WWTP Capacity Study Update

CITY OF NEWBERG

Secondary Treatment and Solids Handling

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ACRONYMS, ABBREVIATIONS, AND SELECTED DEFINITIONS

AAGR	Annual Average Growth Rate
ADF	Average Day Flow
AHF	Average High Flow
ALF	Average Low Flow
BOD_5	5-Day Biochemical Oxygen Demand
DEQ	Oregon Department of Environmental Quality
EPA	Environmental Protection Agency
ft	Feet (or) Foot
gal	Gallons
gpm	Gallons per minute
HLR	Hydraulic Loading Rate
HMI	Human Machine Interface
HP	Horsepower
in	Inch(es)
lbs/day	Pounds per day
MCC	Motor Control Center
MDF	Maximum Day Flow
MGD	Million Gallons per Day
mg/L	Milligrams per liter
mL	Milliliters
mm	Millimeter
MLSS	Mixed Liquor Suspended Solids
MMF	Maximum Month Flow
NPDES	National Pollutant Discharge Elimination System
OH&P	Overhead and Profit
O&M	Operations and Maintenance
P&ID	Process and Instrumentation Diagram
PER	Preliminary Engineering Report
pH	Measure of the acidity or basicity
PHF	Peak Hour Flow
PLC	Programmable Logic Controller
psi	Pounds per square inch
RAS	Return Activated Sludge
SCFM	Standard Cubic Feet per Minute
SCADA	Supervisory Control and Data Acquisition
SF	Square feet

SLR	Solids Loading Rate
SVI	Sludge Volume Index
SWD	Side Water Depth
TDH	Total Dynamic Head
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
VFD	Variable Frequency Drive
WAS	Waste Activated Sludge
WWMP	Wastewater Master Plan
WWTP	Wastewater Treatment Plant

INTRODUCTION

BACKGROUND

The City of Newberg (City) owns and operates a wastewater treatment plant (WWTP) that receives and treats wastewater from throughout the City's service area. The City of Newberg created a Wastewater Master Plan (WWMP) in May 2018 and amended it in May 2021, which forecasted capacity improvements through a 20-year planning period. Adding an oxidation ditch and secondary clarifiers at the WWTP had been contemplated for many years, and the WWMP also included these improvements based on the design criteria projections. Growth in the City has increased the risk of the WWTP exceeding its design capacity.

Before moving forward with improvements, the City requested that Keller Associates (Keller) complete a capacity study to examine the current influent flows, loads, and population projections, and compare those values to the remaining capacity of the oxidation ditches, secondary clarifiers, and solids handling (including composting systems). In addition, a site visit to the WWTP was completed to assess current plant conditions and incorporate observations into the overall evaluation. This Capacity Study Update intends to provide an up-to-date assessment of the required scope and timing of contemplated improvements to the oxidation ditches, secondary clarifiers, and solids handling, and provides an updated cost estimate that reflects current conditions.

CHAPTER 1 - DESIGN CRITERIA

One component of this Capacity Study Update is to establish the design criteria to be used for this evaluation. This involved reviewing recent influent flow and loading, as well as more recent population projections for the City of Newberg. The more recent information is then compared against the values presented in the 2018 WWMP. It was found that the projections presented in the 2018 WWMP appear reasonably consistent with recent data. Therefore, projected design flows presented in the 2018 WWMP will be carried forward for use in this Capacity Study Update and preliminary design of these improvements.

1.1. POPULATION TRENDS

The official population projections for the City of Newberg reflect the collaborative efforts of Yamhill County and Portland State University (PSU). Each year, PSU establishes a preliminary population estimate in July that is sent to state and local jurisdictions and community partners. This is followed by a certified population estimate released in December of that same year. PSU also publishes a population forecast for the various counties and cities throughout Oregon, prepared in roughly 4-year intervals. The forecast published in June 2024 for Yamhill County and the City of Newberg was used for the population analysis component of this Capacity Study Update. The July 1, 2024, certified population estimate for the City was 26,249.

As shown in **Table 1-1**, the more recent certified and forecasted populations were compared against the population data presented in the 2018 WWMP. Overall, the forecasts were very similar. In particular, the percent difference for 2022, which utilizes certified population data, revealed a difference of only approximately 1%. Overall, it appears that the 2018 WWMP population projections are suitable for use in estimating loading in future population growth scenarios without changes.

TABLE 1-1: HISTORICAL POPULATIONS AND PROJECTIONS

Year	2024 PSU Update Population	2018 WWMP Population	% Difference
2022	25,514	25,797	1.1%
2027	28,937	28,343	-2.1%
2032	31,280	31,139	-0.5%
2037	33,511	33,811	0.9%

Sources: 2024 PSU Certified Populations and 2024 PSU Coordinated Population Forecast for Yamhill County

1.2. WASTEWATER FLOW RATES

Historical wastewater flows were prepared for plant data collected between January 2020 through December 2024. The Oregon DEQ *Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon* (April 1996) were used to estimate design flows for the City's system. Some of the methodology was adjusted slightly to allow for a more straightforward comparison between the current historical flows and the 2018 WWMP project design flows.

The evaluated flow parameters include the following:

- **Average Annual Daily Flow (AADF)** – Average daily flow evaluated over an entire year.
- **Average Dry-Weather Flow (ADWF)** – Average daily flow for the dry-weather period between May and October.
- **Average Wet-Weather Flow (AWWF)** – Average daily flow for the wet-weather period between January and April, and November through December

- **Maximum Monthly Dry-weather Flow ($MMDWF_{10}$)** – The maximum monthly dry-weather flow ($MMDWF_{10}$) represents the month with the highest flow during the summer months. DEQ's method for calculating $MMDWF_{10}$ is graphing the January–May monthly average flows for the most recent year against total precipitation for each month. A trend line is fitted to the data, which the MMDWF10 is read from precipitation equal to the May 90% precipitation exceedance value obtained from the National Atmospheric and Administrative Office (NOAA) summary of monthly normals. Since DEQ states that May is typically the maximum monthly flow for the dry-weather period (May– October), selecting the May 90% precipitation exceedance most likely corresponds to the maximum monthly flow during the dry-weather period for a 10-year event. This is the approach for estimating the design flow for this particular flow parameter. In looking at historical flows, the $MMDWF_{10}$ corresponds to the highest monthly flow observed during the dry-weather period for a given year.

- **Maximum Monthly Wet-Weather Flow ($MMWWF_5$)** – The maximum monthly wet-weather flow ($MMWWF_5$) represents the highest monthly average during the winter period of high groundwater. DEQ's method for calculating $MMWWF_5$ involves developing a graph of January–May average daily flows vs. monthly precipitation, then reading $MMWWF_5$ from the trend line at a precipitation equal to the January 80% precipitation exceedance value based on NOAA summary of monthly normals. Since DEQ states that January is typically the maximum monthly flow for wet weather, selecting the January 80% precipitation exceedance most likely corresponds to the maximum monthly flow during the wet-weather period for a 5-year event. In looking at historical flows, the $MMWWF_5$ corresponds to the highest monthly flow observed during the wet-weather period for a given year.

- **Peak Week Flow (PWkF)** – This flow parameter is the 7-day average flow calculated for every day using the 7 previous days of data (rolling average). Peak week flow (PWkF) was then calculated as the maximum of all weekly (7-day) rolling averages in a given year.

- **Peak Daily Average Flow ($PDAF_5$)** – The peak daily average flow ($PDAF_5$) is the peak flow associated with a 5-year storm event and is calculated as the flow resulting from a 5-year storm event during a period of likely high groundwater (January–April). DEQ's method for determining $PDAF_5$ is plotting cumulative daily plant flow against the cumulative precipitation for that day for large storm events over several years, using data only for wet-weather seasons when groundwater is high. A trend line is fitted to the data and the associated $PDAF_5$ flow is then identified for a 5-year, 24-hour storm event (2.9 inches per the NOAA isopluvial maps for Oregon). In looking at historical flows, the $PDAF_5$ is the highest daily flow observed during a given year.

- **Peak Instantaneous Flow (PIF_5)** – The peak instantaneous flow (PIF_5) represents the peak instantaneous flow (or peak hourly flow) associated with the $PDAF_5$. This is estimated by identifying the peaking factor associated with the 24-hour SCADA data, which is the ratio of peak instantaneous flow over a 24-hour operational period relative to the total daily flow for that same period. As shown in **Table 1-2**, the peaking factor was evaluated for the previous five high-flow events that occurred at the plant. The largest peaking factor was identified as being approximately 1.51. For operational years 2020 and 2024, which did not have a peak flow event, the PIF_5 was estimated by multiplying the $PDAF_5$ for that year by the 1.51 peaking factor.

TABLE 1-2: PEAKING FACTORS

Date	Total Daily Flow (MGD)	Max Instantaneous Flowrate (MGD)	Peaking Factor (Max/Total Daily)
12/6/2023	20.05	24.42	1.22
1/12/2021	18.83	21.27	1.13
12/27/2022	16.59	17.57	1.06
11/12/2021	16.08	24.23	1.51
12/10/2023	15.23	20.05	1.32

The design criteria in the 2018 WWMP is shown in **Table 1-3**.

TABLE 1-3: WWMP PROJECTED DESIGN FLOWS

	Design Flow (MGD)	Design Unit Flow (gpcd)	Projected Unit Flow (gpcd)[2]	Projected Design Flow (MGD)				
Year	2015	2015	-	2017	2022	2027	2032	2037
Population	22,900	22,900	-	23,480	25,797	28,343	31,139	33,811
ADWF	**2.27**	99	99	2.33	2.56	2.81	3.09	3.35
$MMDWF_{10}$	**4.48**	196	196	4.60	5.05	5.55	6.09	6.62
AADF	**3.32**	145	145	3.40	3.74	4.11	4.51	4.90
AWWF	**4.38**	191	191	4.49	4.94	5.42	5.96	6.47
$MMWWF_5$	**9.66**	422	250	9.81	10.39	11.02	11.72	12.39
PWkF	**10.0**	438	275	10.19	10.83	11.53	12.30	13.03
$PDAF_5$	**21.5**	941	325	21.73	22.48	23.31	24.22	25.09
PIF_5[1]	**28.0**	1,223	425	28.25	29.23	30.31	31.50	32.64

[1] The DEQ method produces a design flow of 67.1 MGD. PIF_5 flow was adjusted based on continuous flow data from peak days between 2012 and 2015.
[2] Projected unit flow scaled down to reflect reduced I/I in future developments.

Of particular interest is the projected data for 2022 and comparing it to the actual 2022 data. The observed historical flows from January 2020 through December 2024 are summarized in **Table 1-4**. Generally, the actual flows were relatively similar to the design flows. With this confirmation, the City approved utilizing the 2018 WWMP projected flow data through 2037 for this evaluation.

TABLE 1-4: OBSERVED HISTORICAL FLOWS

	Historical Flows (MGD)					Projected Design Flow (MGD)
Year	**2020**	**2021**	**2022**	**2023**	**2024**	**2022**
Population	25,152	25,340	25,514	25,731	26,249	25,797
ADWF	2.48	2.56	2.81	2.51	2.52	2.56
$MMDWF_{10}$	2.76	2.87	4.06	2.81	3.42	5.05
AADF	3.29	3.73	3.51	3.66	3.84	3.74
AWWF	4.09	4.91	4.22	4.83	5.15	4.94
$MMWWF_5$	6.51	6.92	5.29	6.11	7.85	10.39
PWkF	9.12	10.53	10.11	11.25	11.02	10.83
$PDAF_5$	13.15	18.83	16.59	20.05	15.19	22.48
PIF_5	19.86	24.23	17.57	24.42	22.94	29.23

1.3. WASTEWATER LOADING RATES

The methodology used to estimate design loading rates utilizes roughly the same approach for estimating design flows. Loading rates were estimated for the carbonaceous five-day biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), and ammonia (NH_4-N) in the loading analysis. The water quality used in the loading analysis was from 2020 through 2024. The following definitions summarize the terminology of the loading conditions:

- **Average Annual Daily (AAD)** – The average annual (AA) is the average daily load for the entire year.
- **Average Dry-Weather (ADW)** – The average dry-weather (ADW) is the average daily load for the period of May through October.
- **Average Wet-Weather (AWW)** – The average wet-weather (AWW) was calculated as the average daily load for the period encompassing January to April, and November to December.
- **Max Month Dry-Weather (MMDW)** – The maximum month dry-weather (MMDW) is the 91.7 percent probability (11/12) of occurrence in the daily influent wastewater for the period of May through October.
- **Max Month Wet-Weather (MMWW)** – The maximum month wet-weather (MMWW) is the 91.7 percent probability (11/12) of occurrence in the daily influent wastewater for the period January to April and November to December.
- **Peak Week (PWk)** – The peak week (PWk) is the 98.1 percent probability (51/52) of occurrence in the daily influent wastewater for the entire year.
- **Peak Daily Average (PDA)** – The peak daily average (PDA) is the 99.7 percent probability (364/365) of occurrence in the daily influent wastewater for the entire year.

Projected design $cBOD_5$, TSS, and NH_4-N loads reproduced from the 2018 WWMP are summarized in **Table 1-5**, **Table 1-6**, and **Table 1-7**, respectively.

TABLE 1-5: PROJECTED cBOD$_5$ LOADS

	Design Load (lb/d)	Existing Unit Load (ppcd)	Projected Unit Load (ppcd)	Projected Design cBOD$_5$ Load (lb/d)				
Year	**2012–2015**	**2015**	**–**	**2017**	**2022**	**2027**	**2032**	**2037**
Population	–	22,900	–	23,480	25,797	28,343	31,139	33,811
ADW	3,022	0.140	0.134	3,150	3,450	3,800	4,200	4,550
MMDW	3,979	0.183	0.177	4,200	4,600	5,050	5,550	6,000
AAD	3,051	0.139	0.135	3,200	3,500	3,850	4,200	4,600
AWW	3,079	0.137	0.173	4,100	4,500	4,950	5,400	5,900
MMWW	4,321	0.228	0.270	6,350	7,000	7,700	8,450	9,150
PWk	6,129	0.273	0.247	5,850	6,400	7,050	7,750	8,400
PDA	7,714	0.335	0.308	7,250	7,950	8,750	9,600	10,450

TABLE 1-6: PROJECTED TSS LOADS

	Design Load (lb/d)	Existing Unit Load (ppcd)	Projected Unit Load (ppcd)	Projected Design TSS Load (lb/d)				
Year	**2012–2015**	**2015**	**–**	**2017**	**2022**	**2027**	**2032**	**2037**
Population	–	22,900	–	23,480	25,797	28,343	31,139	33,811
ADW	5,310	0.274	0.236	5,550	6,100	6,700	7,350	8,000
MMDW	7,862	0.372	0.331	7,800	8,550	9,400	10,300	11,200
AAD	5,545	0.286	0.246	5,800	6,350	7,000	7,700	8,350
AWW	5,784	0.298	0.256	6,050	6,650	7,300	8,000	8,700
MMWW	9,469	0.482	0.419	9,850	10,850	11,900	13,100	14,200
PWk	13,643	0.669	0.609	14,350	15,750	17,300	19,000	20,600
PDA	20,506	0.872	0.826	19,450	21,350	23,450	25,750	27,950

TABLE 1-7: PROJECTED NH_4-N LOADS

	Design Load (lb/d)	Existing Unit Load (ppcd)	Projected Unit Load (ppcd)	Projected Design NH_4-N Load (lb/d)				
Year	**2012–2015**	**2015**	**–**	**2017**	**2022**	**2027**	**2032**	**2037**
Population	–	22,900	–	23,480	25,797	28,343	31,139	33,811
ADW	365	0.017	0.016	380	410	450	500	540
MMDW	440	0.021	0.018	440	480	530	580	630
AAD	340	0.015	0.015	360	390	430	470	510
AWW	317	0.014	0.014	340	380	410	450	490
MMWW	446	0.020	0.019	450	490	540	590	640
PWk	511	0.026	0.022	530	580	640	700	760
PDA	602	0.026	0.023	540	590	650	710	770

Observed $cBOD_5$, TSS, and NH_4-N maximum month loadings for the years 2020 to 2024 are summarized in **Table 1-8**. Similar to the recent historical flows, the 2022 projected loads are generally similar to the recent actual loads, and the City approved utilizing the 2018 WWMP projected loads for this evaluation.

TABLE 1-8: OBSERVED HISTORICAL LOADS

	Historical Loading - Max Month Values (lb/d)				
Year	**2020**	**2021**	**2022**	**2023**	**2024**
Population	25,152	25,340	25,514	25,731	26,249
$cBOD_5$ Loading (lb/d)	4,335	4,986	4,796	5,683	4,466
Max Month	Jan	Dec	Jan	May	Dec
TSS Loading (lb/d)	11,798	12,489	10,509	11,880	13,740
Max Month	Jan	Dec	Jan	Mar	Jan
NH_4-N Loading (lb/d)	469	518	504	663	661
Max Month	Nov	June	Feb	Sept	June

1.4. EFFLUENT REQUIREMENTS

The City of Newberg WWTP currently operates under the 2004 National Pollutant Discharge Elimination System (NPDES) permit with 2008 modification, which expired May 31, 2009 (Permit Number 100988). The permit was administratively extended until the new permit is issued. Oregon DEQ is the regulatory agency charged with the administration of the NPDES permit program established under the Clean Water Act (CWA). A copy of the permit and modification is included in Appendix A.

Current NPDES effluent water quality requirements for the WWTP are listed in this section. The NPDES permit allows the discharge of treated, disinfected, and dechlorinated effluent to the Willamette River at River Mile 49.7. A summary of required effluent water quality is presented in **Table 1-9, Table 1-10,** and **Table 1-11**.

TABLE 1-9: CURRENT DRY-WEATHER REQUIREMENTS

Parameter	May 1 to October 31				
	Avg. Concentration (mg/L)		Monthly Avg.[2] (lb/d)	Weekly Avg.[2] (lb/d)	Daily Max.[2] (lb/d)
	Monthly	Weekly			
$cBOD_5$[1]	10 mg/L	15 mg/L	330	500	660
TSS	10 mg/L	15 mg/L	330	500	660

1. $cBOD_5$ concentration limits are considered equivalent to the minimum design criteria BOD_5 specified in OAR 340−041.
2. Summer mass load limits are based upon an average dry−weather design flow of 4.0 MGD. Winter mass load limits are based upon an average wet−weather design flow of 6.5 MGD. The daily mass load limit is suspended on any day in which the daily flow to the treatment facility exceeds 8 MGD (twice the design average dry−weather flow).

TABLE 1-10: CURRENT WET-WEATHER REQUIREMENTS

Parameter	November 1 to April 30				
	Avg. Concentration (mg/L)		Monthly Avg.[2] (lb/d)	Weekly Avg.[2] (lb/d)	Daily Max.[2] (lb/d)
	Monthly	Weekly			
$cBOD_5$[1]	25 mg/L	40 mg/L	1,400	2,000	2,700
TSS	30 mg/L	45 mg/L	1,600	2,400	3,200

1. $cBOD_5$ concentration limits are considered equivalent to the minimum design criteria BOD_5 specified in OAR 340−041.
2. Summer mass load limits are based upon an average dry−weather design flow of 4.0 MGD. Winter mass load limits are based upon an average wet−weather design flow of 6.5 MGD. The daily mass load limit is suspended on any day in which the daily flow to the treatment facility exceeds 8 MGD (twice the design average dry−weather flow).

TABLE 1-11: CURRENT YEAR-ROUND REQUIREMENTS

Other Parameters (year-round)	Limitations
E. coli Bacteria	Shall not exceed 126 organisms per 100mL monthly geometric mean. No single sample shall exceed 406 organisms per 100mL.[1]
pH	Shall be within the range of 6.0 to 9.0
cBOD5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for $cBOD_5$ and 85% monthly for TSS.
Total Residual Chlorine	Shall not exceed a monthly average concentration of 0.02 mg/Land a daily maximum concentration of 0.05 mg/L.[2]
Excess Thermal Load (ETL)	Limits are calculated based on the ETL Limit Options A, B, or C.[3]

1. If a single sample exceeds 406 organisms per 100mL, then five consecutive re−samples may be taken at four−hour intervals beginning within 28 hours after the original sample was taken. If the log mean of the five re−samples is less than or equal to 126 organisms per 100mL, a violation shall not be triggered.
2. When the total residual chlorine limitation is lower than 0.10 mg/L, the Department will use 0.10 mg/L as the compliance evaluation level (i.e. daily maximum concentrations below 0.10 mg/L will be considered in compliance with the limitation).
3. See Permit Modification in Appendix A for ETL Limit Options.

Discharge requirements for the recycled wastewater were added in the 2008 NPDES permit modification. The City's reuse water system is used to irrigate a nearby golf course. The requirements for the recycled water include the following:

- All recycled water shall be distributed for an approved use in accordance with OAR 340-055-0012 (1) and (2).
- Receive Class A treatment as defined in OAR 340-055 to:

  Prior to disinfection, turbidity must not exceed an average of 3 nephelometric turbidity units (NTU) within a 24-hour period, 5 NTU more than five percent of the time within a 24-hour period and 10 NTU at any time.

  After disinfection, Total Coliform must not exceed a median of 2.2 organisms per 100mL based on results of the last seven days that analyses have been completed, and 23 total coliform organisms per 100mL in any single sample.
- All use of recycled water shall conform to the Recycled Water Use Plan approved by the Department. Upon approval of the Recycled Water Use Plan, the Plan shall become enforceable through this permit modification.

1.5. BIOSOLID REQUIREMENTS

Both federal and state regulations apply to land application of biosolids from wastewater treatment plants. Title 40 of the Code of Federal Regulations, Part 503 (40 CFR §503) discusses standards for the use and disposal of biosolids. Oregon regulations include OAR 340-50. The state biosolids regulations were most recently revised in July 1995. They reference many of the federal technical biosolids regulations (40 CFR §503), including limits on trace pollutants and pathogens. Under normal circumstances, the City treats all solids removed in the wastewater treatment process by composting, and all compost produced meets requirements for Class A biosolids designation. As such, the compost has no restrictions on its use. The compost produced is sold or given away in bulk at the WWTP. All off-site transportation is done by the purchasers.

1.6. RELIABILITY AND REDUNDANCY

The EPA Technical Bulletin EPA-430-99-74-001: Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability (1973) requires new or expanding wastewater treatment plants that discharge to a receiving stream to meet minimum standards for mechanical, electrical, and component reliability. Redundancy and reliability refer to the level of protection required for the environment and receiving stream. The standards are divided into three increasingly stringent classes of reliability:

- Reliability Class I: Works that discharge, or potential discharge, (1) is into the public water supply, shellfish, or primary contact recreation waters, or (2) as a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted.
- Reliability Class II: Works that discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days).
- Reliability Class III: Works not otherwise classified as Class I or Class II.

The Newberg WWTP is currently operated under a Class II requirement; however, DEQ has indicated that all WWTPs within the Willamette Valley are Class I facilities. Class I and Class II requirements are outlined in **Table 1-12**, which are reproduced from the 2018 WWMP. In addition to these standards, unit operations must be designed to pass the peak hydraulic flow with one unit out of service. Also, mechanical components in the facility must be designed to enable repair or replacement without violating the effluent limitations or causing control diversion.

TABLE 1-12: EPA RELIABILITY REQUIREMENTS

<table>
<tr><th>Component</th><th>Reliability Class I</th><th>Reliability Class II</th></tr>
<tr><td>Raw sewage pumps, lift stations</td><td colspan="2">Peak flow with the largest unit out of service. Peak flow is defined as the maximum wastewater flow expected during the design period.</td></tr>
<tr><td>Mechanical bar screens</td><td colspan="2">One backup with either manual or mechanical cleaning shall be provided. Facilities with only two screens shall have at least one manually cleaned bar screen.</td></tr>
<tr><td>Grit removal</td><td colspan="2">Minimum two units.</td></tr>
<tr><td>Primary sedimentation</td><td colspan="2">50% of the design flow capacity with the largest unit out of service. Design flow is defined as the flow used as the design basis of the component.</td></tr>
<tr><td>Activate sludge process</td><td colspan="2">A minimum of two equal volume basins shall be provided. No backup basin is required.</td></tr>
<tr><td>Aeration blowers</td><td colspan="2">Supply the design air capacity with the largest unit out of service shall be provided. A minimum of two units.</td></tr>
<tr><td>Air diffusers</td><td colspan="2">With the largest section of diffusers isolated or out of service, oxygen transfer capacity shall not be measurably impaired.</td></tr>
<tr><td>Secondary sedimentation</td><td>The units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 75% of the design flow.</td><td>The units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 50% of the design flow.</td></tr>
<tr><td>Filters / advanced treatment</td><td colspan="2">The units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 75% of the design flow.</td></tr>
<tr><td>Disinfection basins</td><td colspan="2">50% of the design flow capacity with the largest unit out of service. Design flow is defined as the flow used as the design basis of the component.</td></tr>
<tr><td>Effluent pumps</td><td colspan="2">Peak flow with the largest unit out of service. Peak flow is defined as the maximum wastewater flow expected during the design period.</td></tr>
<tr><td rowspan="2">Electrical power</td><td colspan="2">Provisions of two separate and independent sources of electrical power, either from two separate utility substations or from a single substation and a works−based generator shall be provided. Designated backup source shall have sufficient capacity to operate all vital components, critical lighting, and ventilation during peak flow conditions.</td></tr>
<tr><td>The provision of backup power capacity for secondary treatment, final clarification, and advanced treatment is required. The provision of capacity for degritting and sludge handling and treatment is optional.</td><td>The provision of backup power capacity for secondary treatment, final clarification, and advanced treatment is optional. The provision of capacity for degritting and sludge handling and treatment is not required.</td></tr>
<tr><td>Sludge holding tanks</td><td colspan="2">The volume of the holding tank shall be based on the expected time necessary to perform maintenance and repair of the component in question.</td></tr>
<tr><td>Anaerobic digestion</td><td colspan="2">At least two digestion tanks shall be provided. Backup sludge mixing equipment shall be provided or the system shall be flexible enough such that with one piece of equipment out of service, total mixing capacity is not lost. It is permissible for backup equipment to not be installed; not be normally used for sludge mixing; or not be at full capacity.</td></tr>
<tr><td>Aerobic digestion</td><td colspan="2">A backup basin is not required. At least two blowers or mechanical aerators shall be provided. Isolation of largest section of diffusers without measurably impairing oxygen transfer is allowed.</td></tr>
<tr><td>Sludge pumping</td><td colspan="2">Pumps sized to pump peak sludge quantity with one pump out of service. Backup pump may be uninstalled.</td></tr>
</table>

Source: EPA Technical Bulletin EPA−430−99−74−001: Design Criteria for Mechanical, Electric, and Fluids system and Components Reliability (1973)

1.7. DESIGN CRITERIA SUMMARY

As demonstrated in the previous sections, the projections presented in the 2018 WWMP are reasonably consistent with recent data. Therefore, this Capacity Study Update will utilize the 2018 WWMP design criteria values to complete the evaluation, as summarized in **Table 1-13**. Similar to the 2018 WWMP, this assumes that total nitrogen and total phosphorus effluent limits will be part of a future permit and thus were included in this evaluation.

TABLE 1-13: DESIGN CRITERIA SUMMARY

Parameters	2037 Design Criteria
Dry-Weather (May 1 – October 31)	
cBOD5 (monthly / weekly averages (mg/L))	10 / 15
TSS (monthly / weekly averages (mg/L))	10 / 15
Temperature	TBD[1]
Wet-Weather (November 1 – April 30)	
cBOD5 (monthly / weekly averages (mg/L))	25 / 40
TSS (monthly / weekly averages (mg/L))	30 / 45
Year-Round Requirements	
pH	6.0 to 9.0
E. Coli Bacteria (monthly / daily (per 100 mL))	126 / 406
cBOD5 and TSS Removal Efficiency	85% Removal
Total Residual Chlorine (monthly / weekly averages (mg/L))	0.02 / 0.05
Copper (mg/L)	NA[2]
Ammonia (mg/L)	NA[2]
Total Nitrogen (mg/L)	10
Total Phosphorus (mg/L)	1
Toxics (mg/L)	NA[2]
Other Requirements	
Biosolids Regulatory Parameters	Class A
Recycled Water Regulatory Parameters	Class A
Facility Reliability and Redundancy Classification	Class I

1. Pending revised DEQ rulemaking.
2. No requirement is anticipated unless changes in mixing zone dilution or regulatory requirements.

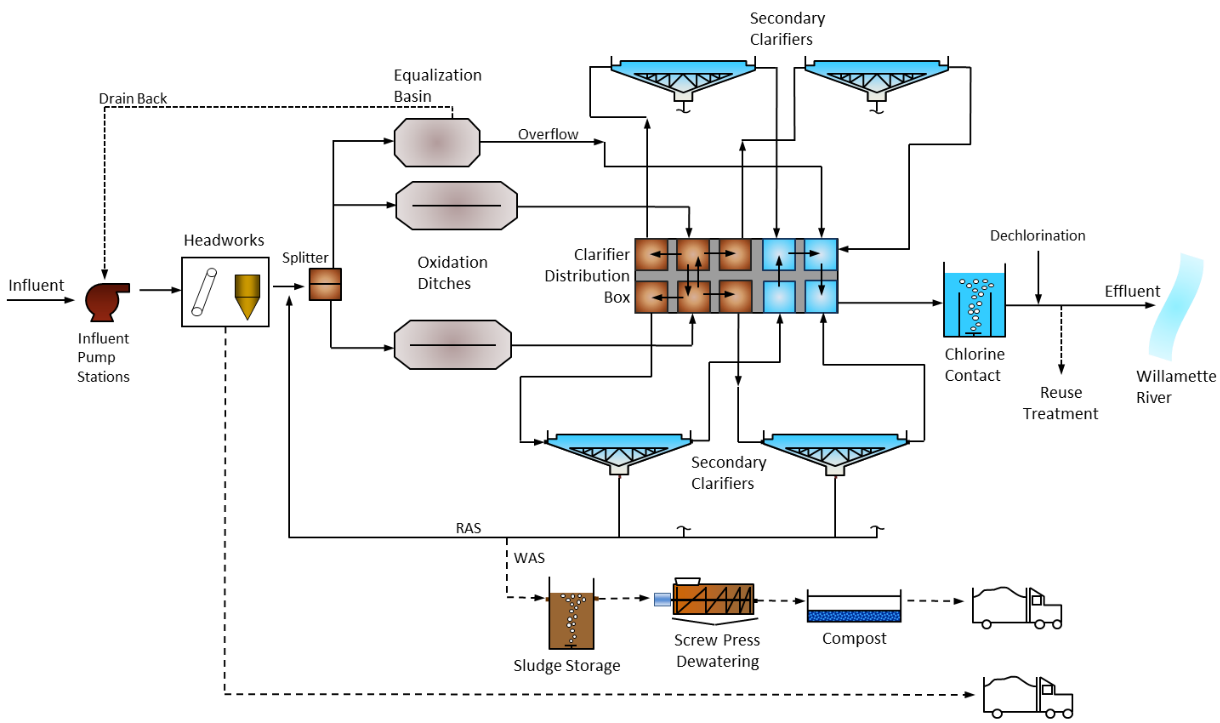
CHAPTER 2 - SITE EVALUATION

This section provides a general overview of the WWTP processes and the condition of the facilities.

2.1. SYSTEM DESCRIPTION

The Newberg WWTP consists of raw influent pumping; headworks facility with influent flow measurement, screening, and grit removal; activated sludge oxidation ditches; equalization basin; secondary clarifiers; hypochlorite disinfection; dechlorination; membrane reuse; effluent outfall; sludge storage; solids dewatering; and biosolids composting. A simplified schematic of the treatment process is provided in **Figure 2-1**.

FIGURE 2-1: WWTP PROCESS FLOW SCHEMATIC



Class A reuse water is sold to the Chehalem Glenn Golf Course for irrigation. Class A composted biosolids are sold to the community. The plant also accepts septage from local septic pumpers and RVs on a daily basis.

2.2. SITE VISIT

A site visit of the WWTP was conducted on January 17, 2025. The focus of the tour was the oxidation ditches, secondary clarifiers, and solids handling (including composting systems). The equipment was similar to that observed during the WWMP, with the exception of the larger RAS pumps had been exchanged for smaller RAS pumps (850 gpm capacity) and the oxidation ditch rotors all being replaced in the past five years.

Deficiencies of the WWTP for these systems included:

- The capacity of the composting system is being reached, especially during the winter months. The City is unable to achieve the composting requirements when the tunnels are at their maximum number of loads (five) per tunnel.

- Compost buildings show evidence of widespread roof leakage, including above the control room. The walls on both sides of the loadout tunnel are cracked and leaking. There is also an air leak on the floor of Train B. Additionally, the main conveyor before the tunnels (Conveyor 805) is crumbling due to suspected water damage. The conveyor is built into the structure so replacement (and timing for the replacement) will be difficult. The operations staff also mentioned that the air system, hydraulic rams, and tunnel doors have required recent work or it is pending. The existing tunnel reactors are expected to require significant refurbishment, if not replacement. Pictures of the cracking on the compost building are shown in **Figure 2-2**.

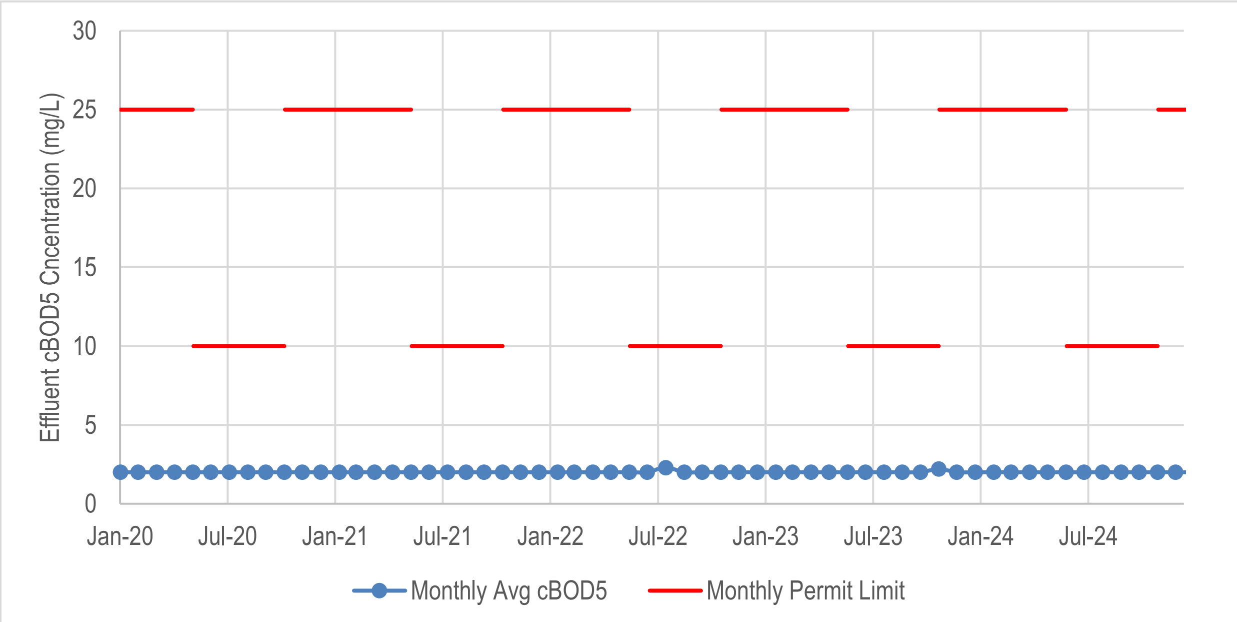
FIGURE 2-2: COMPOST BUILDING

- There are five aerated static piles on-site, three of which are hooked up to a fan to provide aeration. These three piles are used to provide additional composting capacity when the tunnels are at capacity. With additional piping, the other two aerated static piles can be used to also provide compost capacity.

2.3. EFFLUENT PERFORMANCE

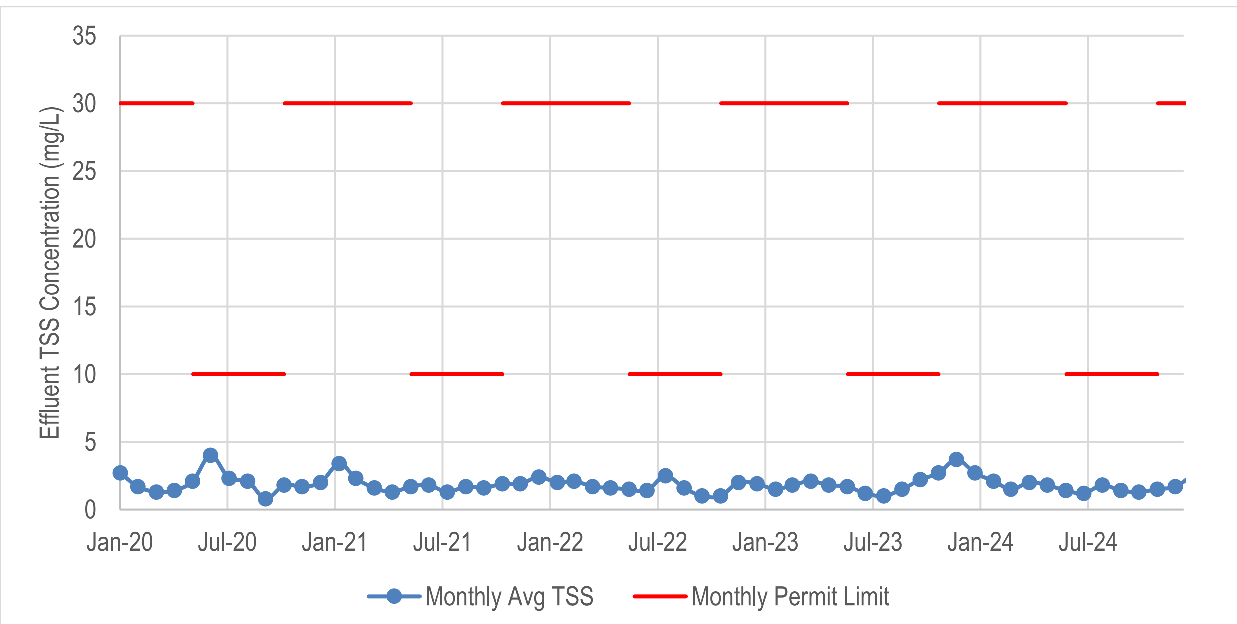
This section demonstrates the WWTP historical performance in meeting the NPDES permit limits. Historical trends of effluent $cBOD_5$ and TSS concentrations are shown in **Figure 2-3** and **Figure 2-4**, respectively. The figures show average monthly effluent concentrations for the past five years in relation to the current permit requirements. The NPDES permit also includes weekly concentration limits and average monthly and weekly mass loading limits. The plant has operated consistently in compliance with these permit limits.

FIGURE 2-3: HISTORICAL EFFLUENT $CBOD_5$



1. The laboratory method detection limit is 2 mg/L.

FIGURE 2-4: HISTORICAL EFFLUENT TSS



In general, the effluent TSS trend line (**Figure 2-4**) matches the shape of the influent flow. During peak flow events, the hydraulic loading rate of the secondary clarifiers increases, effectively reducing settling time and TSS removal.

Additional effluent results are included in this section, which includes effluent E. coli bacteria (**Figure 2-5**), pH (**Figure 2-6**), cBOD and TSS removal efficiency (**Figure 2-7**), and total residual chlorine (**Figure 2-8**). The figures show historical compliance with the year-round limitations.

FIGURE 2-5: HISTORICAL EFFLUENT *E. COLI*

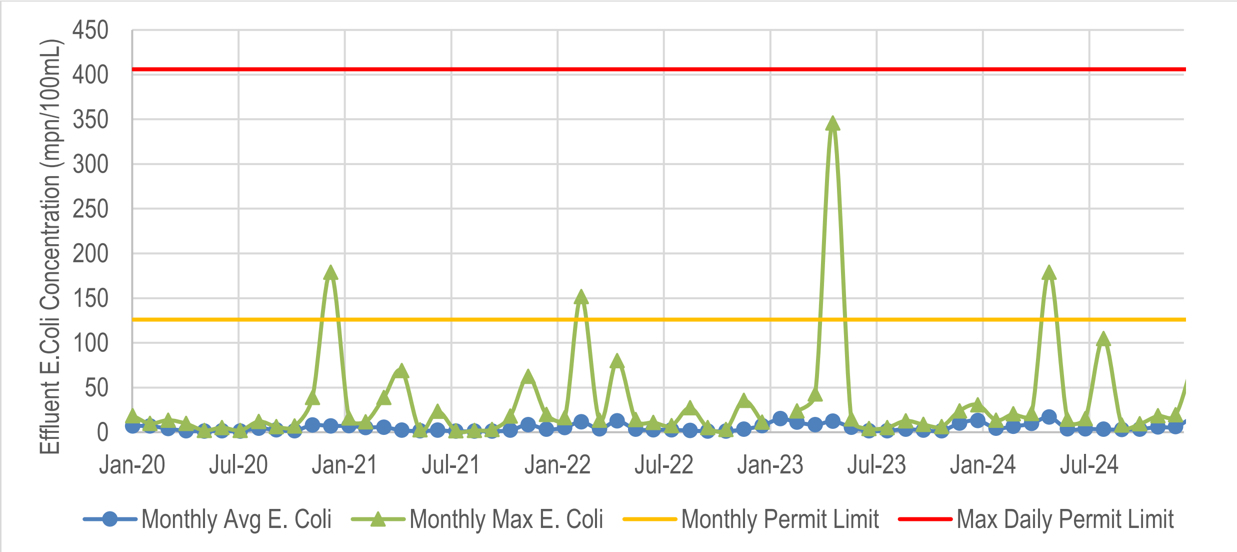


FIGURE 2-6: HISTORICAL EFFLUENT PH

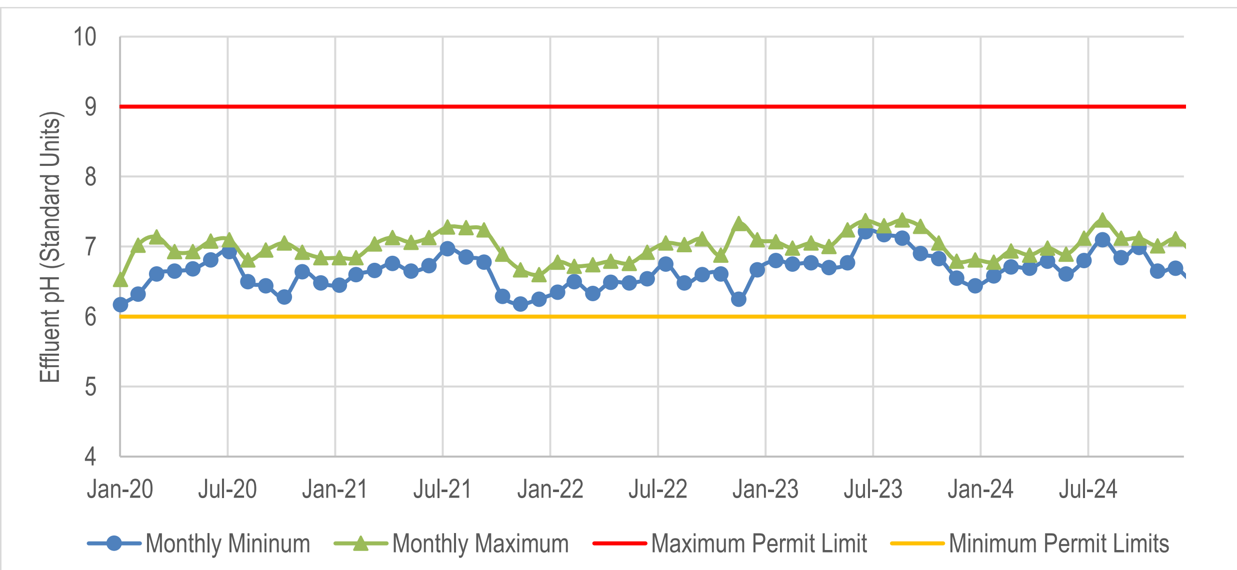


FIGURE 2-7: HISTORICAL $CBOD_5$ AND TSS REMOVAL EFFICIENCY

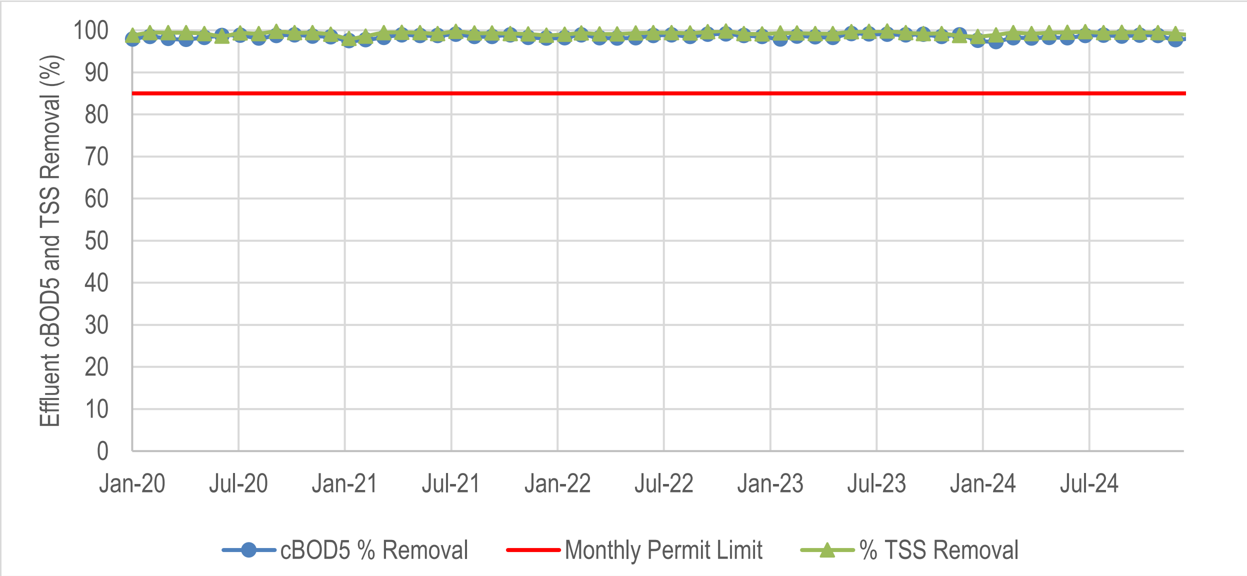
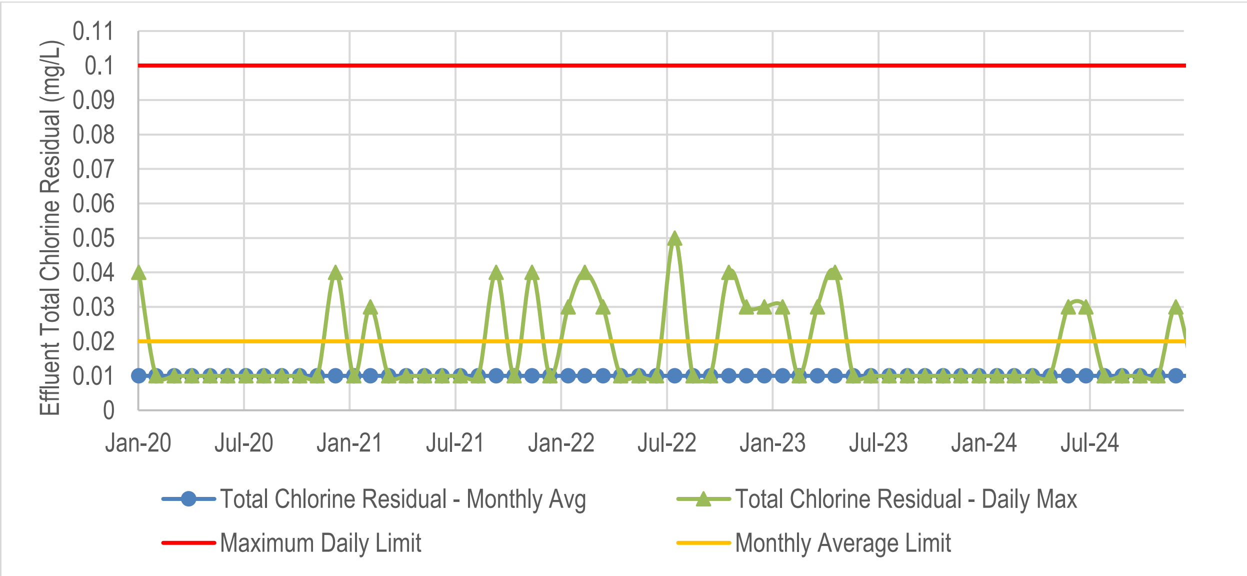


FIGURE 2-8: HISTORICAL EFFLUENT TOTAL RESIDUAL CHLORINE



1. Laboratory method detection limit is 0.01 mg/L.

2.4. COMPOSTING

The composting process is used for biosolids stabilization. The Class A biosolids meet EPA's 40 CFR 503.13 requirements for pollutant concentrations, pathogens, and vector attraction reduction. Reject material that has not met pathogen reduction requirements is recycled back through the tunnel reactors for additional treatment or is treated in a stockpile compost manner until it meets EPA requirements. All compost sold as Newgrow meets EPA requirements for Class A biosolids.

CHAPTER 3 - CAPACITY ANALYSIS

Treatment components at the WWTP were evaluated for hydraulic and treatment performance capacity. Updates to the secondary treatment models for the oxidation ditches and secondary clarifiers were completed to conduct the evaluations. Findings were used to identify the capacity of the secondary treatment, chlorine contact basin, and composting operations at the WWTP.

The rated capacities of the evaluated processes have been noted in past studies and record drawings. The 1985 record drawings documented the two oxidation ditches, three secondary clarifiers (three existing as of 1985), and chlorine contact basin as having capacity for the design flows of 6.5 MGD (average day wet weather). The 1986 record drawings documented the compost reactor tunnels to have 520 cubic yards of capacity each, for a total capacity of 1,040 cubic yards.

In a recent letter for the approval of the Crestview Green Sanitary Pump Station, the DEQ noted that the WWTP wet weather flows were nearing or exceeding the average wet weather flow capacity of 6.5 MGD, and if the problem worsened it may result in the future rejection of plans by DEQ.

3.1. HYDRAULIC ANALYSIS

A model of the plant was developed using Visual Hydraulics© Version 5.1 to determine the hydraulic capacity and identify any hydraulically limiting structures at the existing plant. Each treatment process through the plant is comprised of hydraulic elements such as pipe bends, weirs, and splitter boxes, which all cause energy loss and reduce the energy grade line. As is typical for hydraulic models, the model is based on the worst-case scenario, which is when the Willamette River, the WWTP's effluent discharge point, is at its high water level (flood elevation). By starting the model at the highest discharge water surface level, energy losses can be added back and compared to critical elevations within the plant to identify points of potential overflow or failure. Operating conditions were modeled as follows in **Table 3-1**. It was assumed, as in the 2018 WWMP, that the peak flow event would occur when the equipment was in operation and the equalization basin would not be utilized because the basin is in poor condition and needs to be rehabilitated.

TABLE 3-1: HYDRAULIC MODEL OPERATING CONDITIONS

Treatment Component	Model Conditions
Headworks Screens	Both Units in Service
Grit Removal Cells	Both Units in Service
Oxidation Ditches	Both Units in Service
Secondary Clarifiers	All Units in Service
Chlorine Contact Basin	All in Service
Willamette River Water Level	86.38 ft (Ordinary High Water Level)
RAS Flow	Half of Influent Flow

Elevations of hydraulic elements were taken from existing record drawings of the plant. Drawings dated prior to 2007 required elevation adjustment to 3.382-ft to reflect the NAVD-88 datum. Critical elevations of the various treatment components are shown in **Table 3-2**.

TABLE 3-2: PROCESS HYDRAULIC ELEMENTS

Process	Elevation (NAVD-88)	Notes
Screens	Channel Invert: 178.25' Top of Wall (TOW): 183.42'	
Grit Removal	Effluent Weir Elevation: 177.08' TOW: 183.42'	
RDS Distribution Box	Weir Elevation: 172.45' TOW: 175.70'	Flow is split evenly between oxidation ditches
Oxidation Ditches	Weir Elevation: 170.38' Top of Bank: 172.88'	
Clarifier Distribution Box	Weir Elevation: 167.21' TOW: 170.63'	Flow is split evenly between clarifiers
Secondary Clarifiers 1 & 2	Weir Elevation: 166.88' TOW: 168.38'	
Secondary Clarifiers 3 & 4	Weir Elevation: 164.88' TOW: 166.38'	
Clarifier Effluent Distribution Box	Invert Elevation: 157.38' TOW: 170.63'	
Chlorine Contact Basin	Influent Gate Invert: 158.38' Influent TOW: 166.38' Effluent Weir Elevation: 161.71' Effluent TOW: 165.88'	
Reclaim and Reuse Pump Channel	Weir Elevation: 159.63'	No reclaim or reuse pumps in service
Willamette River	Ordinary High Water Elevation: 86.38'	

The model was used to develop a hydraulic grade line through the WWTP in various scenarios. Flow rates through the plant were varied, and the resulting models were then used to identify limiting flow elements. Impaired flow control or process operation was determined to be reached when the water exceeds an intended water control elevation for effective process operation. Examples include the submergence of splitter box control weirs and clarifier effluent weirs. The maximum process flow conditions are shown in **Table 3-3**, along with the associated flows.

TABLE 3-3: HYDRAULIC ANALYSIS SUMMARY

Process Element	Maximum Process Flow (MGD)	Maximum Process Flow Condition
Raw, Degritted Sewage (RDS) Distribution Box	21.0	Weir Submerged
Oxidation Ditches	30.4 (Influent) + 15.2 (RAS)	Weir Submerged
Clarifier Influent Distribution Box	27.0 (Influent) + 13.5 (RAS)	Weir Submerged
Secondary Clarifiers 1 & 2	30.0 (Influent) + 15.0 (RAS)	Weir Submerged
Secondary Clarifiers 3 & 4	27.5 (Influent) + 13.75 (RAS)	Weir Submerged
Chlorine Contact Basin	29.0	Weir Submerged

The hydraulic analysis suggests that the WWTP as it currently operates has the hydraulic capacity to pass up to 21.0 MGD without experiencing impaired flow and that the bottleneck for process operations is the weir elevation in the Raw, Degritted, Sewage (RDS) distribution box. Additionally, as shown in **Table 3-3**, all evaluated process elements will be impaired at the 2037 PIF_5.

3.2. PROCESS ANALYSIS

3.2.1. Secondary Treatment

The liquid secondary treatment process capacity was evaluated using EnviroSim BioWin 6.2 wastewater modeling software. With this software, biological treatment kinetics, aeration capacity, and return and waste flows can be modeled and varied to test the secondary treatment capacity of the WWTP.

As the plant's oxidation ditches are typically operated with a longer solids retention time (SRT) and hydraulic retention time (HRT) to encourage nitrifying conditions, the model was set up to reflect this operation mode. Record drawings were consulted to establish process sizes, motor sizes, and other design parameters. The model was calibrated with historical maximum month wet weather flows and loads to ensure accuracy before it was used to simulate the 2037 flows and loads.

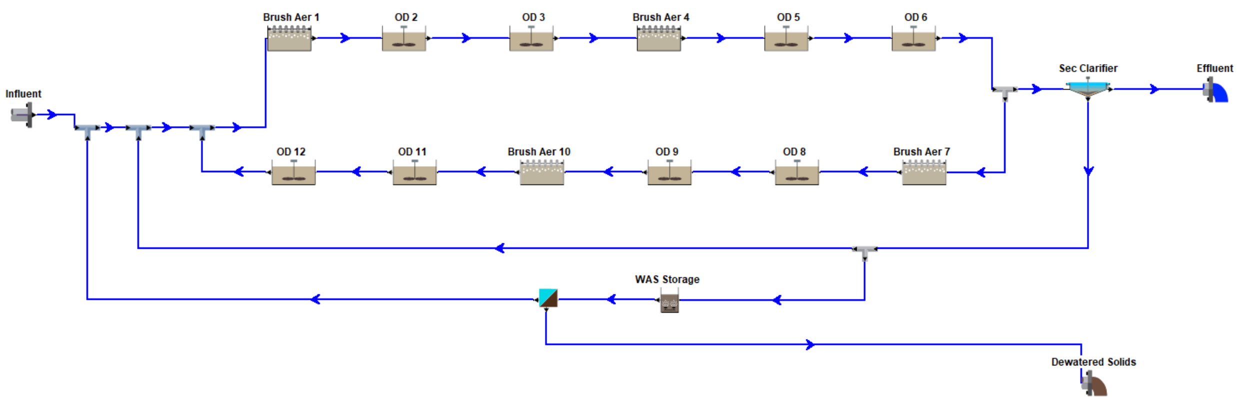
The secondary treatment process design parameters are summarized in **Table 3-4**. The operators report that the WWTP is not able to consistently maintain a MLSS concentration above 3,200 mg/L, so the model has included this constraint. The aerators have been rehabilitated over the past five years and were assumed to be in good operation.

TABLE 3-4: SECONDARY TREATMENT PROCESS DESIGN PARAMETERS

Parameter	Units	Value
Oxidation Ditches		
Number	No.	2
Total Volume	MG	4
Temperature	°C	12
SRT	Days	10
Maximum MLSS	mg/L	3,200
Maximum SVI	mL/g	200
Aerator Power	HP	400
Secondary Clarifiers		
Number	No.	4
Total Surface Area	SF	20,100
Maximum Hydraulic Loading Rate	gpd/sf	1,200
Maximum Solids Loading Rate	ppd/sf	25

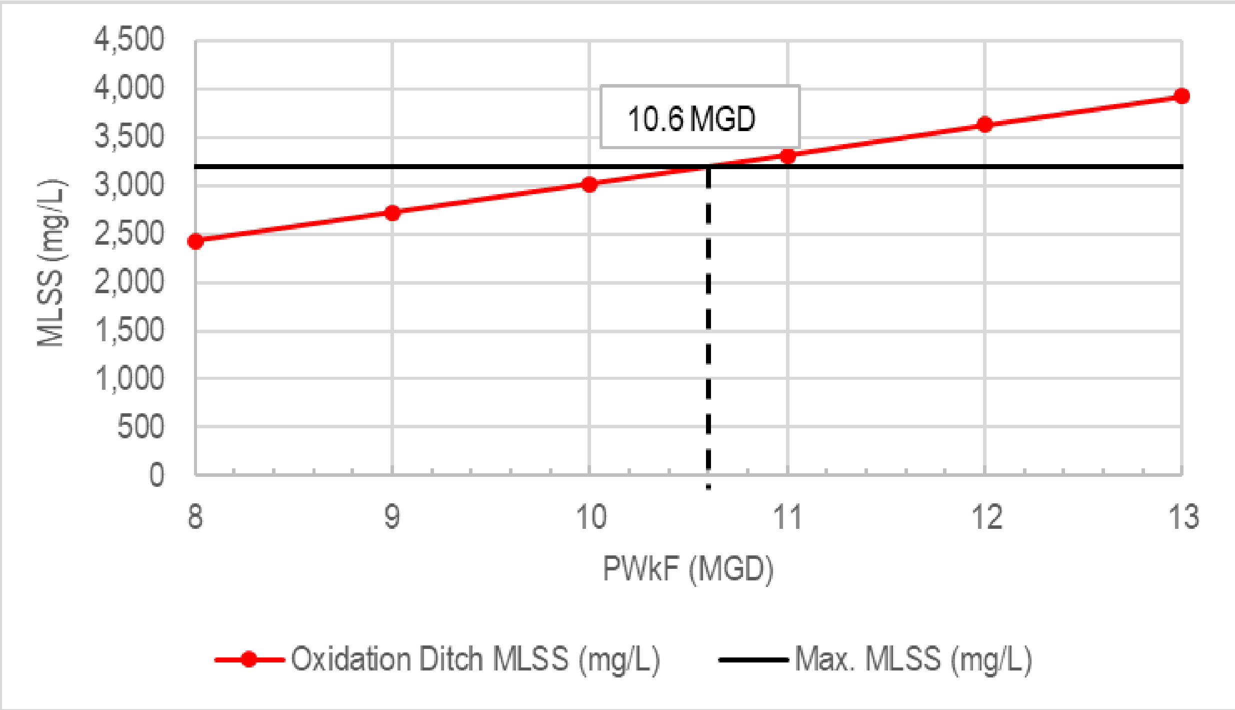
The flow diagram of the BioWin model is shown in **Figure 3-1**.

FIGURE 3-1: BIOWIN MODEL SCHEMATIC



The input influent parameters corresponding to the future loads were utilized. The relationship between flow and MLSS concentrations was evaluated, as is shown in **Figure 3-2**. The capacity of the oxidation ditches corresponds to a flow of 10.6 MGD. A PWkF of 10.6 MGD has already occurred; therefore, the oxidation ditches are currently under capacity.

