Memorandum

February 15, 2024

TO: Historical Memo

FROM: Carol Nelson, Process Analyst
Samayyah Williams, Process Engineer

SUBJECT: Brightwater Treatment Plant
January 2024 Operating Record

All discharge permit requirements were met in January at the Brightwater Treatment Plant (BWTP). All wastewater received Membrane Bioreactor (MBR) secondary treatment. Effluent BOD and TSS averaged <1.0-mg/L and <2.0-mg/L, respectively, and removals were both ≥ 99%. All fecal coliform results were less than 1-cfu/100-mL. Effluent pH was maintained between 6.8 and 7.5. Continuous dosing of 59% Magnesium Hydroxide [$Mg(OH)_2$] was required to ensure permit compliance for pH. Sodium Hydroxide [NaOH] added alkalinity on seventeen days when the inventory of $Mg(OH)_2$ was low and also to ensure that the NaOH dosing pumps were available.

Effluent flow to Puget Sound averaged 23.9-MGD. Less than 0.1-MGD of effluent was used for plant processes; influent flow also averaged 23.9-MGD. The maximum influent and effluent flows, 32.7-MGD and 32.6-MGD, respectively, occurred during a wet weather event on Jan. 28. Influent flows were directed to South Plant via the York Diversion Gate at Hollywood Pump Station on Jan. 31 to flush York Pump station. Repairs to telemetry between Hollywood and Brightwater, noted last month, are ongoing. The monthly total influent sewage directed to South Plant was approximately 1.5-MG. Membrane capacity ranged between 41-MGD and 45-MGD.

January rainfall totaled 7.4-inches based on local rain gauges. The wettest periods occurred on Jan. 5-6 (1.1-inches), Jan. 8-9 (1.1-inches), Jan. 21-22 (1.2 inches), and Jan. 27-28 (1.3-inches). Precipitation recorded for SeaTac Airport was 5.8-inches of rain, which is 0.5-inches above normal. Local area air temperatures averaged 41.5°F, which is 1.3°F below normal. Membrane effluent temperatures decreased from 61.2°F to 58.8°F.

All permit-required samples were collected and analyzed. No blending events occurred this month.

Influent Pumping: Influent flow was pumped using the small raw sewage pump sets (RSP) every day this month. Two pump sets were required for an average of 13 hours per day. One large pump set was used for a total of 14 hours this month to bring the wet well level down more quickly. The IPS wet well was "pumped down" on 25 days in January to remove accumulated grease and rags. Influent flow was not directed to South Plant via the Brightwater Diversion Structure and North Creek Pump Station (NCPS) during pump downs this month. As mentioned above, influent flow was directed to South Plant via the Hollywood Pump station on Jan. 31.

Primary Treatment: Three of five primary clarifiers (PC), PC-1, PC-2, and PC-3, were in service in January, PC-4 was inspected this month. Regular cleaning of the primary effluent screens continued. PC-5 remains out of service because of an apparent leak near the top of the tank wall. This leak results in

puddles of water collecting in an equipment room adjacent to PC-5. Solids return flows were directed to PC-1.

Secondary Treatment: Three aeration basins (AB's) were in service this month. Aeration basins continued to operate in the "zone-DO" control mode this month. Aeration air flow for the month averaged 9,540-scfm total to the three basins. Filamentous growth was present this month but was not abundant. The MLSS and SRT averaged 8,397-mg/L and 22 days, respectively. Secondary foam was present and did not cause any operational problems. The MLSS was maintained primarily by surface wasting.

Full nitrification was achieved most of this month and denitrification was incomplete. Effluent nitrite/nitrate (NO_2+NO_3) and ammonia averaged 30.9-mg/L and 0.2-mg/L as N[1], respectively. Influent concentrations for total Kjeldahl nitrogen (TKN) and TIN in January were higher than in December, but still in a range that is typical for wet weather when the sewage is dilute. Results for November, December and January are summarized in Table 1. January's total nitrogen removal was higher than December's. This was not unexpected given that December's data was skewed by high flows on Dec. 5 which resulted in a lower than average influent concentrations of TKN and TIN for December (December's total nitrogen removal would have been 22% if the Dec. 5 data was not used in the calculation of average influent TKN and TIN).

