Memorandum

May 15, 2024

TO: Historical Memo

FROM: Carol Nelson, Process Analyst
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SUBJECT: Brightwater Treatment Plant
April 2024 Operating Record

All discharge permit requirements were met in April at the Brightwater Treatment Plant (BWTP). All wastewater received Membrane Bioreactor (MBR) secondary treatment. Effluent BOD and TSS averaged <1.1-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 7.1 and 7.5. Continuous dosing of 59% Magnesium Hydroxide [$Mg(OH)_2$] was required to ensure permit compliance for pH. An average flow of 113-gpd of Sodium Hydroxide [NaOH] added alkalinity on six days to ensure that the NaOH dosing pumps were available in the event of a low inventory of $Mg(OH)_2$.

Effluent flow to Puget Sound averaged 18.7-MGD. No reclaimed water was distributed to customer sites this month. Influent flow averaged 18.9-MGD. Approximately 0.2-MGD of treated effluent was used for treatment plant processes, and to make reclaimed water (RW) for flushing the RW distribution pipe. RW flushing water sent to South Plant via York Pump station totaled approximately 1.1-MG. No raw sewage was directed to South Plant this month. The maximum influent (20.9 MGD) and effluent flows (20.7 MGD) occurred on Apr. 3 following a wet weather event on Apr. 2-3. Membrane capacity ranged between 43-MGD and 46-MGD.

A total of 3.2-inches of rainfall was measured in April based on local rain gauges. The wettest periods occurred on Apr. 2-4 (0.9-inches), Apr. 25 (0.6-inches), and Apr 29 (0.5-inches). Precipitation recorded for SeaTac Airport was 1.1-inches of rain[1], well below the normal rainfall of 3.2-inches. Local area air temperatures averaged 50.3°F, which is 1.0°F below normal.

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

Influent Pumping: Influent was pumped using the small raw sewage pump sets (RSP) every day this month. Two pump sets were required for an average of 7 hours per day. The IPS wet well was "pumped down" on 22 days in April to remove accumulated grease and rags. Performing pump downs did not result in directing influent to South Plant via the Brightwater Diversion Structure and North Creek Pump Station (NCPS).

Primary Treatment: Three of five primary clarifiers (PC) were in service in April. PC-4 was put in service on Apr. 6 when PC-1 was taken out of service to remove excess scum from PC-1. PC-2 and PC-3 were in service the entire month. Repair of the leaking concrete joint of PC-5 was completed in March and the tank was refilled and checked for leaks in April. Additional leaks into lower level rooms were observed to be from

[1] Rainfall data from April 24 and April 25 was missing from the Seattle-Tacoma International Airport station. Rainfall data for these two days was from the Seattle Boeing Field weather station.

rainwater leaking through concrete joints in the primary deck and not from the tank. Solids return flows were redirected from PC-1 to PC-2 on Apr. 6. Regular cleaning of the primary effluent screens continued.

Secondary Treatment: Three aeration basins (AB's) were in service this month. Aeration basins continued to operate in "zone-DO" control mode. Aeration air flow averaged 10,050-scfm total to all three basins. Filamentous growth and foam were present this month but was not abundant. Secondary foam was present and did not cause any operational problems. The MLSS and SRT averaged 8,101-mg/L and 25 days, respectively. The MLSS was maintained by both mixed liquor wasting and by surface wasting.

Total Kjeldahl nitrogen (TKN) and TIN concentrations for February, March, and April are summarized below in Table 1. Full nitrification was achieved most of this month and denitrification was incomplete. Effluent nitrite/nitrate (NO_2+NO_3) and ammonia averaged 35.1-mg/L and 0.1-mg/L as N, respectively. Influent TKN and TIN in April were higher than in March, which is typical for the early spring when rainfall and dilution of sewage decline. Total nitrogen removal was slightly higher in April, as compared to March and February results. This was not unexpected as total nitrogen removal typically increases as flows decrease.

Denitrification was limited by the inability to maintain lower DO concentrations with the current aeration system. In contrast with the afternoon and evening hours, the air demand during the morning hours was lower than the minimum air flow for the current blower configuration. Plans for May include installation of a blow-off valve and tuning the blower control system; these changes should 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]
Feb	29	47.4	31.7	21.5	8,491	1.8	32.7	21.4	5,950	27%
Mar	31	52.7	34.0	20.7	9,099	1.2	34.2	20.5	5,858	33%
Apr	30	55.4	37.0	18.9	8,713	1.2	35.2	18.7	5,510	34.5%

[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 2,532-gpd or 134-gallons/MG of influent. An additional 679 gallons of 25% NaOH was also used for alkalinity addition in April. The 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 availability of the NaOH pumping 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 - 0.04 NTU. Membrane Trains were in "relax" mode and LEAP "low" mode this month because filterability was very good. Approximately 2,525-gallons of 12.5% sodium hypochlorite [NaOCl] were used for membrane maintenance cleans. An additional 1,480 gallons of NaOCl were used for recovery cleans on Train 3 and 5.

