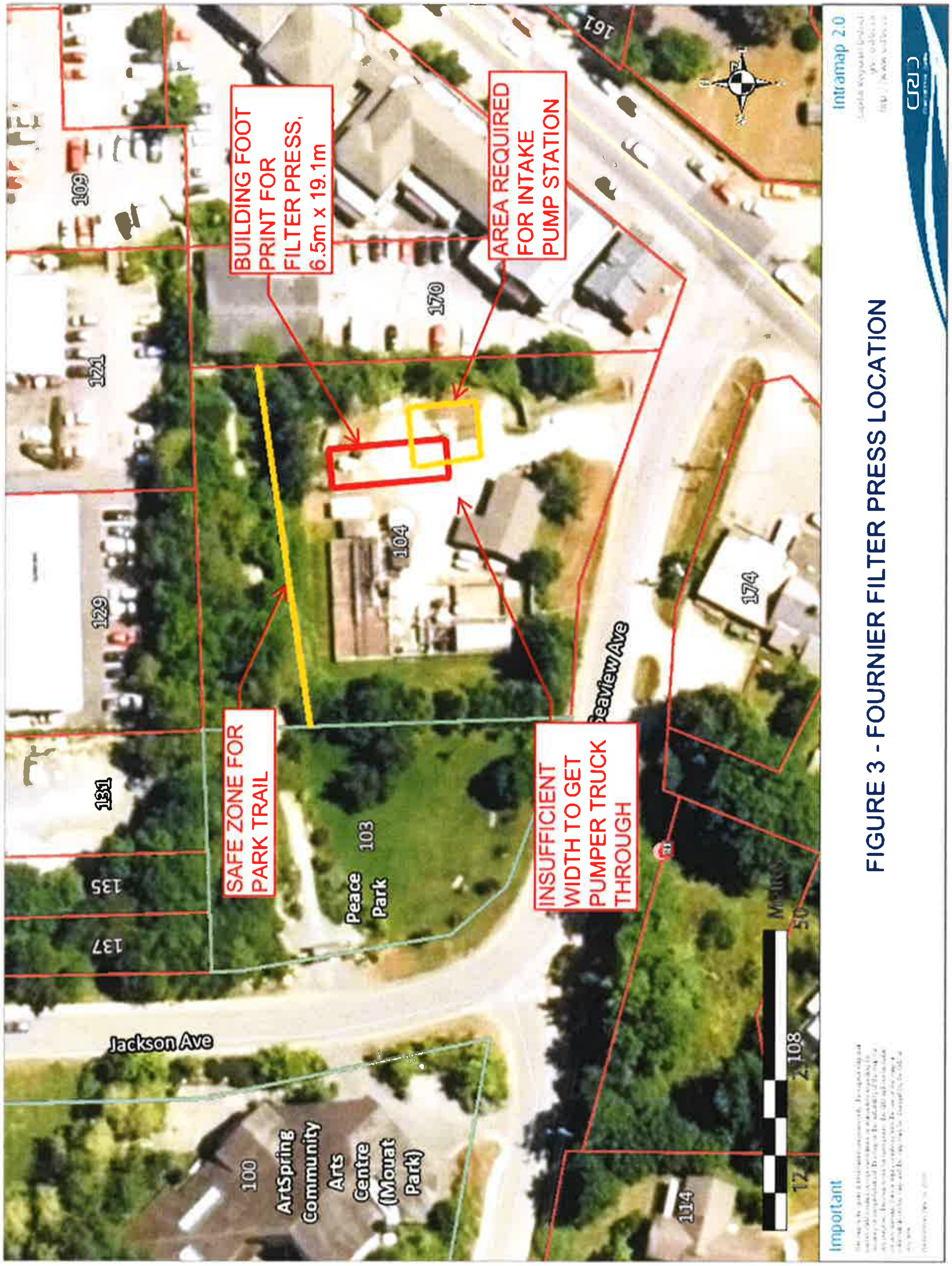


FIGURE 3 - FOURNIER FILTER PRESS LOCATION

APPENDIX A

CRD
Making a difference...together

GANGES SEWER LOCAL SERVICE
FILTER PRESS CAPITAL ESTIMATE

Date: November 24, 2014
Prepared by: Dale Puskas, P.Eng.
Page 1 of 1

Description	Details	Funding Source	Estimated Construction 2015	Contingency (%)	Contingency	Subtotal	Engineering (%)	Engineering	Admin (%)	Admin	Operations (%)	Operation Staff	TOTAL
CAPITAL REQUIREMENTS													
Building	Construct a wood framed building to house the filter press and disposal bin.	Captial	402,000	50	201,000	603,000	20	120,600	5	30,150	10	60,300	$ 810,000
Filter Press	Supply and install a filter press and minor associated mechanical.	Capital	300,000	50	150,000	450,000	20	90,000	5	22,500	10	45,000	$ 610,000
Mechanical Work including piping	Supply and construct mechanical piping associated with filter press	Capital	20,000	50	10,000	30,000	20	6,000	5	1,500	10	3,000	$ 40,000
Carbon Filter	Supply and install carbon filter, including grease filter, for odour control	Capital	30,000	50	15,000	45,000	20	9,000	5	2,250	10	4,500	$ 60,000
TOTAL COST OF ESTIMATED CAPITAL REQUIREMENTS													$ 1,420,000

APPENDIX B

GANGES FILTER PRESS OPERATION COST METHODOLOGY

Use Saanich Peninsula Wastewater Treatment Plant (SPWWTP) information for determination of sludge solids content, efficiency of Fournier Press and polymer usage:

- Average polymer addition ~ 0.54% kg polymer per kg sludge
- Blend Tank solids average ~ 28% of total sludge volume
- Sludge solids content (m^3/m^3) ~ 3.5%, close to the 2-3% at Ganges WWTP
- Hauling cost for a 10 tonne/truck ~ $118/truck excluding trucking hours & ferry
- 22' bin for disposal, truck and bin ~ 30'

**Relationships are derived imperically.

BC Ferries Fare for Hauling:
$3.65/ft commercial rate + 3.4% fuel surcharge = 30' x $3.65/ft x 1.034 = $113/truck

Estimated Trucking Hours:
Approximately 6 hours round trip, therefore 6hrs x $135/hr = $810/truck

Total Hauling Cost/truck:
$118 + $113 + $810 = $1,041/truck

Ganges Sludge Estimation:
Current annual average sludge generation ~ 351,770 igal (1,599.2 m^3) based on volumes billed to Ganges from Burgoyne for 2013 and 2012.

Cake Solids Volume ~ 1,599.2 m^3 x 28% = 447.8 m^3
Assuming density still close to water therefore weight = 447.8 m^3 x 1,000 kg/m^3 = 447,800 kg

Polymer required 1,599.2 m^3 x 3.5% = 55,972 kg sludge x 0.54% = 302 kg
Polymer cost $7.75/kg therefore **$2,340**

Hartland disposal costs $117/tonne, therefore [447,800 kg + 302 kg] x $117/tonne = **$52,427**

Number of trucks/year ~ [447,800 kg + 302 kg] / 10 tonne/truck = 45 pick-ups/year, add 10% due to pick-ups falling on long weekend or weekend, therefore ~ 50 trucks/year

Hauling Cost = $1,041/truck x 50 trucks = **$52,050**

Additional operations and maintenance labour required for additional equipment ~ 4 hrs per week at $100/hr = **$20,800/year**

Assume granular activated carbon needs to be replaced 1/year; approximate cost is $165/$ft^3$ ($5,826/$m^3$). Similar facility use a 114 ft^3 (3.23 m^3) filter therefore carbon cost is **$18,800**

CRD
Making a difference...together

GANGES SEWER UTILITY
FILTER PRESS OPERATING ESTIMATE

Date: November 24, 2014
Prepared by: Dale Puskas, P.Eng.

Description	Details	Funding Source	Estimated Construction 2015	Contingency (%)	Contingency	Subtotal	Engineering (%)	Engineering	Admin (%)	Admin	Operations (%)	Operation Staff	TOTAL
SLUDGE DISPOSAL													
Disposal	Disposal cost of biosolids at Hartland	Operation	52,427	50	26,214	78,641	0	0	0	0	0	0	$ 78,641
SLUDGE HAULING													
Hauling	Haul biosolids from Ganges to Hartland	Operation	52,052	50	26,026	78,078	0	0	0	0	0	0	$ 78,078
SLUDGE PRODUCTION													
Granular Activated Carbon	Annual supply of activated carbon	Operation	18,800	50	9,400	28,200	0	0	0	0	0	0	$ 28,200
Polymer Supply	Polymer supply to achieve dewatering with a filter press	Operation	2,340	50	1,170	3,510	0	0	0	0	0	0	$ 3,510
Additional Labour for Equipment	Estimated cost for additional labour with the operations of the filter press and odour control	Operation	20,800	50	10,400	31,200	0	0	0	0	0	0	$ 31,200
TOTAL COST OF ESTIMATED ANNUAL OPERATIONS & MAINTENANCE													$ 219,629

