2018 Hagersville WWTP Annual Report

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

Prepared by: Stéphanie Nolet, Water and Wastewater Technologist, Haldimand County

Date: March 21, 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 Hagersville wastewater treatment plant (WWTP) is owned by Haldimand County and operated by Veolia Water. The WWTP operates under the Environmental Compliance Approval (ECA) # 9215-AKJL5N issued on May 11, 2017. The WWTP has a nominal design flow of 4,200 m^3/d. The WWTP is equipped with an equalization tank to help manage high flow events. Two parallel extended aeration plants discharge treated effluent into a municipal drain which in turn discharges to Sandusk Creek. The plant is also equipped with tertiary filtration (2 units) and ultraviolet disinfection (2 units). Sludge is aerobically stabilized in four above ground tanks. 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 – Hagersville Per Capita Flows and Loadings			
Parameter	**2017**	**2018**	
Population	2,939	2,939	
Average Daily Influent Flow (m^3/d)	2,476	2,657	
Peak Daily Influent Flow (m^3/d)	13,220	16,191	
Average Influent BOD_5 (mg/L)	241	223	
Average Influent TSS (mg/L)	164	146	
Average Influent TKN (mg/L)	30	28	
Average Influent TP (mg/L)	5.5	4.8	
Per Capita Flows and Loadings			
Parameter	**2017**	**2018**	**Typical**
Per Capita Wastewater Flow (L/person/day)	843	904	350 – 500* 332**
Per Capita BOD_5 Loading (g/person/day)	203	202	80*
Per Capita TSS Loading (g/person/day)	138	132	90*
Per Capita TKN Loading (g/person/day)	25	25	13*
Ratios			
Peak Day / Annual Average Flow	5	6	2.0 – 3.0
Influent TSS/BOD_5	0.7	0.7	0.8 – 1.2

Influent TKN/BOD_5	0.1	0.1	0.1 – 0.2
Notes: * Results are for typical residential wastewater and are identified in Metcalf and Eddy, Wastewater Treatment and Reuse (4th Edition). **Grand River Conservation Authority, "2017 Watershed Overview of Wastewater Treatment Plant Performance", July, 2018.			

Comments:

- The annual average daily flow of 2,657 m^3/d represents 63% of the nominal design flow of 4,200 m^3/d . This is higher than the 2017 flow of 2,476 m^3/d. Significantly greater precipitation contributed to the higher flows.
- Per capita flow in 2018 is higher than typical and 2.7 times the GRCA watershed municipal per capita contribution recorded in 2017. Given the past efforts to address infiltration through sewer and manhole rehabilitation, it is expected that inflow through direct connections is the primary cause of the higher flows.
- Peak day flows are 6 times the average day flows and is higher than 2017 flows. The expected cause of the peak flows are inflow into the collection system.
- High per capita loading (BOD_5, TSS and TKN) are probably caused by high strength industrial discharge.
- The TSS/BOD_5 and TKN/BOD_5 ratios are close or within typical range.

3. Performance

- **Effluent Concentration Compliance**

Table 2 is a summary of the effluent quality objectives and limits identified in the ECA.

Table 2 – Summary of ECA Objectives and Limits for Effluent Quality			
ECA # 9215-AKJL5N Limits and Objectives Rated Capacity: 4,200 m^3/d Effective Date: May 11, 2017			
Parameter	**Objectives (mg/L)**	**Monthly Average Limits (mg/L)**	**Monthly Average Loading Limits (kg/d)**
$cBOD_5$	3.6	7.3	30.6
TSS	3.6	7.3	30.6
Total Phosphorous			
(June 1 – Nov 30)	0.10	0.15	0.61
(Dec 1 – May 31)	0.14	0.2	0.83
Total Ammonia Nitrogen (Nov. – Apr.)	2.2	3.6	
Total Ammonia Nitrogen (May – Oct.)	0.73	2.2	

E. Coli.	100 CFU/100 mL	200 CFU/100 mL	N/A
pH	6.5 – 8.5 (S.U.)	6.0 – 9.5 (S.U.)	N/A

Concentration and loading 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 a monthly Geometric Mean Density of all samples, while pH should be maintained within the range at all times. A summary of all monthly data is included in this report in Section 12.

The average concentrations for $cBOD_5$ compared against the ECA objective and limit are shown in Figure 1.

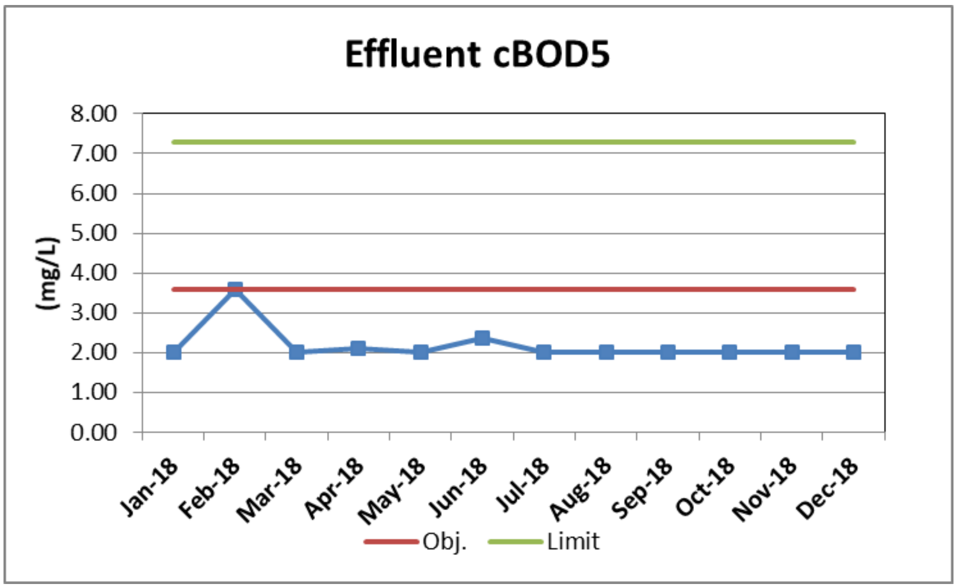

Figure 1 – Monthly Average Effluent $cBOD_5$ Compliance Graph

Comments:

- The monthly average effluent $cBOD_5$ met the compliance limit and objective in all 12 months.

