West Basin Facility Plan Project 7054

TECHNICAL MEMORANDUM 11

Hillsboro WRRF Capacity Assessment

FINAL / September 2025

Produced by: carollo

Clean Water Services

Clean Water Services

West Basin Facility Plan Project 7054

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Abbreviations

A2O	anaerobic/anoxic/oxic
AAF	average annual flow
AB	aeration basin
ADWF	average dry weather flow
AO	anaerobic/oxic
aSRT	aerobic solids retention time
AWW	average wet weather
BOD	biochemical oxygen demand
CAMP®	concentrated, accelerated, motivated, problem-solving
cfs	cubic foot per second
COD	chemical oxygen demand
DEQ	Department of Environment Quality
District	Clean Water Services
FP	Facility Planning Project
ft/hr	feet per hour
ft/s	feet per second
gpd/sf	gallons per day per square foot
HHPS	high-head pump station
hp	horsepower
IPS	influent pump station
L/g	liters per gram
MDWW	maximum day wet weather
MDWWF	maximum day wet weather flow
mg/L	milligrams per liter
mgd	million gallons per day
MHWW	maximum hour wet weather
MHWWF	maximum hour wet weather flow
mL/g	milliliters per gram
MLSS	mixed liquor suspended solids
MMWW	maximum month wet weather
MMWWF	maximum month wet weather flow
MWWW	maximum week wet weather
MWWWF	maximum week wet weather flow
N/A	not applicable
NPDES	National Pollutant Discharge Elimination System
NTS	natural treatment system
PE	primary effluent

ppd/sf	pounds per day per square foot
RS	raw sewage
RWR	reclaimed wastewater
SC	secondary clarifier
SLR	solids loading rate
SOR	surface overflow rate
SVI	sludge volume index
TDH	total dynamic head
TSS	total suspended solids
UV	ultraviolet
WRRF	Water Resource Recovery Facility

TM 11 HILLSBORO WRRF CAPACITY ASSESSMENT

11.1 Introduction and Major Assumptions

The following capacity assessment identifies process capacity deficiencies for the treatment systems at the Hillsboro Water Resource Recovery Facility (WRRF), shown schematically in Figure 11.1. This assessment updates the previous capacity evaluation completed as part of the last facility planning project (FP2014)[1] as well as the preliminary capacity evaluation completed as part of the West Basin Alternatives CAMP® (CAMP2022)[2].

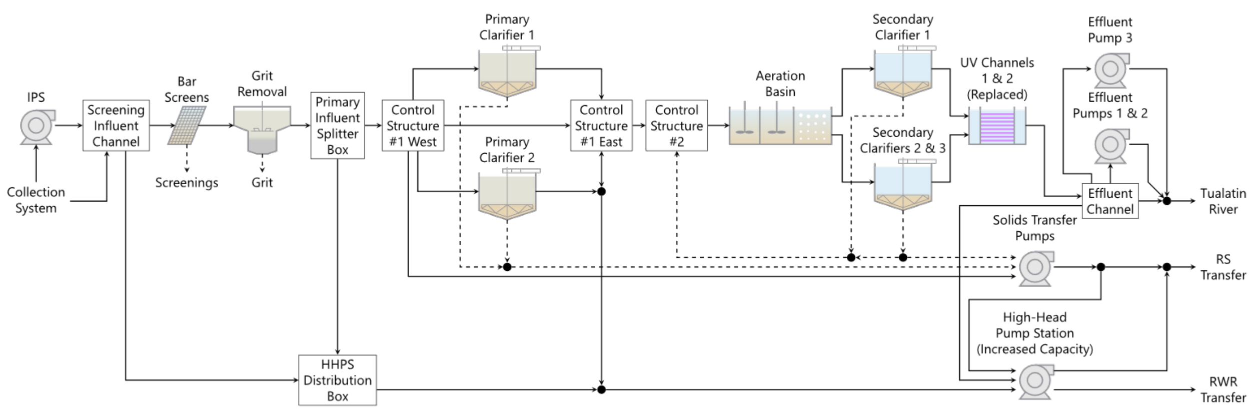

Figure 11.1 Hillsboro WRRF Simplified Process Flow Diagram

The results of current capacity assessment are summarized in Figure 11.2, which depicts the trigger years for each of the processes. As shown:

- Primary clarification is limited currently under maximum month wet weather flow (MMWWF) conditions.
- Screening and the high-head pump station (HHPS) are limited before the end of the planning period (2039 and 2038 to 2040, respectively). The HHPS trigger year range reflects the HHPS capacity with both dedicated and shared transfer pipeline use by the Hillsboro and Forest Grove WRRFs.
- The flow transfer system will be limited under peak conditions with the proposed dry weather operation approach by 2057.
- The influent pump station will experience capacity limitations during maximum daily wet weather flow (MDWWF) in 2073.

[1] Carollo Engineers, Inc., (February 2014). TM 4.5 - Hillsboro and Forest Grove Recommended Plan, West Basin Facilities Plan.
[2] Carollo Engineers, Inc., (March 2023). TM 1 - West Basin Alternatives CAMP® Documentation, West Basin Facility Plan Project 7054.

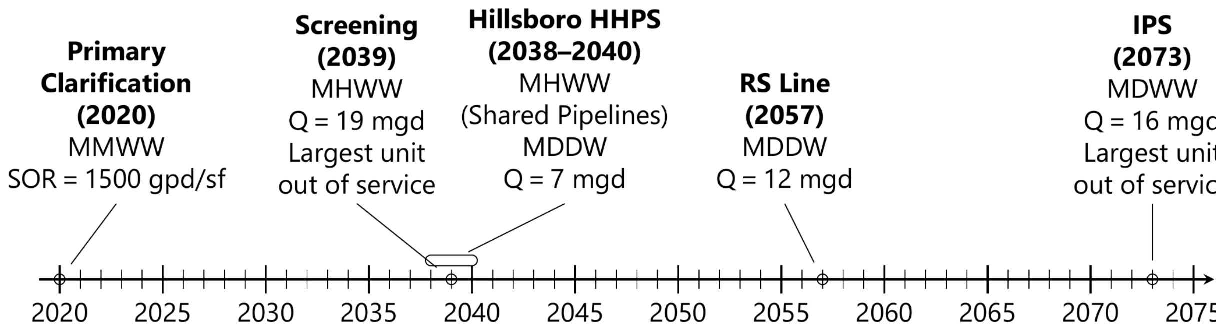

Figure 11.2 Hillsboro WRRF Process Trigger Year Summary Timeline

11.1.1 Flows and Loads

The flow and load projections used for all unit process capacity evaluations are those provided by Clean Water Services (District) on July 19, 2023. These projections are based on the projections developed in the West Basin Flow and Load Memorandum[3] but have been modified to include the planned construction of the Council Creek Pump Station that was recommended as part of the West Basin Alternatives CAMP®[4]. This pump station will intercept the collection system flows originating in West Forest Grove and Banks that have traditionally been tributary to the Hillsboro WRRF and pump the flow to the Forest Grove WRRF. The projections adopted for the present evaluation assumed the pump station was online today. The specific timing of the Council Creek Pump Station construction project has not been finalized; however, it is expected within the next 10 years. With no trigger years occurring in this timeframe (Figure 11.2), it is not expected that assuming the pump station is online currently will significantly alter the trigger years determined herein.