1624786

APPENDIX C

Year	Existing Membrane Sludge Thickener						Fournier Filter Press					
	Expenditures	Cost		Cumulative Costs			Expenditure	Cost		Cumulative Costs		
1	New Capital & Annual Disposal Costs	$	663,670	$	663,670		New Capital & Annual Disposal Costs	$	1,639,629	$	1,639,629	
2	Annual Disposal Cost	$	166,943	$	830,613		Hauling	$	224,021	$	1,863,650	
3	Annual Disposal Cost	$	170,282	$	1,000,896		Annual Disposal Cost	$	228,501	$	2,092,151	
4	Annual Disposal Cost	$	173,688	$	1,174,584		Annual Disposal Cost	$	233,072	$	2,325,223	
5	Annual Disposal Cost	$	177,162	$	1,351,745		Annual Disposal Cost	$	237,733	$	2,562,956	
6	Annual Disposal Cost	$	180,705	$	1,532,450		Annual Disposal Cost	$	242,488	$	2,805,443	
7	Annual Disposal Cost	$	184,319	$	1,716,769		Annual Disposal Cost	$	247,337	$	3,052,781	
8	Annual Disposal Cost	$	188,005	$	1,904,775		Annual Disposal Cost	$	252,284	$	3,305,065	
9	Annual Disposal Cost	$	191,765	$	2,096,540		Annual Disposal Cost	$	257,330	$	3,562,394	
10	Annual Disposal Cost & Capit	$	545,601	$	2,642,141		Annual Disposal Cost & C	$	262,476	$	3,824,871	
11	Annual Disposal Cost	$	199,513	$	2,841,654		Annual Disposal Cost	$	267,726	$	4,092,597	
12	Annual Disposal Cost	$	203,503	$	3,045,157		Annual Disposal Cost	$	273,080	$	4,365,677	
13	Annual Disposal Cost	$	207,573	$	3,252,730		Annual Disposal Cost	$	278,542	$	4,644,219	
14	Annual Disposal Cost	$	211,725	$	3,464,454		Annual Disposal Cost	$	284,113	$	4,928,332	
15	Annual Disposal Cost	$	215,959	$	3,680,414		Annual Disposal Cost & Capital Replacement	$	539,795	$	5,468,127	
16	Annual Disposal Cost	$	220,278	$	3,900,692		Annual Disposal Cost	$	295,591	$	5,763,718	
17	Annual Disposal Cost	$	224,684	$	4,125,376		Annual Disposal Cost	$	301,503	$	6,065,221	
18	Annual Disposal Cost	$	229,178	$	4,354,553		Annual Disposal Cost	$	307,533	$	6,372,754	
19	Annual Disposal Cost	$	233,761	$	4,588,314		Annual Disposal Cost	$	313,684	$	6,686,438	
20	Annual Disposal Cost & Capital Replacement	$	738,436	$	5,326,751		Annual Disposal Cost	$	319,957	$	7,006,395	
21	Annual Disposal Cost	$	243,205	$	5,569,956		Annual Disposal Cost	$	326,356	$	7,332,751	
22	Annual Disposal Cost	$	248,069	$	5,818,025		Annual Disposal Cost	$	332,884	$	7,665,635	
23	Annual Disposal Cost	$	253,030	$	6,071,055		Annual Disposal Cost	$	339,541	$	8,005,176	
24	Annual Disposal Cost	$	258,091	$	6,329,146		Annual Disposal Cost	$	346,332	$	8,351,508	
25	Annual Disposal Cost	$	263,253	$	6,592,399		Annual Disposal Cost	$	353,259	$	8,704,767	
26	Annual Disposal Cost	$	268,518	$	6,860,917		Annual Disposal Cost	$	360,324	$	9,065,091	
27	Annual Disposal Cost	$	273,888	$	7,134,805		Annual Disposal Cost	$	367,530	$	9,432,621	
28	Annual Disposal Cost	$	279,366	$	7,414,172		Annual Disposal Cost	$	374,881	$	9,807,502	
29	Annual Disposal Cost	$	284,953	$	7,699,125		Annual Disposal Cost	$	382,379	$	10,189,880	
30	Annual Disposal Cost & Capital Replacement	$	640,653	$	8,339,778		Annual Disposal Cost & Capital Replacement	$	690,026	$	10,879,906	

Memo

TO:	Karla Campbell Senior Manager, Salt Spring Island Administration
FROM:	Craig Gottfred, P.Eng. Manager, Wastewater Engineering and Planning
DATE:	January 21, 2015 — **FILE:** 0360-20
SUBJECT:	**GANGES SEWER COMMISSION - FOLLOW UP TO JANUARY 8, 2015 STAFF REPORT RE: SLUDGE DISPOSAL OPTIONS**

At the January 8, 2015 Ganges Commission meeting, the Commission had requested clarification regarding the costing information in the Sludge Disposal Options for Ganges Sewer Project staff report presented. The purpose of this memo is to confirm that the information presented at the January 8, 2015 meeting was accurate regarding the sludge disposal options.

In our assessment of the options, the annual Ganges Wastewater Treatment Plant (WWTP) estimated an average sludge volume of 1,599 m^3 (351,770 igal). The staff report illustrated that the sludge volume estimation was based on the volume billed to Ganges from Burgoyne for the 2012 and 2013. The annual average sludge volume was derived as follows:

Year	Volume (m^3)	Volume (igal)
2012	1,620	356,341
2013	1,578	347,190
Average	1,599	351,765

The average sludge disposal for the Ganges WWTP is consistent with the staff report presented, see Appendix B of the January 8, 2015 staff report. Consequently, the annual tipping fee of $137,190 at Burgoyne for the Ganges WWTP sludge, at a rate of $0.39/igal is correct. The following are operating costs for the membrane sludge thickening option:

Annual Average Sludge Disposal	$137,190
Budgeted Sludge Hauling[1]	$ 30,000
Total	**$167,190**

The commission also requested clarification on whether the estimated sludge volumes for the Fournier Press evaluation were correct. As illustrated in Appendix B – Ganges Filter Press Operation Cost Methodology, operational data from the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) shows that cake volume, after dewatering, is 28% of the sludge

[1] 2014 Ganges Sewer Local Service Operating Budget, subject to hauling contract renewal

produced. This percentage is based upon operational data and actual experience from the Fournier Press at SPWWTP for the past 15 years.

The cake volume of 28% was used for estimating the operating costs of a Fournier Press at the Ganges WWTP. For simplicity during the evaluation, the density of the sludge cake produced was assumed to be similar to water. The resulting cake volume (solids & water) of 447.8 m^3 and corresponding weight of 447.8 tonnes is consistent with operational data from SPWWTP and for the purposes of options report presented. Therefore, the estimated disposal and hauling costs presented in the January 8, 2015 staff report, with the 50% contingency as note in Appendix B of the staff report, are as follows:

Annual Average Sludge Disposal	$79,000
Annual Average Sludge Hauling	$78,000
Production Costs	$63,000
Total	**$220,000**

These costs are consisted with the staff report presented January 8, 2015.

The commission also requested clarification of the amount of polymer required and after review of Appendix B – Ganges Filter Press Operation Cost Methodology, it was discovered that the amount of polymer required was underestimated. The polymer dosing was based on operation information from SPWWTP's Fourier Press, but the assumed density of the sludge as 1,000 kg/m^3. The sludge solids has a specific gravity of approximately 2.0, multiplied by the density of water results in a solids density of 2,000 kg/m^3, which should be used to estimate the weight of the solids. At $7.75/kg for the polymer, the cost should be $4,680 per year not $2,340 per year. As the Life Cycle cost is approximately $10.8M, the impact of the adjusted polymer cost on the cost estimate, as in the report presented January 8, 2015 to the Commission, is negligible.

The January 8, 2015 report is a high level comparison of two possible sludge thickening options available, based on operational knowledge CRD staff have with operating both technologies over 15 years. I trust this should satisfy the Commission's inquiries regarding the staff report. If the Commission has any further questions, please do not hesitate to forward them for our review and comment.

DP/CG:ls

Cc: Ted Robbins, General Manager, Integrated Water Services
Peter Sparanese, Senior Manager, Infrastructure Engineering & Operations
Dale Puskas, Project Engineer, Wastewater Engineering & Planning

Appendix B: Product Literature and Quotations

From: Rick Johnson [mailto:rjohnson@ecofluid.com]
Sent: February-28-17 4:19 PM
To: Mangat, Sunny <Sunny.Mangat@amecfw.com>
Subject: Ganges sludge thickener

Hello Sunny – further to our telcon earlier today and as per the sketch that we sent you with the revised hopper, we're now estimating this tank assembly, including the ancillary equipment previously included would be somewhere around $150-155,000, including freight to the site. Unfortunately the estimator from Dennerik is away for a week so we've had to estimate the revised tank cost but this should be close.

We trust that this will be helpful; please do not hesitate to call if you have any questions or require any further information.

When we were speaking earlier today, you mentioned that you had some photos of the existing plant; would you mind sending me copies, please?

Thanks,

Rick Johnson
Manager, Business Development
ECOfluid Systems Inc.
Office: (604) 662-4544 - loc.522
Direct: (604) 696-6946
Mobile: (778) 823-4576

From: Rick Johnson [mailto:rjohnson@ecofluid.com]
Sent: February-22-17 9:57 AM
To: Mangat, Sunny <Sunny.Mangat@amecfw.com>
Subject: FW: Ganges sludge thickener

The revised elevated sludge thickener tank will be consist of a 12' x 12' dia shell with a 60° hopper bottom; open top c/w perimeter and intermediate support structure for full coverage grating; braced support legs c/w baseplates and internal support structure for MBR support. The engineering design is for outdoor location – Ganges, B.C. to meet all applicable regulatory codes (including seismic) and API 650. The foundation design is by others.