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

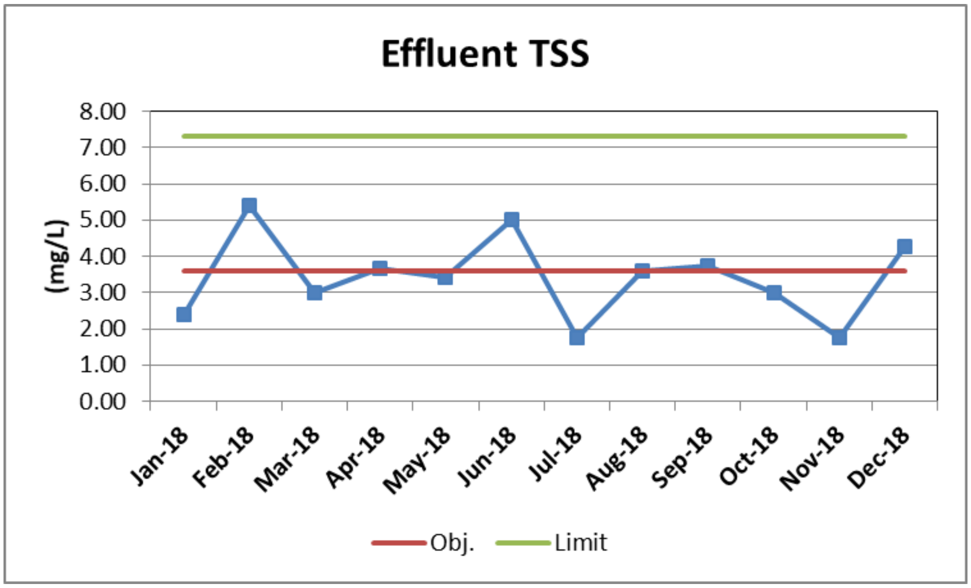

Figure 2 – Monthly Average Effluent TSS Compliance Graph

Comments:

- The monthly average effluent TSS met the compliance limit for all months;
- The monthly average effluent TSS exceeded the objective of 3.6 mg/L in February, April, June, September and December for various reasons. Occasionally the secondary effluent contains extremely small suspended solids particles of which the tertiary filtration system is unable to remove resulting in an elevated monthly average TSS (< 5.5 mg/L throughout the reporting period). These events are a result of high raw sewage flows following rain events and/or issues with phosphorus removal chemical dosing;
- The effluent is essentially free of solids and visual observations indicate that the effluent is free of oils.

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

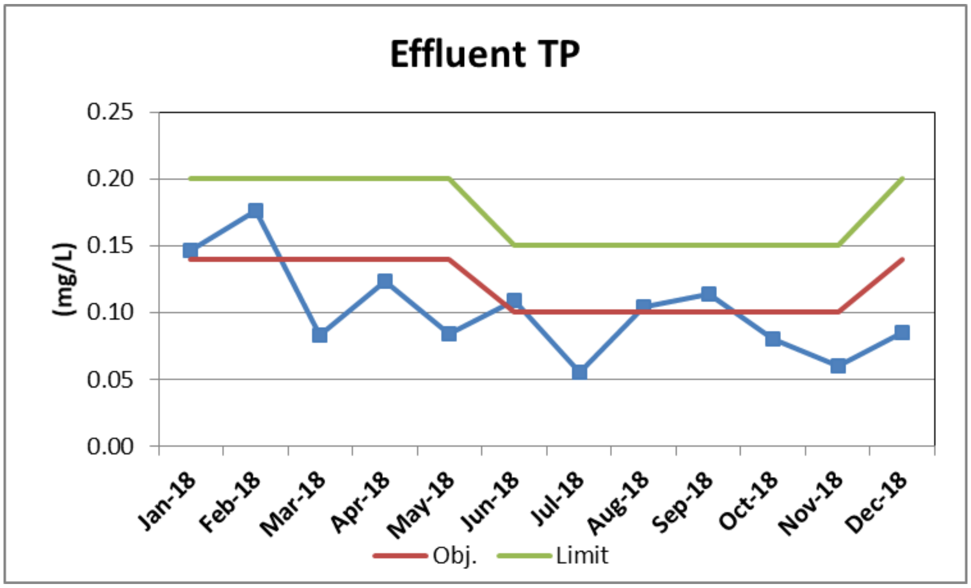

Figure 3 – Monthly Average Effluent TP Compliance Graph

Comments:

- The monthly average effluent TP met the compliance limit in all 12 months;
- The objective was exceeded in January, February, June and September;
- On May 17th, the phosphorous removal chemical was switched from aluminum sulfate to sodium aluminate. The Hagersville WWTP has struggled with low alkalinity during dry months and unlike aluminum sulfate, sodium aluminate does not consume alkalinity.

The monthly average effluent total ammonia nitrogen results compared against the objectives and limits are shown in Figure 4.

