

2018 Caledonia WWTP Annual Report

Prepared for: Zafar Bhatti, MECP West Central Region, Guelph

Prepared by: Jessica Ignaszak, Water and Wastewater Technologist, Haldimand County

Date: February 26, 2019

Copy to: David Kohli, Project Manager, Veolia Water Canada
Jim Matthews, Compliance Supervisor, Haldimand County
Tyler Kelly, MECP Inspector, Hamilton District Office

1. Background

The Caledonia WWTP is owned by Haldimand County and operated by Veolia Water. The WWTP operates under ECA # 0327-9LUNE8 and has a nominal design flow of 7,200 m³/d. The WWTP receives flow from the Nairne St. and Main (on-site) pumping stations. The plant is a stacked conventional activated sludge plant design with tertiary filtration, aerobic digestion, chlorine disinfection and de-chlorination. Treated effluent is discharged to the Grand River. Biosolids are disposed of by land application or stored at Townsend lagoon until conditions allow land application.

2. Per Capita Flows and Loadings

Table 1 – Caledonia Per Capita Flows and Loadings			
Parameter	2017	2018	
Population	9,674	9,674	
Average Daily Influent Flow (m ³ /d)	3,517	3,208	
Peak Daily Influent Flow (m ³ /d)	18,863	16,684	
Average Influent BOD ₅ (mg/L)	197	228	
Average Influent TSS (mg/L)	218	286	
Average Influent TKN (mg/L)	45	47	
Average Influent TP (mg/L)	5.6	6.1	
Per Capita Flows and Loadings			
Parameter	2017	2018	Typical
Per Capita Wastewater Flow (L/person/day)	364	332	350 – 500* 332**
Per Capita BOD ₅ Loading (g/person/day)	72	77	80*
Per Capita TSS Loading (g/person/day)	79	95	90*
Per Capita TKN Loading (g/person/day)	16	16	13*
Ratios			
Peak Day / Annual Average Flow	5.4	5.2	2.0 – 3.0
Influent TSS/BOD ₅	1.1	1.3	0.8 – 1.2
Influent TKN/BOD ₅	0.2	0.2	0.1 – 0.2
Notes:			
* Results are for typical residential wastewater and are identified in Metcalf and Eddy, Wastewater Treatment and Reuse (4 th Edition). **Grand River Conservation Authority, “2017 Watershed Overview of Wastewater Treatment Plant Performance”, July, 2018.			

Comments:

- Flows to the plant were lower in 2018 compared to 2017, this could be due to an decrease in wet weather contributions (2017 total precipitation = 1,309 mm, 2018 total precipitation = 1,079 mm);
- BOD₅ and TSS concentrations are higher compared to 2017 values;
- The BOD₅, TSS and TKN per capita loading are close to typical values;
- Per capita waste water flow of 332 L/person/day is the same as the median value for sewage treatment plants within Grand River watershed (GRCA);
- The ratio for peak day/annual average flow of 5.2 is well above typical 2-3 is due to extreme weather events;
- The TSS/BOD₅ ratio of 1.3 is close to the typical range of 0.8-1.2 and TKN/BOD₅ ratio of 0.2 is within typical range of 0.1-0.2.

3. Performance

3.1. Effluent Concentration Compliance

Table 2 is a summary of the effluent quality objectives and limits identified in the ECA # 0327-9LUNE8.

Parameter	Objectives (mg/L)	Limits (mg/L)	Loading Limits (kg/d)
cBOD ₅	15.0	25	180
TSS	15.0	25	180
Total Phosphorous	0.15	0.3	2.2
Total Ammonia Nitrogen (May – Nov)	0.75	1.0	N/A
Total Ammonia Nitrogen (Dec – Apr)	1.5	2.0	N/A
Total Chlorine Residual	Non - detectable	0.02	N/A
E. Coli	100 CFU/100 mL	N/A	N/A
Best efforts shall be used to maintain the pH of the effluent within the range of 6.0 – 9.5 inclusive, at all times.			

Concentration compliance for all parameters identified in Table 2 (except E. Coli. and pH) are based on monthly averages of samples taken weekly. Compliance for E. Coli is based on Geometric Mean Density of all samples in the month, while pH should be maintained within the range at all times. The loading compliance for all parameters identified in Table 2 is based on annual averages. A summary of all monthly data is included in Table 7 of this report.

Haldimand County is also committed to achieving the Grand River Conservation Authority (GRCA) final effluent targets for total phosphorous (TP) and total ammonia nitrogen (TAN). The targets are shown for secondary treatment plants in Table 3 below.

Table 3: GRCA Tertiary Treatment Targets for Effluent discharging into the Grand River	
Parameter	Final Target (mg/L)
Total Effluent Phosphorous	0.15
Total Ammonia Nitrogen	
Summer	1.0
Winter	2.0

The monthly average concentrations for cBOD₅ compared against the ECA objective and limit are shown in Figure 1.