Also includes:
- Nozzles as required
- Full upper perimeter handrailing (field bolt-on by others)
- Full height cage ladder (field bolt-on by others)
- 30" manway access
- Full coverage galvanized bar grating (fiberglass is optional). The grating will be shipped loose for field installation
    - Internal coating will be SSPC-SP10 (near white) sandblast followed by 2 coats of industrial epoxy (Devoe)
    - External finish will be SSPC SP6 (commercial) sandblast followed by I coat of zinc primer and then I coat high build epoxy urethane (Devoe)
- Full documentation including P.Eng sealed drwgs
- 100% visual weld inspection by independent registered CSA W178.2 weld inspector
- Hydrostatic leak test with water

The balance of the package will be as previously described:
- Two (2), Toray model TRM140-100S membrane modules, each c/w slide-out guide rails to permit the entire membrane assembly to be easily removed; the aeration base would remain in the tank.
- Quick-disconnect permeate piping through the tank wall
- Individual aeration downcomers, each with separate rotometer-type air-flow meters (note, thermal-mass air-flow meters are optional)
- Individual permeate connections, each with separate flow meters
- Skid-mounted permeate pump
- Freight to site – off-loading and placing by others
- GA drawings, site supervision and assembly assistance
- Start-up assistance

Budget price for above package - $180,000 – plus taxes. FOB point will be fabricator's shop with freight pre-paid to the site.

Calculated tank weight is 18,000 pounds incl. the membrane bases, the actual membrane modules and the other ancillary equipment will be shipped separately.

Estimated delivery time wold be 12 – 14 weeks after final drawing approval and receipt of down payment.

Please call if you have any questions or would like any additional details,

Rick Johnson
Manager, Business Development
ECOfluid Systems Inc.
Office: (604) 662-4544 - loc.522
Direct: (604) 696-6946
Mobile: (778) 823-4576

November 8, 2016

AMEC FW
600 - 4445 Lougheed Hwy
Burnaby BC V5C 0E4

Ganges Wastewater Plant Upgrade
Internally Fed Rotary Thickener

BUDGET PROPOSAL

Dear Sunny Mangat,

Mequipco Ltd is pleased to offer the supply of the following thickening equipment for the Ganges Wastewater Treatment Plant. One (1) Internally Fed Rotary Thickener complete with control panel, Polymer Feed System, Polymer Injection Fitting, TWAS Tank, as well as installation inspection, start-up, and operator training.

The budget cost for this equipment, as detailed below **$ 137,000 Canadian**

Above prices are:

- Subject to Mequipco Ltd Standard Terms and Conditions
- Pricing is in Canadian Dollars, with all taxes extra
- Delivery 8 - 10 weeks from receipt of signed purchase order and receipt of deposit. If submittal drawings are required, shipment will be from date of approval of submittals.
- FOB Site. Please note that Mequipco does not include insurance on any shipments. If insurance is required, please request this at the time of order, otherwise the shipping companies standard insurance will apply.

We thank you for the opportunity to provide this offer, and we look forward to supporting you on this project.

Kind regards,

Michael Greig | **Mequipco Ltd.**

304 – 1777 56th Street
Delta, BC V4L 0A6
Mobile: 1-604-644-5051
Tel: 1-604-273-0553, Ext. 142
web: www.mequipco.com

Proposal No. 20161119

To:	AMEC FW – Sunny Mangat	**Voice:**	(604)273-0053
	c/w Mequipco – Mike Greig	**Fax:**	
	#225 – 11020 No. 5 Road	**Email:**	mgreig@mequipco.com
	Richmond, BC V7A 4E7	**Project:**	CRD Ganges WWTP
		Date:	November 8, 2016

WE ARE PLEASED TO QUOTE AS FOLLOWS:

One (1) only **IPEC Model IFT 30 2448 Internally Fed Rotary Thickener**, in all 304 stainless steel construction, with components as follows:

- 24" diameter by 48" long, thickener drum;
- 24" of 350 micron panels and 24" of 425 micron panels;
- headbox tank assembly, extending 24 inches, in 3/16 inch plate, 304 stainless steel;
- drum heads fabricated from 1/4" thick, 304 stainless steel plate;
- main frame and legs in 3" square tube construction;
- top frame in 2" square tube construction;
- housing in 10 gauge construction and covers in 12 gauge construction;
- UHMW, polyurethane trunnions, 8" diameter by 2" wide, internal bearings c/w remote grease points;
- external spray bar, 1-1/4" Sch.40, 304 stainless steel c/w 14 fan jet, spray nozzles, solenoid valve, PRV, ball valve, pressure gauge, manifold and hinged splash cover;
- # 60 stainless steel single roller, stainless steel drive chain and driven sprocket;
- helical parallel gear drive with 1/3 hp, Ex Class 1 Div 1 TEFC motor, 575V/3Ph/60Hz. (additional voltages and classifications available, additional cost may apply).

Control Panel

- stainless steel control panel to control sludge thickening system to include, but not limited to, one VFD for floc tank agitator and one VFD for the thickener, transformer, and spray wash timer, on/off/auto switches;
- relays to interact with the polymer control system;
- sequencing timers;
- panel to have dry contacts for system integration.

Polymer Feed System, manufactured by Excell including (Subject to Change due to low metering)
The Model # 6012-JSX has the following features:

- neat polymer pump (pulse metering) with feed capacity
- pump rate can be controlled locally or by a remote 4-20 mA signal. The pump has a digital rate display;
- 10 to 60 GPH (40 to 220 Liter/hour) dilution water capacity;
- one gallon aging-blending chamber for improved polymer effectiveness.
- low water flow switch. It puts the pump on stand-by until minimum flow resumes(switch setting is field adjustable);
- water solenoid valve; power to the feeder controls water and polymer flow;
- metering pump calibration cylinder;
- self cleaning sight glass.

2889 Norland Avenue Burnaby BC Canada V5B 3A9 Toll Free: (800) 663-8409 Tel: (604) 291-7150 Fax: (604) 291-7190
Email: sales@jwce.com Web Page: http://www.jwce.com

Polymer Injection Fitting
- 4 point injection ring on 3" pipe;
- ANSI flange; line connection; 1/2" FNPT polymer inlet;
- variable orifice with adjustable weight lever;
- all 316 SS wetted parts;
- polymer injections shall be supplied for field installation inline 2-10 metres upstream of screen inlet.

TWAS Tank
- rectangular closed top access door;
- 10 gauge construction 316 stainless steel;
- approximate size 20" x 30" x 20" high;
- flange connection to RDT;
- level sensor port.

Accessories
- support legs, 3 x 3 x 1/4" angle construction, to raise IFT to allow TWAS tank to fit under solids discharge chute.

And Site Visit - One trip, 2 days for inspection, start-up, and operator training.

Manual: Two copies of the Installation, Operation and Maintenance Manual.

Service: To thicken 25 USGPM (352,000 imperial gallons annually 2 -3 % solids) peak pumped 1% MBW WAS sludge to 6%.

50 USGPM of municipal sludge @ 0.50% Suspended Solids (126 lbs/hr dry)
30 USGPM of municipal sludge @ 0.75% Suspended Solids (126 lbs/hr dry)
25 USGPM of municipal sludge @ 1.00% Suspended Solids (126 lbs/hr dry)
15 USGPM of municipal sludge @ 1.50% Suspended Solids (126 lbs/hr dry)
12 USGPM of municipal sludge @ 2.00% Suspended Solids (126 lbs/hr dry)
10 USGPM of municipal sludge @ 2.50% Suspended Solids (126 lbs/hr dry)

The quoted screen will meet the stated flow, provided maximum solids loading does not exceed 1.5 %.

Shipping & Handling: (Will be prepaid and billed at cost plus handling charges)

Taxes: All orders will be billed the applicable sales tax, based on the "ship to address", unless a valid tax exemption certificate is provided prior to shipment.

Terms: 10% upon drawing approval, 80% net 30 days of delivery, 10% upon start-up, OAC.

Shipment: 8 – 10 weeks from receipt of signed confirmation of order and deposit.

Validity: 30 days from quotation date.

WARRANTY

IPEC warrants that the goods sold are fit for the particular purpose of use for which they were offered, and that they conform with, and will perform in accordance with the Purchaser's specifications.

2889 Norland Avenue Burnaby BC Canada V5B 3A9 Toll Free: (800) 663-8409 Tel: (604) 291-7150 Fax: (604) 291-7190
Email: sales@ipec.ca Web Page: http://www.ipec.ca

IPEC also warrants the goods against any defects in material, workmanship and design for the entire warranty period.

IPEC warrants, for a period of 12 months from the delivery of equipment, that any component that is defective shall be replaced. Change out of said components shall be for the Purchaser's account.

All warranty claims must be submitted to IPEC in writing, either by mail, fax or email.

Notes:

1. Please fax or mail a purchase order for the total amount and we can process your order. Please include the following:
   Billing Address, Ship to Address, and sales tax exemption certificate.
2. Please reference our quote number on your purchase order.
3. Availability of parts are subject to change at any time.
4. 20% restocking fee on all returns.
5. Sales tax is not included in price.
6. JWCE-IPEC standard one year warranty included.