Denitrification was limited by the inability to maintain lower DO concentrations with the current aeration system. In contrast with the afternoon and evening hours, during the morning hours, the air demand was lower than the minimum air flow for the current blower configuration. Plans for tuning the system include installation of a blow-off valve, which will improve DO control by allowing a lower minimum air flow to the basins. No DO setpoint changes were made this month due to the current limitations in maintaining low DO throughout the day. Any changes to DO setpoints are done slowly to support process stability.

Table 1. Influent and Effluent TKN and TIN concentrations and loading.

		Influent				Effluent				
	Days in Month	Influent TKN, mg/L	Influent TIN, mg/L	Influent Flow, (MGD)	Influent TKN, lbs per day	Effluent TKN, mg/L	Effluent TIN, mg/L	Effluent Flow, (MGD)	Effluent TIN, lbs per day	Total N Removal[1]
Nov	30	54.4	37.8	19.2	8,729	1.7	35.0	19.2	5,598	33%
Dec	31	38.5	28.8	23.0	7,381	1.8	31.6	23.0	6,159	13%
Jan	31	41.8	30.4	23.9	8,343	1.6	30.7	23.9	6,104	23%

1 Total Nitrogen Removal (TN) is equal to [Influent TKN-(Effluent TKN + Effluent NO_2+NO_3)]/Influent TKN and assumes that the Influent NO_2+NO_3 is very low. TKN is Organic Nitrogen + Ammonia.

Alkalinity in the form of a 59% $Mg(OH)_2$ solution was added to the secondary process to ensure minimum effluent pH limits were met and to achieve complete nitrification. The 59% $Mg(OH)_2$ solution dose averaged approximately 2,629-gpd or 110 gallons/MG of influent. An additional 9,716 gallons of 25% NaOH was also used for alkalinity addition in this month. Higher NaOH volumes were dosed on seven days to supplement $Mg(OH)_2$ due to low levels in the $Mg(OH)_2$ tank. The remaining NaOH addition occurred by gravity flow with the suction and discharge of the NaOH pumps left open and the dosing pumps off. Leaving the pumps valved in facilitated enabling the NaOH pumps in the event that the demand quickly increases due to low influent alkalinity, higher ammonia loading from the solids area, or low $Mg(OH)_2$ inventory.

Membrane effluent turbidity averaged 0.02 - 0.03 NTU. Membrane Trains were in "relax" mode and LEAP "low" mode this month because filterability was very good. Approximately 2,858-gallons of

12.5% sodium hypochlorite [NaOCl] were used for membrane maintenance cleans. An additional 660-gallons of NaOCl were used for a recovery clean on Train 7.

Membrane capacity ranged between 41-MGD and 45-MGD this month. This range was above the range needed to process the average influent flow. Plans are in place to rebuild the effluent check valves for all trains in the coming year to prevent the effluent pumps from shutting down. Soluble COD (sCOD) in the mixed liquor averaged 31-mg/L; this parameter has been well correlated with permeability (lower sCOD is correlated with higher permeability). The maximum hourly flux during peak flow tests was between 16.8-gpd and 17.1-gpd per ft^2 of membrane surface.

Table 2 shows the weekly average trans-membrane pressure (TMP), membrane permeability, and SRT. Flow setpoints for the peak flow tests are normally adjusted up/down depending on the TMP before backpulse and anticipated influent flow. The rated instantaneous peak hourly flow for one membrane train is 4,950-gpm. The peak flow setpoint was 4,700-gpm throughout this month. Results from peak flow tests facilitate discerning when a blending event could occur (requiring chemically enhanced primary treatment). All peak flow tests were run with trains in backpulse mode.

Table 2. Trans-membrane pressure, membrane permeability, and SRT.

