

# Memorandum

November 10, 2022

TO: Historical Memo

FROM: Carol Nelson, Process Analyst  
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SUBJECT: Brightwater Treatment Plant  
October 2022 Operating Record

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All discharge permit requirements were met in October at the Brightwater Treatment Plant (BWTP). All wastewater received Membrane Bioreactor (MBR) secondary treatment. Effluent BOD and TSS averaged <1.4-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 6.9 and 7.4. Continuous dosing of 59% Magnesium Hydroxide ( $\text{Mg}(\text{OH})_2$ ) was required to ensure permit compliance for pH.

Effluent flow to Puget Sound averaged 10.1-MGD. Approximately 4.2 MGD of raw sewage was diverted to South Plant, along with 1.4 MGD of effluent via the Reclaimed Water pipe. Approximately 0.2-MGD of reclaimed water was distributed offsite in October, and approximately 0.5-MGD of effluent was used for plant processes, including filling tanks and flushing the local sewer lines. Approximately 0.6-MGD of effluent was recirculated to the plant influent via the Influent Pump Station (IPS). Influent flow averaged 12.8-MGD. Membrane capacity ranged between 39-MGD and 45-MGD.

In October, the anaerobic digestion system at Brightwater was experiencing process upset. Several measures were taken to reduce solids loading to the plant to improve digester stability, including restricting the influent flows to Brightwater and returning raw sludge generated from the liquid stream processes to the influent sewer. Additional information describing solids recycling can be found later in this memo. Influent flow was limited to between 11-MGD and 15-MGD this month. To further reduce solids loading to the digesters, an average of over 0.3-MGD of raw sludge from the liquid stream processes was allowed to flow to the Brightwater Diversion structure via the influent sewer. From there, it was directed to either the Brightwater IPS or to South Treatment Plant via North Creek- and York- Pump Stations. The raw sludge flow to Brightwater and South Plant averaged approximately 0.25-MGD and 0.10-MGD, respectively. The combined total influent and raw sludge flow directed to South Plant averaged 4.2-MGD. An additional 3.2-MG was directed to West Point via the Swamp Creek gates from Oct. 16 to Oct. 17 to further reduce the solids loading at Brightwater. No bypass or overflows resulted from the redirected influent.

Because of the raw sludge recycle to the Brightwater influent, the monthly average TSS load of 77,935 pounds per day (ppd) appears to exceed the maximum limit of 61,400 ppd. However, of the 77,935 ppd, it is estimated that approximately 42,700 ppd TSS were due to the recycling of raw sludge. October's TSS load does not reflect the TSS loading of Brightwater service area's influent sewers. Without recirculation of solids, the average influent TSS concentration would have been approximately 332 mg/L, equivalent to a TSS load of 35,250 ppd. Influent BOD concentrations and loading were also higher due to this solids recirculation. The liquid stream processes were able to perform without permit exceptions and effluent quality was not impacted. Additional detail regarding recovery plans for the anaerobic digestion process are discussed under Digestion, later in this memo.

October rainfall totaled 3.1-inches based on local rain gauges. Nearly all rain fell between Oct. 21 and Oct. 31. Precipitation recorded for SeaTac Airport was 2.5-inches, which is 1.4-inches below normal. Local area air temperatures were 3.8°F above normal this month. Membrane effluent temperatures averaged 70.5°F, falling from 71.7°F at the beginning of the month to 68.3°F by the end.

All permit-required samples were collected and analyzed. No blending events occurred this month. Modifications to the Influent sampler backflushing and drain system were completed in October. In preparation for reconfiguration of the influent sampler lines, a portable sampler was placed in the influent channel. This portable sampler was in service between Oct. 13 and Oct. 31 for comparison with, and as a backup for, the influent sampler. Results for BOD and TSS from the two samples compared well. On two days, Oct. 24 and Oct. 28, the results from the influent screen sample were substituted for the results from the influent sampler. On Oct. 24<sup>th</sup>, the drain for the influent sampler had become plugged and was subsequently jetted. On Oct. 28, the TSS and BOD results for the anomalously low. The influent sampler modifications appear to perform more reliably than the previous configuration but tuning of the new system is still in progress. Additional modifications may be needed because of the large quantity of rags in the influent.

