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Item 6

CAW 13-31

REPORT TO CORE AREA WASTEWATER TREATMENT PROGRAM COMMISSION MEETING OF FRIDAY, SEPTEMBER 27, 2013

SUBJECT **IMPACT OF FLOWS AND LOAD PROJECTIONS FOR MCLOUGHLIN WASTEWATER TREATMENT PLANT**

ISSUE

The Core Area Wastewater Treatment Program Commission (Commission) has requested additional information on the wastewater flow and load projections for the McLoughlin Point wastewater treatment plant.

BACKGROUND

Staff presented a memo "McLoughlin Wastewater Treatment Plant Capacity" at the May 30, 2013 Commission meeting. The Commission had a number of follow up questions related to impacts on the McLoughlin wastewater treatment plant (WWTP) if flows and loads are higher or lower than the historical and high growth rate projections. The questions and answers are summarized in Section 2.2 of the attached Technical Memorandum "Impact of Wastewater Flow and Load Projections on Plant Capacity, August 7, 2013, Stantec Consulting".

SUMMARY

The Capital Regional District's (CRD) sewerage system was built to flow to the sea through existing outfalls at Clover and Macaulay Points. As a result, after considering many options, the least expensive, by far, was constructing the main core area WWTP at McLoughlin Point.

The plan for treating the wastewater for the Core Area uses three growth scenarios for the sewered population:

a) Expected rate of 1.3 %; population of 436,000 in 2030
b) Historical rate of 1.0%; population of 410,000 in 2030
c) High rate of 2.1%; population of 490,000 in 2030

Development in the Westshore and conversion of septic fields to sewers are key variables. Historically, growth in the Westshore has been about 3% versus less than 1% in Oak Bay, Saanich and Victoria. The expected growth rate scenario of 1.3% assumes 100% septic conversions in the Westshore by 2030.

To handle such planning uncertainty, the current plan uses a multi-phase approach that avoid costly overbuilding, including;

1) Constructing the McLoughlin Point WWTP to handle flows up to 108 million litres per day (ML/d).

2) Prior to reaching 108 ML/d, making minor treatment process and operating modifications to increase the McLoughlin WWTP capacity to 140 ML/d; at that capacity the WWTP will handle expected flows and loads beyond 2040.
3) Prior to reaching 140 ML/d and/or to address the high growth scenario, building a WWTP in the Westshore at the most efficient time, and diverting Westshore wastewater to the new plant will allow McLoughlin to handle flows from its reduced catchment to beyond 2080.

During wet weather, currently on average there are approximately 30 overflows per year, and upon completion of the wastewater treatment program upgrades this will be reduced to between 3 and 6 overflows per year. Discharges at Clover and Macaulay points will also be much reduced as follows:

- Wet weather flows up to three times average dry weather flow (ADWF) from Clover Point and four times ADWF from Macaulay will be diverted to McLoughlin for treatment eliminating all overflows in the regional system for storm events that are less than a 5 year return period (except for Clover Point).
- Through municipal programs to fix leaking sewers as per the Commitment in LWMP Amendment No. 8, the wet weather flow will be reduced to less than 4 x ADWF by 2030 which would eliminate all overflows at Clover Point for up to a 5 year storm event.

CONCLUSION

The CRD's Core Area Liquid Waste Management Plan sets out an approach to allow the CRD to progressively treat wastewater for the next 60 to 80 years by implementing the Core Area Wastewater Treatment Program and, when required, installing minor treatment process and operating modifications at McLoughlin and adding a future WWTP on the Westshore.

RECOMMENDATION

That the Core Area Wastewater Treatment Program Commission receive this report for information.

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TB:ll:hr

Attachment: 1

Technical Memorandum

Core Area Wastewater Treatment
McLoughlin Wastewater Treatment Plant

Impact of Wastewater Flow and Load Projections on Plant Capacity

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1.0 Introduction

The CRD Core Area Wastewater Treatment Program Commission requested that the impact of a variety of load and flow projection scenarios on the life expectancy of the McLoughlin WWTP Plant be depicted graphically. This memo shows how long the plant will last for the three growth scenarios for the equivalent sewered population.

