

# MEMORANDUM

May 14, 2021

TO: Historical Memo

FM: Matt Macdonald / Steven Yee

RE: Carnation Wastewater Treatment Plant  
April 2021 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland for the entire month of April. All reclaimed water quality requirements were met. Effluent Biochemical Oxygen Demand (BOD<sub>5</sub>) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively, and BOD<sub>5</sub> and TSS removals were >99.7% and >99.4%, respectively. The max daily total coliform grab for the month was <1.0-cfu/100-mL. The permeate temperature ranged from 17.2°C to 21.0°C. All permit-required samples were collected and analyzed. Influent and effluent BOD incubated samples collected between 4/27 and 4/29 were outside of their temperature range from sometime after 1030AM on 4/30/21 to a time after 0700 on 5/1/21. The incubator temperature was restored on 5/1 and the 5-day incubation period continued. Less than the ideal three seed dilutions and sample duplicates were used for BOD sample reporting from 4/27 to 4/29.

Effluent flow averaged 0.096-MGD. Influent flow averaged 0.104-MGD; influent flow is slightly higher than effluent flow due to internal recycle flows. The influent flow meter continued to report artificially high flow totals for the duration of the month. In response, daily influent flow totals were estimated by summing the measured effluent flow and an estimate of the internal recycle and wasted activated sludge.

The plant operated with Aeration Basin 1 (AB1) in service the entire month of April. The MLSS averaged 8,200-mg/L. An estimated 5800 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment. Hauled solids were likely underestimated slightly as the majority of wasting this month came from scum.

All five membrane trains were in service for the whole month except train 3 and train 5 which were removed from service for several days to replace chemical feed valves. Train 3 was out of service from April 9 until April 14. Train 5 was out of service from April 9 until April 11. Due to poorer filterability, there were multiple events where membrane trains went into TMP (trans-membrane pressure) control. UV train 1A remained out of service in April; the remaining UV trains ran for the duration of the month.

On April 13 Operations discovered that the headworks screening system did not come online with the plant internal recycle flow and caused flow to be diverted into the solids handling basin (the screens were active exclusively when influent pumps were running). The issue was resolved by enabling the influent flow meter to measure the small amount of recycle flow. Consequently, the influent sampler collected a slightly larger than typical amount of plant recycle flow until it was programmed on April 22 to exclude the small recycle flows. Influent samples were still representative and were not excluded from the DMR.

Total-N removal averaged 86%. Effluent ammonia (NH<sub>3</sub>) averaged 3.0-mg/L as N. Effluent nitrite plus nitrate (NO<sub>2</sub>+NO<sub>3</sub>) averaged 5.2-mg/L as N. Effluent total phosphorus (P) averaged 3.9-mg/L for a total P removal of 59%. N and P analyses were performed every Tuesday.

An issue with Blower 1 led to under-aeration and the high effluent ammonia measured in the April 6 nutrient sample.

After switching to Blower 2 aeration has been reliable and led to full nitrification in subsequent nutrient samples.

Alkalinity was continuously added to the secondary process to maintain the instantaneous effluent pH above pH 7.0. Caustic Soda (25% NaOH solution) was the alkalinity source; a total of 281<sup>1</sup> gallons was used. Effluent alkalinity averaged 111-mg/L (with a range of 87-164) as CaCO<sub>3</sub>; influent alkalinity was in the range of 226-287 mg/l as CaCO<sub>3</sub>. Alkalinity addition replaces the alkalinity lost during nitrification; the effluent pH would likely fall below the permitted minimum pH 6.0 if alkalinity addition stopped.

Tables 1 and 2 present membrane maintenance cleaning information and membrane performance data, respectively. Average TMPs were in the 2.7 to 3.3 psi range. The control system limits flow through the membranes at a TMP 8.0-psi; this protects the membranes' integrity.