Parameter	Week ending 1/01	Week ending 1/08	Week ending 1/15	Week ending 1/22	Week ending 1/29
TMP before backpulse, average psi[2]	-1.3	-1.3	-1.4	-1.4	-1.7
TMP before backpulse, peak flow test, psi	-2.0	-2.1	-2.0	-2.2	-2.1
Permeability temperature-corrected[1], gfd/psi	9.6	8.9	9.5	8.9	9.5
Flow target for peak flow test, gpm[3]	4700	4700	4700	4700	4700
Flow hourly average during peak flow test, gpm	3875	3840	3835	3835	3860
MBR Effluent temperature, degrees F	61.1	61.1	59.5	59.1	58.5
SRT, days	21	21	24	24	19
MLSS, mg/L	7647	7866	7608	8600	9200
ML soluble COD, mg/L	32	32	32	29	34

1 Temperature-corrected Permeability based on Peak Flow Test.
2 TMPs during the moderate flow period of the day
3 Flow target is the instantaneous flow, the hourly flow takes into account time the train is not in production.

Disinfection: Approximately 7,103 gallons of 12.5% NaOCl was used in January for final effluent disinfection. The NaOCl effluent disinfection dose averaged 1.4-mg/L as Cl_2. The monthly average and maximum weekly effluent Cl_2 residual at the outfall (aka Point Wells) were 0.04-mg/L and 0.06-mg/L; both met both the monthly and max-weekly permit limits.

Odor Control: All odor control areas had the design-specified number of trains in service; four for Headworks, and three each for Secondary and Solids, except for several hours on Jan. 14 when below freezing temperatures on impacted pressure sensors. Pressure sensor alarms caused one OC fan to trip offline at each OC area until the interlock between the pressure sensor and fan was temporarily disabled. Cold temperatures may have also caused a crack in the Headworks chemical supply line on Jan. 18. The chemical scrubber pumps were turned off while the leak was repaired and put back in service on Jan. 21. The Headworks bioscrubbers and carbon scrubbers remained online during this outage. Air balancing work will continue next year when upstream ducts in all process areas can be cleaned and repaired.

Thickening: All three gravity belt thickeners (GBTs) operated in January. The GBTs thickened approximately 13.3 MG of feed sludge from an average of 1.4% total solids (TS) to 6.2% TS, with an average solids capture of 93.6%. Sludge loading to the thickeners totaled 798 dry tons. The polymer dose for thickening averaged 4.2 pounds active polymer per dry tons solids processed. The thickening and swing polymer blending units operated normally during the month.

Anaerobic Digestion: The digestion process met time and temperature requirements for Class B biosolids for the month. The temperature in the active digesters averaged 99.0°F and the solids retention time (SRT) averaged 37.0 days, and volatile solids (VS) destruction averaged 58.2%. The total solids concentration in the active digesters averaged 2.6% with a VS fraction of 81.0% VS/TS. Draft tube mixers in Digester 2 (mixer 2) and Digester 3 (mixer 2) were removed in September for repair. A hairline crack was discovered on the Digester 1 Mixer 1 flange, where it was previously welded in 2018. The mixer will remain in place and out of service to reduce potential vibrations that would place additional stress on the crack. Safety staff have determined the likelihood of crack propagation is minimal and that the hazardous emissions emanating from the fissure are minimal. The area has been roped off to limit traffic and staff are periodically checking the crack for expansion. Plans to take the digester out of service to repair the crack are scheduled for 2024.

The average digester VS load was 0.097 lbs-VS/cu-ft./d. Monthly gas production totaled 12.1 million ft^3 (based on the waste gas burner and boiler flow meters). Digesters appear healthy, based on the following indicators: volatile acid (VA) concentrations in the active digesters and the DSST were less than 75 mg/L and digester gas composition of approximately 59% methane.

Dewatering/Biosolids: All biosolids met the requirements for Class B. Dewatering operated 27 days in January, using both centrifuges. Centrifuge feed averaged 2.3% TS and 81.4% VS/TS for the month. Centrifuge biosolids product averaged 21.7% TS at 83.9% VS/TS for Centrifuge 1 and 21.4% TS at 83.8% VS/TS for Centrifuge 3. A total of 289 dry tons of solids were processed (according to the feed flow meters and % solids) and 1,275 wet tons (275.3 dry tons at 21.6% TS) of biosolids cake were produced. A total of 1,300 wet tons (281 dry tons) of biosolids cake were hauled in January. Solids recovery in the dewatering process averaged 95.2%. Polymer dosage averaged 51.1 lbs-active per dry ton produced. The dewatering polymer unit operated normally during the month. Plans to replace all three skid units (thickening, dewatering, and the swing unit) are ongoing.