FIGURE 3-2: FLOW VERSUS MLSS

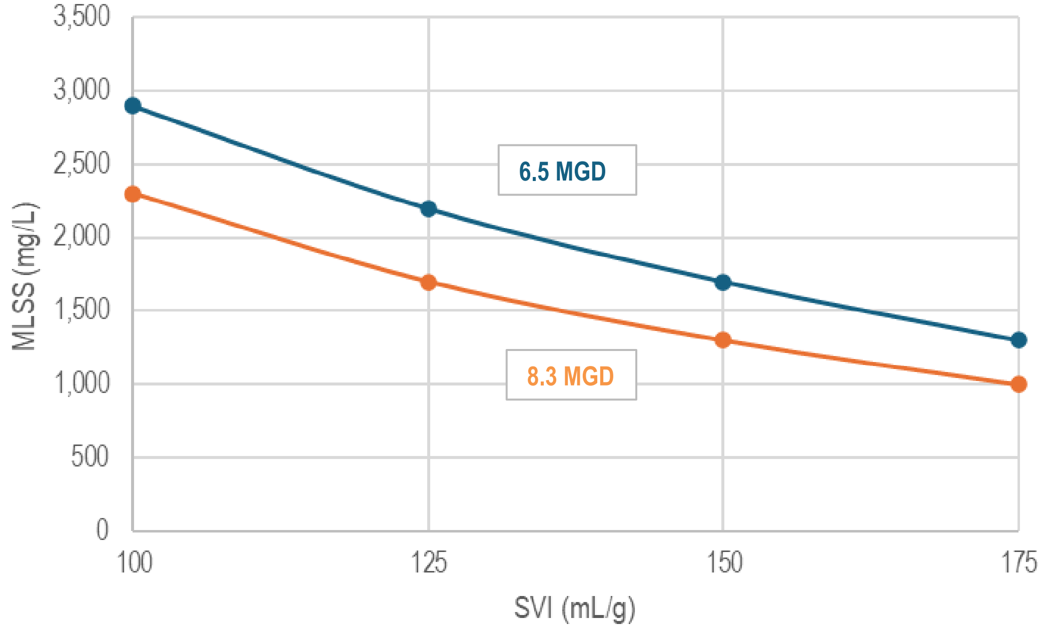


The relationship between flow and clarifier hydraulic and solids loading rates was also evaluated. The hydraulic loading rate (HLR) was found to be the limiting factor in the secondary clarifiers rather than the solids loading rate (SLR). The maximum HLR of 1,200 gpd/sf is for peak flows and will be reached at approximately 24.1 MGD. As shown in **Table 1-4**, the peak flows are already higher than 24.1 MGD; therefore, the clarifiers are currently under capacity.

The City performed a clarifier stress test in 2021 to evaluate the ability of the secondary clarifiers to perform effectively at higher loading rates. During the stress test, plant flows were directed into a single clarifier until failure. The stress test found that the effluent weirs in the stressed clarifier were never flooded but that solids settling issues caused solids to overflow into the effluent launders. It concluded that a higher hydraulic loading rate would not be justified without improvements to RAS pumping capacity and suggested that future stress testing after these improvements could be successful.

The City upgraded the Clarifier 2 RAS pump and performed a new stress test in November 2025. The stress test successfully demonstrated no negative impact on treatment performance or operations during the test, even at flow rates of 8.3 MGD. The testing documentation can be found in Appendix B and was provided to DEQ as justification for re-rating of the clarifiers. The conditions during the clarifier stress test were very good in terms of solids settleability as measured by the sludge volume index (SVI). As shown in **Figure 3-3**, if solids settleability decreases, the rated capacity decreases. Based on the variability in solids settleability, adding a fifth secondary clarifier is recommended. The other clarifier RAS pumps would also need to be upgraded and the hydraulic limitations of the clarifier distribution box would need to be addressed.

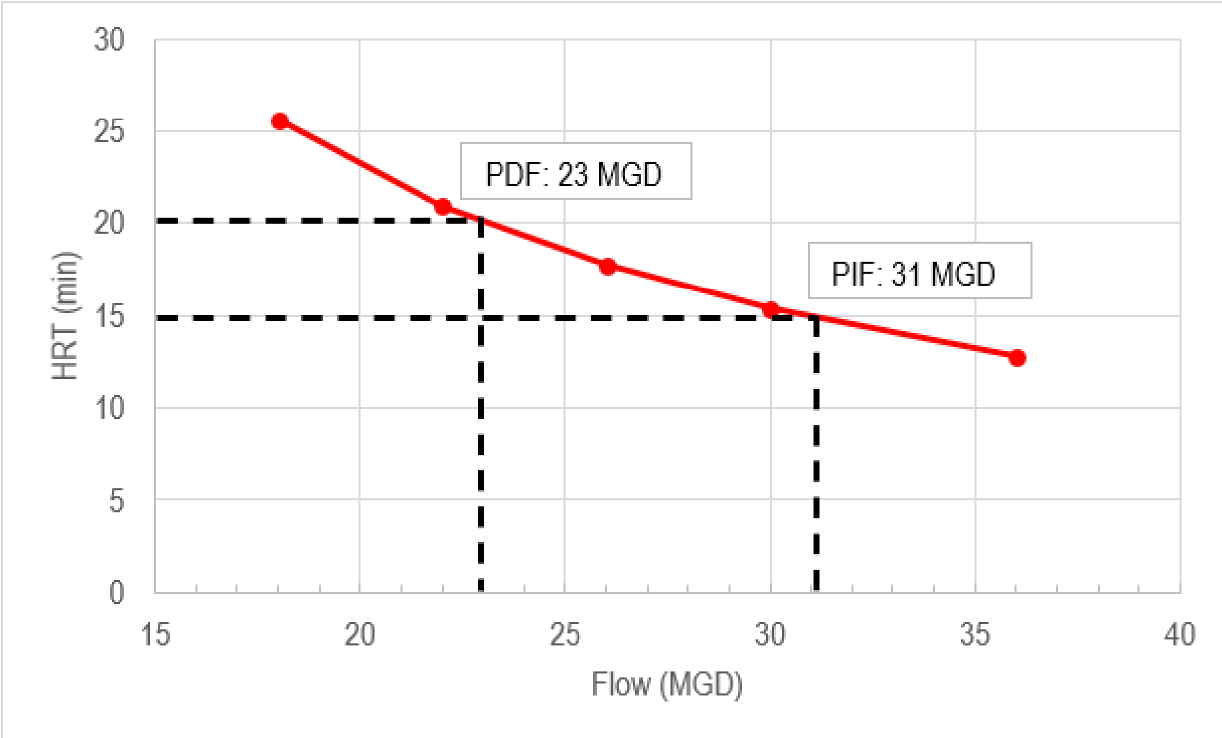
FIGURE 3-3: MAXIMUM MLSS AND SVI



3.2.2. Chlorine Contact

There have been no modifications to the existing chlorine contact basin since 2018, so the capacity evaluation from the 2018 WWMP is unchanged. Based on the projected design flows and the hydraulic residence time requirements in the Ten State Standards (Recommended Standards for Wastewater Facilities, 2014), the chlorine contact basin is approaching its capacity as shown in **Figure 3-4**.

FIGURE 3-4: FLOW VERSUS CHLORINE CONTACT HYDRAULIC RESIDENCE TIME



3.2.3. Solids Process

The solids handling and composting processes have also not been modified recently. The design parameters for the solids processes are summarized in **Table 3-5**. The screw press dewatering system has a capacity ranging from 7,000 ppd dry solids (operating for 40 hours per week) to 27,900 ppd (operating for 161 hours per week). Based on the BioWin modeling, the 2037 maximum month WAS load projection is 10,980 ppd dry solids; therefore, the screw presses have sufficient capacity for the design period.

As noted in the 2018 WWMP, the biosolids capacity of the compost tunnels is 6,200 ppd dry solids. The operators have noted this issue, as during months when more sludge is wasted, the composting tunnels are at capacity to process the biosolids.

TABLE 3-5: SOLIDS PROCESS DESIGN PARAMETERS

Parameter	Units	Value
WAS Loading		
Yield Ratio Based on Influent cBOD Projections	-	1.2
Screw Press Dewatering		
Feed Capacity at 90%	gpm	162
Feed Sludge Concentration	% TS	1.5
Compost Reactor Tunnel		
Tunnel Reactor Volume	cy	1,050
Target Influent Mixture Concentration	% TS	43
Minimum Volumetric Retention Time	days	16
Typical Tunnel Reactor Temperature Range	°C	50 to 70

3.3. RECOMMENDED IMPROVEMENTS

The improvements needed to increase capacity in liquids and solids treatment processes are summarized below.

Oxidation Ditches

The oxidation ditches are beyond their treatment capacity. To provide capacity for the 2037 flow and load projections, it is anticipated that construction of an additional oxidation ditch is needed. For operational simplicity, the oxidation ditch could be designed with the same size, configuration, and aeration system as the existing two oxidation ditches. Constructing a third oxidation ditch and splitting peak flows between the three ditches would address the need for hydraulic improvements in this process. In addition to the oxidation ditch reactor basin, a new RDS splitter box, and associated piping would be installed.

Secondary Clarifiers

The secondary clarifiers were beyond their treatment capacity; however, through a clarifier stress test, the existing clarifiers are now rated for a higher hydraulic loading rate. In order to process this higher flow, the hydraulic limitations of the clarifier distribution box would need to be addressed, and the other clarifier RAS pumps would need to be replaced. Additionally, based on the variability in solids settleability, a fifth secondary clarifier is recommended. The 2018 WWMP recommended adding two new secondary clarifiers, so the City, by re-rating the clarifiers through the stress test, was able to observe a large capital savings by only adding one secondary clarifier.

Chlorine Contact

The existing chlorine contact basins are approaching their capacity. To meet the standard hydraulic retention time of 20 minutes at 2037 $PDAF_5$, the total volume of the chlorine contact basin must be at least 348,500 gallons. It is recommended that the chlorine contact basin be expanded to provide this additional volume. The hydraulic issues noted previously would also be addressed with this improvement.

Solids Handling Process

The screw press dewatering system was found to have sufficient capacity for 2037 loads. However, the compost tunnel reactors are already at capacity, and the condition of the tunnels is deteriorating. An evaluation of different solids handling options was undertaken. The result of the evaluation was a selection of the construction of four new aerated static piles as shown in Appendix C.

CHAPTER 4 - COST ESTIMATE

This chapter includes a project cost estimate for the items discussed in the previous chapters. The cost estimate is planning level (Class 5 cost opinion as classified by the Association for the Advancement of Cost Engineering) and can vary depending on market conditions. The range of accuracy for a Class 5 cost estimate is broad, but these are typical accuracy levels for planning work. The costs are based on experience with similar recent improvement projects. The estimated probable project costs include anticipated contractor markups and contingencies, typical of a planning-level estimate. Overall project costs include total construction costs, costs for engineering design, permitting, construction management services, and administrative costs. The contractor's overhead and profit are included in the line items for the collection system projects. These costs should be updated as the projects are further refined in the pre-design and design phases. The total project costs, with a 30% contingency, is estimated at $32,181,000 (**Table 4-1**).

The estimated system development charges (SDC) percentages from the 2018 WWMP are also shown in **Table 4-1**. The purpose of SDCs is for growth to pay their fair share of the improvement cost rather than the existing customers footing the complete bill for the improvements. Based on the capacity deficiencies identified in the Capacity Study, the Galardi Rothstein Group evaluated the SDC percentages in their Draft Memorandum dated September 29, 2025. The approximate values for the Oxidation Ditch and Chlorine Contact Basin come from that Draft Memorandum. The Secondary Clarifier and Composting Improvements are slightly different due to different estimated costs, but their percentages match the Draft Memorandum.

TABLE 4-1: WWTP IMPROVEMENTS PROJECT COST ESTIMATE (2025)

Item	Cost Estimate (2025)	SDC Growth Apportionment		City's Estimated Portion
		%	SDC	
Oxidation Ditch Improvements	$ 17,551,000	86%	$ 15,127,000	$ 2,424,000
Secondary Clarifier Improvements	$ 8,784,000	97%	$ 8,521,000	$ 263,000
Chlorine Contact Basin Improvements	$ 1,933,000	100%	$ 1,933,000	$ -
Composting Improvements	$ 3,913,000	61%	$ 2,387,000	$ 1,526,000
Total Project Costs	**$ 32,181,000**		**$ 27,968,000**	**$ 4,213,000**

The cost estimates herein are based on our perception of current conditions at the project location. The estimates reflect our professional opinion of accurate costs at this time and is subject to change as the project design matures. Keller has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.

During the 2018 WWMP, cost estimates were created for the oxidation ditch, one secondary clarifier, and the chlorine contact basin. In addition to the cost increases since 2018, the chlorine contact basin was scaled back to a smaller size to treat just the 2037 flows. Also, composting improvements were added due to the City's struggles with seasonal peak solids loading rather than annual average solids loading.

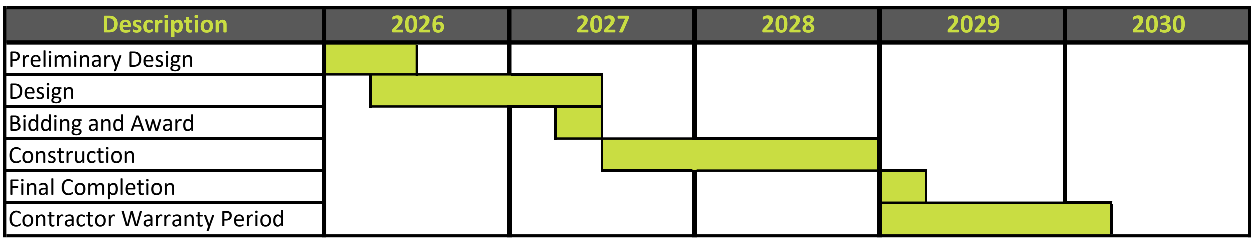
CHAPTER 5 - NEXT STEPS

There are many activities to be undertaken to complete a wastewater treatment project. The implementation and sequencing plan will be developed with the following considerations:

- Project funding
- Equipment procurement methods
- Identifying construction constraints
- Preparing contract documents
- Establishing construction milestones

A schedule of the major milestones is shown in **Table 5-1.**

TABLE 5-1: WWTP IMPROVEMENTS PROJECT SCHEDULE



APPENDIX A

NPDES PERMIT

MODIFICATION
This Modification Shall be Attached to and Made a Part of Permit #100988

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

Department of Environmental Quality
Western Region – Salem Office
750 Front Street NE, Suite 120, Salem, OR 97301-1039
Telephone: (503) 378-8240

Issued pursuant to ORS 468B.050 and The Federal Clean Water Act

ISSUED TO:

Newberg, City of
P.O. Box 970
Newberg, OR 97132

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Outfall Location
Treated Wastewater	001	R.M. 49.7
Recycled Water Reuse	101	Class A Reuse
Emergency Overflows:		
Dayton Avenue PS	002	Chehalem Creek
Andrew Street PS	004	Chehalem Creek
Charles Street PS	005	Chehalem Creek
Chehalem Drive PS	006	Chehalem Creek
Creekside Lane PS	007	Chehalem Creek
Sheridan Street PS	008	Chehalem Creek
Fernwood Road PS	009	Springbrook Creek

FACILITY TYPE AND LOCATION:

Activated Sludge
Newberg - Wynooski Road STP
2301 Wynooski Road
Newberg, Oregon
Treatment System Class: Level IV
Collection System Class: Level III

RECEIVING STREAM INFORMATION:

Basin: Willamette
Sub-Basin: Middle Willamette
Receiving Stream: Willamette River
LLID: 1227618456580 - 49.7 - D
County: Yamhill

EPA REFERENCE NO: OR003235-2

This permit was originally issued on June 22, 2004 in response to Application No. 992393 received April 3, 1997. This modification is in accordance with OAR 340-045-0055. This permit is issued based on the land use findings in the permit record.

Mark E Hamlin
for John J. Ruscigno, Water Quality Manager
Western Region North

July 31, 2008
Date

ADDENDUM NO. 1

Modification #1: Permit No. 100988, Schedule A, Condition 1.a.(3) is modified to add the following effluent limits:

(3) Other parameters

Year-round (except as noted)	Limitations
Excess Thermal Load (ETL)	Limits are calculated based on the ETL Limit Options A, B or C below (see Note 5)

(A) ETL Limits June 1 through September 30: (when no river information is reported)

Must not exceed a rolling seven-day average of 40 million Kcals/day

(B) ETL Limits June 1 through September 30: (when river flows are reported)

Salmon & Steelhead Migration Corridor
The ETL Limit may be calculated on a daily basis when river flows are reported. The ETL may be calculated as follows:

$ETL = (((0.00006878 \times Q_R) + 0.8745) - 0.1) \times 2.94 \times 2.447 \times (24.9 - 20)$

Where: Q_R = the rolling seven-day average ambient river flow (cfs) recorded at USGS Gauge 14197900 (Willamette River at Newberg)

(C) ETL Limits June 1 through September 30: (when river flows and temperatures are reported)

Salmon & Steelhead Migration Corridor
The ETL Limit may be calculated on a daily basis when both river flows and temperatures are reported. The ETL may be calculated as follows:

$ETL = (((0.00006878 \times Q_R) + 0.8745) - a) \times 2.94 \times 2.447 \times (24.9 - 20)$

Where: Q_R = the rolling seven-day average ambient river flow (cfs) recorded at USGS Gauge 14197900 (Willamette River at Newberg)

The value for a in the above equations is determined based on the relationship between the rolling seven-day average maximum natural thermal potential river temperature in °C (T_{RM_N}), the rolling seven-day average natural thermal potential river temperature in °C (T_{RA_N}) and the applicable criteria in °C as follows:

T_{RM_N} = (0.9982 x the daily maximum ambient river temperature in °C) – 0.53
T_{RA_N} = (0.9402 x the daily average ambient river temperature in °C) + 0.21

If T_{RM_N} is less than or equal to 20 °C, then $a = 0$
If T_{RM_N} is greater than 20 °C and T_{RA_N} is greater than or equal to 20 °C, then $a = 0$
If T_{RM_N} is greater than 20 °C and T_{RA_N} is less than 20 °C, then $a = 1 - (T_{RA\_N} \div 20\ °C)$

Modification #2: Permit No. 100988, Schedule A, Condition 1.d. is added to read as follows:

d. Recycled Wastewater Outfall 101

(1) No discharge to state waters is permitted. All recycled water shall be distributed for an approved use in accordance with OAR 340-055-0012 (1) and (2) (2) Prior to land *application of the recycled water, it shall* receive Class A treatment as defined in OAR 340-055 to:

(a) Prior to disinfection, turbidity must not exceed an average of 2 nephelometric turbidity units (NTUs) within a 24-hour period, 5 NTUs more than five percent of the time within a 24-hour period and 10 NTUs at any time.

(b) After disinfection, Total Coliform must not exceed a median of 2.2 organisms per 100 mL based on results of the last seven days that analyses have been completed, and 23 total coliform organisms per 100mL in any single sample.

(3) All use of recycled water shall conform to the Recycled Water Use Plan approved by the Department. Upon approval of the Recycled Water Use Plan, the Plan shall become enforceable through this permit modification.

Modification #3: Permit No. 100988, Schedule A, Note 5 is added to read as follows:

5. If any ETL Option other than Option A is used, the Discharge Monitoring Report must state which option was used during that month and include all data necessary to calculate the ETL limit. Limits are to be calculated and compliance will be evaluated starting on the seventh day of the TMDL period (June 7th).

Modification #4: Permit No. 100988, Schedule B, Condition 1.b. is modified to add the following effluent monitoring requirements:

Item or Parameter	Minimum Frequency	Type of Sample
Temperature:		
Effluent Temperature, Average of Daily Maximums (June 1 through September 30)	Daily (as a rolling seven-day average starting June 7)	Calculation
Excess Thermal Load or ETL (June 1 through September 30)	Daily (as a rolling seven-day average starting June 7)	Calculation (See Note 13)

Modification #5: Permit No. 100988, Schedule B, Condition 1.e. is modified to add the following Willamette River monitoring requirements:

Item or Parameter	Minimum Frequency	Type of Sample
Flow, daily average	Daily when using ETL Limit Option B or C	Continuous (see Note 14)
Flow, average of daily averages	Daily when using ETL Limit Option B or C (as a rolling seven-day average)	Calculation
Temperature	Daily when using ETL Limit Option C	Continuous (see Note 5)
Temperature, daily average	Daily when using ETL Limit Option C	Calculation
Temperature, daily maximum	Daily when using ETL Limit Option C	Continuous (see Note 5)
ETL limit	Daily when using ETL Limit Option B or C	Calculation (see Schedule A, Condition 1.a.(3))

Modification #6: Permit No. 100988, Schedule B, Condition 1.f. is added to read as follows:

f. Recycled Wastewater Outfall 101 (when discharging recycled water)

Item or Parameter	Minimum Frequency	Type of Sample
Total Recycled Flow Discharged (MGD)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
Chlorine Residual	Daily	Grab
pH	2/Week	Grab
Nutrients (TKN, NO_2+NO_3-N, NH_3, Total Phosphorus)	Once during the first quarter of discharge of recycled water	Grab

	(See Note 16)	
Total Coliform	Daily	Grab
Turbidity	Hourly (See Note 17)	Measurement

Modification #7: Permit No. 100988, Schedule B, Condition 3.c. is modified to read as follows:

c. Data from temperature monitoring required by Schedule B, Condition 1.b. shall be submitted on the Permittee's monthly discharge monitoring report.

Modification #8: Permit No. 100988, Schedule B, Condition 3.d. is added to read as follows:

d. By no later than February 15 of each year that recycled water is generated and used, the permittee shall submit to the Department an annual report describing the effectiveness of the recycled water system to comply with approved recycled water use plan, the rules of Division 55, and the limitations and conditions of this permit applicable to reuse of recycled water.

Modification #9: Permit No. 100988, Schedule B, Notes 13, 14, 15, 16, and 17 are added to read as follows:

13. Calculated as follows:
(Rolling seven-day average of daily maximum effluent temperatures in °C - applicable stream temperature standard, 20°C) x (Rolling seven-day average of daily flow in MGD) x 3.785 = Excess Thermal Load, in Million Kcals/day.

14. Receiving stream flow rate may be derived from the USGS gauging station Number 14197900 (Willamette River at Newberg). In the event that this data is temporarily unavailable, the Permittee may use the daily stream flow rate from the nearest USGS gauging station adjusted by the average ratio between the flow rates at the two stations for the seven-day period prior to the loss of data from the Newberg station. If data is not available from either station, the Permittee may use the historical average flow rate for the Newberg station for that date. In the event the gauging station data becomes permanently unavailable, the Permittee must obtain Department approval for an alternative flow determination strategy.

15. In the event that temperature data for the Willamette River is temporarily unavailable from the USGS station at Newberg, the Permittee may use the historical average temperature data from the Newberg station for that date.

16. Upon Department issuance of this permit modification, monitoring for nutrients will only be required once during the initial first quarter of distributing recycled water. After the first quarter, monitoring of the recycled water for nutrients may be eliminated unless otherwise notified in writing by the Department. Monitoring results shall be reported on approved forms and submitted by no later than the 15th day of the month following the month in which the sampling event occurred.

17. Monitoring data for turbidity will be collected continuously using an on-line turbidimeter. Hourly turbidity data may be extracted and reported on approved forms from the continuously recorded data. Should the on-line turbidimeter become inoperable, then the hourly turbidity data may be collected manually on an hourly frequency during the interim period.

Modification #10: Permit No. 100988, Schedule D, Conditions 8, 9 and 10 are added to read as follows:

8. The permittee shall meet the requirements for use of recycled water under Division 55, including the following:

   a. No recycled water shall be released by the permittee until a Recycled Water Use Plan is approved by the Department.

   b. All recycled water shall be managed in accordance with the approved Recycled Water Use Plan. No substantial changes shall be made in the approved plan without written approval of the Department.

   c. The permittee shall notify the Department within 24 hours if it is determined that the treated effluent is being used in a manner not in compliance with OAR 340-055. When the Department offices are not open, the permittee shall report the incident of noncompliance to the Oregon Emergency Response System (Telephone Number 1-800-452-0311).

   d. No recycled water shall be made available to a person proposing to recycle unless that person certifies in writing that they have read and understand the provisions in these rules. This written certification shall be kept on file by the sewage treatment system owner and be made available to the Department for inspection.

9. All recycled water used at the treatment plant site for landscape irrigation shall be exempt from OAR 340-055 provided the recycled water receives secondary treatment and disinfection. All landscape irrigation shall be confined to the treatment plant site. No spray or drift shall be allowed off the treatment plant site. Landscape irrigation shall be conducted following sound irrigation practices.

ISSUED

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT
Department of Environmental Quality
Western Region – Salem Office
750 Front Street NE, Suite 120, Salem, OR 97301-1039
Telephone: (503) 378-8240

Issued pursuant to ORS 468B.050 and The Federal Clean Water Act

ISSUED TO:

Newberg, City of
P.O. Box 970
Newberg, OR 97132

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Outfall Location
Treated Wastewater	001	R.M. 49.7
Emergency Overflows:		
Dayton Avenue PS	002	Chehalem Creek
Andrew Street PS	004	Chehalem Creek
Charles Street PS	005	Chehalem Creek
Chehalem Street PS	006	Chehalem Creek
Creekside Lane PS	007	Chehalem Creek
Sheridan Street PS	008	Chehalem Creek
Fernwood Road PS	009	Sprinbrook Creek

FACILITY TYPE AND LOCATION:

Activated Sludge
Newberg - Wynooski Street STP
2301 Wynooski Street
Newberg, Oregon
Treatment System Class: Level IV
Collection System Class: Level III

RECEIVING STREAM INFORMATION:

Basin: Willamette
Sub-Basin: Middle Willamette
Receiving Stream: Willamette River
LLID: 1227618456580 - 49.7 - D
County: Yamhill

EPA REFERENCE NO: OR003235-2

Issued in response to Application No. 992393 received April 3, 1997.

This permit is issued based on the land use findings in the permit record.

Mark E Hamlin
for *Michael H. Kortenhof, Western Region Water Quality Manager*

June 22, 2004
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to construct, install, modify, or operate a wastewater collection, treatment, control and disposal system and discharge to public waters adequately treated wastewaters only from the authorized discharge point or points established in Schedule A and only in conformance with all the requirements, limitations, and conditions set forth in the attached schedules as follows:

Unless specifically authorized by this permit, by another NPDES or WPCF permit, or by Oregon Administrative Rule, any other direct or indirect discharge to waters of the state is prohibited, including discharge to an underground injection control system.

SCHEDULE A

1. Waste Discharge Limitations not to be exceeded after permit issuance.

a. Treated Effluent Outfall 001

(1) May 1 - October 31:

Parameter	Average Effluent Concentrations Monthly	Average Effluent Concentrations Weekly	Monthly* Average lb/day	Weekly* Average lb/day	Daily* Maximum lbs
$CBOD_5$ (See Note 1)	10 mg/L	15 mg/L	330	500	660
TSS	10 mg/L	15 mg/L	330	500	660

(2) November 1 - April 30:

Parameter	Average Effluent Concentrations Monthly	Average Effluent Concentrations Weekly	Monthly* Average lb/day	Weekly* Average lb/day	Daily* Maximum lbs
$CBOD_5$ (See Note 1)	25 mg/L	40 mg/L	1400	2000	2700
TSS	30 mg/L	45 mg/L	1600	2400	3200

* Average dry weather design flow to the facility equals 4.0 MGD. Summer mass load limits based upon average dry weather design flow to the facility. Winter mass load limits based upon average wet weather design flow to the facility equaling 6.5 MGD. The daily mass load limit is suspended on any day in which the daily flow to the treatment facility exceeds 8 MGD (twice the design average dry weather flow).

(3)

Other parameters (year-round)	Limitations
E. coli Bacteria	Shall not exceed 126 organisms per 100 mL monthly geometric mean. No single sample shall exceed 406 organisms per 100 mL. (See Note 3)
pH	Shall be within the range of 6.0 - 9.0
$CBOD_5$ and TSS Removal Efficiency	Shall not be less than 85% monthly average for $CBOD_5$ and 85% monthly for TSS.
Total Residual Chlorine	Shall not exceed a monthly average concentration of 0.02 mg/L and a daily maximum concentration of 0.05 mg/L. (See Note 4)

(4) Except as provided for in OAR 340-045-0080, no wastes shall be discharged and no activities shall be conducted which violate Water Quality Standards as adopted in OAR 340-041 except in the following defined mixing zone:

The allowable mixing zone is that portion of the Willamette River contained within a band extending out seventy five (75) feet from the west bank of the river and extending from a point fifteen (15) feet upstream of the outfall to a point one hundred fifty (150) feet downstream from the outfall. The Zone of Immediate Dilution (ZID) shall be defined as that portion of the allowable mixing zone that is within fifteen (15) feet of the point of discharge.

b. Emergency Overflow Outfalls 002 and 004 through 009

(1) No wastes shall be discharged from these outfalls, unless the cause of the discharge is due to storm events as allowed under OAR 340-041-0120 (13) or (14) as follows:

(2) Raw sewage discharges are prohibited to waters of the State from November 1 through May 21, except during a storm event greater than the one-in-five-year, 24-hour duration storm, and from May 22 through October 31, except during a storm event greater than the one-in-ten-year, 24-hour duration storm. If an overflow occurs between May 22 and June 1, and if the permittee demonstrates to the Department's satisfaction that no increase in risk to beneficial uses occurred because of the overflow, no violation shall be triggered if the storm associated with the overflow was greater than the one-in-five-year, 24-hour duration storm.

c. No activities shall be conducted that could cause an adverse impact on existing or potential beneficial uses of groundwater. All wastewater and process related residuals shall be managed and disposed in a manner that will prevent a violation of the Groundwater Quality Protection Rules (OAR 340-040).

NOTES:

1. The $CBOD_5$ concentration limits are considered equivalent to the minimum design criteria for BOD_5 specified in Oregon Administrative Rules (OAR) 340-041. These limits and $CBOD_5$ mass limits may be adjusted (up or down) by permit action if more accurate information regarding $CBOD_5/BOD_5$ becomes available.

2. At the point of discharge, the Willamette River is water quality limited for temperature (summer), fecal coliform (fall, winter and spring), several toxic parameters (PCB, aldrin, dieldrin, DDT, DDE, iron and mercury) year around and biological criteria (due to skeletal deformities in juvenile squawfish). A Total Maximum Daily Load (TMDL) has not been issued for any of these parameters at the time of permit issuance. Upon EPA approval of a TMDL addressing any of these pollutants, this permit may be reopened to include any Waste Load Allocation (WLA), best management practice or any other condition required by the TMDL.

3. If a single sample exceeds 406 organisms per 100 mL, then five consecutive re-samples may be taken at four-hour intervals beginning within 28 hours after the original sample was taken. If the log mean of the five re-samples is less than or equal to 126 organisms per 100 mL, a violation shall not be triggered.

4. When the total residual chlorine limitation is lower than 0.10 mg/L, the Department will use 0.10 mg/L as the compliance evaluation level (i.e. daily maximum concentrations below 0.10 mg/L will be considered in compliance with the limitation).

SCHEDULE B

1. **Minimum Monitoring and Reporting Requirements** (unless otherwise approved in writing by the Department).

The permittee shall monitor the parameters as specified below at the locations indicated. The laboratory used by the permittee to analyze samples shall have a quality assurance/quality control (QA/QC) program to verify the accuracy of sample analysis. If QA/QC requirements are not met for any analysis, the results shall be included in the report, but not used in calculations required by this permit. When possible, the permittee shall re-sample in a timely manner for parameters failing the QA/QC requirements, analyze the samples, and report the results.

a. Influent

The facility influent cyanide and grab samples and all measurements are taken at the entrance to grit chamber. Composite and metals samples are taken just after the grit chamber. The composite sampler is located in the grit pump room.

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Semi-Annual	Verification
$CBOD_5$	2/Week	Composite
TSS	2/Week	Composite
pH	3/Week	Grab
Toxics:		
Metals (Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn) & Cyanide, measured as total is mg/L (See Note 1)	Semi-annually using 3 consecutive days between Monday and Friday, inclusive	24-hour daily composite (See Note 2)

b. Treated Effluent Outfall 001

The facility effluent cyanide, bacteria, pH and chlorine residual grab samples and all measurements are taken from the Cipolletti weir discharge. Composite and metals samples are taken just prior to the Cipolletti weir. The composite sampler is located in reclaimed water pump room.

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Calculation (see Note 3)
Flow Meter Calibration (see Note 3)	Semi-Annual	Verification
$CBOD_5$	2/Week	Composite
Ammonia (NH3-N)	2/Week	Composite
TSS	2/Week (see Note 4)	Composite
Hardness (mg/L $CaCO_3$)	See Note 4	Grab
pH	3/Week	Grab
Effluent Temperature, Daily Max (See Note 5)	Daily	Continuous
E. coli	2/Week	Grab (See Note 6)
Quantity Chlorine Used	Daily	Measurement
Total Chlorine Residual	Daily	Grab
Pounds Discharged ($CBOD_5$ and TSS)	2/Week	Calculation

b. *Treated Effluent Outfall 001 (continued)*

Item or Parameter	Minimum Frequency	Type of Sample
Average Percent Removed ($CBOD_5$ and TSS)	Monthly	Calculation
Nutrients		
TKN, NO2+NO3-N, Total Phosphorus	1/Week (May-Oct)	24-hour Composite
Toxics:		
Metals (Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn) & Cyanide, measured as total is mg/L (See Notes 1 and 4)	Semi-annually using 3 consecutive days between Monday and Friday, inclusive	24-hour daily composite (See Note 2)
Iron	Monthly (see Note 7)	24-hour daily composite
Priority Pollutants (see Note 8)	(see Note 8)	24-hour daily composite
Whole Effluent Toxicity (See Note 9)	Annually	Acute & chronic

c. Biosolids Management (see Note 10)

Item or Parameter	Minimum Frequency	Type of Sample
Sludge analysis including: Total Solids (% dry wt.) Volatile solids (% dry wt.) Biosolids nitrogen for: NH_3-N; NO_3-N; & TKN (% dry wt.) Phosphorus (% dry wt.) Potassium (% dry wt.) pH (standard units)	Quarterly	Composite sample to be representative of the product prior to being sold or given away (See Note 11)
Sludge metals content for: Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se & Zn, measured as total in mg/kg	Quarterly	Composite sample to be representative of the product prior to being sold or given away (See Note 11)
Record of amount of Class A biosolids derived material sold or given away.	Each Occurrence	Record of date and volume of compost sold or given away.
Record of locations where Class B biosolids are applied on each DEQ approved site. (Site location maps to be maintained at treatment facility for review upon request by DEQ)	Each Occurrence	Record of date, volume & locations where biosolids were applied recorded on site location map.
Class A PFRP maintain 55C or higher for 3 days or longer.	Daily	Record of temperatures at 55°C or higher
Class B PSRP maintain 40C or higher for 5 days, during which 4 hours must exceed 55C.	Daily	Record of temperatures at 40°C or higher and at 55°C or higher
Vector Attraction Reduction Option #5 at least 14 days at over 40C (104F) with the average temperature of over 45C.	Daily	Record of temperatures at 45°C or higher and at 40°C or higher
Record of compost process time	Quarterly	Record of compost process time by tracking a marker or other known method

c. Biosolids Management (continued)

Item or Parameter	Minimum Frequency	Type of Sample
Fecal coliform bacteria per gram total solids (dry weight basis) or Salmonella sp. bacteria per four grams total solids (dry weight basis)	Quarterly	At least seven (7) individual samples representative of the product to be beneficially used (See Note 11)

d. Emergency Overflow Outfalls 002 and 004 through 009

Item or Parameter	Minimum Frequency	Type of Sample
Flow	Daily (during each occurrence)	Estimate duration and volume

e. Willamette River

Item or Parameter	Minimum Frequency	Type of Sample
Metals (Ag, Cd, Cu, Pb) measured as total in mg/L	Semi-annually during one of the 3 consecutive days of effluent monitoring (See Note 12)	Grab
TSS	See Note 12	Grab
Hardness (mg/L $CaCO_3$)	See Note 12	Grab

2. **Reporting Procedures**

a. Monitoring results shall be reported on approved forms. The reporting period is the calendar month. Reports must be submitted to the appropriate Department office by the 15th day of the following month.

b. State monitoring reports shall identify the name, certificate classification and grade level of each principal operator designated by the permittee as responsible for supervising the wastewater collection and treatment systems during the reporting period. Monitoring reports shall also identify each system classification as found on page one of this permit.

c. Monitoring reports shall also include a record of the quantity and method of use of all sludge removed from the treatment facility and a record of all applicable equipment breakdowns and bypassing.

3. **Report Submittals**

a. The permittee shall have in place a program to identify and reduce inflow and infiltration into the sewage collection system. An annual report shall be submitted to the Department by February 15 each year, which details sewer collection maintenance activities that reduce inflow and infiltration. The report shall state those activities that have been done in the previous year and those activities planned for the following year.

b. For any year in which biosolids are land applied, a report shall be submitted to the Department by February 19 of the following year that describes solids handling activities for the previous year and includes, but is not limited to, the required information outlined in OAR 340-050-0035(6)(a)-(e).

c. An annual report covering temperature monitoring done in the calendar year is due by February 15th of the following year. The report shall include results of any temperature monitoring conducted on the influent, sidestreams or the Willamette River. The report shall include calculations of the weekly averages of the daily maximum temperatures of the effluent.

NOTES:

1. For influent and effluent cyanide samples, at least six (6) discrete grab samples shall be collected over the operating day. Each aliquot shall not be less than 100 mL and shall be collected and composited into a larger container, which has been preserved with sodium hydroxide for cyanide samples to insure sample integrity.

2. Daily 24-hour composite samples shall be analyzed and reported separately. Toxic monitoring results and toxics removal efficiency calculations shall be tabulated and submitted with the Pretreatment Program Annual Report as required in Schedule E. Submittal of toxic monitoring results with the monthly Discharge Monitoring Report is not required.

3. The effluent flow is to be calculated based on the influent flow and adjusted by measure and/or estimated side stream flows. Where possible, calibration of side stream flow meters shall be performed at the frequency specified.

4. During the first two years after permit issuance, special monitoring for cadmium, copper, lead, mercury and silver shall be conducted on the effluent during at least one of the three consecutive days of monitoring. TSS and hardness shall be monitored simultaneously. The special monitoring for cadmium, copper, lead and silver shall be conducted using a "clean" sampling method, an "ultra-clean" sampling method, EPA method 1669 or any other test method approved by the Department. The special monitoring for mercury shall be conducted in accordance with EPA Method 1631. At the permittee's option, the results of the special monitoring may be used for one or more of the three consecutive days monitoring that is required on a semi-annual basis. After the first two years, special monitoring of the effluent for cadmium, copper, lead, mercury and silver may be eliminated unless otherwise notified in writing by the Department. For all tests, the method detection limit *shall be reported along with the sample result.*

5. When continuous monitors are used, record the time between temperature readings, and results are to be tabulated and submitted in an annual report. Continuous temperature monitors must be audited in June and December, following procedures described in DEQ Procedural Guidance for Water Temperature Monitoring. Continuous temperature monitors are to be checked visually monthly to insure that the devices are still in place and submerged.

6. *E. coli* monitoring must be conducted according to any of the following test procedures as specified in **Standard Methods for the Examination of Water and Wastewater, 19th Edition**, or according to any test procedure that has been authorized and approved in writing by the Director or an authorized representative:

Method	Reference	Page	Method Number
mTEC agar, MF	Standard Methods, 18th Edition	9-29	9213 D
NA-MUG, MF	Standard Methods, 19th Edition	9-63	9222 G
Chromogenic Substrate, MPN	Standard Methods, 19th Edition	9-65	9223 B
Colilert QT	Idexx Laboratories, Inc.		

7. During the first year after permit issuance, monitoring for iron shall be conducted on the effluent at the frequency specified. The method detection limit must be lower than 0.3 mg/L. After the first year, iron monitoring of the effluent may be eliminated unless otherwise notified in writing by the Department. For all tests, the method detection limit shall be reported along with the sample result.

8. The permittee shall perform all testing required in Part D of EPA Form 2A. The testing includes all metals (total recoverable), cyanide, phenols, hardness and the 85 pollutants included under volatile organic, acid extractable and base-neutral compounds. In addition, the permittee shall monitor for the pesticide pollutants listed in Table II of Appendix D of 40 CFR Part 122. Three scans are required during the 4 ½ years after

permit issuance. Two of the three scans must be performed no fewer than 4 months and no more than 8 months apart. The effluent samples shall be 24-hour daily composites, except where sampling volatile compounds. In this case, six (6) discrete samples (not less than 100 mL) collected over the operating day are acceptable. The permittee shall take special precautions in compositing the individual grab samples for the volatile organics to insure sample integrity (i.e. no exposure to the outside air). Alternately, the discrete samples collected for volatiles may be analyzed separately and averaged.

9. Beginning no later than calendar year 2004, the permittee shall conduct Whole Effluent Toxicity testing for a period of four (4) years in accordance with the frequency specified above. If the Whole Effluent Toxicity tests show that the effluent samples are not toxic at the dilutions determined to occur at the Zone of Immediate Dilution and the Mixing Zone, no further Whole Effluent Toxicity testing will be required during this permit cycle. Note that four Whole Effluent Toxicity test results will be required along with the next NPDES permit renewal application.

10. If alternative methods of demonstrating compliance with federal pathogen reduction and/or vector attraction reduction requirements are used, the monitoring and sampling frequency shall be based on 40 CFR Part 503 and shall conform to the approved Biosolids Management Plan.

11. Composite samples from the Compost pile shall be taken from reference areas in the Compost pile pursuant to Test Methods for Evaluating Solid Waste, Volume 2; Field Manual, Physical/Chemical Methods, November 1986, Third Edition, Chapter 9.

    Inorganic pollutant monitoring must be conducted according to Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Second Edition (1982) with Updates I and II and third Edition (1986) with Revision I.

12. During the first two years after permit issuance, the Willamette River shall be monitored for cadmium, copper, lead, silver, TSS and hardness when special monitoring of the effluent is conducted (see Note 5). The Willamette River monitoring for cadmium, copper, lead and silver shall be conducted using a "clean" sampling method, an "ultra-clean" sampling method, EPA method 1669 or any other test method approved by the Department. After the first two years, Willamette River monitoring for cadmium, copper, lead and silver may be eliminated. For all tests, the method detection limit shall be reported along with the sample result. The Willamette River shall be sampled for hardness at the same time the river is sampled for metals.

SCHEDULE C

Compliance Schedules and Conditions

1. Within 180 days of permit issuance, the permittee shall submit to the Department for review and approval a proposed program and time schedule for identifying and reducing inflow. Within 60 days of receiving written Department comments, the permittee shall submit a final approvable program and time schedule. The program shall consist of the following:

    a. Identification of all overflow points and verification that sewer system overflows are not occurring up to a 24-hour, 5-year storm event or equivalent;

    b. Monitoring of all pump station overflow points;

    c. A program for identifying and removing all inflow sources into the permittee's sewer system over which the permittee has legal control; and

    d. If the permittee does not have the necessary legal authority for all portions of the sewer system or treatment facility, a program and schedule for gaining legal authority to require inflow reduction and a program and schedule for removing inflow sources.

2. By no later than ninety (90) days after permit issuance, the permittee shall submit to the Department a report which either identifies known sewage overflow locations and a plan for estimating the frequency, duration and quantity of sewage overflowing, or confirms that there are no overflow points. The report shall also provide a schedule to eliminate the overflow(s), if any.

3. By no later than June 30, 2005, the permittee shall submit to the Department for approval Sewer Use Ordinance revisions. The permittee shall conduct a comprehensive review of the City's sewer use ordinance to ensure consistency with 40 CFR § 403 pretreatment regulations and USEPA Region 10 Model Sewer Use Ordinance and revise as necessary to provide the legal authorities to fully implement the federal industrial pretreatment program. (See Note 1)

4. By no later than June 30, 2006, the permittee shall submit to DEQ for approval local limits developed with an emphasis on maximum allowable headworks loading (MAHL) and in accordance with 40 CFR § 403.5(c)(1). (See Note 1)

5. By no later than June 30, 2006, the permittee shall submit to the Department for approval pretreatment program implementation procedures. The procedures must include but not be limited to, industrial user survey, permit application procedure, permit process, IU notification procedures, self monitoring report, inspection procedures, sampling requirements, investigations, budget requirements, data base management, sewer use charges and enforcement response plan. (See Note 1)

6. The permittee is expected to meet the compliance dates, which have been established in this schedule. Either prior to or no later than 14 days following any lapsed compliance date, the permittee shall submit to the Department a notice of compliance or noncompliance with the established schedule. The Director may revise a schedule of compliance if he/she determines good and valid cause resulting from events over which the permittee has little or no control.

NOTE:

1. In the event the City of Newberg or the Department determine the City has acquired a categorical or significant industrial user as defined in 40 CFR § 403.3, the City must submit a revised schedule of

compliance to condense the time allowed to develop a fully functional pretreatment program. The amount of time will be dependent on the circumstances at the time including the City's progress toward developing the pretreatment program and timing of the industry connecting to the sewer but in no case shall exceed one hundred eighty (180) days. Any revised time schedule must be approved by the Department.

SCHEDULE D

Special Conditions

1. All biosolids shall be managed in accordance with the current, DEQ approved biosolids management plan. Any changes in solids management activities that significantly differ from operations specified under the approved plan require the prior written approval of the DEQ. Land application of Class B biosolids is allowed only after site authorization approval is issued by the Department in accordance with the biosolids management plan.

2. This permit may be modified to incorporate any applicable standard for biosolids use or disposal promulgated under section 405(d) of the Clean Water Act, if the standard for biosolids use or disposal is more stringent than any requirements for biosolids use or disposal in the permit, or controls a pollutant or practice not limited in this permit.

   Biosolids that do not meet Class A pathogen and vector attraction reduction requirements of 40 CFR Part 503 or that contain metal concentrations greater than the concentration specified in 40 CRF 503.13 Table 3 shall not be sold or given away.

3. **Whole Effluent Toxicity Testing**

   a. The permittee shall conduct whole effluent toxicity tests as specified in Schedule B of this permit.

   b. Bioassay tests may be dual end-point tests, only for the fish tests, in which both acute and chronic end-points can be determined from the results of a single chronic test (the acute end-point shall be based upon a 48-hour time period).

   c. Acute Toxicity Testing - Organisms and Protocols

      (1) The permittee shall conduct 48-hour static renewal tests with the *Ceriodaphnia dubia* (water flea) and the *Pimephales promelas* (fathead minnow).

      (2) The presence of acute toxicity will be determined as specified in **Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms**, Fourth Edition, EPA/600/4-90/027F, August 1993.

      (3) An acute bioassay test shall be considered to show toxicity if there is a statistically significant difference in survival between the control and 100 percent effluent, unless the permit specifically provides for a Zone of Immediate Dilution (ZID) for toxicity. If the permit specifies such a ZID, acute toxicity shall be indicated when a statistically significant difference in survival occurs at dilutions greater than that which is found to occur at the edge of the ZID.

   d. Chronic Toxicity Testing - Organisms and Protocols

      (1) The permittee shall conduct tests with: *Ceriodaphnia dubia* (water flea) for reproduction and survival test endpoint, *Pimephales promelas* (fathead minnow) for growth and survival test endpoint, and *Raphidocelis subcapitata* (green alga formerly known as *Selanastrum capricornutum*) for growth test endpoint.

      (2) The presence of chronic toxicity shall be estimated as specified in **Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms**, Third Edition, EPA/600/4-91/002, July 1994.

(3) A chronic bioassay test shall be considered to show toxicity if a statistically significant difference in survival, growth, or reproduction occurs at dilutions greater than that which is known to occur at the edge of the mixing zone. If there is no dilution data for the edge of the mixing zone, any chronic bioassay test that shows a statistically significant effect in 100 percent effluent as compared to the control shall be considered to show toxicity.

e. Quality Assurance

(1) Quality assurance criteria, statistical analyses and data reporting for the bioassays shall be in accordance with the EPA documents stated in this condition and the Department's **Whole Effluent Toxicity Testing Guidance Document**, January 1993.

f. Evaluation of Causes and Exceedances

(1) If toxicity is shown, as defined in sections c.(3) or d.(3) of this permit condition, another toxicity test using the same species and Department approved methodology shall be conducted within two weeks, unless otherwise approved by the Department. If the second test also indicates toxicity, the permittee shall follow the procedure described in section f.(2) of this permit condition.

(2) If two consecutive bioassay test results indicate acute and/or chronic toxicity, as defined in sections c.(3) or d.(3) of this permit condition, the permittee shall evaluate the source of the toxicity and submit a plan and time schedule for demonstrating compliance with water quality standards. Upon approval by the Department, the permittee shall implement the plan until compliance has been achieved. Evaluations shall be completed and plans submitted to the Department within 6 months unless otherwise approved in writing by the Department.

g. Reporting

(1) Along with the test results, the permittee shall include: 1. the dates of sample collection and initiation of each toxicity test; 2. the type of production; and 3. the flow rate at the time of sample collection. Effluent at the time of sampling for bioassay testing should include samples of required parameters stated under Schedule B, condition 1. of this permit.

(2) The permittee shall make available to the Department, on request, the written standard operating procedures they, or the laboratory performing the bioassays, are using for all toxicity tests required by the Department.

h. Reopener

(1) If bioassay testing indicates acute and/or chronic toxicity, the Department may reopen and modify this permit to include new limitations and/or conditions as determined by the Department to be appropriate, and in accordance with procedures outlined in Oregon Administrative Rules, Chapter 340, Division 45.

4. The permittee shall comply with Oregon Administrative Rules (OAR), Chapter 340, Division 49, "Regulations Pertaining To Certification of Wastewater System Operator Personnel" and accordingly:

a. The permittee shall have its wastewater system supervised by one or more operators who are certified in a classification and grade level (equal to or greater) that corresponds with the classification (collection and/or treatment) of the system to be supervised as specified on page one of this permit.

Note: A "supervisor" is defined as the person exercising authority for establishing and executing the specific practice and procedures of operating the system in accordance with the policies of the permittee and requirements of the waste discharge permit. "Supervise" means responsible for the technical operation of a system, which may affect its performance or the quality of the effluent produced. Supervisors are not required to be on-site at all times.

b. The permittee's wastewater system may not be without supervision (as required by Special Condition 4.a. above) for more than thirty (30) days. During this period, and at any time that the supervisor is not available to respond on-site (i.e. vacation, sick leave or off-call), the permittee must make available another person who is certified at no less than one grade lower then the system classification.

c. If the wastewater system has more than one daily shift, the permittee shall have the shift supervisor, if any, certified at no less than one grade lower than the system classification.

d. The permittee is responsible for ensuring the wastewater system has a properly certified supervisor available at all times to respond on-site at the request of the permittee and to any other operator.

e. The permittee shall notify the Department of Environmental Quality in writing within thirty (30) days of replacement or redesignation of certified operators responsible for supervising wastewater system operation. The notice shall be filed with the Water Quality Division, Operator Certification Program, 811 SW 6th Ave, Portland, OR 97204. This requirement is in addition to the reporting requirements contained under Schedule B of this permit.

f. Upon written request, the Department may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system. The written request must include justification for the time needed, a schedule for recruiting and hiring, the date the system supervisor availability ceased and the name of the alternate system supervisor(s) as required by 4.b. above.

5. The permittee shall notify the appropriate DEQ Office in accordance with the response times noted in the General Conditions of this permit, of any malfunction that could result in a permit violation or endanger public health or the environment so that corrective action can be coordinated between the permittee and the Department.

6. Unless otherwise approved in writing by the Department, all inflow sources are to be permanently disconnected from the sanitary sewer system in accordance with the approved inflow removal plan required by Schedule C, Condition 1.

7. The permittee shall not be required to perform a hydrogeologic characterization or groundwater monitoring during the term of this permit provided:

a. The facilities are operated in accordance with the permit conditions, and;

b. There are no adverse groundwater quality impacts (complaints or other indirect evidence) resulting from the facility's operation.

If warranted, at permit renewal the Department may evaluate the need for a full assessment of the facilities impact on groundwater quality.

SCHEDULE E

Pretreatment Activities

Upon Permit issuance, the permittee shall implement the following pretreatment activities:

1. The permittee shall update its inventory of industrial users at a frequency and diligence adequate to ensure proper identification of industrial users subject to pretreatment standards, but no less than once per year. The permittee shall notify these industrial users of applicable pretreatment standards in accordance with 40 CFR § 403.8(f)(2)(iii).

2. The permittee must develop and maintain a data management system designed to track the status of the industrial user inventory, discharge characteristics, and compliance. In accordance with 40 CFR § 403.12(o), the permittee shall retain all records relating to pretreatment program activities for a minimum of three years, and shall make such records available to the Department and USEPA upon request. The permittee shall also provide public access to information considered effluent data under 40 CFR Part 2.

3. The permittee shall submit by March 1 of each year, a report that describes the permittee's pretreatment program during the previous calendar year. The content and format of this report shall be as established by the Department.

4. The permittee shall submit in writing to the Department a statement of the basis for any proposed modification of its approved program and a description of the proposed modification in accordance with 40 CFR § 403.18. No substantial program modifications may be implemented by the permittee prior to receiving written authorization from the Department.

Upon Department approval of the revised pretreatment program procedures (required by Schedule C, Conditions 3, 4 and 5), the permittee shall implement the following pretreatment activities:

5. The permittee shall conduct and enforce its Pretreatment Program, as approved by the Department, and comply with the General Pretreatment Regulations (40 CFR Part 403). The permittee shall secure and maintain sufficient resources and qualified personnel to carry out the program implementation procedures described in this permit.

6. The permittee shall adopt all legal authority necessary to fully implement its approved pretreatment program and to comply with all applicable State and Federal pretreatment regulations. The permittee must also establish, where necessary, contracts or agreements with contributing jurisdictions to ensure compliance with pretreatment requirements by industrial users within these jurisdictions. These contracts or agreements shall identify the agency responsible for all implementation and enforcement activities to be performed in the contributing jurisdictions. Regardless of jurisdictional situation, the permittee is responsible for ensuring that all aspects of the pretreatment program are fully implemented and enforced.

7. The permittee shall enforce categorical pretreatment standards promulgated pursuant to Section 307(b) and (c) of the Act, prohibited discharge standards as set forth in 40 CFR § 403.5(a) and (b), or local limitations developed by the permittee in accordance with 40 CFR § 403.5(c), whichever are more stringent, or are applicable to nondomestic users discharging wastewater to the collection system. Locally derived discharge limitations shall be defined as pretreatment standards under Section 307(d) of the Act.

   A technical evaluation of the need to revise local limits shall be performed at least once during the term of this permit and must be submitted to the Department as part of the permittee's NPDES permit application, unless the Department requires in writing that it be submitted sooner. Limits development will be in accordance with the procedures established by the Department.

8. The permittee shall issue individual discharge permits to all Significant Industrial Users in a timely manner. The permittee shall also reissue and/or modify permits, where necessary, in a timely manner. Discharge permits must contain, at a minimum, the conditions identified in 40 CFR § 403.8(f)(1)(iii). Unless a more stringent definition has been adopted by the permittee, the definition of Significant Industrial User shall be as stated in 40 CFR § 403.3(t).

9. The permittee shall randomly sample and analyze industrial user effluents at a frequency commensurate with the character, consistency, and volume of the discharge. At a minimum, the permittee shall sample all Significant Industrial Users for all regulated pollutants twice per year. Alternatively, at a minimum, the permittee shall sample all Significant Industrial Users for all regulated pollutants once per year, if the permittee has pretreatment program criteria in its approved procedures for determining appropriate sampling levels for industrial users, and provided the sampling criteria indicate once per year sampling is adequate. At a minimum, the permittee shall conduct a complete facility inspection once per year. Additionally, at least once every two years the permittee shall evaluate the need for each Significant Industrial User to develop a slug control plan. Where a plan is deemed necessary, it shall conform to the requirements of 40 CFR § 403.8(f)(2)(v).

   Where the permittee elects to conduct all industrial user monitoring in lieu of requiring self-monitoring by the user, the permittee shall gather all information which would otherwise have been submitted by the user. The permittee shall also perform the sampling and analyses in accordance with the protocols established for the user.

   Sample collection and analysis, and the gathering of other compliance data, shall be performed with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Unless specified otherwise by the Director in writing, all sampling and analyses shall be performed in accordance with 40 CFR Part 136.

10. The permittee shall review reports submitted by industrial users and identify all violations of the user's permit or the permittee's local ordinance.

11. The permittee shall investigate all instances of industrial user noncompliance and shall take all necessary steps to return users to compliance. The permittee's enforcement actions shall track its approved Enforcement Response Plan, developed in accordance with 40 CFR § 403.8(f)(5). If the permittee has not developed an approved Enforcement Response Plan, it shall develop and submit a draft to the Department for review within 90 days of the issuance of this permit.

12. The permittee shall publish, at least annually in the largest daily newspaper published in the permittee's service area, a list of all industrial users which, at any time in the previous 12 months, were in Significant Noncompliance with applicable pretreatment requirements. For the purposes of this requirement, an industrial user is in Significant Noncompliance if it meets one or more of the criteria listed in 40 CFR 403.8(f)(2)(vii).

NPDES GENERAL CONDITIONS
(SCHEDULE F)

SECTION A. STANDARD CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of Oregon Revised Statutes (ORS) 468B.025 and is grounds for enforcement action; for permit termination, suspension, or modification; or for denial of a permit renewal application.

2. Penalties for Water Pollution and Permit Condition Violations

Oregon Law (ORS 468.140) allows the Director to impose civil penalties up to $10,000 per day for violation of a term, condition, or requirement of a permit.

In addition, a person who unlawfully pollutes water as specified in ORS 468.943 or ORS 468.946 is subject to criminal prosecution.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment. In addition, upon request of the Department, the permittee shall correct any adverse impact on the environment or human health resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and have the permit renewed. The application shall be submitted at least 180 days before the expiration date of this permit.

The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

5. Permit Actions

This permit may be modified, suspended, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any term, condition, or requirement of this permit, a rule, or a statute;

b. Obtaining this permit by misrepresentation or failure to disclose fully all material facts; or

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

The filing of a request by the permittee for a permit modification or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

6. Toxic Pollutants

The permittee shall comply with any applicable effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

7. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privilege.

8. Permit References

Except for effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants and standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, all rules and statutes referred to in this permit are those in effect on the date this permit is issued.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls, and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Duty to Halt or Reduce Activity

For industrial or commercial facilities, upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production or all discharges or both until the facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced or lost. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The term "bypass" does not include nonuse of singular or multiple units or processes of a treatment works when the nonuse is insignificant to the quality and/or quantity of the effluent produced by the treatment works. The term "bypass" does not apply if the diversion does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities or treatment processes which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Prohibition of bypass.

(1) Bypass is prohibited unless:

(a) Bypass was necessary to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and

(c) The permittee submitted notices and requests as required under General Condition B.3.c.

(2) The Director may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, when the Director determines that it will meet the three conditions listed above in General Condition B.3.b.(1).

c. Notice and request for bypass.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior written notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in General Condition D.5.

4. <u>Upset</u>

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of General Condition B.4.c are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the causes(s) of the upset;

(2) The permitted facility was at the time being properly operated;

(3) The permittee submitted notice of the upset as required in General Condition D.5, hereof (24-hour notice); and

(4) The permittee complied with any remedial measures required under General Condition A.3 hereof.

d. Burden of proof. *In any enforcement proceeding the permittee seeking to establish the occurrence of* an upset has the burden of proof.

5. Treatment of Single Operational Event

For purposes of this permit, A Single Operational Event which leads to simultaneous violations of more than one pollutant parameter shall be treated as a single violation. A single operational event is an exceptional incident which causes simultaneous, unintentional, unknowing (not the result of a knowing act or omission), temporary noncompliance with more than one Clean Water Act effluent discharge pollutant parameter. A *single operational event does not include Clean Water Act violations involving discharge without a NPDES* permit or noncompliance to the extent caused by improperly designed or inadequate treatment facilities. Each day of a single operational event is a violation.

6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definitions

(1) "Overflow" means the diversion and discharge of waste streams from any portion of the wastewater conveyance system including pump stations, through a designed overflow device or structure, other than discharges to the wastewater treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the *conveyance system or pump station which causes them to become inoperable, or substantial* and permanent loss of natural resources which can reasonably be expected to occur in the absence of an overflow.

(3) "Uncontrolled overflow" means the diversion of waste streams other than through a designed overflow device or structure, for example to overflowing manholes or overflowing into residences, commercial establishments, or industries that may be connected to a conveyance system.

b. Prohibition of overflows. Overflows are prohibited unless:

(1) Overflows were unavoidable to prevent an uncontrolled overflow, loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the overflows, such as the use of auxiliary pumping or conveyance systems, or maximization of conveyance system storage; and

(3) The overflows are the result of an upset as defined in General Condition B.4. and meeting all requirements of this condition.

c. Uncontrolled overflows are prohibited where wastewater is likely to escape or be carried into the waters of the State by any means.

d. Reporting required. Unless otherwise specified in writing by the Department, all overflows and uncontrolled overflows must be reported orally to the Department within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D.5.

7. Public Notification of Effluent Violation or Overflow

If effluent limitations specified in this permit are exceeded or an overflow occurs, upon request by the Department, the permittee shall take such steps as are necessary to alert the public about the extent and nature of the discharge. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

8. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in such a manner as to prevent any pollutant from such materials from entering public waters, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Sampling and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and shall be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10 percent from true discharge rates throughout the range of expected discharge volumes.