**Influent Pumping:** Influent flow was pumped using the small raw sewage pump sets (RSP). This month, only one small pump set was required. The IPS wet well was “pumped down” on 22 days in October to remove accumulated grease and rags. As noted above, an average of 4.2-MGD of influent and raw sludge was directed to South Plant daily via the Brightwater diversion structure and the North Creek Pump Station (NCPS). Between Oct. 4 and Oct. 31, an average 1.9-MGD of effluent was recirculated to the Brightwater diversion structure to facilitate movement of solids and dilute and freshen the flow going to the influent of both plants.

**Primary Treatment:** Three of five primary clarifiers (PC) were in service during the month of September: PC-2, PC-3 and PC-4. Solids return flows were directed to PC-2. 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:** Three aeration basins (AB's) were in service this month. Aeration basins continued to operate in the new “zone-DO” control mode this month, which is part of the Brightwater Aeration Basin Optimization (BWABO) project. On average, DO concentrations were at the desired levels in each zone. After Oct.16, DO concentrations steadily rose above setpoints because of the reduced flow to the plant. Reduced influent flow resulted in aeration demand being 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. Aeration air flow for the month averaged 7,000-scfm to all three basins. The MLSS and SRT averaged 8,546-mg/L and 64 days, respectively. The SRT and MLSS were allowed to increase during this month to reduce the WAS fraction of solids loading to the Digesters. Secondary foam was present but minimal this month. The MLSS was maintained primarily by surface wasting with minimal mixed liquor wasting.

Full nitrification was achieved this month and denitrification showed improvement, although the amount of denitrification was likely skewed by the high concentration of solids in the influent, since nitrogen species in the recycled solids may not have been converted or degraded through the treatment process. TKN analyses is done once per week, while TSS is performed every day; the influent TKN load maybe more variable than calculated. Effluent nitrite/nitrate (NO<sub>2</sub>+NO<sub>3</sub>) and ammonia averaged 27-mg/L and 0.03-mg/L as N, respectively. October's total effluent nitrogen loading, (TIN, lb/month), was lower than September's primarily because of reduced flow to the plant. Results for August, September, and October are summarized in Table 1.

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

		Influent				Effluent				
		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	
Aug	31	69.9	40.0	16.3	9,505	2.1	39.3	15.7	5,166	41%
Sep	30	71.2	41.7	15.5	9,208	1.8	35.5	14.8	4,306	48%
Oct	31	79.3	37.0	12.8	8,465	1.6	27.8	10.1	2,339	63%

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 820-gpd or 81 gallons/MG of influent. 25% Sodium Hydroxide (NaOH) was not used to supplement the dose of Mg(OH)<sub>2</sub> this month.

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. All cassettes were in service. Approximately 5,620-gallons of 12.5% NaOCl were used for membrane maintenance cleans.

Membrane capacity ranged between 39-mgd and 45-mgd this month. This range was well above the range needed to process the influent flow. Permeability continued to be good this month, averaging 9.5 gfd/psi during the peak flow tests. Soluble COD (sCOD) in the mixed liquor, which has been well correlated with permeability, was relatively low at an average of 25-mg/L. The maximum hourly flux during peak flow tests was between 14.8-gpd and 16.5-gpd per ft<sup>2</sup> of membrane surface.

Table 2 shows the weekly average trans-membrane pressure (TMP), membrane permeability, and SRT. Peak flow tests were run on two trains per day. Flow setpoints for the peak flow tests are normally adjusted up/down depending on the TMP before backpulse. This month the flow setpoint remained at 4500-gpm (changes in permeability with time are easily observed when the peak-flow setpoint is held constant); the rated instantaneous peak hourly flow for one membrane train is 4950-gpm. TMPs did not drop below -3.0 psi during the peak flow test, indicating that the capacity was adequate for the peak hourly design flow for the month.

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

Parameter	Week ending 10/03	Week ending 10/10	Week ending 10/17	Week ending 10/24	Week ending 10/31
TMP before backpulse, average psi <sup>2</sup>	-0.7	-0.7	-0.7	-0.6	-0.6
TMP before backpulse, peak flow test, psi	-1.8	-1.6	-1.7	-1.7	-1.7
Permeability temperature-corrected <sup>1</sup> , gfd/psi	9.0	9.7	9.2	9.5	9.7
Flow target for peak flow test, gpm	4500	4500	4500	4500	4500
Flow hourly average during peak flow test, gpm	3690	3700	3640	3680	3680
MBR Effluent temperature, degrees F	71.3	70.9	70.7	69.7	68.5
SRT, days	86	88	67	37	39
MLSS, mg/L	7050	7990	8840	9035	8425
ML soluble COD, mg/L	29	27	25	23	29