2.0 Flow and Load Scenarios

Currently in 2013, the two outfalls serve sewered equivalent populations and flows as follows:

Outfall	Population	ADWF
Macaulay Point	156,000 persons	39 ML/day
Clover Point	204,000 persons	51 ML/day
Total	**360,000 persons**	**90 ML/day**

Part of the flow discharging at Macaulay Point is approximately 7 ML/day generated on the Westshore from the sewered population in Colwood and Langford.

The three growth scenarios considered for CRD sewered population were:

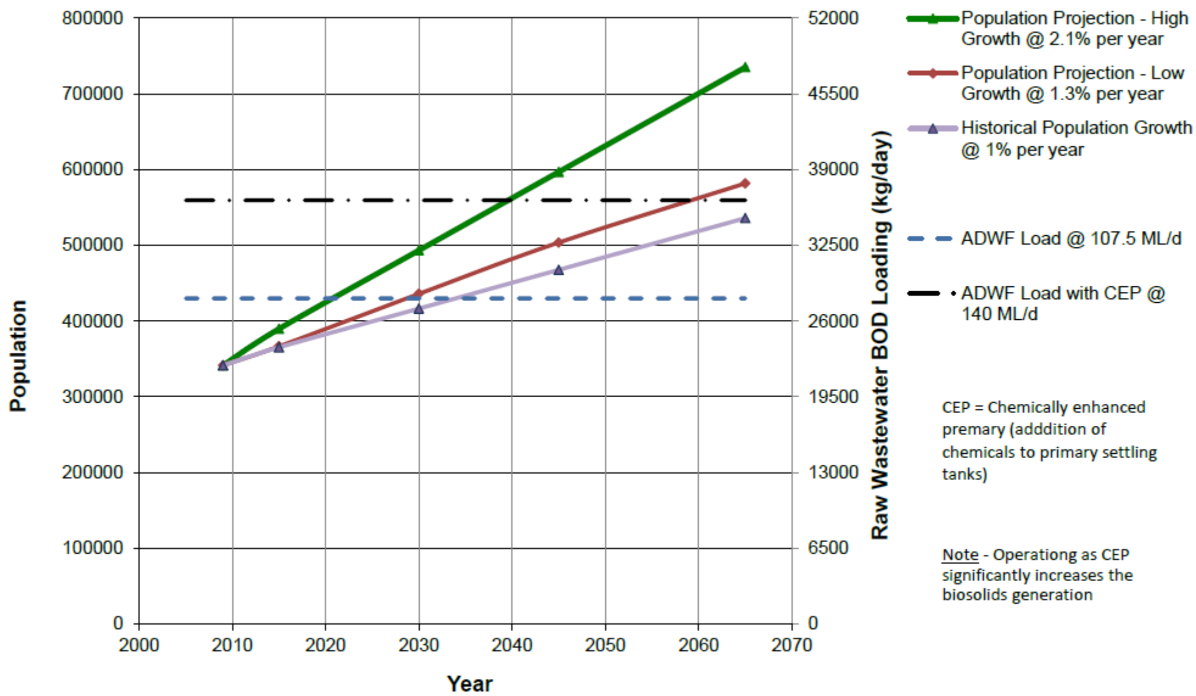
- Expected Growth Rate 1.3% per year CRD wide 2030 sewered population 436,000
- High Growth Rate 2.1% per year 2030 sewered population 493,500
- Low growth rate (historical) 1.0% per year 2030 sewered population 410,000

2.1 Graphical Presentation of the Growth Scenarios:

Figure 1 is a graph of population versus time starting with Year 2008 for sewered population to McLoughlin Point. It also shows the raw wastewater BOD applied to the plant for the population projections as a function of time. The curves assume that the per capita organic (BOD) load used to develop this curve is 65 grams/capita/day for all population growth scenarios.

The McLoughlin Point plant indicative design was developed to handle an AWDF Raw BOD load of 27,950 kg/day of BOD and a maximum month BOD load of 34,900 kg/day of BOD.