Table 11.1 summarizes the flow and load projections for 2020, the end of the current planning period (2045), and buildout (2075). The full projections are provided in Appendix 10A of TM10.[5]

Table 11.1 Hillsboro WRRF Flow and Load Projection Summary

Facility/Year	MMDW cBOD Load (ppd)	MMDW TSS Load (ppd)	MMWW cBOD Load (ppd)	MMWW TSS Load (ppd)	MDDW Flow (mgd)	MDWW Flow (mgd)	MHWW Flow (mgd)
2020	6097	7229	5568	7286	5.2	14.1	15.9
2045	8233	9655	7518	9732	7.7	18.1	20.4
2075	11,184	13,085	10,213	13,188	10.6	22.7	25.6

Notes:
cBOD - carbonaceous biochemical oxygen demand; MDDW - maximum day dry weather; MDWW - maximum day wet weather; mgd - million gallons per day; MHWWF - maximum hour wet weather flow; MMDW - maximum month dry weather; MMWW - maximum month wet weather; ppd - pound per day; TSS - total suspended solids; WRRF - water resource recovery facility

[3] Jacobs (2022-02-08). Flow and Load Projections. Memorandum. West Basin Master Planning Preliminary Work.
[4] Carollo Engineers, Inc., (March 2023). TM 1 - West Basin Alternatives CAMP® Documentation, West Basin Facility Plan Project 7054.
[5] Carollo Engineers, Inc. (June 2025). TM 10 - Forest Grove WRRF Capacity Evaluation, West Basin Facility Plan Project 7054.

11.1.2 Overall West Basin Operation and Flow Transfers

Based on the West Basin Alternatives CAMP® recommendations, the present analysis assumes the following operation for the West Basin:

- All solids generated at the Forest Grove and Hillsboro WRRFs will be transferred to the Rock Creek WRRF for treatment.
- Forest Grove WRRF:
  - Will operate year-round.
  - Will have primary clarifiers operational by March 2026.
  - Primary solids, waste activated sludge, and transfer flows will be conveyed to the Rock Creek WRRF via the flow transfer system.
  - Peak flows up to 30 million gallons per day (mgd) will be treated during the wet weather season.
  - Influent flows exceeding 12 mgd during the dry weather season will be transferred to the Rock Creek WRRF via the flow transfer system (limited by the natural treatment system [NTS]). Peak dry weather flows are currently transferred to the Rock Creek WRRF based on this limit. Historically, the District has operated the primary clarifiers at the Hillsboro WRRF during the dry weather season. Once dry weather operation of the Hillsboro WRRF transitions to only preliminary treatment (screening and grit removal), the primary solids and carrier water flow that has historically been conveyed to the Rock Creek WRRF will be transferred to the Forest Grove WRRF. As a result, the magnitude and frequency of peak dry weather flow diversions to the Rock Creek WRRF are expected to increase once this change is made. By 2046, flow will need to be transferred from the Forest Grove WRRF to the Rock Creek WRRF under the maximum month dry weather (MMDW) condition.[6] The District is currently reviewing the hydraulic capacity of the NTS as part of the ongoing Forest Grove WRRF capacity evaluation. Depending on the outcome of this analysis, this assumption may need to be revisited.
- Hillsboro WRRF:
  - Will operate during the wet weather season, with primary solids, waste activated sludge, and excess primary effluent transfer flows being conveyed to the Rock Creek WRRF via the flow transfer system.
  - Primary effluent flows exceeding the 20 mgd hydraulic limit of the outfall during the wet weather season will be transferred to Rock Creek WRRF via the flow transfer system.
  - Will transfer screened and degritted collection system influent to the Forest Grove WRRF during the dry weather season after the primary clarifiers are completed at the Forest Grove WRRF. Until then, primary effluent will be transferred to the Forest Grove WRRF.

[6] Carollo Engineers, Inc. (June 2025). Forest Grove WRRF Capacity Evaluation. Technical Memorandum 10. West Basin Facility Plan Project 7054.

11.1.3 Regulatory Assumptions

This capacity analysis assumes that the current National Pollutant Discharge Elimination System (NPDES) permit for the Hillsboro WRRF will remain in effect. The regulatory assumptions adopted for the current analysis are consistent with those adopted for the West Basin Alternatives CAMP®.[7] Specific assumptions include:

- The Hillsboro WRRF will not discharge during the dry weather season when river flows are low.
- The total suspended solids (TSS) mass load limit will increase in the future such that the current effluent TSS concentration may be maintained. The Hillsboro WRRF's effluent TSS loads must comply with individual federal secondary treatment standards as well as a bubbled TSS mass load limit across the District's four facilities. The current bubbled average monthly mass load limit under high river flow conditions is 17,000 pounds per day (ppd) (assuming the Rock Creek, Hillsboro, Forest Grove, and Durham WRRFs are discharging).
- Nitrification will not be required at the Hillsboro WRRF to meet effluent ammonia limits for toxicity. Effluent ammonia limits apply at the Hillsboro WRRF when the stream flow is less than 1000 cubic foot per second (cfs). It was assumed that the Hillsboro WRRF would not discharge under these conditions and secondary effluent would be sent to the Rock Creek WRRF via the flow transfer system.

11.1.4 Design Criteria

The design criteria used in this analysis were developed based on values established in the last Facility Plan[8] and those used in the West Basin Alternatives CAMP® capacity assessment[9]. Each criterion was evaluated in the context of recent historical data from 2015 through 2021. Consistent with previous capacity assessments, the design criteria used to evaluate unit process capacity are largely based on process performance. In general, hydraulic constraints and limitations in ancillary or supporting systems (e.g., pumping and aeration) were not considered. Hydraulic constraints will be identified as part of the Hillsboro WRRF hydraulic modeling task currently underway.[10]

11.2 Liquid Treatment Process Capacity

The Hillsboro WRRF liquid stream processes are shown schematically in Figure 11.1. The capacity of each liquid stream process—including influent pumping, screening, grit removal, primary clarification, secondary treatment, disinfection, and the flow transfer system—are described below.

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[7] Clean Water Services., (December 2021, updated May 2022). West Basin Facility Planning – Regulatory Requirements for the Hillsboro WRRF. CWS Internal Memo. West Basin Facility Plan Project 7054.
[8] Carollo Engineers, Inc., (February 2014). TM 4.5 - Hillsboro and Forest Grove Recommended Plan, West Basin Facilities Plan.
[9] Carollo Engineers, Inc., (March 2023). TM 1 - West Basin Alternatives CAMP® Documentation, West Basin Facility Plan Project 7054.
[10] Carollo Engineers, Inc. (July 2025). TM 15 - Hillsboro WRRF Hydraulic Capacity Assessment, West Basin Facility Plan Project 7054.

11.2.1 Influent Pumping

The influent pump station (IPS) consists of four variable speed submersible pumps. Table 11.2 summarizes the pump sizes and capacities. The pumps are operated in a lead-lag configuration with a small pump typically in the lead position. Under high flows, a large pump is in the lead position.

Table 11.2 Existing Influent Pump Station

Description	Units	Large Pumps	Small Pumps
Number of pumps	quantity	2	2
Capacity per pump	gpm	7015 at 43 feet TDH	2430 at 35 feet TDH
Total dynamic head operating range	feet	41 to 45	36 to 40
Motor size	hp	115	33.5

Notes:
hp - horsepower; TDH - total dynamic head.

As summarized in Table 11.3, the IPS needs to have the capacity to pump the MDWWF with one unit out of service and the maximum hour wet weather flow (MHWWF) with all units in service. While these design criteria are consistent with those adopted for the Rock Creek WRRF IPS, they are less stringent than Oregon State Department of Environmental Quality's (DEQ) recommendation of firm capacity for the MHWWF[11].

Table 11.3 Influent Pump Station Design Criteria

Flow/Load Condition	Design Criteria	Redundancy Criteria	Performance Assumption	Reference
MDWWF	Installed Firm Capacity	Largest unit out of service	N/A	Criteria consistent with Rock Creek WRRF
MHWWF	Installed Rated Capacity	All units in service	N/A	Criteria consistent with Rock Creek WRRF

Notes:
N/A - not applicable.

Importantly, a significant portion of the collection system influent does not require pumping. This flow, together with the IPS effluent, is combined in the inlet box upstream of screening (Figure 11.1). The total influent flow to the facility is determined from downstream measurements. The District does not measure the IPS or gravity flows directly and has estimated that approximately 70 percent of the total influent flow passes through the IPS. This value was adopted for the present capacity assessment and improvements to the influent flow measurement are recommended to improve this estimate. Given the uncertainty, the impact of higher fractions of the influent going through the IPS was also evaluated.