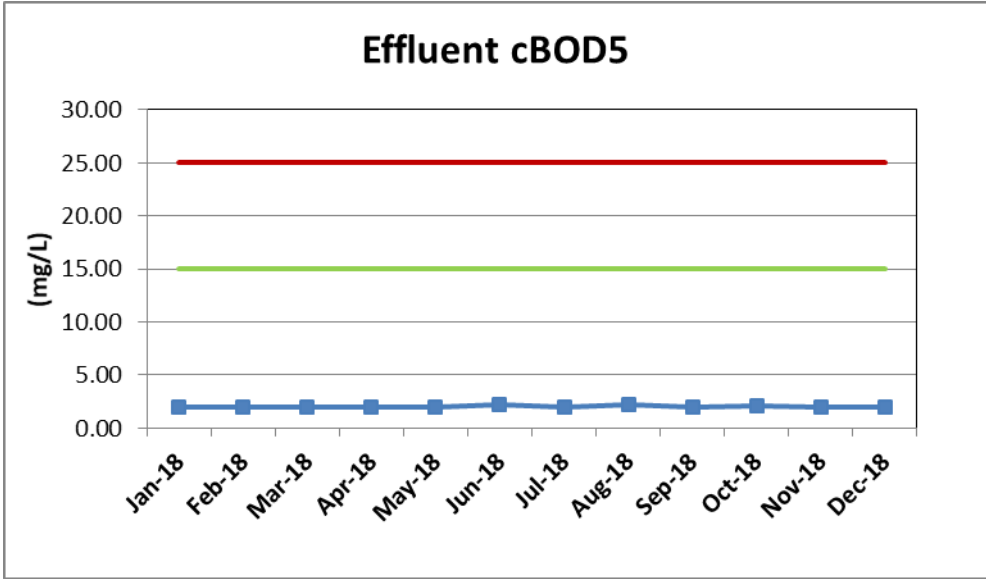


Figure 1 – Monthly Average Effluent cBOD₅ Compliance Graph

Comments:

- Monthly average effluent cBOD₅ met the compliance limit and objective in all 12 months.

The monthly average concentrations for TSS compared against the ECA objective and limit are shown in Figure 2.

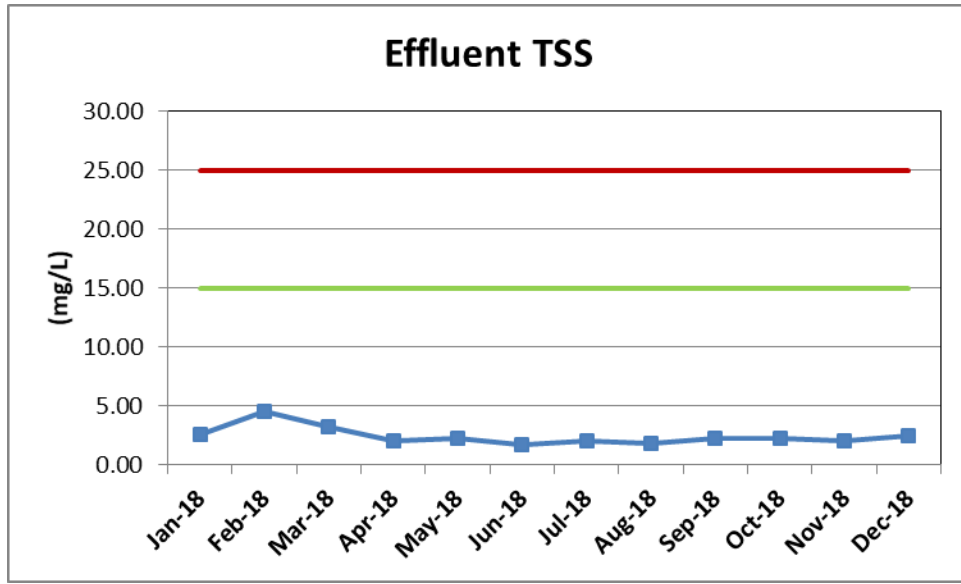


Figure 2 – Monthly Average Effluent TSS Compliance Graph

Comments:

- Monthly average effluent TSS met the compliance limit and objective in all 12 months;
- The effluent is essentially free of solids and visual observations indicate that the effluent is free of oils.

The monthly average concentrations for TP compared against the ECA objective and limit and the GRCA final target are shown in Figure 3.