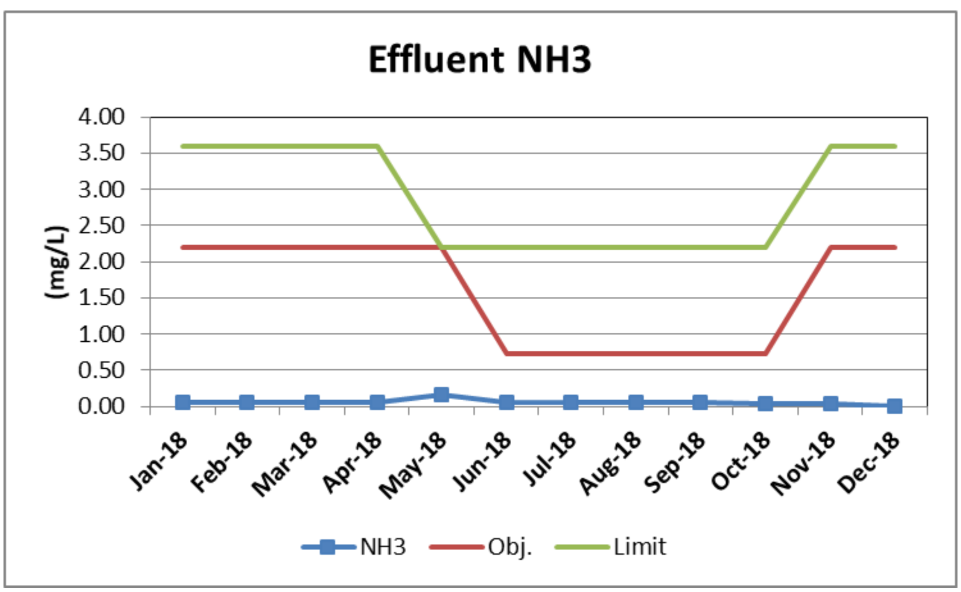

Figure 4 – Monthly Average Effluent Total Ammonia Nitrogen Compliance Graph

Comments:

- The monthly average effluent total ammonia nitrogen met the ECA compliance limits and objectives in all 12 months.

The monthly geometric mean density for E. coli compared against the limit are shown in Figure 5.

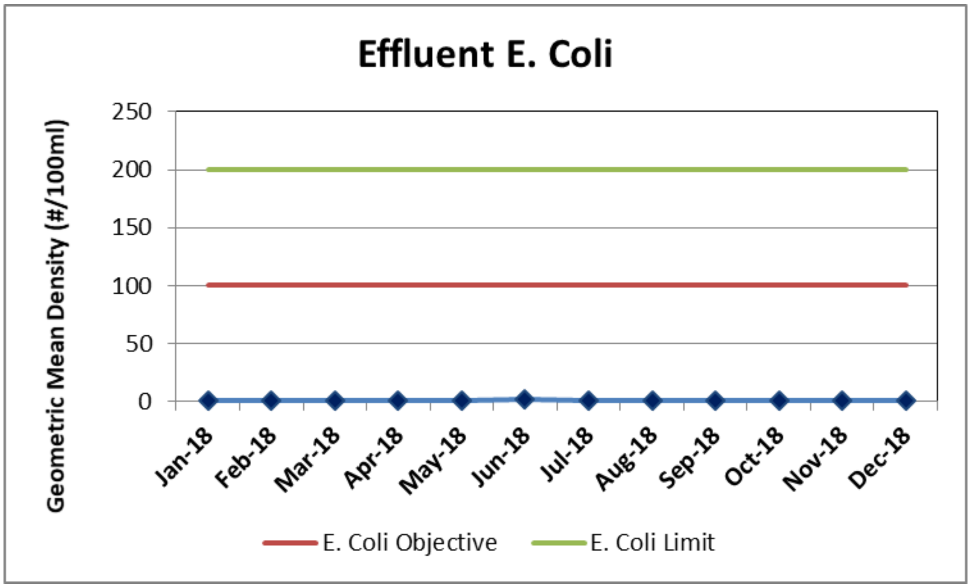

Figure 5 – Monthly Geometric Mean for E. coli Compliance Graph

Comments:

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

Effluent pH results compared against the ECA limits and objectives is shown in Figure 6.

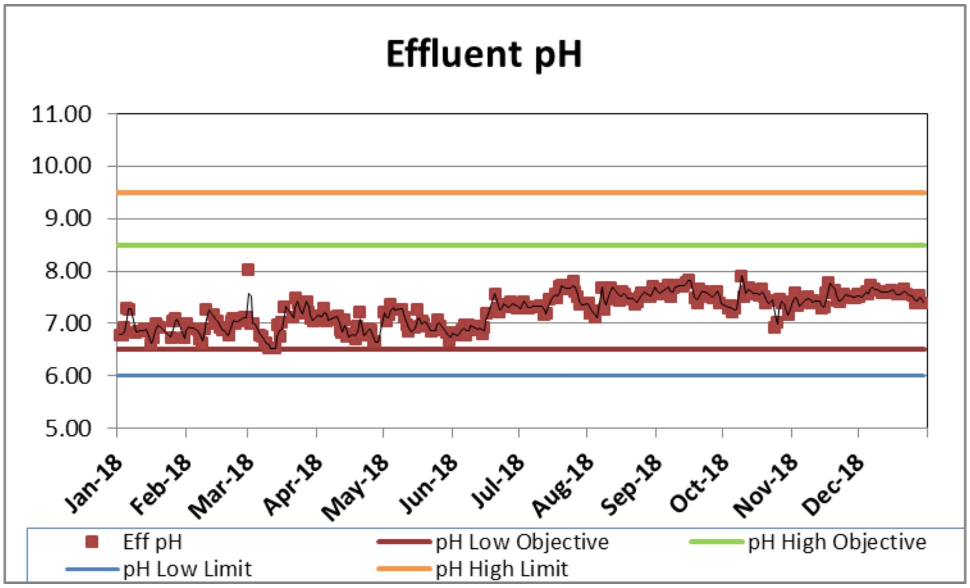

Figure 6 – Effluent pH Compliance Graph

Comments:

