

# MEMORANDUM

February 13, 2023

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant  
January 2023 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland for the entire month of January and all water quality requirements were met. Effluent Carbonaceous Biochemical Oxygen Demand (CBOD<sub>5</sub>) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively, and CBOD<sub>5</sub> and TSS removals were >99% and >99%, respectively. The max daily total coliform grab for the month was an estimated <1.0-cfu/100-mL (there were no observed coliform colonies this month). All permit-required samples were collected and analyzed. The permeate temperature averaged 15.6°C.

Effluent flow averaged 0.103-MGD. Influent flow averaged 0.109-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.

Effluent total-nitrogen (TN) averaged 8.6-mg/L as N. Ammonia (NH<sub>3</sub>) and nitrite plus nitrate (NO<sub>2</sub>+NO<sub>3</sub>) averaged 0.5-mg/L and 7.0-mg/L, respectively. The max-weekly average effluent TN was 8.9-mg/L as N and the monthly average TN removal rate was 87%<sup>1</sup> in January. Effluent total phosphorus (P) averaged 3.1-mg/L for the month with a Total P removal of 66%. The 2023 year-to-date average effluent Total-P and Total Kjeldahl Nitrogen (TKN) are 3.1-mg/L as P and 1.5-mg/L as N, respectively. Effluent nutrient sampling in January 2023 was performed twice per week (Monday and Tuesday); influent nutrient sampling was performed once per week (Tuesday).

Alkalinity was added to the secondary process to maintain the instantaneous effluent pH above pH 6.9. A total of 333<sup>2</sup> gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 96-mg/L (with a range of 87-128) as CaCO<sub>3</sub>; influent alkalinity was in the range of 205-246 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.

The plant operated with Aeration Basin 1 (AB1) in service the entire month of January. The mixed liquor total suspended solids (MLSS) averaged 10,500-mg/L with a range of 9,600-mg/L to 11,200-mg/L. An estimated 9,600 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment.

All 5 membrane trains were available for service for the duration for the month.

One of two parallel UV trains was in operation with both subsystems running (in series) while permeating. The decision to operate both UV subsystems was based on earlier issues with the UV system.

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<sup>1</sup>Calculated using days when both influent and effluent nutrients were sampled.

<sup>2</sup>Calculated by tank level drop.

A single UV train with one subsystem in operation provides sufficient dosage; the second subsystem is operated for redundancy.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 1.3-psi and temperature corrected permeability averaged 7.4-gfd/psi. The upward trend in average TMP was largely due to membrane train 5; month average TMP increased from 1.2-psi for November to 1.9-psi for December and 1.6-psi in January. Other membrane train TMPs increased by 0.2-psi or less. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity.

A total of 23 maintenance cleans were performed in January.

Table 1: Membrane Maintenance Cleans Performed January 2023

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
1/1	MC <sup>1</sup> x 2		MC		MC
1/8	MC	MC	MC	MC	MC
1/15	MC	MC	MC	MC	MC
1/22	MC	MC	MC	MC	MC
1/29	MC	MC			

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<sup>1</sup> Maintenance Clean

<sup>3</sup> no Recovery Cleans performed in September

Table 2: Membrane Performance January 2023

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
<b>Permeate Turbidity (NTU)<sup>1</sup></b>					
Average for Month	0.08	0.12	0.09	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	35,761	35,158	25,129	25,707	31,016
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	81,921	69,504	63,013	38,851	71,988
<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	32	36	27	25	31
Peak Hour for Month	114	133	106	139	122
<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	9.0	8.7	8.6	8.7	8.7
<b>Trans-Membrane Pressure (PSI)<sup>6</sup></b>					
Average for Month	1.2	1.2	1.3	1.3	1.6
Maximum for Month	2.7	2.5	2.4	3.1	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	14.0	14.0	14.0	14.0	14.0
<i>Design</i>	> 12	> 12	> 12	> 12	> 12
<b>Permeability at 20°C (GFD/PSI)<sup>8</sup></b>					
Average for Month	8.3	7.8	7.2	7.5	6.4
<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 16,340 square feet of surface area (formerly 12,920 square feet).

<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. Control system limits TMP to 8 psi.

<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.