MEMORANDUM

May 14, 2019

TO: Historical Memo

FM: Peter Carter / Steven Yee

RE: Carnation Wastewater Treatment Plant
April 2019 Process Summary

The Carnation Treatment Plant (CTP) discharged to the Chinook Bend wetlands for the entire month of April. Effluent Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) averaged <1.4 mg/L and <2.0 mg/L, respectively. BOD_5 and TSS removals were both >99%. All permit-required samples were collected and analyzed. Effluent flow averaged 0.104-MGD. Influent flow to the CTP averaged slightly higher (0.110-MGD) due to internal recycle flows. The max-day effluent flow was 0.185-MGD on April 9. This high effluent flow was due to storing flows from the previous day because of communication problems between Carnation and South Plant (which monitors the Carnation Plant when it is not staffed). The permeate temperature increased from 63ºF to 66ºF across the month.

The plant operated with one of two aeration basins in service (Basin 1). The MLSS averaged 8850-mg/L. An estimated 7770 dry lbs. of waste sludge and scum were hauled to the South Plant for further treatment. Flow was cycled through all five membrane trains and both UV trains in April.

Total-N removal averaged 75%. Effluent ammonia (NH_3) averaged 12.2-mg/L as N. Effluent nitrite plus nitrate (NO_2+NO_3) averaged 3.7-mg/L as N. Total-N removal was lower, and effluent NH_3-N was higher, than usual due to an operational oversight. During the second week of the month, a partial tank of weak (4%) sodium hypochlorite solution was drained to the plant influent line to make ready for a new shipment of solution. Unfortunately, the drain rate turned out to be too aggressive for the MLSS to handle, resulting in accidentally knocking out the nitrifying bacteria and resulting in high effluent ammonia values in the middle of the month. Several 5,000-gallon loads of nitrifying mixed liquor from the Vashon Treatment Plant was seeded into the CTP to accelerate recovery; nitrification (and denitrification) was fully restored by the end of the month. Total phosphorus (P) averaged 4.2-mg/L for a total P removal of 50%. N and P analyses are performed on a weekly basis.

Alkalinity was added to the secondary process to always maintain the effluent pH above pH 6.5. Caustic Soda was the alkalinity source this month; a total of 558 gallons was used. Effluent alkalinity averaged 189-mg/L (with a range of 134-291) as $CaCO_3$; influent alkalinity was in the range of 216-260 mg/l as $CaCO_3$. Alkalinity addition replaces the alkalinity lost during nitrification; the effluent pH would likely fall below the permitted minimum pH 6.0 if alkalinity addition stopped.

Tables 1 and 2 present membrane maintenance cleaning information and membrane performance data, respectively. Average TMPs were in the 1.7 to 2.2 psi range. The control system limits flow through the membranes to keep the TMP <8.0-psi; this protects the membranes' integrity. An estimated 51-gallons of 6 % sodium hypochlorite were used for maintenance cleans in April. In addition, recovery cleans with sodium hypochlorite and citric acid were performed on membrane trains 1, 2 and 3. An estimated 243 gallons of sodium hypochlorite and 33 gallons of citric acid were used for recovery cleans.

Table 1: Membrane Maintenance Cleans Performed

Week Beginning	Train 1	Train 2	Train 3	Train 4	Train 5
4/1	MC[1]	MC	MC	MC	MC
4/7	RChypo[2] RCcitric[3]		MC	MC	MC
4/14		MC RChypo RCcitric	MC	MC	MC
4/21	MC				
4/28	MC	MC	RChypo		

[1] MC refers to a maintenance clean
[2] RChypo refers to a sodium hypochlorite recovery clean
[3] RCcirtic refers to a citric acid recovery clean

Table 2: Membrane Performance April 2019

MEMBRANE PARAMETERS	Train 1	Train 2	Train 3	Train 4	Train 5
Permeate Turbidity (NTU)[1]					
Average for Month	0.09	0.09	0.06	0.10	0.15
Design	*< 0.2*	*< 0.2*	*< 0.2*	*< 0.2*	*< 0.2*
Permeate Flow (GPD)[2]					
Average Daily for Month	26,709	24,867	22,522	23,761	18,309
AADF (Annual Average Flow) Design	*97,500*	*97,500*	*97,500*	*97,500*	*97,500*
Maximum Daily for Month	41,635	36,742	42,684	39,070	35,636
PDF (Peak Day) Design	*165,000*	*165,000*	*165,000*	*165,000*	*165,000k*
Permeate Flow Rate (GPM)[3]					
Average for Month	19	19	17	17	15
Peak Hour for Month	98	107	99	92	85
PHF (Peak Hour) Design	*180*	*180*	*180*	*180*	*180*
Instantaneous Flux (GFD[4])[5]					
Average for Month	7.7	7.4	7.3	7.3	7.2
Trans-Membrane Pressure (PSI)[6]					
Average for Month	1.9	2.2	1.7	2.0	1.8
Maximum for Month	8.1	8.1	7.8	8.2	8.1
(Average/Maximum) Design	*2.0/10*	*2.0/10*	*2.0/10*	*2.0/10*	*2.0/10*
Permeate Temperature (ºC)[7]					
Minimum for Month	14.2	14.2	14.2	14.2	14.2
Design	*>12*	*> 12*	*> 12*	*> 12*	*> 12*
Permeability at 20ºC (GFD/PSI)[8]					
Average for Month	4.6	4.2	4.5	4.1	4.6
(Recovery Clean Trigger) Design	*< 3.0*	*< 3.0*	*< 3.0*	*< 3.0*	*< 3.0*

[1] Permeate turbidity – indication of membrane integrity.
[2] Permeate flow – compares operating to design capacity. The design capacity (AADF and PDF) are both based on entire treatment plant flow with four membrane trains available.
[3] Permeate flow rate – check of acute operating conditions to confirm peak hour design condition is not being approached. The design capacity (PHF) is based on entire treatment plant flow with five membrane trains available. The average rate is only for when the membrane is operating.
[4] "GFD" is shorthand for "GPD/Ft^2". GFD is a flux measurement based on the flow (gallons/day) of permeate that passes through a square foot of membrane surface. Each train has one membrane cassette with 12,920 square feet of surface area.
[5]Instantaneous flux – check of membrane operating flux. Instantaneous differs from net flux in that it does not account for backpulse and/or relax periods (It is therefore always slightly higher). The design condition is based on net flux and therefore not included. The permeate flow design conditions provide the same information since only a single cassette is operating in each membrane train.
[6] Trans-membrane pressure – provides information related to fouling and biological process operation (MLSS and filterability). The average and maximum TMP are included for reference.
[7] Permeate temperature – listed since the hydraulic capacity can be reduced when operating below the minimum design temperature (de-rating of membrane capacity).
[8] Permeability (temperature corrected to 20ºC) – parameter assesses fouled condition of membrane. The trigger value listed is from the GE O&M manual.