Figure 11.3 depicts the current pumping capacity relative to the projected MDWWF and MHWWF flows (panels A and B, respectively) assuming 70 percent of the total facility influent flow goes through the IPS. With this fraction, the IPS is projected to have sufficient capacity until 2073. The IPS will reach capacity earlier with higher influent flow fractions going through the IPS. Less than approximately 87 percent of

[11] Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities. Business Oregon, United States Department of Agriculture, Rural Community Assistance Corporation, State of Oregon Department of Environmental Quality; 2018.

the projected total influent flow would need to pass through the IPS for this unit operation to not be triggered before the end of the planning period (2045).

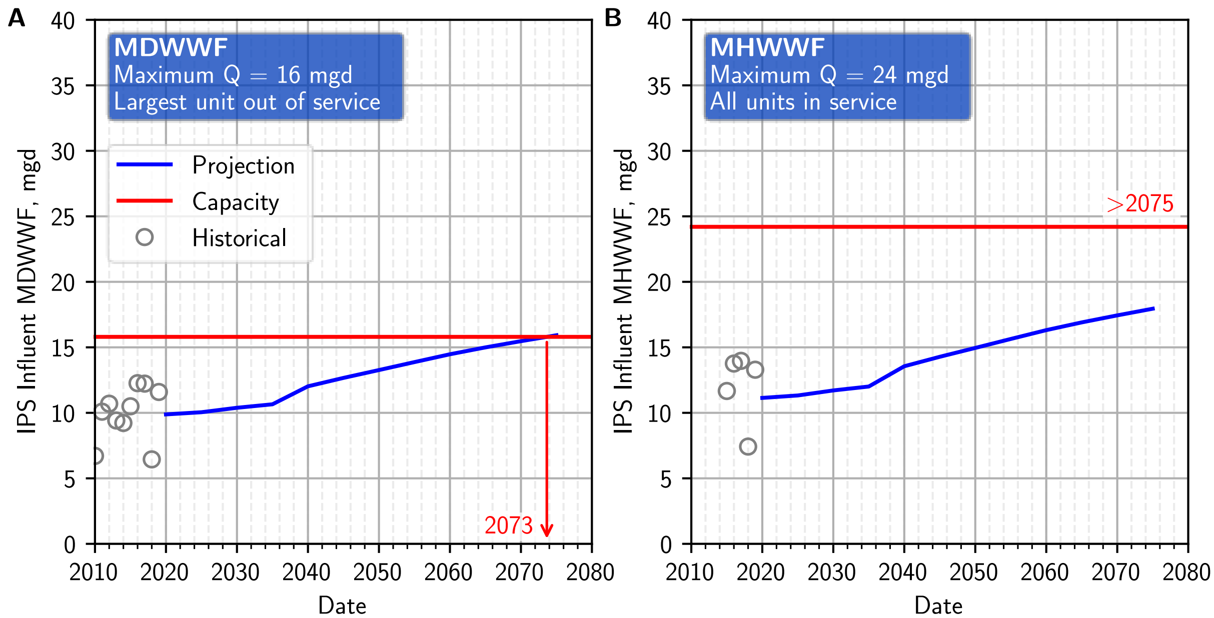

Figure 11.3 Influent Pump Station Trigger Plots

The historical and projected influent pump station flows are 70 percent of the total influent flow.

11.2.2 Influent Screening

The headworks at the Hillsboro WRRF consists of two channels, both with mechanically cleaned bar screens (summarized in Table 11.4). The existing system has a total rated capacity of 38 mgd and a firm capacity (capacity with the largest unit out of service) of 19 mgd.

Table 11.4 Existing Influent Screening

Description	Units	Value
Width, Each	feet	3.5
Opening Size	inches	0.437
Capacity, Each	mgd	19

With no screening bypass channels available, the screens need to be able to pass the MHWWF with one unit out of service (Table 11.5). Based on this criterion, influent screening will reach capacity in 2039. This is depicted in Figure 11.4A which compares the current screening capacity to the projected MHWWF.

Table 11.5 Influent Screening Design Criteria

Flow/Load Condition	Design Criteria	Redundancy Criteria	Performance Assumption	Reference
MHWWF	Installed Firm Capacity	Largest unit out of service	N/A	FP2014

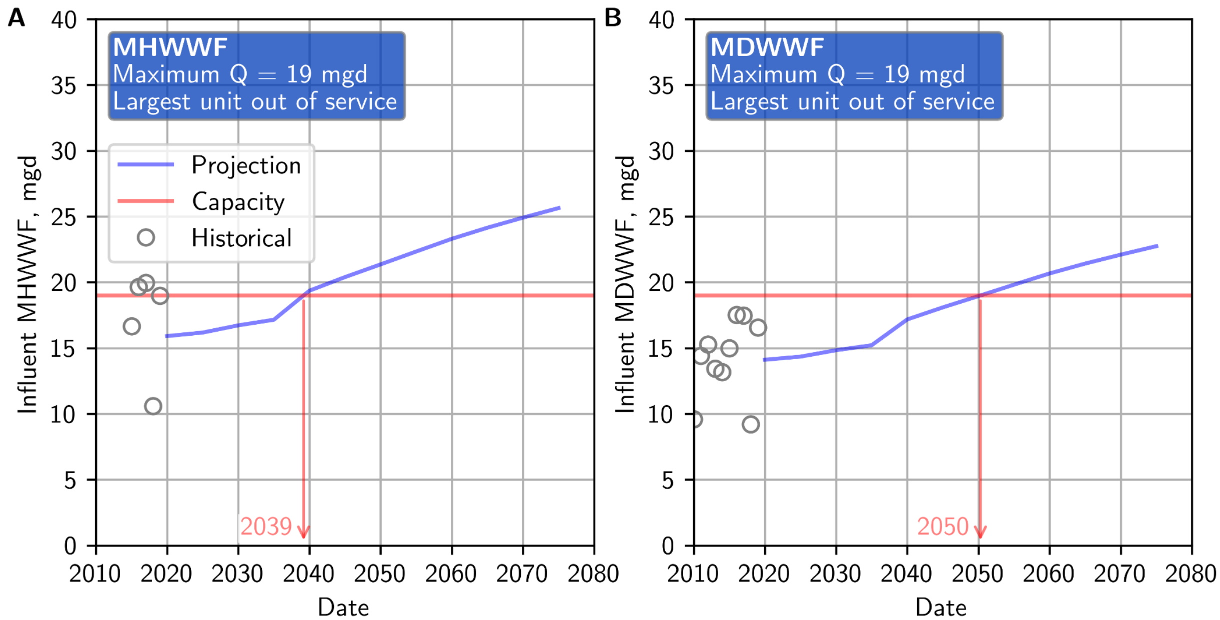

Figure 11.4 Influent Screening Trigger Plot

Importantly, peak wet weather flows may be diverted to the Rock Creek WRRF prior to screening. This practice may be used to accommodate high flows when a screen is out of service and extend the screening trigger year beyond 2039. However, the District prefers to avoid operating in this manner due to excessive ragging of the HHPS Transfer pumps. With one screen offline, the system would have sufficient capacity to pass the MHWWF through 2066 at which point a total of 5.6 mgd would be transferred from the Hillsboro WRRF to the Rock Creek WRRF and the total flow capacity of the flow transfer system would be limiting. As discussed in Section 11.2.9, the Hillsboro WRRF and Forest Grove WRRF will both need to discharge to the RS line under the MHWWF condition after 2038.

The District prefers to maintain consistent design criteria across their facilities. If held to firm capacity under the projected MDWWF (the design criteria adopted for the Rock Creek WRRF), influent screening would have sufficient capacity until 2050 (shown in Figure 11.4B).

11.2.3 Grit Removal

Two vortex grit removal chambers follow screening. The existing system has a design capacity of 20 mgd per chamber. The District has adopted a design criterion at the Durham WRRF for grit removal of all units in service under MHWWF (Table 11.6).[12] As noted above, peak wet weather flows may be diverted to the Rock Creek WRRF when a unit is out of service.