2889 Norland Avenue Burnaby BC Canada V5B 3A9 Toll Free: (800) 663-8409 Tel: (604) 291-7150 Fax: (604) 291-7190
Email: sales@ipec.ca Web Page: http://www.ipec.ca

GANGES SUMMARY

		Centrifuge - 1 x D3L		
PROCESS DATA	Sludge volume per year	4800 m3		
	Feed solids concentration	1.0% TS		
	Total solids per year	48 dry tons		
	Operating hours per year	12 hours per week = 600 hours per year		
	Discharge Solids Concentration	20% TS		
	Cake - wet tons per year	240 wet tons		
	Cake volume at 600 kg/cu.m	400 m3		
	Solids Capture Efficiency	96% TSS		
	Polymer dosage	12 active kg per tonne dry solids		
	Total polymer used per year	600 active kg		
CAPITAL COST				
	Capital Cost - Dewatering Equipment			
	FOB Jobsite			
Equipment Costs	Supply cost - not installed cost	Centrifuge with Control Panel	$	260,000
	Capital Cost - Ancillary Equipment	Progressive cavity sludge feed pump, sludge		
	Estimated cost, FOB Jobsite	flowmeter, emulsion polymer system,		
	Supply cost - not installed cost	discharge conveyor, centrate tank and pump	$	100,000
	Spare parts for one year	Drive belts, seals, main bearings	$	2,000
	Startup and training	1 trip x 5 days on site plus expenses	$	16,000
Building Costs	TBD	Centrifuge footprint approx 4m2		
OPERATING COSTS				
	Disposal Cost - $250/wet ton?			
Cake Disposal	To be confirmed	240 wet tons x $250/wet ton	$60,000 per year	
Polymer Usage	TBD - based on cost/kg of polymer			
		Connected Load		
		Centrifuge Drives: 22 kW		
	Based on $0.065 per kwh?	Ancillary Equipment: 8 kW		
Power	To be confirmed	Total Connected: 32 kW	$1,250 per year	
		Assume 40 hours per year for maintenance		
Maintenance	Plant Maintenance Personnel	and lubrication		
		Assume 2 hours per shift x 2 shifts per week		
Operations	Plant operator time	= 200 hours per year		

ANDRITZ Separation

CRD - Ganges WWTP
Sludge Dewatering Options

For:	**AMEC**	By:	Denis Piche
To:	Sunny Mangat	Tel:	(403) 650-4131
Ref:	17404086-2	Email:	denis.piche@andritz.com
Date:	3-Nov-16		

	Option 1 **Centrifuge**	**Option 2** **Belt Filter Press**
DESIGN CRITERIA		
Sludge description	Undigested WAS from MBR	Undigested WAS from MBR
MBR fine screening	2mm perforated screen	2mm perforated screen
Volatile solids content	<75% assumed	<75% assumed
Solids concentration after MBR	0.8-1.0% TS	1.0% TS
Sludge solids per year	48 dry tons	48 dry tons
Sludge volume per year	4800-6000 m^3/year	4800-6000 m^3/year
Dewatering period	1 unit x 12 hours per week	1 unit x 12 hours per week
Design flow per unit	10 m^3/h	10 m^3/h
Design solids load per unit	80 kg/h	80 kg/h
CENTRIFUGE SELECTION (Note 1)		
Centrifuge Model	**Andritz D3L**	**1m Quantum S-8**
Expected cake solids discharge	18 ± 2 %TS	15 ± 2 %TS
Expected solids capture efficiency	>95% TSS	>93% TSS
Expected polymer dosage (emulsion)	12 ± 2 active kg per tonne TS	8 ± 2 active kg per tonne TS
BUDGET PRICE (Note 2)		
Dewatering equipment with control panel	$260,000	$340,000

NOTES:
1. Performance values listed are subject to testing a representative sample of sludge at our lab
2. Budget price is given in Canadian Dollars, FOB Jobsite, Taxes Extra. Does not include start-up service and spare parts.

ANDRITZ SEPARATION INC.
1010 Commercial Blvd. S.
Arlington, Texas 76001
Tel. (817) 465-5611
Fax (817) 468-3961
www.andritz.com

Mangat, Sunny

From:	Michael Greig <mgreig@mequipco.com>
Sent:	November-17-16 12:46 PM
To:	Mangat, Sunny
Subject:	FW: Ganges WWTP - Odour Control for New Dewatering Building
Attachments:	Evoqua ZABOCS.pdf; ZABOCS Process Description.pdf; ZABOCS 7010.pdf

Hi Sunny

Please see the information below and attached from Evoqua Water Technologies. Please review and let me know if you have any questions on this odour control option. Given the time Bryan simply took the worst case scenario (belt filter press building foot print) to give a "not to exceed" type of budget quote on the odour control for this site, once things are narrowed down a little we can certainly revisit this and pull together a more formal and detailed offer.

Bryan Haan and Rick Parker (manager of Odour Control for Evoqua N.A.) are in Vancouver next week on Tuesday, if it works on your end we'd be happy to come by and discuss this with you in more detail. Please let me know.

Thanks Sunny.

Regards,
Mike

Michael Greig | Mequipco Ltd.

Mobile: 1-604-644-5051
Tel: 1-604-273-0553, Ext. 142
web: www.mequipco.com

***Confidentiality Note**: This e-mail message and any attachments to it are intended only for the named recipients and may contain confidential information. If you are not one of the intended recipients, please do not duplicate or forward this e-mail message and immediately delete if from your computer.*

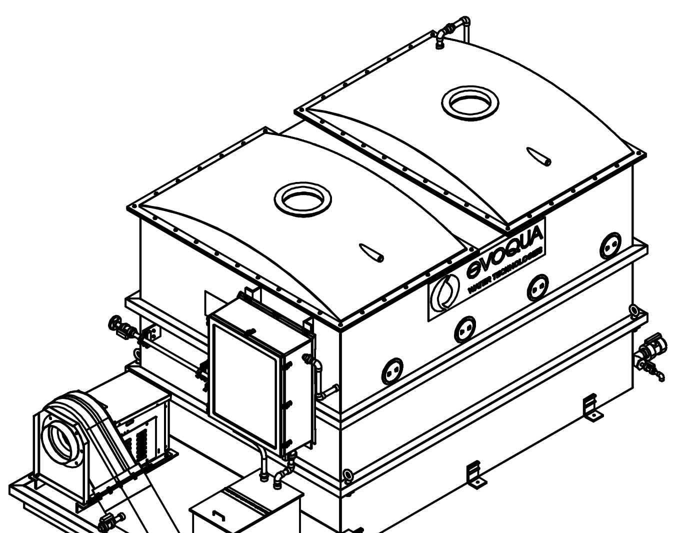
From: Haan, Bryan D [mailto:bryan.haan@evoqua.com]
Sent: November 17, 2016 12:30 PM
To: Michael Greig <mgreig@mequipco.com>
Subject: RE: Ganges WWTP - Odour Control for New Dewatering Building

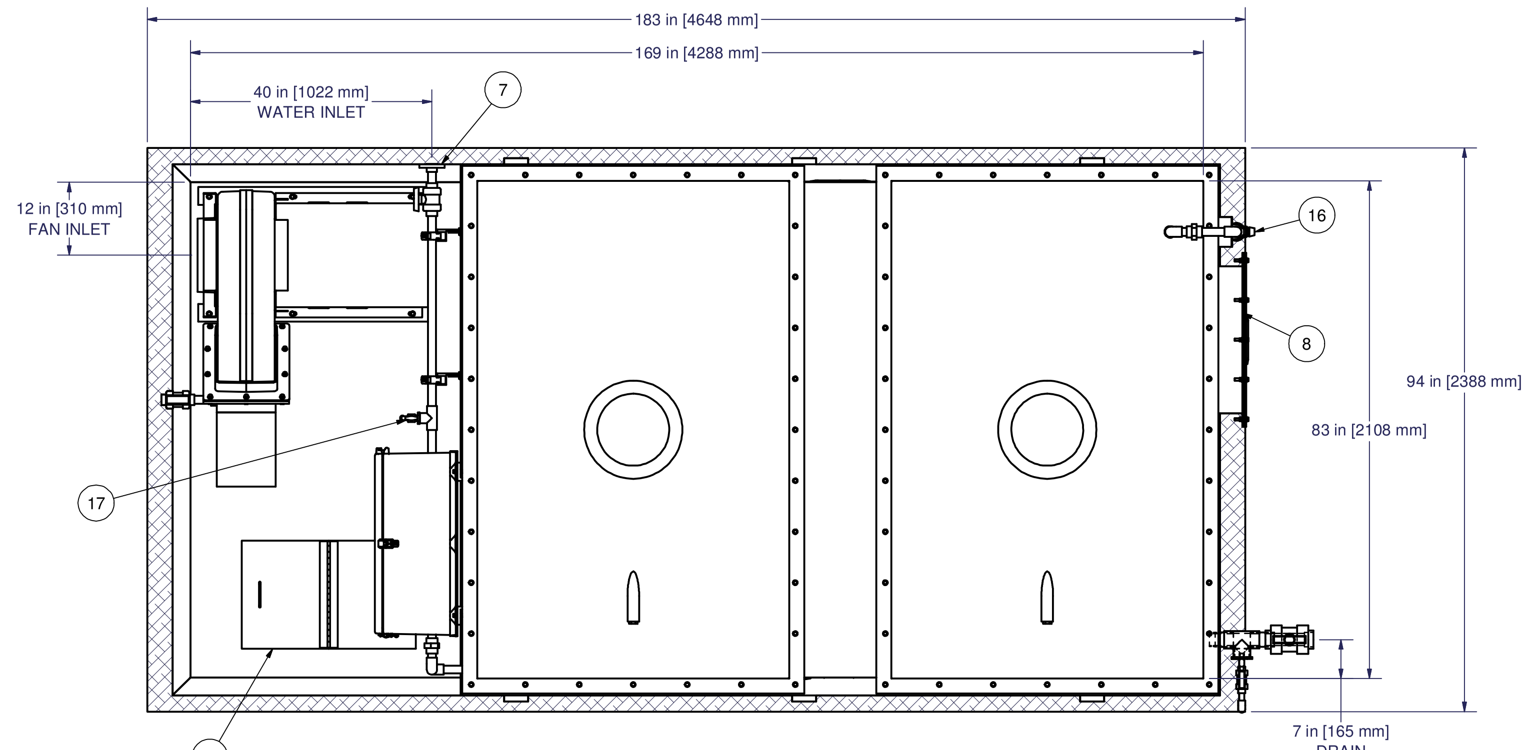
Mike,
A quick calculation gives me:

- sludge storage (6 ACH) at ~450 cfm – 20 ppm H_2S avg all the time
- belt filter press building (20 ACH) at ~1,170 cfm – 2 ppm H_2S avg when running

Total is 1,620 cfm which puts us into a ZB7010. I have attached the brochure, a process description page and a GA for the unit. The preference would be to have the unit inside, possibly an adjacent room to the filter press room. Rough budget is $165,000 CDN for the standard model with a VFD. I would suggest VFD so that the airflow can be adjusted when the belt filter press building is not being used. That would allow for longer contact for the foul air originating from the sludge storage tank.