Figure 1
Serviced Population and Loading Capacity of Secondary Treatment Plant



The average dry weather load for a 107.5 ML/day plant of 27,950 kg/day is represented by the blue dashed horizontal line on the graph.

This shows that, for the expected growth rate in population of 1.3% per year, the combination of primary settling/BAF plant would reach capacity in 2030 (at the point of intersection of the light blue dashed line with the red curve). Westshore sewered population growth would be about 4% to achieve this overall growth rate.

Similarly, if the growth rate of sewered population were lower at 1% per year, then the plant would be of appropriate size until 2035 (intersection with the light purple curve). Note that the growth rate of sewer population varies with the municipality within the CRD, e.g. for Oak Bay, it is close to 0.0%, Saanich is about 1.0%, Victoria is < 1.0%, while Langford and Colwood have historically been 3% .

On the other hand, should the growth rate be at 2.1%, then the plant would be of appropriate size only until 2020 (intersection with the green loading population curve). For this overall growth rate, the Westshore growth of sewered population would be about 6%.

As discussed below, addition of coagulating chemicals such as alum or ferric as well as polymer to the primaries [operating the primary treatment as chemically enhanced primaries (CEP)], would easily extend the capacity of the plant so that it would provide secondary effluent quality until 2040 should the high rate of sewered population growth occur.

Figure 1 also shows the calculated raw wastewater loading capacity, if the primary tank was to be operated as chemically enhanced primaries (CEP's) under all flow and load conditions. This is the black dashed line, which shows a 30% increase in the BOD load to 36,000 kg/day that could be accommodated by the BAF system. This would extend the satisfactory operating range of the plant to 2040 for the high growth scenario, 2060 for the expected or design growth scenario, and to 2065 for the low growth scenario. Note that a loading of 36,000 kg/day BOD as raw wastewater is equivalent at ADWF conditions to the organic load contained in a flow rate of about 140 ML/day.

In actual fact, the plant has been designed to accommodate a BOD load of about 34,000 kg/day for maximum month loading condition. There is also a 12.5 % redundancy built into the module sizing and number of modules, i.e. with all modules operating, the plant capacity would 12.5 % higher.

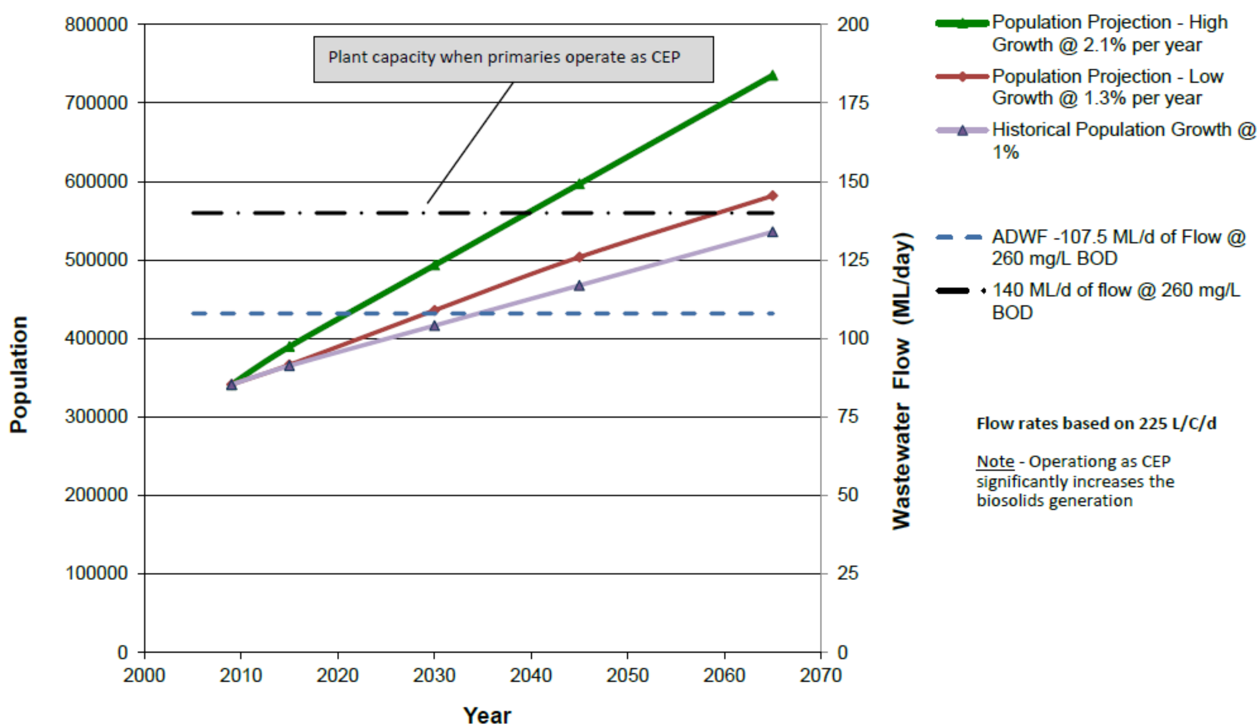
This figure is the best tool to compare how long the plant would last into the future because the per capita BOD load in CRD is expected to be constant at the 65 grams/capita/day level because the waste loads will mostly remain as residential, institutional, or commercial. It would take some major industries to locate in Victoria to increase the per capita loading. Should such an industry locate in Victoria, then there would be a requirement for an individual industry pre-treatment facility to be built.