On April 14 and 15 approximately 590 gal of weak solution of sodium hypochlorite (approximately 7%) was pumped from the hypochlorite storage tank to the solids handling basin as a method of cleaning the tank and discarding the chemical. On April 19 approximately 750 gallons of 12.5% strength sodium hypochlorite was received. Replacing the low concentration sodium hypochlorite solution with full strength was done to facilitate upcoming recovery cleans. A delivery of 2500 gal of caustic soda was received April 20.

An estimated 126<sup>2</sup>-gallons of sodium hypochlorite was used in April for maintenance cleans. Additional maintenance cleans were performed this month due to trains going into TMP control. The membrane clean cycle was set to twice per week as of March 22.

Table 1: Membrane Maintenance Cleans Performed April 2021

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
4/1	MC <sup>3</sup>	MC	MC	MC	MC
4/4	MC x2	MC x2	MC	MC x2	MC x2
4/11	MC x2	MC x2	MC	MC x2	MC x2
4/18	MC x2	MC x2	MC x2	MC x2	MC x2
4/25	MC x2	MC x2	MC	MC x2	MC x2

<sup>1</sup>Calculated by tank level drop

<sup>2</sup> Calculated using tank level drop across the month

<sup>3</sup> MC refers to a maintenance clean

Table 2: Membrane Performance April 2021

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
<b>Permeate Turbidity (NTU)<sup>1</sup></b>					
Average for Month	0.09	0.10	0.11	0.10	0.13
<i>Design</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
<b>Permeate Flow (GPD)<sup>2</sup></b>					
Average Daily for Month	27,078	28,309	18,459	29,969	24,578
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	39,851	39,296	38,120	37,426	37,288
<i>PDF (Peak Day) Design</i>	165,000	165,000	165,000	165,000	165,000
<b>Permeate Flow Rate (GPM)<sup>3</sup></b>					
Average for Month	48	53	33	49	45
Peak Hour for Month	136	135	140	141	140
<i>PHF (Peak Hour) Design</i>	180	180	180	180	180
<b>Instantaneous Flux (GFD<sup>4</sup>)<sup>5</sup></b>					
Average for Month	9.6	9.7	9.6	9.8	9.6
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month	3.3	2.7	3.1	3.2	2.8
Maximum for Month	8.8	8.1	9.3	8.5	8.2
<i>(Average/Maximum) Design</i>	2.0/10	2.0/10	2.0/10	2.0/10	2.0/10
<b>Permeate Temperature (°C)<sup>7</sup></b>					
Minimum for Month	15.9	15.9	15.9	15.9	15.9
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month	3.5	3.8	3.5	3.4	3.8
<i>(Recovery Clean Trigger) Design</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

<sup>1</sup> Permeate turbidity – indication of membrane integrity.

<sup>2</sup> Permeate flow – compares operating to design capacity. The design capacity (AADF and PDF) are both based on entire treatment plant flow with four membrane trains available.

<sup>3</sup> Permeate flow rate – check of acute operating conditions to confirm peak hour design condition is not being approached. The design capacity (PHF) is based on entire treatment plant flow with five membrane trains available. The average rate is only for when the membrane is operating.

<sup>4</sup> “GFD” is shorthand for “GPD/Ft<sup>2</sup>”. GFD is a flux measurement based on the flow (gallons/day) of permeate that passes through a square foot of membrane surface. Each train has one membrane cassette with 12,920 square feet of surface area.

<sup>5</sup> Instantaneous flux – check of membrane operating flux. Instantaneous differs from net flux in that it does not account for backpulse and/or relax periods (It is therefore always slightly higher). The design condition is based on net flux and therefore not included. The permeate flow design conditions provide the same information since only a single cassette is operating in each membrane train.

<sup>6</sup> Trans-membrane pressure – provides information related to fouling and biological process operation (MLSS and filterability). The average and maximum TMP are included for reference.

<sup>7</sup> Permeate temperature – listed since the hydraulic capacity can be reduced when operating below the minimum design temperature (de-rating of membrane capacity).

<sup>8</sup> Permeability (temperature corrected to 20°C) – parameter assesses fouled condition of membrane. The trigger value listed is from the GE O&M manual.