

MEMORANDUM

April 10, 2024

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant
March 2024 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Snoqualmie river outfall in March to facilitate commissioning the new UV system. Reclaimed water regulations require that the new UV system have a bioassay validation that confirms virus removal performance prior to producing reclaimed water. Thus, during commissioning and until the bioassay is completed, the CCTP must discharge to the Snoqualmie river outfall. The Bioassay testing began on March 27 and will continue into April. Effluent Carbonaceous Biochemical Oxygen Demand (CBOD₅) and Total Suspended Solids (TSS) averaged <1.0 mg/L and <2.0 mg/L, respectively. CBOD₅ and TSS removals were >99% and >99%, respectively. All fecal coliform and *E.coli* grab samples for the month produced no colony forming units. On the week of March 10, the weekly fecal coliform/*E. coli* sample was not processed by the lab. As part of the new UV system commissioning work, total coliforms were sampled twice that week and yielded no colony forming units. Since fecal coliforms and *E. coli* are a subset of the total coliforms, both fecal coliforms and *E. coli* were also reported as <1.0-cfu/100mL. All permit-required samples were collected and analyzed.

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 6.2-mg/L as N. Ammonia (NH₃) and nitrite plus nitrate (NO₂+NO₃) averaged 0.15-mg/L and 5.1-mg/L, respectively. The max-weekly average effluent TN was 7.8-mg/L as N and the monthly average TN removal rate was 91%¹ in March. Effluent total phosphorus (P) averaged 4.1-mg/L for the month with a Total P removal of 51%. Effluent nutrient sampling in March 2024 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 approximately 389² gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 111-mg/L (with a range of 95-120 mg/L) as CaCO₃; influent alkalinity was in the range of 240-263 mg/l as CaCO₃. 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 2 (AB2) in service. The mixed liquor total suspended solids (MLSS) averaged 9,500-mg/L with a range of 8,900-mg/L to 10,200-mg/L. An estimated 7,900 dry lbs.

¹Calculated using days when both influent and effluent nutrients were sampled.

²Calculated by tank level drop and assumed the same rate of use from March 23 to March 30.

of waste activated sludge were hauled to the South Plant for further treatment. Of the volume wasted, approximately 97% was from the memDense hydrocyclone.

Four of the five membrane trains were available for service in March; train 4 remains out of service with a permeate pump and VFD issue. UV train 1 operated with both subsystems on for the duration of the month.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 0.5-psi and temperature corrected permeability averaged 19.5-gfd/psi. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity.

Approximately 37¹ gallons of sodium hypochlorite was used to perform 17 maintenance cleans in March.

Table 1: Membrane Maintenance Cleans Performed March 2024

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
2/25	MC ²	MC	MC		MC ³
3/3	MC x 2	MC x 2	MC		
3/10	MC		MC		MC
3/17	MC	MC	MC		MC
3/24	MC	MC	MC		MC

¹ Calculated by flow meter totalizer

² Maintenance Clean

³ Recovery Clean

Table 2: Membrane Performance March 2024

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4 Out of Service	Train 5
Permeate Turbidity (NTU)¹					
Average for Month	0.11	0.10	0.09		0.10
<i>Design</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Permeate Flow (GPD)²					
Average Daily for Month	36,443	31,749	32,432		30,495
<i>AADF (Annual Average Flow) Design</i>	97,500	97,500	97,500	97,500	97,500
Maximum Daily for Month	68,652	68,911	66,530		69,192
<i>PDF (Peak Day) Design</i>	165,000	165,000	165,000	165,000	165,000
Permeate Flow Rate (GPM)³					
Average for Month	36	31	33		32
Peak Hour for Month	184	159	130		147
<i>PHF (Peak Hour) Design</i>	180	180	180	180	180
Instantaneous Flux (GFD⁴)⁵					
Average for Month	8.3	8.2	8.4		8.5
Trans-Membrane Pressure (PSI)⁶					
Average for Month	0.5	0.5	0.5		0.5
Maximum for Month	1.9	1.8	4.2		1.8
<i>(Average/Maximum) Design</i>	2.0/10	2.0/10	2.0/10	2.0/10	2.0/10
Permeate Temperature (°C)⁷					
Minimum for Month	14.5	14.5	14.5		14.5
<i>Design</i>	>12	> 12	> 12	> 12	> 12
Permeability at 20°C (GFD/PSI)⁸					
Average for Month	20.6	17.7	19.4		20.4
<i>(Recovery Clean Trigger) Design</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

¹ Permeate turbidity – indication of membrane integrity.

² 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.

³ 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.

⁴ “GFD” is shorthand for “GPD/Ft²”. 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).

⁵ 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.

⁶ 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.

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

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