- The rise in pH in June is attributed to switching to sodium aluminate for phosphorous removal. Sodium aluminate is not acidic like aluminum sulfate;
- Lower pH values were due to a decline in leachate which lowered supplemental alkalinity as well as higher influent concentrations of ammonia due to dry weather events;
- Industrial discharge has also impacted pH as the industry has installed pH adjustment in their process to meet Sewer Use By-law requirements. Historical discharge pH for this industry was significantly higher.

- **Effluent Loading Compliance**

The Hagersville WWTP ECA has monthly average loading limits. The monthly average loading results compared against the limits are shown as follows:

The monthly average flows compared against design is shown in Figure 7.

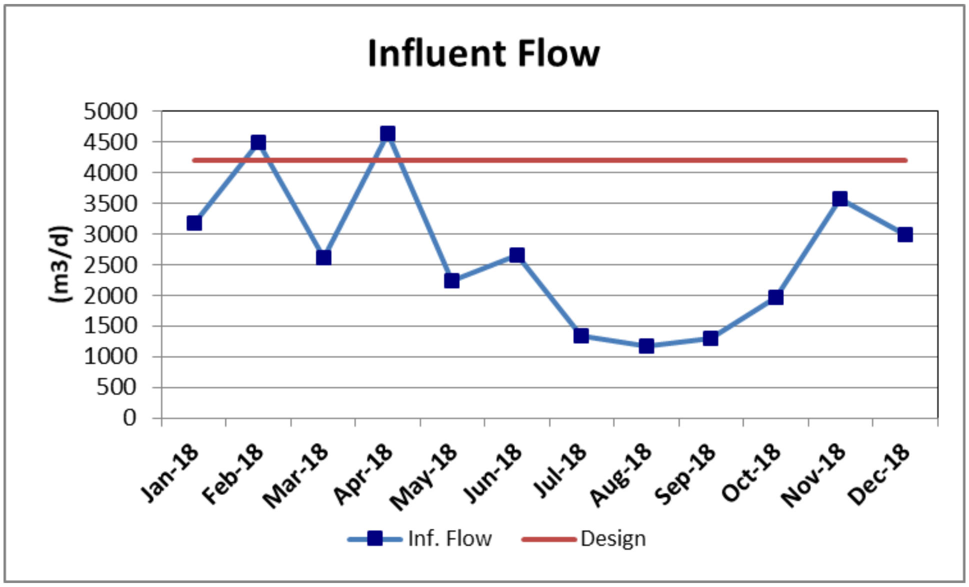

Figure 7 – Monthly Average Flow Compliance Graph

Comments:

- The monthly average flows were below design in 10 of 12 months;
- The flows were above design in February and April due to wet weather events.

The monthly average $cBOD_5$ loadings compared against the ECA limit is shown in Figure 8.

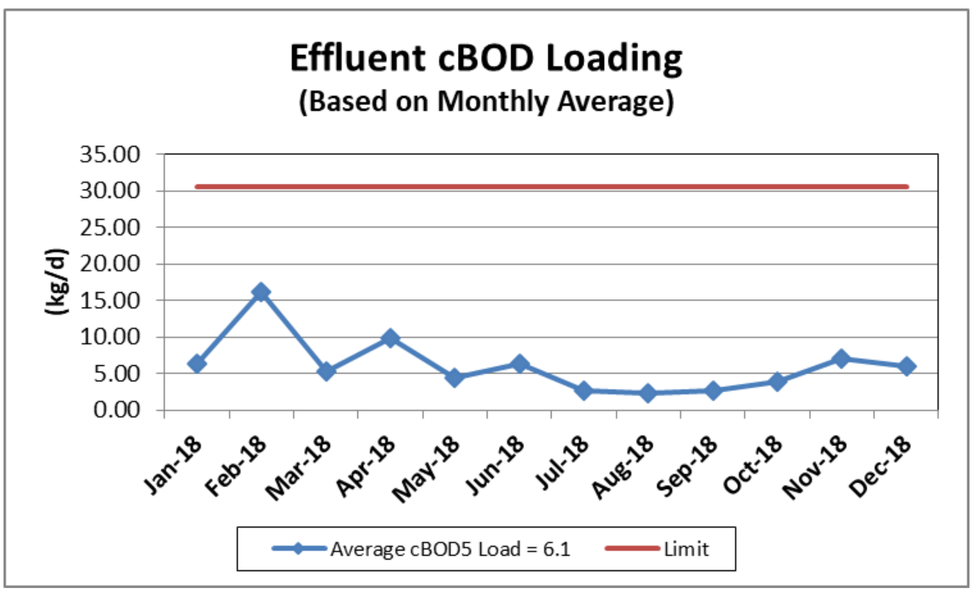

Figure 8 – Monthly Average $cBOD_5$ Loading Compliance Graph

Comments:

- The monthly average $cBOD_5$ loading met the compliance limit in all 12 months.

The monthly average TSS loadings compared against the ECA limit is shown in Figure 9.