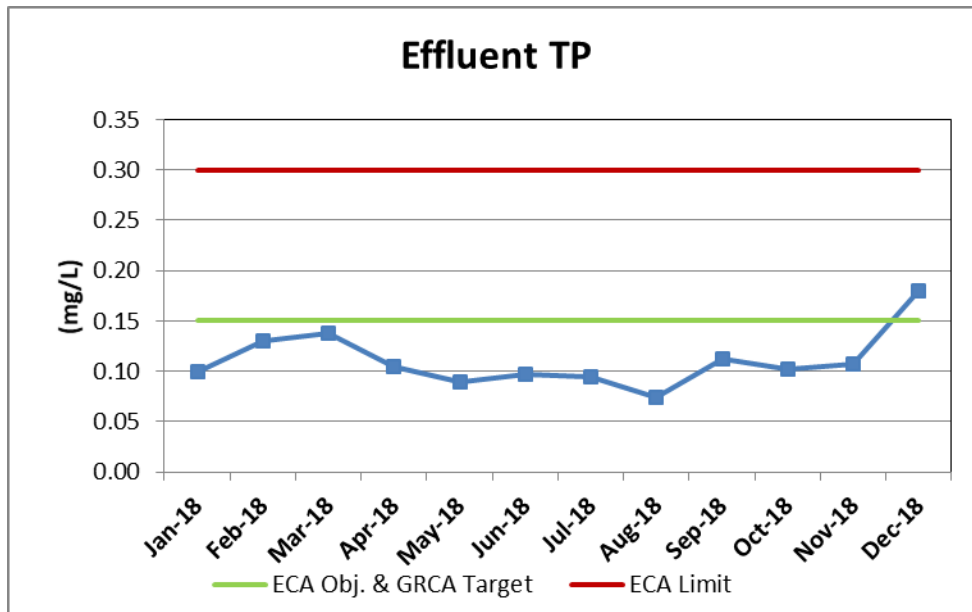


Figure 3 – Monthly Average Effluent TP Compliance Graph

Comments:

- Monthly average effluent TP met the ECA limit in all 12 months and the objective in 11 of 12 months;
- A high TP result reported by the outside lab in December 2018 did not compare with in-house testing;
- The GRCA final TP target of 0.30 mg/L was achieved in 11 of 12 months.

The monthly average concentrations for NH₃ compared against the ECA objective and limit and GRCA final target are shown in Figure 4.

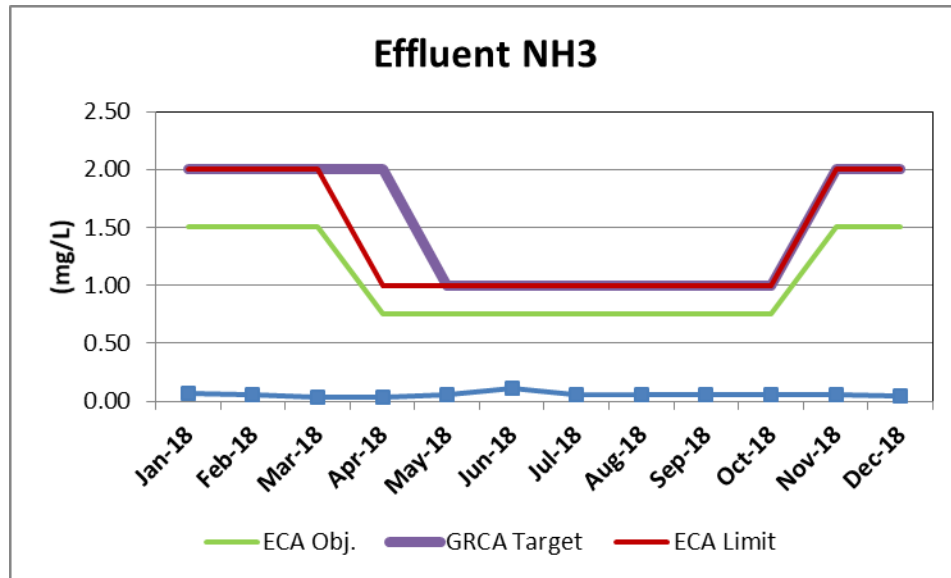


Figure 4 – Monthly Average Effluent NH₃ Compliance Graph

Comments:

- Monthly average effluent ammonia met the ECA compliance limit and objective in all 12 months.
- The GRCA final target of 2.0 mg/L (November to April) and 1.0 mg/L (May to October) was achieved in all 12 months.

The monthly average concentration for Total Chlorine Residual compared against the ECA objective and limit are shown in Figure 5.