Figure 2 is a graph of population increase and flow versus time for the three growth scenarios from above. The graph utilizes a conservative approach of 225 l/capita/day and does not account for expected water reductions.

As discussed above, although we understand capacity in terms of flow for a secondary biological treatment plant, it is not as relevant as organic loading. Hydraulically, the plant is designed to pass 2 times the 108 ML/day ADWF or 216 ML/day. The primary plant is very flexible in terms of its hydraulic capacity being able to treat up to 430 ML/day when operated as a CEP plant. Increasing the growth rate of population will increase both the flows to be treated at the plant and, at the same time, creating a proportional organic load increase.

Figure 2 shows the ADWF design capacity of the plant at 107.5 ML/day as a dashed light blue line that intersects with the 1.3 % expected growth rate curve at the year 2030 (red line). At an increased growth rate of 2.1%, the plant capacity is reached much sooner by the year 2018. At the lowest growth rate, which jives with historical growth rate information, the plant capacity in terms of flow is not reached until 2036. To cope with the high growth rate scenario, CEP operation would most likely be implemented to maintain adequate capacity until 2040.

Figure 2
Serviced Population and Flow Capacity of Secondary Treatment Plant



Operating the primary clarifiers as CEP facilities significantly increases the ability to handle increased loadings equivalent to the loading from a 140 ML/day plant, which stretches the life line of the plant to 2040 for the high growth scenario and 2060 and 2065 for the most probable growth and low growth rate respectively. If water reductions were incorporated, these life lines would be stretched even further into the future. Essentially Figure 2 is echoing the same conclusions as Figure 1**.**

2.2 The Sewage Commission Questions

The Sewage Commission asked some very pointed questions as “what ifs”?

A. Flows were higher than expected, what would be the impact on the McLoughlin plant if:

We consider this as the High Growth Scenario? – The plant would not last as long unless CEP operations were implemented, see above.

All properties on septic tanks were connected? – This is actually included in all growth rate scenarios in that most septic tank areas are located in the Westshore - currently the Westshore flows sent to Macaulay are about 7 ML/day from about 31,000 connected equivalent persons.

Colwood connects rapidly? –A portion is already connected and rapid connection is covered by all growth scenarios.

Municipalities don't achieve expected reductions in I&I? – This would not change the design capacity of the BAF plant. Hydraulically the BAF plant can handle 2 x ADWF or 216 ML/day, which currently is reached only a small percentage of the time. The organic load on the plant would not change, so BAF plant size would not change. The lack of reduction in I&I would only impact the primary plant operations. The primary plant is designed to accommodate up to 4 times ADWF or 430 ML/day. No reduction in I&I would mean that more overflows would occur at Clover and Macaulay pump stations or chemical addition (CEP operation) would be required more frequently if this additional I&I were conveyed to McLoughlin. There would be no real impact on our current design of plant facilities.