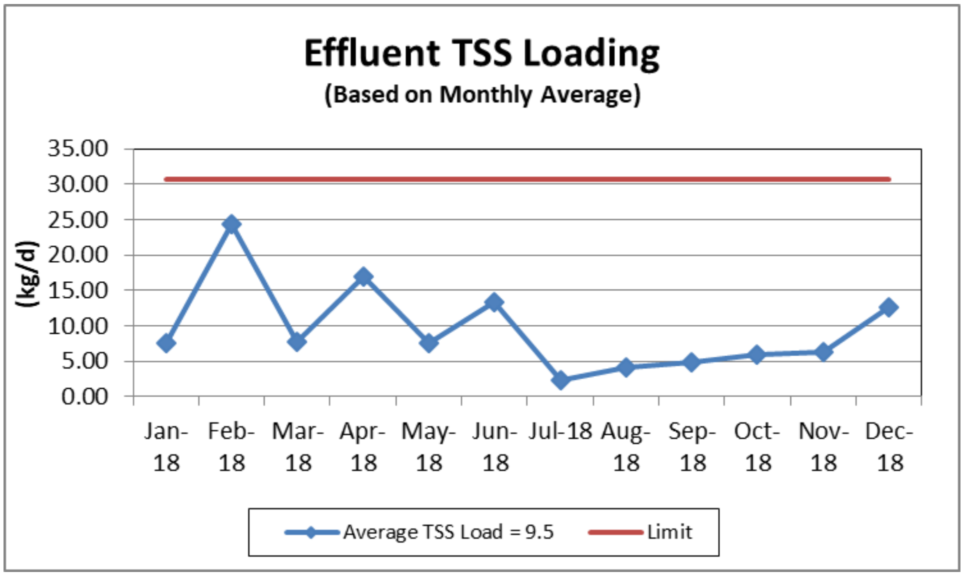

Figure 9 – Monthly Average TSS Loading Compliance Graph

Comments:

- The monthly average TSS loading met the compliance limit in all 12 months.

The monthly average TP loadings compared against the ECA limit is shown in Figure 10.

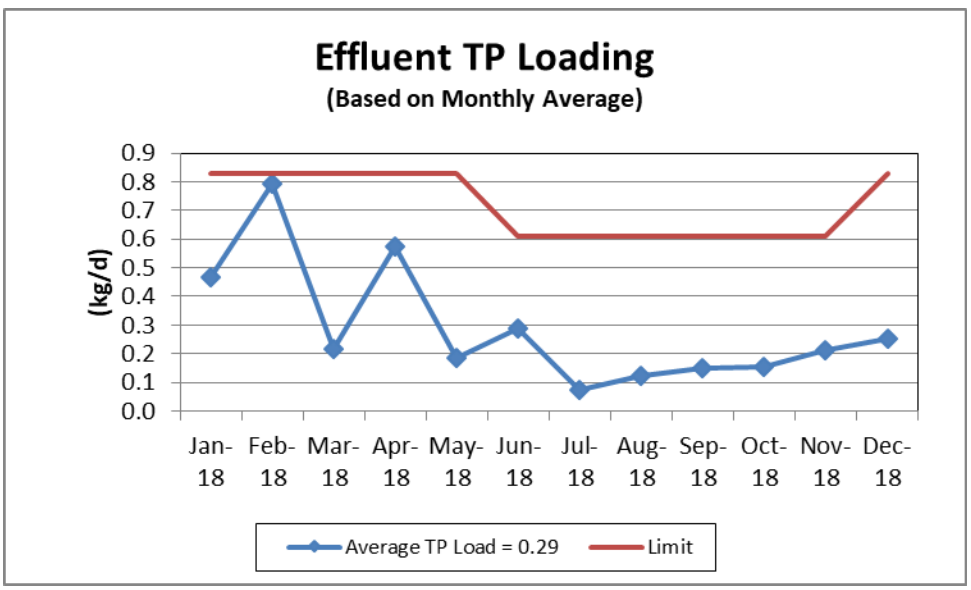

Figure 10 – Monthly Average TP Loading Compliance Graph

Comments:

- The monthly average TP loading met the compliance limit in all 12 months.

4. Non-Regulated Effluent Sampling

The Hagersville WWTP is also required to sample the effluent for temperature, with the following results collected:

The daily effluent temperature results are displayed in Figure 12.

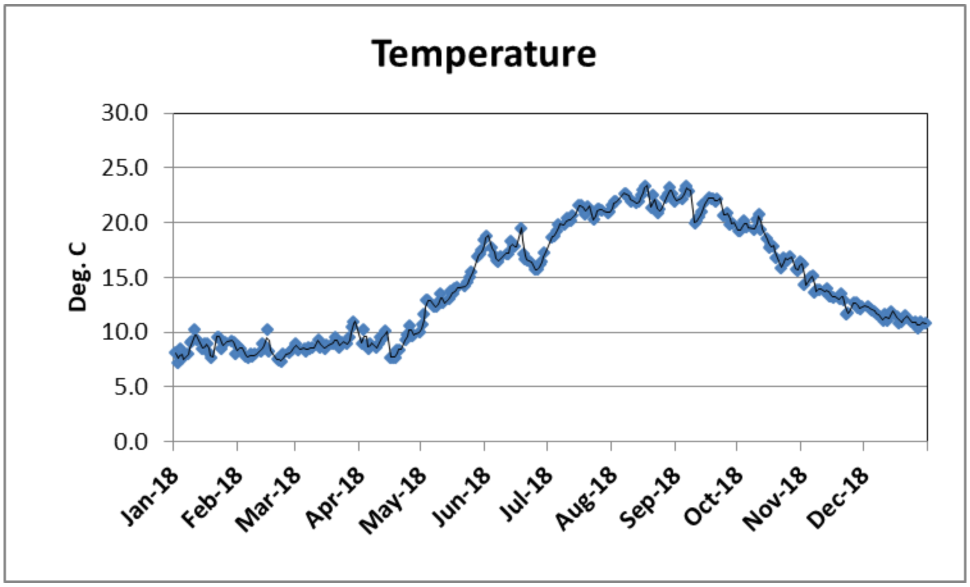

Figure 12 – Daily Effluent Temperature Graph

Comments:

- Minimum water temperature ranged from approximately 7.2°C in January to 23°C in August.