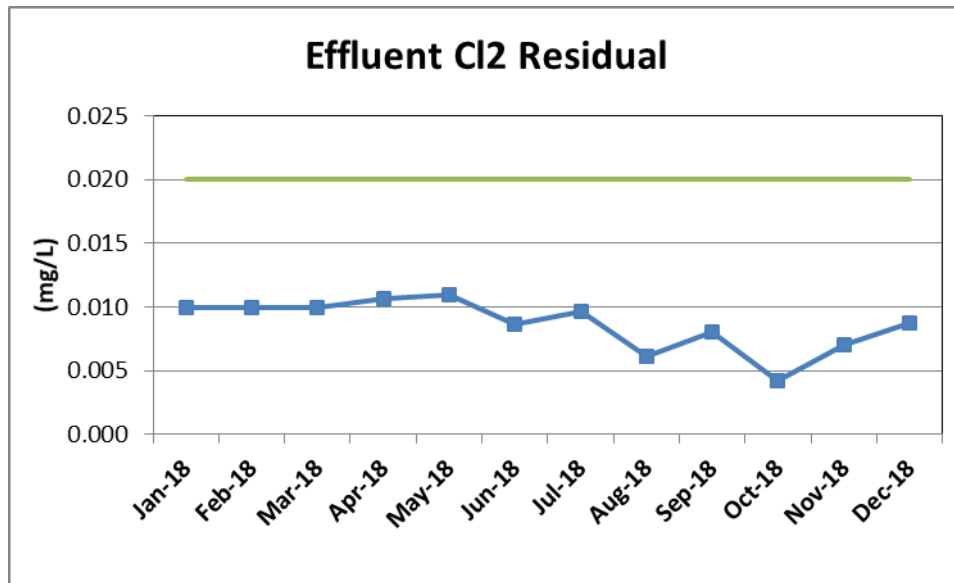


Figure 5 – Monthly Average Total Chlorine Residual Compliance Graph

Comments:

- Monthly average effluent total residual chlorine met the compliance limit in all 12 months.

The monthly geometric mean density for E. Coli compared against the ECA objective is shown in Figure 6.

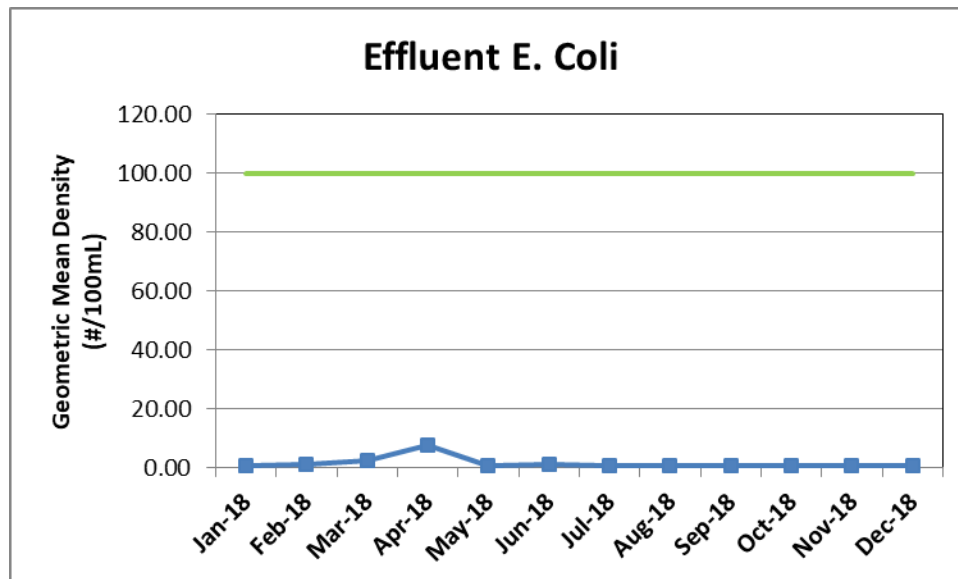


Figure 6 – Monthly Geometric Mean Density for E. Coli Compliance Graph

Comments:

- Monthly E. Coli Geometric Mean Density met the compliance limit and objective in all 12 months.

Effluent pH results compared against the ECA objective is shown in Figure 7.

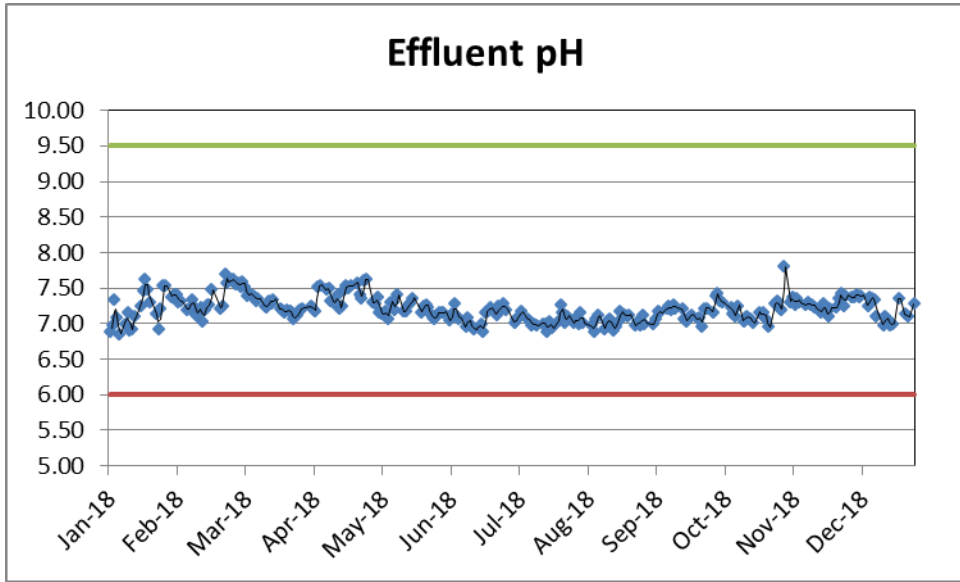


Figure 7 – Effluent pH Compliance Graph

Comments:

- pH values for the year 2018 met the compliance limit and objective in all 12 months.