Organic load is higher than expected? – This eventuality is covered off by the high growth rate scenario. The useful life of the plant would be reduced and the West Shore plant would need to be constructed prior to 2030 or most likely, CEP would be operated to stretch the life of the plant.

Less than expected benefits of water conservation? – This means that the per capita flows would remain closer to 225 l/capita/day than 195 l/capita/day - 15% increase in flow. Therefore the concentration of BOD and TSS would reduce, but no impact on organic load. Extra flow can be easily accommodated by the flexible primary plant design resulting in no loss of life expectancy of secondary plant.

Other factors that would increase flows or loads? – Flows not a problem as discussed above. Load increases might come from either (i) accelerated downtown redevelopment and increase in density of population or (ii) major industrial development and increase of organic load. The densification issue is partially covered by 2.1% growth rate comments. If the densification occurs faster than expected, development of another plant site on the Westshore would be required prior to 2030 to redirect the current Westshore flows and loads. As a contingency, the CRD could also start negotiating access to nearby DND lands to enable future expansion.

B. Probable Flow and Load Growth Scenario

There is a high probability that the 1.3% growth rate will occur. This growth scenario was exactly the set of conditions specified as the basis for the design (i.e. operating costs will be close to the design predictions and sludge quantities will be at the loadings predicted) and covers off:

- The impacts of sewering all septic tank connections in the Westshore by 2030.

- Sewering an expected expansion and connection to sewers in Colwood and the Westshore. The overall 1.3 % growth included higher growth rates of sewered population on the Westshore of say 3 to 5 % per year compared to < 1% growth for infill sewering and densification in the other municipalities such as Victoria, Saanich, and Oak Bay.

- As indicated above, the impact of I&I is not of key importance to sizing the secondary plant facilities, and a very conservative level of reduction has been selected to size the transmission piping changes and pump stations as well as the storm flow capability of the primary settling CEP facilities.

- Organic loads of 65 grams BOD/capita/day have historically been experienced, which is within the normal range for municipalities with a largely residential population.

- The reduction of sewage flow per capita rates is in line with the records of water consumption experienced since the program of water conservation began and is evident in the gradual increase in BOD and TSS concentrations measured and used in the design calculations.

C. Low Growth Rate Scenario - Flow and Load Considerations

This scenario is all good news because the facilities will produce a plant that will have a useful life significantly longer than the chosen design scenario.

If estimates of growth were high? – The 1% growth rate curve for both BOD and flow show that the plant would have sufficient capacity 2035 without CEP and almost to 2070 with chemically enhanced primary operation of the primaries.

If no properties on septic tanks connect? – Then future growth of the Westshore sewer connection would drop and the plant would last proportionately longer, say to 2040.

Colwood doesn't connect? – Same as the above, in that the plant would last even longer-then the Westshore plant would not have to be built until well into 2040's.

Municipalities achieve higher than expected I & I control? – The concentrations of BOD, and TSS would increase during storm flows but the plant would not last any longer - and the frequency and severity of storm flows above 2 to 4 times ADWF would decrease, resulting in less frequent use of CEP mode of operation.

Organic Load is lower than expected? – Plant lasts longer, operating costs for power and sludge handling will decrease and sludge quantities will be proportionately less.

Higher than expected benefits from water conservation? – Then the concentration of BOD and TSS will go up in proportion to the reduction but loads would remain the same – very little impact on useful life expectancy of the plant.

Other factors reducing flow and load? – This could be such occurrences of an industry such as some industries moving out of town, which would have the result of increasing the plant capacity by as much as 5 %.

D. Timing and Impact of Developing a Westshore Plant

Planning reports supporting the conceptual design and sizing of the Mcloughlin Point WWTP have always intended that a Westshore plant be established when the flows and loads to the Mcloughlin plant match the capacity of that facility.