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties of Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years or both.

5. Reporting of Monitoring Results

Monitoring results shall be summarized each month on a Discharge Monitoring Report form approved by the Department. The reports shall be submitted monthly and are to be mailed, delivered or otherwise transmitted by the 15th day of the following month unless specifically approved otherwise in Schedule B of this permit.

6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency shall also be indicated. For a pollutant parameter that may be sampled more than once per day (e.g., Total Chlorine Residual), only the average daily value shall be recorded unless otherwise specified in this permit.

7. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean, except for bacteria which shall be averaged as specified in this permit.

8. Retention of Records

Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR part 503), the permittee shall retain records of all monitoring information, including all calibration and maintenance records of all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time.

9. Records Contents

Records of monitoring information shall include:

a. The date, exact place, time and methods of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative upon the presentation of credentials to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, and

d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by state law, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

The permittee shall comply with Oregon Administrative Rules (OAR) 340, Division 52, "Review of Plans and Specifications". Except where exempted under OAR 340-52, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers shall be commenced until the plans and specifications are submitted to and approved by the Department. The permittee shall give notice to the Department as soon as possible of any planned physical alternations or additions to the permitted facility.

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

3. Transfers

This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit shall be transferred to a third party without prior written approval from the Director. The permittee shall notify the Department when a transfer of property interest takes place.

4. Compliance Schedule

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

5. Twenty-Four Hour Reporting

The permittee shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally (by telephone) within 24 hours, unless otherwise specified in this permit, from the time the permittee becomes aware of the circumstances. During normal business hours, the Department's Regional office shall be called. Outside of normal business hours, the Department shall be contacted at 1-800-452-0311 (Oregon Emergency Response System).

A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. If the permittee is establishing an affirmative defense of upset or bypass to any offense under ORS 468.922 to 468.946, and in which case if the original reporting notice was oral, delivered written notice must be made to the Department or other agency with regulatory jurisdiction within 4 (four) calendar days. The written submission shall contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected;

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and

e. Public notification steps taken, pursuant to General Condition B.7.

The following shall be included as information that must be reported within 24 hours under this paragraph:

a. Any unanticipated bypass which exceeds any effluent limitation in this permit.

b. Any upset which exceeds any effluent limitation in this permit.

c. Violation of maximum daily discharge limitation for any of the pollutants listed by the Director in this permit.

The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

6. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under General Condition D.4 or D.5, at the time monitoring reports are submitted. The reports shall contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected; and

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

7. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information that the Department may request to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

Other Information: When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Department, it shall *promptly submit such facts or information.*

8. Signatory Requirements

All applications, reports or information submitted to the Department shall be signed and certified in accordance with 40 CFR 122.22.

9. Falsification of Information

A person who supplies the Department with false information, or omits material or required information, as specified in ORS 468.953 is subject to criminal prosecution.

10. Changes to Indirect Dischargers - **[Applicable to Publicly Owned Treatment Works (POTW) only]**

The permittee must provide adequate notice to the Department of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the Clean Water Act if it were directly discharging those pollutants and;

b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

c. For the purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

11. Changes to Discharges of Toxic Pollutant - **[Applicable to existing manufacturing, commercial, mining, and silvicultural dischargers only]**

The permittee must notify the Department as soon as they know or have reason to believe of the following:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:

    (1) One hundred micrograms per liter (100 μg/L);

    (2) Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

    (3) Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or

    (4) The level established by the Department in accordance with 40 CFR 122.44(f).

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

    (1) Five hundred micrograms per liter (500 μg/L);

    (2) One milligram per liter (1 mg/L) for antimony;

    (3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or

    (4) The level established by the Department in accordance with 40 CFR 122.44(f).

SECTION E. DEFINITIONS

1. BOD means five-day biochemical oxygen demand.
2. TSS means total suspended solids.
3. mg/L means milligrams per liter.
4. kg means kilograms.
5. m^3/d means cubic meters per day.
6. MGD means million gallons per day.
7. Composite sample means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow.
8. FC means fecal coliform bacteria.
9. Technology based permit effluent limitations means technology-based treatment requirements as defined in 40 CFR 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR 340-41.
10. CBOD means five day carbonaceous biochemical oxygen demand.
11. Grab sample means an individual discrete sample collected over a period of time not to exceed 15 minutes.
12. Quarter means January through March, April through June, July through September, or October through December.
13. Month means calendar month.
14. Week means a calendar week of Sunday through Saturday.
15. Total residual chlorine means combined chlorine forms plus free residual chlorine.
16. The term "bacteria" includes but is not limited to fecal coliform bacteria, total coliform bacteria, and E. coli bacteria.
17. POTW means a publicly owned treatment works.

Updated 4-23-04 AR der
Updated 5-14-04 PN 199114 der

APPENDIX B

SECONDARY CLARIFIER STRESS TEST

Clarifier Stress Test

CITY OF NEWBERG

Secondary Clarifiers

FEBRUARY 2026 | Project No. 224060-007

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ACRONYMS, ABBREVIATIONS, AND SELECTED DEFINITIONS

CCB	Chlorine Contact Basin
DEQ	Oregon Department of Environmental Quality
gpd/sf	Gallons per day per square foot
gpm	Gallons per minute
IPS	Influent Pump Station
MGD	Million Gallons per Day
mg/L	Milligrams per liter
mL/g	Milliliters per gram
MLSS	Mixed Liquor Suspended Solids
ppd/sf	Pounds per day per square foot
RAS	Return Activated Sludge
SCADA	Supervisory Control and Data Acquisition
SOR	Surface Overflow Rate
SVI	Sludge Volume Index
TSS	Total Suspended Solids
WAS	Waste Activated Sludge
WWMP	Wastewater Master Plan
WWTP	Wastewater Treatment Plant

CHAPTER 1 - INTRODUCTION

The City of Newberg's (City) wastewater treatment plant (WWTP) utilizes four 80-foot diameter secondary clarifiers for solids settling. As discussed in the most recent wastewater master plan (2018 WWMP), the clarifiers are a major limitation to increasing the WWTP capacity. Rerating the secondary clarifiers for a higher capacity would allow the City to reduce the number of additional secondary clarifiers needed in the future. A clarifier stress test can be performed in which higher than typical flows are directed through a clarifier to evaluate the capability to adequately treat increased hydraulic and solids loading. The results of the clarifier stress test would be used to indicate if the clarifiers can be appropriately rerated for a higher capacity.

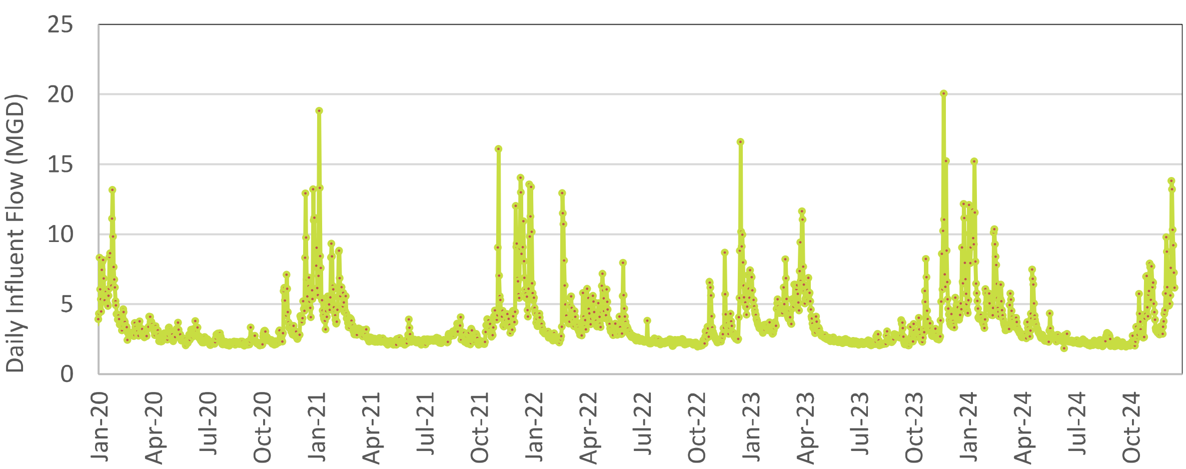
A previous stress test was conducted in 2021, but was unsuccessful due to inadequate Return Activated Sludge (RAS) pumping capacity and poor sludge settling as shown by high sludge volume index (SVI) measurements (see Appendix D). A new clarifier stress test was conducted by City staff with support from Keller Associates from November 4 through November 7, 2025. Before the test was completed, an additional higher-capacity RAS pump was installed at the WWTP to address the RAS pumping capacity issues noted during the previous stress test.

The City's existing secondary clarifiers are currently rated for a peak surface overflow rate (SOR) of 1,200 gallons per day per square foot (gpd/sf). The goal of the secondary clarifier stress test was to achieve a sustained 1,650 gpd/sf loading rate without significantly changing the secondary effluent water quality. If this is achieved, no additional secondary clarifiers would be required during the 20-year planning period specified in the 2018 WWMP (planning period was through 2037). If the primary goal is not achieved, an alternative goal would be to rerate the secondary clarifiers to 1,300 gpd/sf, which would mean that only one new secondary clarifier, rather than two, would be needed during the planning period.

As noted in the 2018 WWMP, there may also be hydraulic capacity limitations at the clarifier distribution box when the influent flows are approximately 27 MGD. The flow was not this high during the stress test, so this hydraulic constraint could not be tested.

In order to perform the stress test, the flow to the clarifier must be above ~6.5 MGD (1,300 gpd/sf). Ideally, the flow would be as high as ~8.3 MGD (1,650 gpd/sf). As shown in Figure 1-1, it is not common for the influent flow to reach that level for several consecutive days, which makes conducting the stress test challenging. To achieve targeted flow rates, the testing was completed during a period of high precipitation, which typically increases the influent flows. Additionally, the flows can be supplemented by diverting finished water from the chlorine contact basin (CCB) back to the WWTP's influent pump station (IPS).

FIGURE 1-1: HISTORICAL DAILY AVERAGE FLOW (MGD)



CHAPTER 2 - STRESS TEST OBSERVATIONS

This chapter contains a summary of stress test events. Clarifier 2 was selected as the clarifier for stress testing, as it was the same clarifier that was stress tested unsuccessfully in 2021 (see Appendix D), and WWTP staff noted similar performance historically between the two first-stage clarifier options (Clarifiers 1 and 2). The clarifier configuration at the WWTP allows operation of the clarifiers in series; thus, during the test, Clarifiers 3 and 4 can be placed in series after Clarifier 2 to protect against any Clarifier 2 upsets. During the test, samples and measurements were made in accordance with the Sampling Plan (see Appendix A) to monitor the performance of the secondary clarifier. Detailed testing results are provided in Appendix B.

2.1 NOVEMBER 4-5, 2025 – BASELINE CONDITIONS

On the first day of testing (November 4) and immediately before the test began on November 5, all four clarifiers were operated in parallel to establish baseline data. Mixed liquor suspended solids (MLSS) grab samples collected from Oxidation Ditch 1 and 2 were 2,180 milligrams per liter (mg/L) and 2,220 mg/L, respectively. The RAS sample collected from the RAS pump room was 4,570 mg/L. A WWTP secondary effluent total suspended solids (TSS) grab sample was 1.0 mg/L.

Immediately before stress testing began on the morning of November 5, the MLSS grab samples from Oxidation Ditch 1 and 2 were 2,384 mg/L and 2,134 mg/L, respectively. The RAS sample was 5,600 mg/L, and the WWTP secondary effluent TSS was 1.2 mg/L. Overall, the system was performing well on both days, and the sample results were within normal ranges.

2.2 NOVEMBER 5, 2025 – STRESS TEST OBSERVATIONS

During the first day of stress testing the influent flows ranged between 5.4 and 6.8 MGD. Figure 2-2 shows a sample being collected from the clarifier effluent trough.

FIGURE 2-1: CLARIFIER SAMPLE COLLECTION AT CLARIFIER 2

Beginning around 7:40 AM, plant staff redirected all the flow to Clarifier 2 and placed Clarifiers 3 and 4 in series operation to serve as backup clarifiers in the event of a Clarifier 2 failure. The target SOR for this day was at and above 1,300 gpd/sf (~6.5 MGD). To achieve this flow, supplemental water from the CCB was redirected to the IPS through manual adjustments of the CCB drain. Influent flows in the morning fluctuated between 4.8 and 5.5 MGD immediately before the test. Target flows were achieved over the course of the next hour by making adjustments to the CCB drain. Beginning around 8:50 AM, flows stabilized near the target flow rate of 6.7 MGD and remained steady throughout the remainder of the test until it was concluded at approximately 1:45 PM. The overall average influent flow rate during the stress test on this day was 6.7 MGD.

With the supplemental flows, the SOR in Clarifier 2 hovered between 1,320 and 1,350 gpd/sf. Clarifier 2 managed the additional hydraulic load without issue, and the level of the effluent in the launder was generally about 8 inches below the bottom of the v-notch weirs and remained consistent throughout the test. During initial adjustments to the CCB drain valve, there was one observed instance of the effluent in the launder being approximately 3 inches below the bottom of the v-notch weirs, but this was only temporary. The distribution box feeding Clarifier 2 had a water level estimated at approximately 2 feet, 7 inches, indicating significant additional capacity in the distribution box.

From a solids management perspective, at the start of the test, the sludge blanket level was approximately 14 inches deep. However, the blanket rose to approximately 5 feet of sludge accumulation during the middle of the test and then remained relatively stable at this level throughout the testing period. To maintain the balance of solids, the RAS flows were adjusted from 1 MGD at test start to 1.75 MGD at about 10:30 AM, which was maintained through the remainder of the test. There did not appear to be any limitations in RAS pumping capacity throughout the test as the blanket level was able to stabilize. The WAS pumping rate increased from 100 gallons per minute (gpm) to 200 gpm by 11:40 AM.

A sample was taken from the distribution box. The SVI was observed to be approximately 91 milliliters per gram (mL/g) and the MLSS was observed to be 2,156 mg/L. According to WWTP operators, the SVI had generally been around 90 for the last several weeks. The RAS concentration was observed to be 10,080 mg/L, which was nearly twice the baseline concentration. However, as the RAS rate increased in subsequent days of the test, the RAS concentration decreased to near baseline levels. The clarifier solids loading rate varied between 27.5 and 30.3 ppd/sf.

From an effluent water quality perspective, the TSS from Clarifier 2 ranged between 3.4 and 4.6 mg/L and remained relatively stable throughout the test. This is within the typical effluent ranges seen at the WWTP and is in compliance with permit requirements. Overall, Clarifier 2 maintained the necessary effluent water quality and performed well hydraulically at the target SOR.

2.3 NOVEMBER 6, 2025 – STRESS TEST OBSERVATIONS

During the next day of testing, the City targeted a flow of 8.3 MGD for the stress test. Following the previous day of testing, the system was configured to operate in parallel during overnight operations. Beginning around 7:25 AM, plant staff redirected all flow to Clarifier 2 and placed Clarifiers 3 and 4 in series operation to serve as backup clarifiers. Flows in the morning fluctuated between 5.8 and 7.1 MGD immediately before the test; therefore, the CCB drain was cracked open to increase flow to the IPS to reach the target SOR at and above 1,650 gpd/sf (~8.3 MGD). The overall average influent flow rate on this day was 8.6 MGD. Figure 2-2 shows a picture of Clarifier 2 during the testing.

FIGURE 2-2: CLARIFIER 2 UNDER STRESSED CONDITIONS

With the supplemental flows, the SOR in Clarifier 2 hovered between 1,649 and 1,750 gpd/sf. During the first several hours of the test, the effluent in the launder was observed to be one to two inches below the bottom of the v-notch weirs. As the test progressed, however, the effluent water level in the launder reduced and stabilized around two to three inches below the v-notch weirs. The distribution box feeding Clarifier 2 had a water level estimated at approximately 2 feet, 3 inches, indicating significant additional capacity in the distribution box and only a modest increase relative to Day 1 of stress testing.

At the start of the test, there was approximately one foot of sludge accumulation. As the test progressed, the sludge levels increased and reached a height of approximately six and a half feet of sludge during the middle of the test. To maintain the solids balance, the RAS flows were adjusted to 2.25 MGD at the start of the test and then further increased to 3.0 MGD at about 11:00 AM. The WAS pumping rate was maintained at 200 gpm throughout the duration of the test. The SVI was observed to be approximately 93 mL/g and the MLSS collected from the distribution box was observed to be 2,020 mg/L. The RAS concentration was observed to be 8,560 mg/L. This represented a solids loading rate between 36.4 and 38.9 ppd/sf.

The effluent TSS from Clarifier 2 ranged between 4.0 and 7.8 mg/L. The 7.8 mg/L high was observed immediately after the test began and may be explained by high turbulence from increased flows suspending more solids. After the initial TSS spike, the TSS stabilized between 4.0 and 6.2 mg/L during the remainder of the test. Overall, Clarifier 2 maintained the necessary effluent water quality at the much higher SOR.

2.4 NOVEMBER 7, 2025 – STRESS TEST OBSERVATIONS

Similar to the previous day, the target flow rate for the stress test was ~8.3 MGD. The day of testing began around 6:45 AM as plant staff again redirected all flow to Clarifier 2 and placed Clarifiers 3 and 4 in series operation after Clarifier 2. Influent flows in the morning fluctuated between 4.0 to 5.3 MGD immediately before the test; therefore, the CCB drain was again cracked to increase flow to the IPS to achieve the target SOR above 1,650 gpd/sf (~8.3 MGD). Beginning around 8:50 AM, the flows stabilized near the target and the overall average flow rate for the day of testing was 8.6 MGD. The test concluded at approximately 12:55 PM. Figure 2-3 shows one of the oxidation ditches during stress testing.

FIGURE 2-3: OXIDATION DITCH DURING STRESS TESTING

With the supplemental flows, the SOR in Clarifier 2 hovered between 1,640 and 1,896 gpd/sf. During the first several hours of the test, the effluent in the launder was observed to be one to two inches below the bottom of the v-notch weirs, which suggests that the additional flows stressed the hydraulics of Clarifier 2. As the test progressed, however, the effluent water level in the launder reduced and stabilized around two to three inches below the v-notch weirs. The distribution box feeding Clarifier 2 had a water level estimated at approximately 2 feet, 3 inches, indicating significant additional capacity in the distribution box. These conditions were consistent with what was observed during the previous day of testing.

At the start of the test, there was approximately 14 inches worth of sludge accumulation. As the test progressed, the sludge blanket rose to almost 7 feet in the middle of the test. To maintain the solids balance, the RAS flows were set to 3.0 MGD at the start of the test, which was maintained throughout the duration of testing. The WAS pumping rate was maintained at 200 gpm throughout the duration of the test. The SVI was observed to be approximately 97 mL/g and the MLSS collected from the distribution box was observed to be 2,096 mg/L. The RAS concentration was observed to be 6,040 mg/L. This represented a solids loading rate of 40.3 ppd/sf.

The TSS from Clarifier 2 ranged between 3.2 and 10.2 mg/L. The 10.2 mg/L high was observed a few hours after the test began but quickly fell. Overall, Clarifier 2 maintained the necessary effluent water quality and performed well.

CHAPTER 3 - TEST RESULTS

During the first day of testing at the lower influent of 6.5 MGD, the SOR in Clarifier 2 ranged between 1,102 and 1,611 gpd/sf. Sludge blanket levels were approximately 5 feet deep, and generally only changed between 1 and 2 feet between hourly measurements. Hydraulically, Clarifier 2 performed well. The effluent weirs were never flooded during the test. Clarifier 2 performed well from a solids loading standpoint and managed solids loading rates between 27.5 and 30.3 ppd/sf during the first day of testing.

During the second and third day of testing at the higher influent flow, the SOR in Clarifier 2 ranged between 1,640 and 1,896 gpd/sf. Sludge blanket levels were as high as approximately 7 feet deep, which still left a large separation (approximately 10 feet at the mid-point) between the blanket and the effluent weir. Hydraulically, Clarifier 2 performed well. The effluent weirs were never flooded during the test. The risk of flow overtopping the weirs was present but may not have been consequential, as the effluent launder generally had low TSS concentrations throughout the testing and the sludge blanket was low. As noted in the 2018 WWMP, there may be hydraulic capacity limitations at the clarifier distribution box when the influent flows are approximately 27 MGD. The flow was not this high during the stress test, so this hydraulic constraint could not be tested. Clarifier 2 performed well from a solids loading standpoint and managed solids loading rates between 36.4 and 40.3 ppd/sf throughout the higher influent flow testing period.

Throughout all three days of testing, Clarifier 2 maintained good settling with an SVI between 91 and 97 mL/g. During the previous 2021 stress test, SVIs were observed to be between 180 and 210 mL/g, which contributed to the difficulty in managing the accumulated sludge in Clarifier 2. According to Figure 7 in Appendix D, historical WWTP data indicate that settleability has been better during high flow events, so the SVIs during the previous stress test appear to be an anomaly.

Below are plots created for each day of testing to summarize the test results (Figures 3-1 through 3-3, respectively). Each plot depicts: (1) the Clarifier 2 influent flow (influent flow and flow from CCB drain in MGD), (2) SCL #2 RAS pumping rate (MGD), (3) top of sludge blanket observed at the halfway point of Clarifier 2 (ft), (4) the Clarifier 2 effluent TSS concentration (mg/L), and (5) the surface overflow rate (SOR in gpd/sf).

FIGURE 3-1: STRESS TEST PERFORMANCE - NOVEMBER 5, 2025

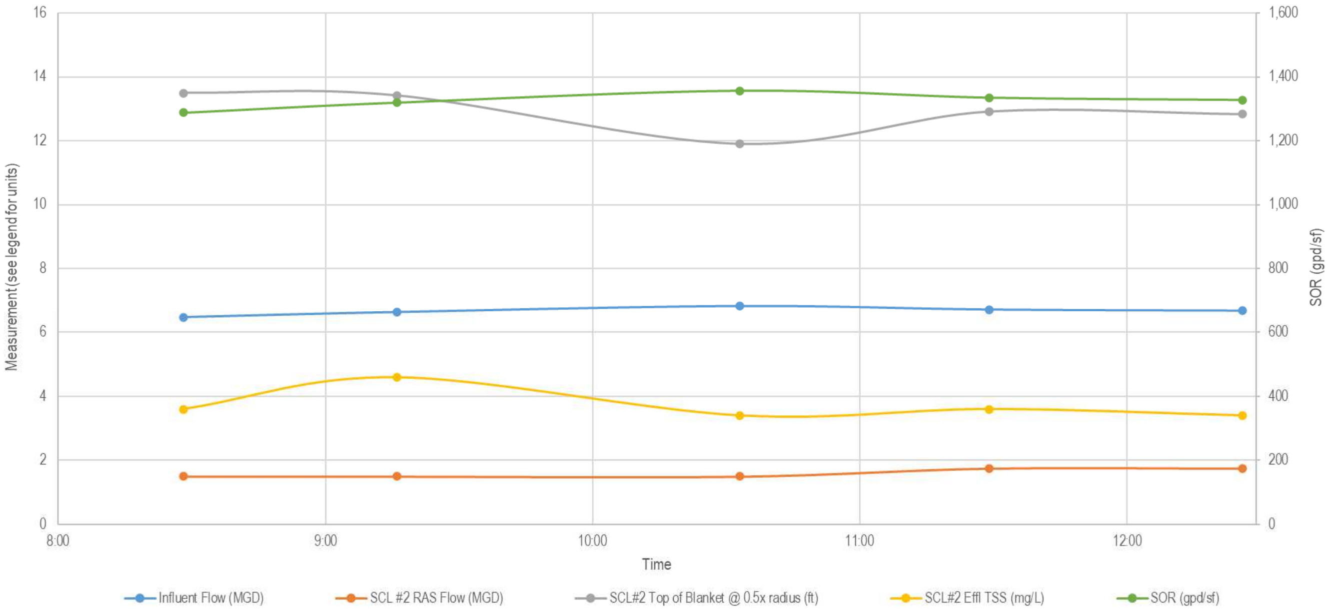


FIGURE 3-2: STRESS TEST PERFORMANCE - NOVEMBER 6, 2025

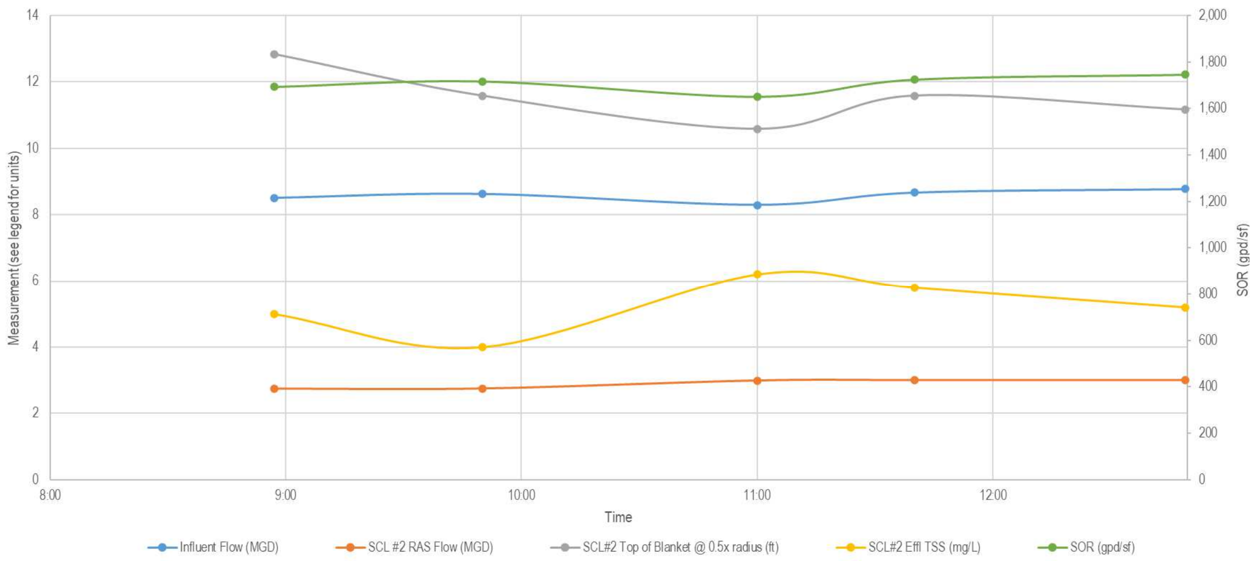
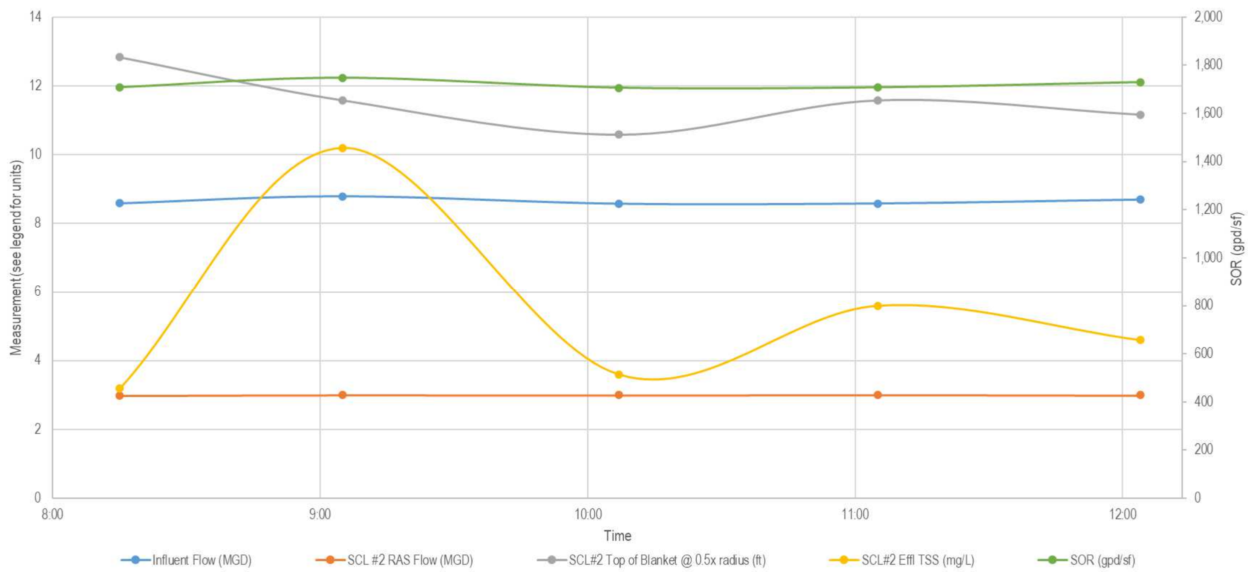


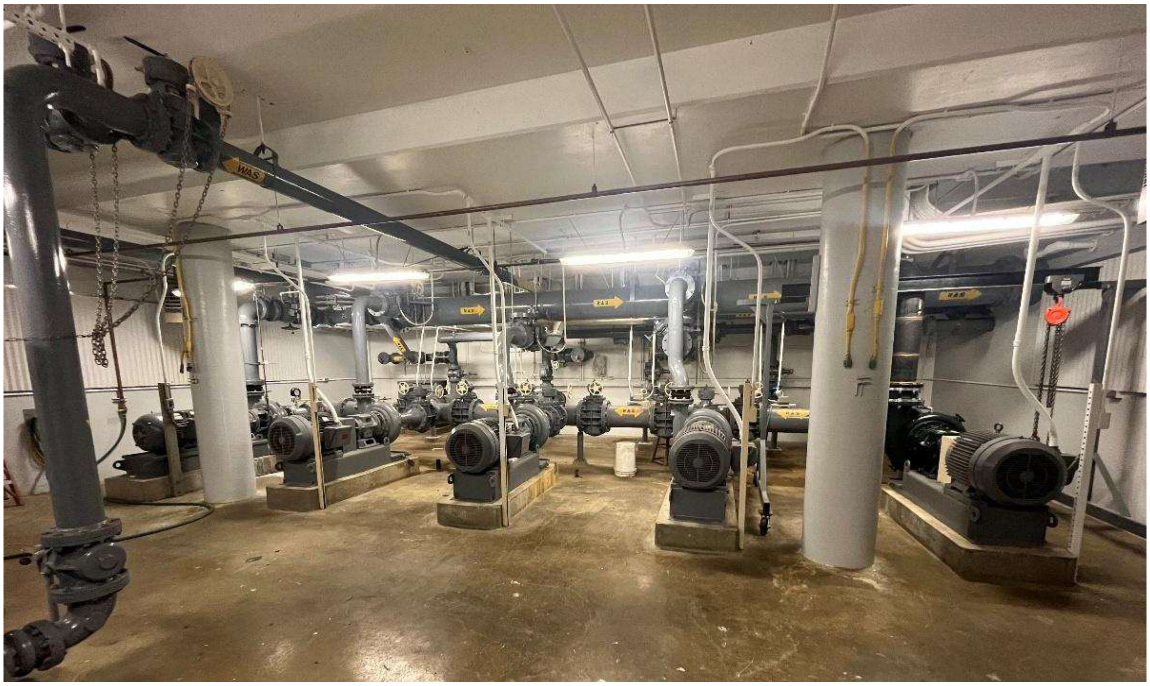
FIGURE 3-3: STRESS TEST PERFORMANCE - NOVEMBER 7, 2025



As shown in the state point analysis figures in Appendix C, during stress testing, the solids loading rates were within the capabilities of the clarifiers at the operating conditions experienced (indicated by the state point located below the gravity flux curve).

RAS pumping capacity appeared to be adequate throughout the testing period, with only a single 3.3 MGD capacity pump being operated. The current total RAS pumping capacity is 10.8 MGD split between two 3.3 MGD capacity pumps and three 1.4 MGD capacity pumps. This represents a reliable firm capacity of 7.5 MGD with the largest pump out of service. During the low flow conditions on Day 1 of stress testing, a RAS pumping rate of 1.75 MGD was shown to be adequate. This represents RAS flows, which were approximately 26% of the influent flows. During the high flow conditions on Days 2 and 3, a RAS pumping rate of 3.0 MGD was shown to be adequate. This represents RAS flows, which were approximately 34% of the influent flows. Figure 3-4 is a photo of the current RAS pump gallery.

FIGURE 3-4: RETURN ACTIVATED SLUDGE PUMP GALLERY



To provide sufficient RAS pumping capacity for each of the secondary clarifiers, the three smaller capacity pumps should be replaced. While a 3.0 MGD RAS flow was sufficient for one clarifier during the stress test, a poorer settling sludge (higher SVI) could require additional RAS pumping capacity.

CHAPTER 4 - CONCLUSIONS

Clarifier 2 was successfully operated at the higher SOR throughout the test, including the 1,300 gpd/sf on Day 1, and 1,650 gpd/sf on Days 2 and 3. During testing, Clarifier 2 performed well hydraulically, although during portions of testing on Days 2 and 3, the effluent in the launder was near the v-notch weirs indicating the potential for flows to overtop. Clarifier 2 handled the additional solids loading well and the test benefited from sludge settling characteristics with an SVI between 88 and 98 mL/g through the testing period. The sludge blanket fluctuated throughout the test, but was still less than half of the clarifier depth at the highest point of sludge blanket accumulation.

Based on the stress testing, the secondary clarifiers can be rerated to 8.3 MGD each (33 MGD combined according to Class I redundancy requirements, which is with one secondary clarifier out of service, the remaining clarifiers are able to provide treatment capacity for at least 75 percent of the design flow). The rerating assumes operations at an SVI less than 100 mL/g and MLSS less than 2,300 mg/L. There are also potential limitations that should be addressed, particularly the RAS pumping capacity. Additionally, there may be hydraulic capacity limitations at the clarifier distribution box when the influent flows are approximately 27 MGD. The flow was not this high during the stress test, so this hydraulic constraint could not be tested. An upcoming improvement project will address the hydraulic limitations of the clarifier distribution box. This will likely be accomplished through increasing the weir lengths; however, a detailed assessment will take place during the design.

Since the rerating is contingent on the SVI and MLSS concentrations, it is crucial for the WWTP staff to continue to optimize the secondary treatment to operate the clarifiers in underloaded conditions. According to Figures 7 and 9 in Appendix D, historical WWTP data indicate that typical SVIs and MLSS concentrations during high flow events range between 100 - 150 mL/g and 1,500 - 2,000 mg/L, respectively. These trends are consistent with more recent data from 2021 through 2025 as shown in Figures 4-1 and 4-2. A red circle has been added to emphasize the SVI and MLSS readings recorded during the highest flow events.

FIGURE 4-1: SVI VS FLOW (2021-2025)

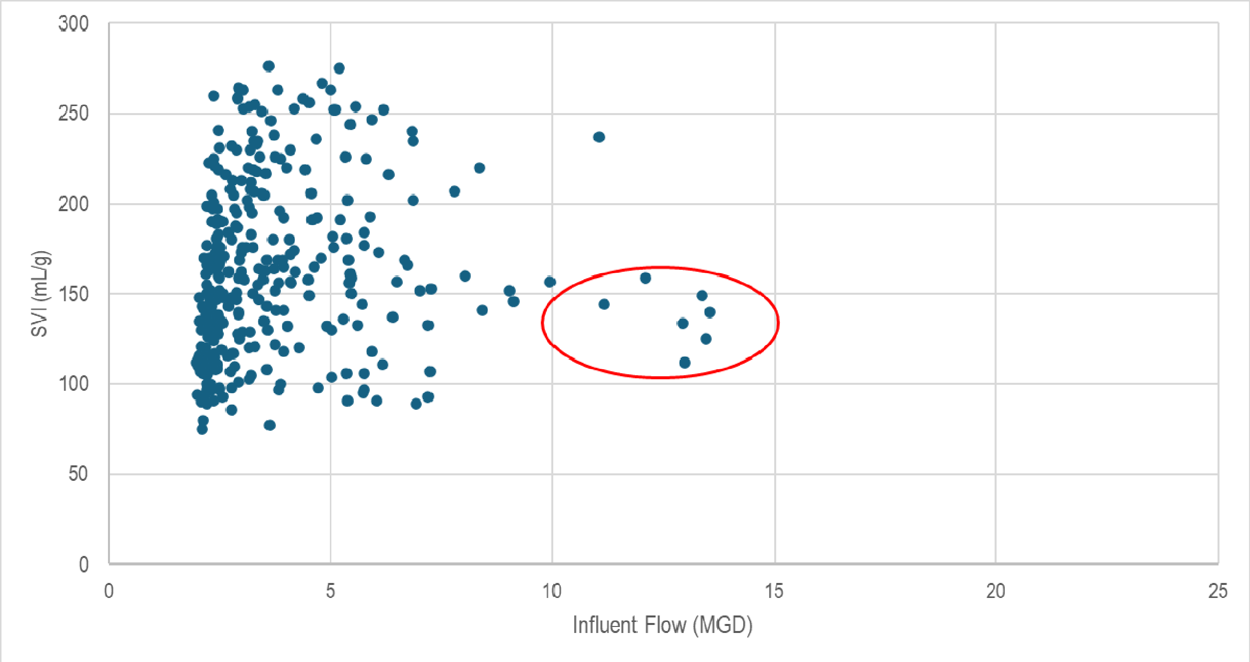
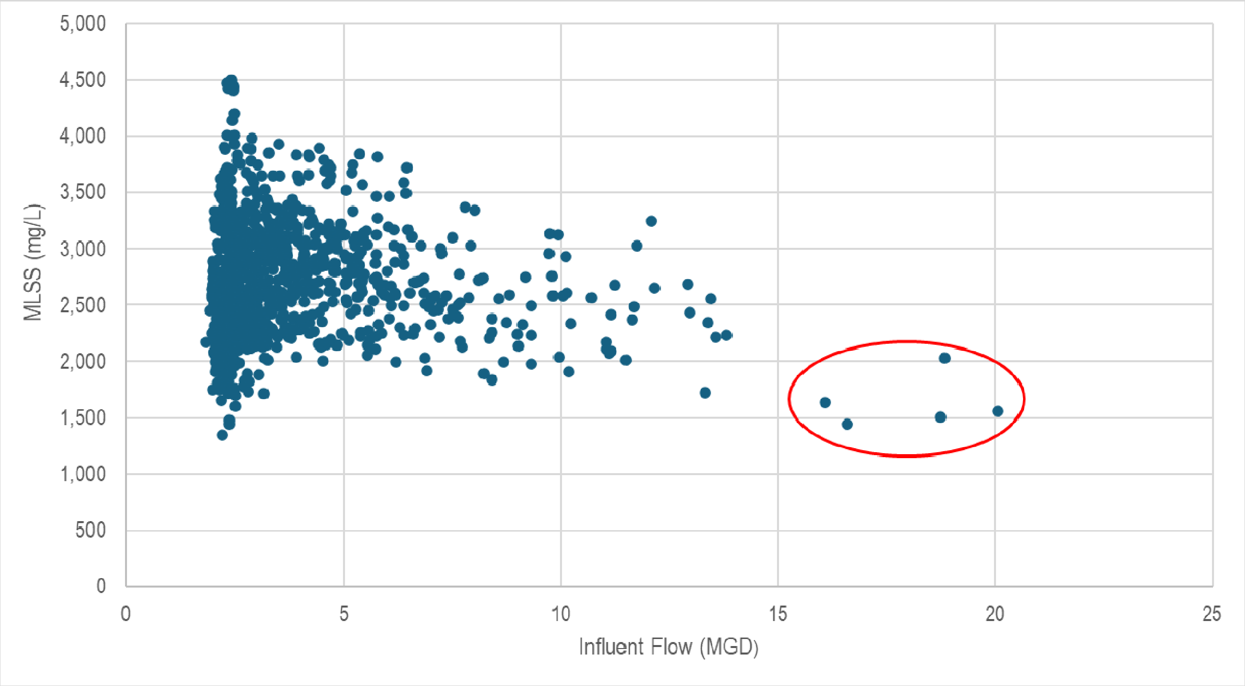
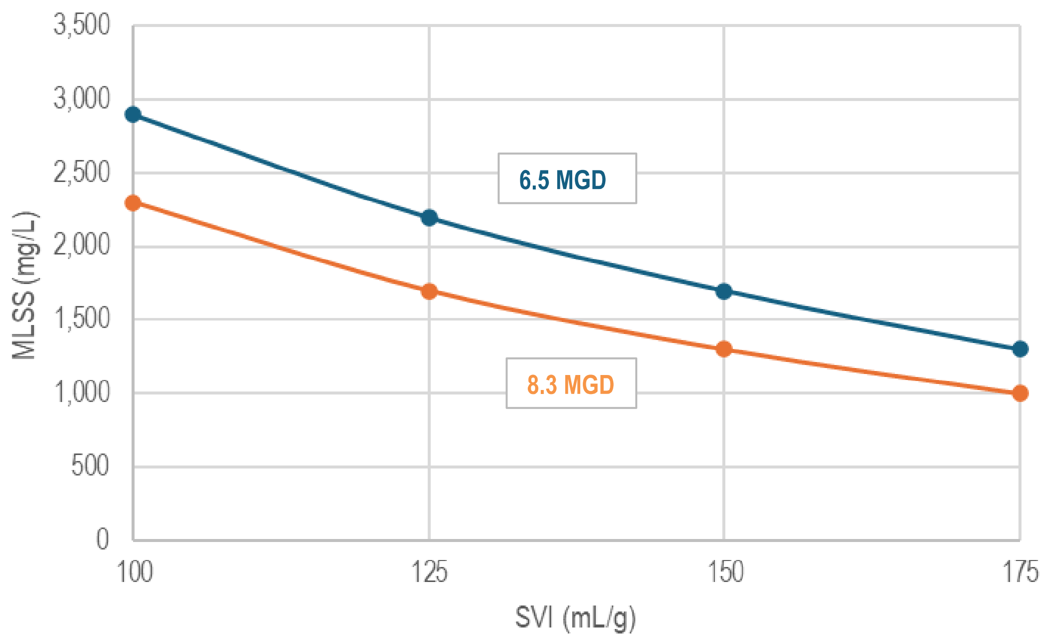


FIGURE 4-2: MLSS VS FLOW (2021-2025)



The SVI and MLSS observed during the stress test were in the normal range; however, historically higher SVIs have been encountered. Figure 4-3 depicts the relationship between the maximum MLSS concentration and SVIs that can maintain the secondary clarifiers at underloaded conditions. If the WWTP can be operated at or below the curve, then the secondary clarifiers should be capable of managing the solid and hydraulic loads. These bounds should be carefully considered when operating the secondary clarifiers to adequately treat incoming wastewater in high-flow conditions.

FIGURE 4-3: MAXIMUM MLSS AND SVI



APPENDIX A

Sampling Plan

FINAL Technical Memorandum

TO: City of Newberg

FROM: Keller Associates, Inc.

DATE: October 30, 2025

SUBJECT: Sampling Plan for Clarifier Stress Test

1. INTRODUCTION

The City of Newberg's (City) wastewater treatment plant (WWTP) utilizes four secondary clarifiers for solids settling. As discussed in the most recent wastewater master plan (2018 WWMP), the clarifiers are a major restriction to increasing the WWTP's capacity. Rerating the secondary clarifiers would allow the City to reduce the number of additional secondary clarifiers needed in the future. This Sampling Plan will assist the City in conducting a clarifier stress test to determine if the secondary clarifiers can handle a higher capacity than their existing rating. If the clarifier stress test is successful, documentation for rerating the clarifiers will be provided to the Oregon Department of Environmental Quality (DEQ) for approval.

The City's existing secondary clarifiers are rated for a peak hydraulic loading rate of 1,200 gallons per day per square foot (gpd/sf). The primary goal of this secondary clarifier stress test is to achieve a sustained 1,650 gpd/sf loading rate without significantly changing the secondary effluent water quality. If this is achieved, no additional secondary clarifiers would be required during the 20-year planning period in the 2018 WWMP. If the primary goal is not achieved, another goal would be to rerate the secondary clarifiers for 1,300 gpd/sf, which would mean that only one new secondary clarifier would be needed during the planning period.

2. STRESS TEST OVERVIEW

Since peak flows into the WWTP can be infrequent, it is likely that only one clarifier will be operated to achieve the required higher hydraulic loading rate for the clarifier stress test. The City has the flexibility to operate the clarifiers in either parallel or series. Typically, during the spring wet weather, the City operates all four of the clarifiers in parallel to handle the peak flows and minimize the hydraulic loading rate. However, during the clarifier stress test, it is best to operate the clarifiers in series. Operating the clarifiers in series will allow more flow to be sent to the primary clarifier, and if there are any issues with the effluent quality during the clarifier stress test, the clarifier(s) downstream will provide additional settling to protect the effluent quality.

Before the clarifier stress test, the following criteria should be met:

- The influent flow should be 6.5 MGD or greater.
- The return activated sludge (RAS) flow rate should be tested to confirm that 4 million gallons per day (MGD; 2,800 gallons per minute (gpm)) of capacity is provided.
- The mixed liquor suspended solids (MLSS) concentration is at a normal level (typically between 1,500 and 2,000 mg/L) for peak events.
- The secondary effluent quality should be 15 mg/L TSS or less, which is typical.
- All required sampling and measurement equipment should be available and ready for the test.

- City staff need to have availability to cover regular duties and the three-day stress test.

During the test, City staff will take samples and measurements in accordance with the next section.

3. DATA COLLECTION

Data collection during the clarifier stress test is essential to the test's success. The following parameters are recommended to be monitored by the City of Newberg Operations Staff:

- Plant influent flow from supervisory control and data acquisition (SCADA)
- Chlorine contact basin drain flow to the influent pump station from SCADA
- Equalization basin flow to the influent pump station from SCADA
- Oxidation ditch flow from SCADA
- Return activated sludge (RAS) flow from each clarifier from SCADA
- Waste activated sludge (WAS) flow from SCADA
- Secondary effluent flow from SCADA
- Sludge blanket level measured hourly during normal operating hours. Observations to be completed at roughly 0.5x the radius of the clarifier (i.e. halfway along radius span).
- Clarifier distribution box water surface elevation measured daily
- Clarifier effluent launder water surface elevation measured daily
- Mixed liquor suspended solids (MLSS) concentration sampled one time per day from the clarifier distribution box.
- RAS solids concentration sampled one time per day
- Sludge volume index (SVI) tested one time per day
- Secondary clarifier effluent total suspended solids (TSS) composite sample or five times per day

A data sheet for recording the test data is included in Appendix A. Additional samples and observations may be made if stress test is not performing ideally (e.g. rapid rise of sludge blanket in clarifier). Contact Keller Associates to inform of any changes.

APPENDIX A

Data Sheet

Client: City of Newberg
Project: Clarifier Stress Test
Project No.: 224060-007

KELLER ASSOCIATES

Name
Date

Date and Time	Total Inf. Flow (MGD)	CCB to IPS (MGD)	EQ to IPS (MGD)	OD Flow to DB (MGD)	Sec. Eff. Flow (MGD)	SC #2 RAS (MGD)	SC #3 RAS (MGD)	SC #4 RAS (MGD)	SC #2 WAS (gpd)	SC #3 WAS (gpd)	SC #4 WAS (gpd)	SC #2 Distribution Box Elev (ft)	SC #2 Blanket (ft)	SC #2 Launder (in)
Frequency	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	Daily	Hourly	Daily

KELLER ASSOCIATES

Date and Time	Ox1 SVI (mL/g)	Ox2 SVI (mL/g)	Avg SVI (mL/g)	Ox1 MLSS (mg/L)	Ox2 MLSS (mg/L)	Ox Avg MLSS (mg/L)	SC #2 RAS (mg/L)	SC #2 Eff TSS (mg/L)	Sec. Eff. TSS (mg/L)	Comments
Source	Daily	Daily	Daily	Daily	Daily	Daily	Daily	5x per day	5x per day	

Clarifier Stress Testing Checklist

Name:
Date:
Weather:

Target Measurement	Frequency	Completed?	Notes
Plant influent flow	Continuous (SCADA)		
Chlorine contact basin drain flow to the influent pump station	Continuous (SCADA)		
Equalization basin flow to the influent pump station	Continuous (SCADA)		
Oxidation ditch flow	Continuous (SCADA)		
Return activated sludge (RAS) flow from each clarifier	Continuous (SCADA)		
Waste activated sludge (WAS) flow from each clarifier	Continuous (SCADA)		
Secondary effluent flow	Continuous (SCADA)		
Sludge blanket level for each clarifier in operation measeured at 0.5x radius	Hourly		
Clarifier distribution box water surface elevation (at each active cell)	Daily		
Clarifier effluent launder water surface elevation for each clarifier in operation	Daily		
Mixed liquor suspended solids (MLSS) concentration	Daily (from splitter box)		
RAS TSS	Daily		
Sludge volume index (SVI) - sample mixed liquor from each oxidation ditch	Daily		
Secondary clarifier effluent TSS - SC#2 and Overall Effluent	5x per day		

APPENDIX B

Stress Test Data

Client: City of Newberg
Project: Clarifier Stress Test
Project No.: 224060-007

Date and Time	Total Inf. Flow (MGD)	Sec. Eff. Flow (MGD)	SC #3 RAS (MGD)	SC #4 RAS (MGD)	SC #2 RAS (MGD)	SC #2 WAS (gpm)	SC #2 Distribution Box Elev (ft) Top of Box to WS	SC #2 Blanket (ft)	SC #2 Launder (in)
Frequency	SCADA	SCADA	SCADA	SCADA	SCADA	SCADA	Daily	Hourly	Daily
11/5/2025 7:23	Test Start				1.0	101.1		16' 4"	
8:05	6.84	7.36	0.504	0.499	1.51	105.4	2'7"	13'6"	3.0
9:04	6.69	5.75	0.498	0.507	1.50	100.8		13'5"	8.0
10:18	6.68	5.57	0.500	0.501	1.76	149.3		11'11"	8.0
11:04	6.71	4.95	0.492	0.503	1.75	150.5		12'11"	8.0
12:15	6.68	4.70	0.497	0.499	1.74	198.2		12'10"	8.0
~13:45	Test Ended								
11/6/2025 7:20	Test Start				1.0	0.0		16'2"	
8:40	8.72	6.99	0.502	0.502	2.2	0.0		12'10"	1-2"
9:30	8.59	6.92	0.499	0.506	2.7	199.0		11'7"	
10:45	8.39	6.83	0.498	0.467	2.76	201.5	2'3"	10'7"	2-3"
11:30	8.69	6.16	0.497	0.502	3.0	203.3		11'7"	
12:39	8.57	6.20	0.495	0.496	3.0	203.3		11'2"	
13:21	8.71	5.85	0.500	0.502	3.0	199.1			
13:32	8.73	5.85	0.500	0.502	3.0	202.2		11'8"	
~13:30	Test Ended								
11/7/2025 6:45	Test Start				3.0	0.0		16'0"	
8:00	8.77				3.0	197.9		11'2"	1.0
8:55	8.63				3.0	200.6	2'3"	10'7"	1.0
9:57	8.50				3.0	199.2		11'0"	1.0
10:55	8.54				3.0	198.2		10'4"	2.0
11:52	8.59				3.0	199.7		11'7"	2.0
12:52	8.66				3.0	43.5		11'0"	2.0
~12:55	Test Ended								

Notes:

1. Ox AVG MLSS is represented by a grab from the splitter box.
2. Only flows from CCB are being added back into system, no flows from EQ
3. To estimate flows from CCB, it is the difference between the influent and effluent.
4. To estimate depth in distribution box, the water surface was measured from edge of distribution box. The distribution box chamber is split in middle by a weir/gate. There is an estimated 2-3" difference between water level where entering box and where exiting.
5. RAS flows are manually adjusted.
6. WAS flows are manually adjusted and typically are done so based on laboratory testing results. WAS routed through a single dedicated pipe at a time.
7. Total depth of Clarifier 2 at 0.5x radius is 17'2"

Date and Time	Ox1 SVI (mL/g)	Ox2 SVI (mL/g)	Avg SVI (mL/g)	Ox1 MLSS (mg/L)	Ox2 MLSS (mg/L)	Ox MLSS from DB (mg/L)	SC #2 RAS (mg/L)	SC #2 Eff TSS (mg/L)	Sec. Eff. TSS (mg/L)	Comments
Source	Daily	Daily	Daily	Daily	Daily	Daily	Daily	5x per day	5x per day	
Pre-test				2180.0	2220.0		5600.0	3.8	1.2	WAS = 27,540 mg/L, Cl#1 = 1.8, CL#3 = 1.4, CL#4 = 1.6
11/5/2025 7:59	88	94	91	2384	2136	2156				SVI has been typically in 90s for the past few weeks
8:29								3.6		
8:54									3.8	
9:17								4.6		
10:34									2.4	
10:37								3.4		
11:30								3.6	2.0	CL#3 = 2.2, CL#4 = 3.0
12:21									2.2	
12:27								3.4		
13:24									2.0	
13:34							10080.0			Test ended at ~1:45
~13:45	Test Ended									
11/6/2025 7:13				2260.0	2168.0					
7:30										Test Start
7:43	93.0	92.0	92.5					7.8		15 min after test
8:58							8560.0	5.0	6.0	CL#3 = 3.2; CL#4 = 6.0
9:51						2020.0		4.0	3.4	WAS = 11,280 mg/L
11:01								6.2	3.4	
11:41								5.8	3.2	
12:50								5.2	2.6	
12:55										test ended at ~13:30
11/7/2025 6:45										Test Start
7:13	95.0	98.0	97.0	2516.0	1932.0	2096.0	6040.0			
8:16								3.2	1.6	
9:06								10.2	2.8	
10:08								3.6	2.4	
11:06								5.6	3.0	
12:05								4.6	2.4	
13:00								4.6	2.2	
12:55										test ended at ~12:55

$Date	$Time	INFLUENT_CHANNEL_1_FLOW	INFLUENT_CHANNEL_2_FLOW	Hydraulic Loading	FINAL_PLANT_EFFLUENT	WW_CL5-01_FIT-514_	WW_CL5-02_FIT-515_	WW_CL5-03_FIT-516_	WW_CL5-04_FLOW	WAS_LINE2_FLOW
11/4/2025	6:00:00	0.001459122	4.09481	203.6408395	3.80415	0.5815077	0.5978894	0.6964636	0.6030822	95.97206
11/4/2025	6:05:00	0.001459122	4.459798	221.792222	3.798122	0.5975866	0.596199	0.7000518	0.6032467	98.65513
11/4/2025	6:10:00	0.001459122	4.321203	214.8996917	3.798122	0.5975866	0.596199	0.7000518	0.6032467	98.33946
11/4/2025	6:15:00	0.001459122	4.116769	204.7328924	3.798122	0.5975866	0.596199	0.7000518	0.6032467	98.33946
11/4/2025	6:20:00	0.001266003	4.14676	206.2243883	3.841524	0.6138349	0.6021428	0.7016063	0.6023335	98.44818
11/4/2025	6:25:00	0.001266003	4.682114	232.8483191	3.841524	0.6138349	0.6021428	0.7016063	0.6023335	103.4529
11/4/2025	6:30:00	0.001266003	4.442253	220.9196837	3.841524	0.6138349	0.6021428	0.7016063	0.6023335	98.44398
11/4/2025	6:35:00	0.00123024	4.285147	213.1065745	4.014053	0.6126142	0.599916	0.6958628	0.5999589	99.86706
11/4/2025	6:40:00	0.00123024	4.318013	214.7410483	4.215994	0.6126142	0.599916	0.6958628	0.5999589	99.86706
11/4/2025	6:45:00	0.00123024	4.343398	216.0034812	4.215994	0.6126142	0.599916	0.6958628	0.6074762	99.86706
11/4/2025	6:50:00	0.001516342	4.889781	243.1759001	4.222746	0.6177211	0.6009722	0.7011962	0.5986834	98.97575
11/4/2025	6:55:00	0.001516342	4.595389	228.5353591	4.222746	0.6177211	0.6009722	0.7011962	0.5986834	98.97575
11/4/2025	7:00:00	0.001516342	4.124501	205.117416	4.222746	0.6177211	0.6009722	0.7011962	0.5986834	98.97575
11/4/2025	7:05:00	0.001409054	4.171078	207.4337577	4.350195	0.587604	0.6004262	0.6945801	0.5907536	100.4257
11/4/2025	7:10:00	0.001409054	4.835815	240.4920927	4.350195	0.587604	0.6004262	0.6945801	0.6228924	100.4257
11/4/2025	7:15:00	0.001409054	5.249841	261.0822061	4.350195	0.587604	0.6004262	0.6945801	0.6228924	100.4257
11/4/2025	7:20:00	0.001487732	4.943805	245.862592	4.236279	0.5906892	0.6026411	0.7037807	0.6039858	100.329
11/4/2025	7:25:00	0.001487732	4.726832	235.0722101	4.439545	0.5906892	0.6026411	0.7037807	0.6039858	100.329
11/4/2025	7:30:00	0.001487732	4.621289	229.8234036	4.64304	0.5906892	0.6026411	0.7037807	0.6040645	100.329
11/4/2025	7:35:00	0.001523495	4.837725	240.5870798	4.664297	0.5922151	0.5990529	0.7020593	0.6481361	100.4709
11/4/2025	7:40:00	0.001523495	4.938948	245.6210463	4.664297	0.5922151	0.5990529	0.7020593	0.6277585	100.4709
11/4/2025	7:45:00	0.001523495	4.713857	234.4269445	4.664297	0.5922151	0.5990529	0.7020593	0.6229091	100.4709
11/4/2025	7:50:00	0.001459122	4.80016	238.7189178	4.642572	0.5920744	0.6037068	0.700047	0.5318022	101.2733
11/4/2025	7:55:00	0.001459122	5.428355	269.9599662	4.642572	0.5920744	0.6037068	0.700047	0.7606459	101.2733
11/4/2025	8:00:00	0.001459122	5.176456	257.4326636	4.642572	0.5920744	0.6037068	0.700047	0.6616712	96.39969
11/4/2025	8:05:00	0.001208782	5.011725	249.2403521	4.633102	0.5840516	0.6022882	0.7039905	0.6436634	98.29941
11/4/2025	8:10:00	0.001208782	4.688902	233.1858962	4.833927	0.5840516	0.6022882	0.7039905	0.5771279	98.29941
11/4/2025	8:15:00	0.001208782	4.836645	240.5333698	4.833927	0.5840516	0.6022882	0.7039905	0.6204367	104.4855
11/4/2025	8:20:00	0.001344681	5.304229	263.7870002	4.867153	0.5930567	0.5975485	0.7062006	0.6091142	101.2453
11/4/2025	8:25:00	0.001344681	5.259469	261.5610205	4.867153	0.5930567	0.5975485	0.7062006	0.6485152	100.9727
11/4/2025	8:30:00	0.001344681	5.064011	251.8406107	4.867153	0.5930567	0.5975485	0.7062006	0.5814171	105.8084
11/4/2025	8:35:00	0.001301765	4.918649	244.6115476	4.795761	0.6191039	0.5986762	0.6959677	0.6284356	95.96882
11/4/2025	8:40:00	0.001301765	4.747252	236.0877263	4.795761	0.6191039	0.5986762	0.6959677	0.6284356	102.2314
11/4/2025	8:45:00	0.001301765	5.144649	255.8508554	4.795761	0.6191039	0.5986762	0.6959677	0.6284356	102.2314
11/4/2025	8:50:00	0.001280308	5.167501	256.9873185	4.842072	0.5869317	0.5977058	0.7047868	0.5927873	101.0643
11/4/2025	8:55:00	0.001280308	4.803178	238.8690074	4.842072	0.5869317	0.5977058	0.7047868	0.5927873	101.0687
11/4/2025	9:00:00	0.001280308	4.301877	213.9385817	4.842072	0.5869317	0.5977058	0.7047868	0.5927873	101.0687
11/4/2025	9:05:00	0.001344681	5.130687	255.1565049	4.870491	0.6028867	0.5980515	0.6968689	0.5902529	100.7057
11/4/2025	9:10:00	0.001344681	5.161049	256.6664512	4.669762	0.6028867	0.5980515	0.6968689	0.5902529	101.7687
11/4/2025	9:15:00	0.001344681	5.26813	261.9917446	4.669762	0.6028867	0.5980515	0.6968689	0.5902529	93.97926
11/4/2025	9:20:00	0.001437664	5.017984	249.5516212	4.720135	0.6157541	0.6004882	0.7038808	0.5962324	99.05014
11/4/2025	9:25:00	0.001437664	4.831216	240.2633778	4.720135	0.6157541	0.6004882	0.7038808	0.5962324	99.05014
11/4/2025	9:30:00	0.001437664	4.707921	234.1317386	4.720135	0.6157541	0.6004882	0.7038808	0.7083392	99.05014
11/4/2025	9:35:00	0.001301765	4.944456	245.8949672	4.142237	0.6166482	0.6005502	0.7024407	0.6105947	99.15218
11/4/2025	9:40:00	0.001301765	4.706097	234.0410284	4.142237	0.6166482	0.6005502	0.7024407	0.6105947	99.15218
11/4/2025	9:45:00	0.001301765	4.597936	228.6620251	4.545956	0.6166482	0.6005502	0.7024407	0.6105947	99.15218
11/4/2025	9:50:00	0.001444817	4.86522	241.954446	4.665079	0.5863857	0.5968237	0.6990933	0.6037951	98.84911
11/4/2025	9:55:00	0.001444817	5.468624	271.9626019	4.86639	0.5863857	0.5968237	0.6990933	0.6037951	102.5528
11/4/2025	10:00:00	0.001444817	5.576162	277.3106226	4.86639	0.5863857	0.5968237	0.6990933	0.6037951	97.05849
11/4/2025	10:05:00	0.001244545	4.896312	243.5006962	5.183372	0.6103253	0.6004119	0.6971478	0.6090856	98.09093
11/4/2025	10:10:00	0.001244545	4.585505	228.0438134	5.383968	0.6103253	0.6004119	0.6971478	0.6399012	103.2494
11/4/2025	10:15:00	0.001244545	4.396927	218.665556	5.383968	0.6103253	0.6004119	0.6971478	0.6731653	101.4917
11/4/2025	10:20:00	0.001344681	5.003514	248.8320072	5.315475	0.581615	0.5966282	0.6952262	0.6188273	98.65971
11/4/2025	10:25:00	0.001344681	4.885826	242.9792123	5.113621	0.581615	0.5966282	0.6952262	0.5947566	98.65971
11/4/2025	10:30:00	0.001344681	4.902763	243.8215138	5.113621	0.581615	0.5966282	0.6952262	0.5766892	98.65971
11/4/2025	10:35:00	0.001323223	4.726868	235.0740004	4.953184	0.5842257	0.5984497	0.704546	0.6033587	99.73125
11/4/2025	10:40:00	0.001323223	4.969246	247.1278098	4.953184	0.5842257	0.5984497	0.704546	0.6336141	101.3979
11/4/2025	10:45:00	0.001323223	4.969704	247.1505868	4.953184	0.5842257	0.5984497	0.704546	0.5810881	101.3979
11/4/2025	10:50:00	0.001387596	4.830194	240.2125522	5.028419	0.6183815	0.6025386	0.6976414	0.5948234	99.77875
11/4/2025	10:55:00	0.001387596	4.324207	215.0490849	5.028419	0.6183815	0.6025386	0.6976414	0.6361985	99.77875
11/4/2025	11:00:00	0.001387596	4.277823	212.7423414	5.028419	0.6183815	0.6025386	0.6976414	0.6234431	99.77875
11/4/2025	11:05:00	0.001401901	4.917405	244.5496817	4.930801	0.5847454	0.6005192	0.6945634	0.583601	101.4801
11/4/2025	11:10:00	0.001401901	5.142875	255.7626318	4.930801	0.5847454	0.6005192	0.6945634	0.6383777	99.87488
11/4/2025	11:15:00	0.001401901	4.578052	227.6731649	4.930801	0.5847454	0.6005192	0.6945634	0.6286597	99.0469
11/4/2025	11:20:00	0.001208782	4.704366	233.9549433	4.899559	0.5803752	0.6000304	0.6996322	0.6379747	100.6882
11/4/2025	11:25:00	0.001208782	4.501383	223.8603044	4.899559	0.5803752	0.6000304	0.6996322	0.6155467	98.41137
11/4/2025	11:30:00	0.001208782	4.578581	227.6994728	4.899559	0.5803752	0.6000304	0.6996322	0.6341958	98.41137
11/4/2025	11:35:00	0.001165867	4.916682	244.5137259	4.948816	0.6037474	0.6045389	0.7011652	0.6069756	101.0445
11/4/2025	11:40:00	0.001165867	4.704144	233.9439029	5.150328	0.6037474	0.6045389	0.7011652	0.6069756	101.0445
11/4/2025	11:45:00	0.001165867	4.255815	211.6478516	5.150328	0.6037474	0.6045389	0.7011652	0.6069756	101.0445
11/4/2025	11:50:00	0.001437664	4.575527	227.547593	5.149412	0.6184602	0.6002879	0.7048082	0.5898666	99.16363
11/4/2025	11:55:00	0.001437664	4.598544	228.6922618	4.948854	0.6184602	0.6002879	0.7048082	0.5898666	100.5642
11/4/2025	12:00:00	0.001437664	4.838533	240.6272628	4.748259	0.6184602	0.6002879	0.7048082	0.5700874	105.2383
11/4/2025	12:05:00	0.001187325	4.986677	247.9946787	4.736319	0.6142044	0.5991912	0.6978035	0.6087732	101.004
11/4/2025	12:10:00	0.001187325	4.601676	228.8480207	4.937162	0.6142044	0.5991912	0.6978035	0.6087732	101.004
11/4/2025	12:15:00	0.001187325	4.25329	211.5222797	4.937162	0.6142044	0.5991912	0.6978035	0.6087732	101.004
11/4/2025	12:20:00	0.001380444	4.016962	199.7693455	5.081215	0.5930686	0.5982041	0.6973696	0.6017828	101.2981
11/4/2025	12:25:00	0.001380444	4.049656	201.3952656	4.879227	0.5930686	0.5982041	0.6973696	0.6017828	101.2981
11/4/2025	12:30:00	0.001380444	4.854827	241.437587	4.676809	0.5930686	0.5982041	0.6973696	0.6017828	101.2981
11/4/2025	12:35:00	0.001358986	4.863317	241.859807	4.633274	0.5816245	0.5979562	0.6945276	0.60956	100.7387
11/4/2025	12:40:00	0.001358986	4.431231	220.3715437	4.633274	0.5816245	0.5979562	0.6945276	0.60956	100.7387
11/4/2025	12:45:00	0.001358986	4.55708	226.6301969	4.633274	0.5816245	0.5979562	0.6945276	0.60956	100.7387
11/4/2025	12:50:00	0.001523495	4.261494	211.9302765	4.818935	0.5844069	0.6001377	0.7089972	0.5964732	100.6599
11/4/2025	12:55:00	0.001523495	4.594266	228.4795106	4.818935	0.5844069	0.6001377	0.7089972	0.5964732	100.6599
11/4/2025	13:00:00	0.001523495	4.608014	229.1632186	4.818935	0.5844069	0.6001377	0.7089972	0.5964732	100.6599
11/4/2025	13:05:00	0.001223087	4.274833	212.5936443	4.704933	0.6032467	0.5962563	0.6985259	0.5318069	99.15943
11/4/2025	13:10:00	0.001223087	4.425452	220.0841456	4.704933	0.6032467	0.5962563	0.6985259	0.5318069	99.15943
11/4/2025	13:15:00	0.001223087	4.217899	209.7622339	4.704933	0.6032467	0.5962563	0.6985259	0.5318069	98.60554
11/4/2025	13:20:00	0.001330376	4.323156	214.9968172	4.702721	0.5964279	0.5976844	0.6991267	0.5991054	100.5011
11/4/2025	13:25:00	0.001330376	4.81571	239.4922419	4.702721	0.5964279	0.5976844	0.6991267	0.5991054	100.5011
11/4/2025	13:30:00	0.001330376	4.764419	236.9414661	4.702721	0.5964279	0.5976844	0.6991267	0.5991054	100.5011
11/4/2025	13:35:00	0.00120163	3.751795	186.5822061	4.602423	0.5799556	0.599618	0.7055378	0.6031895	99.99866
11/4/2025	13:40:00	0.00120163	4.431431	220.38149	4.602423	0.5799556	0.599618	0.7055378	0.6031895	99.99866
11/4/2025	13:45:00	0.00120163	4.002478	199.0490352	4.602423	0.5799556	0.599618	0.7055378	0.6031895	99.99866
11/4/2025	13:50:00	0.001480579	4.037089	200.7702904	4.47196	0.5895519	0.5999088	0.7032943	0.596559	100.6958
11/4/2025	13:55:00	0.001480579	4.718328	234.6492938	4.269438	0.5895519	0.5999088	0.7032943	0.596559	101.2764
11/4/2025	14:00:00	0.001480579	4.134364	205.6079172	4.269438	0.5895519	0.5999088	0.7032943	0.596559	101.2764