Table 11.6 Grit Removal Design Criteria

Flow/Load Condition	Design Criteria	Redundancy Criteria	Performance Assumption	Reference
MHWWF	Installed Rated Capacity	All units in service	N/A	East Basin 2021

[12] Carollo Engineers, Inc., (June 2021). TM 11 - Liquids Treatment Process Capacity Analysis, East Basin 2019 Master Plan Project.

Figure 11.5 compares the grit removal capacity with the projected MHWWF. As shown, grit removal will have sufficient capacity through buildout.

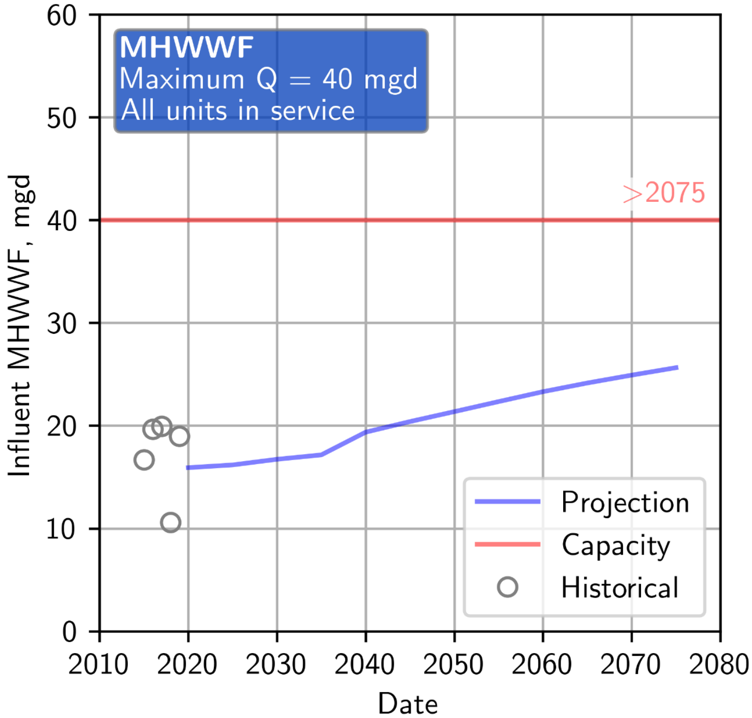

Figure 11.5 Grit Removal Trigger Plot

11.2.4 Primary Clarification

Primary treatment at the Hillsboro WRRF is provided with two 60-foot diameter clarifiers. Both clarifiers are typically in operation during the wet weather season. The District has also operated the clarifiers during the dry weather season, with the primary effluent being directed to the Forest Grove WRRF. Once the primary clarifiers at the Forest Grove WRRF are completed (anticipated by March 2026), the District anticipates that the primary clarifiers at the Hillsboro WRRF will remain offline during the dry weather season. When operational, primary solids and scum are pumped to the Rock Creek WRRF for treatment.

The total primary influent flow is limited to 12 mgd by a passive weir in Control Structure 2 which delivers flow to the primary clarifiers. Grit effluent flows above this threshold overflow the weir and combine with primary effluent to go on to secondary treatment or the high-head pump station.

Primary clarifier design criteria are summarized in Table 11.7. Primary clarifier capacity is rated based on the surface overflow rate (SOR). Redundancy is provided in the dry weather season. The MMWWF design criterion SOR of 1500 gpd/sf was adopted in the 2014 facility plan[13] and is consistent with the design criteria adopted for the primary clarifiers at the Durham WRRF and the new primary clarifiers at the

[13] Carollo Engineers, Inc., (February 2014). TM 4.5 - Hillsboro and Forest Grove Recommended Plan, West Basin Facilities Plan.

Forest Grove WRRF. The SOR of 2500 gpd/sf under MHWWF is based on the 7 mgd per clarifier hydraulic limitation identified in the previous facility plan. This limitation will be verified as part of the Hillsboro WRRF hydraulic evaluation currently underway as part of the current project. Higher SORs were adopted for the MMWWF and MHWWF conditions for the Rock Creek WRRF capacity evaluation based on work completed in preparation for the addition of that facility's fourth primary clarifier.[14]

Table 11.7 Primary Clarification Design Criteria

Flow/Load Condition	Design Criteria	Redundancy Criteria	Performance Assumption	Reference
MMWWF	1500 gpd/sf	All units in service	TSS removal = 62%(1)	FP2014
MHWWF	2500 gpd/sf(2)	All units in service	N/A	FP2014

Notes:
(1) TSS removal under MMWW conditions adopted for the primary clarifier in the secondary treatment capacity evaluation. This assumes the primary clarifier capacity limitation identified herein will be addressed.
(2) SOR based on a hydraulic limitation of 7 mgd per clarifier. This hydraulic limitation will be verified as part of the hydraulic evaluation underway for the current project.
gpd/sf - gallons per day per square foot; SOR - surface overflow rate.

Figure 11.6 depicts the primary clarifier capacities based on the design criteria in Table 11.7 with the historical and projected MMWWF and MHWWF. As shown in Figure 11.6A, the primary clarifiers have sufficient MHWWF capacity through buildout due to the passive weir limiting the primary influent flow rate to less than 12 mgd. If this limitation were removed, the primary clarifiers would not have sufficient capacity to pass the MHWWF currently. From 2015 through 2019, the MHWWF consistently exceeded both the 12 mgd passive weir threshold and the 14 mgd combined hydraulic limit of the primary clarifiers.

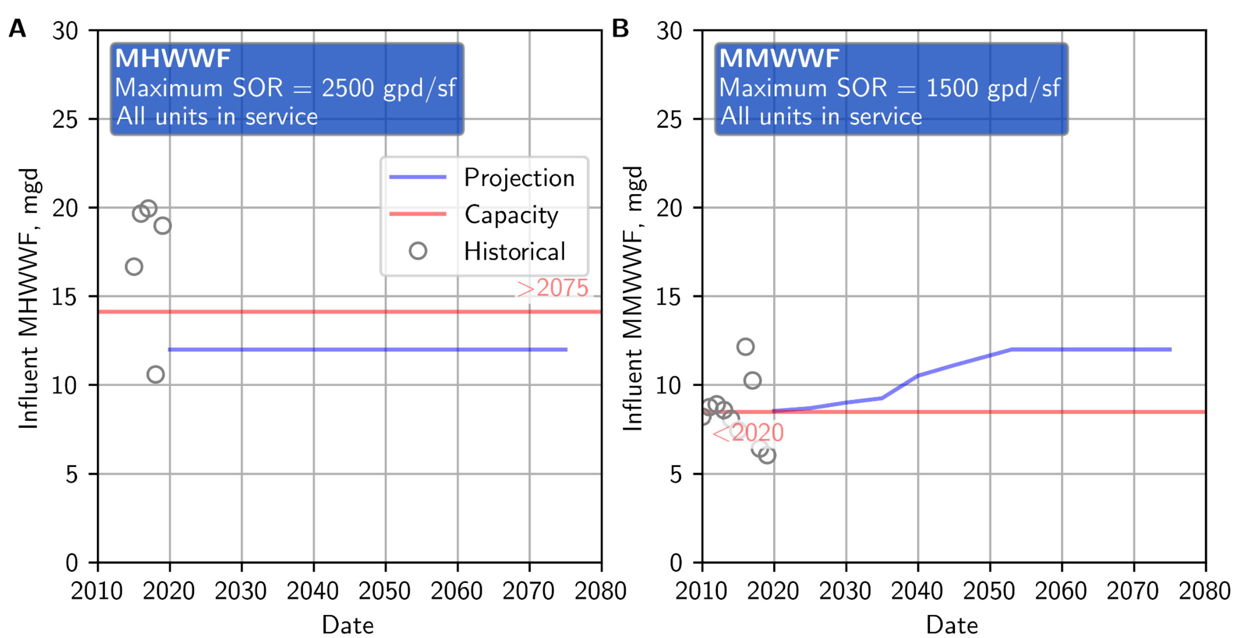

Figure 11.6 Primary Clarification Trigger Plot

Flow through the primary clarifier is limited to 12 mgd by the passive weir in the primary influent splitter box.