The monthly average flow compared to design flow is shown in Figure 8.

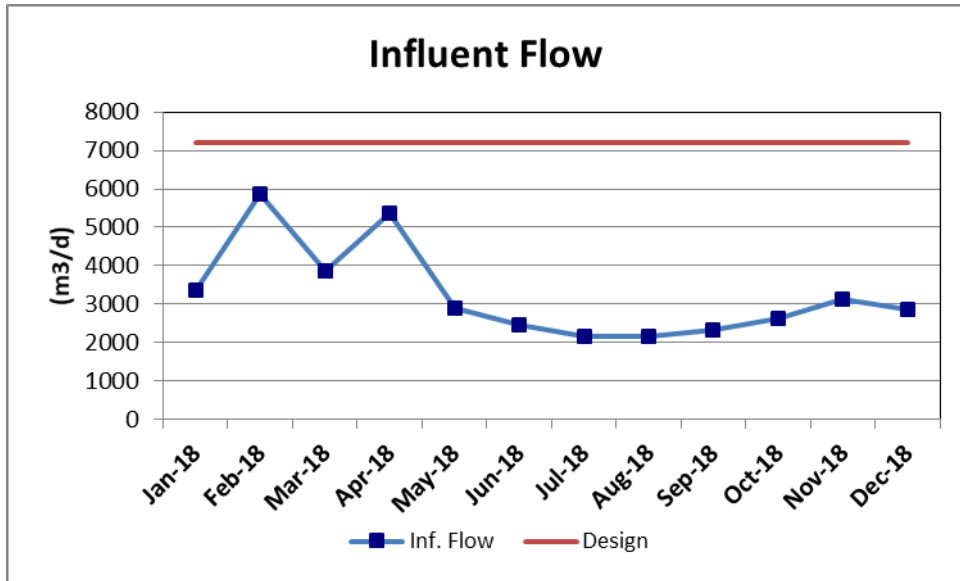


Figure 8 – Monthly Average Flow Compliance Graph

Comments:

- The monthly average flows were below design in all 12 months.

- **Effluent Loading Compliance**

A summary of the annual average effluent loading compliance is displayed in Table 4.

Table 4 – Summary of Annual Average Effluent Loading Compliance		
Parameter	Annual Average Loading	Annual Average Loading Limit
cBOD ₅ Loading	6.6 kg/d	180 kg/d
TSS Loading	8.5 kg/d	180 kg/d
TP Loading	0.4 kg/d	2.2 kg/d

Comments:

- The annual average loading limits were met for cBOD₅, TSS and TP for 2018.

- **Non-Regulated Effluent Sampling**

Caledonia is also required to sample the final effluent for alkalinity and temperature. The following are the results:

The non-regulated weekly final effluent alkalinity results are displayed in Figure 9.

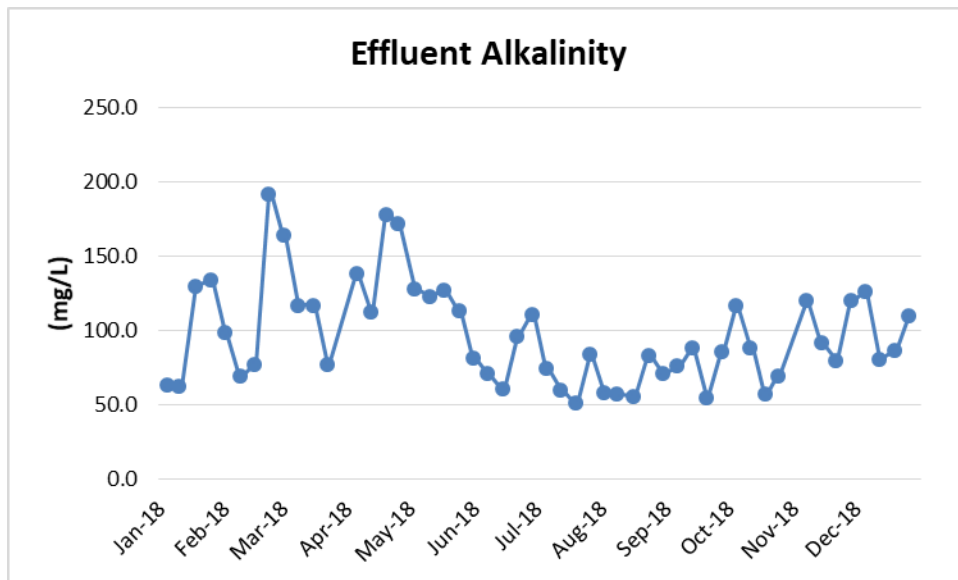


Figure 9 – Non-Regulated Final Effluent Alkalinity Trend

Comments:

- Operations staff ensure that adequate alkalinity is available for complete nitrification. Alkalinity boosting chemical (soda ash) is added to the raw sewage when the concentration drops to less than 60 mg/L in the effluent.

