

# Memorandum

October 13, 2023

TO: Historical Memo

FROM: Carol Nelson, Process Analyst  
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SUBJECT: Brightwater Treatment Plant  
September 2023 Operating Record

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All discharge permit requirements were met in September at the Brightwater Treatment Plant (BWTP). All wastewater received Membrane Bioreactor (MBR) secondary treatment. Effluent BOD and TSS averaged <1.3-mg/L and <2.0-mg/L, respectively, and removals were both  $\geq 99\%$ . All fecal coliform results were less than 1-cfu/100-mL. Effluent pH was maintained between 7.2 and 7.7. Continuous dosing of 59% Magnesium Hydroxide [ $Mg(OH)_2$ ] was required to ensure permit compliance for pH. 25% Sodium Hydroxide [ $NaOH$ ] was dosed for alkalinity addition on one day because of a low inventory of  $Mg(OH)_2$ .

Effluent flow to Puget Sound averaged 16.8-MGD. Approximately 0.6-MGD of effluent was used for plant processes and for directing Reclaimed Water (RW) to the Influent Pump Station (IPS). No RW was distributed downstream of IPS. Influent flow averaged 17.4-MGD. In September, influent flow was directed to South Plant three times via the North Creek Pump Station (NCPS) to facilitate electrical work in the Secondary process area as well as wet well pump downs. Influent was also directed to South Plant once via the Hollywood diversion structure for inspections. The monthly total influent sewage directed to South Plant was 0.3-MG. No bypass or overflows resulted from the redirected influent. Membrane capacity was adequate for the influent flow in September with measured capacity ranging between 30-MGD and 44-MGD.

September rainfall totaled 4.7-inches based on local rain gauges. The wettest period occurred between Sep.24-28 (4.0-inches). The maximum influent and effluent flows were both 21.5-MGD, and occurred on the wettest day of the month, Sep. 27, when 1.6-inches fell. Precipitation recorded for SeaTac Airport was 3.4-inches of rain, which is 1.8-inches above normal. Local area air temperatures averaged 62.0°F, which is 0.6°F below normal. Membrane effluent temperatures decreased from 72.3°F to 70.0°F.

All permit-required samples were collected and analyzed. No blending events occurred this month. Effluent samples for Sep. 9 were collected but not analyzed. Because there were no blending events, analytical results for membrane effluent and final effluent are typically similar. Membrane effluent BOD and TSS results for Sep. 9 were 1.3 mg/L and <2.0 mg/L, respectively. Effluent samples for Sep. 20 were a grab rather than a composite because of sampler malfunction which was corrected the following day. Membrane effluent BOD and TSS results for Sep. 20 were 2.6 mg/L and <2.0 mg/L, respectively.

**Influent Pumping:** Influent flow was pumped using the small raw sewage pump sets (RSP). Two pump sets were required on 22 days for an average of 5 hours per day. The IPS wet well was “pumped down” on 22 days in September to remove accumulated grease and rags. Influent flow was directed to South Plant via the Brightwater diversion structure and NCPS on three days in September. Restricting influent flow on those days facilitated pumping down of the IPS wet well. As noted above, influent flow was also directed to South Plant via the Hollywood diversion structure to facilitate inspections.

**Primary Treatment:** Three of five primary clarifiers (PC), PC-1, PC-2, and PC-4, were in service in September. 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.