The weekly un-ionized Ammonia results are displayed in Figure 13.

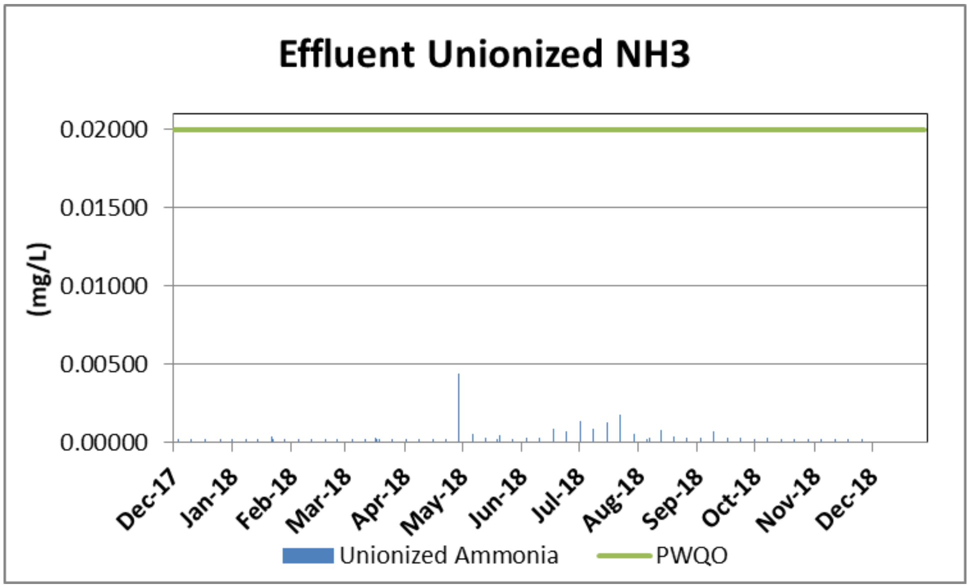

Figure 13 – Weekly effluent un-ionized ammonia results

Comments:

- The effluent un-ionized ammonia results were below the provincial water quality objectives for all samples in 2018.

5. Operational Issues

- High raw sewage flows following significant rain events in February, April and June resulted in a need to implement both the step feed protocol to protect the biomass in the aeration process and partial tertiary bypasses due to overload conditions on the tertiary sand filters.

6. Sludge Generation

- **Sludge Production**

Reported sludge being removed from the treatment plant is compared to projected sludge that Hagersville would be expected to produce. If the difference between the two sludge masses (kg/d) is within ± 15%, then the sludge data is probably accurate. The sludge accountability is reported in Table 6. See Appendix 1 for sludge accountability calculations.

Table 6 – Summary of Sludge Accountability				
Reported Sludge (kg/d)		**Projected Sludge (kg/d)**		**Accountability**
Intentional Wasting	356	Biological Sludge	290	
Unintentional Wasting	8	Chemical Sludge	80	

Total Reported Sludge	**364**	Total Projected Sludge	**370**	2%

Comments:

- The sludge accountability calculation closed within ± 15% (2%), meaning the reported data probably accurately reflects the true performance of the facility.

- **Biosolids Removal**

Table 7 identifies a monthly summary of the volume of biosolids removed from the digesters at the Hagersville WWTP.

Table 7 – Monthly Summary of Biosolids Removed

Month	Biosolids Volume Removed To Townsend (m^3)		Biosolids Volume Removed for Land Application (m^3)		Concentration (mg/L)		Hauled Biosolids Generated (kg)	
	2017	2018	2017	2018	2017	2018	2017	2018
January								
February								
March								
April								
May		135.5	869.1	1,828.9	22,700	23,977	19,729	47,100
June			1,049.0	490.1	21,300	23,300	22,344	11,419
July								
August			710.9		14,500		10,308	
September								
October			1214.8	976.1	16,000	29,473	19,437	28,769
November			618.4		14,500		8,967	
December								
Total	**0**	**135.5**	**4462.2**	**3,295.1**			**80,785**	**87,288**
Average					**17,800**	**25,583**		

Note: Due to a reporting error in the Hagersville 2017 Annual Report, the Hauled Biosolids Generated was reported to be 58,260 kg instead of 80,785 kg.

Comments:

- The volume of biosolids removed in 2018 of 3,431 m^3 was 1,031 m^3 less than the volume hauled in 2017 of 4,462 m^3.
- The mass of solids removed in 2018 of 87,288 kg was 6,503 kg more than in 2017 (80,785 kg).
- In 2019 it is estimated that the mass of sludge removed will be comparable to 2018.

8. Biosolids Removal

- Biosolids were applied to land in May, June and October to the following approved sites: HN1334, HN1315, HN1122, HN1355, HN1348 and HN1084.

9. Leachate Loading Objectives

The Owner uses best efforts to operate the Works such that the Monthly Average Loading of 82 kg/day for leachate BOD_5 and Monthly Average Loading of 36 kg/day for leachate Total Ammonia Nitrogen are not exceeded.