Review the above approach Sunny at AMECFW and let me know if there are any changes to approach that he would suggest. Possibly we can stop in next week to discuss the approach with him.


ISOMETRIC

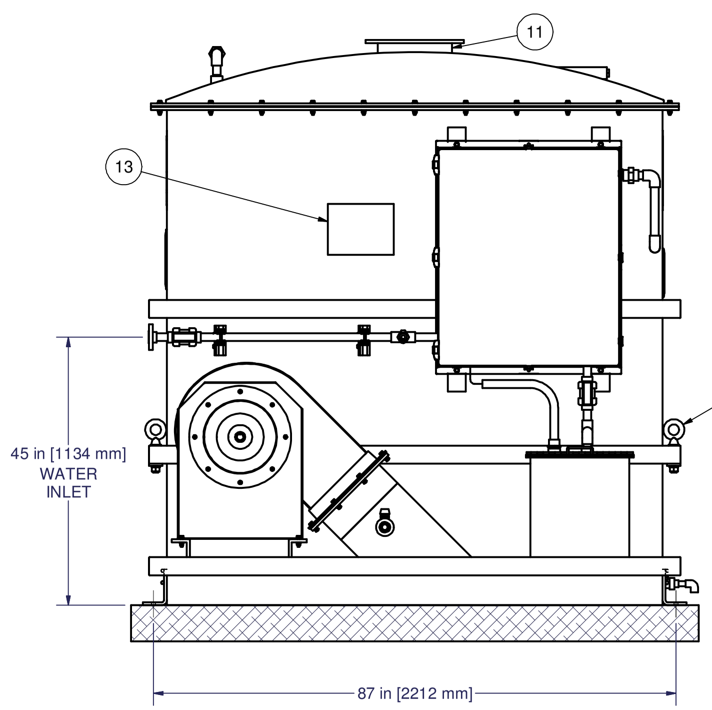


PLAN

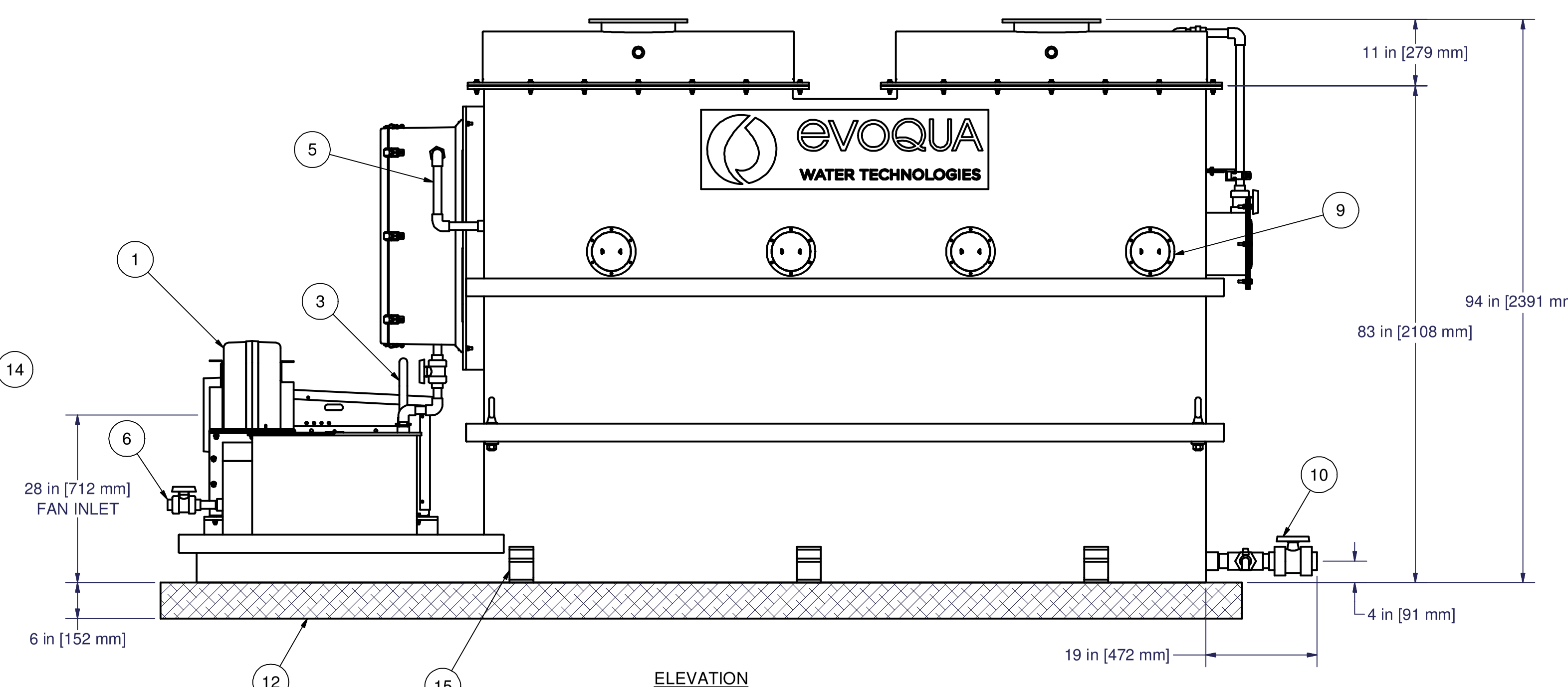
NOMENCLATURE

1. EXHAUST FAN (12.25" O.D. SLIP INLET)
2. NUTRIENT TANK
3. NUTRIENT FEED LINE
4. WATER CONTROL CABINET
5. WATER FEED LINE
6. INLET AIR SAMPLE PORT
7. WATER INLET CONNECTION (1.00" UNIVERSAL FLANGE)
8. MAIN ACCESS FLANGE
9. ACCESS PORTS (TYP. OF 6)
10. 2.00" DRAIN VALVE (N.O.) + 0.50" pH SAMPLE VALVE (N.C.)
11. STACK OUTLET FLANGE - 12.00" I.D. (TYP. 2X)
12. SLOPED CONCRETE EQUIPMENT PAD
13. ID TAG
14. POSITIONING EYES (TYP. OF 4)
15. ANCHOR LUGS (TYP. OF 6)
16. OUTLET AIR SAMPLE PORT
17. HOSE BIBB

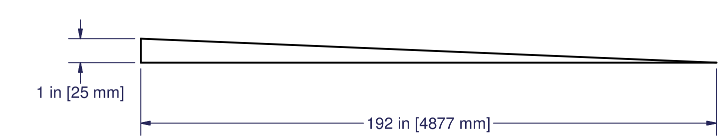
NOTES:
1. VESSEL SHIPPING WEIGHT: ~3,500 lbs
   MEDIA SHIPPING WEIGHT: ~15,455 lbs
   OPERATING WEIGHT: ~24,500 lbs
2. PLACE ON SLOPED CONCRETE, 0.0625" PER FOOT FROM FAN TO DRAIN
3. SERVICE REQUIREMENTS:
   ELECTRICAL: 600 VAC, 3 PH, FLA = 9.0A, 60 HZ
   POTABLE WATER: 1.00" LINE (30 PSI MIN.)
4. BACKFLOW PREVENTER, IF REQUIRED, PROVIDED BY OTHERS.
5. 7.00" (MIN.) BAROMETRIC P-TRAP ON DRAIN, PROVIDED BY OTHERS.
6. UNIT TO BE INSTALLED (BY CONTRACTOR) ON 0.25" THICK NEOPRENE RUBBER SHEET OF 60 DUROMETER.



LEFT SIDE



ELEVATION



SLOPED CONCRETE PAD

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS.