$Date	$Time	INFLUENT_CHANNEL_1_FLOW	INFLUENT_CHANN	TOTAL INFLUENT	Hydr Loading Rate (gpd/sf)	FINAL_PLANT_EFFLUENT	WW_CL5-01_FIT-514_RAS	WW_CL5-02_FIT-515_RAS	WW_CL5-03_FIT-516_RAS	WW_CL5-04_FLOW_RAS	WAS_LINE2_FLOW
11/5/2025	6:00:00	0.001444817	4.332883	4.334327817	215.5524078	4.14669	0.6144881	0.5979276	0.7034326	0.6733561	0
11/5/2025	6:05:00	0.001466274	4.197457	4.198923274	208.8185436	4.249401	0.5812788	0.5956674	0.7015014	0.5924702	0
11/5/2025	6:10:00	0.001466274	4.652088	4.653554274	231.4280025	4.249401	0.5812788	0.5956674	0.7015014	0.5924702	0
11/5/2025	6:15:00	0.001466274	4.963567	4.965033274	246.9183049	4.249401	0.5812788	0.5956674	0.7015014	0.6022954	0
11/5/2025	6:20:00	0.001344681	4.446781	4.448125681	221.2117407	4.312849	0.5937672	0.5973482	0.6987953	0.6014085	0
11/5/2025	6:25:00	0.001344681	3.968668	3.970012681	197.4344878	4.51292	0.5937672	0.5973482	0.6987953	0.6014085	95.50743
11/5/2025	6:30:00	0.001344681	4.42415	4.425494681	220.0862682	4.51292	0.5937672	0.5973482	0.6987953	0.6014085	100.6639
11/5/2025	6:35:00	0.001251698	4.673331	4.674582698	232.4737765	4.415751	0.6128621	0.6023026	0.6942081	0.5953908	103.4735
11/5/2025	6:40:00	0.001251698	4.683552	4.684803698	232.9820817	4.415751	0.6128621	0.6023026	0.6942081	0.5953908	98.35186
11/5/2025	6:45:00	0.001251698	4.79991	4.801161698	238.7687337	4.415751	0.6128621	0.6023026	0.6942081	0.5953908	102.8431
11/5/2025	6:50:00	0.001387596	4.856086	4.857473596	241.5692061	4.388857	0.6179738	0.5974007	0.7010603	0.5962467	101.5438
11/5/2025	6:55:00	0.001387596	5.164611	5.165998596	256.9126018	4.388857	0.6179738	0.5974007	0.7010603	0.5962467	101.512
11/5/2025	7:00:00	0.001387596	5.263116	5.264503596	261.8113982	4.58951	0.6179738	0.5974007	0.7010603	0.5962467	101.512
11/5/2025	7:05:00	0.001330376	4.864697	4.866027376	241.994598	4.613132	0.586803	0.6013155	0.7005668	0.5955815	97.61181
11/5/2025	7:10:00	0.001330376	5.291719	5.293049376	263.2310213	4.815359	0.586803	0.6013155	0.7005668	0.5829883	97.61181
11/5/2025	7:15:00	0.001330376	5.489194	5.490524376	273.0517394	4.815359	0.586803	0.6013155	0.7005668	0.5829883	103.0926
11/5/2025	7:20:00	0.001459122	4.847395	4.848854122	241.1405471	4.916449	0.6156826	0.6012607	0.6975293	0.6020904	95.55626
11/5/2025	7:25:00	0.001459122	4.847395	4.848854122	241.1405471	5.767326	0.6156826	0.6012607	0.6975293	0.6162834	101.0651
11/5/2025	7:30:00	0.001459122	5.207562	5.209021122	259.0521744	3.684111	0.6156826	0.6012607	0.6975293	0.59057	101.0651
11/5/2025	7:35:00	0.001366138	5.490124	5.491490138	1092.399073	3.628187	0.6147885	0.6998014	0.5993676	0.432725	100.2468
11/5/2025	7:40:00	0.001366138	6.953623	6.954989138	1383.526783	4.043961	0.6147885	0.9625316	0.4972363	0.5912209	100.6271
11/5/2025	7:45:00	0.001366138	8.083498	8.084864138	1608.288072	3.420963	0.6147885	0.9625316	0.4972363	0.4345894	101.2066
11/5/2025	7:50:00	0.001280308	8.097189	8.098469308	1610.994491	3.177547	0.612843	0.9969068	0.4980278	0.4223824	99.50867
11/5/2025	7:55:00	0.001280308	7.994614	7.995894308	1590.589677	4.211254	0.612843	0.9969068	0.4980278	0.5911684	102.0767
11/5/2025	8:00:00	0.001280308	7.994614	7.995894308	1590.589677	5.889893	0.612843	0.9969068	0.4980278	0.460484	101.0738
11/5/2025	8:05:00	2.673926	4.097571	6.771497	1347.025463	7.362385	0.610435	0.9986758	0.503726	0.4988813	105.442
11/5/2025	8:10:00	0.001938343	5.538762	5.540700343	1102.188252	7.9778	0.610435	1.438706	0.503726	0.486083	103.6032
11/5/2025	8:15:00	0.001938343	5.971456	5.973394343	1188.262252	7.365971	0.610435	1.438706	0.503726	0.4272175	101.5158
11/5/2025	8:20:00	0.001301765	6.552637	6.553938765	1303.747516	6.627874	0.5793786	1.505597	0.4962301	0.4680181	100.1755
11/5/2025	8:25:00	0.001301765	6.410451	6.411752765	1275.463053	6.224661	0.5793786	1.505597	0.4962301	0.456512	102.7016
11/5/2025	8:30:00	0.001301765	6.47222	6.473521765	1287.7505	6.013632	0.5793786	1.505597	0.4962301	0.4871702	98.94657
11/5/2025	8:35:00	0.001480579	7.070217	7.071697579	1406.743103	5.962734	0.6180167	1.509116	0.5018973	0.5159593	99.25461
11/5/2025	8:40:00	0.001480579	6.147795	6.149275579	1223.249568	5.962734	0.6180167	1.509116	0.5018973	0.496304	107.1507
11/5/2025	8:45:00	0.001480579	6.255991	6.257471579	1244.772544	5.962734	0.6180167	1.509116	0.5018973	0.487361	102.0771
11/5/2025	8:50:00	0.001487732	6.730363	6.731850732	1339.138797	5.881748	0.6104302	1.498988	0.5014896	0.5067325	102.5023
11/5/2025	8:55:00	0.001487732	6.719263	6.720750732	1336.930721	5.881748	0.6104302	1.498988	0.5014896	0.5067325	94.95678
11/5/2025	9:00:00	0.001487732	6.69543	6.696917732	1332.189722	5.881748	0.6104302	1.498988	0.5014896	0.4643488	97.70031
11/5/2025	9:05:00	0.00128746	6.70073	6.70201746	1333.204189	5.751934	0.5850601	1.502357	0.4984975	0.506537	100.7677
11/5/2025	9:10:00	0.00128746	6.764674	6.76596146	1345.924301	5.751934	0.5850601	1.502357	0.4984975	0.506537	101.2503
11/5/2025	9:15:00	0.00128746	6.629655	6.63094246	1319.065538	5.751934	0.5850601	1.502357	0.4984975	0.506537	101.2503
11/5/2025	9:20:00	0.001409054	6.730149	6.731558054	1339.080576	5.922174	0.6000662	1.500204	0.5022097	0.4483438	100.3004
11/5/2025	9:25:00	0.001409054	6.743581	6.744990054	1341.752547	5.922174	0.6000662	1.500204	0.5022097	0.4483438	99.93343
11/5/2025	9:30:00	0.001409054	6.657608	6.659017054	1324.650299	5.883579	0.6000662	1.500204	0.5022097	0.4483438	98.72875
11/5/2025	9:35:00	0.001637936	6.743603	6.745240936	1341.802454	5.769577	0.5828023	1.501455	0.4970527	0.5010629	99.36848
11/5/2025	9:40:00	0.001637936	6.743603	6.745240936	1341.802454	5.769577	0.5828023	1.501455	0.4970527	0.487957	101.5837
11/5/2025	9:45:00	0.001637936	6.704006	6.705643936	1333.925589	5.769577	0.5828023	1.501455	0.4970527	0.487957	100.242
11/5/2025	9:50:00	0.001480579	6.693606	6.695086579	1331.825458	5.904541	0.6163883	1.497715	0.4979324	0.4949021	103.0499
11/5/2025	9:55:00	0.001480579	6.650283	6.651763579	1323.207396	5.904541	0.6163883	1.497715	0.4979324	0.4949021	99.68662
11/5/2025	10:00:00										
11/5/2025	10:05:00										
11/5/2025	10:10:00	0.001401901	6.70553	6.706931901	1334.181798	5.773611	0.5752015	1.505444	0.4996562	0.5013251	101.4467
11/5/2025	10:15:00	0.001401901	6.694579	6.695980901	1332.003362	5.773611	0.000829697	1.505444	0.4996562	0.5013251	149.3164
11/5/2025	10:20:00	0.001401901	6.751335	6.752736901	1343.293595	5.567961	0.000829697	1.505444	0.4996562	0.5013251	151.2028
11/5/2025	10:25:00	0.00128746	6.727881	6.72916846	1338.605224	5.372658	0	1.500659	0.5031729	0.5090427	150.6163
11/5/2025	10:30:00	0.00128746	6.733282	6.73456946	1339.679622	5.372658	0	1.759613	0.5031729	0.5090427	150.9199
11/5/2025	10:35:00	0.00128746	6.814635	6.81592246	1355.862833	4.969521	0	1.759613	0.5031729	0.5090427	151.7737
11/5/2025	10:40:00	0.001437664	6.760097	6.761534664	1345.043697	4.849815	0.01968145	1.748226	0.4974723	0.5009341	150.9054
11/5/2025	10:45:00	0.001437664	6.794987	6.796424664	1351.984218	4.849815	0.01968145	1.748226	0.4974723	0.5009341	151.5923
11/5/2025	10:50:00	0.001437664	6.669252	6.670689664	1326.972282	4.849815	0.01968145	1.748226	0.4974723	0.5009341	150.2306
11/5/2025	10:55:00	0.001330376	6.686325	6.687655376	1330.3472	4.952641	0.02591848	1.745975	0.4919577	0.5025625	150.7984
11/5/2025	11:00:00	0.001330376	6.737609	6.738939376	1340.548911	4.952641	0.02591848	1.745975	0.4919577	0.5025625	150.7984
11/5/2025	11:05:00	0.001330376	6.770446	6.771776376	1347.081038	4.952641	0.02591848	1.745975	0.4919577	0.5025625	150.5274
11/5/2025	11:10:00	0.00128746	6.726873	6.72816046	1338.404707	4.92775	0.02151728	1.751025	0.50107	0.4992175	147.5601
11/5/2025	11:15:00	0.00128746	6.741393	6.74268046	1341.293109	4.92775	0.02151728	1.751025	0.50107	0.4992175	147.2836
11/5/2025	11:20:00	0.00128746	6.660054	6.66134146	1325.112684	4.92775	0.02151728	1.751025	0.50107	0.4992175	149.8533
11/5/2025	11:25:00	0.001208782	6.693692	6.694900782	1331.788499	4.935169	0.02563477	1.748962	0.5012894	0.4962492	150.3
11/5/2025	11:30:00	0.001366138	6.707118	6.708484138	1334.490578	4.886513	0	1.75087	0.4958606	0.4951215	146.1681
11/5/2025	11:35:00	0.001366138	6.707661	6.709027138	1334.598595	4.886513	0	1.75087	0.4958606	0.4951215	149.3996
11/5/2025	11:40:00	0.001366138	4.966056	4.967422138		4.886513	0	1.75087	0.4958606	0.4951215	199.086
11/5/2025	11:45:00	0.001022816	6.73964	6.740662816	1340.891748	4.726601	0	1.746213	0.4952574	0.4930758	205.6084
11/5/2025	11:50:00	0.001022816	6.719685	6.720707816	1336.922183	4.726601	0	1.746213	0.4952574	0.4930758	203.6354
11/5/2025	11:55:00	0.001022816	6.68021	6.681232816	1329.069587	4.726601	0	1.746213	0.4952574	0.4930758	198.0789
11/5/2025	12:00:00	0.001401901	6.810694	6.812095901	1355.101631	4.717693	0.01834869	1.750314	0.5022526	0.4956341	199.55
11/5/2025	12:05:00	0.001401901	6.750684	6.752085901	1343.164094	4.717693	0.01834869	1.750314	0.5022526	0.4956341	205.0795
11/5/2025	12:10:00	0.001401901	6.706982	6.708383901	1334.470639	4.717693	0.01834869	1.750314	0.5022526	0.4956341	199.5932
11/5/2025	12:15:00	0.001173019	6.741943	6.743116019	1341.379753	4.699745	0.02055883	1.744497	0.4968429	0.4987288	198.2075
11/5/2025	12:20:00	0.001173019	6.779351	6.780524019	1348.821169	4.699745	0.02055883	1.744497	0.4968429	0.4987288	196.8433
11/5/2025	12:25:00	0.001173019	6.672342	6.673515019	1327.534318	4.699745	0.02055883	1.744497	0.4968429	0.4987288	200.8566
11/5/2025	12:30:00	0.001251698	6.712031	6.713282698	1335.445136	4.719181	0	1.759186	0.5022264	0.4978013	202.2356
11/5/2025	12:35:00	0.001251698	6.759918	6.761169698	1344.971096	4.719181	0	1.759186	0.5022264	0.4978013	199.4284
11/5/2025	12:40:00	0.001251698	6.6625	6.663751698	1325.592142	4.719181	0	1.759186	0.5022264	0.4978013	199.4284
11/5/2025	12:45:00	0.001108646	6.742036	6.743144646	1341.385448	4.697304	0.02523184	1.746562	0.5001831	0.4738998	199.2647
11/5/2025	12:50:00	0.001108646	6.679759	6.680867646	1328.996946	4.697304	0.02523184	1.746562	0.5001831	0.4738998	200.5457
11/5/2025	12:55:00										
11/5/2025	13:00:00	0.001165867	6.632853	6.634018867	1319.677515	4.75873	0	1.756418	0.4999661	0.5017757	201.0508
11/5/2025	13:05:00	0.001165867	6.722531	6.723696867	1337.516783	4.75873	0	1.756418	0.4999661	0.5017757	201.6554
11/5/2025	13:10:00	0.001165867	6.695015	6.696180867	1332.04314	4.75873	0	1.756418	0.4999661	0.5017757	201.4763
11/5/2025	13:15:00	0.001187325	6.690824	6.692011325	1331.213711	4.738102	0.002827644	1.750793	0.494957	0.4957628	198.6544
11/5/2025	13:20:00	0.001187325	6.734233	6.735420325	1339.848881	4.738102	0.002827644	1.750793	0.494957	0.4957628	199.2931
11/5/2025	13:25:00	0.001187325	6.777005	6.778192325	1348.357335	4.738102	0.002827644	1.750793	0.494957	0.4957628	199.2931
11/5/2025	13:30:00	0.001323223	6.747079	6.748402223	1342.431315	4.723692	0.02507687	1.74777	0.5037189	0.4925346	199.1964
11/5/2025	13:35:00	0.001323223	6.6465	6.647823223	1322.423557	4.723692	0.02507687	1.74777	0.5037189	0.5068636	199.1964
11/5/2025	13:40:00	0.001323223	6.701832	6.703155223	1333.43052	4.723692	0.02507687	1.74777	0.5037189	0.5068636	21.13724
11/5/2025	13:45:00	0.001151562	6.647623	6.648774562	1322.612803	4.664211	0.01417398	1.752012	0.5014181	0.5060172	9.052277
11/5/2025	13:50:00	0.001151562	4.584954	4.586105562	912.2947209	4.873219	0.01417398	1.752012	0.5014181	0.5060172	9.052277
11/5/2025	13:55:00	0.001151562	4.837861	4.839012562	962.6044484	9.380102	0.01417398	1.752012	0.5014181	0.5060172	9.052277
11/5/2025	14:00:00	0.001366138	5.481856	5.483222138	1090.754354	17.2569	0.0257659	1.749291	0.4956079	0.4913259	4.276657

$Date	$Time	INFLUENT_CHANNEL_1_FLOW	INFLUENT_CHANNEL_2_FLOW	TOTAL INFLUENT	Hydr Loading Rate (gpd/sf)	FINAL_PLANT_EFFLUENT	WW_CL5-01_FIT-514_RAS	WW_CL5-02_FIT-515_RAS	WW_CL5-03_FIT-516_RAS	WW_CL5-04_FLOW_RAS	WAS_LINE2_FLOW
11/6/2025	6:00:00	2.336404	3.49052	5.826924	1159.125522	6.240425	0.581429	1.000154	0.5996037	0.4963446	0
11/6/2025	6:05:00	2.551668	3.933105	6.484773	1289.988661	6.034098	0.581429	1.000154	0.5996037	0.4963446	0
11/6/2025	6:10:00	2.554142	3.842447	6.396589	1272.446588	6.034098	0.581429	1.000154	0.5996037	0.4963446	0
11/6/2025	6:15:00	2.43968	3.710725	6.150405	1223.474239	5.918169	0.5973673	1.004593	0.6056833	0.499301	0
11/6/2025	6:20:00	2.643442	4.080327	6.723769	1337.531132	5.918169	0.5973673	1.004593	0.6056833	0.499301	0
11/6/2025	6:25:00	2.386587	3.523257	5.909844	1175.62045	5.918169	0.5973673	1.004593	0.6056833	0.499301	0
11/6/2025	6:30:00	2.667139	3.995326	6.662465	1325.336185	6.316357	0.5828881	0.9978509	0.6025791	0.5060816	0
11/6/2025	6:35:00	2.470136	3.618307	6.088443	1211.148399	6.316357	0.5828881	0.9978509	0.6025791	0.5060816	0
11/6/2025	6:40:00	2.813201	4.154255	6.967456	1386.006763	6.316357	0.5828881	0.9978509	0.6025791	0.5060816	0
11/6/2025	6:45:00	2.75033	4.263783	7.014113	1395.288045	6.412973	0.6203723	1.002798	0.6002212	0.5036998	0
11/6/2025	6:50:00	2.560723	3.94598	6.506703	1294.351104	6.412973	0.6203723	1.002798	0.6002212	0.5036998	0
11/6/2025	6:55:00	2.506649	3.930867	6.437516	1280.588025	6.613493	0.6203723	1.002798	0.6002212	0.5036998	0
11/6/2025	7:00:00	2.756946	4.321976	7.078922	1408.180227	6.769867	0.6157041	0.9995174	0.6001186	0.4902387	0
11/6/2025	7:05:00	2.561145	3.869376	6.430521	1279.196539	6.769867	0.6157041	0.9995174	0.6001186	0.4902387	0
11/6/2025	7:10:00	2.690442	4.244807	6.935249	1379.59996	6.769867	0.6157041	0.9995174	0.6001186	0.4902387	0
11/6/2025	7:15:00	2.675936	4.118564	6.7945	1351.601353	9.879456	0.5814219	1.002529	0.5976272	0.5019712	0
11/6/2025	7:20:00	2.605247	4.075856	6.681103	1329.043764	4.600554	0.5814219	1.002529	0.5976272	0.5019712	0
11/6/2025	7:25:00	3.4339	5.245092	8.678992	1726.475433	4.076166	0.5814219	1.002529	0.5976272	0.5019712	0
11/6/2025	7:30:00	3.416126	5.154827	8.570953	1704.983688	5.397282	0	2.25199	0.5005765	0.5043006	0
11/6/2025	7:35:00	3.390391	5.181799	8.57219	1705.229759	5.598135	0	2.25199	0.5005765	0.5043006	0
11/6/2025	7:40:00	3.355114	5.241179	8.596293	1710.024468	6.001616	0	2.25199	0.5005765	0.5103636	0
11/6/2025	7:45:00	3.372159	5.204408	8.576567	1706.100458	6.251469	0.008621216	2.247372	0.4949927	0.5093908	0
11/6/2025	7:50:00	3.392086	5.211432	8.603518	1711.461707	6.451483	0.008621216	2.247372	0.4949927	0.5318713	0
11/6/2025	7:55:00	3.492794	5.326066	8.81886	1754.298787	6.652622	0.008621216	2.247372	0.4949927	0.5318713	0
11/6/2025	8:00:00	3.391471	5.258625	8.650096	1720.727273	6.658335	0	2.248485	0.4998803	0.5125451	0
11/6/2025	8:05:00	3.381014	5.219793	8.600807	1710.922419	6.658335	0	2.248485	0.4998803	0.5125451	0
11/6/2025	8:10:00	3.468254	5.321081	8.789335	1748.425502	6.658335	0	2.248485	0.4998803	0.5125451	0
11/6/2025	8:15:00	3.432362	5.302935	8.735297	1737.67595	6.641235	0.01293659	2.253149	0.5033875	0.4960275	0
11/6/2025	8:20:00	3.441203	5.278444	8.719647	1734.562761	6.641235	0.01293659	2.253149	0.5033875	0.4960275	0
11/6/2025	8:25:00	3.40853	5.213742	8.622272	1715.192361	6.641235	0.01293659	2.253149	0.5033875	0.4999256	0
11/6/2025	8:30:00	3.421082	5.334649	8.755731	1741.7408	6.783648	0	2.246025	0.5017209	0.5011225	0
11/6/2025	8:35:00	3.424079	5.220687	8.644766	1719.666998	6.783648	0	2.246025	0.5017209	0.5011225	0
11/6/2025	8:40:00	3.44101	5.279195	8.720205	1734.673762	6.985588	0	2.246025	0.5017209	0.5018616	0
11/6/2025	8:45:00	3.219759	5.283737	8.503496	1691.56475	7.090034	0	2.741485	0.4954338	0.4915404	0
11/6/2025	8:50:00	3.175292	5.259469	8.434761	1677.891585	6.888504	0	2.741485	0.4954338	0.4915404	198.8098
11/6/2025	8:55:00	3.092752	5.303299	8.396051	1670.191168	6.888504	0	2.741485	0.4954338	0.4915404	186.1986
11/6/2025	9:00:00	3.18326	5.325365	8.508625	1692.585041	6.742792	0.009226799	2.747028	0.4994416	0.4954553	201.5537
11/6/2025	9:05:00	3.279748	5.344727	8.624475	1715.630595	6.742792	0.009226799	2.747028	0.4994416	0.4922509	201.3243
11/6/2025	9:10:00	3.200147	5.246408	8.446555	1680.237716	6.742792	0.009226799	2.747028	0.4994416	0.4922509	199.1913
11/6/2025	9:15:00	3.301427	5.304945	8.606372	1712.029441	6.855402	0.02009153	2.755537	0.4935288	0.50349	203.132
11/6/2025	9:20:00	3.15623	5.326588	8.482818	1687.451363	6.855402	0.02009153	2.755537	0.4935288	0.50349	194.359
11/6/2025	9:25:00	3.235502	5.232289	8.467791	1684.462105	6.855402	0.02009153	2.755537	0.4935288	0.50349	197.8481
11/6/2025	9:30:00	3.272331	5.322597	8.594928	1709.752934	6.918011	0.01532316	2.748497	0.4989004	0.5057597	198.9855
11/6/2025	9:35:00	3.272331	5.306697	8.579028	1706.590014	6.918011	0.01532316	2.748497	0.4989004	0.5057597	198.9855
11/6/2025	9:40:00	3.272331	5.371163	8.643494	1719.413965	6.918011	0.01532316	2.748497	0.4989004	0.5057597	202.6171
11/6/2025	9:45:00	3.289382	5.305989	8.595371	1709.841058	6.893473	0.0223875	2.752395	0.4949355	0.5018997	201.1225
11/6/2025	9:50:00	3.322477	5.305989	8.628466	1716.424508	6.893473	0.0223875	2.752395	0.4949355	0.5018997	200.9804
11/6/2025	9:55:00	3.316798	5.315316	8.632114	1717.150189	6.893473	0.0223875	2.752395	0.4949355	0.5018997	199.1627
11/6/2025	10:00:00	3.304002	5.221395	8.525397	1695.921424	6.940784	0	2.757556	0.4972577	0.5041671	203.183
11/6/2025	10:05:00	3.287587	5.320802	8.608389	1712.430674	6.952515	0	2.757556	0.4972577	0.5041671	197.7543
11/6/2025	10:10:00	3.26324	5.119779	8.383019	1667.598767	6.961861	0	2.757556	0.4972577	0.5041671	200.2363
11/6/2025	10:15:00	3.339608	5.226974	8.566582	1704.114183	6.947317	0.02552032	2.746663	0.5039859	0.4933834	201.5959
11/6/2025	10:20:00	3.339608	5.294559	8.634167	1717.558584	6.947317	0.02552032	2.746663	0.5039859	0.4933834	198.1575
11/6/2025	10:25:00	3.259907	5.176985	8.436892	1678.315496	6.947317	0.02552032	2.746663	0.5039859	0.4933834	198.7707
11/6/2025	10:30:00	3.296821	5.14919	8.446011	1680.129501	6.986876	0.02306461	2.746489	0.500741	0.5060077	201.8147
11/6/2025	10:35:00	3.34902	5.230751	8.579771	1706.737816	6.986876	0.02306461	2.746489	0.500741	0.5082464	200.205
11/6/2025	10:40:00	3.245902	5.157137	8.403039	1671.581261	6.986876	0.02306461	2.746489	0.500741	0.5082464	198.847
11/6/2025	10:45:00	3.192608	5.19526	8.387868	1668.563358	6.826944	0.02517939	2.760084	0.4980445	0.467422	201.502
11/6/2025	10:50:00	3.246489	5.10963	8.356119	1662.247663	6.826944	0.02517939	2.760084	0.4980445	0.4661465	201.2203
11/6/2025	10:55:00	3.349249	5.174339	8.523588	1695.561568	6.826944	0.02517939	2.760084	0.4980445	0.4661465	200.6783
11/6/2025	11:00:00	3.220646	5.073495	8.294141	1649.918639	6.815395	0.02471209	2.991946	0.4984021	0.5118823	200.9451
11/6/2025	11:05:00	3.298337	5.034628	8.332965	1657.641735	6.663065	0	3.003821	0.4977965	0.500648	202.7149
11/6/2025	11:10:00	3.253884	5.310073	8.563957	1703.592003	6.663065	0	3.003821	0.4977965	0.500648	197.6025
11/6/2025	11:15:00	3.163519	5.336902	8.500421	1690.953054	6.663065	0	3.003821	0.4977965	0.500648	199.0448
11/6/2025	11:20:00	3.069098	5.326331	8.395429	1670.067436	6.619558	0	3.00133	0.496335	0.4998159	198.0602
11/6/2025	11:25:00	3.274148	5.29973	8.573878	1705.565546	6.416416	0	3.00133	0.496335	0.4998159	197.7428
11/6/2025	11:30:00										
11/6/2025	11:35:00	3.344994	5.344992	8.689986	1728.662423	6.155014	0	3.003938	0.4965734	0.502274	203.3499
11/6/2025	11:40:00	3.348026	5.319278	8.667304	1724.150388	6.155014	0	3.003938	0.4965734	0.502274	202.4506
11/6/2025	11:45:00	3.348026	5.409958	8.757984	1742.18898	6.155014	0	3.003938	0.4965734	0.502274	200.5777
11/6/2025	11:50:00	3.352976	5.364268	8.717244	1734.084742	6.264038	0.007240772	2.99643	0.4995537	0.4963708	198.2012
11/6/2025	11:55:00	3.254435	5.364268	8.618703	1714.482395	6.264038	0.007240772	2.99643	0.4995537	0.4963708	202.034
11/6/2025	12:00:00	3.280764	5.428734	8.709498	1732.543863	6.264038	0.007240772	2.99643	0.4995537	0.4963708	202.034
11/6/2025	12:05:00	3.452053	5.102706	8.554759	1701.762284	6.284199	0	3.00595	0.499742	0.5047989	202.0555
11/6/2025	12:10:00	3.49577	5.131016	8.626786	1716.090312	6.284199	0	3.00595	0.499742	0.5047989	201.5285
11/6/2025	12:15:00	3.507078	5.17715	8.684228	1727.517008	6.284199	0	3.00595	0.499742	0.5047989	200.8984
11/6/2025	12:20:00	3.497329	5.083537	8.580866	1706.95564	6.206179	0.02197981	3.006959	0.5004907	0.492754	198.8687
11/6/2025	12:25:00	3.452761	5.081012	8.533773	1697.587627	6.206179	0.02197981	3.006959	0.5004907	0.492754	198.8687
11/6/2025	12:30:00	3.444779	5.12392	8.568699	1704.535309	6.206179	0.02197981	3.006959	0.5004907	0.492754	200.8261
11/6/2025	12:35:00	3.427455	5.090225	8.51768	1694.386314	6.201649	0.01083851	3.011885	0.4947233	0.4958177	201.3643
11/6/2025	12:40:00	3.461037	5.109344	8.570381	1704.869903	6.201649	0.01083851	3.011885	0.4947233	0.4958177	196.2681
11/6/2025	12:45:00	3.461037	5.182786	8.643823	1719.479411	5.999537	0.01083851	3.011885	0.4947233	0.4958177	201.0866
11/6/2025	12:50:00	3.646002	5.129328	8.77533	1745.639546	5.881643	0.008904934	3.003676	0.500648	0.4956698	199.3269
11/6/2025	12:55:00	3.542154	5.214078	8.756232	1741.840462	5.881643	0.008904934	3.003676	0.500648	0.4956698	199.037
11/6/2025	13:00:00	3.542154	5.257688	8.799842	1750.515616	5.881643	0.008904934	3.003676	0.500648	0.4956698	199.037
11/6/2025	13:05:00	3.534436	5.135772	8.670208	1724.728068	5.925093	0.02458334	2.997286	0.4974556	0.5021691	199.8831
11/6/2025	13:10:00	3.524315	5.127332	8.651647	1721.035807	5.925093	0.02458334	2.997286	0.4974556	0.5021691	199.9556
11/6/2025	13:15:00	3.524315	5.154798	8.679113	1726.499503	5.925093	0.02458334	2.997286	0.4974556	0.5021691	196.394
11/6/2025	13:20:00	3.531218	5.180991	8.712209	1733.083151	5.848932	0.02468824	3.009837	0.5002284	0.5021214	199.1133
11/6/2025	13:25:00	3.531218	5.194588	8.725806	1735.787945	5.848932	0.02468824	3.009837	0.5002284	0.5021214	199.1133
11/6/2025	13:30:00	3.529501	5.200996	8.730497	1736.721106	5.848932	0.02468824	3.009837	0.5002284	0.5021214	202.2402
11/6/2025	13:35:00	3.451695	5.138934	8.590629	1708.897752	6.016941	0.02527237	3.001804	0.502789	0.497098	198.3721
11/6/2025	13:40:00	0.03165007	4.108186	4.13983607	823.5202049	7.073421	0.8056784	3.001804	0.502789	0.497098	198.6729
11/6/2025	13:45:00	0.03165007	6.933439	6.96508907	1385.53592	7.07531	1.014824	3.001804	0.502789	0.497098	201.0385
11/6/2025	13:50:00	0.00128746	7.127767	7.12905446	1418.152867	5.071707	1.182008	1.501396	0.5038452	0.5006123	37.56371
11/6/2025	13:55:00	0.00128746	6.909084	6.91037146	1374.651176	5.506067	1.182008	1.501396	0.5038452	0.5006123	10.69088
11/6/2025	14:00:00	0.00128746	6.470304	6.47159146	1287.366513	6.323986	1.182008	1.501396	0.5038452	0.5006123	10.69088

$Date	$Time	INFLUENT_CHANNEL_1_FLOW	INFLUENT_CHANNEL_2_FLOW	Total Influent	Hydraulic Loading Rate	FINAL_PLANT_EFFLUENT	WW_CL5-01_FIT-514_	WW_CL5-02_FIT-515_	WW_CL5-03_FIT-516_	WW_CL5-04_FLOW	WAS_LINE2_FLOW
11/7/2025	6:00:00	0.001308918	4.276056	4.277364918	850.8782411	4.285936	1.185155	1.504893	0.496664	0.4990196	0
11/7/2025	6:05:00	0.001301765	3.979404	3.980705765	791.8650816	4.412069	1.213918	1.499796	0.5021811	0.4950452	0
11/7/2025	6:10:00	0.001301765	4.198244	4.199545765	835.3980038	4.412069	1.213918	1.499796	0.5021811	0.4950452	0
11/7/2025	6:15:00	0.001301765	4.519272	4.520573765	899.2587557	4.210682	1.213918	1.499796	0.5021811	0.4950452	0
11/7/2025	6:20:00	0.00156641	4.760191	4.76175741	947.2364054	4.143505	1.20708	1.498528	0.5002761	0.4382443	0
11/7/2025	6:25:00	0.00156641	4.898314	4.89988041	974.7126338	4.143505	1.20708	1.498528	0.5002761	0.4382443	0
11/7/2025	6:30:00	0.00156641	4.524786	4.52635241	900.4082773	4.344587	1.20708	1.498528	0.5002761	0.4382443	0
11/7/2025	6:35:00	0.001366138	4.466586	4.467952138	888.7909564	4.439993	1.2023	1.503794	0.5011153	0.5025697	0
11/7/2025	6:40:00	0.001366138	5.281663	5.283029138	1050.930801	4.439993	0.04165411	1.741555	0.5011153	0.5025697	0
11/7/2025	6:45:00	3.368998	5.161164	8.530162	1696.869306	4.23995	0.04165411	2.958212	0.5011153	0.5025697	0
11/7/2025	6:50:00	3.356953	5.10453	8.461483	1683.207281	3.74258	0.000507832	2.986453	0.5020833	0.5022621	0
11/7/2025	6:55:00	3.290856	5.101426	8.392282	1669.441416	3.948164	0.000507832	2.986453	0.5020833	0.5022621	0
11/7/2025	7:00:00	3.194153	5.049047	8.2432	1639.78516	4.353886	0.000507832	2.986453	0.5020833	0.5022621	203.281
11/7/2025	7:05:00	3.178625	5.266628	8.445253	1679.978715	4.73568	0.02385139	2.997074	0.4957891	0.4958606	200.8688
11/7/2025	7:10:00	3.237934	5.187407	8.425341	1676.017704	4.73568	0.02385139	2.997074	0.4957891	0.5199051	200.3544
11/7/2025	7:15:00	3.336089	4.976141	8.31223	1653.517008	4.937515	0.02385139	2.997074	0.4957891	0.5199051	199.2527
11/7/2025	7:20:00	3.094068	5.15542	8.249488	1641.036006	4.946461	0.02547026	3.000159	0.4948831	0.5055046	198.5603
11/7/2025	7:25:00	3.219852	5.307984	8.527836	1696.406604	4.946461	0.02547026	3.000159	0.4948831	0.5055046	199.2081
11/7/2025	7:30:00	3.36334	5.336051	8.699391	1730.53332	4.946461	0.02547026	3.000159	0.4948831	0.4913116	198.8466
11/7/2025	7:35:00	3.329637	5.269625	8.599262	1710.615079	4.736023	0	2.998941	0.500927	0.5048275	200.7069
11/7/2025	7:40:00	3.177717	5.370848	8.548565	1700.530137	4.736023	0	2.998941	0.500927	0.5048275	199.4637
11/7/2025	7:45:00	3.405025	5.364718	8.769743	1744.528148	4.736023	0	2.998941	0.500927	0.5048275	197.3219
11/7/2025	7:50:00	3.298151	5.428126	8.726277	1735.881639	4.768791	0.01605988	2.994249	0.496788	0.4960084	201.882
11/7/2025	7:55:00	3.28459	5.356236	8.640826	1718.883231	4.768791	0.01605988	2.994249	0.496788	0.4960084	197.3099
11/7/2025	8:00:00	3.322542	5.451951	8.774493	1745.473046	4.970922	0.01605988	2.994249	0.496788	0.4960084	197.867
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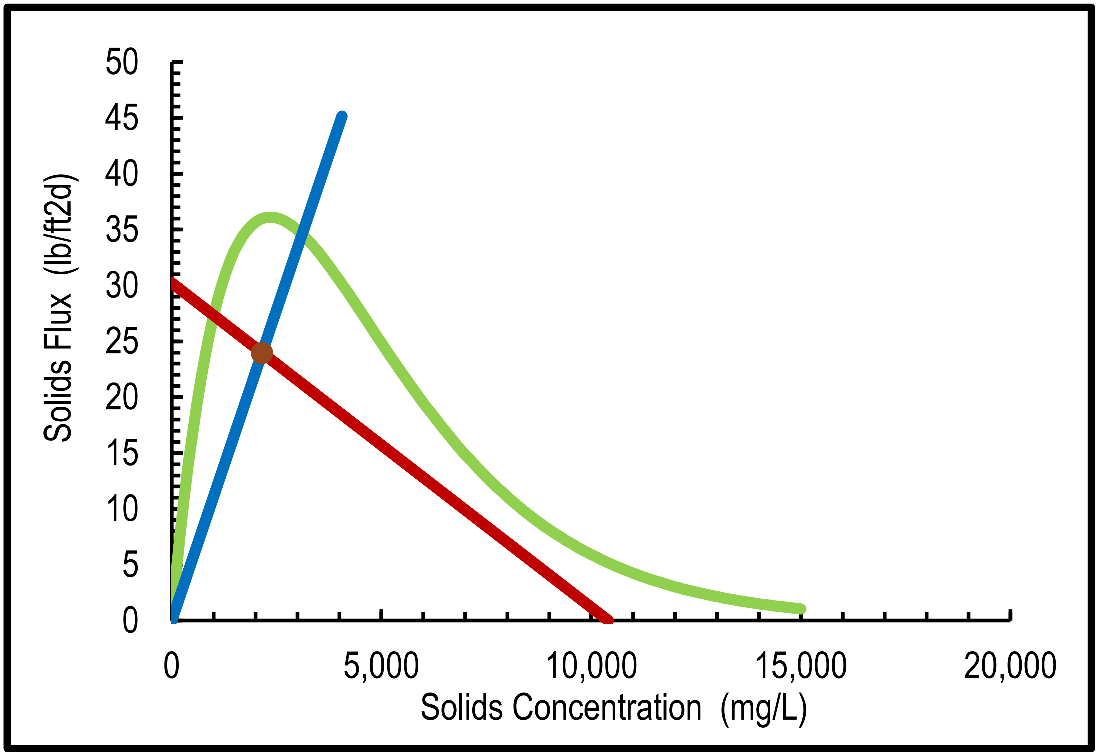
11/7/2025	13:35:00	0.001487732	5.726423	5.727910732	1139.429229	4.577627	0.6855798	0.7532454	0.6998539	0.5467534	29.07639
11/7/2025	13:40:00	0.001487732	5.876384	5.877871732	1169.260341	4.375105	0.6855798	0.7532454	0.6998539	0.5467534	3.440666

APPENDIX C

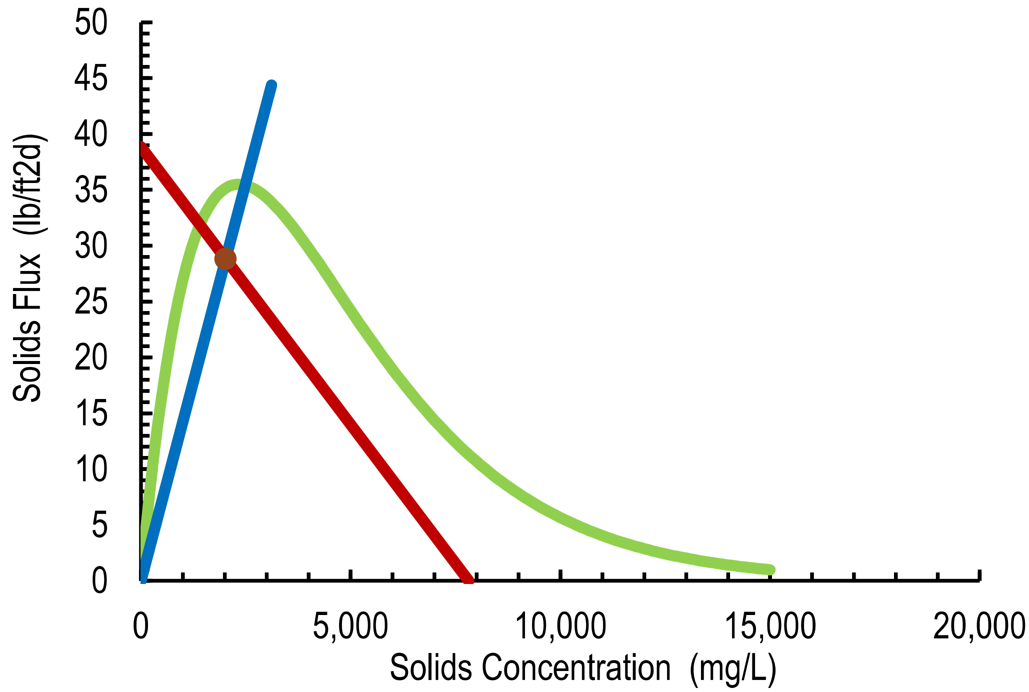
State Point Analysis

November 5, 2025



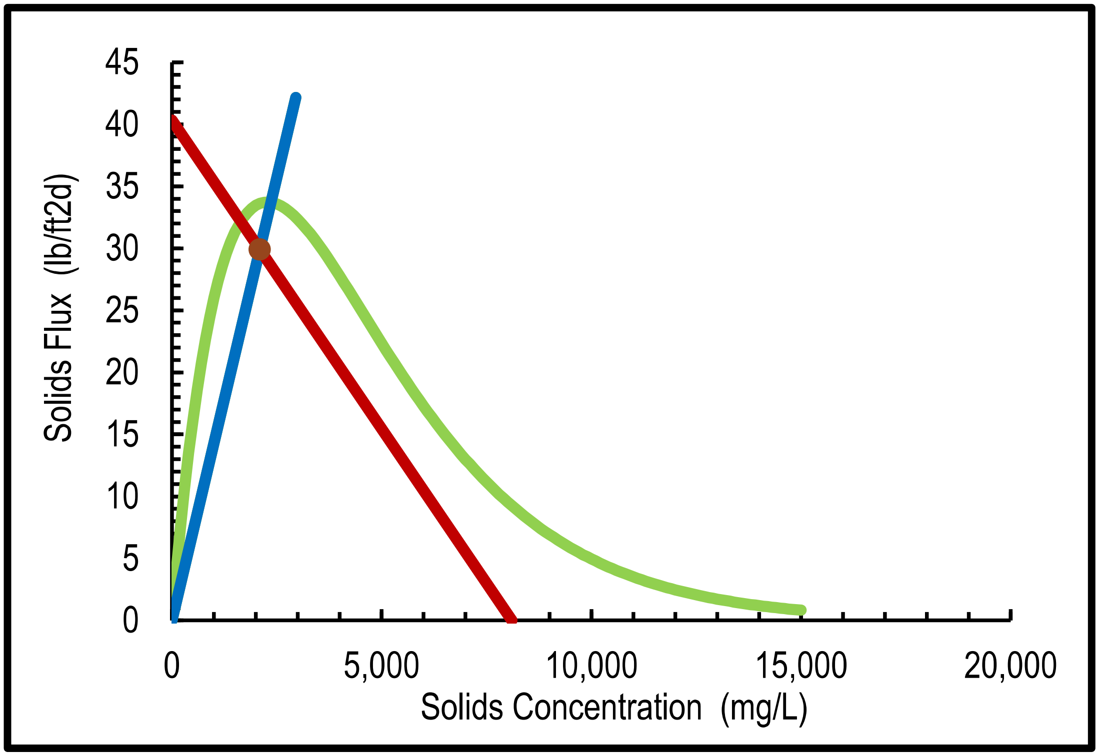
Influent Flow	6.7 MGD
Surface Overflow Rate	1,333 gal/ft^{2}d
SVI	91 mL/g
Total Clarifier Surface Area	5,027 ft^2
MLSS Concentration	2,156 mg/L
Solids Loading	30.2 lb/ft2d
RAS Flow	1.75 MGD
RAS Concentration	10,410 mg/L

November 6, 2025



Influent Flow	8.6	MGD
Surface Overflow Rate	1,711	gal/ft^{2}d
SVI	93	mL/g
Total Clarifier Surface Area	5,027	ft^2
MLSS Concentration	2,020	mg/L
Solids Loading	38.9	lb/ft2d
RAS Flow	3.0	MGD
RAS Concentration	7,811	mg/L

November 7, 2025



Influent Flow	8.6	MGD
Surface Overflow Rate	1,711	gal/ft^2d
SVI	97	mL/g
Total Clarifier Surface Area	5,027	ft^2
MLSS Concentration	2,096	mg/L
Solids Loading	40.3	lb/ft2d
RAS Flow	3.0	MGD
RAS Concentration	8,105	mg/L

APPENDIX D

Clarifier Stress Test
2021-09-30

Secondary Clarifier Stress Testing Study

Newberg WWTP Secondary Clarifier Rerating Study

Newberg, Oregon

September 30, 2021

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Contents

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Acronyms and Abbreviations

AADF	annual average daily flows
City	City of Newberg
DEQ	Department of Environmental Quality
gpd/sf	gallons per day per square foot
IPS	influent pump station
mg/L	milligrams per liter
mgd	million gallons per day
mL/g	milliliters per gram
MLSS	mixed liquor suspended solids
MMWWF	Maximum Month Wet Weather Flow
PDAF	peak day average flows
RAS	return activated sludge
SVI	sludge volume index
TSS	total suspended solids
WWTP	Wastewater Treatment Plant

1 Introduction

The City of Newberg (City) requested HDR assess the capacity of the secondary clarifiers at the Newberg Wastewater Treatment Plant (WWTP) to determine whether the clarifiers are capable of performing effectively at higher loading rates to allow for the rerating of the clarifiers to higher capacities. As discussed in the 2018 Wastewater Master Plan, this may allow the City to postpone or reduce the number of additional secondary clarifiers. The WWTP's secondary clarifiers are currently rated for a peak hydraulic loading rate of 1,200 gallons per day per square foot (gpd/sf) based on industry standards (Keller 2018). The testing was designed to evaluate whether rerating to at least 1,300 gpd/sf would be justified with the existing infrastructure and operating strategies, and if so, provide a summary of the testing with supporting documentation for the City to present to the Oregon Department of Environmental Quality (DEQ) for approval. Stress testing showed that the secondary clarifiers cannot handle the higher loading rates without some improvements, which are outlined in this document.

1.1 Background

From 2015 through 2020, the influent averaged flow was 3.6 million gallons per day (mgd; Figure 1). Historical data suggests that peak flow events that would trigger the need for additional clarifier capacity are infrequent (less than 3 days per year) and of short duration (less than 24 hours per event). The stress testing required plant flow to exceed 6 mgd in order to test loading rates above 1,200 gpd/sf for a single clarifier. The unique clarifier configuration with four secondary clarifiers that can be operated with two and two in series allows one upstream clarifier to be pushed to failure. Required influent flow to test higher loading rates based on the number of clarifiers online are summarized in Table 1.

Figure 1. WWTP Influent Flows

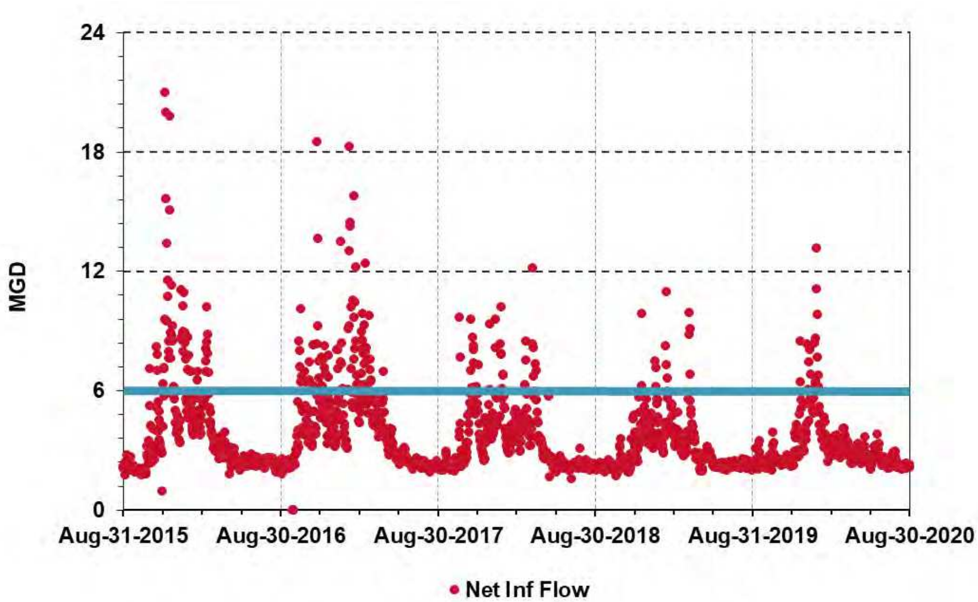


Table 1. Flow Requirement for Stressed System Conditions

Number of Clarifiers Operating in Parallel	Surface Overflow Rate (gpd/sf)				
	1,200	**1,300**	**1,400**	**1,500**	**1,600**
	Required Plant Flow (mgd)*				
1	6	6.5	7	7.5	8
2	12	13	14	15	16
3	18	19.5	21	22.5	24
4	24	26	28	30	32

*To achieve specified surface overflow rate

Over the five-year period, only 39 days on average each year exceeded that flow, with only a few storm events per year having the duration and magnitude to provide consistent high flows over multiple consecutive days for a testing event to be practical.

According to DEQ all WWTPs within the Willamette Valley are considered Class I facilities. As such, secondary clarifiers must provide treatment capacity for at least 75 percent of the design flow (75 percent of 2037 Maximum Month Wet Weather Flow [MMWWF] of 12.4 mgd) with the largest unit out of service. At the currently rated 1,200 gpd/sf, the secondary clarifiers can provide 9.1 mgd MMWWF (24 mgd peak instantaneous flow) capacity (Keller 2018). Rerating the clarifiers to 1,300 gpd/sf would provide 9.9 mgd MMWWF (26 mgd peak instantaneous flow) capacity, which would reduce the number of clarifiers required to reach 2037 design capacity (from 6 to 5). Rerating to 1,650 gpd/sf would provide 12.6 mgd MMWWF (33 mgd peak instantaneous flow) capacity, which would likely not require any additional clarifiers to achieve 2037 design capacity.

Past hydraulic capacity evaluations (Keller 2018) have noted that the current clarifier distribution box and clarifiers can handle up to 27.5 mgd prior to it impairing process operations due to hydraulic issues. During testing, flows did not approach these levels, so this peak system-wide flow criterion was not evaluated. Downstream hydraulic issues that could back flows up during peak flow events were not considered as those conditions could not be tested. Hydraulic evaluation of the effluent launders was provided qualitatively.

2 Assessment

The clarifier stress testing, performed February 17 through 19, 2021, evaluated the hydraulic and solids loading capacities of the clarifiers. Testing was carried out in coordination with WWTP staff.

2.1 Test Methods

To perform this analysis, data for the following process parameters were collected throughout the test:

- Plant influent flow
- Chlorine contact basin drain flow to the influent pump station (IPS)
- Equalization basin flow to IPS
- Return activated sludge (RAS) flows from each clarifier
- Secondary clarifier effluent total suspended solids (TSS)
- Sludge blanket level
- Sludge blanket concentration
- RAS concentration
- Sludge volume index (SVI)
- Mixed liquor suspended solids (MLSS) concentration

Test data is provided in Appendix A.

2.2 Day 1, February 17 – Baseline Conditions

On the first day of testing, the clarifiers were operated normally to establish baseline data, optimize testing protocols, and practice under non-stressed conditions. All four clarifiers were running in parallel, the WWTP's winter operating strategy (Table 2 and Figure 2).

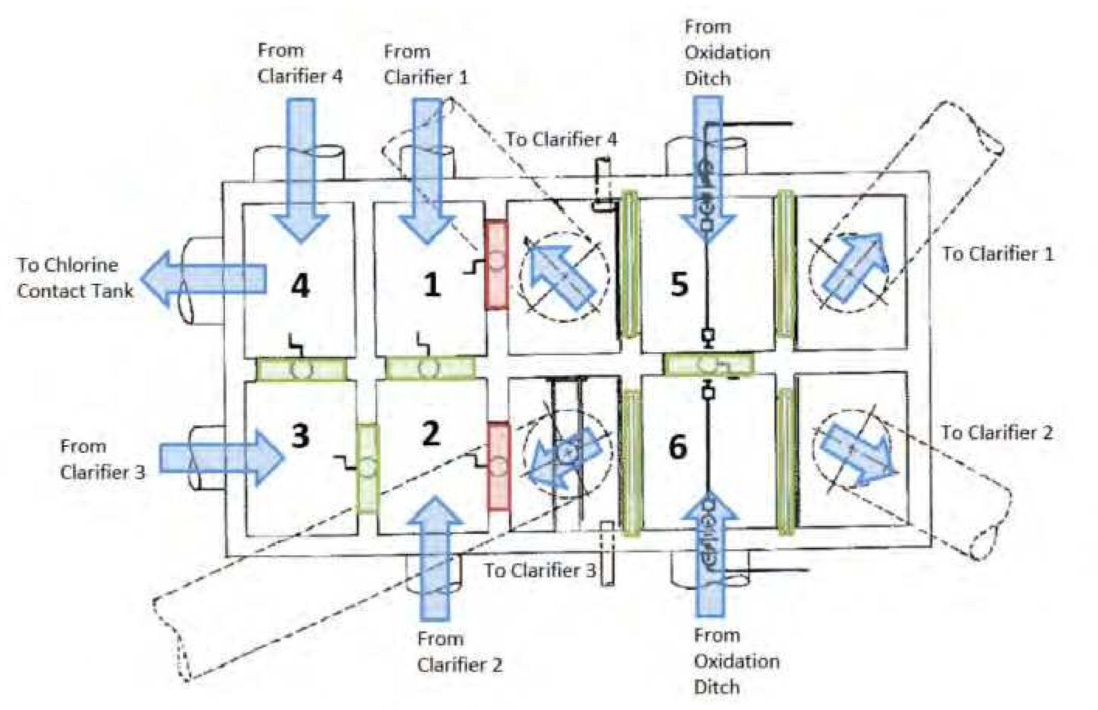
Measured clarifier blanket levels were low (approximately 1-foot). MLSS grab samples measured 2,250 milligrams per liter (mg/L) and clarifier effluent TSS ranged between 1 and 4 mg/L, both within the WWTP's normal operating ranges. The SVI was measured at 210 milliliters per gram (mL/g), falling in the 84th percentile of plant SVIs over the past 5 years. Overall, the system was performing well but all clarifiers were online and operating at the low end (300 – 400 gpd/sf) of their design loading rates, well within their capacity (1,200 gpd/sf).