**Secondary Treatment:** Two aeration basins (AB's), AB#1 and AB#3 were in service this month. AB#2 was taken out of service in July for tank modifications included in the Brightwater Aeration Basin Optimization (BWABO) project. These modifications include the replacement of diffusers, installation of new scum gate actuators, and installation of level-indicating bubbler. The basin is expected to return to service in mid-October. Aeration basins continued to operate in the "zone-DO" control mode this month. Aeration air flow for the month averaged 10,432-scfm to the two basins. Filamentous growth was present this month but was not abundant. The MLSS and SRT averaged 6,263-mg/L and 14 days, respectively. Secondary foam was minimal 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<sub>2</sub>+NO<sub>3</sub>) and ammonia averaged 38.2-mg/L and 0.7-mg/L as N<sup>1</sup>, respectively. Influent concentrations for total Kjeldahl nitrogen (TKN) and TIN in September were similar to August's. Results for July, August, and September are summarized in Table 1. To improve denitrification, DO setpoints were decreased by 0.1-ppm on Sep. 6. After Sep. 20, ammonia concentrations observed from an online analyzer were greater than 5-mg/L in the membrane effluent for up to eight hours in the afternoon and evening hours, indicating insufficient aeration for full nitrification. On Sep. 26, the DO setpoint for zone 4 was increased by 0.3-mg/L to decrease the effluent ammonia. When AB#2 is back in service, the increased aeration capacity should allow for complete nitrification at the current DO setpoints. Any changes to DO setpoints will be done slowly to support process stability.

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.

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

	Days in Month	Influent				Effluent				Total N Removal <sup>1</sup>
		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	
July	31	61.2	41.3	16.1	8,199	1.6	40.3	15.2	5,062	32%
Aug	31	62.1	39.0	17.2	8,911	1.4	39.8	15.7	5,263	34%
Sep	30	61.4	40.0	17.4	8,902	2.2	39.0	15.8	5,429	34%

<sup>1</sup> Total Nitrogen Removal (TN) is equal to [Influent TKN-(Effluent TKN + Effluent NO<sub>2</sub>+NO<sub>3</sub>)]/Influent TKN and assumes that the Influent NO<sub>2</sub>+NO<sub>3</sub> is very low. TKN is Organic Nitrogen + Ammonia.

Alkalinity in the form of a 59% Mg(OH)<sub>2</sub> solution was added to the secondary process to ensure minimum effluent pH limits were met and to achieve complete nitrification. The 59% Mg(OH)<sub>2</sub> solution dose averaged approximately 1,924-gpd or 110 gallons/MG of influent. An additional 1,414 gallons of 25% NaOH were used on Sep.22 due to low Mg(OH)<sub>2</sub> inventory.

Membrane effluent turbidity averaged 0.03 - 0.05 NTU. Membrane Trains were in "relax" mode and LEAP "low" mode this month because filterability was very good. Approximately 4,000-gallons of 12.5% NaOCl were used for membrane maintenance cleans. An additional 790-gallons of 12.5% NaOCl were used for a recovery clean on Train #8. Staff performed membrane integrity tests or "bubble tests" on Trains #2 in September. Bubble test results indicate the location of cassettes that are most in need of replacement or repair. Trains 3 and 5 were among the poorest performing trains. Modules in Train 3 were replaced in September, and modules in Train 5 will be replaced in October.

Membrane capacity ranged between 30-mgd and 44-mgd this month. This range was well above the range needed to process the influent flow. The lower capacity estimate occurred on a day when multiple trains were out of service for bubble testing or for module replacement. Soluble COD (sCOD) in the mixed liquor, which has been well correlated with permeability (higher sCOD is correlated with lower permeability), decreased to an average of 30-mg/L. The maximum hourly flux during peak flow tests was between 14.4-gpd and 15.5-gpd per ft<sup>2</sup> of membrane surface.

Table 2 shows the weekly average TMP, membrane permeability, and SRT. Peak flow tests were run on two trains four times per week. Flow setpoints for the peak flow tests are normally adjusted up/down depending on the TMP before backpulse. The rated instantaneous peak hourly flow for one membrane train is 4950-gpm. This month the flow setpoint remained at 4300-gpm which was still above the current influent flow for Brightwater. Four peak flow tests were performed each week this month. The testing frequency would be increased to daily if conditions indicate a blending event could occur (requiring chemically enhanced primary treatment); current conditions indicate this scenario is very unlikely. All peak flow tests were run with trains in backpulse mode.