Membrane capacity 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 35-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 16.6-gpd and 17.4-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 increased or decreased 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 are used to calculate the capacity of the membrane trains. These results help staff anticipate when the need for storage in the influent structure, diverting flow to other treatment plants, or chemically enhanced primary treatment would occur. All peak flow tests were run with trains in backpulse mode.

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

Parameter	Week ending 4/1	Week ending 4/8	Week ending 4/15	Week ending 4/22	Week ending 4/29
TMP before backpulse, average psi[2]	-1.2	-1.2	-1.0	-1.1	-1.1
TMP before backpulse, peak flow test, psi	-2.2	-2.1	-2.1	-2.0	-2.1
Permeability temperature-corrected[1], gfd/psi	8.7	9.1	9.0	9.2	8.8
Flow target for peak flow test, gpm[3]	4700	4700	4700	4700	4700
Flow hourly average during peak flow test, gpm	3875	3895	3875	3890	3825
MBR Effluent temperature, degrees F	60.9	61.0	61.5	62.1	62.8
SRT, days	18	21	31	29	20
MLSS, mg/L	8521	7984	7320	8092	8808
ML soluble COD, mg/L	39	35	44	32	29

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 6,598 gallons of 12.5% NaOCl was used in April for final effluent disinfection. The NaOCl effluent disinfection dose averaged 1.7-mg/L as Cl_2. The monthly average and maximum weekly effluent Cl_2 residual at the outfall (aka Point Wells) were 0.05-mg/L and 0.08-mg/L respectively; 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 Plans to inspect and clean the main odor control ductwork for Headworks and Solids are ongoing.

Thickening: All three of the gravity belt thickeners (GBTs) operated in April. GBT 1 was placed back in service April 25th following repair of a leak on the feed pipe. The GBTs thickened approximately 15.6 MG of feed sludge from an average of 1.3% total solids (TS) to 6.1% TS, with an average solids capture of 92.3%. Sludge loading to the thickeners totaled 846 dry tons. The polymer dose for thickening averaged 4.1 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 36.2 days, and volatile solids (VS) destruction averaged 62.8%. The total solids concentration in the active digesters averaged 2.9% with a VS fraction of 78.2% VS/TS. Two of the three draft tube mixers in Digester 3 (Mixer 1 and Mixer 2) were replaced on April 23rd; Digester 3 has been operating with all three draft tube mixers in service since April 24th. Digester 2-Mixer 2 remains out of service while plans to replace and repair the mixer are ongoing. Digester 1-Mixer 1 remains out of service following the discovery

of a hairline crack on the mixer flange early November 2023. The mixer will remain in place and out of service to reduce potential vibrations that would place additional stress on the crack. Plans to take the digester out of service to repair the crack are scheduled for July 2024

The average digester VS load was 0.10 lbs-VS/cu-ft./d. Approximately 13.5 million ft3 (MMCF) of digester gas was produced in April, using the gas flow meters to the flares and the boilers. Volatile acid (VA) concentrations in the active digesters and the DSST ranged between 45 to 64 mg/L (concentrations less than 500 mg/L are ideal); and digester gas composition of approximately 59% methane.

Dewatering/Biosolids: Time and temperature requirements for Class B biosolids were met via anaerobic digestion. Dewatering operated 26 days in April, using both centrifuges. Centrifuge feed averaged 2.3% TS and 81.3% VS/TS for the month. Centrifuge biosolids product for Centrifuge 1 averaged 21.3% TS at 83.6% VS/TS and product for Centrifuge 3 averaged 20.3% TS at 83.6% VS/TS. A total of 282 dry tons of solids were processed (according to the feed flow meters and % solids) and 1,305 wet tons (269.2 dry tons at 20.7% TS) of biosolids cake were produced. A total of 1,320 wet tons (273 dry tons) of biosolids cake were hauled in April. Solids recovery in the dewatering process averaged 95.1%. Polymer dosage averaged 53.0 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.