

MEMORANDUM

March 13, 2024

TO: Historical Memo

FM: Matt Macdonald

RE: Carnation Wastewater Treatment Plant
February 2024 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetland from the beginning of the month until February 20 when flow was directed to the Snoqualmie river outfall 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 Carnation Treatment Plant must discharge to the Snoqualmie river outfall. Effluent Carbonaceous Biochemical Oxygen Demand (CBOD₅) and Total Suspended Solids (TSS) averaged <1.4 mg/L and <2.0 mg/L, respectively. CBOD₅ and TSS removals were >99% and >99%, respectively. The max daily total coliform grab for the month was <1.0-cfu/100-mL (on February 11 one colony forming unit was observed). All permit-required samples were collected and analyzed.

Effluent flow averaged 0.100-MGD. Influent flow averaged 0.106-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. On February 14 an issue with the rotary drum screen in service caused approximately 25,000 gallons of influent to overflow into a storage basin and resulted in an unusually low effluent flow that day. The stored influent was returned to the plant over the proceeding days.

Monthly effluent total-nitrogen (TN) averaged 7.1-mg/L as N. Ammonia (NH₃) and nitrite plus nitrate (NO₂+NO₃) averaged 0.37-mg/L and 5.6-mg/L, respectively. The monthly average TN removal rate was 90%¹ in February. Effluent total phosphorus (P) averaged 3.4-mg/L for the month with a Total P removal of 64%.

For the portion of the month where the Carnation Treatment Plant discharged to the Chinook Bend Wetland, effluent total-nitrogen (TN) averaged 6.6-mg/L as N. Ammonia (NH₃) and nitrite plus nitrate (NO₂+NO₃) averaged 0.48-mg/L and 4.9-mg/L, respectively. The max-weekly average effluent TN was 9.0-mg/L as N and the monthly average TN removal rate was 90%² in February. Effluent total phosphorus (P) averaged 3.2-mg/L for the month with a Total P removal of 66%. The 2024 year average effluent Total-P and Total Kjeldahl Nitrogen (TKN) are 2.7-mg/L as P and 2.2-mg/L as N, respectively. Effluent nutrient sampling was performed twice per week (Monday and Tuesday); influent nutrient sampling was performed once per week (Tuesday).

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

²Calculated using days when both influent and effluent nutrients were sampled.

Alkalinity was added to the secondary process to maintain the instantaneous effluent pH above pH 6.9. A total of approximately 330¹ gallons of Caustic Soda (25% NaOH solution) was added. Effluent alkalinity averaged 108-mg/L (with a range of 93-117 mg/L) as CaCO₃; influent alkalinity was in the range of 236-268 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 9,000-mg/L with a range of 9,200-mg/L to 10,100-mg/L. An estimated 10,000 dry lbs. of waste activated sludge were hauled to the South Plant for further treatment. Of the volume wasted, approximately 90% was from the memDense hydrocyclone.

Four of the five membrane trains were available for service in February; train 4 remains out of service with a permeate pump and VFD issue. UV train 2 operated with both subsystems on until February 20 when UV train 1 commissioning was restarted. For the remainder of the month, UV train 1 (the new system) operated for commissioning part of the day with operator oversight, and UV train 2 ran otherwise. UV train 2 experienced brief episodes of communication loss, but the UV reactor operation remained continuous.

Tables 1 and 2 present monthly membrane maintenance cleaning information and membrane performance data, respectively. Trans-membrane pressure (TMP) averaged 0.4-psi and temperature corrected permeability averaged 22.1-gfd/psi. The control system limits flow through the membranes to a TMP value of 8.0-psi; this protects the membranes' integrity.

Approximately 48² gallons of sodium hypochlorite was used to perform 18 maintenance cleans between the last week of January through February. Approximately 32 gallons of sodium hypochlorite was used for a recovery clean on train 5.

Table 1: Membrane Maintenance Cleans Performed February 2024

| Week Beginning | Train 1 | Train 2 | Train 3 | Train 4 | Train 5 |
|----------------|-----------------|---------|---------|---------|-----------------|
| 1/28 | MC ³ | MC | MC | | RC ⁴ |
| 2/4 | MC | MC | MC | | MC |
| 2/11 | MC | | MC | | MC |
| 2/18 | | MC | MC | | MC |
| 2/25 | MC | MC | MC | | |

¹Calculated by tank level drop and assumed the same rate of use from February 23 to February 30.

² Calculated by flow meter totalizer

³ Maintenance Clean

⁴ Recovery Clean

Table 2: Membrane Performance February 2024

| MEMBRANE PARAMETERS | Train 1 | Train 2 | Train 3 | Train 4 Out of Service | Train 5 |
|---|----------------|----------------|----------------|-----------------------------------|----------------|
| Permeate Turbidity (NTU)¹ | | | | | |
| Average for Month | 0.08 | 0.10 | 0.09 | | 0.11 |
| <i>Design</i> | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Permeate Flow (GPD)² | | | | | |
| Average Daily for Month | 36,491 | 35,720 | 35,554 | | 33,164 |
| <i>AADF (Annual Average Flow) Design</i> | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 |
| Maximum Daily for Month | 65,624 | 76,108 | 65,141 | | 64,238 |
| <i>PDF (Peak Day) Design</i> | 165,000 | 165,000 | 165,000 | 165,000 | 165,000 |
| Permeate Flow Rate (GPM)³ | | | | | |
| Average for Month | 33 | 34 | 32 | | 30 |
| Peak Hour for Month | 184 | 139 | 136 | | 142 |
| <i>PHF (Peak Hour) Design</i> | 180 | 180 | 180 | 180 | 180 |
| Instantaneous Flux (GFD)⁴⁵ | | | | | |
| Average for Month | 8.4 | 8.1 | 8.2 | | 8.0 |
| Trans-Membrane Pressure (PSI)⁶ | | | | | |
| Average for Month | 0.4 | 0.5 | 0.4 | | 0.4 |
| Maximum for Month | 1.9 | 1.8 | 3.0 | | 1.7 |
| <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 | 14.7 | 14.7 | 14.7 | | 14.7 |
| <i>Design</i> | > 12 | > 12 | > 12 | > 12 | > 12 |
| Permeability at 20°C (GFD/PSI)⁸ | | | | | |
| Average for Month | 23.2 | 19.7 | 22.4 | | 23.2 |
| <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.