[14] Carollo Engineers, Inc. (2024). Rock Creek WRRF Capacity Assessment. Technical Memorandum 2. West Basin Facility Plan Project 7054.

As shown in Figure 11.6B, the primary clarifiers are currently out of capacity based on the 1500 gpd/sf SOR under the MMWWF condition. The MMWWF from 2010 through 2019 ranged from 6.1 mgd to 12.2 mgd with an average of 8.5 mgd. These flows equate to a MMWWF SOR range of 1100 gpd/sf to 2200 gpd/sf with an average SOR equal to 1500 gpd/sf. Importantly, the MMWWF is projected to increase, reaching the 12 mgd threshold in 2052.

Historical TSS and chemical oxygen demand (COD) removals for the Hillsboro WRRF primary clarifiers were reviewed to characterize the anticipated performance reduction under the projected SORs (shown in Figure 11.7). Historically, TSS and COD removals have decreased with increasing SOR and both have generally been consistent with expectations for conventional primary clarification for SORs less than approximately 1500 gpd/sf, achieving 50 to 70 percent TSS removal and 25 to 40 percent COD removal. TSS and COD removal at SORs greater than 1500 gpd/sf have been much lower. The District noted that the primary effluent sample is collected from a location that includes both the primary effluent and screened and degritted flow that bypasses primary treatment. This bypass occurs at flows above 12 mgd. Assuming a maximum to average diurnal flow peaking factor of 1.6, TSS and COD removals at daily average SORs greater than approximately 1350 gpd/sf may not be representative of actual performance.

The District conducted a short evaluation from 2024-02-22 through 2024-03-01 to collect additional performance data at elevated SORs by taking one primary clarifier out of service. This evaluation was planned for a longer period but was cut short due to solids settling issues at the Rock Creek WRRF. The findings from this short run (included in Figure 11.7), suggest higher TSS and COD removals may be possible at SORs greater than 1500 gpd/sf. Additional testing is recommended to corroborate these results.

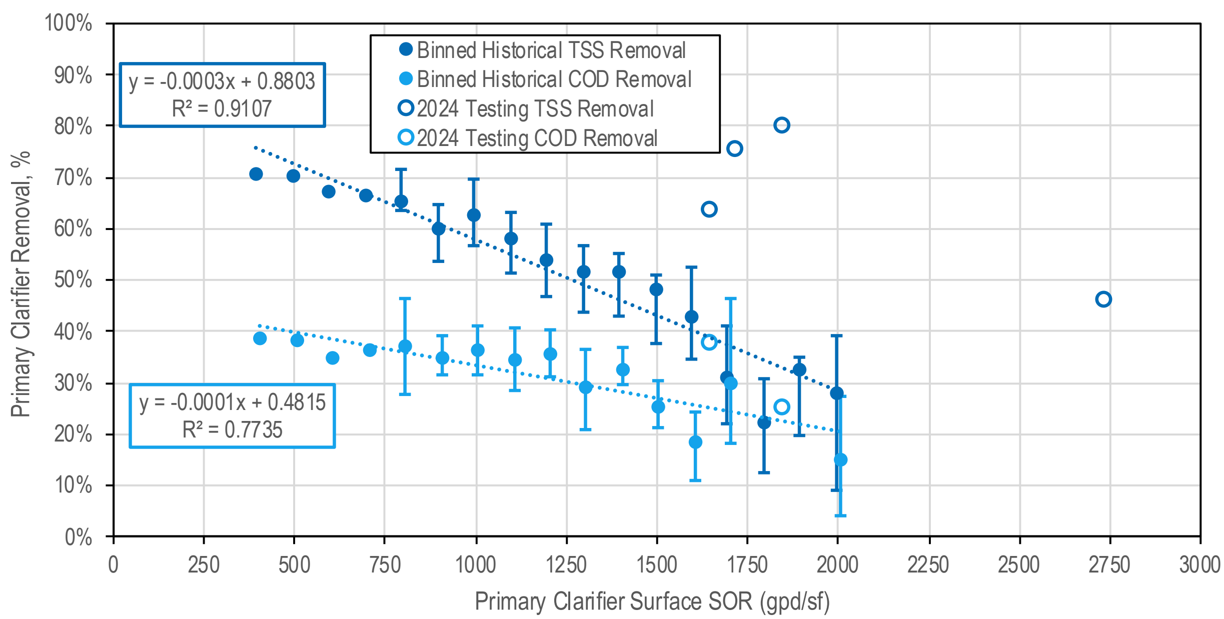

Figure 11.7 Historical Primary Clarifier Performance

The primary effluent sample is collected from a location that includes both the primary effluent and screened and degritted flow that bypasses primary treatment. TSS and COD removals are estimated from concentrations measured in the influent and primary effluent from November 1, 2014 through December 31, 2021. Removals greater than 100 percent and less than 0 percent have been dropped. Historical data were binned by SOR with bins of width 100 gpd/sf. Median values shown with upper and lower bars denoting the 25th and 75th percentile, respectively.

A TSS removal of 62 percent was selected to evaluate secondary treatment capacity under the MMWW condition (Table 11.7). This removal was selected with the assumption that TSS removals have been higher than observed historically due to the biased primary effluent sample location. The District measured TSS removals between 64 and 80 percent at SORs between 1650 and 1850 gpd/sf during the winter 2024 stress testing. The 62 percent TSS removal was selected from the historical wet weather primary clarifier TSS removal at the Rock Creek WRRF[15] with the projected MMWWF of 11.5 mgd at the end of the planning period. In summary, the primary clarifiers are currently out of capacity based on the MMWWF SOR design criterion and the TSS removals observed historically at SORs projected for the MMWWF condition may be biased low. The TSS removal adopted to evaluate secondary treatment capacity under the MMWW condition assumes that additional primary clarification capacity will be installed.

11.2.5 Secondary Treatment

Secondary treatment at the Hillsboro WRRF is performed by a single 1.04 million gallon aeration basin with a 15 foot side water depth. The aeration basin is split into eight zones and configured for flexible operation. Figure 11.8 depicts the primary modes of operation available, including anaerobic/oxic (AO, panel A), contact stabilization (panel B), and anaerobic/anoxic/oxic (A2O, panel C). The aeration basins have historically operated in the AO configuration. With all zones online, this configuration provides approximately 16 percent anaerobic volume. Mixed liquor is split between three circular secondary clarifiers for solids settling. Secondary clarifier 1 has a diameter of 112 feet and a side water depth of 18 feet. Secondary clarifiers 2 and 3 each have a diameter of 80 feet and a side water depth of 13 feet.