Table 2. Operating Configurations Breakdown

Number of Clarifiers in Series (Acting as Polishing Clarifiers)	Number of Clarifiers in Parallel (Secondary Clarifiers)				
	1	2	3	4	Total
	Days in Operating Condition (Percent of Days)				
0	11 (<1%)	65 (4%)	374 (20%)	851 (47%)	1,301 (71%)
1	75 (4%)	389 (21%)	-	-	464 (25%)
2	2 (<1%)	60 (3%)	-	-	62 (3%)
Total	**88 (5%)**	**514 (28%)**	**374 (20%)**	**851 (47%)**	**1,827**

Note: Based on data from September 2015 - August 2020 provided by City.

Figure 2. Winter Clarifier Operation: Four Clarifiers in Parallel



To hedge against insufficient influent flow during the scheduled stress test, plant staff started diverting reclaimed water to the WWTP's equalization basin. From there it could be configured to drain back to the WWTP's IPS to increase influent flows.

2.3 Day 2, February 18 – Stressed Condition (Clarifier 2)

Day 2 influent flows ranged between 5.5 and 7.0 mgd. The system was configured to operate with one first stage secondary clarifier (Clarifier 2) to achieve hydraulic loading rates at and above

1,200 gpd/sf. WWTP staff had previously noted similar performance historically between the two first-stage clarifier options (Clarifiers 1 and 2), so Clarifier 2 was selected due to ease of access from the testing setup location in the chlorination building. At 7 am, plant staff stopped flow to Clarifiers 1, 3, and 4 pushing all flow to Clarifier 2 and switched Clarifiers 3 and 4 to series operation to serve as backup clarifiers during the test in the event of a Clarifier 2 failure. With flows in the morning hovering just below 6 mgd, equalization basin and chlorine contact basin drain valves were cracked open to increase flow at the WWTP's IPS, upstream of the clarifiers. At the start, clarifier effluent TSS was low, ranging between 2 and 5 mg/L, similar to the previous day. MLSS and SVI measurements also were similar to the previous day.

With the supplemental flows throughout the morning, Clarifier 2's hydraulic loading rate reached between 1,400 and 1,600 gpd/sf. Over the next few hours, effluent TSS samples and visual inspection indicated the clarifier was performing fine hydraulically. Measurements and visual inspection indicated there were no significant changes to effluent water quality indicating settling in the clarifier was achievable at the elevated hydraulic loading rates.

Any launder hydraulic limitations and backwater effects from downstream systems were not significant enough at the established flow range (up to 7.9 mgd and 1,580 gpd/sf) to flood the launder weirs (launder water level was at least 2 inches below bottom of v-notch in weirs).

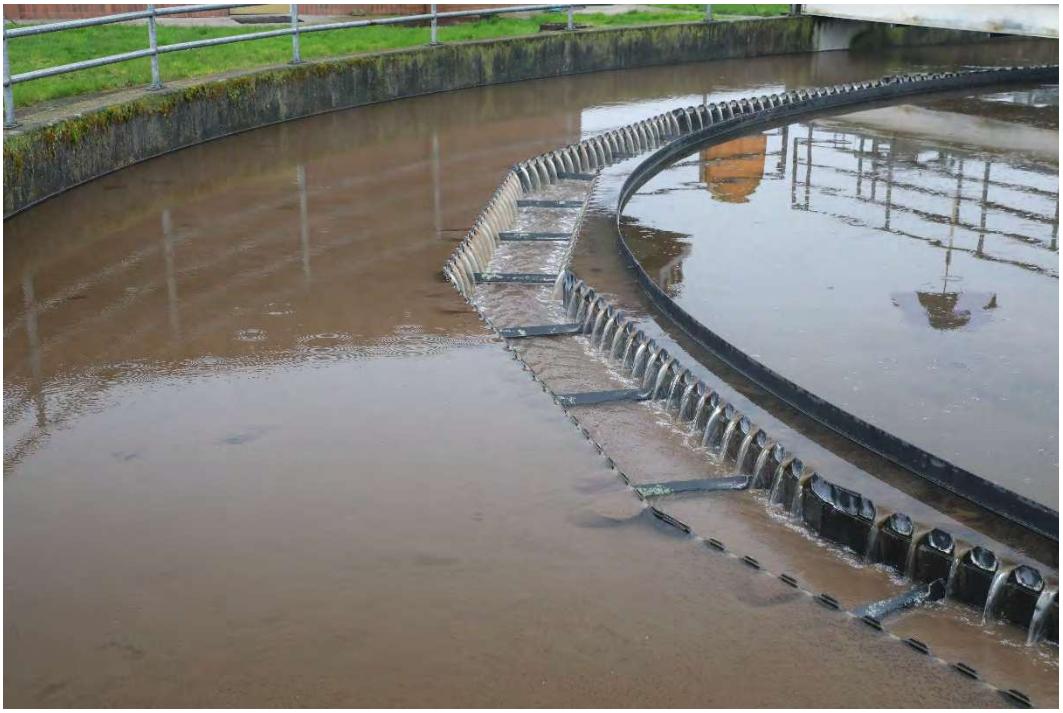
While Clarifier 2 performed well from an effluent water quality standpoint, quickly rising blanket levels (~ 4 feet/hour) made one critical bottleneck self-evident, insufficient RAS flow (Table 3). Solids were settling but not returned fast enough to prevent an accumulation of solids in the clarifier. Solids loading rates were estimated to range between 27 and 34 pounds per day per square foot during the days test.

Table 3. Clarifier Blanket Level Rise

	Day 2 (2/18) RAS Q = 1.1 MGD w/ 1 pump	Day 3 (2/19) RAS Q = 2.5 MGD w/ 2 pumps
Test start time	7:00 am	7:00 am
Blanket within 10 ft of surface	7:56 am	7:51 am
Blanket reaches surface	10:25 am	10:40 am
Blanket growth rate	4.0 ft/hour	3.6 ft/hour

Testing was stopped at 11 am after the blanket level had reached the surface (Figure 3) and the system was put back into standard operating mode with Clarifier 1 back online.

Figure 3: Sludge Blanket Flooding Effluent Launder, February 18, 2021

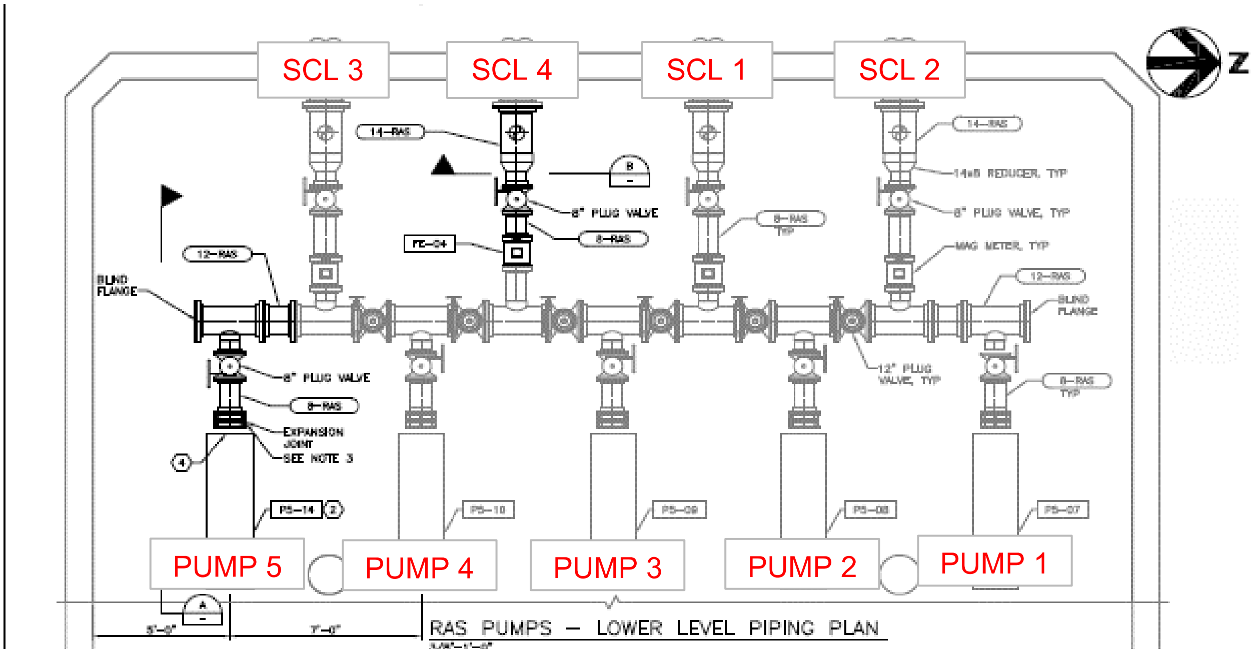


2.4 Day 3, February 19 – Stressed Condition (Clarifier 2)

Day 3 plant influent flows ranged between 6.2 and 6.8 mgd so the system was again configured to operate with only one first-stage secondary clarifier (Clarifier 2). An additional RAS pump was configured to operate with Clarifier 2 to increase the RAS pumping capacity in an attempt to address the solids accumulation issue that ended the previous day's test. At 7 am, Clarifier 1 was taken offline with all mixed liquor from the oxidation ditches directed to Clarifier 2. By 9 am, Clarifier 2's sludge blanket had already risen by 6 feet and it was noted the RAS lines from Clarifiers 1 and 2 had not been isolated from one another, allowing RAS pumps 1 and 2 to pump from both Clarifier 2 and the offline Clarifier 1.

Clarifier 1 RAS line was then isolated from the pumps and RAS pump 3 was put into service to supplement pumps 1 and 2 already operating (Figure 4 illustrates RAS piping connections). The additional pumping did not increase reported RAS flows, SCADA readings stayed at approximately 2.5 mgd. By 10:40 am, the blanket had risen to the surface and was overflowing into the effluent launders. RAS pumps for Clarifiers 3 and 4 were brought back online as solids started collecting in the second stage clarifiers and Clarifier 1 was brought back online, concluding the test.

Figure 4. RAS Pumps and Piping Connections



2.5 Test Results

Over the two-day period stress testing Clarifier 2, hydraulic loading rates ranged between 1,250 and 1,720 gpd/sf with effluent flows ranging from 6.3 to 8.6 mgd (Figure 5 and Figure 6). During both days, within 4 hours of starting the test the sludge blanket overflowed into the effluent launders. Hydraulically, Clarifier 2's operations were acceptable. The effluent weirs were never flooded – the highest water level recorded in the launders was approximately 2 inches below the bottom of the v-notch weirs – and the overflow had low TSS concentrations until the blanket reached the surface indicating clarifier velocities were appropriate for settling. However, Clarifier 2 performed poorly from a solids loading standpoint with solids overflowing into the effluent launders due to a thickening failure caused by poor settling sludge and low RAS rates. These solids loading performance issues are discussed further in the following sections.

Figure 5. Day 2 Data Time Series

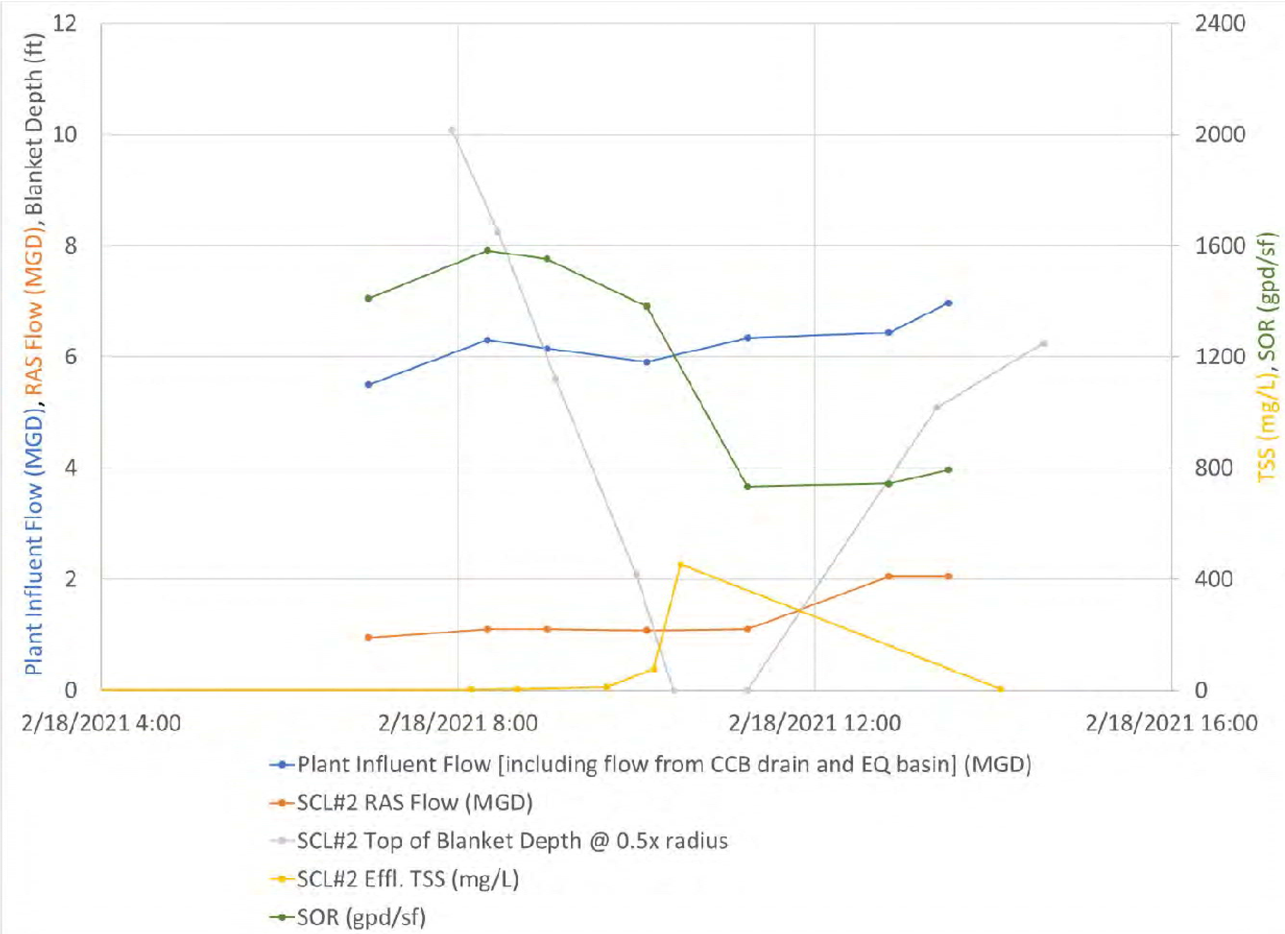
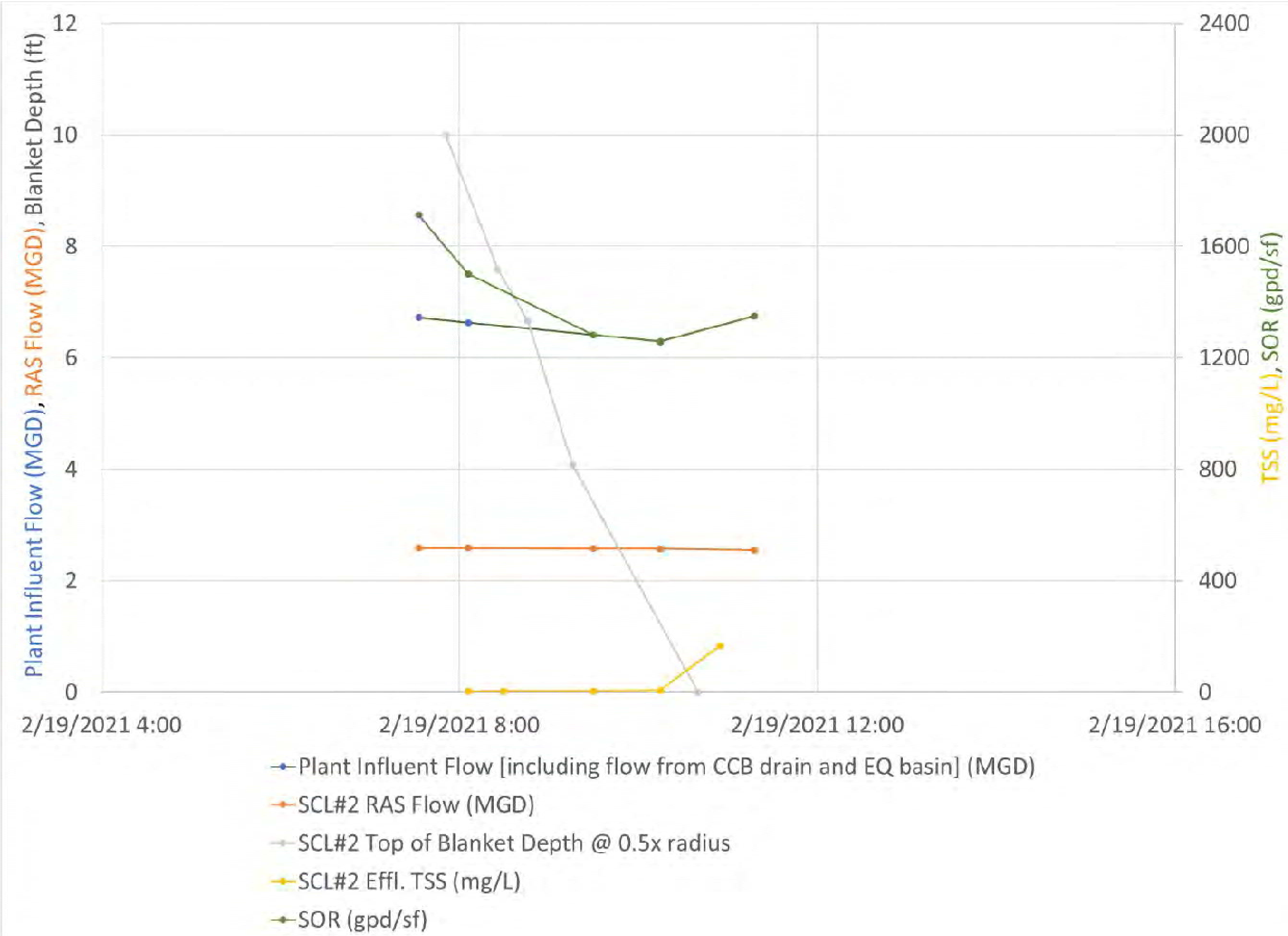


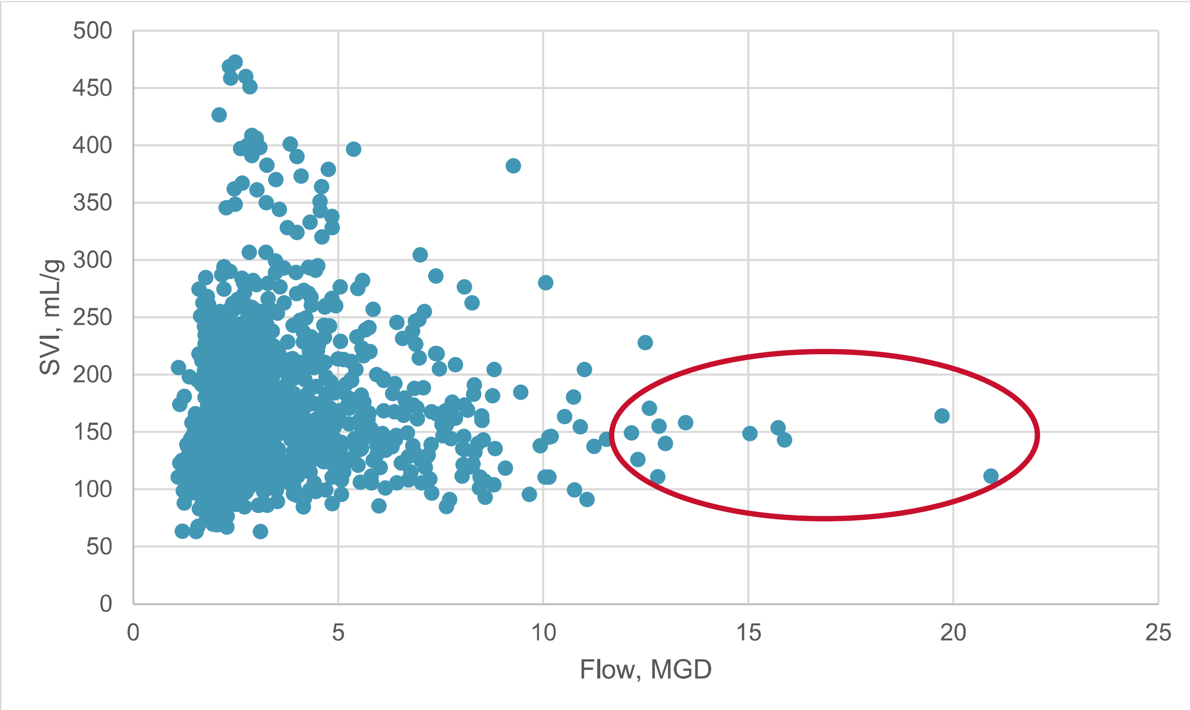
Figure 6. Day 3 Data Time Series



2.5.1 Sludge Settleability

Throughout the testing period, SVIs ranged between approximately 180 and 200 mL/g, indicating suboptimal settleability during the testing period. Historically, settleability has been better during high flow events with SVIs commonly falling close to 150 mL/g (Figure 7).

Figure 7. Historical SVI vs. Flow (2006-2020)

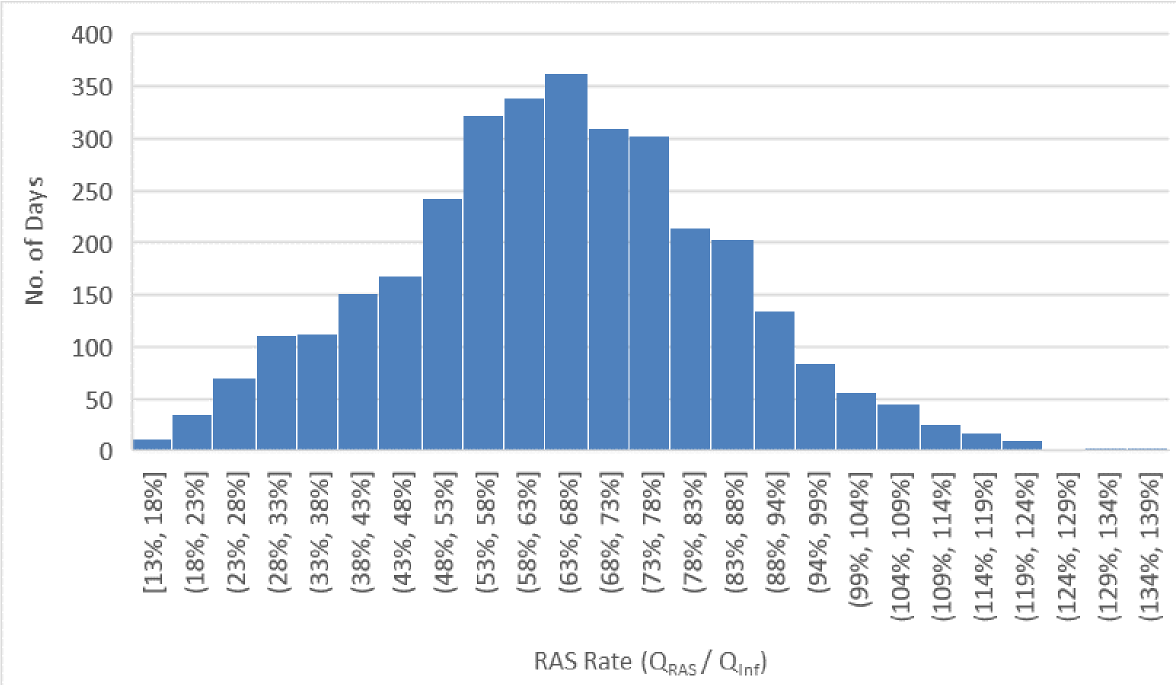


As shown in the state point analysis figures in Appendix B, during both days of stress testing, the loading rates were outside the capabilities of the clarifiers at the operating conditions experienced (indicated by the state point located above the gravity flux curve). Improved settleability can increase the solids loading capacity of the clarifiers and prevent the overloaded conditions exhibited to some extent.

2.5.2 Sludge Pumping Limitations

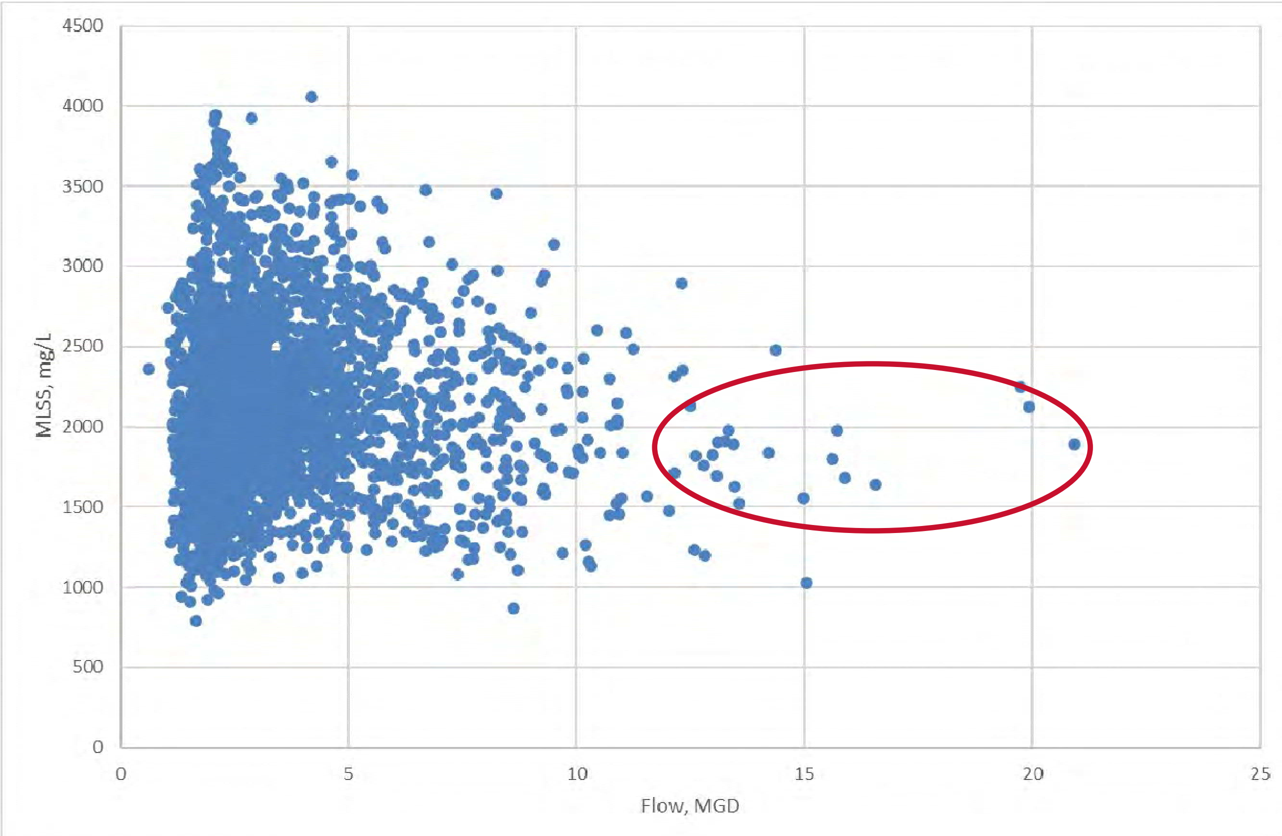
Return pumping rates during the test ranged between 15 and 20 percent of the influent flow on Day 2 (1st day stress testing clarifier) and 38 and 42 percent on Day 3 (when extra RAS pumps were put online), compared to a historical average of 65 percent (Figure 8). Over the past few years, the facility has replaced RAS pumps 1 through 4, due to observed water hammer and extreme pump and building vibrational issues. The pumps were downsized from 4.0 mgd capacity pumps to 1.2 mgd capacity pumps (Appendix C provides new pump information). This has reduced the RAS pumping capacity from 17.4 mgd down to 8.7 mgd. During a large storm event, when all four clarifiers are needed, at the currently-rated surface overflow rate of 1,200 gpd/sf and at the plant's firm pumping capacity of 4.6 mgd (largest pump out of service), the clarifiers would only be able to provide RAS flows that are 19 percent of the influent flow.

Figure 8. Daily Average RAS Rates (2011-2020)



A mass balance for the oxidation ditches using typical MLSS concentrations (2,000 mg/L) and RAS TSS (estimated at 5,000 mg/L from Cerlic blanket meter measurements during the test) indicates that RAS flows near 70 percent of the influent flow are needed to maintain the MLSS concentration in the oxidation ditches and prevent an accumulation of solids in the clarifiers. This would require RAS pumping capacity at or above 16 mgd. Operating at lower MLSS concentrations could extend the operability of the current RAS pumping system’s capacity to an extent, however historically the plant has kept MLSS concentrations above approximately 1,600 mg/L during peak flow events (Figure 9).

Figure 9. Historical MLSS vs. Flow (2006-2020)



Overall, testing illustrated that the current system cannot operate at higher flows until sludge settleability and/or sludge pumping issues are improved, as hydraulics were not the limiting constraint of the test.

3 Additional Considerations

To further investigate issues identified with testing the following considerations are proposed:

- RAS pumping capacity:
  - Perform condition assessment of RAS pipelines to identify potential solids accumulation and pipe scaling due to low pipeline velocities.
  - Validate RAS flow meter calibration. During testing, bringing additional RAS pumps online did not always indicate increases to RAS flow.
  - Perform drawdown test to identify each pumps operational capacity.
  - Visually inspect organ pipes and centerwell box connections for leaks or misalignments when clarifiers are next offline to investigate integrity of sludge conveyance systems within Clarifiers 1, 2, and 3.
- Sludge settleability:

- Perform jar testing to identify potential coagulants/ballasts and their optimal doses to improve settleability during wet weather events.
- Pilot-test a gravimetric selective wasting system (i.e., InDense) to identify potential improvements to sludge settleability that can be achieved full scale.
- Identify strategies to manage SVI leading up to wet weather events, implement strategy and perform additional stress testing at the lower SVIs to evaluate impact.

The facility may also want to consider operating at lower solids inventories leading up to potential high flow events to reduce the solids loading of the secondary clarifiers and allow higher flow throughput. In the short term, the City could look at temporary storage of solids in their equalization basin. Long term, the City could consider investigating step-feed options for their future oxidation ditch improvements and/or expansions.

As discussed in the 2018 Wastewater Master Plan (Keller 2018), hydraulic limitations in the clarifier distribution box and connecting piping have been identified for peak flow conditions and should be remedied to support any future capacity rerating pursuits. Due to the 50 percent reduction in RAS pumping capacity over the past few years, re-increasing pumping capacity is also recommended to support higher process capacity, but would need to be done thoughtfully to prevent past vibration issues from reoccurring.

4 Conclusion and Recommendations

Based on stress testing conditions (MLSS, SVI) and historical high flow data, the capacity of the existing clarifiers may be as low as 14 mgd from the initial analysis (Table 4).

Table 4. Secondary Clarifier Existing Capacity

		MLSS (mg/L)	
		1,600	2,200
RAS Pumping Capacity	**SVI (mL/g)**	**Secondary Clarifier Flow (mgd)**	
Full Capacity (8.7 MGD)	**150**	40 (10 mgd/clarifier)	27 (6.75 mgd/clarifier)
	200	31 (7.8 mgd/clarifier)	20 (5 mgd/clarifier)
Firm Capacity (4.6 MGD)	**150**	26 (6.5 mgd/clarifier)	18 (4.5 mgd/clarifier)
	200	21 (5.3 mgd/clarifier)	14 (3.5 mgd/clarifier)

If pumping limitations and sludge settleability issues are addressed, the following capacities could be achieved at various operating conditions (Table 5). With the current capacity target of 33 mgd peak instantaneous flow, this analysis assumes RAS pumping capacity increases to achieve 4 mgd capacity per clarifier with one pump on standby. For this evaluation, improved settleability is defined as operating at an SVI of 100.

Table 5. Secondary Clarifier Enhanced Capacity

		MLSS (mg/L)	
		1,600	2,200
RAS Pumping Capacity	**SVI (mL/g)**	**Secondary Clarifier Flow (mgd)**	
Full Capacity (20 MGD)	**100**	60 (15 mgd/clarifier)	45 (11.3 mgd/clarifier)
	150	42 (10.5 mgd/clarifier)	32 (8 mgd/clarifier)
Firm Capacity (16 MGD)	**100**	60 (15 mgd/clarifier)	45 (11.3 mgd/clarifier)
	150	42 (10.5 mgd/clarifier)	32 (8 mgd/clarifier)

In recent years, the peak flow events have decreased in size and magnitude with no daily max flows above 14 mgd since the winter of 2016–2017. Figure 10 and Figure 11 show historical annual average daily flows (AADF) and peak day average flows (PDAF) versus the 2018 Wastewater Master Plan's projected values. Though AADFs have varied quite a bit from year to year and there is a limited dataset available since the Master Plan's development, the trend of historical AADFs appear to be trending with the projections so far. When looking at historical peak flow events, peak instantaneous flows are important to consider from a capacity evaluation standpoint, however continuous flow data is not stored by the WWTP so daily average flows were reviewed as they provide the highest resolution flow data available. The PDAF has been decreasing over the past 5 years and has consistently been below the PDAF5 projections during that period, potentially indicating a change from the projected flow trends. However, those Master Plan projections correspond to flows during a 5-year storm event, indicating a storm event large enough to create a PDAF5 flow would be expected only once every 5 years on average, which was last seen at the end of 2015 when a peak flow event was within 0.3 mgd of the PDAF5 projections. Comparing PDAF data to PDAF5 projections, historical peak daily average flows are expected to meet or exceed the Master Plan PDAF5 projections 20 percent of years on average. With this type of comparison over a short 5-year time span, and the inherent variability present with peak flow events, the data since 2015 are insufficient to prove conclusively whether actual peak flows to the WWTP are significantly deviating from projections. The City should continue to monitor plant flows and reassess flow projections within the next 5 years as collection system improvements continue and climate impacts alter storm event characteristics to determine appropriate scheduling for future expansion.

Figure 10. Historical Annual Average Daily Flows vs. Projections

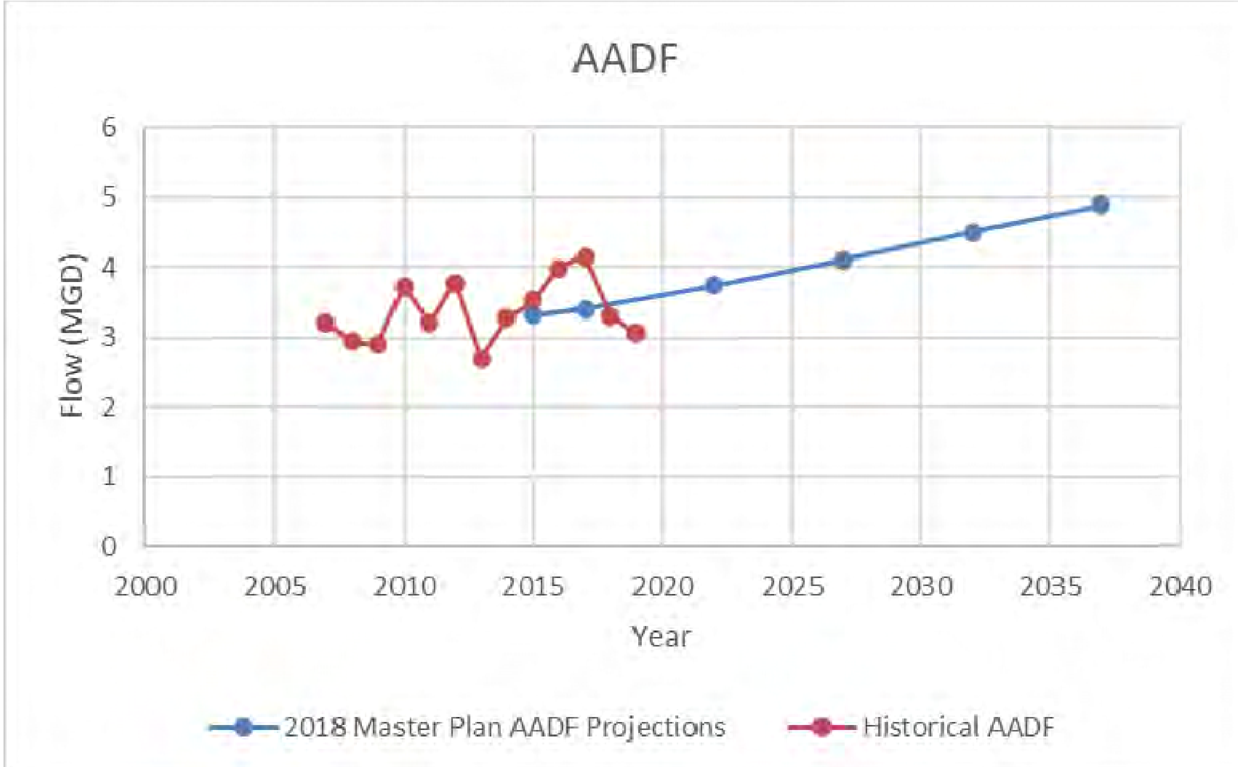
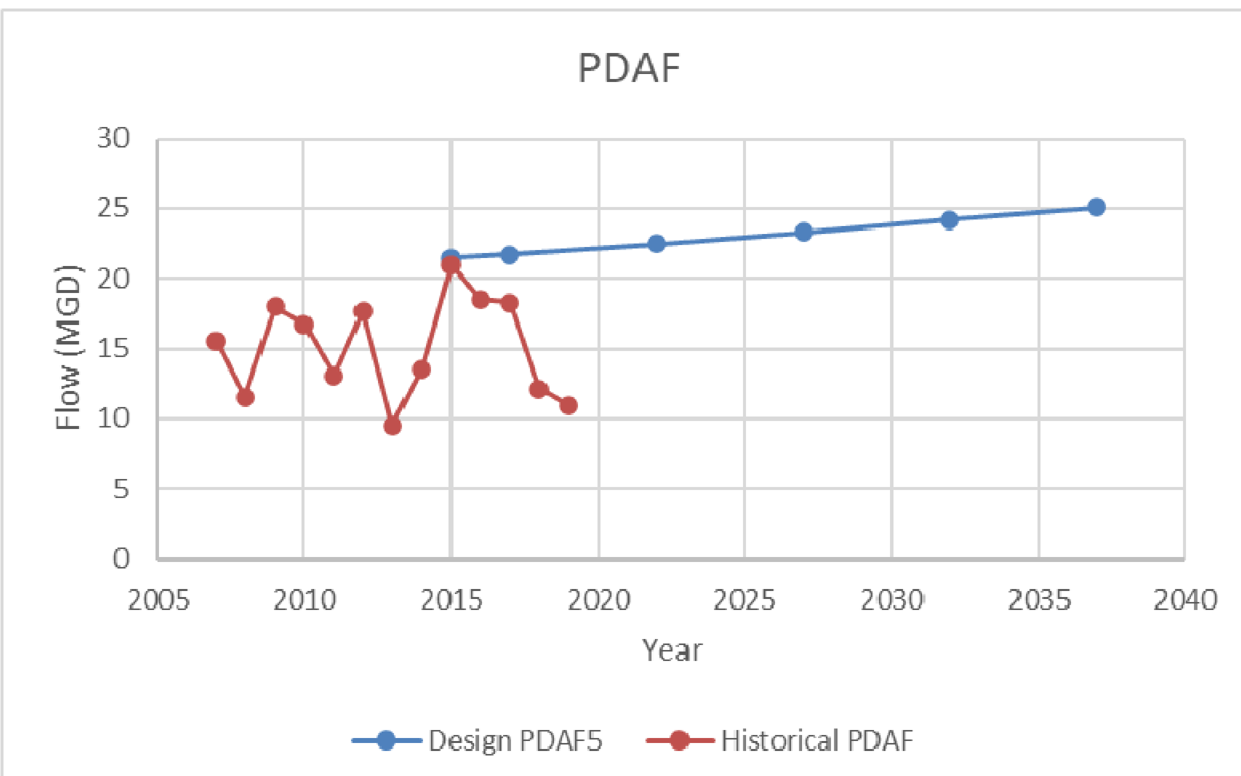


Figure 11. Historical Peak Day Average Flows vs. Projections



When increased secondary clarifier capacity is next evaluated, the following improvements are recommended for evaluation and implementation:

- Add RAS pumping capacity
- Improve sludge settleability using coagulant or ballast additions or add gravimetric selective wasting (e.g., InDense system)
- When adding the 3rd oxidation ditch, consider adding a step-feed option to reduce MLSS during peak flow events

5 References

Keller Associates

2018 City of Newberg Wastewater Master Plan. May 2018. Adopted July 2, 2018. City Ordinance: 2018-2831.

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Appendix A. Stress Testing Data

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				City Provided Data																		
Measurement	Date	Time	Date & Time	SCL #1 Config	SCL #2 Config	SCL #3 Config	SCL #4 Config	SCL#1 Effl. TSS (mg/L)	SCL#2 Effl. TSS (mg/L)	SCL#3 Effl. TSS (mg/L)	SCL#4 Effl. TSS (mg/L)	OD1 MLSS (mg/L)	OD2 MLSS (mg/L)	Avg OD MLSS (mg/L)	Plant Influent Flow [including flow from CCB drain and EQ basin] (MGD)	CCB drain flow to IPS (MGD)	EQ basin to IPS (MGD)	SCL#1 RAS Flow (MGD)	SCL#2 RAS Flow (MGD)	SCL#3 RAS Flow (MGD)	SCL#4 RAS Flow (MGD)	Total RAS Flow (MGD)
SCL TSS	17-Feb	11:48	2/17/2021 11:48	1	1	1	1	3.1	3.6	2.0	2.4											
OD TSS, SVI	17-Feb	10:35	2/17/2021 10:35	1	1	1	1					2156	2339	2247								
SCL TSS	17-Feb	14:30	2/17/2021 14:30	1	1	1	1	1.0	1.2	1.2	1.8											
Blanket Depth	17-Feb	15:27	2/17/2021 15:27	1	1	1	1															
Flow	18-Feb	7:00	2/18/2021 7:00	0	1	2	2								5.5	<0.4	0.274		0.95	0.95	0.6	2.5
Blanket Depth	18-Feb	7:56	2/18/2021 7:56	0	1	2	2															
Blanket Depth	18-Feb	8:00	2/18/2021 8:00	0	1	2	2															
SCL TSS, OD TSS	18-Feb	8:09	2/18/2021 8:09	0	1	2	2		3.4	3.2	2.8	2144	2376	2260								
Flow	18-Feb	8:20	2/18/2021 8:20	0	1	2	2								6.3	<0.4	0.305		1.10	0.998	0.616	2.71
Blanket Depth	18-Feb	8:27	2/18/2021 8:27	0	1	2	2															
Blanket Depth	18-Feb	8:32	2/18/2021 8:32	0	1	2	2															
SCL TSS	18-Feb	8:40	2/18/2021 8:40	0	1	2	2		4.7	4.0	2.0											
Flow	18-Feb	9:00	2/18/2021 9:00	0	1	2	2								6.15	<0.4	0.305		1.10	1	0.612	2.71
Blanket Depth	18-Feb	9:06	2/18/2021 9:06	0	1	2	2															
Blanket Depth	18-Feb	9:12	2/18/2021 9:12	0	1	2	2															
SCL TSS	18-Feb	9:40	2/18/2021 9:40	0	1	2	2		12.8	3.2	2.2											
Blanket Depth	18-Feb	10:00	2/18/2021 10:00	0	1	2	2															
Flow	18-Feb	10:07	2/18/2021 10:07	0	1	2	2								5.91	0	0.305		1.08	0.44	0.56	2.08
Blanket Depth	18-Feb	10:08	2/18/2021 10:08	0	1	2	2															
SCL TSS	18-Feb	10:12	2/18/2021 10:12	0	1	2	2		78													
Blanket Depth	18-Feb	10:25	2/18/2021 10:25	0	1	2	2															
SCL TSS, OD TSS, SVI	18-Feb	10:30	2/18/2021 10:30	0	1	2	2		453			1944	2048	1996								
Flow, Blanket Depth	18-Feb	11:15	2/18/2021 11:15	1	1	2	2								6.34	0	0.364	1.01	1.10	0.45	0.54	3.1
Blanket Depth	18-Feb	11:44	2/18/2021 11:44	1	1	2	2															
Blanket Depth	18-Feb	11:47	2/18/2021 11:47	1	1	2	2															
Flow	18-Feb	12:50	2/18/2021 12:50	1	1	2	2								6.44	0	0.312	0.998	2.05	0.472	0.528	4.05
Blanket Depth	18-Feb	13:22	2/18/2021 13:22	1	1	2	2															
Blanket Depth	18-Feb	13:25	2/18/2021 13:25	1	1	2	2															
Flow	18-Feb	13:30	2/18/2021 13:30	1	1	2	2								6.97	0	0.300	1.01	2.05	0.45	0.51	4.02
SCL TSS	18-Feb	14:05	2/18/2021 14:05	1	1	2	2		4.4													
Blanket Depth	18-Feb	14:30	2/18/2021 14:30	1	1	2	2															
Blanket Depth	18-Feb	14:34	2/18/2021 14:34	1	1	2	2															
Blanket Depth	18-Feb	14:41	2/18/2021 14:41	1	1	2	2															
Blanket Depth	18-Feb	14:44	2/18/2021 14:44	1	1	2	2															
Day 3 Test start	19-Feb	6:59	2/19/2021 6:59	1	1	2	2															
Flow	19-Feb	7:33	2/19/2021 7:33	0	1	2	2								6.72			0.97	2.59	0.43	0.44	4.43
Blanket Depth	19-Feb	7:51	2/19/2021 7:51	0	1	2	2															
SCL TSS, OD TSS	19-Feb	8:06	2/19/2021 8:06	0	1	2	2		3.7	1.6	2.2	2312	1740	2026	6.63				2.59	0.43	0.44	3.46
Blanket Depth	19-Feb	8:26	2/19/2021 8:26	0	1	2	2															
SCL TSS	19-Feb	8:30	2/19/2021 8:30	0	1	2	2		4.4	0.8	2.6											
Blanket Depth	19-Feb	8:46	2/19/2021 8:46	0	1	2	2															
SCL TSS	19-Feb	9:30	2/19/2021 9:30	0	1	2	2		4.6	1.4	2.4				6.41				2.58	0.00	0.00	2.58
Blanket Depth	19-Feb	9:16	2/19/2021 9:16	0	1	2	2															
OD TSS, SVI	19-Feb	9:45	2/19/2021 9:45	0	1	2	2					1976	1652	1814								
Flow, SCL TSS	19-Feb	10:15	2/19/2021 10:15	0	1	2	2		6.4	0.8	4.4				6.29				2.57	0	0	2.57
Blanket Depth	19-Feb	10:40	2/19/2021 10:40	0	1	2	2															
SCL TSS	19-Feb	10:55	2/19/2021 10:55	0	1	2	2		166	1.6	4											
Flow	19-Feb	11:18	2/19/2021 11:18	0	1	2	2								6.75				2.55	0	0	2.55

Key:

Approximated data
Interpolated data

Newberg WWTP Stress Test Data 2/17/21-2/19/21

HDR Collected/Calculated Data

Measurement	Date	Time	Date & Time	Avg OD MLSS [w/ extrapolated data] (mg/L)	Total 1st Stage SCLs Effluent Flow (MGD)	SOR (gpd/sf)	SLR (ppd/sf)	SCL #1 Top of Blanket Depth @ 0.5x radius	SCL #1 Floor Depth @ 0.5x radius	SCL#2 Top of Blanket Depth @ 0.5x radius	SCL# 2 Floor Depth @ 0.5x radius	SCL#2 Top of Blanket Depth @ 0.75x radius	SCL# 2 Floor Depth @ 0.75x radius	SCL #3 Top of Blanket Depth @ 0.5x radius	SCL# 3 Floor Depth @ 0.5x radius	SCL #4 Top of Blanket Depth @ 0.5x radius	SCL# 4 Floor Depth @ 0.5x radius	RAS rate Q_RAS/ Q_Inf (MGD/ MGD)	SCL1 Effl. TSS - AMA (mg/L)	SCL2 Effl. TSS - AMA (mg/L)	SCL3 Effl. TSS - AMA (mg/L)	OD1 MLSS - AMA (mg/L)	OD2 MLSS - AMA (mg/L)	OD1 30 Min Settlometer Reading (mL/L)	OD2 30 Min Settlometer Reading (mL/L)	OD1 SVI (mL/g)	OD2 SVI (mL/g)	Average SVI (mL/g)
SCL TSS	17-Feb	11:48	2/17/2021 11:48																4.1	8.2	2.0							
OD TSS, SVI	17-Feb	10:35	2/17/2021 10:35	2247																				400	550	186	235	210
SCL TSS	17-Feb	14:30	2/17/2021 14:30																									
Blanket Depth	17-Feb	15:27	2/17/2021 15:27																									
Flow	18-Feb	7:00	2/18/2021 7:00		7.05	1410												0.2										
Blanket Depth	18-Feb	7:56	2/18/2021 7:56							10.1	17.3																	
Blanket Depth	18-Feb	8:00	2/18/2021 8:00									9.8	16.2															
SCL TSS, OD TSS	18-Feb	8:09	2/18/2021 8:09	2260																								
Flow	18-Feb	8:20	2/18/2021 8:20	2239	7.914	1583	34											0.17										
Blanket Depth	18-Feb	8:27	2/18/2021 8:27							8.3	17.3																	
Blanket Depth	18-Feb	8:32	2/18/2021 8:32											17.3														
SCL TSS	18-Feb	8:40	2/18/2021 8:40																									
Flow	18-Feb	9:00	2/18/2021 9:00	2165	7.762	1552	32											0.18										
Blanket Depth	18-Feb	9:06	2/18/2021 9:06							5.6	17.3																	
Blanket Depth	18-Feb	9:12	2/18/2021 9:12									4.9	16.2															
SCL TSS	18-Feb	9:40	2/18/2021 9:40																									
Blanket Depth	18-Feb	10:00	2/18/2021 10:00							2.1	17.3																	
Flow	18-Feb	10:07	2/18/2021 10:07	2039	6.91	1382	27											0.18										
Blanket Depth	18-Feb	10:08	2/18/2021 10:08									1.3	16.2															
SCL TSS	18-Feb	10:12	2/18/2021 10:12																									
Blanket Depth	18-Feb	10:25	2/18/2021 10:25							0.0	17.3																	
SCL TSS, OD TSS, SVI	18-Feb	10:30	2/18/2021 10:30	1996																		1933	1906	340	470	175	229	202
Flow, Blanket Depth	18-Feb	11:15	2/18/2021 11:15		7.33	733	16			0.0	17.3							0.17										
Blanket Depth	18-Feb	11:44	2/18/2021 11:44											17.2	17.2													
Blanket Depth	18-Feb	11:47	2/18/2021 11:47													17.7	17.7											
Flow	18-Feb	12:50	2/18/2021 12:50		7.44	744												0.32										
Blanket Depth	18-Feb	13:22	2/18/2021 13:22							5.1	17.3																	
Blanket Depth	18-Feb	13:25	2/18/2021 13:25					13.0																				
Flow	18-Feb	13:30	2/18/2021 13:30		7.93	793												0.29										
SCL TSS	18-Feb	14:05	2/18/2021 14:05																									
Blanket Depth	18-Feb	14:30	2/18/2021 14:30					11.8																				
Blanket Depth	18-Feb	14:34	2/18/2021 14:34							6.3	17.3																	
Blanket Depth	18-Feb	14:41	2/18/2021 14:41											17.2	17.2													
Blanket Depth	18-Feb	14:44	2/18/2021 14:44													16.6	16.6											
Day 3 Test start	19-Feb	6:59	2/19/2021 6:59																									
Flow	19-Feb	7:33	2/19/2021 7:33	2097	8.56	1712	39											0.39										
Blanket Depth	19-Feb	7:51	2/19/2021 7:51					11.9	15.8	10.0	17.3	9.3	16.2	17.2	17.2	17.6	17.6											
SCL TSS, OD TSS	19-Feb	8:06	2/19/2021 8:06	2026	7.50	1500	34											0.39										
Blanket Depth	19-Feb	8:26	2/19/2021 8:26							7.6	17.3	7.3	16.2															
SCL TSS	19-Feb	8:30	2/19/2021 8:30																									
Blanket Depth	19-Feb	8:46	2/19/2021 8:46							6.7	17.3																	
SCL TSS	19-Feb	9:30	2/19/2021 9:30		6.41	1282												0.40										
Blanket Depth	19-Feb	9:16	2/19/2021 9:16					13.0	15.8	4.1	17.3																	
OD TSS, SVI	19-Feb	9:45	2/19/2021 9:45	1814																				390	270	197	163	180
Flow, SCL TSS	19-Feb	10:15	2/19/2021 10:15	1750	6.29	1258	26											0.41										
Blanket Depth	19-Feb	10:40	2/19/2021 10:40							0.0	17.3																	
SCL TSS	19-Feb	10:55	2/19/2021 10:55																									
Flow	19-Feb	11:18	2/19/2021 11:18	1615	6.75	1350	25											0.38										

Key:

Approximated data

Interpolated data

Appendix B. State Point Analysis

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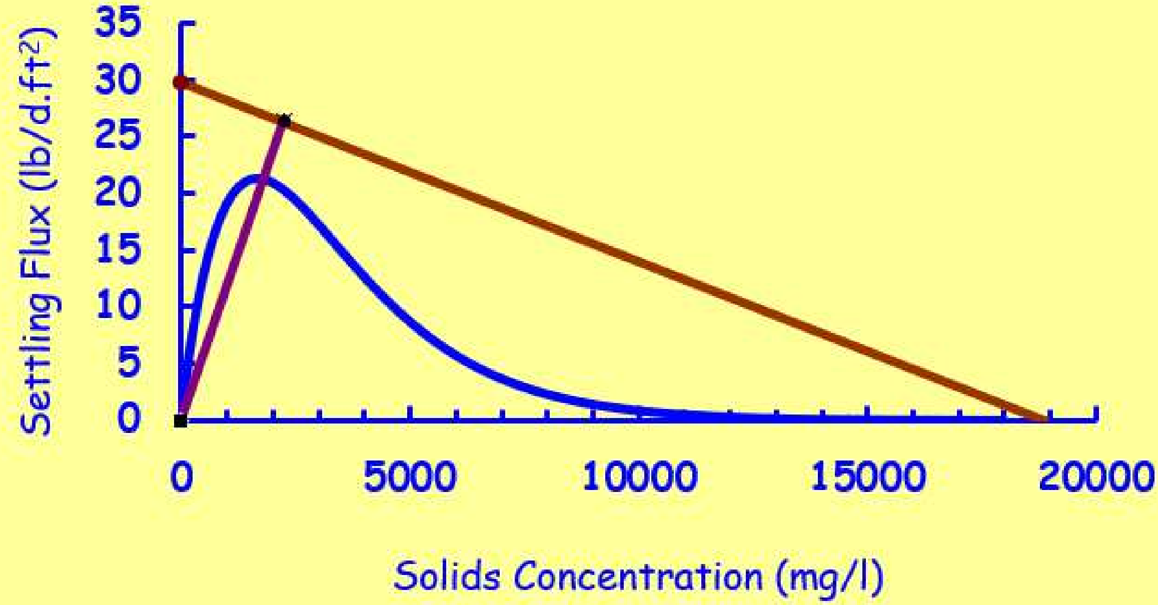
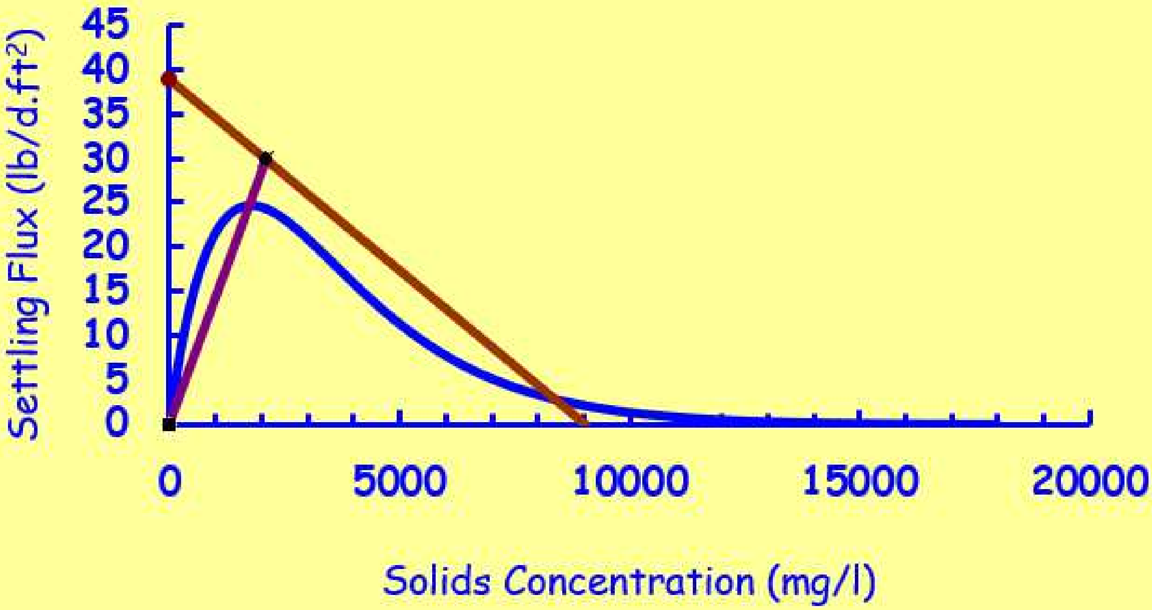
February 18, 2021 7:00 am



EFFLUENT FLOW RATE	7.05 mgd
RETURN SLUDGE FLOW RATE	0.95 mgd
TOTAL CLARIFIER SURFACE AREA	5000 ft^2
MLSS	2239 mg/l
SURFACE OVERFLOW RATE	1410 gpd/ft^2
SOLIDS LOADING RATE	29.8772 lb/d.ft^2
RETURN SLUDGE CONCENTRATION	18855 mg/l

February 19, 2021 7:33 am



EFFLUENT FLOW RATE	8.56 mgd
RETURN SLUDGE FLOW RATE	2.59 mgd
TOTAL CLARIFIER SURFACE AREA	5000 ft^2
MLSS	2097 mg/l
SURFACE OVERFLOW RATE	1712 gpd/ft^2
SOLIDS LOADING RATE	39.0004 $lb/d.ft^2$
RETURN SLUDGE CONCENTRATION	9028 mg/l

Appendix C. RAS Pump Data Sheet

Pump Data Sheet - Cornell

Company: City of Newberg
Name: Brad Snethen
Date: 10/29/2018

CORNELL

Pump:

Size:	4NHTA	Dimensions:	Suction:	4 in
Type:	Encl Solids Handling		Discharge:	4 in
Synch Speed:	1200 rpm			
Dia:	11.1875 in			
Curve:	4NHTA12			

Fluid:

Name:	Water		
SG:	1	Vapor Pressure:	0.256 psi a
Density:	62.4 lb/ft³	Atm Pressure:	14.7 psi a
Viscosity:	1.1 cP		
Temperature:	60 °F		

Pump Limits:

Temperature:	250 °F	Sphere Size:	3 in
Wkg Pressure:	150 psi g		

Search Criteria:

Flow:	800 US gpm	Near Miss:	---
Head:	38 ft	Static Head:	0 ft

Motor:

Standard:	NEMA	Size:	15 hp
Enclosure:	TEFC	Speed:	1200 rpm
Frame:	284T		
Sizing Criteria:	Max Power on Design Curve		

Pump Selection Warnings:

None

--- Duty Point ---

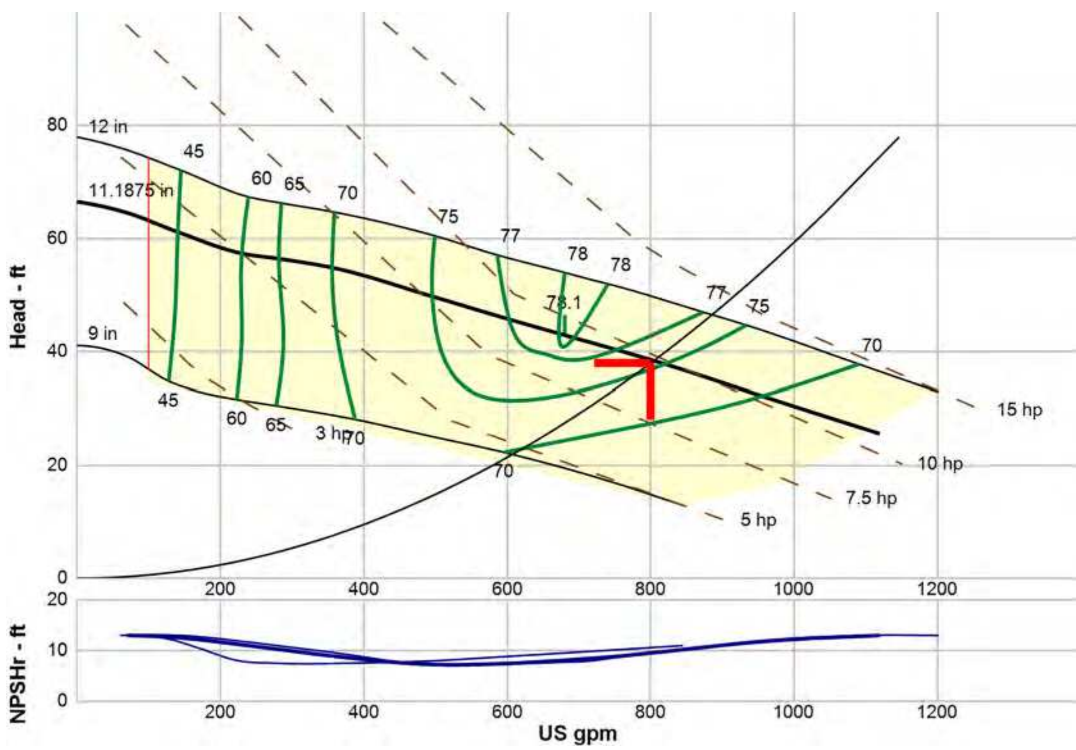
Flow:	804 US gpm
Head:	38.4 ft
Eff:	75%
Power:	10.3 hp
NPSHr:	9.61 ft
Speed:	1170 rpm

--- Design Curve ---

Shutoff Head:	66.5 ft
Shutoff dP:	28.8 psi
Min Flow:	100 US gpm
BEP: 78.1% @ 680 US gpm	
NOL Power:	11.1 hp @ 955 US gpm

--- Max Curve ---

Max Power: 14.9 hp @ 1201 US gpm



Performance Evaluation:

Flow	Speed	Head	Efficiency	Power	NPSHr
US gpm	rpm	ft	%	hp	ft
960	1170	32	70	11.1	11.8
800	1170	38.5	76	10.3	9.55
640	1170	44.4	78	9.23	7.77
480	1170	50.3	74	8.17	7.45
320	1170	55.6	68	6.63	9.58

Selected from catalog: Cornell.60, Vers 3.12.4

Appendix D. Stress Testing Protocol

Stress Testing Protocol

City of Newberg WWTP Secondary Clarifiers Rerating Study

Newberg, OR

December 17, 2020

Contents

Tables

Figures

Acronyms

City	City of Newberg
DEQ	Oregon Department of Environmental Quality
gpd/sf	gallons per day per square foot
L	liter
mgd	million gallons per day
mg/L	milligrams per liter
mL	milliliter
MLSS	mixed liquor suspended solid
RAS	return activated sludge
SCADA	supervisory control and data acquisition
SE	secondary effluent
SVI	sludge volume index
TSS	total suspended solids
WAS	waste activated sludge
WWTP	Wastewater Treatment Plant

1 Introduction

The City of Newberg's (City) Wastewater Treatment Plant's (WWTP) secondary clarifiers are rated for a peak hydraulic loading rate of 1,200 gallons per day per square foot (gpd/sf) based on industry standards. This Secondary Clarifiers Rerating Study's stress testing protocol will be followed to determine whether the secondary clarifiers at the WWTP are capable of performing effectively when hydraulic loading rates reach up to 1,400 gpd/sf. The test's approach includes hydraulically stressing the clarifiers and evaluating any changes that occur in secondary effluent water quality to determine the actual hydraulic capabilities of the secondary clarifiers. Because the historical data suggests that the current peak hydraulic loadings are infrequent (< 3 times/year) and of short duration (< 24 hours/event), testing during these rare peak events may prove difficult and impractical. Instead, the proposed test will simulate similar hydraulic loading scenarios for the clarifiers by operating at high (but likely not peak) flows and limiting the number of clarifiers in operation. This testing supports an effort to justify rerating the clarifiers to at least 1,300 gpd/sf, which may postpone the need for further secondary clarifier expansion. Stress testing results will be presented as part of a rerating technical memorandum to the Oregon Department of Environmental Quality (DEQ) for their approval of an increased peak hydraulic loading rate.

