

Memorandum

May 14, 2024

TO: Historical Memo

FROM: Andy Strehler, Process Engineer; Rachael Dyda, Process Supervisor; Curtis Steinke, Process Engineer

SUBJECT: South Treatment Plant (STP) DMR Memo
April 2024 Operating Record

STP met its conventional permit limits for secondary effluent. Operation in April 2024 was characterized by lower than normal rainfall and typical temperatures. The plant continued to nitrify/denitrify in April. Chlorinated secondary effluent was recycled internally with the goal of removing additional nitrate to improve TIN removal. The recycle flow also has the benefit of returning alkalinity to the process and raising the final effluent pH. The average SVI improved in April: 91 mL/g and varied between 79-115 mL/g. Additional observations include good effluent quality, lower septage loading than in April of previous years, stormwater was valved to the influent the entire month.

Climate

April rainfall was considerably lower than normal and average temperatures were the same compared to historical averages. Rainfall (1.09-inches at SeaTac Airport¹) was less than half the historical average (3.18-inches at SeaTac Airport). The observed daily average high and low air temperatures were 72°F and 36°F. The monthly average of daily maximum and minimum air temperatures were 57.7°F and 42.7°F which are 1.6°F and 0.6°F lower than the maximum and minimum long-term averages, respectively. The average wastewater effluent temperature ranged from 69.0°F to 71.4°F throughout the month.

Effluent Quality

Effluent flow averaged 67.1-million gallons per day (mgd), which falls within the historical April flow range. Final effluent quality for the month averaged 3-mg/L carbonaceous BOD (CBOD₅), 5-mg/L TSS and 10-mg/L total BOD₅. Respective removals were 99%, 98% and 97%. Maximum weekly average values were 4-mg/L, 5-mg/L and 12-mg/L, respectively. All conventional permit limits for secondary effluent were met.

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 Boeing Field weather station.

Offsite Flows and Loads

1.72-MG of septage was received at STP in April (287,100 lbs at approximately 2% TS), which was approximately 13% lower loading than in April 2023 and accounted for an estimated 5% of STP's influent solids load for the month. Southern Transfer (aka Allentown) flow averaged 5.1-mgd, with a peak-daily flow estimate of 7.0-mgd on April 25. Brightwater did not divert any flow to STP via the North Creek Pump Station or the York Diversion Gate at Hollywood Pump Station all month. The Port of Seattle sent an estimated 26,560 total pounds of BOD (as deicer) to STP over 9 days in April.

Sampling and Analyses

All permit-required samples (influent and effluent) were collected and analyzed. The final ETS effluent sample line/sampler was usually chlorinated every fourth day. Influent flow, including recycled flows, ranged from 82.4-mgd to 96.9-mgd with an average of 87.8-mgd. Daily effluent flows ranged from 61.1-mgd to 76.1-mgd with an average flow of 67.1-mgd. Typically, around 6-8-mgd of the total influent flow is from various internal processes and is returned to the influent via the plant sanitary drain system, causing the influent flow to be higher than effluent flow; recycle of chlorinated secondary effluent continued throughout April, adding an estimated 14-mgd additional flow to the influent. The influent loads averaged 72-tons/day CBOD₅, 97-tons/day BOD₅, and 80-tons/day TSS. The average monthly effluent chlorine (Cl₂) at the ETS outfall was <52-ug/L with minimum and maximum daily average values of <50 and 70-ug/l, respectively. This is well below the permitted max-day limit of 750-ug/L and the monthly average limit of 500-ug/L.

STP Facility Area Status

Primary Treatment: There were 4 north and 8 south primary tanks in service all month. The primary effluent TSS averaged 69-mg/L, resulting in an average TSS removal rate in the primary clarifiers of 69%. Primary effluent CBOD averaged 106-mg/L resulting in an average CBOD removal rate across the primaries of 45%. The hydraulic loading rate (HLR) ranged from 1,189 – 1,398-gpd per ft², with an average of 1,268-gpd per ft².