Table 8 – Summary of Leachate Loading to the Hagersville WWTP in 2018				
Parameter	Average BOD Loading (kg/d)	BOD Load Objective (kg/d)	Average Ammonia Loading (kg/d)	Ammonia Load Objective (kg/d)
January	N/A	82	N/A	36
February	N/A	82	N/A	36
March	10.6	82	7.6	36
April	1.4	82	10.0	36
May	3.2	82	27.1	36
June	6.8	82	28.5	36
July	4.8	82	22.7	36
August	3.2	82	22.1	36
September	4.6	82	32.6	36
October	2.4	82	22.8	36
November	1.1	82	3.3	36
December	1.0	82	3.1	36
Average	**3.2**	**82**	**15.0**	**36**

Comments:

- There was no leachate brought to Hagersville WWTP in January and February of 2018;
- The leachate BOD_5 loading met the objective for all 12 months in 2018;
- The leachate ammonia loading met the objective for all 12 months in 2018.

10. Facility Activities in 2018

- Replaced check valves at Tuscarora and Parkview pumping stations;
- Replaced both pumps and upgraded electrical control system at the McKeen pumping station;
- Diesel fuel tank replacements at Tuscarora and Parkview pumping stations;
- Started up new phosphorus removal chemical storage and dosing system (sodium aluminate);
- Replaced the variable frequency drive for raw sewage pump #2;
- Participated in workshops:
  - Solids Mass Control,
  - Step Feed,
  - Phosphorous Control.

11. Planned Activities for 2019

- Install a new lighting and gas monitoring system in the wet well building;
- Install a new electric valve actuator on the storm tank flow control valve to restore remote operation for use during storm events;
- Make necessary repairs to the Turbo Blower #1 to restore its operation;
- Install new motors and replace bearings on the three (3) multi-stage centrifugal blowers to extend their useful life;
- Replace defective unit heaters and service other HVAC systems at the Tuscarora pumping station.

12. Bypasses, Spills and Overflows

- Table 9 is a summary of all bypass events at the Hagersville WWTP in 2018.

Table 9 – Summary of Bypass Events

Date(s)	Duration (hours)	Volume Bypassed (m^3)	Reason	Process Bypassed
February 20, 2018	47	13,460	High Flows	Partial Tertiary
April 16, 2018	12.3	3,998	High Flows	Partial Tertiary
June 18, 2018	12.5	6,602	High Flows	Partial Tertiary

Comments:

- The February, April and June events were a result of severe wet weather causing high flows through the plant requiring by-pass of the tertiary filters.

13. Public Complaints

- Received complaints in May 2018 due to odours from the sludge digester and holding tanks. This occurred just prior to the spring biosolids removal from the plant when all of the digester tanks were at capacity and two blowers were out of service. Dissolved oxygen in the digesters decreased and caused sludge to become septic and produce odours. Turbo blowers operation was restored and the septic conditions and odours eliminated.

14. Monthly Average Effluent Data Summary

- Table 10 displays a summary of all monthly average effluent data.

15. Tom Howe Landfill Leachate Monitoring Program Reports

- See Attached

16. Calibration Reports

- See attached

17. 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 the ultraviolet disinfection 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 10 – Summary of Monthly Average Effluent Data																		
	Plant Flow	CBOD	ECA CBOD Limit	CBOD Loading	ECA CBOD Load Limit	TSS	C of A TSS Limit	TSS Loading	ECA TSS Load Limit	Phosphorous	ECA TP Limit	Phosphorous Loading	ECA TP Load Limit	Ammonia	ECA Ammonia Limit	E. Coli	ECA E. Coli Limit
Month	(m^3/d)	(mg/L)	(mg/L)	(kg)	(kg)	(mg/L)	(mg/L)	(kg)	(kg)	(mg/L)	(mg/L)	(kg)	(kg)	(mg/L)	(mg/L)	#/100m	#/100ml
Jan-18	1552	2	7.3	3.1	30.6	2	7.3	3.5	30.6	0.15	0.20	0.23	0.83	0.05	3.6	1	200
Feb-18	1565	2	7.3	3.1	30.6	2	7.3	3.5	30.6	0.18	0.20	0.28	0.83	0.06	3.6	1	200
Mar-18	1577	2	7.3	3.2	30.6	2	7.3	3.5	30.6	0.08	0.20	0.13	0.83	0.05	3.6	1	200
Apr-18	1589	2	7.3	3.2	30.6	2	7.3	3.5	30.6	0.12	0.20	0.20	0.83	0.06	3.6	1	200
May-18	1554	2	7.3	3.1	30.6	2	7.3	3.5	30.6	0.08	0.20	0.13	0.83	0.16	2.2	1	200
Jun-18	1534	2	7.3	3.1	30.6	2	7.3	3.4	30.6	0.11	0.15	0.17	0.61	0.05	2.2	2	200
Jul-18	1523	2	7.3	3.0	30.6	2	7.3	3.5	30.6	0.06	0.15	0.08	0.61	0.06	2.2	1	200
Aug-18	1523	2	7.3	3.0	30.6	2	7.3	3.4	30.6	0.10	0.15	0.16	0.61	0.05	2.2	1	200
Sep-18	1531	2	7.3	3.1	30.6	2	7.3	3.4	30.6	0.11	0.15	0.17	0.61	0.05	2.2	1	200
Oct-18	1546	2	7.3	3.1	30.6	2	7.3	3.4	30.6	0.08	0.15	0.12	0.61	0.04	2.2	1	200
Nov-18	1697	2	7.3	3.4	30.6	2	7.3	3.4	30.6	0.06	0.15	0.10	0.61	0.03	3.6	1	200
Dec-18	2005	2	7.3	4.0	30.6	2	7.3	3.7	30.6	0.09	0.20	0.17	0.83	0.03	3.6	1	200
Average	2650	2		3.1		2		4.9		0.10		0.16		0.09		1	