Final effluent temperature results are displayed in Figure 10.

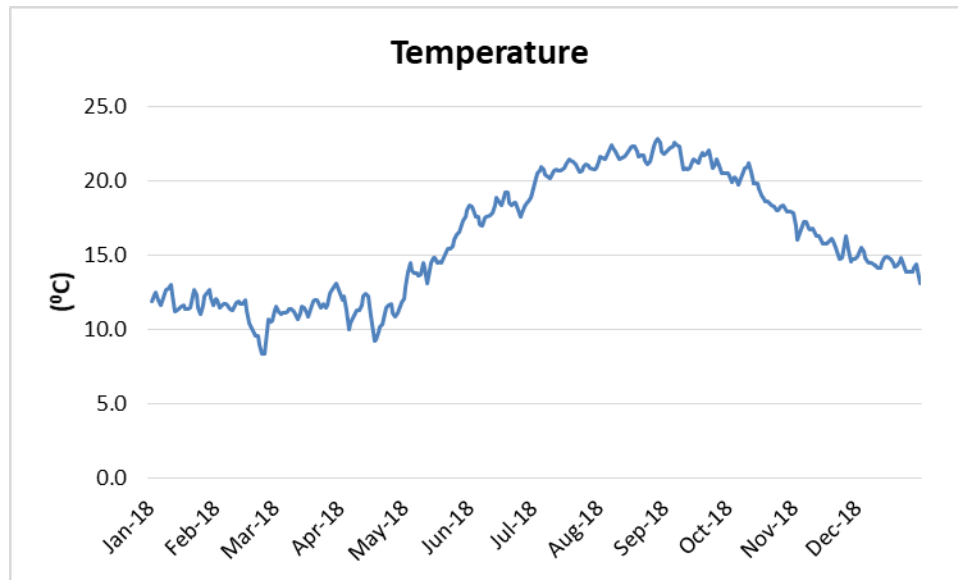


Figure 10 – Final Effluent Temperature Trend

Comments:

- The temperature ranges from 8.3°C in February to 22.9°C in August.

4. Operational Issues

- Significant rain events and snow melt in mid-February resulted in extremely high levels and flows in the Grand River. Inflows to the facility were extremely high during this period and on two occasions the Nairne Street Pumping Station was overwhelmed and raw sewage overflows were necessary to protect equipment and property. Both overflow events were reported as required.

5. Sludge Generation

- **Sludge Production**

Reported sludge being removed from the treatment plant is compared to projected sludge that Caledonia should produce. If the difference between the projected and actual masses (kg/d) is within $\pm 15\%$, then the reported data is likely accurate. A summary of the sludge accountability calculation is displayed in Table 5. See Appendix 1 for sludge accountability calculations.

Table 5 – Summary of Sludge Accountability				
Reported Sludge (kg/d)		Projected Sludge (kg/d)		Accountability
Intentional Wasting	744kg/d	Primary Sludge	693 kg/d	31%
Unintentional Wasting	8 kg/d	Biological Sludge	273 kg/d	
Total Reported Sludge	752 kg/d	Chemical Sludge	121 kg/d	
		Total Projected Sludge	1,087 kg/d	

Comments:

- The sludge accountability calculation did not close within $\pm 15\%$ (31%). This indicates there may be some data accuracy issues with the sampling of raw sewage and primary effluent streams or on the reported sludge, the volume and concentration of solids from the primary clarifiers to the digesters may be inaccurate.

Biosolids Removal

Table 6 identifies a monthly summary of the volume of biosolids removed from the digesters at the Caledonia WWTP.

Month	Volume of Biosolids Removed to Townsend (m ³)		Volume of Biosolids Removed for Land Application (m ³)		Concentration (mg/L)		Hauled Biosolids Generated (kg)	
	2017	2018	2017	2018	2017	2018	2017	2018
January	675	819			20,403	24,607	13,772	20,153
February	483	904			26,203	24,694	12,656	22,323
March	861	724			22,670	25,217	19,519	18,257
April	611	722	45		22,858	23,808	14,995	17,189
May	990	406		317	22,366	21,194	22,142	15,323
June	862	816	136	181	23,012	20,739	22,966	20,676
July	1,127	450		362	17,003	16,968	19,162	13,778
August	588	496	137	495	21,261	16,734	15,414	16,616
September	665	722			30,221	17,035	20,097	12,299
October	313	180	271	1,160	26,502	24,386	15,477	32,652
November	270	225	270		24,359	28,588	13,154	6,432
December	628	779			31,989	25,289	20,089	19,700
Total	8,932	7,244	859	2,515			209,443	215,398

Comments:

- The volume of biosolids removed in 2018 of 9,759 m³ was 1,688 m³ less than the volume hauled in 2017 of 11,447 m³.
- The mass of solids removed in 2018 of 215,398 kg was 5,955 kg more than in 2017 (209,443 kg).
- Differences in solids removed from the digesters may be due to process upsets throughout the year resulting in less decanting being done prior to haulage.
- In 2019 it is estimated that the mass of sludge removed will be comparable to 2018.