1 Temperature-corrected Permeability based on Peak Flow Test.

2 TMPs during the moderate flow period of the day

**Disinfection:** Approximately 4,880 gallons of 12.5% sodium hypochlorite (NaOCl) was used in September for final effluent disinfection. The NaOCl effluent disinfection dose averaged 2.2-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 0.04-mg/L and 0.05-mg/L, respectively. An additional 7,390-gallons of NaOCl was used to disinfect Reclaimed Water, which was distributed to customers and used for flushing to North Creek via the Brightwater Diversion Structure.

**Odor Control:** The Odor Control (OC) facilities performed well during the month. Repairs to metering pumps and minor chemical leaks are ongoing. Replacement of the pH and ORP probes for the chemical scrubbers is continuing. All odor control areas had the design-specified number of trains in service; three each for Secondary and Solids and four for Headworks.

**Thickening:** Only one gravity belt thickener (GBT) was operated in October. However, due to upset conditions within the anaerobic digestion process, Brightwater found it necessary to minimize solids loading to the Digesters. Approximately 1.7 M-lbs pounds of solids were discharged to sewer from the RSBT between Oct 4 to Oct 31; as mentioned above, much of this load was recycled to Brightwater, and some was diverted to South Plant. Overflowing solids from the RSBT and diversion to South Plant and recycling to Brightwater will continue into November. GBT 3 operated 15 days in October and thickened approximately 1.5 MG of feed sludge from an average of 2.5% total solids (TS) to 6.6% TS, with an average solids capture of 94.0%. Sludge loading to the thickeners totaled 150 dry tons. The polymer dose for thickening averaged 4.8 pounds active polymer per dry tons solids processed.

**Anaerobic Digestion:** The digestion process met time and temperature requirements for Class B biosolids for the full month of October, despite upset conditions. Digester 3 was taken out of service on June 27th to prepare it for cleaning, equipment maintenance, and inspection. Digester 3 is expected to return to service in November. Solids loading to the two active Digesters was significantly reduced for the month as part of the effort to recover digestion performance. In the active digesters: the solids retention time averaged 178 days, temperature averaged 98.9°F, and volatile solids (VS) destruction averaged 60.9%. The total solids concentration in the active digesters averaged 2.6% with a VS fraction of 81.3% VS/TS. The average digester VS load was 0.021 lbs-VS/cu-ft./d. Monthly gas production totaled 2.5 million ft<sup>3</sup> (based on the waste gas burner and boiler flow meters).

Due to ongoing upset conditions, Brightwater staff continued to monitor volatile acid (VA) concentrations in Digesters 1 and 2 throughout the month of October. VA concentrations in Digester 1 and Digester 2 averaged 332 mg/L and 643 mg/L, respectively. Peak VA concentrations in Digester 1 and Digester 2 were 814 mg/L on Oct. 12th and 2,040 mg/L on Oct 4<sup>th</sup>, respectively. Efforts continue to reduce VA concentrations in the active digesters by decreasing digester loading (decreasing wasting, carrying larger primary sludge inventory in primary sedimentation tanks, shedding raw sewage flow to South Plant, shedding blended raw sludge to South Plant via Trunk Sewer and BW Diversion Structure) as well as expedited efforts to restore Digester 3 to service. Investigation into the root cause of Digester 1 going sour in September is ongoing.

**Dewatering/Biosolids:** All biosolids met the requirements for Class B. Dewatering operated 6 days in October, using both Centrifuges 1 and 3. Centrifuge feed averaged 1.8% TS and 80.6% VS/TS for the month. Centrifuge biosolids product averaged 20.8% TS at 81.4% VS/TS for centrifuge 1 and 20.5% TS at 80.9% VS/TS for centrifuge 3. A total of 22 dry tons of solids were processed (according to the feed flow meters and % solids) and 99 wet tons (21 dry tons at 21.1% TS) of biosolids cake were produced. A total of 156 wet tons (33 dry tons) of biosolids cake were hauled in October. Solids recovery in the dewatering process averaged 91.8%. Polymer dosage averaged 75.9 lbs-active per dry ton produced; this value is higher than typical and probably due to degradation of polymer batches sitting in the tanks for days between centrifuge operation.