Appendix #1 - Hagersville WWTP Sludge Accountability 2018

Data January to June 21, 2018 (2 trains in service)
Alum Used January to May 17, 2018

Combined Influent Flow = 3,048 m^3/d	Effluent TSS = 0.0039 kg/m^3
Combined Influent BOD = 0.170 kg/m^3	Effluent cBOD = 0.0024 kg/m^3
Sludge Production Ratio = 0.65 – EA (0.70 – CAS)	Alum Dosage = 0.226 m^3/d
WAS Flow = 44.6 m^3/d	WAS Concentration = 8.505 kg/m^3
Density of Alum = 1330 kg/m^3	% Aluminum in Alum = 4.4%
Alum Sludge Production Ratio = 4.79	

Projected Sludge

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

Biological Sludge = 3,048 m^3/d * (0.170 kg/m^3 – 0.0024 kg/m^3) * 0.65

Biological Sludge = 332.0 kg/d

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

Chemical Sludge = 0.226 m^3/d * 1330 kg/m^3 * 0.044 * 4.79

Chemical Sludge = 63.4 kg/d

Reported Sludge

Intentional Wasting = WAS Flow * WAS Concentration

Intentional Wasting = 44.6 m^3/d * 8.505 kg/m^3

Intentional Wasting = 379.3 kg/d

Unintentional Wasting = Influent Flow * Effluent TSS

Unintentional Wasting = 3,048 m^3/d * 0.0039 kg/m^3

Unintentional Wasting = 11.9 kg/d

Data June 22 to November 6, 2018 (1 train in service)

Combined Influent Flow = 1,538 m^3/d	Effluent TSS = 0.0020 kg/m^3
Combined Influent BOD = 0.261 kg/m^3	Effluent cBOD = 0.0020 kg/m^3
Sludge Production Ratio = 0.65 – EA (0.70 – CAS)	Alum Dosage = 0.134 m^3/d
WAS Flow = 28.1 m^3/d	WAS Concentration = 13.594 kg/m^3
Density of SAX = 1470 kg/m^3	% Aluminum in SAX = 10.7%
SAX Sludge Production Ratio = 4.79	

Projected Sludge

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

Biological Sludge = 1,538 m^3/d * (0.261 kg/m^3 – 0.0020 kg/m^3) * 0.70

Biological Sludge = 278.8 kg/d

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

Chemical Sludge = 0.134 m^3/d * 1470 kg/m^3 * 0.107 * 4.79

Chemical Sludge = 101.0 kg/d

Reported Sludge

Intentional Wasting = WAS Flow * WAS Concentration

Intentional Wasting = 28.1 m^3/d * 13.594 kg/m^3

Intentional Wasting = 382.0 kg/d

Unintentional Wasting = Influent Flow * Effluent TSS

Unintentional Wasting = 1,538 m^3/d * 0.0020 kg/m^3

Unintentional Wasting = 3.1 kg/d

Data November 7 to December 31, 2017 (2 trains in service)

Combined Influent Flow = 2,584 m^3/d	Effluent TSS = 0.0030 kg/m^3
Combined Influent BOD = 0.157 kg/m^3	Effluent cBOD = 0.0020 kg/m^3
Sludge Production Ratio = 0.65 – EA (0.70 – CAS)	SAX Dosage = 0.100 m^3/d
WAS Flow = 44.1 m^3/d	WAS Concentration = 6.971 kg/m^3
Density of SAX = 1470 kg/m^3	% Aluminum in Alum = 10.7%
SAX Sludge Production Ratio = 4.79	

Projected Sludge

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

Biological Sludge = 2,584 m^3/d * (0.157 kg/m^3 – 0.0020 kg/m^3) * 0.65

Biological Sludge = 260.3 kg/d

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

Chemical Sludge = 0.100 m^3/d * 1470 kg/m^3 * 0.107 * 4.79

Chemical Sludge = 75.3 kg/d

<u>Reported Sludge</u>

Intentional Wasting = WAS Flow * WAS Concentration

Intentional Wasting = 44.1 m^3/d * 6.971 kg/m^3

Intentional Wasting = 307.4 kg/d

Unintentional Wasting = Influent Flow * Effluent TSS

Unintentional Wasting = 2,584 m^3/d * 0.0030 kg/m^3

Unintentional Wasting = 7.8 kg/d

<u>Sludge Accountability Calculations</u>

Biological = (332.0 kg/d + 278.8 kg/d + 260.3 kg/d)/3 = 290.4 kg/d

Chemical = (63.4 kg/d + 101.0 kg/d + 75.3 kg/d)/3 = 79.9 kg/d

Total Projected = 290.4 kg/d + 79.9 kg/d = 370.3

Intentional Wasting = (379.3 kg/d + 382.0 + 307.4 kg/d)/3 = 356.2 kg/d

Unintentional Wasting = (11.9 kg/d + 3.1 kg/d + 7.8 kg/d)/3 = 7.7 kg/d

Total Reported = 356.2 + 7.7 kg/d = 363.9 kg/d

Sludge Accountability = (Projected Sludge – Reported Sludge) * 100

Projected Sludge

Sludge Accountability = (370.3 kg/d – 363.9 kg/d) * 100

370.3 kg/d

Sludge Accountability = 1.7%

The sludge accountability if one train out of service was not considered was 1.7