Figure 3 - Impact of Westshore Plant Construction on McLoughlin Plant Useful Life at Various Sewered Population Growth Rates

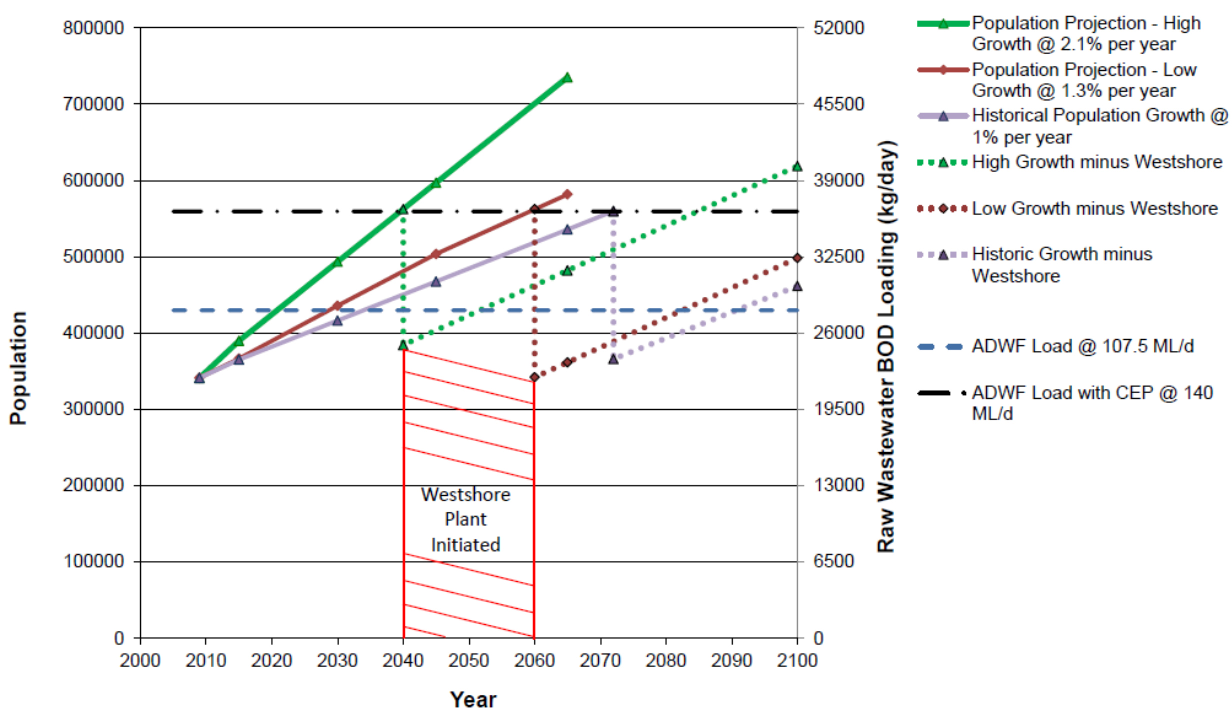


Figure 3 illustrates when this Westshore plant onset of operation might be required:

- For the most probable growth rate scenario of 1.3% per year, the Westshore plant could be delayed until about 2060 by operating the facility as a CEP/BAF plant.

- Similarly for the high growth rate of sewered population of 2.1%, operation as a CEP plant at Mcloughlin would provide sufficient capacity to treat Westshore flows and loads until 2040.

Figure 3 also shows that splitting of the Westshore loads to a Westshore plant would extend the useful life of the Mcloughlin facility to about 2080 for the high growth rate scenario and almost to the turn of the century for the most probable growth rate, provided Mcloughlin was to continue to operate as a CEP/BAF facility. In fact, for the 1.3% growth scenario, the plant could return to BAF operation without primaries until 2080.

Operation as a CEP/BAF plant does generate significantly more bio-solids and the CRD could decide to bring on the Westshore plant earlier, say around 2035 to 2040 because of the impact of additional inert sludge on the bio-solids stabilization facilities. It is common practice at BAF facilities to operate chemically enhanced primary treatment.