FABRICATION	MACHINE
.XX +/- .06	.XX +/-.03
[X +/- 2]	.XXX +/-.005
< +/- 2	[X +/- 1]
	[.X +/- .1]
	< +/- 1

STD: 2-0200-22X34D BAR= 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
00	FIRST ISSUE	04/24/15	TDR	NN	DNP	

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		DATE
DESIGNER	TDR	4/24/2015
CHECKER	NN	4/24/2015
ENGINEER	DNP	4/24/2015
MANAGER	DNP	4/24/2015

FILE:
SCALE: NONE

TITLE: ZB-7010 BIOLOGICAL ODOR CONTROL SYSTEM
GENERAL ARRANGEMENT DRAWING

CLIENT: HARMONY WWTP
MAPLE REINDERS, INC., EDMONTON, AB, CANADA

EVOQUA WATER TECHNOLOGIES
WATER TECHNOLOGIES
SAN DIEGO, CA
(858) 487-2200

PROJECT	PART NUMBER	DRAWING	SHEET	REV
2033/000539		20745576	1 OF 1	00

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

Customer' data	
Type of sludge	Aerobically digested MBR
Total Solid (%ts)	Minimum of 2% **(Sludge will require to be thickened)**
Maximum production of sludge	
Quantity of suspended solid (tss) to dewater	131 dry kg/day increasing at the rate of 2% per year for next 30 years In 2047: 237 dry kg/day

Results of filtration	
Flocculation of the sludge	8% $FeCl_3$ and 35% lime
Cake Thickness	32 mm before compaction
Cake Dryness	30% ± 2%
Cake Density	1.15
Cycle Time	3h00

Operating schedule	
Number of cycles per day	In 2017: 3 In 2047: 5
Operation of the unit	In 2017: 9 hours/day In 2047: 15 hours/day

Sizing of the filter press

$$\mathbf{V}_{Filter\ press} = \frac{\boldsymbol{Mass\ of\ dry\ matter + Mass\ of\ flocculant}}{\boldsymbol{\#filter\ press \times \#cycles\ \times cake\ dryness \times cake\ density}}$$

$$\mathrm{V}_{Filter\ press} = \frac{237 + 102}{1 \times 5\ \times 0{,}30 \times 1{,}15} = \mathbf{197\ L}$$

(*) *Anticipated production rate is based on experience with similar type of sludge. If sludge conditions change, our performance may be affected; please advise us of any changes in sludge properties, so we may amend this proposal.*

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

To meet the dewatering requirements shown above, we offer the following equipment and services:

One (1) FullAuto Filter press 211
Equipped with 35 Mixed pack plates (17 membrane and 18 recessed plates)
Plate dimension: 630 x 630 mm
Volume of the filter press: 244 L before squeezing

The following equipment, described above, and services are included in our budget:

- ONE (1) FRAME of the filter press
- ONE (1) MOBILE SUPPORTING BEAM in carbon steel
- ONE (1) FIXED BEAM with round side bars
- ONE (1) HYDRAULIC CLOSING SYSTEM
  Fixed to the filter-press allowing the opening, closing and gripping by a double effect hydraulic ram, and moved with a two stage hydraulic pump.
  Power: 2.2 kW
- ONE (1) HYDRAULIC RAM – Double effect
- ONE (1) MECHANISED SHIFTING CORROSION PROOF
  The plates' shifting is fully automatic. A hydraulic motor moves two trolleys with two «fingers» in stainless steel. This allows the separation of the plates for cake discharge, one by one.
  Trolleys are moved by two (2) polyurethane notched straps (one on each side) armed with glass fiber.

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

- ONE (1) FULLAUTO ROBOT: Core blower, Shaking, Weighing, Washing
  This system allows operation of the filter press 24/7 without the presence of an operator during the release phase. The filter press operates fully automatic from the closing to the cake release, including filtration, compaction, discharge, for several cycles.
  - The discharge occurs plate by plate.
  - Depending on the type of sludge, the operator will activate the mechanical core blower. Then, the FullAuto Robot core blows the feed eye of the plate by using a pneumatic jack.
  - The second step is to weigh each plate to ensure the cake has discharged. The weight is compared with the initial tare weight. Should the weight exceed tolerance, plate shaking is used to remove any piece of cake that might have remained stuck on the cloth.
  - The plates will be weighed again to guarantee cake's discharge. The next cycle will begin in a fully automated manner after cake discharge.

(Patented Technology – more than 100 FullAuto Robots in operation on 100% automatic dewatering units).

  - ONE (1) CLOTH WASHING SYSTEM AT HIGH PRESSURE
    When necessary, the FullAuto Robot will wash cloth from the top to the bottom on both sides of each plate. Depending on the needs, the duration of the washing will be between 15 seconds and 3 minutes per plate and won't exceed 4 hours for the entire filter press.

(Patented Technology – More than 250 Automatic Washing Robots in operation)

- ONE (1) SYSTEM FOR MEMBRANE COMPACTION
  Storage tank of 500 liters with a closed circuit
  Multi cellular pump: 1 500 kPa – P= 2.2 kW
  Equipped with a distributor to feed the 17 membrane plates a regulation valve to maintain the squeezing pressure
  The tank should be installed at a lower level than the filter press (the aim is to empty the water contained in membranes via gravity at the end of the compaction).

Ancillary equipment

- ONE (1) SAFETY AND PROTECTION SYSTEM
  Safety light curtain and movement detection switch along with rigid guards to assure complete safe operation and injury prevention when the machine is tightening.
  Meets Canadian Safety Standards
  Validation after final implantation.

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

- One (1) SET OF PNEUMATIC ACTUATED VALVES: Bowl type
  - Valve – Sludge inlet feed
  - Valve – Core blowing
  - Valve – Filtrate return

- ONE (1) DETECTION SWITCH: For automatic detection of end of filtration cycle (by pressure and timer)

- ONE (1) ELECTRICAL CABINET
  Control and power for the filter press, proposed equipment and the pump regulation.
  Power: 600 Volts 60 Hz.

- ONE (1) CONTROL PANEL
  Installed next to the filter press. It allows control of the filter press for daily operations (opening, closing, discharge, acknowledgement of the safety light curtain).

- ONE (1) SLUDGE PUMP: piston-membrane pump COTRE 3000, integrated control flow/pressure
  Maximum pumping capacity: 3 m^3/hr
  Pressure up to 1 500 kPa
  Power: 5.5 kW

- ONE (1) SWING DOOR SYSTEM made in Stainless Steel 304
  Allows collection of the wash water and any dripping which may occur while dewatering. This equipment avoids spraying water on cakes if they are stored directly under the filter press.

- ONE (1) SOUNDPROOF AIR COMPRESSOR
  Including one (1) tank in galvanized steel of 500 liters for the core blow and to feed the valves
  Given flow: 36 m^3/hr (21.2 cfm)
  Pressure: 800 kPa
  Power: 5.5 kW

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

- ONE (1) HIGH PRESSURE WASHING GROUP
  Water pressure generator for the washing cloths which includes a piston pump with flow of 4 m^3/hour at a pressure of 10 000 kPa.
  Industrial water can be used if it is filtered at 200 µm (70 mesh).
  One (1) tank of 1 m^3 with a float and a valve to regulate the water level upstream of the pump.
  Power: 15 kW
  Provided with an ear-protection headset.

- ONE (1) ACID WASHING SYSTEM for cloths
  Includes a proportional dosing system running without electricity, valves, high level probe, vents.
  The whole system is mounted on a skid. The supply of acid in a double-wall tank is at the customer's charge.
  Not included: *storage of acid*

Options

- ONE (1) SOUNDPROOFING OF THE HOOD FOR THE HP WASHING GROUP
  Sound reduction of 15 ± 2 dB(A) à 1 m

- ONE (1) COVER PROTECTION OF ACID WASHING

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

Budgetary Proposal:

For the above equipment and services, our budget price is: 254 280.00 $CA.
Options are not included.

Our budgetary price is as follows:

Summary of equipment	
1 FullAuto Filter press 211 – 35 plates	
Ancillary equipment	
Protection and Safety System	
High Pressure Washing Group	
Instrumentation and control	
Sludge Pump	
Commissioning, optimisation and training of operators	
Options	
Soundproofing of the HP group	
Cover protection for acid washing	

Total budget price, including options: 268 932.00 $CA.

Drawing: D-41309.

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

NOTES :

1. Our budget price **includes** the following items:
   a. Start-up and complete staff training for operation and mechanics. Maximum of three (3) weeks on site.

2. Our budget price **does not include** the following items:
   a. Transport is not included.
   b. Crane or lifting services for unloading the equipment on site.
   c. Work to assemble the equipment on site
   d. Connection (Electrical, Air, Water, Sludge, Chemical)
   e. Conveyor and bin for cake transport and storage

3. Our price is valid for a period of one ninety (90) days.

4. Cake conveyor or cake discharge disposal bin are not included, but can be added by request.

5. Standard Terms of Payment:
   a. 20% with purchase order at reception of invoice
   b. 20% at drawings delivery
   c. 10% at the drawings approval
   d. 45% at equipment delivery
   e. 5 % following commissioning and training completion

6. Shop drawings and equipment delivery
   a. Shop drawings: Six to eight (6 to 8) weeks
   b. Equipment delivery: Twenty-two (22) weeks, after drawing approval.

7. All taxes: Extra if applicable.

Subject: Budgetary Proposal_REV01
Fournier FullAuto Filter Press (Cont'd)

Please do not hesitate to contact us for any additional information you may require.
Anticipating satisfaction, please accept our best regards.

LES INDUSTRIES FOURNIER INC.