2 Testing Background

The following parameters will be monitored/tested during each test event:

- Secondary effluent (SE) total suspended solids (TSS) – sampled a minimum of five times per day
- Blanket level – measured hourly
- Plant influent flow – reported continuously from plant supervisory control and data acquisition (SCADA)
- Secondary effluent flow – reported continuously from plant SCADA
- Oxidation ditch flow – reported continuously from plant SCADA
- Return activated sludge (RAS) flow – reported continuously from plant SCADA
- Waste activated sludge (WAS) flow – reported continuously from plant SCADA
- Mixed liquor suspended solids (MLSS) – sampled one time per day
- Sludge volume index (SVI) – tested one time per day
- Clarifier distribution box water surface elevation – measured daily
- Clarifier effluent launder water surface elevation – measured daily

Flow measurements can be monitored in real time in the field from tablet computers with SCADA/HMI software. Flow measurements at sampling times will be documented manually. The City will attempt to capture continuous flow data to share with HDR after the testing event to be reviewed and used as part of re-rating evaluation.

The secondary clarifiers have multiple possible operating configurations (Table 1). When in operation, Clarifiers 1 and 2 receive mixed liquor from the oxidation ditches fed through the Clarifier

Distribution Box, while Clarifiers 3 and 4 either also receive flow from the oxidation ditches (i.e., parallel operations) or act as polishing clarifiers, running in series with Clarifier 1 and/or Clarifier 2. Historically, clarifier configuration has varied throughout the year, with Clarifiers 3 and 4 commonly operating in parallel during the wet season and in series during the dry season. The testing will include both normal modes of operation to develop a baseline and stressed modes of operation to test the system's capabilities at various hydraulic loading rates. The normal mode of operation is defined by the secondary clarifiers operating at or below 1,200 gpd/sf and the stressed condition is defined by secondary clarifiers operating, in parallel, above 1,200 gpd/sf. Table 2 identifies the flow requirements needed to achieve various surface overflow rates across different clarifier operating configurations.

Table 1. Operating Configurations

Days (Percent of Days) in Operating Condition		Number of Clarifiers in Parallel (Secondary Clarifiers)				
		1	**2**	**3**	**4**	**Total**
Number of Clarifiers in Series (Acting as Polishing Clarifiers)	**0**	11 (<1%)	65 (4%)	374 (20%)	851 (47%)	1,301 (71%)
	1	75 (4%)	389 (21%)	-	-	464 (25%)
	2	2 (<1%)	60 (3%)	-	-	62 (3%)
	Total	**88 (5%)**	**514 (28%)**	**374 (20%)**	**851 (47%)**	**1,827**

Note: Based on data from Sept. 2015- Aug. 2020 provided by City.

Table 2. Flow Requirement for Stressed System Conditions

Required Plant Flow (mgd)*		Surface Overflow Rate (gpd/sf)				
		1,200	**1,300**	**1,400**	**1,500**	**1,600**
Number of Clarifiers Operating in Parallel	**1**	6	6.5	7	7.5	8
	2	12	13	14	15	16
	3	18	19.5	21	22.5	24
	4	24	26	28	30	32

Note: * To achieve specified surface overflow rate.

3 Staging of Tests

The testing protocol outlined in this technical memorandum will be conducted over a period of four days during the wet weather permit season, November 1 to April 30. Because hydraulic stress testing of the secondary clarifiers requires high influent flows (> 6 million gallons per day [mgd]), testing dates will be set during the wet weather season when periods of high flows are noted/expected (i.e., prolonged storm event). The protocol includes a day to day breakdown of activities to be conducted, equipment required, identification of areas of City involvement or participation, and sampling to be conducted. The specialized testing will be conducted by HDR staff supported by City of Newberg WWTP operations staff.

3.1 Assumptions

- City will make all operational changes to the system. HDR will not operate the plant.
- HDR will collect samples, perform SVI test, monitor clarifier blankets, and track water surface elevation changes in the effluent launders and clarifier distribution box.
- City operations staff will perform TSS analyses (following Standard Method 2540D). HDR can help support, if needed.
- RAS rates will be set manually by plant operators and operated normally.
- MLSS concentration target will be less than or equal to 2,000 milligrams per liter (mg/L) during test, similar to normal operational targets for high flow events.
- The following equipment will be needed to complete the testing:
  - City – Sampling containers (500-millileter [mL] containers for secondary effluent and mixed liquor) with quantities noted in daily test plans.
  - City – Two 2L settlometers
  - City – Sample collection device(s): sample stick, bucket, sample pumps, etc.
  - City – Sludge Judge or portable optical sludge blanket meter.
  - HDR – Waterproof flashlight.
  - HDR – Timer, with seconds accuracy.
  - HDR – Measuring tape.
  - HDR – Automated moisture analyzer (optional).

3.2 Action Levels

The following conditions must be met to start each day of testing:

- Daily average influent flow rate is expected to exceed 6 mgd.
- Effluent TSS over the prior 7-day period never exceeded 15 mg/L.
- Key plant staff availability.

Plant staff will be notified immediately, if any of the following conditions occur during the test, to proactively implement process changes:

- When operating any clarifiers in series:
  - Effluent TSS from polishing clarifiers exceeds 15 mg/L.
  - Clarifier blanket visibly overflowing into effluent launders from first stage clarifiers.
- When operating no clarifiers in series:
  - Effluent TSS from any operating clarifiers exceeds 15 mg/L.

- Clarifier blanket visible with naked eye.

3.3 Test Day 1

On the first day of testing, the plant will be operated in its normal mode of operation (assuming either three or four clarifiers are online during the winter season). Prior to starting the test, HDR will confirm with City staff that plant flows are sufficient, proper positioning of Clarifier Distribution Box gates (Figure 1 and Figure 2 provide four-clarifier and three-clarifier configurations, respectively), and which clarifiers are currently pumping RAS to ensure that the proper number of clarifiers are operational.

Figure 1. Four Clarifiers in Parallel Configuration

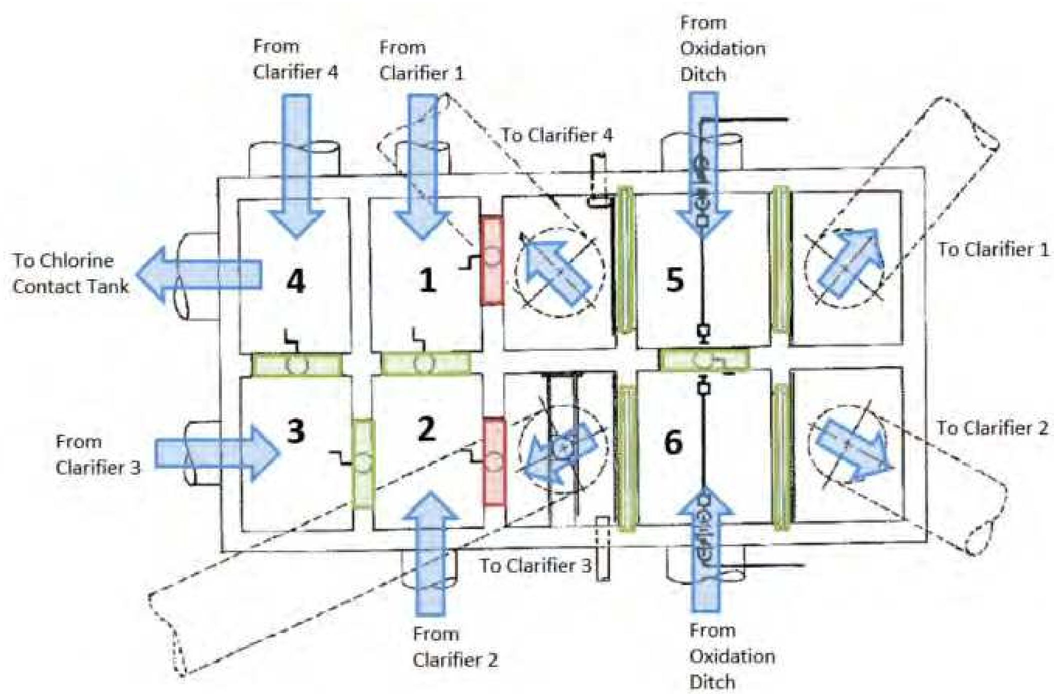
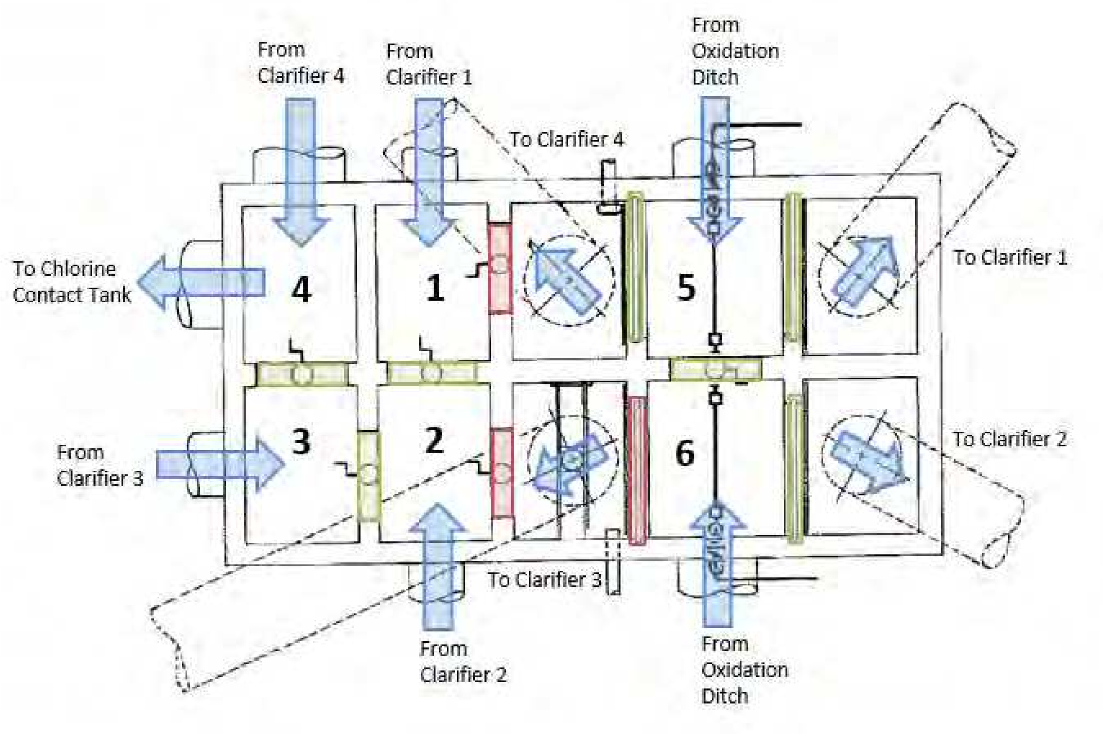


Figure 2. Three Clarifiers in Parallel Configuration



Testing will include:

- SE TSS (effluent trough from each clarifier)
- MLSS (mixed liquor from each oxidation ditch*)
- SVI (mixed liquor from each oxidation ditch*)

  *Note: Sampling will be taken at each oxidation ditch's effluent MLSS sample point and results averaged.

Secondary clarifier effluent sampling will occur at a minimum of five, roughly evenly-spaced times throughout the day. Additional samples will be taken as determined necessary. A minimum of five SE samples per clarifier and two mixed liquor samples will be collected for TSS analysis. Testing will begin directly after sample collection. SVI settling tests will use mixed liquor collected at the same time as samples are collected for MLSS analysis.

Field monitoring will include:

- Blanket level (measured for each clarifier)
- Clarifier distribution box water surface elevation (measured for each active cell)
- Clarifier effluent launder water surface elevation (measured for each clarifier)

Online monitoring will include:

- Plant influent flow – V1019
- Oxidation ditch flow – V1020
- RAS flow – V1002, V1003, V1004, V1005

- WAS flow – V1006, V1007

3.4 Test Days 2 through 4

On the remaining three days of testing, the plant will be operated with fewer clarifiers online to achieve targeted test-condition surface overflow rates. Prior to the start of each day's testing, HDR will coordinate with City staff to confirm the proper number of secondary clarifiers are operating to achieve the desired hydraulic loading rates based on current and expected plant flows for the day (Table 2). HDR staff will work with City staff to also confirm proper positioning of clarifier distribution box gates (Figure 3 through Figure 5) and note current RAS flows, verifying the proper number of clarifiers are operational. Clarifiers 3 and/or 4 should be run in series as polishing clarifiers to allow for testing the first stage clarifier(s) (Clarifier 1 and/or 2) without affecting the plant's ability to comply with effluent permit limits. With only one first stage clarifier operating, running two polishing clarifiers in series (Figure 5) will reduce the hydraulic loading rate to the second stage and provide better settling conditions to capture solids if the first stage clarifier reaches its hydraulic failure point.

Figure 3. Two Clarifiers in Parallel Followed by Two Clarifiers in Series

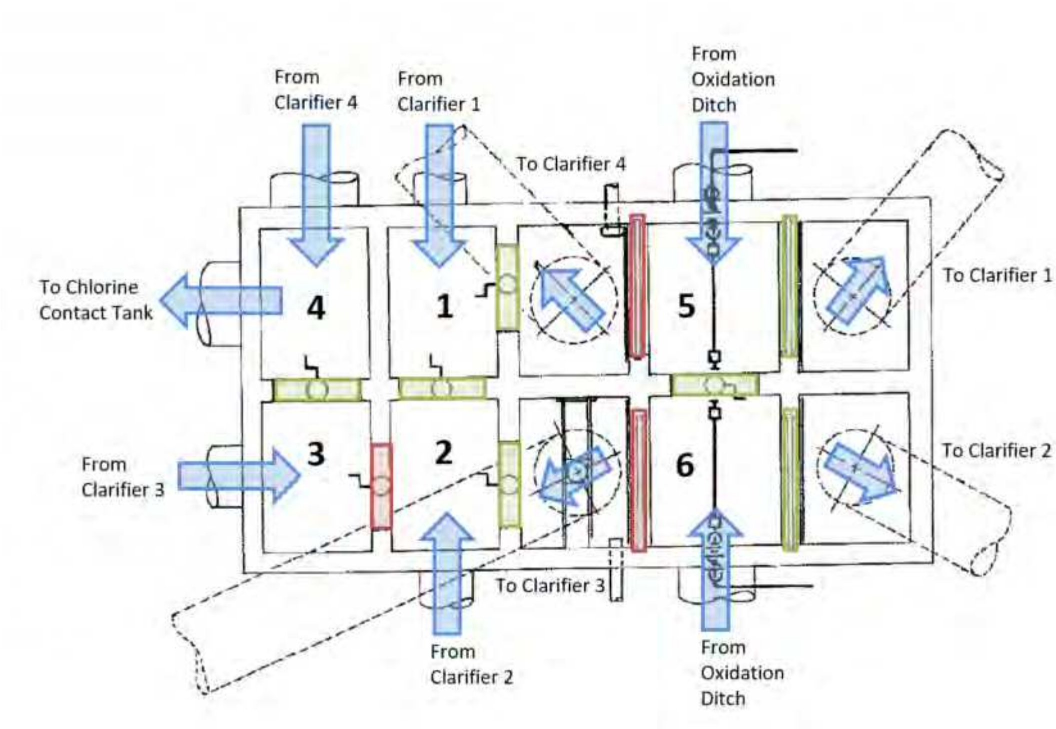


Figure 4. One Clarifier in Parallel Followed by One Clarifier in Series

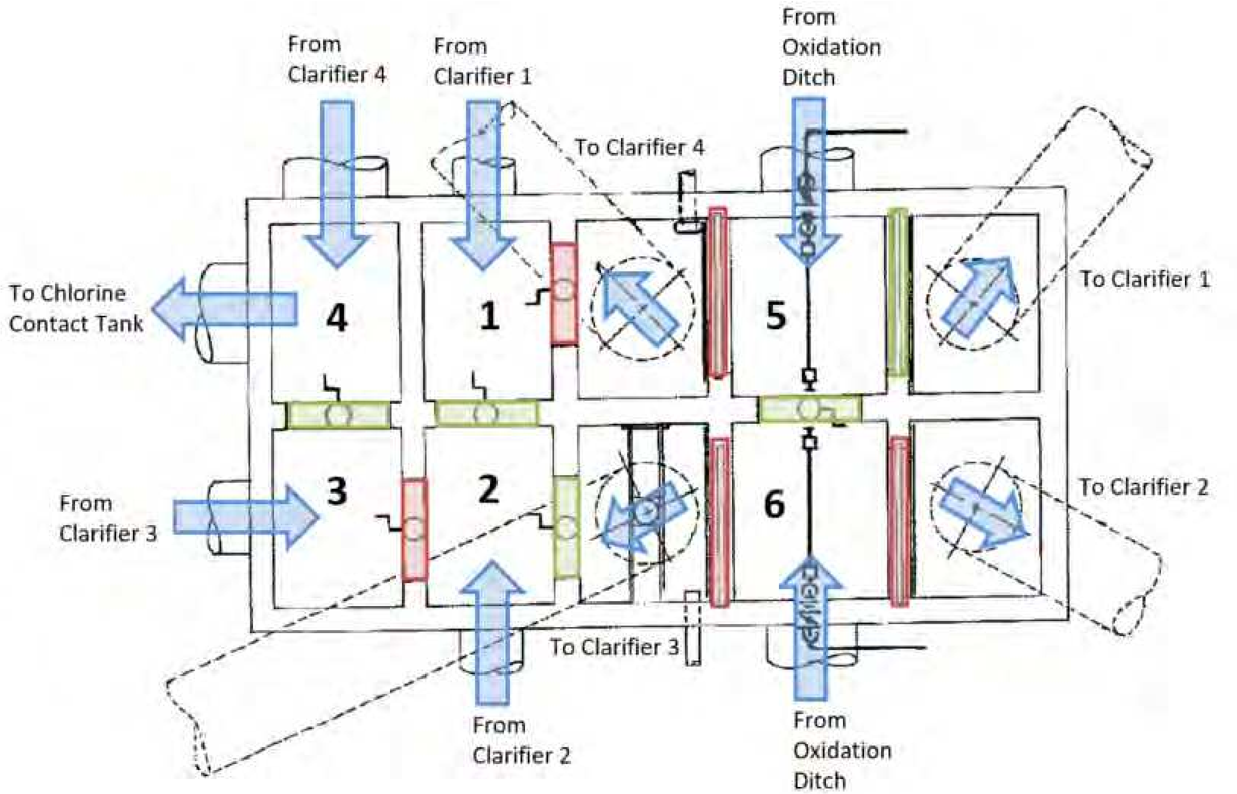
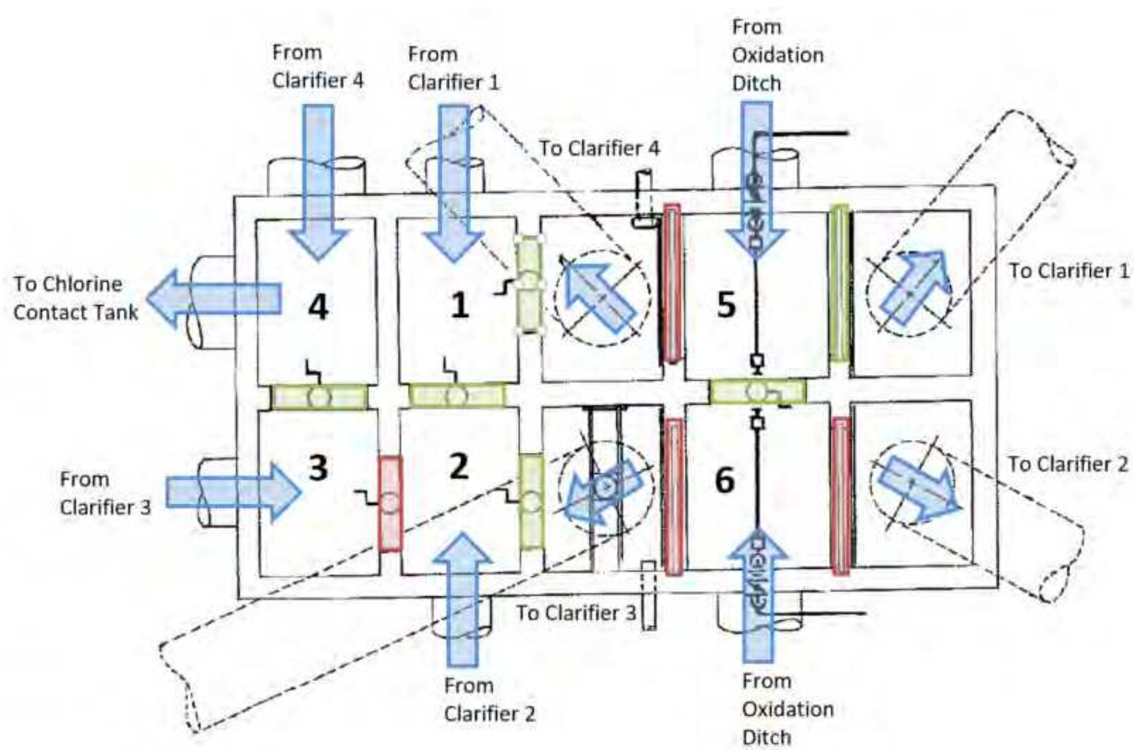


Figure 5. One Clarifier in Parallel Followed by Two Clarifiers in Series



Testing will include:

- SE TSS (effluent trough from each clarifier)
- MLSS (mixed liquor from each oxidation ditch)
- SVI (mixed liquor from each oxidation ditch)

Secondary clarifier effluent sampling will occur at a minimum of five, roughly evenly-spaced times throughout the day. Additional samples will be taken as determined necessary. A minimum of five SE samples per clarifier (including polishing clarifiers) and two mixed liquor samples will be collected for TSS analysis. Testing will begin directly after sample collection. SVI settling tests will use mixed liquor collected at the same time as samples are collected for MLSS analysis.

Field Monitoring will include:

- Blanket level (measured for each clarifier)
- Clarifier distribution box water surface elevation (measured for each active cell)
- Clarifier effluent launder water surface elevation (measured for each clarifier)

Online Monitoring will include:

- Plant influent flow – V1019
- Oxidation ditch flow – V1020
- RAS flow – V1002, V1003, V1004, V1005
- WAS Flow – V1006, V1007

At the end of the day's testing, City can return to operating additional clarifiers if desired.

4 Description of Methods

4.1 Total Suspended Solids

The SE TSS measurements will be used to evaluate the performance of the secondary clarifiers at various surface loading rates and the MLSS concentrations will be used to determine SVIs and solids loading rates, and for mass balance/state point analysis calculations.

1. Collect sufficient quantity of homogenized sample from designated sampling location.
    a. For SE, collect 500 mL from each clarifier's effluent launder, providing sufficient sample quantities for triplicates analysis.
    b. For mixed liquor, collect 25 to 50 mL from the oxidation ditch effluent trough providing sufficient sample quantities for triplicates analysis.
2. Analyze samples for TSS following Standard Method 2540 D.

4.2 Sludge Volume Index

The SVI will be used to assess the settleability of the activated sludge and approximate the settling flux curve envelope.

1. Draw a large sample (>2 L) of mixed liquor from the oxidation ditch effluent trough. Immediately collect approximately 25-50 mL of the unsettled mixed liquor in a small sample container and set aside for TSS analysis following methods described in Section 4.1.
2. Using the remaining sample, fill a settlometer with the sludge sample.
3. Just before starting the timer for the test, stir the sample to ensure mixed liquor is initially well mixed.
4. After 30 minutes of settling, read the volume occupied by the sludge from the settlometer (SV_{30} in mL L-1).
5. After the 30-minute test is complete, analyze the 40 mL sample to determine the TSS (i.e, MLSS) concentration.
6. Calculate the SVI using the following equation, with X_{TSS} being the measured concentration of the sample in g L-1:

$$SVI = \frac{SV_{30}}{X_{TSS}}$$

4.3 Blanket Level

The blanket level will be used to track the solids inventory in the secondary clarifiers and help prevent solids from building up to a level that could affect system performance.

1. Using a sludge judge, identify the depth of the blanket for each operating clarifier.*

   * Note: Ensure rake and skimming arms are not in the immediate vicinity of the location where the sludge judge sampling takes place to prevent damage to the device.

4.4 Clarifier Distribution Box Water Surface Elevation

Visual inspections and measurements of the clarifier distribution box's water surface elevations will be used to evaluate potential hydraulic bottlenecks within the secondary clarification system or downstream treatment systems during high flow conditions.

1. Measure from the top of the distribution box's wall to the water surface and top of weir in a given cell.
2. Repeat measurement for each active cell in the distribution box.

4.5 Clarifier Effluent Water Surface Elevation

Visual inspection of the secondary clarifier effluent launders' water surface elevations will be performed to track potential hydraulic limitations.

1. Visually inspect full circumference of clarifier launder and identify the location of highest launder water surface elevation relative to the top of the weir.

If accessible, measure height between water surface in the launder and top of weir. If not accessible, qualitatively note condition and measure at closest accessible location to assess free flow conditions.

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Appendix E. Jar Testing Protocol

Memo

Date:	Thursday, August 26, 2021
Project:	Newberg WWTP Secondary Clarifier Rerating Study: Potential Chemical Injection Modifications
To:	Paul Chiu, Andrew Shepherd, April Catan, Craig Pack
From:	Jeff Semigran, Karen Bill
Subject:	**Bench Scale Testing Procedure for Ferric Chloride and Polymer**

1.0 Purpose

HDR recently evaluated the secondary clarifier capacity for the City of Newberg (City). As part of the assessment, it was observed that clarifiers had trouble efficiently settling and pumping solids from the tested clarifier, leading to a rapid solids blanket accumulation that overflowed into the clarifier's effluent launders. As part of the study, one of the recommendations to increase existing capacity was to investigate possible sludge settleability improvements, which included the use of coagulants. To support the City in investigating the benefits of coagulant addition this memorandum has been prepared to provide guidance for bench-scale jar testing parameters and protocols that the City's staff can use to evaluate potential improvements to sludge settleability from chemical additions. If settleability improvements are found to be significant, the testing methodology can be adapted and repeated during peak flow/loading events to identify appropriate dosing levels to improve sludge settleability that can be implemented full scale.

2.0 Testing Equipment and Materials

Testing will be conducted in the wastewater treatment plant (WWTP) laboratory using a Phipps and Bird six-gang jar tester. For some of the testing, two 2L settleometers will be used for concurrent SVI testing (1 without chemical addition and 1 with chemical addition).

The City's chemicals of interest are ferric chloride and polymer. The City has access to a 43 percent stock solution of ferric chloride. Dewatering polymer (Praestol K279FLX) can be used and sourced from the bulk neat tank or off of the polymer activation skid. Neat polymer will need activation prior to use in jar testing. Mixed liquor test sample will be from WWTP's oxidation ditch effluent sample point.

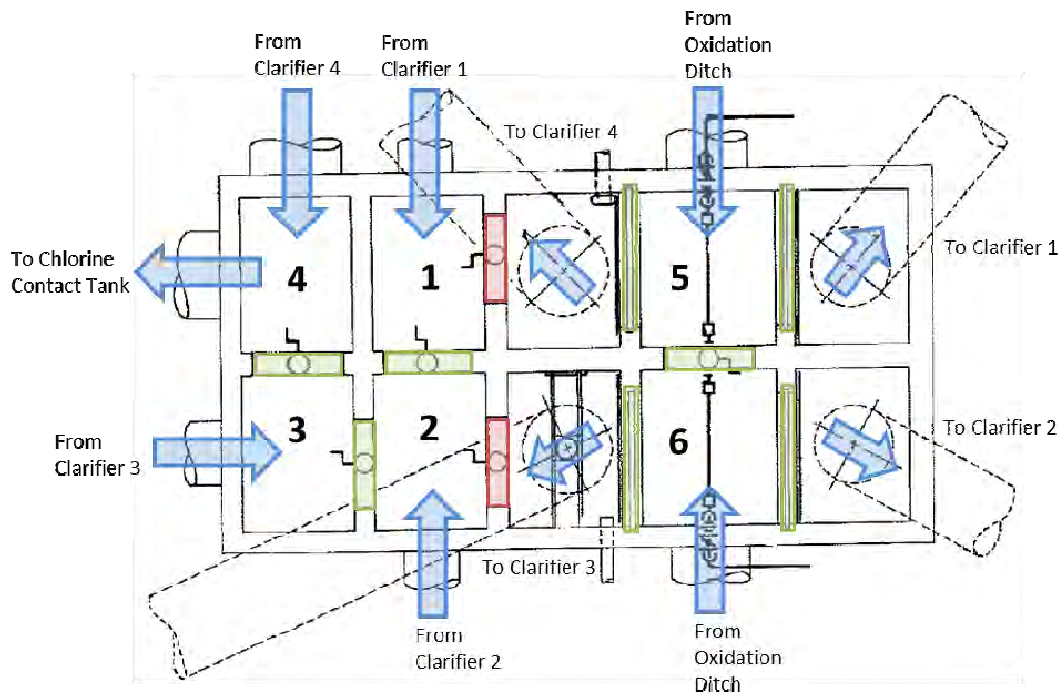
3.0 Test Procedure

Testing procedures vary depending on the testing goals (i.e., initial mixer sizing or dose response to identify appropriate full-scale dose) and past test results (initial tests may dictate different doses, mixing energy, or sampling times). These test procedures provide the City with a testing framework, but City staff should revise testing protocols as necessary to adapt to site-specific conditions and address testing issues that may arise. HDR can assist and answer questions to support a successful outcome.

3.1 Mixing Optimization

City staff have indicated that the existing mixer located in Cell 6 (see Figure 1 for cell reference) has not been operational in the past 13 years or more. Jar testing can be used to evaluate the effectiveness of various levels of mixing with the chemical addition. The results may suggest the City procure new mixing equipment if chemical addition is going to be used full scale, in which case the mixing equipment sizing and configuration could be optimized. The mixing power per unit volume of the mixing reactor can be used to approximate mixing effectiveness. Equation 1 illustrates the relationship between mixing power and the velocity gradient, a commonly used measurement of mixing effectiveness.

Figure 1. Clarifier Distribution Box Configuration



$$P = G^2 V\mu \tag{1}$$

Where:

G = average velocity gradient, sec^{-1}
P= power requirement, W
μ = dynamic viscosity, $N*s/m^2$
V = reactor volume, m^2

Typical rapid mix average velocity gradients for chemical dispersion range between 500 and 1500 sec^{-1} (Metcalf and Eddy 2003). However, most rapid mix systems are implemented for different treatment processes where high mixing energy and shearing of existing floc structures (as have developed in the oxidation ditches) are not a concern or are not applicable. For ferric and polymer addition prior to secondary clarification, sufficient mixing is necessary to ensure proper chemical dispersal, however excessive mixing can have an overall negative impact on settling due to the destruction of existing floc structures. For the jar testing system, the Phipps and Bird paddle speed is limited to 300 RPM, which is equivalent to a velocity gradient of approximately 300 to 350 sec^{-1}. To determine the appropriate average velocity gradient (and mixing power) for new full-scale mixing systems, a bench scale test with the parameters shown in Table 1 could be used. The active ferric chloride and polymer doses span the range of likely effective doses and uses one jar as a control with no chemical addition. To calculate the applied doses needed, use Equation 2. The rapid mix speeds range from 100 RPM (velocity gradient of approx. 90 sec^{-1}) to 300 RPM. To target a 300 sec^{-1} velocity gradient using a recirculation pump mixing system for the clarifier distribution box, it is approximated that a 4 to 5 HP pump would be required.

If both ferric and polymer are being tested, it is recommended that ferric be introduced upstream of (or before) the polymer. For full-scale implementation, one potential dose point is in each of the oxidation ditch effluent boxes. As previously discussed, mixing energy should be limited to minimize the degradation of the existing flocs. If dosing at the oxidation ditch effluent boxes, hydraulic mixing energy can be used to disperse the coagulant, so introducing the ferric just below the weirs would be a recommended option. For the bench scale test, a rapid mix time of 15 seconds is recommended to simulate the mixing in the oxidation ditch effluent boxes.

Mixed liquor with dispersed coagulant would then travel through piping to the clarifier distribution box. Mixing speeds and times that simulate the turbulent flow through the pipe to the clarifier distribution box are noted in Table 1 (referenced as Pipe #1). It is recommended that polymer be added near the oxidation ditch pipes' entrance into the clarifier distribution box. At full-scale, if determined necessary, a small recirculation pump or pump diffusion system could be implemented to provide increased mixing energy. An initial range of polymer doses are noted below but can be revised based on initial testing. Conservatively dosing polymer and limiting overmixing can help prevent biomass from floating to the surface of the clarifiers as polymer in the flocs can entrain air during upstream mixing. Bench scale rapid mix timing for polymer addition is based on an approximated mixing time in the clarifier distribution box at a flow of 24 MGD prior to flow entering each dedicated clarifier's influent box. Mixing speeds and times that simulate the turbulent flow through the pipe to the clarifier center wells are noted in Table 1 (referenced as Pipe #2) with the assumption that 6 MGD is directed to each clarifier. The settling duration is set at 30 minutes with samples taken at various increments.

Table 1. Mixing Optimization Test Parameters

Jar #	Active Ferric Chloride Dose (mg/L)	Ferric Rapid Mix Speed (RPM) [Test #1/2/3]	Ferric Rapid Mix Time (min: secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (mins: secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM) [Test #1/2/3]	Polymer Rapid Mix Time (min: secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (mins: secs)	Settling Time (mins: secs)
1	0	100/ 200/ 300	0:15	60	2:45	0	60/ 90/ 120	0:30	35	1:15	30:00
2	10	100/ 200/ 300	0:15	60	2:45	1	60/ 90/ 120	0:30	35	1:15	30:00
3	20	100/ 200/ 300	0:15	60	2:45	2	60/ 90/ 120	0:30	35	1:15	30:00
4	30	100/ 200/ 300	0:15	60	2:45	3	60/ 90/ 120	0:30	35	1:15	30:00
5	40	100/ 200/ 300	0:15	60	2:45	4	60/ 90/ 120	0:30	35	1:15	30:00
6	50	100/ 200/ 300	0:15	60	2:45	5	60/ 90/ 120	0:30	35	1:15	30:00

It is recommended that ferric be dosed from the stock solution. If a diluted solution is preferred due to equipment limitations or for ease of dosing, limit dilutions to 3 or 4 parts water to 1 part stock solution. More diluted solutions can lead to ferric hydroxide precipitating in the dilution prior to dosing. If precipitates are visible in a ferric dilution, makeup a new less-diluted solution. To determine the dose to apply use the calculation below:

$$\text{Applied Dose (mL)} = \frac{\left[\text{Active Dose Required } \left(\frac{\text{mg}}{\text{L}}\right)\right] * [\text{Beaker Filled Volume (L)}]}{[\text{Diluted or Stock Concentration (\%)}] * [\text{Specific Gravity of Solution}] * \left[\text{Density of Water } \left(1000\,\frac{\text{mg}}{\text{mL}}\right)\right]} \quad (2)$$

For ease and convenience, it is recommended that polymer be supplied from the polymer activation skid. If neat emulsion polymer is being used, produce a batch of activated polymer following the following steps:

1. Determine target polymer dose for activated solution. An active concentration of 0.1% polymer can be used.

2. Determine the amount of polymer and makeup water needed to produce 1L of the targeted active concentration. For example, if the neat emulsion polymer is a 50% stock solution with a specific gravity of 1.00, add 2 mL of neat emulsion polymer to 998 mL water. [2 mL neat solution volume to add = (0.1% target solution concentration) * (1,000,000mg/L) * (1L batch volume) / (50% neat solution concentration) / (1.00 neat solution specific gravity) / (1000 mg/L water density)]

3. Cap bottle and shake bottle vigorously for approximately 30 seconds.
4. Add a magnetic stir bar to the bottle and set bottle on magnetic stir plate set to a low speed to gently continue to mix the solution for 30 to 45 minutes. The colder the makeup water, the longer the maturation/aging period that is required. Do not use hot water.
5. After mixing for 30 to 45 minutes, the solution is ready to be dosed into the jar testing beakers. Use necessary volumes of solution to provide each jar with its target dose.

The steps for the jar testing are as follows:

1. Set aside a sample of mixed liquor for TSS analysis (i.e., MLSS) at the end of the test.
2. Fill six 1L (or 2L) beakers with homogenized mixed liquor.
3. Set jar tester mix speed for the appropriate rapid mixing speed (Set 1: 100 RPM, Set 2: 200 RPM, Set 3: 300 RPM) to simulate the mixing of ferric in the oxidation ditch effluent box.
4. Add ferric at the calculated applied dose.
5. At the end of the rapid mix time, decrease the jar tester mix speed to simulate the turbulence in the pipelines going to the clarifier distribution box (pipe #1 mixing).
6. At the end of the first pipe mixing simulation, increase the mixing speed to simulate the rapid mixing for polymer addition at the clarifier distribution box. Set the mixer to the appropriate speed (Set 1: 60 RPM, Set 2: 90 RPM, Set 3: 120 RPM) as noted in Table 1 and add the polymer.
7. At the end of the rapid mix time, decrease the jar tester mix speed to simulate the turbulence in the pipelines going to the clarifier center wells (pipe #2 mixing).
8. At the end of the second pipe turbulence period, turn off the jar tester and allow the water to settle.
9. At 1 min, 5 min, 10 min, 20 min, and 30 min into the settling period, measure and record the top of the sludge/water interface in each graduated beaker or jar to understand settling characteristics of the sludge. Also observe and note whether any solids are floating to the surface during this period.
10. At the end of the settling period obtain an aliquot of water from the settled supernatant for turbidity analysis.
11. Repeat test varying rapid mix speeds.

3.2 Dose Response

During high flow event, a dose response test, similar to the mixing optimization test, can be carried out to identify target doses for full scale applications. Use the rapid mixing speed that translates most closely to the estimated full-scale rapid mixing velocity gradients. If either full-scale rapid mixing system has an estimated average velocity gradient over 300 sec^{-1}, use 300

RPM (the maximum speed of the jar tester). Key differences from the mixer optimization test parameters include:

- Removal of the lowest two ferric doses and the lowest and highest polymer doses.
- Replacement of two graduated beakers with settleometers to determine SVIs with and without ferric addition. If settleometers do not fit with jar stirring equipment, perform all chemical dosing and mixing using beakers and transfer dosed and stirred mixed liquor to settleometers for final settling period. See test steps below for additional details.
- Omission of repeat testing for various rapid mix speeds.

Table 2. Dose Response Test Parameters

Jar #	Active Ferric Chloride Dose (mg/L)	Ferric Rapid Mix Speed (RPM)[A]	Ferric Rapid Mix Time (min: secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (mins: secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)[A]	Polymer Rapid Mix Time (min: secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (mins: secs)	Settling Time (mins: secs)
1	20	TBD	0:15	60	2:45	1	TBD	0:30	35	1:15	30:00
2	30	TBD	0:15	60	2:45	2	TBD	0:30	35	1:15	30:00
3	40	TBD	0:15	60	2:45	3	TBD	0:30	35	1:15	30:00
4	50	TBD	0:15	60	2:45	4	TBD	0:30	35	1:15	30:00
5 (SVI test)	0	TBD	0:15	60	2:45	0	TBD	0:30	35	1:15	30:00
6 (SVI test)	30	TBD	0:15	60	2:45	2	TBD	0:30	35	1:15	30:00

[A] Use the rapid mix speed that translates most closely to the velocity gradient of the full-scale mixing system.

The steps for the test are as follows with changes from the mixer selection test italicized and bolded:

1. Set aside a sample of mixed liquor for TSS analysis (i.e., MLSS) at the end of the test.
2. Fill ***four 1L (or 2L) beakers and two 2L settleometers*** with homogenized mixed liquor. ***If settleometers do not fit the jar tester equipment, revise dosing of beakers #3 and #4 to be duplicates of beakers #5 and #6. These four jars will be used for SVI testing at the end of the mixing.***
3. Set jar tester mix speed for the appropriate rapid mixing speed (***as determined by the full-scale mixing configuration***) to simulate the mixing of ferric in the oxidation ditch effluent box.
4. Add ferric at the calculated applied dose.
5. At the end of the rapid mix time, decrease the jar tester mix speed to simulate the turbulence in the pipelines going to the clarifier distribution box (pipe # 1 mixing).
6. At the end of the first pipe mixing simulation, increase the mixing speed to simulate the rapid mixing for polymer addition at the clarifier distribution box. Set the mixer to the appropriate speed (***as determined by the full-scale mixing configuration***) and add the polymer.

7. At the end of the rapid mix time, decrease the jar tester mix speed to simulate the turbulence in the pipelines going to the clarifier center wells (pipe #2 mixing).
8. At the end of the second pipe turbulence period, turn off the jar tester. ***If settleometers were used for beakers #5 and #6, start the settling period allowing solids in all beakers to settle. If settleometers did not fit with the jar tester equipment, carefully transfer liquid from beakers #3 and #5 (beakers without chemical addition) to one settleometer and liquid from beakers #4 and #6 (beakers with chemical addition) to the second settleometer. Briefly stir all beakers gently to resuspend flocs and then begin settling period.***
9. At 1 min, 5 min, 10 min, 20 min, and 30 min into the settling period, measure and record the top of the sludge/water interface in each graduated beaker or jar to understand settling characteristics of the sludge. Also observe and note whether any solids are floating to the surface during this period.
10. At the end of the settling period obtain an aliquot of water from the settled supernatant for turbidity analysis.
11. ***Calculate SVI for mixed liquor in the two settleometers based on MLSS and 30 min sludge volumes.***

If not using one of the two chemicals, at the step where that chemical is normally added, skip the dosing of the omitted chemical while still maintaining the same mixing stage durations.

4.0 Results to Collect

- Measure TSS of the mixed liquor using WWTP instruments.
- Measure turbidity of the settled supernatant using WWTP instruments.
- Record settled sludge volumes at 1 min, 5 min, 10 min, 20 min, 30 min for all jars. It is also recommended that the settling period be documented with photos and/or videos to provide a visual record of floc sizes, settling rate, turbidity, and any testing abnormalities (e.g., floating solids) that can be used for future comparison.
- Calculate SVI for the two settleometers in the test.

SVI improvements can be used to approximate magnitude of benefits of chemical additions as well as for state point analyses. Rate of settling and supernatant turbidity can be used to determine appropriate chemical doses.

Appendix F. Jar Testing Results Memo

Memo

Date:	Thursday, September 30, 2021
Project:	Newberg WWTP Secondary Clarifier Rerating Study: Potential Chemical Injection Modifications
To:	Paul Chiu, Andrew Shepherd, April Catan, Craig Pack
From:	Jeff Semigran, Karen Bill
Subject:	**Bench Scale Jar Testing Results**

1 Purpose

HDR recently evaluated the secondary clarifier capacity for the City of Newberg (City). As part of the assessment it was observed that clarifiers had trouble efficiently settling and pumping solids from the tested clarifier. This lead to a rapid solids blanket accumulation that overflowed into the clarifier's effluent launders. As part of the study, one of the recommendations to increase existing capacity was to investigate possible sludge settleability improvements, which included the use of coagulants. The City has carried out jar testing to provide an initial characterization of the sludge settleability improvements from chemical addition.

2 Test Conditions

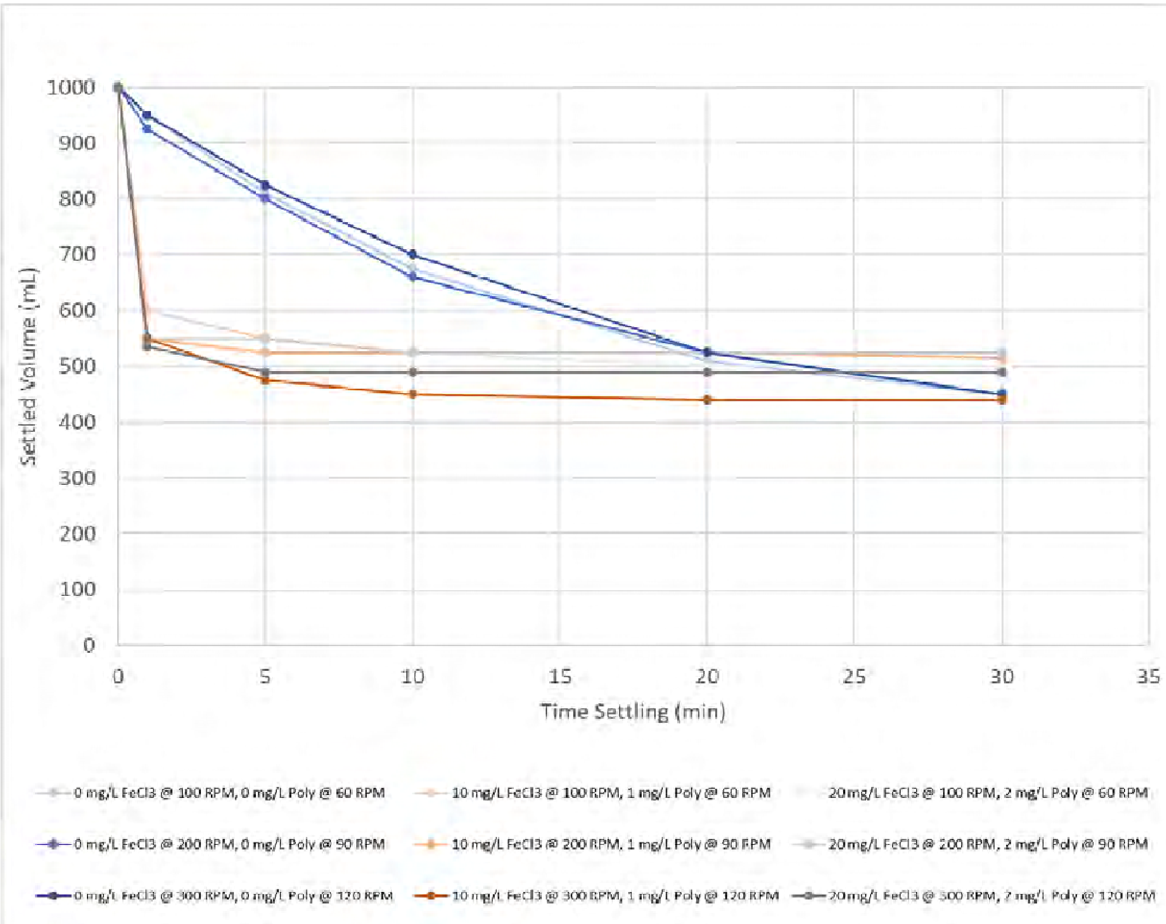
Jar testing was performed by Wastewater Treatment Plant (WWTP) staff between September 17 and 23, 2021. HDR's August 2021 *Bench Scale Testing Procedure for Ferric Chloride and Polymer* memo describes the initial test plan guidance the City adopted for their testing. Testing procedures were adjusted by City staff as necessary based on initial test runs. Testing included initial mixing optimization to compare performance at various rapid mixing speeds for both ferric and polymer injection. Testing was then replicated without ferric addition (i.e., with only polymer addition) to compare performance as it was hypothesized that ferric addition would not provide significant benefit to sludge settleability. Based on the first few sets of tests, an additional round of testing was performed at optimal doses using settleometers to determine sludge volume indexes (SVIs) as a method to quantify chemical dosing improvements on a useful scale that WWTP staff are familiar. The City's testing data is reported in Attachment A.

3 Test Results

3.1 Ferric and Polymer Testing

City staff performed dose response tests at various mixing speeds to understand the impact of mixing energy on the settleability improvements from chemical addition. When dosing both ferric and polymer, the mixed liquor in the two low-dose jars (10 mg/L $FeCl_3$ with 1 mg/L polymer and 20 mg/L $FeCl_3$ with 2 mg/L polymer) rapidly settled in the first minute with minimal additional compaction after that point (Figure 1). Across the mixing speeds tested, the highest mixing speed performed slightly better from a settleability standpoint, with minimal differences in supernatant quality.

Figure 1. Tests #1-3 Settling Profile Comparison



While some of the higher dosed jars (30 to 50 mg/L FeCl3 with 3 to 5 mg/L polymer) often reached similar levels of compaction at the end of the 30-minute period (Figure 2, Figure 3, and Figure 4), the mixed liquor in those jars settled more gradually and were found to have significantly higher turbidities in their supernatant (Figure 5). City staff noted that ferric hydroxide precipitates were visible in those jars' supernatant, and likely a main cause of the higher turbidity.

Figure 2. Jar Test #1 Settling Profile (Low Speed Mixing)

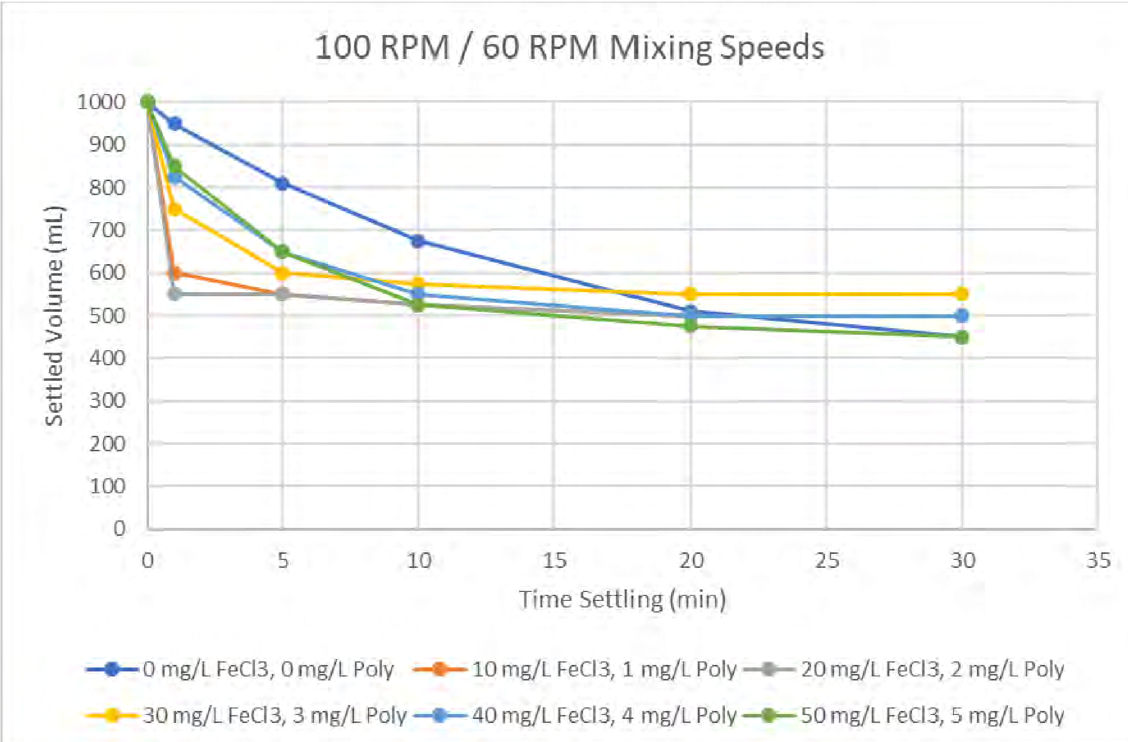


Figure 3. Jar Test #2 Settling Profile (Medium Speed Mixing)

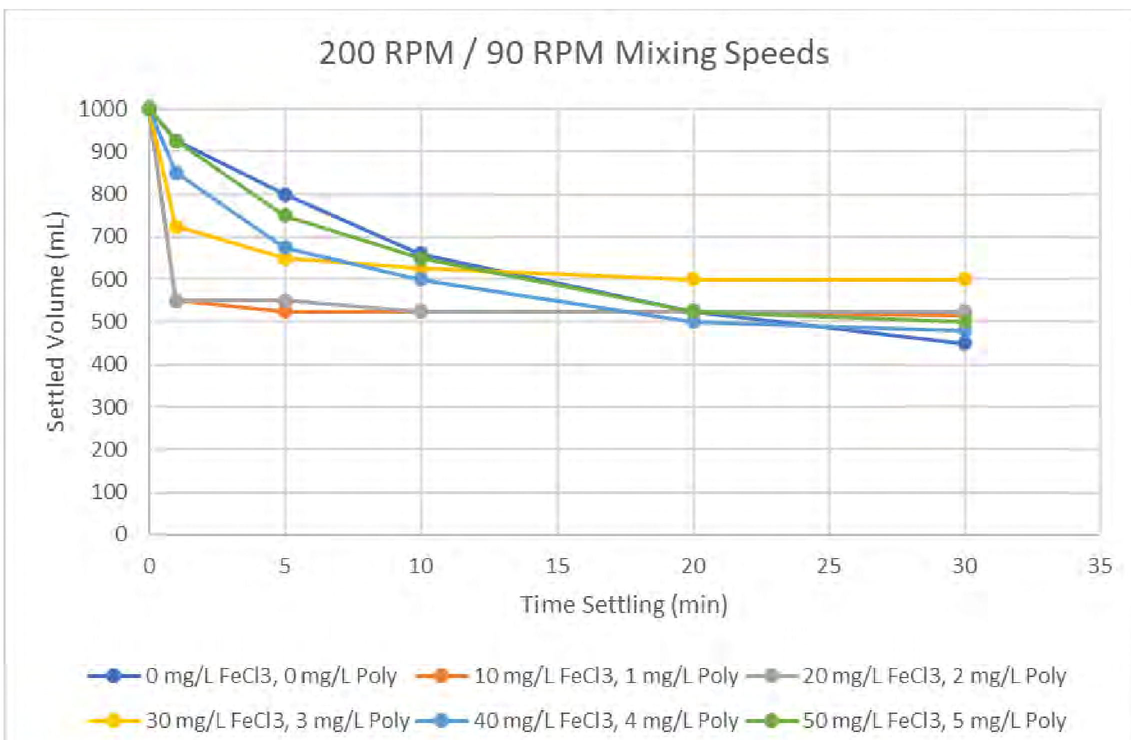


Figure 4. Jar Test #3 Settling Profile (High Speed Mixing)

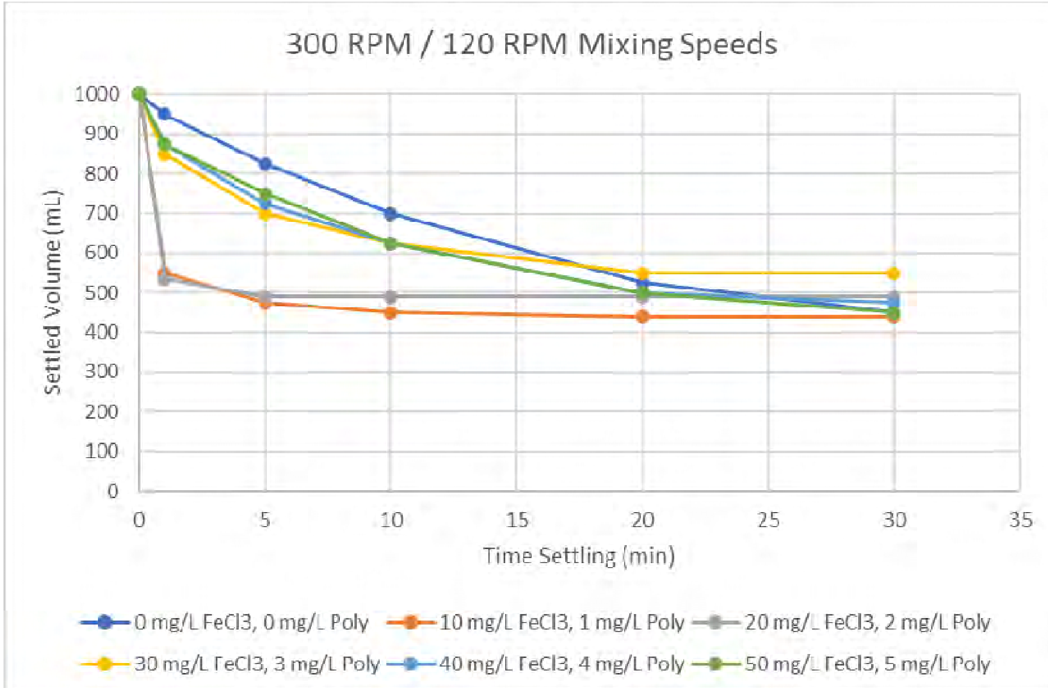
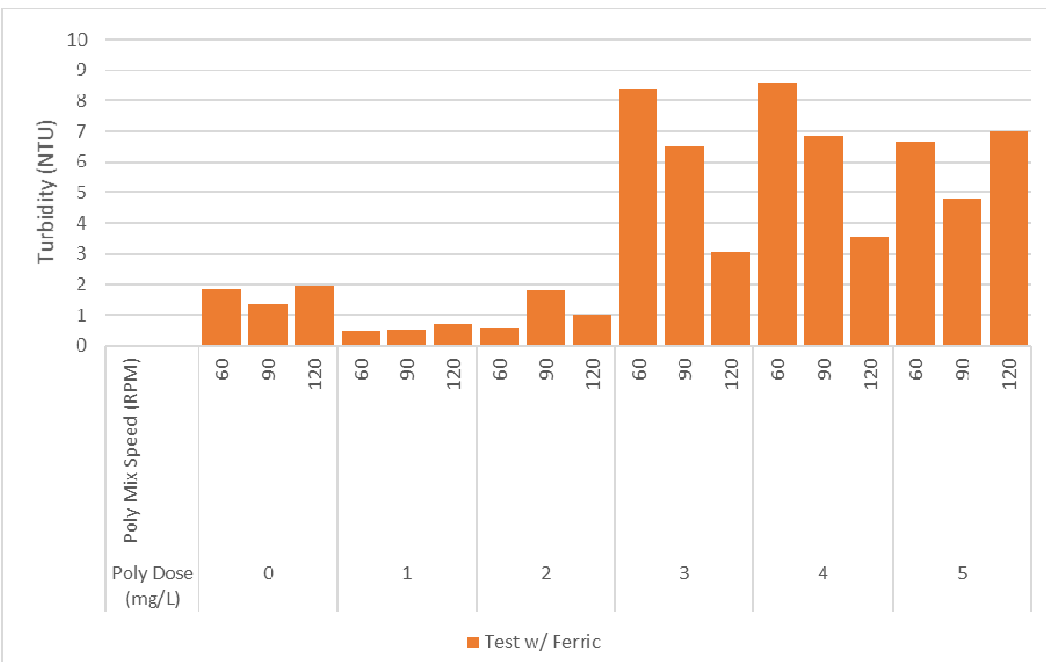


Figure 5. Supernatant Turbidity with Ferric and Polymer Addition



3.2 Polymer-Only Testing

In comparison the polymer-only dosed jars consistently settled more quickly than the jars tested with ferric addition, especially at the higher polymer doses (Figure 6), The polymer-only jars' final (i.e., 30-minute) compacted volumes were similar to those of both the jars tested with ferric added and the control jars with no chemical addition, except for at the two lowest polymer doses where compaction was increased. Turbidities for polymer-only jars did not show improvement over the control jars (i.e., no chemical addition) and performed slightly worse to the jars with ferric addition (Figure 7).