6. Biosolids Disposal

- Biosolids were applied to agricultural land from May to August and October. Land application sites were B1195, HN1039, HN1315, HN1331, HN1236, HN1341, B1055, HN1229, HN1355, HN1369 and HN1084.

7. Facility Activities in 2018

- Environmental sampling of the Grand River was conducted for determination of next steps in providing more wastewater treatment capacity for Caledonia;
- Options analysis being conducted as to whether to upgrade existing plant or build a new facility in 10 year forecast;
- Diesel tank replacements for plant and pump stations;
- Completed sodium bi-sulphite special study to determine optimal dosage for process and minimizing receiving water quality impacts.

8. Planned Activities for 2019

- Aeration tank air diffuser upgrades;
- Installation of new sodium hypochlorite storage and dosing system;
- Rebuild the remaining two (2) of three (3) raw sewage pumps at the Nairne Street Pumping Station;
- Install new explosion proof rated lighting in the wet-well at the Nairne Street Pumping Station;
- Replace the emergency power automatic transfer switch (ATS) for the emergency power diesel generator system at the WWTP.

9. Bypasses, Spills and Overflows

- Table 7 is a summary of all bypass events at the Caledonia WWTP in 2018.

Table 7 – Summary of Bypass Events				
Date(s)	Duration (hours.min)	Volume Bypassed (m ³)	Reason	Process Bypassed
February 21, 2018	4.30	378.0	High Flows	Raw (Overflow)
February 23, 24 2018	23.25	1,265	High Flows	Raw (Overflow)

Comments:

- There were no by-pass events in 2018.
- There were 2 overflow events at the Nairne pumping station.
- Both events reported in 2018 were the result of rain events and snow melt increasing levels in the Grand River and increasing inflow/infiltration to the system.

10. Public Complaints

- Two odour complaints from local residents in September and November at the Nairne pumping station. As part of the recent upgrades to that location to accommodate the new McClung pumping station discharge, a new chamber was added adjacent to the Nairne pumping station and odours were believed to be coming from that chamber. A manhole seal was installed by the Haldimand County staff on an access hatch to the chamber.

11. Monthly Average Effluent Data Summary

- Table 8 displays a summary of all monthly average effluent data

12. Calibration Reports

- See attached

13. Maintenance Activities

Routine preventative maintenance was performed on various plant and pumping station equipment during the reporting period. This includes tasks such as:

- the lubrication of applicable bearings and/or gearboxes on various equipment;
- the removal, inspection and servicing of numerous submersible pumps;
- the inspection and servicing of chemical feed systems;
- the regular inspection and cleaning of the tertiary filtration system;
- the inspection and servicing of various HVAC systems;
- the inspection, testing and servicing of various back-up generator systems;
- See attached for the complete annual maintenance report.

Table 8 - Summary of Monthly Average Effluent Data

Month	Effluent Flow	CBOD	CBOD Limit	CBOD Loading	CBOD Loading Limit	TSS	TSS Limit	TSS Loading	TSS Loading Limit	Phosphorous	Phosphorous Limit	Phosphorous Loading	Phosphorous Loading Limit	pH	Temperature	Ammonia	Ammonia Limit	Unionized Ammonia	Alkalinity	Chlorine Residual	E. Coli	E. Coli Limit
	m ³ /d	mg/L	mg/L	kg/d	kg/d	mg/L	mg/L	kg/d	kg/d	mg/L	mg/L	kg/d	kg/d	(SU)	°C	mg/L	mg/L	mg/L	mg/L	mg/L	No/100 ml	No/100ml
Jan-18	3372	2.00	25	6.7	180	2.60	25	8.8	180	0.10	0.3	0.34	2.2	7.2	12.0	0.06	2	0.0003	97	0.010	1.0	200
Feb-18	5862	2.00	25	11.7	180	4.50	25	26.4	180	0.13	0.3	0.76	2.2	7.3	11.0	0.06	2	0.0003	109	0.010	1.2	200
Mar-18	3848	2.00	25	7.7	180	3.25	25	12.5	180	0.14	0.3	0.53	2.2	7.3	11.6	0.04	2	0.0002	119	0.010	2.4	200
Apr-18	5357	2	25	10.7	180	2	25	10.7	180	0.11	0.3	0.56	2.2	7.4	11.1	0.04	2	0.0002	150	0.011	7.8	200
May-18	2900	2	25	5.8	180	2.2	25	6.4	180	0.09	0.3	0.26	2.2	7.2	15.0	0.06	1	0.0008	114	0.011	1.0	200
Jun-18	2475	2.2	25	5.4	180	1.75	25	4.3	180	0.10	0.3	0.24	2.2	7.1	18.2	0.11	1	0.0006	85	0.009	1.4	200
Jul-18	2157	2	25	4.3	180	2	25	4.3	180	0.10	0.3	0.20	2.2	7.0	20.9	0.06	1	0.0003	67	0.010	1.0	200
Aug-18	2168	2.16	25	4.7	180	1.8	25	3.9	180	0.07	0.3	0.16	2.2	7.0	21.9	0.05	1	0.0003	65	0.006	1.0	200
Sep-18	2322	2	25	4.6	180	2.25	25	5.2	180	0.11	0.3	0.26	2.2	7.1	21.5	0.05	1	0.0003	76	0.008	1.0	200
Oct-18	2615	2.08	25	5.4	180	2.2	25	5.8	180	0.10	0.3	0.27	2.2	7.2	19.3	0.06	1	0.0003	83	0.004	1.0	200
Nov-18	3113	2	25	6.2	180	2	25	6.2	180	0.11	0.3	0.33	2.2	7.3	15.9	0.06	1	0.0003	103	0.007	1.0	200
Dec-18	2850	2	25	5.7	180	2.5	25	7.1	180	0.18	0.3	0.51	2.2	7.2	14.4	0.04	2	0.0002	101	0.009	1.0	200
Average	3,253	2		6.6		2.4		8.5		0.10	2.48	0.40		7.2	16.1	0.10		0.0003	97	0.009	1.7	