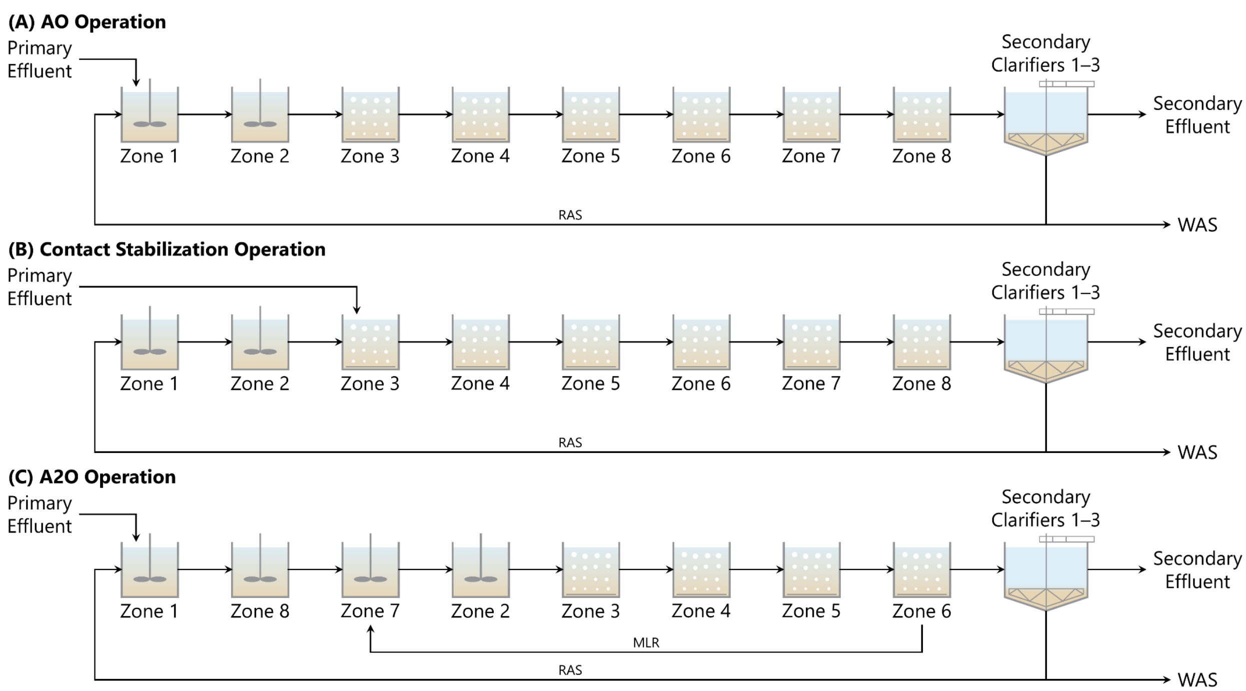

Figure 11.8 Hillsboro Aeration Basin Operating Modes

[15] Carollo Engineers, Inc. (2024). TM 2 - Rock Creek WRRF Capacity Assessment, West Basin Facility Plan Project 7054.

11.2.5.1 Secondary Treatment Design Criteria

Table 11.8 summarizes the design criteria adopted in the secondary treatment capacity evaluation. As the Hillsboro WRRF is not permitted to discharge in the dry weather season, the capacity was only evaluated under wet weather conditions. Secondary treatment capacity is determined through a combination of biological process modeling and a state point analysis (discussed below). The process is rated by the sum of the maximum sustained overflow flowrates that each secondary clarifier can pass with the secondary inventory resulting from the MMWW primary effluent load.

Table 11.8Secondary Treatment Design Criteria

Flow/Load Condition	Design Criteria	Redundancy Criteria	Performance Assumption	Reference
▪ ABs evaluated on MMWW PE BOD Load ▪ SCs evaluated on MDWWF.	▪ aSRT = 3 day ▪ AO mode ▪ SLR ≤ 48 ppd/sf at peak flow ▪ Terminal MLSS ≤ 4300 mg/L	▪ All AB zones in service ▪ All SCs in service	SVI = 174 mL/g	▪ Non-nitrifying aSRT from FP2014 ▪ 90th percentile SVI data
▪ ABs evaluated on MMWW PE BOD Load ▪ SCs evaluated on MDWWF.	▪ aSRT = 4.7 day ▪ A2O mode ▪ SLR ≤ 48 ppd/sf at peak flow ▪ Terminal MLSS ≤ 4300 mg/L	▪ All AB zones in service ▪ All SCs in service	SVI = 174 mL/g	▪ Nitrifying aSRT based on minimum 30d average of influent and effluent temperatures in May (13.5°C) and a nitrification safety factor (NSF) of 1.5 ▪ 90th percentile SVI data

Notes:
AB - aeration basin; aSRT – aerobic solids retention time; BOD - biochemical oxygen demand; mg/L - milligram per liter; mL/g - milliliters per gram; MLSS - mixed liquor suspended solids; PE - primary effluent; ppd/sf - pounds per day per square foot; SC - secondary clarifier; SLR - solids loading rate; SVI - sludge volume index.

The process is generally operated in the AO configuration (panel A of Figure 11.8) with an aerobic solids retention time (aSRT) that provides for good settling without nitrification. Hillsboro is not permitted to discharge under low river flow conditions (the dry weather season). The start of the low river flow condition occurs when the 7 day median river flow measured at the Farmington station dips below 250 cfs starting May 1st of each year or at least by July 1st. The low river flow condition ends when the 7 day median river flow measured at the Farmington station rises above 350 cfs starting September 30th of each year or at least by November 15th. It was assumed that maintenance of the aeration basins and secondary clarifiers may be performed during the dry weather season when the secondary treatment process is not in service.

When discharging to the Tualatin River, the Hillsboro WRRF is subject to peak day and monthly average effluent ammonia limits (≤ 50.4 mg/L and ≤ 17.4 mg/L, respectively) when the 30-day average of the daily average stream flow measured at the Farmington station is less than 1000 cfs. These conditions generally occur in the shoulder seasons when the Hillsboro WRRF is transitioning into and out of operation. Based on Farmington station data from 2005 through 2024, the probability that the Tualatin River flow would be high enough to allow Hillsboro WRRF to continue discharging into May but would be low enough that the facility would be subject to the effluent ammonia limit is approximately 40 percent. To evaluate this condition, it was assumed that the process would operate in the A2O configuration (panel C of Figure 11.8) to maintain settleability with a sufficient aSRT to nitrify. A nitrification safety factor (NSF) of 1.5 was adopted based on the magnitude of the effluent ammonia limit and the ability to transfer flow to the Rock Creek WRRF if the limit cannot be achieved. Historically, operation at aSRTs between 4.2 day and 5.2 day with temperatures between 13°C and 14°C has produced incomplete nitrification and has allowed the facility to meet the effluent ammonia limit. Given the ability to transfer flows to the Rock Creek WRRF, this condition was not considered to be capacity limiting for secondary treatment.

11.2.5.2 State Point Analysis

Secondary clarification capacity was evaluated using state point analysis. This approach estimates secondary clarifier performance by graphically comparing the applied solids flux and underflow solids flux to the solids settling flux. The solids settling flux was modeled using the Vesilind relationship for the solids settling velocity, reduced by a non-ideality factor of 1.2:

$$V = V_0 \cdot e^{-n \cdot X}$$

The District has developed their own correlation between SVI and the Vesilind settling velocity parameters V_0 and n. The Vesilind parameters for the SVIs adopted herein are summarized in Table 11.9.

Table 11.9 SVI and Vesilind Parameters Based on the District's Correlation

SVI, mL/g	Initial Settling Velocity V_0 (ft/s)(1)	Exponent, n (mL/g)(2)
112	40.6	0.4420
150	34.4	0.4078

Notes:

(1) The initial settling velocity was estimated using the District's correlation: $V_0 = 589.37 \cdot SVI^{-0.567}$ where the SVI is in units of mL/g and V_0 has units of ft/hr.

(2) The exponential parameter, n, was calculated using the District's correlation: $n = 0.5428 - 0.0009 \cdot SVI$ where SVI is in units of mL/g n has units of L/g.

ft/hr - foot per hour; ft/s - foot per second; L/g - liter per gram.

11.2.5.3 Secondary Treatment Capacity

The trigger plot for secondary treatment capacity is shown in Figure 11.9, which shows that the secondary treatment process has sufficient capacity through buildout (panel A). As noted above, this assumes the primary clarifier capacity limitation is alleviated and primary clarifier TSS removal under the MMWW condition is consistent with typical primary clarifier performance (62 percent). If additional primary clarification capacity is not provided, secondary treatment would reach capacity earlier. This also assumes that nitrification is not required at the Hillsboro WRRF and if the 30-day average stream flow drops below 1000 cfs, Hillsboro influent would be transferred to the Rock Creek WRRF during the wet weather season.