Secondary Treatment:

All four ATs were in service all month. 23 of 24 secondary clarifiers were in service all month; clarifier 8 was out of service all month due to a leaking collector seal. The POD5 effluent control valve continues to be operated manually. POD 3 effluent flow control valve failed in a fixed position on April 28 and was discharging at a fixed flow around 15.5-mgd afterwards. South Plant operated the secondary process to partially nitrify and denitrify. Settled sewage feed gates were in plug flow mode all month (i.e., AT feed gates open only in Pass-1).

Average MLSS concentration ranged from 2,894 – 3,240-mg/L, with a monthly average concentration of 3,051-mg/L. The solids SRT ranged from 4.6 – 5.9-days, with an average of 5.4-days. The average mixed liquor settling (SVI) was lower in April compared to March,

with values ranging from 79 – 115-mL/g, with an average of 91-mL/g. The RAS flowrate was held constant at 3.0-mgd per clarifier in service, or around 107% of plant effluent flow.

Aeration tank air use ranged from 80.5 – 102.2-million-ft³/day with an average of 87.7-million-ft³/day for the month, which was significantly higher than in March due to nitrifying the full month. Wasting rates varied throughout the month in response to changes in flow and in activated sludge inventory. WAS flows and loads along with dissolved oxygen (DO) setpoints for passes 1&2 and 3&4 varied throughout the month to maintain partial nitrification. DO probe #5, located ½ way down pass 2, was used for control of airflow to passes 1&2 all month for all tanks. DO probe #10 was used to control airflow to passes 3&4 through Apr. 20 then switched to probe #12 the rest of the month, for better aeration control while nitrifying.

Nutrient Removal and Puget Sound Nutrient (Nitrogen) General Permit (PSNGP)

STP operated the secondary process for total inorganic nitrogen (TIN) removal during all of April in order to meet the WTD bubbled PSNGP annual total inorganic nitrogen action level for 2024. TIN removal averaged 54.1% in April. Effluent ammonia (NH₃) and nitrite plus nitrate (NO₂+NO₃) averaged 6.8-mg/L as N and 12.2-mg/L as N, respectively, resulting in an average effluent TIN of 18.9-mg/L as N. On a mass (as N) basis, the daily average effluent NH₃, NO₂+NO₃, and TIN loads were 3,849-lbs/day, 6,780-lbs/day and 10,629-lbs/day, respectively. The monthly total effluent TIN load for STP in April was 318,878-lbs, which was 282,761-lbs below STP's individual monthly limit, if STP had a monthly limit (calculated using STP's individual action level of 7.34 million lbs/year divided by 366 days and multiplied by # of days per month if WTD had not bubbled and STP had a monthly limit). All permit-required samples (influent and effluent) were collected and analyzed.

Phosphorus (P) removal in April averaged 53% and effluent Total-P averaged 3.53-mg/L or 1,975-lbs/day.

Disinfection

39,010 gallons of 12.5% sodium hypochlorite (NaOCl) were used to disinfect STP's final effluent in April. This resulted in an average dose of 2.2-mg/L as chlorine (Cl₂) based on secondary effluent (POD) flow. Hypochlorite use in April averaged 1,300-gpd, which was slightly higher than March's use (1,068-gpd) and April 2023 (1,155-gpd). This increased NaOCl usage was due the additional flow from secondary effluent recycle and the need to re-disinfect this flow. Dechlorination via sodium bisulfite was not required.

Both the north and south CCCs were in service. A gate between the north and south CCCs near POD4 directed PODs 5&6 effluents to flow down the south CCC while PODs 1-4 effluent flowed down the north CCC.