Appendix #1 Caledonia WWTP Sludge Accountability 2018

Influent Flow = 3,208 m ³ /d	Primary Effluent TSS = 0.0701 kg/m ³
Primary Effluent BOD = 0.1237 kg/m ³	Secondary Effluent cBOD = 0.0020 kg/m ³
Sludge Production Ratio = 0.70 – CAS (0.65 – EA)	SAX Dosage = 0.160 m ³ /d
Primary Sludge Flow = 29 m ³ /d	Primary Sludge Concentration = 25.664 kg/m ³
Density of SAX = 1480 kg/m ³	% Aluminum in SAX = 10.7 %
Sodium aluminate Sludge Production Ratio = 4.79	Influent TSS = 0.286 kg/m ³
Final effluent TSS = 0.0024 kg/m ³	

Projected Sludge

Biological Sludge = Influent Flow * (Primary Effluent BOD – Secondary Effluent BOD) * SPR

Biological Sludge = 3,208 m³/d * (0.1237kg/m³ – 0.0020 kg/m³) * 0.70

Biological Sludge = 273.3 kg/d

Chemical Sludge = SAX Dosage * SAX Density * % Aluminum * SPR

Chemical Sludge = 0.160 m³/d * 1480 kg/m³ * 0.107 * 4.79

Chemical Sludge = 121.1 kg/d

Primary Sludge = Influent Flow * (Influent TSS – Primary Effluent TSS)

$$\text{Primary Sludge} = 3,208 \text{ m}^3/\text{d} * (0.286 \text{ kg}/\text{m}^3 - 0.0701 \text{ kg}/\text{m}^3)$$

$$\text{Primary Sludge} = 693 \text{ kg}/\text{d}$$

$$\text{Total Projected Sludge} = \text{Biological Sludge} + \text{Chemical Sludge} + \text{Primary Sludge}$$

$$\text{Total Projected Sludge} = 273.3 \text{ kg}/\text{d} + 121.1 \text{ kg}/\text{d} + 693 \text{ m}^3/\text{d}$$

$$\text{Total Projected Sludge} = 1,087 \text{ kg}/\text{d}$$

Reported Sludge

$$\text{Intentional Wasting} = \text{Primary Sludge Flow to Digester} * \text{Primary Sludge Concentration}$$

$$\text{Intentional Wasting} = 29 \text{ m}^3/\text{d} * 25.664 \text{ kg}/\text{m}^3$$

$$\text{Intentional Wasting} = 744.3 \text{ kg}/\text{d}$$

$$\text{Unintentional Wasting} = \text{Influent Flow} * \text{Effluent TSS}$$

$$\text{Unintentional Wasting} = 3,208 \text{ m}^3/\text{d} * 0.0024 \text{ kg}/\text{m}^3$$

$$\text{Unintentional Wasting} = 7.7 \text{ kg}/\text{d}$$

$$\text{Total Reported Sludge} = \text{Intentional Wasting} + \text{Unintentional Wasting}$$

$$\text{Total Reported Sludge} = 744.3 \text{ kg}/\text{d} + 7.7 \text{ kg}/\text{d}$$

$$\text{Total Reported Sludge} = 752 \text{ kg}/\text{d}$$

Sludge Accountability Calculations

$$\text{Sludge Accountability} = \frac{(\text{Projected Sludge} - \text{Reported Sludge})}{\text{Projected Sludge}} * 100$$

Projected Sludge

$$\text{Sludge Accountability} = \frac{(1,087 \text{ kg/d} - 752 \text{ kg/d})}{1,087 \text{ kg/d}} * 100$$

1,087 kg/d

$$\text{Sludge Accountability} = 31\%$$