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

Parameter	Week ending 9/04	Week ending 9/11	Week ending 9/18	Week ending 9/25
TMP before backpulse, average psi <sup>2</sup>	-0.6	-0.9	-0.8	-0.6
TMP before backpulse, peak flow test, psi	-1.8	-1.7	-1.6	-1.6
Permeability temperature-corrected <sup>1</sup> , gfd/psi	7.9	8.5	8.9	9.0
Flow target for peak flow test, gpm	4300	4300	4300	4300
Flow hourly average during peak flow test, gpm	3380	3360	3350	3320
MBR Effluent temperature, degrees F	72.3	71.9	72.0	71.6
SRT, days	13	16	13	14
MLSS, mg/L	5878	6244	6061	6253
ML soluble COD, mg/L	33	29	29	32

1 Temperature-corrected Permeability based on Peak Flow Test.

2 TMPs during the moderate flow period of the day

**Disinfection:** Approximately 8,570 gallons of 12.5% sodium hypochlorite (NaOCl) was used in September for final effluent disinfection. The NaOCl effluent disinfection dose averaged 2.4-mg/L as Cl<sub>2</sub>. Effluent Cl<sub>2</sub> residual at the outfall (aka Point Wells) met both the monthly and max-weekly permit limits. The monthly average and maximum weekly residuals were 0.06-mg/L and 0.07-mg/L, respectively.

**Odor Control:** The Odor Control (OC) facilities performed well during the month. All odor control areas had the design-specified number of trains in service; three each for Secondary and Solids and four for Headworks. The Secondary Odor control facility was offline for approximately 6 hours on two days in September for inspection of the foul air duct and plenum. Air balancing work will continue next year when upstream ducts in all process areas can be cleaned and repaired.

**Thickening:** Two of the three gravity belt thickeners (GBTs) operated in September. The belt on GBT 1 was found to be misaligned and was taken out of rotation in mid-April and repairs are pending. The GBTs thickened approximately 12.2 MG of feed sludge from an average of 1.4% total solids (TS) to 6.6% TS, with an average solids capture of 93.2%. Sludge loading to the thickeners totaled 728 dry tons. The polymer dose for thickening averaged 6.4 pounds active polymer per dry tons solids processed. All three polymer blending units (thickening, dewatering, and swing units) continue to operate normally. Plans to replace all three, skid mounted units are ongoing.

**Anaerobic Digestion:** The digestion process met time and temperature requirements for Class B biosolids for the month. The temperature in the active digesters averaged 98.9°F and the solids retention time (SRT) averaged 40.0 days, and volatile solids (VS) destruction averaged 56.5%. The total solids concentration in the active digesters averaged 3.1% with a VS fraction of 80.1% VS/TS. TS for Digester 2 began remained higher than for the other digesters in September, indicating that inert material continues to settle in the cone of digester. Inadequate mixing caused by a failed draft tube is the likely cause of the settling and the noticeably higher %TS concentrations. Staff have been utilizing the withdrawal pumps to transfer settled material into the Storage Tank. Draft tube mixer 1 in Digester 1 was replaced during the month. Draft tube mixers in Digester 2 (mixer 2) and Digester 3 (mixer 2) were removed for repair. There was no evidence of increased TS settling in these two digesters to date. The average digester VS load was 0.10 lbs-VS/cu-ft./d. Monthly gas production totaled 12.9 million ft<sup>3</sup> (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 24 days in September. Centrifuge feed averaged 2.4% TS and 82.7% VS/TS for the month. Centrifuge biosolids product averaged 20.6% TS at 84.4% VS/TS for centrifuge 1 and 20.3% TS at 84.7% VS/TS for centrifuge 3. A total of 290 dry tons of solids were processed (according to the feed flow meters and % solids) and 1338 wet tons (275 dry tons at 20.6% TS) of biosolids cake were produced. A total of 1,384 wet tons (285 dry tons) of biosolids cake were hauled in September. Solids recovery in the dewatering process averaged 95.2%. Polymer dosage averaged 53.3 lbs-active per dry ton produced.