DAFT

An average of 88.9-dry-tons/day (0.364-mgd at 5.86% TS) of co-thickened raw and waste activated sludge (THS) was produced by the DAFTs and the THS TS values were typical all month. There were 4 DAFTs in service (DAFT 2, 3, 5 & 6) all month. All four DAFTs operated with two pressurization units the entire month. 14,850-lbs of polymer (Polydyne WE-1531) were added to DAFT feed sludge in April. The solids loading rate (SLR) averaged 22.8-lbs./d/ft² for the smaller DAFTs and 24.7-lbs./d/ft² for the larger DAFTs. SLR ranged from 19.0-lb/ft²/day to 30.8-lb/ft² /day throughout the month.

Anaerobic Digestion

Time and temperature requirements for Class B biosolids were met via anaerobic digestion. All five digesters were in service. Digesters 1-4 were the primary digesters, operated in parallel and fed equal amounts of THS. Each discharged to Digester 5, which served as the blending tank before dewatering. Over the month, the primary digester detention time averaged 29.5-days with Digester 5 providing an additional 3.3-days. Volatile solids (VS) reduction through the digestion process averaged 67.2%.

Digester 3 Heat Exchanger was removed from service between Apr. 01 – 05 to accommodate acid washing to remove struvite and other scale. During the four days the heat exchanger was out of service Digester 3 was not fed, and its temperature only dropped 1.5°F (99.3 to 97.8). The VS loading rate averaged 0.11-lbs./day/ft³ for the four primary digesters. The VS/TS percent entering and leaving the digestion process averaged 88.2% and 71.1%, respectively. The alkalinity concentrations were in the 6,200 – 7,600-mg/L as calcium carbonate (CaCO₃) for Digesters 1-4. Digester temperatures were in the 97 – 100°F range.

Energy

The gas scrubbing system operated and sold biomethane every day in April. 253,160-therms of scrubbed gas (biomethane) was distributed into PSE's pipeline. 5,115-therms, or approximately 2% of the biogas produced, was flared.

Both Cogen Turbines were available most of April. There was a vent fan alarm which prevented both units from operating on Apr. 04, and a fire alarm panel prevented Cogen 1 from operating on Apr. 28. Both Cogen 1 & 2 were operated on Apr. 08 & 15 and Cogen 1 on Apr. 20 for routine PM.

The gas fired boiler operated all of April and supplied the plant heat loop, except for periods when the new gas-fired boilers in the Cogen facility underwent testing (Apr. 23 – 30). The digester temperature setpoints were set at 99°F between Apr. 01 - 18, and then set at 97.5°F the rest of the month. Prior to testing of the new boilers, the HRS temperature supplied by the solids boiler varied between 117 - 142°F with the boiler in cascade control based upon digester HRS valve MOV control. The electric boiler in Main Control ran most of the month to supply heat to the Administration Building and Main Control. It was isolated from the plant heat loop while in operation. During testing of the new gas boilers at Cogen,

heat to the Administration Building and Main Control was supplied by the main heat loop and the boilers at Cogen (Apr. 23 – 29).

The treatment plant was operated to partially nitrify and denitrify all of April. This required additional energy use: higher aeration rates to achieve nitrification, and higher RAS pumping rates, and re-treatment of effluent recycle to enhance denitrification.

Dewatering/Biosolids

1,093-dry-tons biosolids (5,062-wet-tons at 21.6% TS) were hauled in April. Approximately 74% of the biosolids (based on wet tons) were distributed to Western Washington (WA) forest sites and 26% to Eastern WA agricultural sites. An estimated 55,800-lbs. of active polymer were applied for dewatering biosolids equal to an average dose of 51.2 lb-active/dry ton hauled. The polymer was Polydyne WE1514, a 43% active cationic emulsion solution.

Dewatering operated on 30 days in April. Dewatering operation was 24-hour shifts on weekdays and half-day shifts on weekends. Two centrifuges were typically in service during dewatering operations. Typical centrifuge feed rate ranged between 150 – 230-gpm per each centrifuge in service. Some gas-scrubbing water was sent to the centrate sump to provide struvite control. Centrate was valved to the DAFTs in April. Centrifuges 1 and 2 were available for service all month, centrifuge 3 was out of service for preventive maintenance the first 3 weeks of the month.