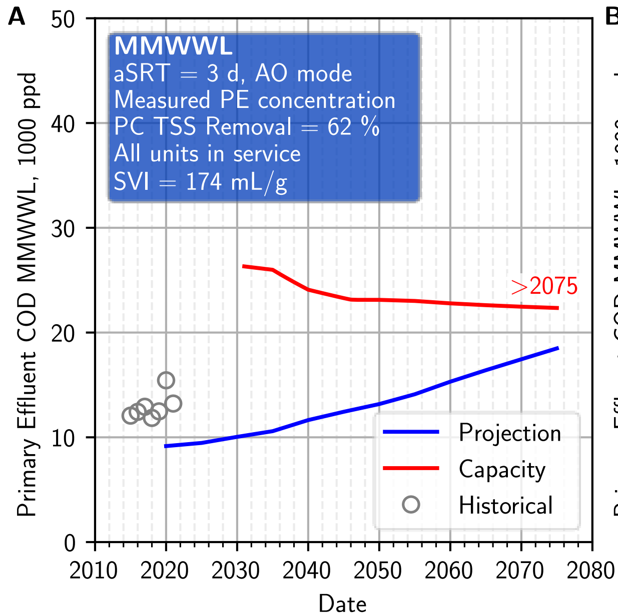

Figure 11.9 Secondary Treatment Trigger Plots

Panel B of Figure 11.9 depicts the secondary treatment capacity if the Hillsboro WRRF discharges to the Tualatin River into May under the current effluent ammonia limit. As shown, this operating condition is projected to remain feasible through the planning period. As noted above, this operating condition was not treated as limiting for secondary treatment capacity. Given that the Tualatin River flow determines if the Hillsboro WRRF can continue to discharge past April 30, the present analysis as well as the Forest Grove WRRF Capacity Assessment[16] conservatively assumed the Hillsboro WRRF would send screened and degritted wastewater to the Forest Grove WRRF throughout the dry weather season. Until 2051 and only in years when river flows permit, continuing to operate secondary treatment at the Hillsboro WRRF into May would provide the District with additional operating flexibility in the shoulder season.

11.2.6 Disinfection

The Hillsboro WRRF uses ultraviolet (UV) disinfection in an open channel configuration to treat secondary effluent prior to discharge. Secondary effluent is split through two channels. Each channel has 48 high-power (500 W), low-pressure UV lamps and a hydraulic capacity of 18 mgd. The design criteria adopted for the system assumed a treatment capacity of 12 mgd per channel, which was evaluated in a performance review by Carollo in 2015.[17] This review found higher ultraviolet transmittance (UVT) and delivered UV doses than adopted for design, indicating that the 12 mgd may be conservative. Additional performance testing is recommended to determine the current treatment capacity of the UV disinfection system. For the present analysis, the 12 mgd treatment capacity adopted in the original design criteria was assumed.

[16] Carollo Engineers, Inc. (June 2025). Forest Grove WRRF Capacity Assessment. Technical Memorandum 10. West Basin Facility Plan Project 7054.

[17] Carollo Engineers, Inc. (2015-01-28). Hillsboro WWTF – UV Disinfection System Performance Review. Memorandum.

Table 11.10 summarizes the design criteria for disinfection. Redundancy for disinfection has been provided under average dry weather flow (ADWF) conditions at the Rock Creek WRRF and average annual flow (AAF) at the Durham WRRF, both of which are consistent with Oregon DEQ guidance.[18] Historically, Carollo has designed UV disinfection systems to provide treatment under the peak day flow with one unit out of service. Since the Hillsboro WRRF does not operate during the dry weather season and can divert peak wet weather flows to the Rock Creek WRRF, firm capacity was assumed to be provided under average wet weather flow (AWWF) conditions. Importantly, this redundancy criterion differs from the District's other UV disinfection system at the Forest Grove WRRF which was designed to pass the MDWWF with the largest unit out of service.

Table 11.10 Disinfection Design Criteria

Flow/Load Condition	Design Criteria	Redundancy Criteria	Performance Assumption	Reference
AWWF	Installed Firm Capacity	One unit out of service.	N/A	
MHWWF	Installed Rated Capacity	▪ All units in service. ▪ Can transfer flow to the Rock Creek WRRF during maintenance.	N/A	

Figure 11.10 depicts the disinfection trigger plots for the two conditions evaluated. As shown, the system will have sufficient capacity through buildout. If the same redundancy criterion adopted for the UV system at the Forest Grove WRRF is applied to the system at the Hillsboro WRRF (i.e., firm capacity under the MDWWF), the system would be out of capacity today.

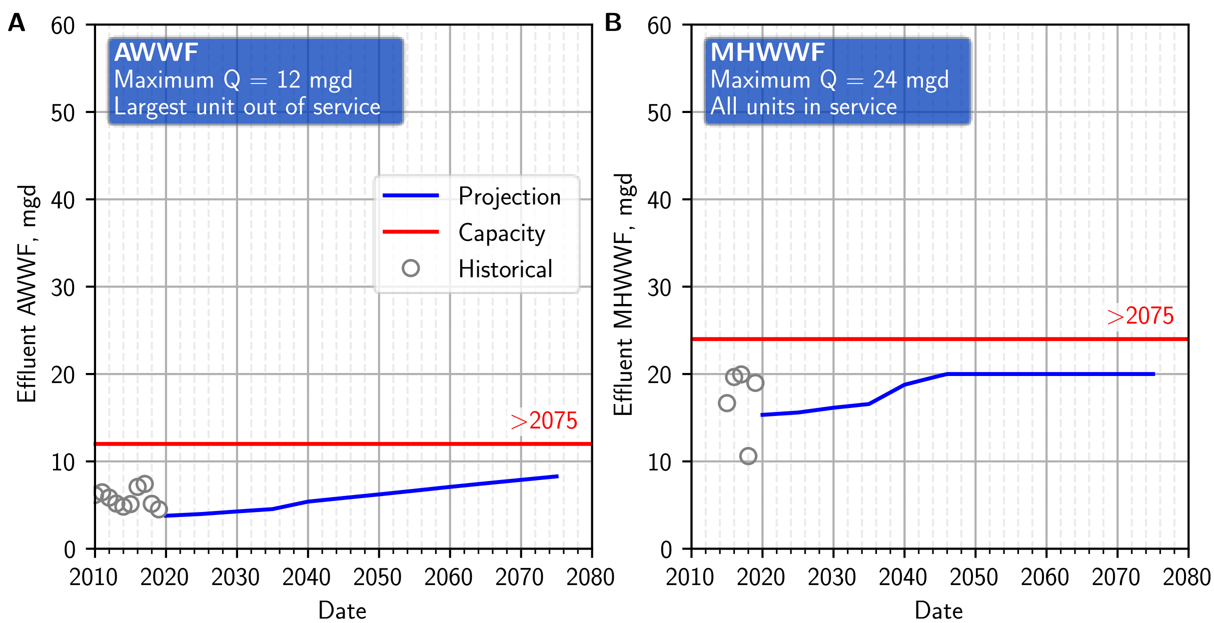

Figure 11.10 Disinfection Trigger Plot

[18] Oregon Department of Environmental Quality. (2009-06) Implementing Oregon's Recycled Water Use Rules. Internal Management Directive.

11.2.7 Effluent Pumping

Effluent from the Hillsboro WRRF flows by gravity to the Tualatin River under normal river flow conditions. Under high river flow conditions, effluent pumping is required. The effluent pump station consists of two 75 hp pumps, each of which can deliver up to 14 mgd. With one pump out of service, the firm capacity of the effluent pump station (14 mgd) is less than the hydraulic capacity of the outfall (20 mgd). However, during periods of high river levels when one of the effluent pumps is offline, the facility can divert influent or effluent to the Rock Creek WRRF through the flow transfer system. This is consistent with the District's historical operation and the District intends to continue this practice. As such, the effluent pumping capacity was not considered limited in the present analysis.

The 14 mgd effluent pumping capacity would require flows to be transferred to the Rock Creek WRRF as summarized in Table 11.11. Transfers will be necessary by 2028 and 2041 to accommodate the MDWW and MWWW flows, respectively, with one effluent pump offline. MHWW flows would require transfer immediately. Transfer flows will not be necessary under average wet weather (AWW) and MMWW conditions through buildout.