Figure 6. Settling Profiles With and Without Ferric

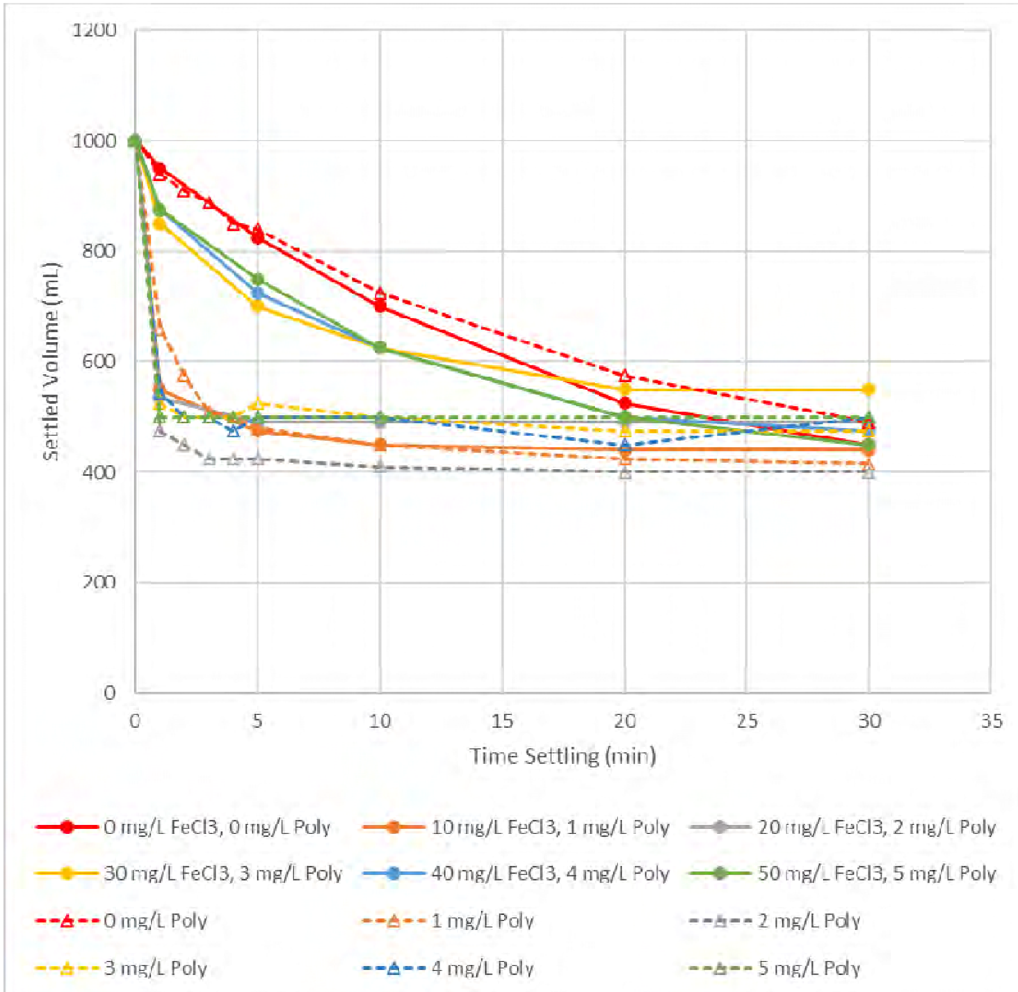
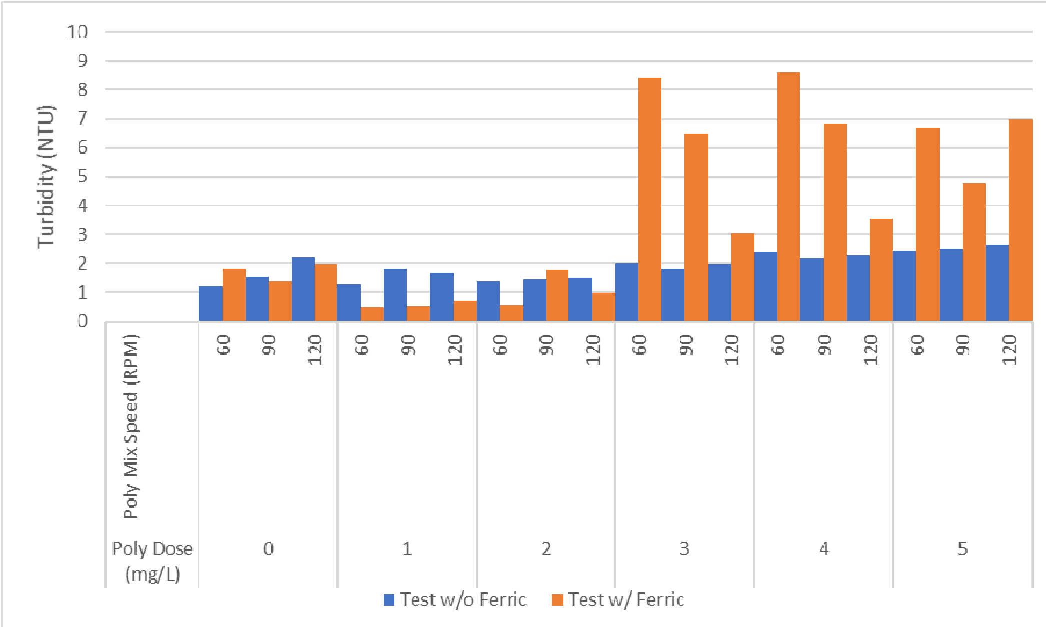
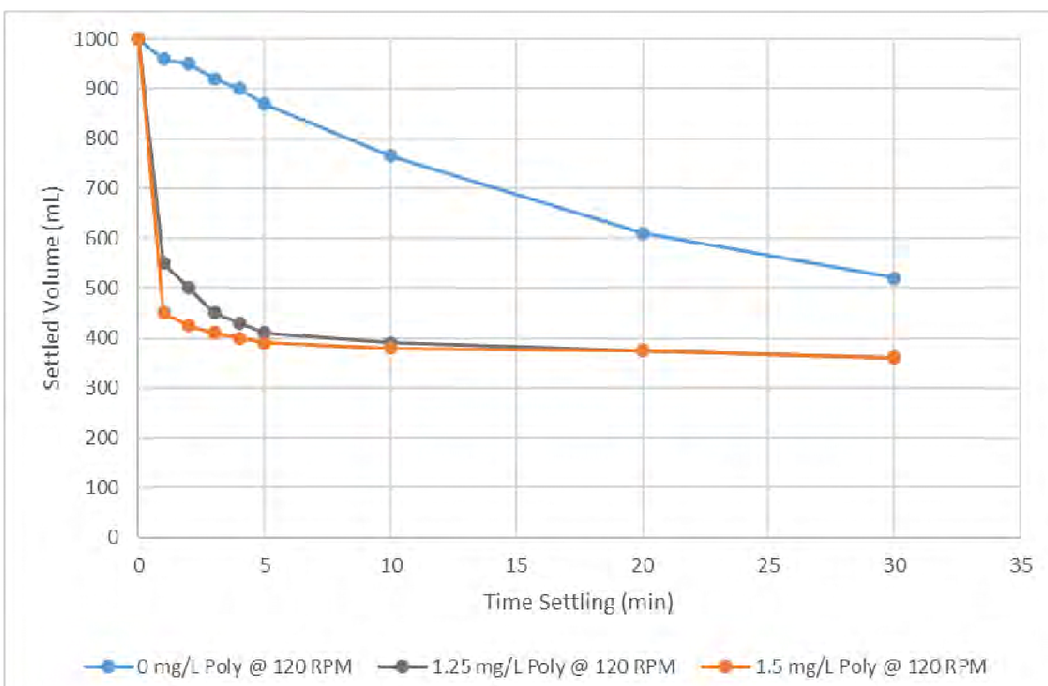


Figure 7. Supernatant Turbidity with Polymer Addition with and without Ferric



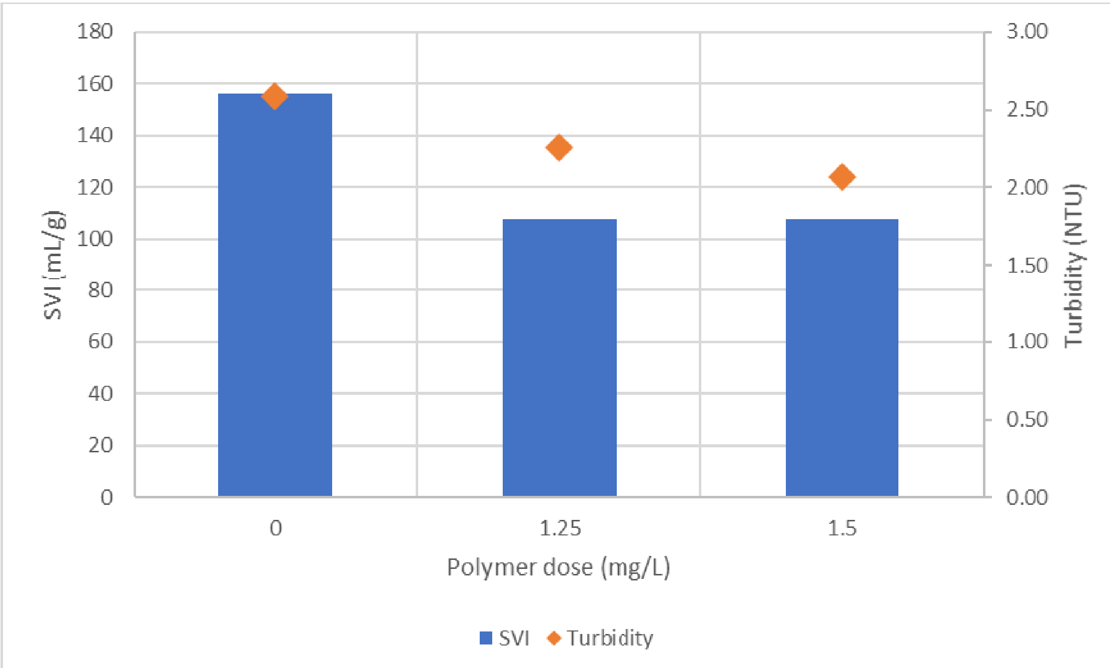
Based on the dose response testing at various mixing speeds and chemical doses, the City performed an additional set of tests at the highest mixing speed, targeting polymer doses between 1 and 2 mg/L. This testing was done with settleometers in the place of some of the jars so that SVIs could also be used to compare the chemically dosed jars and the jars without chemicals added. The two jars with polymer dosed at 1.25 mg/L and 1.5 mg/L followed the previously described trends where rapid settling occurred within the first few minutes (Figure 8).

Figure 8. Test #7 Settling Profile in Settleometers



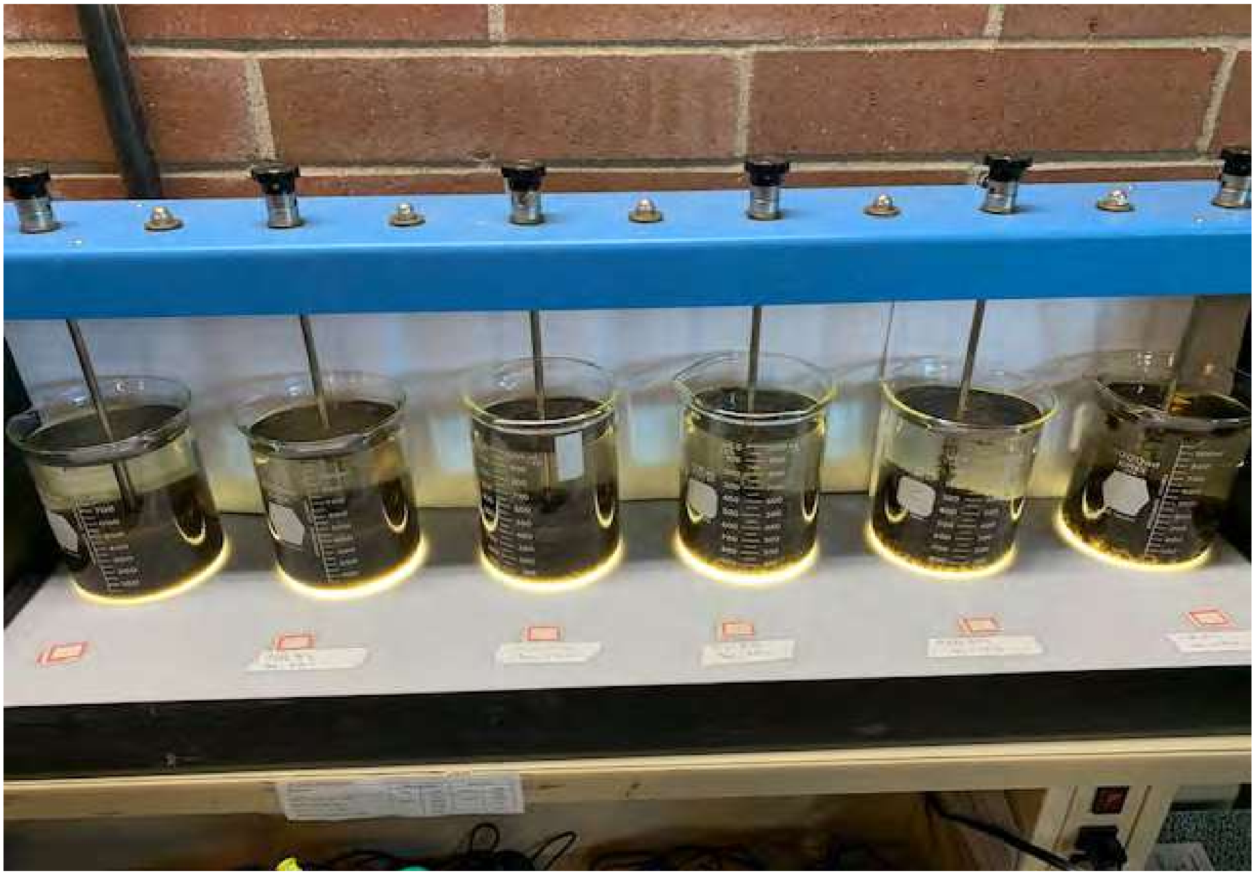
As noted previously for jars with low polymer doses (less than 2 mg/L), the compacted volume after 30 minutes of settling was noticeably improved when compared to the settleometer without any chemical addition, leading to a lower calculated SVI for those jars (Figure 9). The supernatant turbidity was slightly improved for the chemically dosed jars.

Figure 9. Test #7 SVI and Supernatant Turbidity



There was noticeably more floating solids at the end of the testing in the chemically dosed jars than in the jars without chemical additions. The far-left jar in Figure 10 had no chemical addition and shows the least amount of floating solids. As the chemical dose increased from left to right, the amount of floating solids also increased. While limited amounts of floating solids may not present a major operational concern, it should be monitored in any further testing or full-scale implementation as overdosing polymer or overmixing polymer and entraining air, can lead to serious operational issues with large quantities of solids floating to the surface and leaving in the overflow. Floating solids may be an improvement to an already overloaded clarifier but should be minimized as much as possible.

Figure 10. Floating Solids at End of Settling Period



4 Conclusions and Recommendations

4.1 Conclusions

Study conclusions are:

- Based on current mixed liquor characteristics, polymer doses between 1 and 2 mg/L, and without any ferric addition, appear optimal and should provide a useful starting range for future testing during high-flow, or poor-settling periods.
- Polymer addition appears to benefit the initial settling. Polymer addition in the 1 to 2 mg/L range significantly increased sludge settling rates in the initial settling regimes (discrete and hindered settling occurring in approximately the first 5 minutes).
- Polymer addition appeared to also benefit solids compaction and led to thickener sludge (characterized by the 30-minute settling volumes). Better compaction allows a lower RAS rate, which lowers the clarifier solids load. The final test using polymer doses at 1.25 and 1.5 mg/L showed SVI improvements from 156 to 108 mL/g.
- Including low doses of ferric along with the polymer provided minor benefits to supernatant (i.e., effluent) turbidity over polymer use alone. High ferric doses (greater than 20 mg/L in this testing) showed to have a negative effect on turbidity, likely caused by the precipitation

of ferric hydroxide. It is important to note, turbidity is not a testing parameter currently requiring improvement nor optimization, but is being used as one indicator to monitor for chemical overdosing and poor clarification (i.e., poor solids capture of small, suspended solids and flocs).

4.2 Recommendations

The results of the jar testing show the addition of polymer significantly improves the solids settling velocity. Therefore it is recommended the City consider the use of polymer addition at the secondary clarifiers during peak events in planning to accommodate future flows and expansion. This option should continue to be evaluated with the others discussed in HDR's September 2021 *Secondary Clarifier Stress Testing Study* report (i.e., additional RAS pumping capacity and gravimetric selective wasting). Additional considerations:

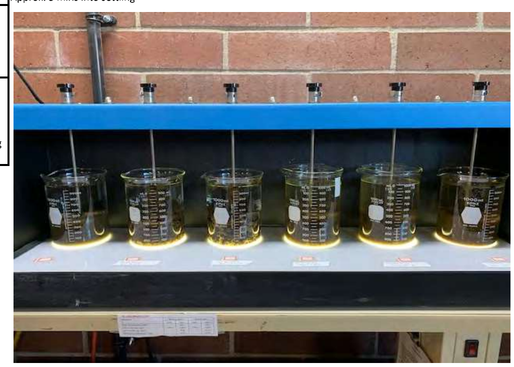
- If configuring a full-scale polymer dosing system in the future, dosing at the first cell of the Clarifier Distribution Box is recommended.
- Appropriate polymer dispersion methods should be considered to provide proper mixing energy and minimize the quantity of air introduced into the mixing process that can become entrained and lead to floating sludge in the clarifiers. Standard vertical flash mixers are not recommended for this application as they often introduce significant air into the fluid. One potential mixing option includes discharging into the mixed liquor pipes just prior to where they enter the splitter box using a chemical feed pipe that discharges polymer against the mixed liquor's flow direction to provide turbulent mixing. Another chemical dispersion method to consider includes locating submersible pumps in the splitter box and injecting polymer near the suction of those pumps where the chemical would be pulled through the pump and mixed in with the surrounding fluid. Evaluation of options should consider the optimal velocity gradient based on jar testing results (optimal G was approximately 100 1/s from initial testing).
- During the testing period, SVIs ranged between 150 and 190 mL/g. The City could consider additional jar testing during events when SVIs are poor (250 mL/g or more) to determine the extent of setting improvements with chemical dosing.
- Any initial full-scale implementation should be tested during dry weather periods to understand system operations and troubleshoot any dosing system issues during a period when the system is not overloaded and clarifiers can be run in series if needed.

Attachment A. City of Newberg Testing Data

2021 Mixing Optimization Test Parameters

Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	100	0:15	60	2:45	0	60	0:30	35	1:15	1	950		
											5	810		
											10	675	1.82	
											20	510		
											30	450		SVI = 182
2	10	100	0:15	60	2:45	1	60	0:30	35	1:15	1	600		
											5	550		
											10	525	0.48	
											20	500		Settled very quickly w/ polymer addition. Very
											30	500		clear supernatant, but very clumpy sludge
3	20	100	0:15	60	2:45	2	60	0:30	35	1:15	1	550		
											5	550		
											10	525	0.57	
											20	500		
											30	500		More clumpy even than #2
4	30	100	0:15	60	2:45	3	60	0:30	35	1:15	1	750		
											5	600		
											10	575	8.39	Iron precipitate in supernatant; sludge fluffier
											20	550		and large floc; settled quicker initially than #4
											30	550		and #5; OK compaction
5	40	100	0:15	60	2:45	4	60	0:30	35	1:15	1	825		
											5	650		
											10	550	8.60	Iron precipitate in superntant; Good
											20	500		compaction; continued compaction
											30	500		throughout test
6	50	100	0:15	60	2:45	5	60	0:30	35	1:15	1	850		
											5	650		
											10	525	6.68	
											20	475		Iron precipitate in supernatant; continued
											30	450		compaction throughout, but slowest settling
Date:	9/16/2021	MLSS:	3348	SVI:	182									of Jars 4-6

Approx. 5 mins into settling

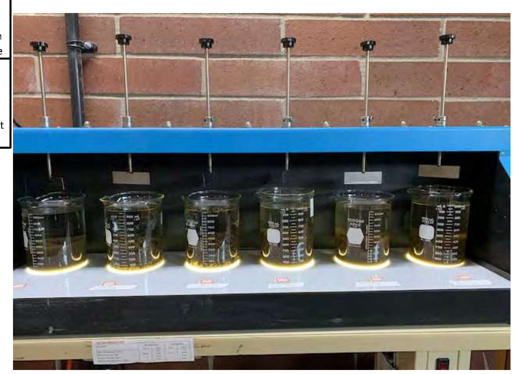


After 30 minutes of settling

2021 Mixing Optimization Test Parameters

Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	200	0:15	90	2:45	0	90	0:30	35	1:15	1	925		
											5	800		
											10	660	1.35	
											20	525		
											30	450		SVI: 172
2	10	200	0:15	90	2:45	1	90	0:30	35	1:15	1	550		
											5	525		
											10	525	0.527	Clear supernatatnt; very large floc; less clumping than 100 RPM; some floating solids near and on surface
											20	525		
											30	515		
3	20	200	0:15	90	2:45	2	90	0:30	35	1:15	1	550		
											5	550		
											10	525	1.78	Clear supernatant; very large floc; clumping almost identical to #2; some floating solids near and on surface
											20	525		
											30	525		
4	30	200	0:15	90	2:45	3	90	0:30	35	1:15	1	725		
											5	650		
											10	625	6.48	Large fluffy floc, poor compaction; supernatant much clearer than 100 RPM, but still a bit orange
											20	600		
											30	600		
5	40	200	0:15	90	2:45	4	90	0:30	35	1:15	1	850		
											5	675		
											10	600	6.84	
											20	500		Settling slower than #4; supernatant much clearer than 100 RPM, but still a bit orange
											30	480		
6	50	200	0:15	90	2:45	5	90	0:30	35	1:15	1	925		
											5	750		
											10	650	4.78	
											20	525		
											30	500		Settling slow and similar to #1; supernatant clearest of #4-6, bit still a bit orange
Date:	9/17/2021	MLSS:	3576	SVI:	172									

Approx. 5 mins into settling

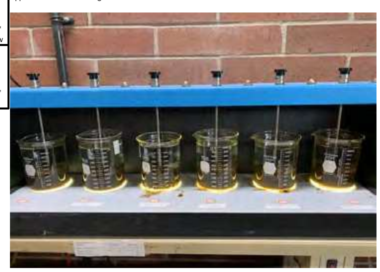


After 30 mins of settling

2021 Mixing Optimization Test Parameters

Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	300	0:15	300	2:45	0	120	0:30	35	1:15	1	950		
											5	825		
											10	700	1.97	
											20	525		
											30	450		SVI: 176
2	10	300	0:15	300	2:45	1	120	0:30	35	1:15	1	550		
											5	475		Decent sludge quality; large, but not clumpy floc; rapid settling; some floating solids on surface (see photo below); very good compaction
											10	450	0.722	
											20	440		
											30	440		
3	20	300	0:15	300	2:45	2	120	0:30	35	1:15	1	535		
											5	490		
											10	490	0.999	**Some MLSS spilled during rapid mixing** Very clumpy sludge, good supernatant; some floating solids; not good compaction
											20	490		
											30	490		
4	30	300	0:15	300	2:45	3	120	0:30	35	1:15	1	850		
											5	700		
											10	625	3.05	
											20	550		Much clearer supernatant than 100 & 200 RPM; settling rate slower than previous tests
											30	550		
5	40	300	0:15	300	2:45	4	120	0:30	35	1:15	1	875		
											5	725		
											10	625	3.55	
											20	500		**Some MLSS spilled during rapid mixing** Supernatant much clearer; settling rate slow
											30	475		
6	50	300	0:15	300	2:45	5	120	0:30	35	1:15	1	875		
											5	750		
											10	625	6.99	
											20	500		
											30	450		**Some MLSS spilled during rapid mixing** Supernatant more turbid than #4 & #5
Date:	9/17/2021	MLSS:	3416	SVI:	176									

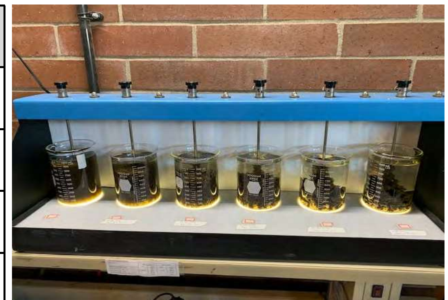
Approx. 5 mins into settling



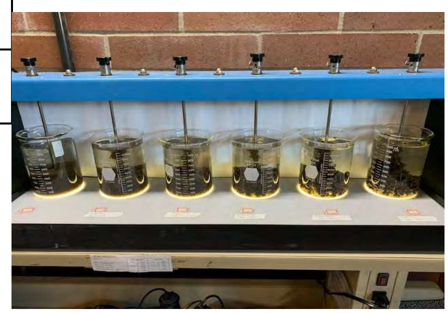
After 30 mins of settling

2021 Mixing Optimization Test Parameters

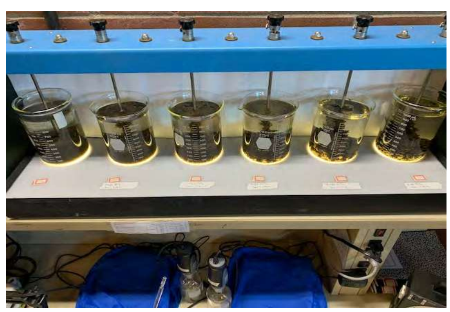
Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	100	0:15	60	2:45	0	60	0:30	35	1:15	1	925		
											5	810		
											10	700	1.20	
											20	550		
											30	500		SVI: 183
2	0	100	0:15	60	2:45	1	60	0:30	35	1:15	1	600		
											5	450		
											10	425	1.30	Fair amount of solids on surface; good compaction and floc; decent settling speed; extremely clear supernatant
											20	425		
											30	425		
3	0	100	0:15	60	2:45	2	60	0:30	35	1:15	1	525		
											5	500		
											10	475	1.36	Fair amount of solids on surface; decent compaction, but fluffier floc; poorer settling speed; extremely clear supernatant
											20	475		
											30	475		
4	0	100	0:15	60	2:45	3	60	0:30	35	1:15	1	525		
											5	450		
											10	450	2.02	Floating solids; very rapid settling; flocs very clumpy w/ bad to no compaction; clear supernatant
											20	450		
											30	450		
5	0	100	0:15	60	2:45	4	60	0:30	35	1:15	1	550		
											5	500		
											10	500	2.40	
											20	500		Extremely clumpy floc; rapid settling; no compaction; clear supernatant
											30	500		
6	0	100	0:15	60	2:45	5	60	0:30	35	1:15	1	575		
											5	525		
											10	525	2.43	
											20	525		
											30	525		Extremely clumpy floc; rapid settling; no compaction; clear supernatant
Date:	9/20/2021	MLSS:	3552	SVI:	183									



Approx. 1 minute of settling



30 mins of settling



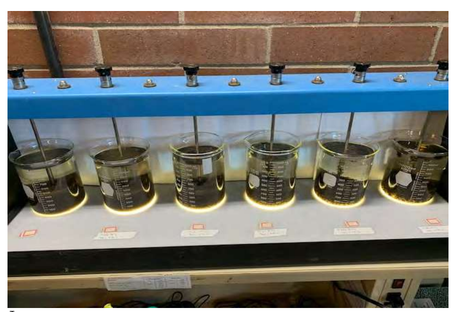
Solids on surface

2021 Mixing Optimization Test Parameters

Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	200	0:15	60	2:45	0	90	0:30	35	1:15	1	950		2 Min: 910
											5	825		3 min: 890
											10	700	1.55	4 min: 850
											20	550		
											30	460		SVI: 174
2	0	200	0:15	60	2:45	1	90	0:30	35	1:15	1	825		2 min: 710
											5	530		3 min: 625
											10	450	1.83	4 min: 575
											20	425		Fast settling; great compaction; clear
											30	410		supernatant; solids on surface
3	0	200	0:15	60	2:45	2	90	0:30	35	1:15	1	525		2 min: 475
											5	450		3 min: 475
											10	430	1.43	4 min: 450
											20	425		Fast settling; great compaction; clear
											30	410		supernatant; solids on surface
4	0	200	0:15	60	2:45	3	90	0:30	35	1:15	1	550		2 min: 525
											5	500		3 min: 500
											10	500	1.81	4 min: 500
											20	500		Clumpy; no compaction; fast settling; clear
											30	500		supernatant
5	0	200	0:15	60	2:45	4	90	0:30	35	1:15	1	525		2 min: 500
											5	500		3 min: 500
											10	500	2.15	4 min: 500
											20	500		More clumpy; no compaction; fast settling;
											30	500		clear supernatant
6	0	200	0:15	60	2:45	5	90	0:30	35	1:15	1	500		2 min: 450
											5	450		3 min: 450
											10	450	2.52	4 min: 450
											20	450		
											30	450		Extremely clumpy; no compaction; fast
Date:	9/21/2021	MLSS:	3640	SVI:	174									settling; clear supernatant

Approx. 10 minutes (forgot to capture 1 min)

30 mins

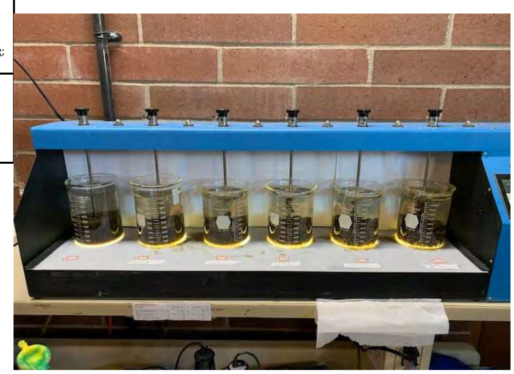


Top

2021 Mixing Optimization Test Parameters

Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	300	0:15	60	2:45	0	120	0:30	35	1:15	1	940		2 min: 910
											5	840		3 min: 890
											10	725	1.11	4 min: 850
											20	575		
											30	490		SVI: 171
2	0	300	0:15	60	2:45	1	120	0:30	35	1:15	1	660		2 min: 575
											5	480		3 min: 510
											10	450	1.65	4 min: 500
											20	425		Good compaction; clear supernatant; fast
											30	415		settling after 1 min; some surface solids
3	0	300	0:15	60	2:45	2	120	0:30	35	1:15	1	475		2 min: 450
											5	425		3 min: 425
											10	410	1.52	4 min: 425
											20	400		Great compaction; clear supernatant; fastest
											30	400		settling; some surface solids
4	0	300	0:15	60	2:45	3	120	0:30	35	1:15	1	525		2 min: 500
											5	525		3 min: 500
											10	500	1.98	4 min: 500
											20	475		Clumping; fast settling; no compaction; clear
											30	475		supernatant
5	0	300	0:15	60	2:45	4	120	0:30	35	1:15	1	545		2 min: 500
											5	500		3 min: 500
											10	500	2.30	4 min: 475
											20	450		Very clumpy; no compaction; fast settling;
											30	500		clear supernatant
6	0	300	0:15	60	2:45	5	120	0:30	35	1:15	1	500		2 min: 500
											5	500		3 min: 500
											10	500	2.63	4 min: 500
											20	500		
											30	500		Extremely clumpy; no compaction; fast
Date:	9/21/2021	MLSS:	3516	SVI:	171									settling; clear supernatant

Approx. 1 min

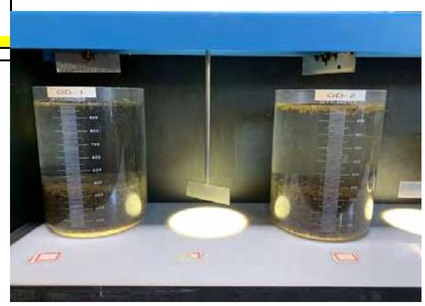


30 min

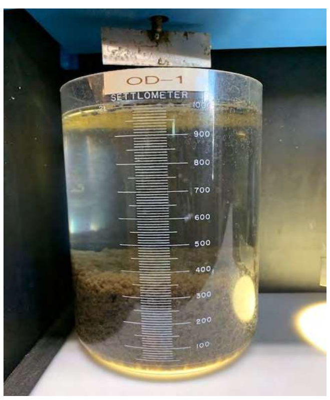
2021 Dose Response Test Parameters

Jar #	Activer Ferric Chloride Dose (mg/L	Feric Rapid Mix Speed (RPM)	Ferric Rapid Mix Time (min:secs)	Pipe #1 Mix Speed (RPM)	Pipe #1 Mix Time (min:secs)	Active Polymer Dose (mg/L)	Polymer Rapid Mix Speed (RPM)	Polymer Rapid Mix Time (min:secs)	Pipe #2 Mix Speed (RPM)	Pipe #2 Mix Time (min: secs)	Settling Time (min:secs)	Settling Measured (mL)	Turbidity (NTU)	Notes
1	0	300	0:15	60	2:45	1.25	120	0:30	35	1:15	1	550		2 min: 500
											5	410		3 min: 450
(2L)											10	390	2.26	4 min: 430
														Slightly slower settling than #2; clear supernatant; good compaction; some solids on surface
											20	375		
											30	360		
2	0	300	0:15	60	2:45	**1.5**	120	0:30	35	1:15	1	450		2 min: 425
(2L)											5	390		3 min: 410
SVI Test											10	380	**2.07**	4 min: 400
														Fast settling; clear supernatant; good
Target											20	375		compaction; some solids on surface
											30	360		**SVI: 108**
3	0	300	0:15	60	2:45	0	120	0:30	35	1:15	1	950		2 min: 925
											5	825		3 min: 880
(1L)											10	700	2.60	4 min: 850
											20	525		
											30	450		
4	0	300	0:15	60	2:45	0	120	0:30	35	1:15	1	950		2 min: 925
											5	825		3 min: 880
(1L)											10	700	2.58	4 min: 850
											20	550		
											30	475		
5	0	300	0:15	60	2:45	0	120	0:30	35	1:15	1	960		2 min: 950
(SVI test)											5	870		3 min: 920
Control											10	765		4 min: 900
											20	610		*Combined contents of Jars 3 & 4 to run SVI
											30	520		**SVI: 156**
Date:	9/23/2021	MLSS:	3336		SVI:	156								

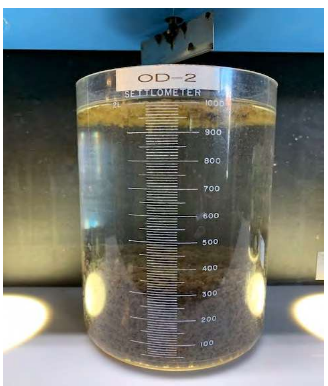
Approx 1 min settling



30 mins settling



Jar #1 at 30 mins



Jar #2 at 30 mins

Control jars at 30 mins

Appendix G. Stress Test Results Discussion Slides, July 29, 2021

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Secondary Clarifier Rerating Study

Draft Test Report Review Discussion

HDR

7/29/2021

Draft Secondary Clarifier Stress Testing Study Sections

Introduction

Testing Goal

Assess capacity of secondary clarifiers to determine whether capable of effective operations at higher loading rates

→supports ODEQ's re-rating of the secondary clarifiers' peak hydraulic loading rate of 1300 gpd/sf or greater

→potentially postpones the need for a secondary clarifier expansion

Assessment

Summary

System cannot operate at higher flows/loading rates until sludge settleability and/or sludge pumping issues are improved.

Assessment

Day 1 – Baseline Conditions

- MLSS: 2,250 mg/L
- SVI: 210 mL/g
- SOR: 300-400 gpd/sf
- Effluent TSS: 1-4 mg/L

Assessment

Day 2 – Stressed Conditions

- One clarifier online (#2) w/ 1 RAS pump
- MLSS: 2200
- SOR: 1,400-1,600 gpd/sf
- SLR: 27 to 34 ppd/sf
- Effluent TSS:
  - Initially 2-5 mg/L
  - >400 mg/L after blanket reached surface

Assessment

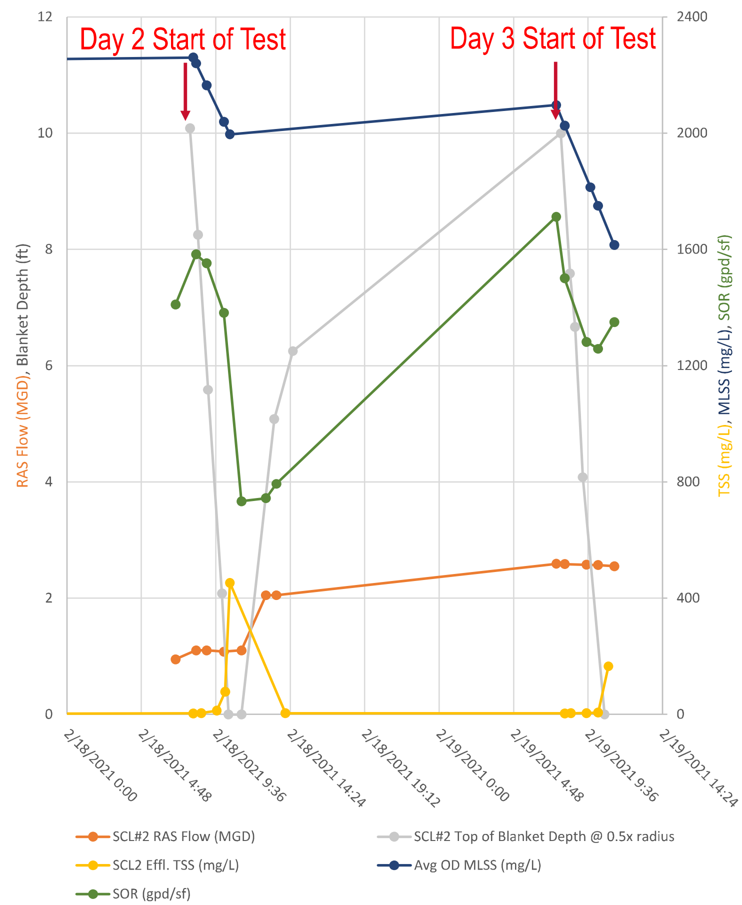
Day 3 – Stressed Conditions

- One clarifier online (#2) w/ 2 RAS pumps
- MLSS: 2100
- SOR: 1,250-1,720 gpd/sf
- SLR: 26 to 39 ppd/sf
- Effluent TSS:
  - Initially 3-5 mg/L
  - >100 mg/L after blanket reached surface

Assessment

Testing Summary

- Day 2 Testing:
  - RAS flow: 1.1 mgd (1 pump)
  - Hydraulic loading rate: 1400 to 1600 gpd/sf
  - MLSS: 2200 mg/L at start and 2000 mg/L at end
  - SVI: 202 mL/g
- Day 3 Testing:
  - RAS flow: 2.5 mgd (2 pumps)
  - Hydraulic loading rate: 1250 to 1720 gpd/sf
  - MLSS: 2100 mg/L at start and 1600 mg/L at end
  - SVI: 180 mL/g



Assessment

Blanket Rise

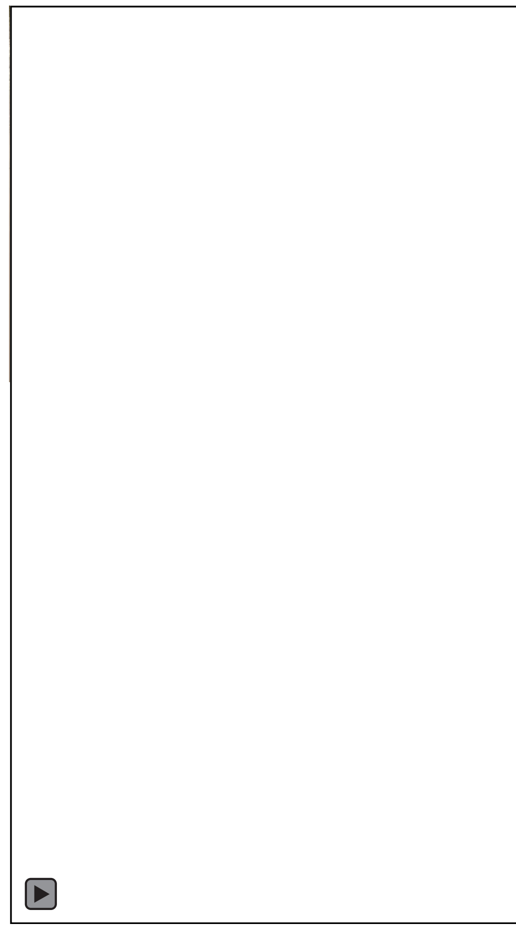
- On both days of testing, solids accumulated, raising the blanket and leading to solids overflowing into the launder

	2/18 (SCL#2 w/ 1 RAS pump ~1.1 MGD)	2/19 (SCL#2 w/ 2 RAS pumps ~2.5 MGD)
Test starts	7:00 am	7:00 am
Blanket reaches 10 ft below surface	7:56 am	7:51 am
Blanket reaches surface	10:25 am	10:40 am
Blanket growth rate	4.0 ft/hour	3.5 ft/hour

Assessment

Hydraulic Loading Performance

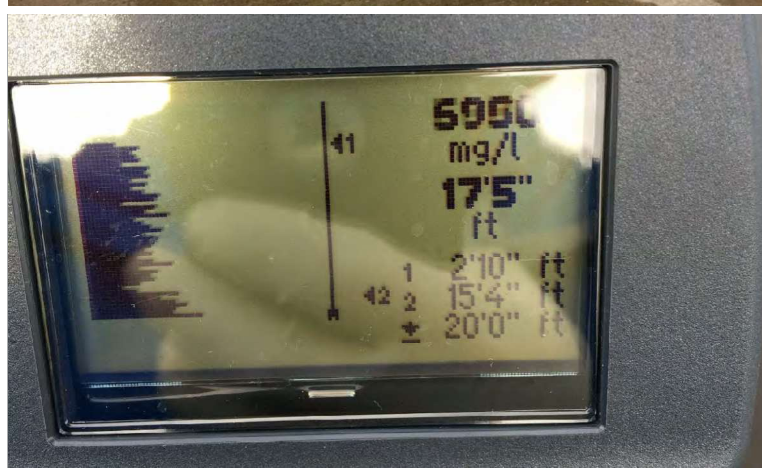
- Hydraulically, Clarifier 2 looked fine during testing
  - Weirs were not flooded – highest water level recorded in launders was ~2” below bottom of v-notch weirs
  - Clarifier discharge box did not appear to be backing up flow – water appeared to be free flowing through the launders without significant backwater effects from the downstream sections
  - Overflow had low TSS until the blanket overflowed - solids were settling, just not compacting and being pumped out fast enough



Assessment

Solids Loading Performance

- Day 2 - Solids loading rate 27 to 34 ppd/sf
- Day 3 - Solids loading rate: 26 to 39 ppd/sf
- Secondary clarifier typical solids loading design criteria[1]:
  - Average: 19-29 ppd/sf
  - Peak: 38 ppd/sf
- Thickening failure due to poor settleability and low RAS rates at relatively high solids loading rates for the given SVIs

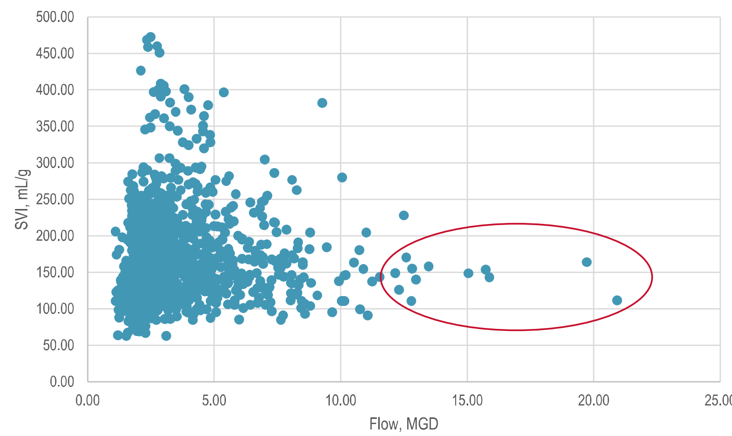


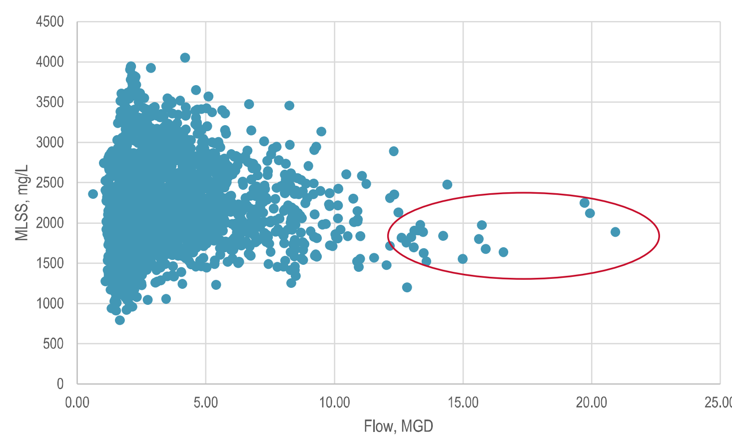
[1] Metcalf & Eddy, *Wastewater Engineering*, 2003

Assessment

Were these operating conditions normal?

- Hard to tell as there is limited data at peak flows conditions
- High flow SVI: ~150 mL/g
- High flow MLSS: ~1600 to 2200 mg/L
- Stress test conditions had higher SVIs but similar MLSS, leading to slightly worse settleability conditions than historically seen during high flows (based on limited data)





Assessment

Sludge Settleability

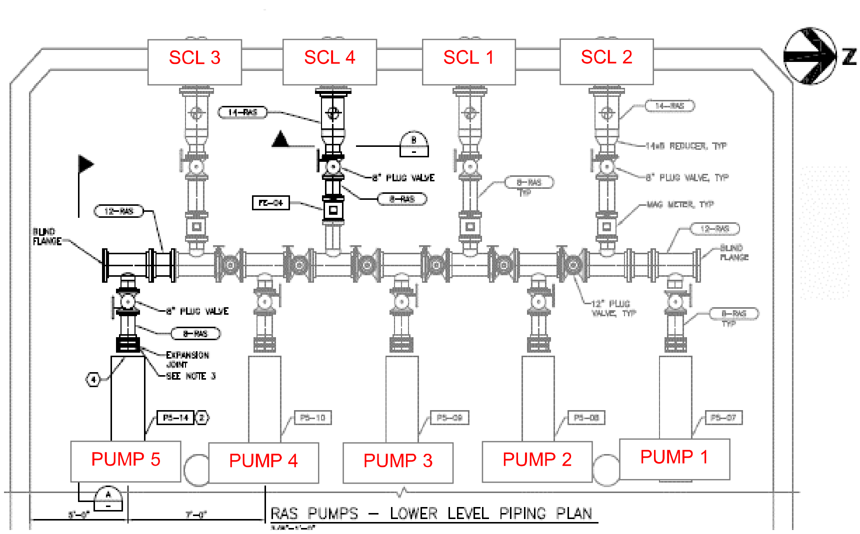
- SVIs 180 to 200 mL/g during testing
- Not optimal settleability when peak loading system

Assessment

Sludge Pumping

RAS pump changes:

- Downsized pumps to address extreme vibration issues
- Capacity: 17.4 mgd → 8.7 mgd (50% reduction)
- At rated hydraulic capacity of 1,200 gpd/sf (24 mgd), pumping at firm capacity (4.6 mgd) translates to 19% RAS rate (typically ~65%)



Assessment

Summary

System cannot operate at higher flows/loading rates until sludge settleability and/or sludge pumping issues are improved.

Additional Considerations

RAS Pumping Capacity

To further investigate issues identified with testing the following considerations are proposed:

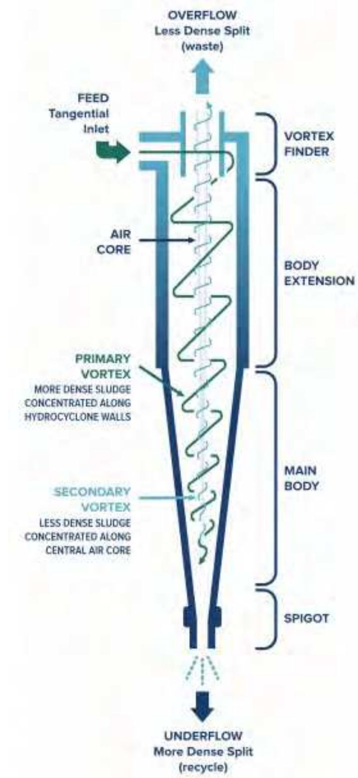
- Perform condition assessment of RAS pipelines to identify potential solids accumulation and pipe scaling due to low pipeline velocities.
- Validate RAS flow meter calibration. During testing, bringing additional RAS pumps online did not always indicate increases to RAS flow.
- Perform drawdown test to identify each pumps operational capacity.
- Visually inspect organ pipes and centerwell box connections for leaks or misalignments when clarifiers are next offline to investigate integrity of sludge conveyance systems within Clarifiers 1, 2, and 3.

Additional Considerations

Sludge Settleability

To further investigate issues identified with testing the following considerations are proposed:

- Perform jar testing to identify potential coagulants/ballasts and their optimal doses to improve settleability during wet weather events.
- Pilot-test a gravimetric selective wasting system (i.e., InDense) to identify potential improvements to sludge settleability that can be achieved full scale.
- Identify strategies to manage SVI leading up to wet weather events, implement strategy and perform additional stress testing at the lower SVIs to evaluate impact.



Conclusions and Recommendations

Existing and Future Process Capacity

- Current estimated capacity:
  - 14 to 40 mgd (700 to 2000 gpd/sf)
- Enhanced estimated capacity:
  - 32 and 60 mgd (1600 to 3000 gpd/sf)

Existing Capacity

		MLSS (mg/L)	
		1,600	2,200
RAS Pumping Capacity	**SVI (mL/g)**	**Secondary Clarifier Flow (mgd)**	
Full Capacity (8.7 MGD)	**150**	40 (10 mgd/clarifier)	27 (6.75 mgd/clarifier)
	200	31 (7.8 mgd/clarifier)	20 (5 mgd/clarifier)
Firm Capacity (4.6 MGD)	**150**	26 (6.5 mgd/clarifier)	18 (4.5 mgd/clarifier)
	200	21 (5.3 mgd/clarifier)	14 (3.5 mgd/clarifier)

Enhanced Capacity*

		MLSS (mg/L)	
		1,600	2,200
RAS Pumping Capacity	**SVI (mL/g)**	**Secondary Clarifier Flow (mgd)**	
Full Capacity (20 MGD)	**100**	60 (15 mgd/clarifier)	45 (11.3 mgd/clarifier)
	150	42 (10.5 mgd/clarifier)	32 (8 mgd/clarifier)
Firm Capacity (16 MGD)	**100**	60 (15 mgd/clarifier)	45 (11.3 mgd/clarifier)
	150	42 (10.5 mgd/clarifier)	32 (8 mgd/clarifier)

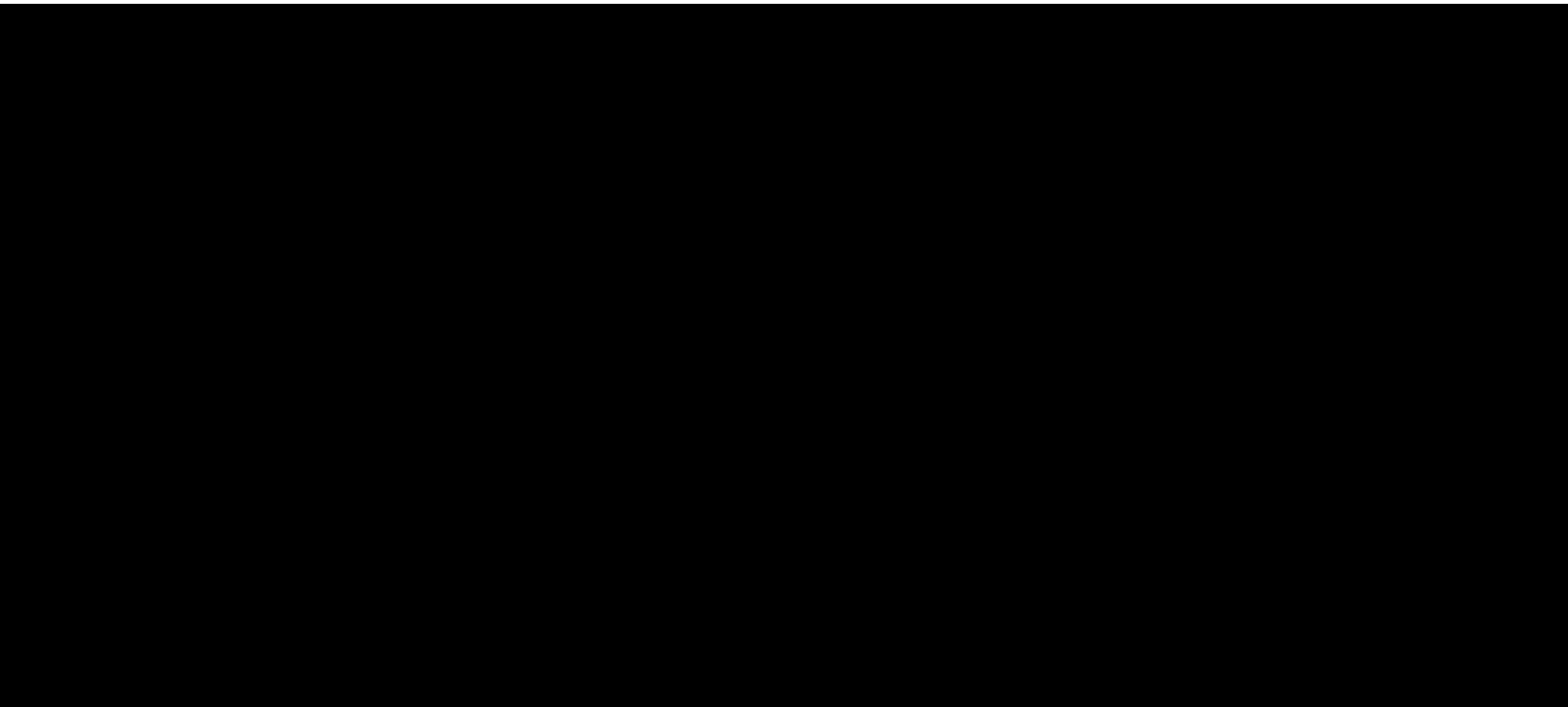
* Increased RAS pumping capacity and improved settleability

Conclusions & Recommendations

- Reassess future flow projections – peak flow events have been decreasing in frequency and magnitude in recent years
- To increase secondary clarifier capacity, the following improvements are recommended for evaluation and implementation:
  - Add RAS pumping capacity
  - Improve sludge settleability using coagulant or ballast additions or add gravimetric selective wasting (e.g., InDense system)
  - When adding the 3rd oxidation ditch, consider adding a step-feed option to reduce MLSS during peak flow events

Questions?