GF/

Guillaume Fabre
Project Manager
Dewatering Department

Encl.: Drawing D-41309
FullAuto Filter Press Brochure

c.c.: M. Francis Caouette, Sales & Development Manager, Phone (418) 423-4241
Ms. Deirdre Moran, EIT, Waste 'n WaterTech, Phone (250) 889-3340

Appendix C: Detailed Cost Spreadsheets

Year	Expenditures	Option 1A Membrane Sludge			Option 1B Rotary Drum Thickener			Option 2A Centrifuge			Option 2B Filter Press		
	Type	Cost	Cumulative Costs	Present Value	Cost	Cumulative Costs	Present Value	Cost	Cumulative Costs	Present Value	Cost	Cumulative Costs	Present Value
0	Annual O&M+New Capital	$ 534,980	$ 534,980	$ 534,980	$ 1,530,340	$ 1,530,340	$ 1,530,340	$ 2,303,370	$ 2,303,370	$ 2,303,370	$ 2,692,820	$ 2,692,820	$ 2,692,820
1	Annual O & M Cost	$ 109,180	$ 644,160	$ 103,981	$ 129,040	$ 1,659,380	$ 122,895	$ 144,870	$ 2,448,240	$ 137,971	$ 133,020	$ 2,825,840	$ 126,686
2	Annual O & M Cost	$ 111,364	$ 755,524	$ 101,010	$ 131,621	$ 1,791,001	$ 119,384	$ 147,767	$ 2,596,007	$ 134,029	$ 135,680	$ 2,961,520	$ 123,066
3	Annual O & M Cost	$ 113,591	$ 869,114	$ 98,124	$ 134,253	$ 1,925,254	$ 115,973	$ 150,723	$ 2,746,730	$ 130,200	$ 138,394	$ 3,099,914	$ 119,550
4	Annual O & M Cost	$ 115,863	$ 984,977	$ 95,321	$ 136,938	$ 2,062,192	$ 112,659	$ 153,737	$ 2,900,467	$ 126,480	$ 141,162	$ 3,241,076	$ 116,134
5	Annual O & M Cost	$ 118,180	$ 1,103,157	$ 92,597	$ 139,677	$ 2,201,869	$ 109,441	$ 156,812	$ 3,057,279	$ 122,866	$ 143,985	$ 3,385,061	$ 112,816
6	Annual O & M Cost	$ 120,544	$ 1,223,701	$ 89,951	$ 142,471	$ 2,344,340	$ 106,314	$ 159,948	$ 3,217,227	$ 119,356	$ 146,865	$ 3,531,926	$ 109,593
7	Annual O & M Cost	$ 122,954	$ 1,346,655	$ 87,381	$ 145,320	$ 2,489,660	$ 103,276	$ 163,147	$ 3,380,375	$ 115,946	$ 149,802	$ 3,681,728	$ 106,462
8	Annual O & M Cost	$ 125,414	$ 1,472,069	$ 84,885	$ 148,226	$ 2,637,886	$ 100,325	$ 166,410	$ 3,546,785	$ 112,633	$ 152,798	$ 3,834,527	$ 103,420
9	Annual O & M Cost	$ 127,922	$ 1,599,990	$ 82,460	$ 151,191	$ 2,789,077	$ 97,459	$ 169,738	$ 3,716,523	$ 109,415	$ 155,854	$ 3,990,381	$ 100,465
10	Annual O&M+Capital Repl	$ 283,480	$ 1,883,471	$ 174,032	$ 154,215	$ 2,943,292	$ 94,674	$ 173,133	$ 3,889,656	$ 106,289	$ 158,971	$ 4,149,352	$ 97,595
11	Annual O & M Cost	$ 187,150	$ 2,070,620	$ 109,423	$ 157,299	$ 3,100,591	$ 91,969	$ 176,596	$ 4,066,252	$ 103,252	$ 162,151	$ 4,311,503	$ 94,806
12	Annual O & M Cost	$ 190,893	$ 2,261,513	$ 106,296	$ 160,445	$ 3,261,036	$ 89,342	$ 180,128	$ 4,246,379	$ 100,302	$ 165,394	$ 4,476,896	$ 92,097
13	Annual O & M Cost	$ 194,711	$ 2,456,224	$ 103,259	$ 163,654	$ 3,424,690	$ 86,789	$ 183,730	$ 4,430,110	$ 97,436	$ 168,702	$ 4,645,598	$ 89,466
14	Annual O & M Cost	$ 198,605	$ 2,654,829	$ 100,309	$ 166,927	$ 3,591,617	$ 84,309	$ 187,405	$ 4,617,514	$ 94,652	$ 172,076	$ 4,817,673	$ 86,910
15	Annual O & M Cost	$ 202,577	$ 2,857,406	$ 97,443	$ 170,266	$ 3,761,883	$ 81,901	$ 191,153	$ 4,808,667	$ 91,948	$ 175,517	$ 4,993,190	$ 84,427
16	Annual O & M Cost	$ 206,629	$ 3,064,034	$ 94,659	$ 173,671	$ 3,935,553	$ 79,561	$ 194,976	$ 5,003,643	$ 89,321	$ 179,027	$ 5,172,218	$ 82,015
17	Annual O & M Cost	$ 210,761	$ 3,274,795	$ 91,954	$ 177,144	$ 4,112,698	$ 77,287	$ 198,875	$ 5,202,519	$ 86,769	$ 182,608	$ 5,354,826	$ 79,671
18	Annual O & M Cost	$ 214,976	$ 3,489,772	$ 89,327	$ 180,687	$ 4,293,385	$ 75,079	$ 202,853	$ 5,405,372	$ 84,290	$ 186,260	$ 5,541,086	$ 77,395
19	Annual O & M Cost	$ 219,276	$ 3,709,047	$ 86,775	$ 184,301	$ 4,477,686	$ 72,934	$ 206,910	$ 5,612,282	$ 81,881	$ 189,985	$ 5,731,071	$ 75,184
20	Annual O & M Cost	$ 223,661	$ 3,932,709	$ 84,296	$ 187,987	$ 4,665,673	$ 70,850	$ 211,048	$ 5,823,330	$ 79,542	$ 193,785	$ 5,924,856	$ 73,036
	Net Present Value			$ 2,508,500			$ 3,422,800			$ 4,428,000			$ 4,643,700

Inflation Rate Used: 2%

Discount Rate Used: 5%

MEMBRANE THICKENER
MEMBRANE ESTIMATED CAPITAL & O & M COST

MEMBRANE ESTIMATED CAPITAL COST

No.	ITEM	UNIT	QTY	PER COST	SUBTOTAL	Notes
1	Equipment Cost	LS	1	$ 225,000	$ 225,000	Installation factor 50%;
2	Slab Cost	LS	1	$ 10,000	$ 10,000	No Building Required
3	Odor Control Unit Cost Incl. Unit, Duct Works	LS	1	$ -	$ -	Based on current experience
4	Sludge Storage Tank (retrofit existing Clarifier)	LS	1		$ -	Clarifier retrofit not included; no preprocessing storage required
5	Piping for Permeate and Aeration System etc	ls	1	25000	$ 25,000	
	Subtotal				$ 260,000	

MEMBRANE ESTIMATED ANNUAL OPERATIONAL COST

No.	ITEM	Unit	QTY	Per Cost	Cost	
1	Annual Power Cost	kwh	7020	$ 0.064	$ 450	Assume 3 hrs each day for 5 days per week operation
2	Labour Cost	hrs	104	$ 100	$ 10,400	Allowed 1 hrs per shift x 2 shifts per week
3	Building Operational Cost	ls	1	$ -	$ -	No Building
4	Annual Maintenance Cost	ls	1	$ 5,000	$ 5,000	Estimated for general maintenance of pumps, valves etc.
5	Sludge Disposal & Hauling Cost	m^3	850	$ 109.80	$ 93,330	
6	Chemical Cost	ls	1	$0.00	$ -	
	Subtotal				$ 109,180	

ROTARY DRUM THICKENER

ROTARY DRUM THICKENER ESTIMATED CAPITAL & O & M COST

ROTARY DRUM THICKENER ESTIMATED CAPITAL COST

No.	ITEM	UNIT	QTY	PER COST	SUBTOTAL	Notes
1	Equipment Cost Including Sludge Bin Installed	LS	1	$ 230,500	$ 230,500	Installation factor 50%; Bin $25000
2	Building Cost	LS	1	$ 270,000	$ 270,000	
3	Odor Control Unit Cost Incl. Unit, Duct Works	LS	1	$ 270,000	$ 270,000	Installation factor 50%; Include Unit and Duct Work Cost
4	Sludge Storage Tank (retrofit existing Clarifier)	LS	1	$ 100,000	$ 100,000	Clarifier retrofit including cover and duct
	Subtotal				$ 870,500	

ROTARY DRUM THICKENER ESTIMATED ANNUAL OPERATIONAL COST

No.	ITEM	Unit	QTY	Per Cost	Cost	
1	Annual Power Cost	kwh	41144	$ 0.064	$ 2,640	Assume 3 hrs each day for 5 days per week operation; power consumption for odour control unit accounted
2	Annual Polymer Cost	ls	1	1429	$ 1,430	Used 12 kg per dry tonne solids
3	Activated Carbon Renewal	kg	114	$ 165	$ 18,810	Vendor estimate adjusted for building size
4	Labour Cost	hrs	364	$ 100	$ 36,400	Allowed 7 hrs per week
5	Building Operational Cost	ls	1	$ 1,500	$ 1,500	Estimated
6	Annual Maintenance Labour Cost	hrs	125	$ 100	$ 12,500	From manufacturer's data water & Wastetech
7	Annual Maintenance Equipment Cost	ls	1	$ 2,500	$ 2,500	
8	Sludge Disposal & Hauling Cost	m^3	485	$ 109.80	$ 53,260	
	Subtotal				$ 129,040	

CENTRIFUGE

CENTRIFUGE ESTIMATED CAPITAL & O & M COST

CENTRIFUGE ESTIMATED CAPITAL COST

No.	ITEM	UNIT	QTY	PER COST	SUBTOTAL	Notes
1	Equipment Cost Including Sludge Bin Installed	LS	1	$ 568,000	$ 568,000	See Quote; Installation factor 50%; Bin $25000
2	Building Cost	LS	1	$ 405,000	$ 405,000	Estimated
3	Odor Control Unit Cost Incl. Unit, Duct Works	LS	1	$ 270,000	$ 270,000	Installation factor 50%; Include Unit and Duct Work Cost
4	Sludge Storage Tank (retrofit existing Clarifier)	LS	1	$ 100,000	$ 100,000	Clarifier retrofit including cover and duct
	Subtotal				$ 1,343,000	

CENTRIFUGE ESTIMATED OPERATIONAL ANNUAL COST

No.	ITEM	Unit	QTY	Per Cost	Cost	
1	Annual Power Cost	kwh	82776	$ 0.064	$ 5,300	Assume 3 hrs each day for 5 days per week operation; power consumption for odour control unit accounted for
2	Annual Polymer Cost	ls	1	$ 3,174.5	$ 3,180	Used 12 kg per dry tonne solids
3	Activated Carbon Renewal	kg	114	$ 165	$ 18,810	Vendor estimate adjusted for building size
4	Labour Cost	hrs	520	$ 100	$ 52,000	Allowed 5 hrs/shift x 2 shifts/week (includes 2 hrs/week for odour control)
5	Building Operational Cost	ls	1	$ 1,500	$ 1,500	Estimated
6	Annual Maintenance Labour Cost	hrs	40	$ 100	$ 4,000	From manufacturer's data
7	Annual Maintenance Parts Cost	ls	1	$ 5,000	$ 5,000	Mfg Info
8	Sludge Disposal & Hauling Cost	trucks	24	$ 2,295	$ 55,080	
	Subtotal				$ 144,870	

FAURE FILTER PRESS

FAURE FILTER PRESS CAPITAL & O&M COST ESTIMATE

FOURIER FILTER PRESS ESTIMATED CAPITAL COST

No.	ITEM	UNIT	QTY	PER COST	SUBTOTAL	Notes
1	Equipment Cost Including Sludge Bin Installed	LS	1	$ 633,900	$ 633,900	Installation factor 50%+Thickener Cost at $137,000; Bin $25000
2	Building Cost	LS	1	$ 540,000	$ 540,000	See Estimate
3	Odor Control Unit Cost Incl. Unit, Duct Works	LS	1	$ 306,000	$ 306,000	Installation factor 50%; Include Unit and Duct Work Cost
4	Sludge Storage Tank (retrofit existing Clarifier)	LS	1	$ 100,000	$ 100,000	Clarifier retrofit including cover and duct
	Subtotal				$ 1,579,900	

FAURE FILTER PRESS ESTIMATED OPERATIONAL ANNUAL COST

No.	ITEM	Unit	QTY	Per Cost	Cost	
1	Annual Power Cost	kwh	91128	$ 0.064	$ 5,840	Assume 3 hrs each day for 5 days per week operation for filter press; power consumption for odour control unit also accounted for.
2	Annual Polymer Cost	ls	1	$ 2,645.4	$ 2,650	See Estimate
3	Activated Carbon Renewal	kg	114	$ 165	$ 18,810	Vendor estimate adjusted for building size
4	Labour Cost	hrs	520	$ 100	$ 52,000	Allowed 5 hrs/shift x 2 shifts/week (includes 2 hrs/week for odour control)
5	Building Operational Cost	ls	1	$ 2,000	$ 2,000	Estimated
6	Annual Maintenance Labour Cost	hrs	80	$ 100	$ 8,000	From manufacturer's data
7	Annual Maintenance Equipment Cost	ls	1	$ 7,000	$ 7,000	
8	Sludge Disposal & Hauling Cost	trucks	16	$ 2,295	$ 36,720	
	Subtotal				$ 133,020	

REPORT TO ELECTORAL AREA SERVICES COMMITTEE
MEETING OF WEDNESDAY, FEBRUARY 17, 2016

SUBJECT **Combining Salt Spring Island Sewer and Liquid Waste Local Area Services Commissions (Ganges, Maliview, and Liquid Waste)**

ISSUE

To consider establishing one sewer and liquid waste local service commission to administer the Ganges sewer, Maliview sewer and Liquid Waste services on Salt Spring Island (SSI).

BACKGROUND

Local services were established for Maliview Estates Sewer (Bylaw No. 1938), Ganges Sewerage (Bylaw No. 1923) and SSI Liquid Waste Disposal (Bylaw. No. 2118). At that time, committees were established by the CRD Board to administer these services. Bylaw No. 3693, "Salt Spring Island Water, Sewer and Liquid Waste Disposal Commissions Bylaw No. 1, 2010", converted these committees to the following commissions and delegated administrative powers to these commissions subject to the policies and procedures of the regional board and limitations in the CRD Delegation Bylaw:

- Ganges Local Sewer Commission
- Highland Water and Sewer Services Commission – includes administration of the Maliview Estates sewer service
- SSI Liquid Waste Disposal Local Service Commission

Bylaw No. 3693 sets out the services for each of these commissions that are comprised of volunteers and each service has a separate infrastructure, budget, and tax base. Operationally, the three services are intended to provide ratepayer direction in the delivery of sewer and liquid waste services, and provide advice on the financial, operational and capital aspects of delivering these services. While the services are established by separate bylaws, the services do integrate in that both the Maliview and Ganges sewer services contribute product and revenue to the Liquid Waste service; and the Maliview sewer or Ganges Sewer have one appointed representative on the Liquid Waste Commission.

There are approximately 12 CRD established commissions on Salt Spring Island to administer various services. These commissions are comprised of volunteers appointed by the CRD Board. The Salt Spring Island Liquid Waste Commission currently does not have sufficient members to establish a quorum and recent efforts to find volunteers from the community to join the commission have been unsuccessful. This has presented an administrative challenge and requires the Electoral Area Services Committee to provide direction on the operating and capital budget and the project delivery approach to complete the Burgoyne Bay Septage Facility Project. The Ganges Local Sewer Commission has one member vacancy following a recent search for members. The Highland Water and Sewer Services Commission that administers the Maliview Estates sewer has had no new members step forward for many years.

ALTERNATIVES

Alternative 1:

1. That staff consult with the Ganges Local Sewer Commission, the Highland Water and Sewer Services Commission and the SSI Liquid Waste Disposal Local Service Commission to determine a proposed governance model for managing liquid waste and sludge on Salt Spring Island; and

2. That based on the consultation, staff be directed to draft a bylaw to create one Salt Spring Island Sewer and Liquid Waste Local Area Service Commission to administer the Ganges sewer, Maliview Estates sewer and SSI liquid waste disposal services.

Alternative 2:

That the report be received for information.

IMPLICATIONS

The CRD Board Strategic Priorities 2 (c) supports ‘integrated waste management plans’ and ‘establishing a systematic process of evaluation for all liquid waste decisions’. The following benefits ensue from integrating these commissions as it relates to liquid waste and sludge:

- provides efficiencies from an organizational and reporting perspective;
- facilitates filling a large number of vacancies to administer three similar functions;
- Salt Spring Island as a whole can provide stewardship for liquid waste management planning and work towards a harmonized framework in managing liquid waste and sludge;
- better service the SSI in a consistent manner;
- one commission will provide a coordinated and uniform approach in providing island solutions; and
- knowledge sharing will be an asset to the Commission and SSI.

Examples where committees were combined to administer a service are (1) Port Renfrew Utility Services Committee (Juan de Fuca Electoral Area) amalgamated sewer, street lighting, water and Snuggery Cover water services; and (2) Highland and Fernwood Water Service joined to fund and facilitate the construction of a joint water treatment facility that services users in both areas.

The creation of one commission to administer these three services will result in administrative time and cost savings as it relates to coordinating meetings and project delivery approvals.

Each service will continue to have separate budgets as required by provincial legislation.

CONCLUSION

The lack of volunteer commission members willing to serve is posing significant administrative challenges. The Salt Spring Island Electoral Area Services division is currently engaged in significant capital infrastructure improvements and asset management planning within each of these services. At the time of establishing these services, the governance model met the needs of the communities it served; however, the current structure and administrative system is challenged in dealing with multiple commissions and commissioners, in particular where their product and representation are already interconnected and impact the Liquid Waste budget, operations, and future infrastructure capacity.

RECOMMENDATION(S)

That the Electoral Area Services Committee recommends to the Capital Regional District Board:

1. That staff consult with the Ganges Local Sewer Commission, the Highland Water and Sewer Services Commission and the SSI Liquid Waste Disposal Local Service Commission to determine a proposed governance model for managing liquid waste and sludge on Salt Spring Island; and

2. That based on the consultation, staff be directed to draft a bylaw to create one Salt Spring Island Sewer and Liquid Waste Local Area Service Commission to administer the Ganges sewer, Maliview Estates sewer and SSI liquid waste disposal services.

Submitted by:	Karla Campbell, Senior Manager, Salt Spring Island Electoral Area
Concurrence:	Ted Robbins, General Manager, Integrated Water Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

KC:kc