HDR



Extra slides

Discussion & Next Steps

Potential Wet-Weather Improvements

Constraints:

- SVI
- RAS rate

Next Steps:

- Run test at lower SVI
- Jar Testing with coagulants
- Verify RAS flow meter calibration

Testing Results

- Stress tested Clarifier 2 with operating conditions in the following ranges:
  - Clarifier 2 effluent flow: 6.3 to 8.6 mgd
  - Clarifier 2 hydraulic loading rate: 1250 to 1700 gpd/sf
  - MLSS: 1800 to 2300 mg/L
  - SVI: 180 to 210 mL/g

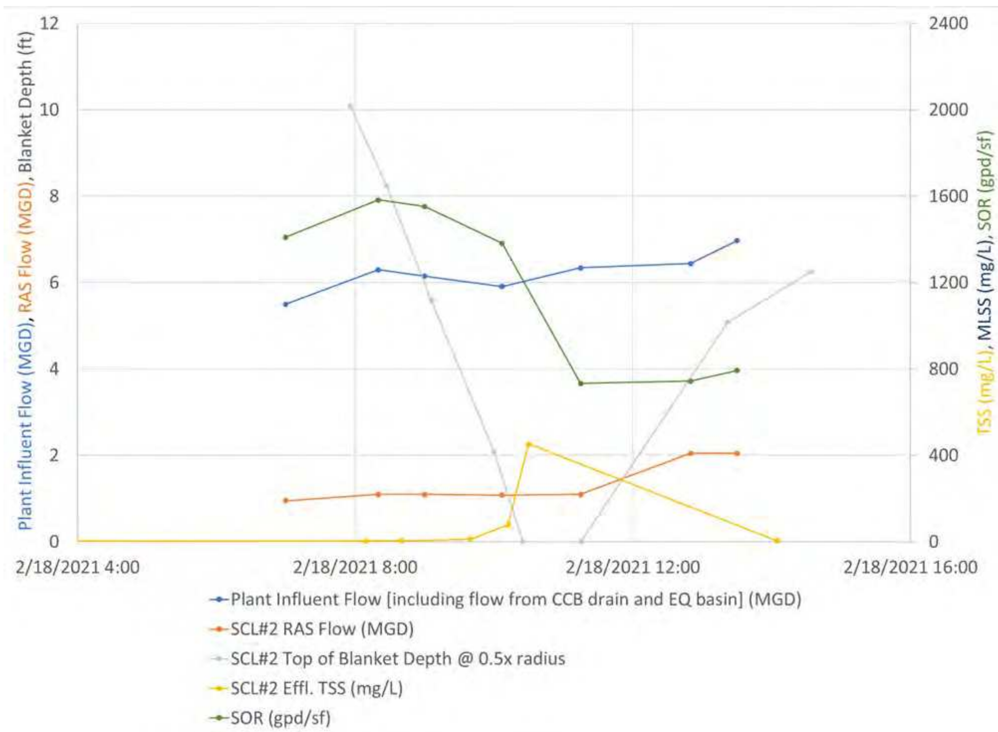
Testing Goal

Provide appropriate justification to support ODEQ's re-rating of the secondary clarifiers' peak hydraulic loading rate to 1300 gpd/sf

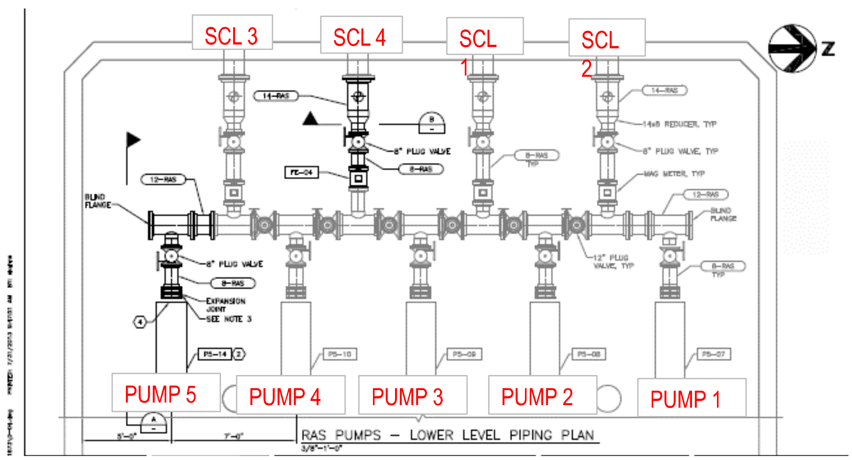
→potentially postponing the need for a secondary clarifier expansion

Assessment

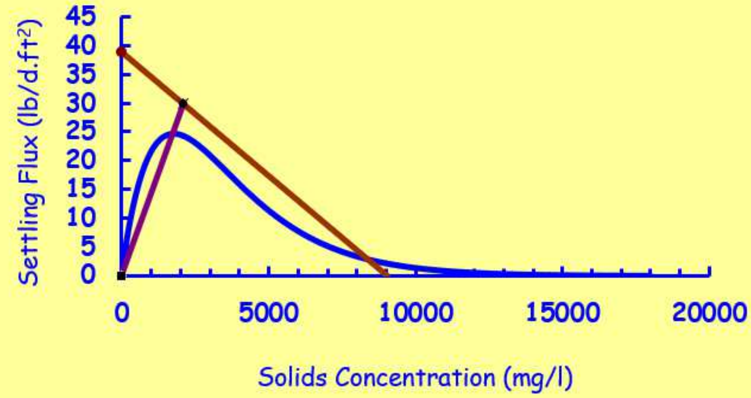
Day 2 Time Series



Pump configuration

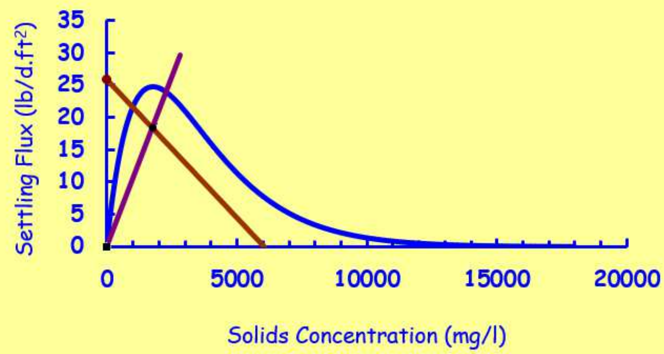


State Point Analysis



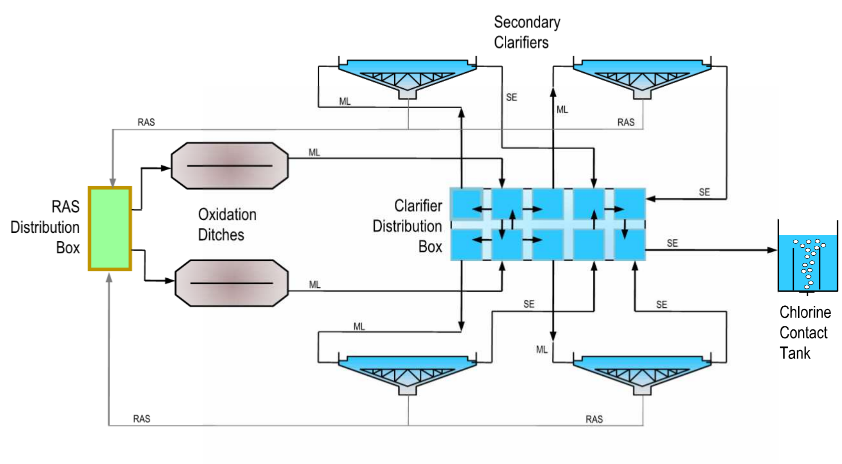
EFFLUENT FLOW RATE	8.56 mgd
RETURN SLUDGE FLOW RATE	2.59 mgd
TOTAL CLARIFIER SURFACE AREA	5000 ft^2
MLSS	2097 mg/l
SURFACE OVERFLOW RATE	1712 gpd/ft^2
SOLIDS LOADING RATE	39.0004 $lb/d.ft^2$
RETURN SLUDGE CONCENTRATION	9028 mg/l

2/19 @ 10:15



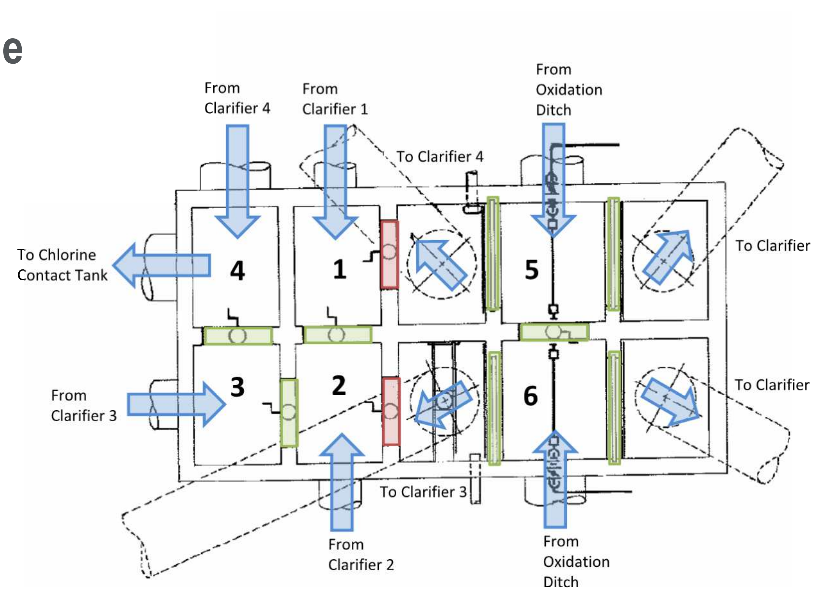
EFFLUENT FLOW RATE	6.29 mgd
RETURN SLUDGE FLOW RATE	2.57 mgd
TOTAL CLARIFIER SURFACE AREA	5000 ft^2
MLSS	1750 mg/l
SURFACE OVERFLOW RATE	1258 gpd/ft^2
SOLIDS LOADING RATE	25.8623 lb/d.ft^2
RETURN SLUDGE CONCENTRATION	6033 mg/l

Review of Secondary Clarifier Operation



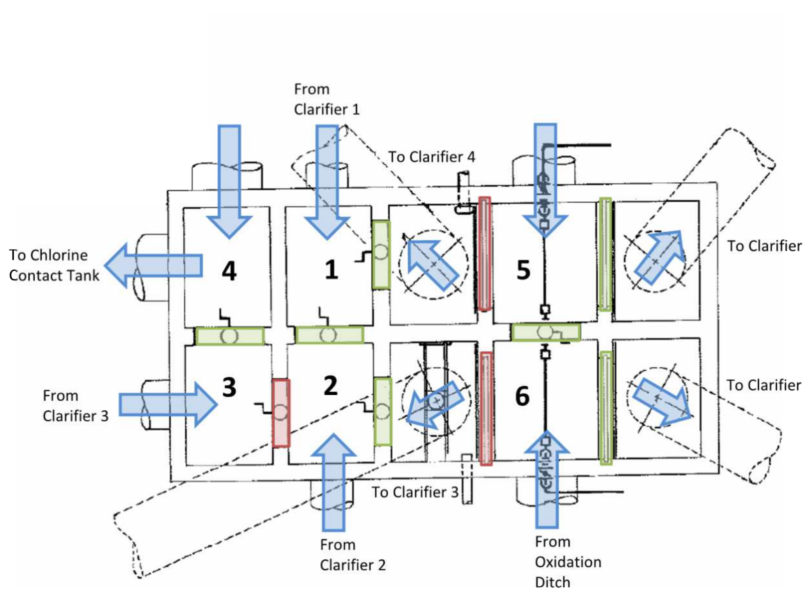
Review of Secondary Clarifier Operation

Parallel Operation w/ all 4 SCL online



Review of Secondary Clarifier Operation

Series Operation w/ all 4 SCL online



Testing Results

- On both days of testing, solids accumulated, raising the blanket and leading to solids overflowing into the launder.
- Blanket rose slightly faster with one RAS pump running than with two.

	2/18 (SCL#2 w/ 1 RAS pump ~1.1 MGD)	2/19 (SCL#2 w/ 2 RAS pumps ~2.5 MGD)
Test starts	7:00 am	7:00 am
Blanket reaches 10 ft below surface	7:56 am	7:51 am
Blanket reaches surface	10:25 am	10:40 am
Blanket growth rate	4.0 ft/hour	3.5 ft/hour

Questions for City

- What were the drivers for putting in smaller RAS pumps for pumps 1-4?
- How is the plant typically operated during a large storm event?
  - It has previously been noted that lower MLSS concentrations (≤2000 mg/L) are targeted as large flow events approach. Is a specific SVI also targeted?
- What is the operational strategy for RAS pumping during high flow?
- Above what influent flow threshold or for what size storm event are these process/operational changes typically considered necessary?
- What are the most recent SVI and MLSS values for the oxidation ditches?
- Were flow meters replaced/recalibrated with the replacement of the RAS pumps?

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APPENDIX C

WWTP SOLIDS HANDLING ALTERNATIVES

CITY OF NEWBERG

WWTP Solids Handling Alternatives

NOVEMBER 2025 | Project No. 224060-009

EXPIRES: 06-30-2026

PREPARED BY

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS, ABBREVIATIONS, AND SELECTED DEFINITIONS

ADF	Average Day Flow
ASP	Aerated Static Piles
$cBOD_5$	5-Day Carbonaceous Biochemical Oxygen Demand
cfm	Cubic feet per minute
CFR	Code of Federal Regulations
CMU	Concrete Masonry Unit
DEQ	Oregon Department of Environmental Quality
EPA	Environmental Protection Agency
ft	Feet (or) Foot
gal	Gallons
gpm	Gallons per minute
lb./day	Pounds per day
MMBTU	Million British Thermal Units
MMF	Maximum Month Flow
OAR	Oregon Administrative Rules
OH&P	Overhead and Profit
O&M	Operations and Maintenance
PDF	Peak Day Flow
PER	Preliminary Engineering Report
WAS	Waste Activated Sludge
WWMP	Wastewater Master Plan
WWTP	Wastewater Treatment Plant

CHAPTER 1 - INTRODUCTION

1.1 BACKGROUND

The City of Newberg (City) owns and operates a wastewater treatment plant (WWTP) that receives and treats wastewater from throughout the City's service area. The City of Newberg created a Wastewater Master Plan (WWMP) in May 2018 and amended it in May 2021, which forecasted capacity improvements through a 20-year planning period. A WWTP Capacity Study was completed in April 2025 and identified solids handling deficiencies and capacity limitations in the composting system because of the age and condition of the composting system, as well as increasing population within Newberg. The City requested an evaluation of alternatives to increase the solids handling system capacity and address deficiencies previously identified. These alternatives include aerated static piles, composting vessels, drum dryers with pelletizers, and paddle dryers. The alternatives were evaluated assuming no further use of the existing compost system. This technical memorandum provides a discussion of the evaluation performed, including capital and life cycle cost estimates.

CHAPTER 2 - DESIGN CRITERIA

An essential component of any alternative evaluation is establishing the design criteria to be used. The 2037 population projection and future flow and load values presented in the 2018 WWMP were utilized for this evaluation because they still apply as discussed in the WWTP Capacity Study. According to the City, the existing compost system achieves Class A biosolids requirements outlined in Title 40 of the Code of Federal Regulations, Part 503 (40 CFR §503) and OAR 340-50. Therefore, each solids handling alternative should continue to achieve Class A biosolid requirements. As such, the solids would have no restrictions on their use, and they could continue to be sold or given away at the WWTP.

The EPA Technical Bulletin EPA-430-99-74-001: Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability (1973) requires new or expanding wastewater treatment plants to meet minimum standards for mechanical, electrical, and component reliability. Redundancy and reliability refer to the level of protection required to avoid environmental impacts. The City has indicated that the WWTP should be operated as a Class I facility as discussed with Oregon Department of Environmental Quality (DEQ). Also, mechanical components in the facility must be designed to enable repair or replacement without violating the effluent limitations or causing control diversion.

2.1 WAS LOADING PROJECTIONS

As shown in Table 2-1, current certified and forecasted populations were compared against the population data presented in the 2018 WWMP. Overall, the current forecasts and those presented in the 2018 WWMP were very similar. In particular, the percent difference for 2022, which utilizes certified population data, revealed a difference of only approximately 1%. Overall, it appears that the current population projections are suitable for use in estimating loading in future population growth scenarios without changes. To be consistent with the 2018 WWMP, this alternative evaluation only addresses loadings through 2037 as shown in Table 2-2, which form the primary design criteria.

TABLE 2-1: HISTORICAL POPULATIONS AND PROJECTIONS

Year	2024 PSU Update Population	2018 WWMP Population	% Difference
2022	25,514	25,797	1.1%
2027	28,937	28,343	-2.1%
2032	31,280	31,139	-0.5%
2037	33,511	33,811	0.9%

Sources: 2024 PSU Certified Populations and 2024 PSU Coordinated Population Forecast for Yamhill County

TABLE 2-2: WAS LOADING PROJECTIONS

Projected Design WAS Load (dry lb./day)				
Year	2022	2027	2032	2037
ADF	4,200	4,620	5,040	5,520
MMF	8,400	9,240	10,140	10,980
PDF	9,540	10,500	11,520	12,540

2.2 EXISTING COMPOSTING SYSTEM

Tunnel composting is the current biosolids stabilization method used at Newberg. Solids from the secondary treatment process are stored in aerated tanks. Biosolids are dewatered by the screw press, then mixed with sawdust and compost recycle to achieve a solids content of approximately 43%. The mixed solids then travel along a conveyor to the tunnel reactors. A hydraulic ram at the back of the tunnel reactor is withdrawn about three feet, then the mixed solids are put into the start of the tunnel reactor.

Aeration pipes in the floor of the reactor provide air throughout the composting pile. The hydraulic ram pushes the compost forward slowly, resulting in a retention time of about 16 days. From the tunnels, the compost is moved using a front-end loader to curing piles with low-rate aeration. The end of the tunnel compost system is shown in Figure 2-1. After curing finishes, the compost is moved to storage piles on-site for distribution. A site layout of the existing compost system at Newberg is shown in Figure 2-2.

During current operation, reject material that has not met EPA pathogen reduction requirements is recycled back through the tunnel reactors for additional treatment or is treated in the curing bays until it meets EPA requirements. After meeting Class A biosolid requirements, finished compost is sold or given away as NewGrow Compost. This compost is used by landscapers, greenhouses, and homeowners.

The company which produced Newberg's existing composting system, Ashbrook-Simon-Hartley, has been purchased by Alfa Laval and no longer offers an equivalent system. Other composting companies offer in-vessel composting, but without the hydraulic ram.

FIGURE 2-1: NEWBERG TUNNEL COMPOSTING

FIGURE 2-2: EXISTING COMPOSTING SITE LAYOUT

2.2.1 Solids Handling System Capacity

Several components of the existing solids handling system can be used for future treatment alternatives. All alternatives would require dewatering prior to further treatment. The existing screw press capacity was estimated in the 2018 WWMP to have a capacity of 7,000 lb/day when operating 40 hours per week and 16,700 lb/day when operating both screw presses 96 hours per week. The screw presses can operate without observation, so the screw press system dewatering capacity, when compared with design loads in Table 2-4, is anticipated to be sufficient for 2037 design loads and does not require expansion.

For composting alternatives, the existing sawdust drying system and the mixing system may be used. In 2024, the highest weekly run time for the sawdust dryer was 50 hours, so the burner run time can be increased as biosolids loading increases during the design period . Therefore, the sawdust drying system is not expected to require expansion. The sawdust silo volume is 5,500 cubic feet, which can store 5 days' worth of sawdust at maximum month flows. Additional sawdust is stored under awnings on-site.

The existing mixing system combines biosolids dewatered by the screw press, dried sawdust from the storage silo, and compost recycle from the compost pad. Newberg compost building drawings do not provide the compost mixer capacity. However, drawings indicate the compost mixer discharge conveyor capacity is 70.8 tons per hour. Using current sawdust operating ratios, the compost mixer loading rate is 2.8 tons per hour at peak daily flow. Therefore, the mixing system is expected to not require expansion.

TABLE 2-3: EXISTING COMPOST SYSTEM CAPACITY

Parameter	Capacity Condition	Capacity	Comments
Screw Press Dewatering	$cBOD_5$ ADF	7,000 lb./day	Operating time: 40 hours per week
	$cBOD_5$ MMF	16,700 lb./day	Operating time: 96 hours per week

2.2.2 Odor Control System Capacity

The existing odor control system at Newberg treats odorous air from the composting tunnels, the curing piles, and the headworks. However, the controls for this system have failed. Therefore, this system will not be used for any new treatment alternatives.

2.2.3 Existing System Refurbishment

A site visit was conducted on January 17, 2025. Compost buildings showed evidence of widespread roof leakage, including above the control room. The walls on both sides of the loadout tunnel are cracked and leaking. There is also an air leak on the floor of Train B. Additionally, the main conveyor before the tunnels (Conveyor 805) is crumbling due to suspected water damage. The conveyor is built into the structure so replacement would be difficult. Pictures of the cracking on the compost building are shown in Figure 2-3. The operations staff also mentioned that the air system, hydraulic rams, and tunnel doors have required recent work or it is pending. The existing tunnel reactors are expected to require significant refurbishment, if not replacement, to enable continued use, so design criteria assume no continued usage of the existing tunnel reactors after alternatives are constructed. For cost savings, cost estimates also assumed the tunnel reactors would not be demolished at this time.

FIGURE 2-3: EXISTING COMPOST BUILDING

2.2.4 Existing Aerated Static Piles

Newberg has five aerated static piles on-site, three of which are hooked up to a fan to provide aeration. These three piles are used to provide additional composting capacity when the tunnels are at capacity. With additional piping, the other two aerated static piles can be used to also provide compost capacity. Based on fan model and motor specifications, the existing fan is expected to provide sufficient aeration for use of the five existing aerated static piles. However, this should be verified throughout the design phase.

2.3 BIOSOLID REQUIREMENTS

Both federal and state regulations apply to land application of biosolids from wastewater treatment plants. Title 40 of the Code of Federal Regulations, Part 503 (40 CFR §503) discusses standards for the use and disposal of biosolids. Oregon regulations include OAR 340-50 and reference many of the federal technical biosolids regulations (40 CFR §503), including limits on trace pollutants and pathogens.

Newberg's existing composting system meets Class A biosolids standards, so all alternatives are expected to continue to meet EPA and Oregon requirements for pollutant concentrations, pathogens, and vector attraction reduction. For vessel or aerated static pile composting, the pile temperature must reach 55°C or higher for at least three days to maintain current biosolids standards. The compost must also remain at a temperature of at least 40°C for 14 days, with the average temperature equal to at least 45°C. Additionally, the quantity of fecal coliform shall be less than 1,000 per gram of solids, or Salmonella bacteria quantity must be less than 3 per gram of solids.

For paddle or drum drying, the biosolids must have a solids content of at least 90% solids. Additionally, the dryers must heat the sludge to at least 50 degrees C. Additionally, the drying time and temperature must comply with the following equation, where D is the drying time in days and t is the temperature in degrees Celsius.

$$D = \frac{131{,}700{,}000}{10^{0.1400t}}$$

2.4 PERMIT REQUIREMENTS

Depending on the alternative selected, the Biosolids Management Plan may need to be modified. Additionally, air quality permits are required for large natural gas consumption and for sources that DEQ determines cause an air quality concern, which may be applicable to some of the alternatives. Newberg currently operates aerated static piles without an odor control system and does not have an air quality permit. All alternatives besides aerated static piles include an odor control system. Because of previous operation and planned odor control systems, it is not anticipated that an air quality permit would be required for any alternatives. However, this is subject to DEQ review.

Building permits would also be required. Plans and specifications would need to be submitted for review by the Public Works Department, where they will be reviewed by engineering and wastewater treatment operations staff. If plans and specifications need review by other City departments (e.g., Building, Planning and Zoning, Fire Department, Parks and Recreation), the Public Works Department normally disperses these documents to them electronically.

2.5 RANKING CRITERIA

Many different factors are important in selecting the preferred alternative. The City selected the following criteria based on their experience and ability to address the solids handling deficiencies.

- Capital Cost – 35%: This includes the cost of the equipment, installation, ancillary equipment, and modifications to existing equipment and structures to provide a complete and operable system.
- Life Cycle Cost – 20%: This includes total installed cost, plus the annual costs of equipment over the course of ownership, with an assumed life of 10 years.
- Ease of Maintenance – 20%: Measures the difficulty to access and safely repair the typical wear items within the units.
- Reliability – 15%: Ability of equipment to function for long periods of time at the duty required. Also considers whether the technology was designed for this particular application.
- Track Record – 10%: This considers how many similar installations there are which utilize this technology successfully.

CHAPTER 3 - ALTERNATIVES OVERVIEW

This section of the technical memorandum provides a general overview of the solids handling alternatives. Several alternatives were discussed with the City. Based on the City's input, the alternatives selected for evaluation were composting and drying alternatives.

3.1 AERATED STATIC PILES

The aerated static piles (ASP) consist of piles covered by an awning, as shown in Figure 3-1. The compost product from aerated static pile composting is similar to Newberg's existing product and can continue to be distributed as NewGrow Compost. ASPs are expected to use the existing screw presses, conveyors, sawdust drying system, and mixing system.

Biosolids are dewatered using the existing screw presses, mixed with bulking agent (sawdust), and conveyed to the outside of the building. A front-end loader is used to construct composting piles. Compost piles are aerated using piping throughout the ASP floor. There are two piping configurations available: positive and reversing aeration. Positive aeration pushes air through compost, while reversing aeration alternates between pushing and pulling air through compost piles. Positive aeration decreases the cost requirements by removing blowers and the biofilter, while reversing aeration provides odor control and decreases the required solids retention time.

Most of the decomposition occurs during composting. This phase is when the time and temperature regulatory targets for pathogen kill and vector attraction reduction are reached. Temperature probes are placed in each pile to monitor EPA biosolids requirements and adjust aeration rates. Aeration provides oxygen to the microbes in the process and controls temperatures in the pile. The design detention time for the active composting phase is 16 to 18 days. During this time, the material is stabilized sufficiently to minimize future odor generation.

After composting is complete, biosolids are moved to the next step in the process, curing or storage. Curing involves continued low-rate aeration to supply oxygen for microbes. Curing is not required to produce Class A biosolids, but it produces a higher-quality compost, including decreased biological activity, decreased odor production, and more effective nitrogen fertilization. If curing is selected, compost is moved from composting to curing piles using a front-end loader. The typical curing retention time is 25 days. After curing is complete, compost is moved to piles for storage and distribution.

The Class A biosolids meet EPA's 40 CFR 503.13 requirements for pollutant concentrations, pathogens, and vector attraction reduction. For aerated static pile composting, the pile temperature must reach 55°C or higher for at least three days. Additionally, the quantity of fecal coliform shall be less than 1,000 per gram of solids, or the Salmonella bacteria quantity must be less than 3 per gram of solids.

FIGURE 3-1: COVERED AERATED STATIC PILE

3.2 IN-VESSEL COMPOSTING

As mentioned in Chapter 2, tunnel composting is not analyzed in this report. This alternative looks at in-vessel composting without the hydraulic ram. An example is shown in Figure 3-2. In-vessel composting consists of creating aerated static piles within insulated structures. Because composting is enclosed, vessel composting is more effective at odor containment and treatment than aerated static piles. The vessels also decrease the required retention time and composting footprint.

Biosolids are mixed with bulking agent (sawdust) and loaded using a front-end loader. The aerated floor enables efficient composting. After 14 days of composting, the compost is moved to storage or curing piles to produce higher-quality product. If curing is selected, compost is moved to storage piles after 25 days of curing. In-vessel composting is expected to use the existing screw press, conveyors, sawdust drying system, and mixing system, as well as a new conveyor to send compost outside of the building. The compost product could continue to be distributed as NewGrow Compost.

The Class A biosolids meet EPA's 40 CFR 503.13 requirements for pollutant concentrations, pathogens, and vector attraction reduction. For in-vessel static pile composting, the pile temperature must reach 55°C or higher for at least three days. Additionally, the quantity of fecal coliform shall be less than 1,000 per gram of solids, or the *Salmonella* bacteria quantity must be less than 3 per gram of solids.

FIGURE 3-2: IN-VESSEL COMPOSTING SYSTEM

3.3 DRUM DRYER

As an alternative to composting, the City could treat the biosolids to Class A requirements using a dryer. A drum dryer has been successfully used at other treatment plants and is shown in Figure 3-3. Drum dryers do not require bulking agent, such as sawdust. Because no bulking agent is required, the dried biosolids product volume is less than the product volume for composting alternatives. This system is expected to use the existing screw press but will not use sawdust or the existing mixing system. A new conveyor would discharge excess dewatered solids to the dryer sludge hopper.

During drum dryer operation, dewatered biosolids are stored in a sludge hopper then mixed with recycled dried solids to improve the quality of the product. This biosolids mixture passes through the dryer alongside hot gas, which dries the biosolids to more than 90% solids content. After drying is completed, the biosolids can be screened to improve product size consistency and pelletized. Biosolids smaller or larger than the desired pellet size are removed and crushed, while biosolids of the desired size are stored for distribution. Example pelletized product from the Chambers Creek, WA WWTP is shown in Figure 3-4. These pellets can be used as fertilizer but are different from NewGrow Compost.

To meet EPA Class A biosolids requirements, a drum dryer must reduce the moisture content of the sludge to 10 percent or lower. The time and temperature retention of the sludge must meet EPA requirements as discussed above in section 2.1.

FIGURE 3-3: CHAMBERS CREEK WWTP DRUM DRYER

FIGURE 3-4: CHAMBERS CREEK WWTP PELLETIZED PRODUCT

3.4 PADDLE DRYER

Another alternative dryer technology, the paddle dryer, was also evaluated. An example paddle dryer from the Wilsonville, OR WWTP site tour is shown in Figure 3-5. This system is expected to use the existing screw presses but does not require bulking agents such as sawdust. Similar to the drum dryer, a paddle dryer produces material that is different from Newberg's existing compost. This product can be used as fertilizer. An example final product from the Wilsonville WWTP site tour is shown in Figure 3-6.

During paddle dryer operation, biosolids are dewatered then conveyed to a sludge hopper. Biosolids then enter the paddle dryer, where two counter-rotating paddle dryers serve as both the heat transfer surface and the conveyance system. As solids pass from the wet end of the unit to the dry end, thermal fluid transfers heat from the interior of the hollow dryers to dry the biosolids.

Similar to the drum dryer, Class A biosolids are required to reach at least 90% solids and must meet time and temperature requirements as discussed in Section 2.1.

FIGURE 3-5: WILSONVILLE WWTP PADDLE DRYER

FIGURE 3-6: WILSONVILLE WWTP FINAL PRODUCT

CHAPTER 4 - AERATED STATIC PILES

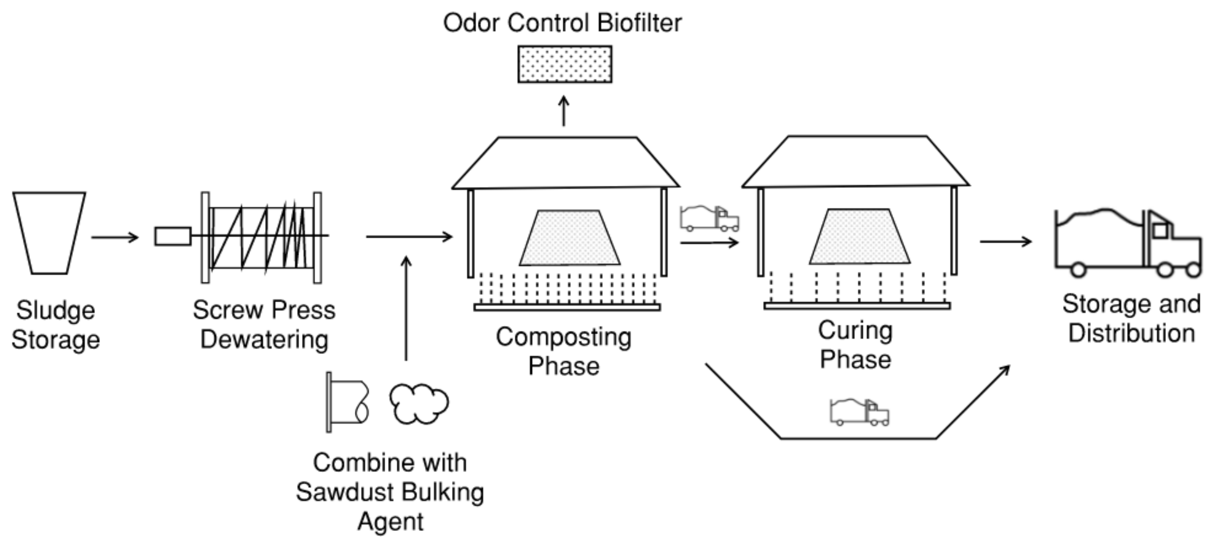
4.1 TECHNOLOGY DESCRIPTION

At Newberg, biosolids are stored in tanks then dewatered using screw presses. These biosolids are then mixed with sawdust and compost recycle as bulking agents. Compost is then sent from the mixing system to the outdoors via a new compost conveyor. From there, a front-end loader is used to construct composting piles in new and existing ASPs. In the composting phase, air is forced through the piles. After 18 days of composting, biosolids are moved to storage piles for distribution.

Because of the difference between Newberg's average annual and maximum month loads, aerated static piles could be used to provide compost curing outside of maximum month loads. Curing helps increase the quality of the produced biosolids by decreasing odor production. If ASPs are used as curing piles, compost would be moved to vacant ASPs or left in place, with the aeration rate decreased from the composting aeration rate. The process flow, including ASPs being used as curing piles, is shown in Figure 4-1.

There are two aeration types available for aerated static piles. Positive aeration decreases cost requirements, while reversing aeration provides odor control. In this report, both positive and reversing aeration are analyzed to provide an incremental cost for odor control.

FIGURE 4-1: AERATED STATIC PILE PROCESS FLOW DIAGRAM



4.2 DESIGN CONSIDERATIONS

The main design constraint for aerated static piles is footprint and site location. Newberg has five existing ASPs, three of which are hooked up to a blower. With minor piping modifications, all five ASPs can be used for positive aeration, which decreases the amount of new ASPs required.

The aerated static piles are expected to use the existing mixing system for mixing and a new compost conveyor. After compost is mixed, it will be sent outside the building via a new conveyor. The compost will then be moved with a front-end loader to the ASPs, existing and new. The new ASPs in this design are laid out in four zones with 35 ft. x 45 ft. dimensions with a design retention time of 18 days. If reversing aeration is selected, a biofilter with an area of about 470 ft^2 is recommended for the new ASPs. A recommended site layout is provided in Figure 4-2.

Under DEQ rules, composting systems require an air quality permit if the DEQ determines that an air quality concern exists or if the source would emit significant malodorous emissions. Newberg currently operates three ASPs without odor control and has not received odor complaints. The existing compost system does not have an air quality permit, so the new system is not anticipated to require a permit. However, this is subject to DEQ approval.

FIGURE 4-2: AERATED STATIC PILE SITE LAYOUT

4.3 EASE OF MAINTENANCE

Aerated static pile maintenance requires floor cleaning to prevent clogging of aeration piping. Additionally, sumps and drains must be flushed every year. Fan bearings require quarterly lubrication. Finally, temperature probes will wear out and should be replaced approximately every year.

It is assumed the existing mixer and a new conveyor would be used to deposit biosolids outside, where a front-end loader would be used to construct piles. The bottom of the pile may include a shallow layer of sawdust or woodchips to facilitate air distribution. The mixed biosolids form the majority of the pile, with a shallow layer of finished compost on top to reduce odors. After pile construction is complete, the pile would be aerated without disturbance for 18 days, after which it can be moved to piles for storage and distribution or left in place for curing.

The existing odor control system does not have additional capacity, so the new odor control system, if reversing aeration is selected, would require maintenance every couple years. Biofilter media would take approximately one day to replace.

4.4 RELIABILITY

ASP systems can produce compost meeting Class A biosolids standards. The recommended solids concentration for the initial biosolids mixture is similar to the solids concentration used in current tunnel composting. When discussing with Engineered Compost Systems (ECS), they recommended higher compost mix moisture content than the current mixture used by Newberg. This could allow use of non-dried sawdust, more compost recycle, or less sawdust.

ASP composting equipment involves a front-end loader, fans, and aeration pipes, as well as a biological odor control system. If fans went offline, a backup fan would be switched in and fan repairs or replacement would occur. The biological odor control system requires little machinery except for during biofilter media replacement.

4.5 TRACK RECORD

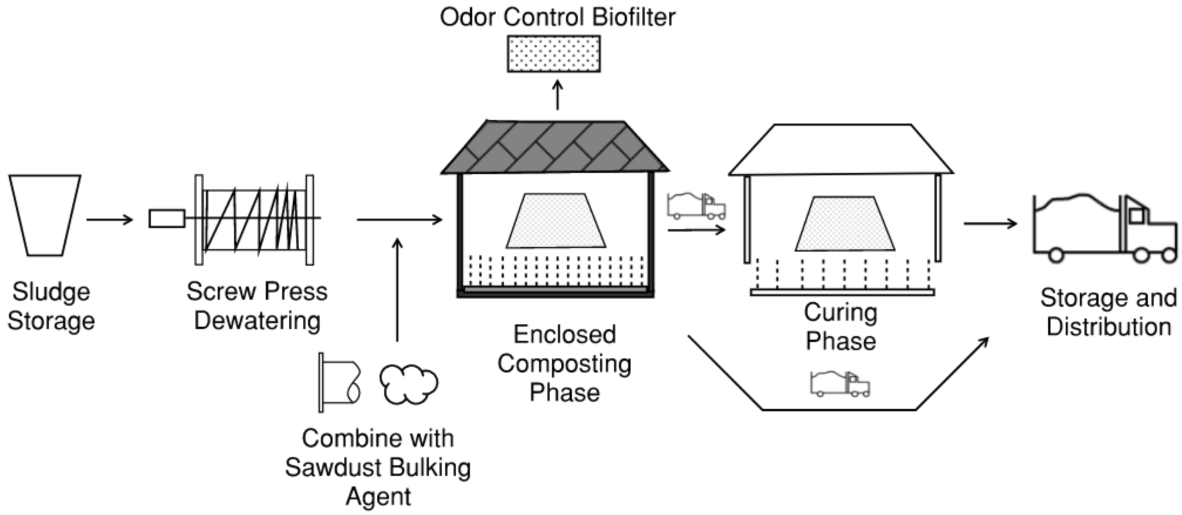
Aerated static piles are commonly used for composting. For example, ECS has designed ASPs for Albany, Oregon; Spokane, Washington; and Lynden, Washington. Many of their systems have been operating for more than 10 years.

CHAPTER 5 - IN-VESSEL COMPOSTING

5.1 TECHNOLOGY DESCRIPTION

The in-vessel composting process flow is similar to the aerated static pile process flow, including optional curing. However, the composting retention time is 14 days, 2 to 4 days less than aerated static piles. A front-end loader is used to construct composting piles. In the composting phase, air is pushed through the compost piles. Then, air is captured from the vessel and sent to odor control. After 14 days of composting, biosolids are moved to the curing piles, if selected, or storage using a front-end loader. During curing, the aeration rate is lower than the composting phase. After 25 days of curing, piles are moved to storage piles for distribution. This process flow is shown in Figure 5-1.

FIGURE 5-1: IN-VESSEL COMPOSTING PROCESS FLOW DIAGRAM



5.2 DESIGN CONSIDERATIONS

In-vessel composting, with static piles and aeration within constructed buildings, provides similar odor containment as the existing tunnels system but requires compost movement with a front-end loader. The existing screw presses, conveyors, and mixing system would be used, as well as a new conveyor to deposit biosolids outside. As discussed previously, these systems are expected to have enough capacity for 2037 WAS loads. Nine vessels with dimensions of 20 ft. x 55 ft. would be required to treat all biosolids with vessel composting, with a design retention time of 14 days. If separate curing is selected, there would be thirteen curing zones with dimensions of 20 ft. x 55 ft, although existing ASPs could be used to provide a portion of the curing space. A recommended site layout is shown below in Figure 5-2.

One of the main advantages of vessel composting is odor containment. Composting within vessels allows for greater odor containment, which is then treated with an odor control system. Because of this system, in-vessel composting is not anticipated to require an air quality permit.

FIGURE 5-2: IN-VESSEL COMPOSTING SITE LAYOUT

5.3 EASE OF MAINTENANCE

In-vessel composting involves the same sawdust drying and mixing processes as the existing compost system. Operators transport compost to the vessels, curing piles, and storage using front-end loaders. Regular maintenance tasks involve sawdust drying, compost movement, and aeration unclogging, if needed. Media for the new odor control system requires replacement every couple of years.

5.4 RELIABILITY

The in-vessel system is anticipated to produce compost meeting Class A biosolids standards, similar to the existing tunnel reactors. In-vessel composting equipment involves a front-end loader, fans, and diffuser pipes, as well as a biological odor control system. If the fans went offline, a standby fan would be switched on and fan repairs or replacement would occur. The odor control system involves filter media and is not anticipated to have high maintenance requirements.

5.5 TRACK RECORD

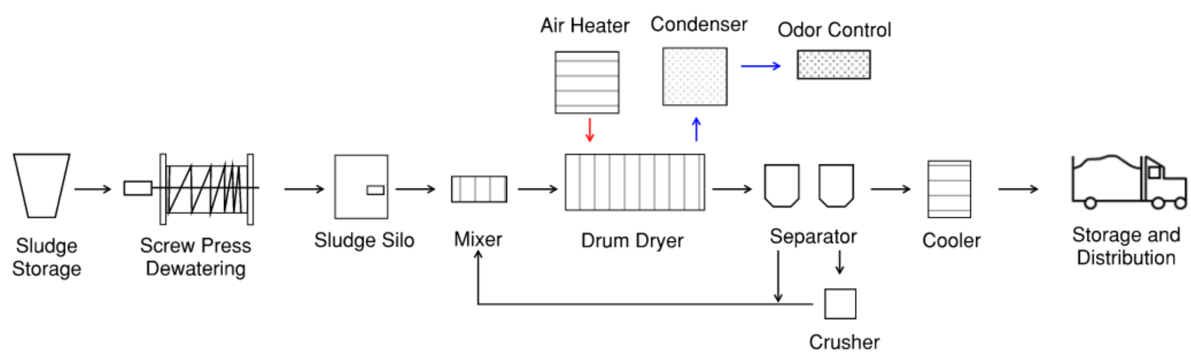
In-vessel composting has a long track record for achieving Class A biosolids. For example, ECS has in-vessel composting facilities in Long Beach, Washington; Granby, Colorado; and Augusta, Maine. Some of these systems have been running for more than 20 years. Another manufacturer, Green Mountain Technologies, has in-vessel installations in Nampa, Idaho and King County, Washington.

CHAPTER 6 - DRUM DRYER

6.1 TECHNOLOGY DESCRIPTION

Biosolids are initially dewatered by screw presses, then conveyed to and stored in a sludge silo. From the silo, the solids are sent to a mixer, where they are mixed with recycled biosolids. The biosolids and heated gas enter the drum dryer. Solids slowly pass through the dryer, conveyed by the heated gas. After exiting the dryer, the dried solids can be screened. Biosolids smaller or larger than the desired product size are removed, crushed, and mixed with the input biosolids. This process flow is shown in Figure 6-1.

FIGURE 6-1: DRUM DRYER PROCESS FLOW DIAGRAM



6.2 DESIGN CONSIDERATIONS

Drum drying would require a conveyor or cake pump to convey biosolids from the screw presses to the dryer. The drum dryer would require a fuel source, which would likely be natural gas. As there is currently no natural gas at the WWTP, installation adds an additional cost for this alternative. A building layout is shown in Figure 6-3.

For air quality permitting, there are two requirements specified in DEQ rules. A permit is required if natural gas input exceeds 9.9 MMBTU/hour. Because the drum dryer input is less than 9.9 MMBTU/hr. (~4.5 MMBTU/hr.), this alternative would not reach that requirement. Because an odor control system is included with the drum dryer, it is not anticipated that an air quality permit is required to avoid odor concerns.

FIGURE 6-3: DRUM DRYER SITE LAYOUT

6.3 EASE OF MAINTENANCE

Because of the high temperature gas and dust particles in the drum dryer, fire and explosion risks are present. Therefore, safety features are included to reduce the risk of deflagration. Each safety feature adds complexity and mechanical and electrical maintenance requirements to ensure the features are working properly. A correctly operating system that is proactively maintained does not require significant attention to these systems. However, faulty equipment or failure to keep up with maintenance schedules can create safety concerns.

Keller and Newberg toured a drum dryer at the Chambers Creek Regional WWTP in University Place, Washington. The maintenance for this system was significant, with five full-time employees working on their system each day. Maintenance includes common mechanical equipment tasks, such as cleaning the air filters, checking and replacing oil, and inspecting equipment performance. The most maintenance had to do with the pelletizing operation. Dust collectors at Chambers Creek required weekly maintenance. More specialized periodic maintenance includes replacing sensors and cleaning the thermal heater used for odor control. More complex work may need to be completed by the manufacturer. When the system is operating, an operator must be present at all times, which can significantly increase personnel costs.

The Chambers Creek drum dryer requires gasket replacement and yearly odor control media replacement. Dried biosolids cause wear on internal parts, which may require periodic replacement of drum liners. Because the drum dryer consists of one primary unit, unit shutdown would require auxiliary treatment of biosolids.

6.4 RELIABILITY

The Chambers Creek system required significant maintenance personnel on-site at all times. Additionally, the maintenance issues at Chambers Creek have been present throughout the life of the system, not just due to the age of the equipment. The dust collector requires significant weekly maintenance, and the odor control system must be scrubbed once per month.

6.5 TRACK RECORD

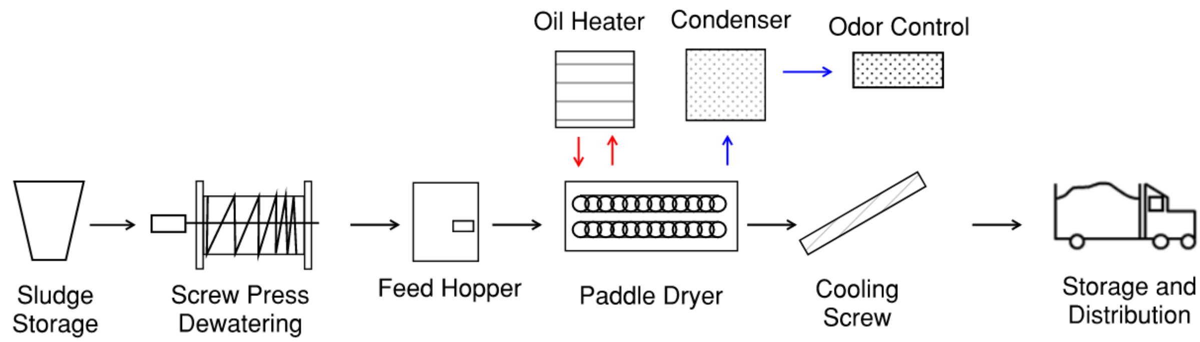
Heat drying has been used for biosolids processing since the 1920s. For example, Andritz has drum dryer installations around the world, with limited installations in the U.S. (Philadelphia and Nashville, for example), as well as installations in the UK, France, and Germany.

CHAPTER 7 - PADDLE DRYER

7.1 TECHNOLOGY DESCRIPTION

Paddle drying could use the existing screw presses. The dewatered solids would then be conveyed to a feed hopper. Biosolids enter the paddle dryer, where heated rotating paddles convey biosolids through the dryer. Thermal fluid is pumped through the paddles to heat the biosolids. After exiting the dryer, biosolids are cooled by a screw, then stored for distribution. This process is shown in Figure 7-1.

FIGURE 7-1: PADDLE DRYER PROCESS FLOW DIAGRAM



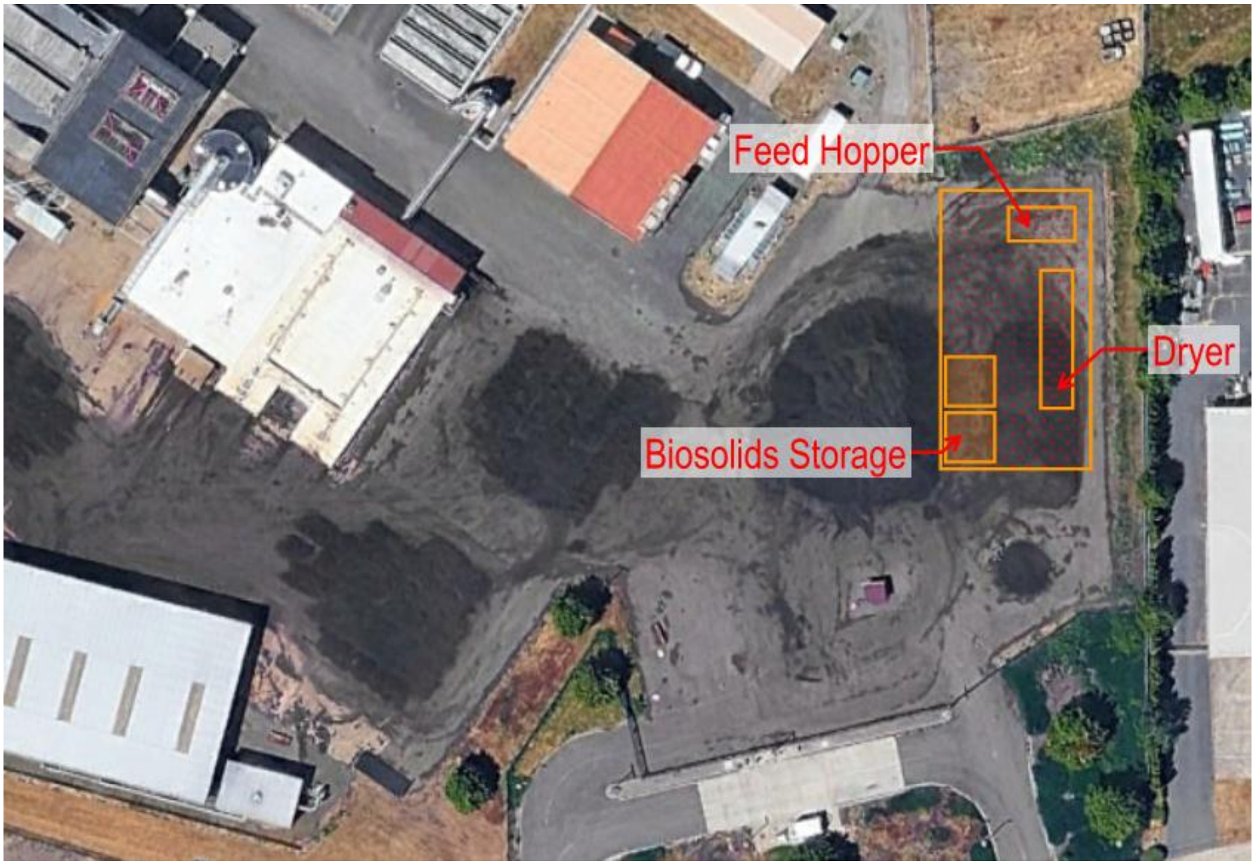
7.2 DESIGN CONSIDERATIONS

The paddle dryer would require a fuel source. For Newberg, it is anticipated that a natural gas connection would be required, which would add cost to the paddle dryer installation.

The paddle dryer size is anticipated to be larger than the available space in the mixing building; however, this would require further analysis. A building layout, assuming the paddle dryer is located in a separate building, is shown in Figure 7-2.

Similar to the drum dryer, a paddle dryer is not anticipated to require an air quality permit because the natural gas input is less than Oregon permit requirements and because an odor control system is included with the dryer.

FIGURE 7-2: PADDLE DRYER SITE LAYOUT



7.3 EASE OF MAINTENANCE

As with other indirect dryers, several safety features are included to reduce the risk of deflagration. Each safety feature adds complexity and mechanical and electrical maintenance requirements to ensure the features are working properly. A correctly operating system that is proactively maintained does not require significant attention to these systems; however, faulty equipment or failure to keep up with maintenance schedules can create safety concerns.

Beyond the potential concerns with safety equipment, regular maintenance is not overly burdensome. These items include common mechanical equipment tasks, such as cleaning the air filters, checking and replacing oil, inspecting equipment performance, etc. More specialized periodic maintenance includes replacing sensors and cleaning the thermal heater. More complex work, such as replacement or rehabilitation of the paddles, may need to be completed by the manufacturer.

7.4 RELIABILITY

The paddle dryer system can produce dried solids meeting the Class A design criteria. Keller and Newberg toured a paddle dryer installation at the Wilsonville WWTP in Wilsonville, Oregon. The paddle dryer did not require significant maintenance time but does require staff to check on it every 2 hours. A heating oil joint, costing $7,000 at Wilsonville, must be replaced every couple of months. In addition, the Wilsonville site has issues with dried solids and dust management.

Dried biosolids cause wear on internal parts, which may require periodic replacement of paddle liners. Because the paddle dryer consists of one primary unit, shutdown would require auxiliary treatment or storage of biosolids.

7.5 TRACK RECORD

There are multiple manufacturers of paddle dryers. These include Andritz, BCR (formerly Therma-Flite), and Komline-Sanderson. The technology has a long list of installations. For example, BCR has over 50 paddle dryer installations around the world, with at least 12 installations within the U.S. The earliest of these installations in the U.S. dates back to 2010.

CHAPTER 8 - ALTERNATIVE EVALUATION

The biosolids handling technologies are evaluated in this section by the following methods: life cycle cost estimates, table of non-monetary advantages and disadvantages, and a pairwise evaluation based on the criteria established in this memorandum.

8.1 LIFE CYCLE COSTS

The summary of the capital and life cycle costs for each solids handling alternative is shown in Table 8-1. All alternatives analyzed assume continued operation of the existing composting facility and include O&M costs for the existing facility. The following assumptions were made:

- All biosolids are treated by the selected alternative. No costs associated with refurbishment or decommissioning of the existing tunnel reactors are included.
- Covered aerated static piles assume usage of five existing ASPs with trench floors, with an additional cost associated with connection of all five bays to the existing fan. Existing ASPs would require additional cost to retrofit for odor control.
- Dryer buildings are assumed to be CMU, with similar architectural features as the existing buildings.
- New covered aerated static piles are assumed to be awnings without full height walls. The slab under new ASPs is assumed to be similar to the existing curing bays to allow for aeration trenching and front-end loader operation.
- Operational costs of \$0.12/kWh (electricity), \$6/MMBTU (natural gas), \$12.50/yd^3 sawdust, and \$61.20/hr. (labor) were used.
- Costs for the drum and paddle dryer options assume the equipment will need to be installed within a new building. If either of these options were to be selected, a more detailed evaluation of whether the equipment can fit in the existing building should be considered.
- Equipment costs for drying alternatives include the cost of a new conveyor and a new natural gas installation and service fee.
- Several percentage factors were applied to account for market contingency, contractor overhead and profit, and general administrative costs.
- Annual O&M Costs do not include compost or dried solids sales, assuming a worst-case scenario where all the final materials are given away.
- Polymer and sawdust material usage are based on plant operational data scaled by future average biosolids loadings.

TABLE 8-1: LIFE CYCLE COST ESTIMATE

Item	Aerated Static Pile	Vessel Composting	Drum Dryer	Paddle Dryer
Project Costs				
Equipment	$ 430,000	$ 1,544,000	$ 11,359,000	$ 6,910,000
Total Project Cost	**$ 3,913,000**	**$ 12,353,000**	**$ 48,230,000**	**$ 28,482,000**
Odor Control Cost	**$ 321,000**	**$ -**	**$ -**	**$ -**
Annual O & M Costs				
Estimated Annual O&M	**$ 449,000**	**$ 473,000**	**$ 608,000**	**$ 462,000**
10-Year Life Cycle Cost	**$ 8,060,000**	**$ 16,720,000**	**$ 53,840,000**	**$ 32,750,000**
Life Cycle Cost with Odor Control	**$ 8,380,000**	**$ -**	**$ -**	**$ -**

8.2 NON-MONETARY ADVANTAGES AND DISADVANTAGES

The advantages and disadvantages of each evaluated alternative are provided in Table 8-2 below.

TABLE 8-2: ALTERNATIVE ADVANTAGES AND DISADVANTAGES

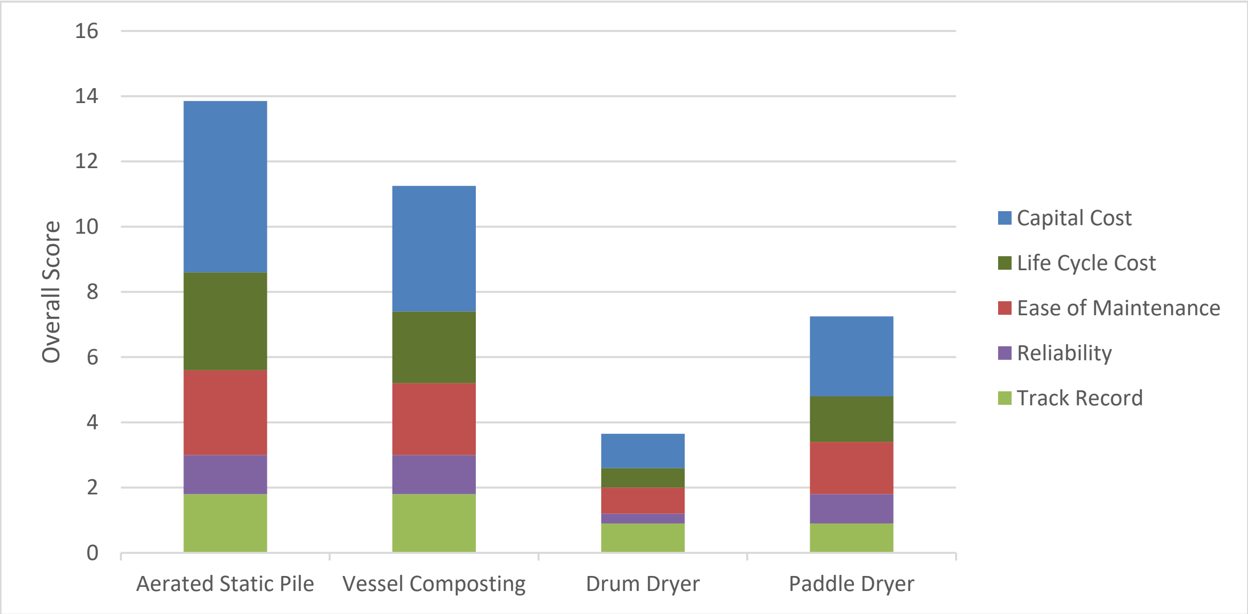
Alternative	Advantages	Disadvantages
Covered Aerated Static Piles	• The most common biosolids composting method • Can use existing mixing system, sawdust system, and existing ASPs • Fewer safety risks • Can be sold as NewGrow Compost • Easily configured to facility shape and size requirements	• Requires front-end loader to transport biosolids • Sawdust required for operation
In-Vessel Composting	• More effective odor control than ASPs • Can use existing mixing system and sawdust drying system • Fewer safety risks • Can be sold as NewGrow Compost • Easily configured to facility shape and size requirements • Shorter retention time and smaller footprint than ASPs	• In-vessel composting is slightly different from the existing system but is more standardized. • Requires front-end loader to transport biosolids in an enclosed structure • Sawdust required for operation • Odor control system required
Drum Dryer	• Smaller footprint • Able to accept lower solids concentrations • No bulking agent required • Product can be sold as fertilizer • Lower product volume	• High-temperature operation with risk of deflagration • Requires additional conveyance units, such as cake pumps or additional conveyors • Complex mechanical system • Requires significant operator attention • Requires dust control • Odor control involves different media from existing odor control • Less efficient heating than paddle dryer • More air to treat than paddle dryer although it can treat and recirculate the hot air to increase efficiency
Paddle Dryer	• Smaller footprint • Able to accept lower solids concentrations • No bulking agent required • Can be sold as fertilizer • Lower product volume • Less air to treat than drum dryer • More efficient heating than drum dryer	• High-temperature operation with risk of deflagration • Requires additional conveyance units, such as cake pumps or additional conveyors • Complex mechanical system • Requires dust control • Odor control involves different media from existing odor control • Nitrogen control system required to reduce deflagration risks

8.3 PAIRWISE EVALUATION

The four different biosolids alternatives were evaluated based on the criteria discussed. The criteria weights were discussed in the kickoff meeting based on the level of importance. The criteria and weights are as discussed in Section 2.5 above.

A pairwise evaluation compares each alternative and scores them based on how they compare. These scores are based on a scale of one to five, with one representing the first alternative being much less favorable than the compared alternative, and five representing the first alternative being much more favorable than the compared alternative. The scores for each alternative are then tallied up and multiplied by the respective weighting. The results of the pairwise weighted evaluation are provided in Figure 8-1.

FIGURE 8-1: WEIGHTED PAIRWISE EVALUATION RESULTS



8.4 RECOMMENDED ALTERNATIVE

Based on the pairwise scoring, capital cost, and advantages, aerated static piles are the recommended alternative to increase Newberg's biosolids treatment capacity. This recommendation should be revisited if certain factors change, such as the following:

1. New environmental regulations or considerations.
2. Changes in demand for the material, which could result in hauling costs.
3. Changes to drying technologies or reductions in equipment prices.

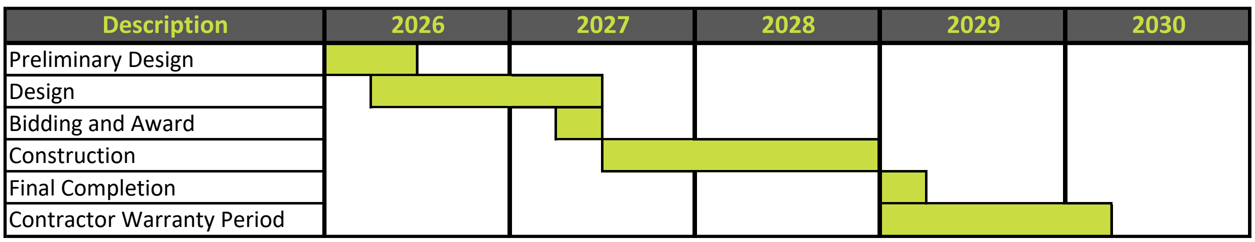
CHAPTER 9 - NEXT STEPS

Should the City decide to proceed with various improvements to the WWTP, the following next steps are recommended:

1. Clarifier stress test to determine clarifier construction requirements (recently completed November 5-7, 2025)
2. Procure funding for WWTP improvements
3. Complete CMGC design and construction of WWTP improvements

An adjusted schedule from the 2025 WWTP Capacity Study is found below in Figure 9-1. This schedule accounts for both composting improvements and other WWTP improvements that are expected to occur in the same period.

FIGURE 9-1: PROJECT SCHEDULE



9.1 PHASING PLAN

Because of the construction schedule, composting improvements cannot easily be split into phases. 2027 maximum month WAS loadings were projected to be 9,240 lb./day, which is 3,265 lb./day greater than the capacity of the five existing ASPs (with improvements). Installation of three additional aerated static piles would increase the ASP composting capacity from 5,975 lb./day to 9,560 lb./day. Assuming a linear growth rate, three aerated static piles will provide sufficient maximum month composting capacity until 2029, but construction of WWTP improvements, including aerated static piles, is expected to be completed in 2029 per the project schedule in Figure 9-1. Therefore, all four piles should be constructed.

This construction involves a new conveyor, piping for the existing five ASPs and four new ASPs, located under awnings. An odor control system could also be constructed for the four new ASPs. In addition to meeting maximum month biosolids loads, installing the four new ASPs also provides Newberg with more redundancy outside of maximum month loadings. If maintenance is required for fans or trench floors, having more ASPs than needed at average annual loads allows some of the ASPs to be shut down for maintenance.

If the budget for upcoming composting improvements is not sufficient for construction of four new aerated static piles, Newberg may be able to landfill a portion of their biosolids; however, there are some concerns with this approach. Based on previous operation data, two to three months per year have higher biosolids loadings. This approach would decrease capital costs; however, landfilling increases operation and maintenance costs due to hauling and tipping fees. Also, very few landfills accept biosolids and they may have additional biosolids requirements, such as a required dewatered solids content that further increases costs. Without further information, it is not recommended the City pursue landfilling.