Table 11.11 Transfer Flow Required with One Effluent Pump Out of Service

Year	AWW (mgd)	MMWW (mgd)	MWWW (mgd)	MDWW (mgd)	MHWW (mgd)
2025	0	0	0	0	1.6
2035	0	0	0	0.6	2.6
2045	0	0	0.7	3.5	5.8
2055	0	0	2.1	5.2	7.8
2065	0	0	3.5	6.8	9.6
2075	0	0	4.6	8.2	11.1

11.2.8 Outfall

The Hillsboro WRRF discharges directly to the Tualatin River during the wet weather season. The hydraulic capacity of the outfall is 20 mgd, which will be verified as part of the Hillsboro WRRF hydraulic evaluation.[19] For the present analysis, it was assumed that the effluent flow under wet weather conditions would be limited to 20 mgd. Influent flow was diverted to the HHPS from the primary influent as needed to maintain an effluent flow less than or equal to this threshold under wet weather conditions.

- The 20 mgd outfall capacity would require influent flows to be transferred to the Rock Creek WRRF as summarized in Table 11.12. Transfers will be necessary by 2060 and 2046 to accommodate the MDWW and MWWW flows, respectively, with one effluent pump offline. MWWW, MMWW, and average wet weather (AWW) flows would not need to be transferred through buildout.

[19] Carollo Engineers, Inc. (July 2025). TM15 - Hillsboro WRRF Hydraulic Capacity Assessment, West Basin Facility Plan Project 7054.

Table 11.12 Transfer Flow Required for Wet Weather Outfall Hydraulic Capacity

Year	AWW (mgd)	MMWW (mgd)	MWWW (mgd)	MDWW (mgd)	MHWW (mgd)
2025	0	0	0	0	0
2035	0	0	0	0	0
2045	0	0	0	0	0
2055	0	0	0	0	1.8
2065	0	0	0	0.8	3.6
2075	0	0	0	2.2	5.1

- Transferring peak flows to the Rock Creek WRRF under wet weather conditions is consistent with the District's historical operation and the District intends to continue this practice. As such, the outfall capacity was not considered limited in the present analysis.
- Expanding the wet weather outfall capacity would allow higher flows through the facility. If completed, disinfection, transfer flow pumping, and the flow transfer system pipelines may have trigger years earlier than identified herein.

11.2.9 Flow Transfer System

The flow transfer system (shown schematically in Figure 11.11) allows for the transfer of liquid and solids streams between the Rock Creek, Hillsboro, and Forest Grove WRRFs. It consists of a HHPS at each facility, a pair of 24 inch diameter pipelines that run between the facilities, and a valve tree at the central nexus that interconnects the pipelines (colloquially referred to as the Christmas Tree by the District). Due to its interconnected nature, the capacity of the flow transfer system is addressed in the both the Hillsboro WRRF capacity evaluation and the Forest Grove WRRF capacity evaluation.[20]

[20] Carollo Engineers, Inc. (June 2025). TM 10 - Forest Grove WRRF Capacity Evaluation, West Basin Facility Plan Project 7054.

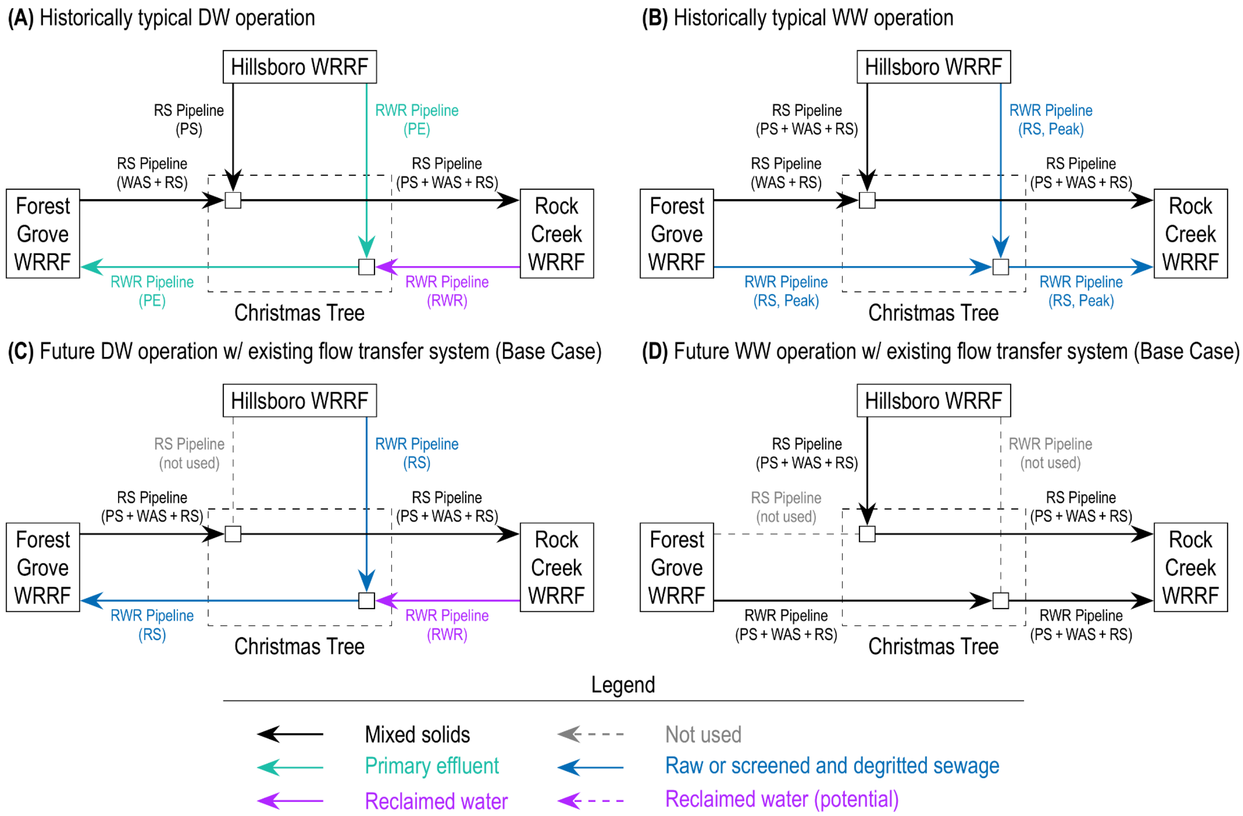

Figure 11.11 Flow Transfer System Schematic

The HHPS at the Hillsboro WRRF historically consisted of two 13 mgd, 400 hp pumps to transfer raw wastewater, screened and degritted wastewater, primary effluent, final effluent, scum, waste activated sludge (WAS), and primary solids (PS) to the Rock Creek or Forest Grove WRRFs via either the raw sewage (RS) or reclaimed water (RWR) pipelines. A rehabilitation project was completed in April 2025 providing three 140 hp pumps capable of delivering 10 mgd with two pumps in service (firm capacity). Scum, WAS, and PS discharges to the HHPS wet well or directly to the RS line (downstream of the HHPS discharge) by two 1 mgd 40 hp sludge transfer pumps.

Historically the Hillsboro and Forest Grove WRRFs have operated on independent flow transfer pipelines to Rock Creek WRRF during winter season (shown in Figure 11.11B). Competition between the pumps at the two facilities has made discharging to a common line difficult. Based on the District's operating experience and consistent with the recent rehabilitation project, the Hillsboro WRRF HHPS can operate up to the following design capacities[21] when transferring flow to the Rock Creek WRRF under these alternative operation conditions:

- 10 mgd in the RWR line.
- 12 mgd in the RS line.
  - 10 mgd into the RS line leaving the HHPS.
  - 2 mgd into the RS directly from the solids transfer pumps.

Under dry weather conditions, primary effluent from the Hillsboro WRRF has historically been transferred to the Forest Grove WRRF (shown in Figure 11.11A). The maximum flow that can be transferred to the Forest Grove WRRF is estimated at 7.1 mgd. It was assumed that the HHPS rehabilitation project will not increase this capacity. These limitations were adopted for the present capacity evaluation. A hydraulic evaluation of the flow transfer system is underway to refine these capacities.

Figure 11.11C and Figure 11.11D depict the flow transfer system configurations assumed for the present analysis under dry and wet weather conditions, respectively. Under dry weather conditions, the RWR line would be used to convey screened and degritted sewage to the Forest Grove WRRF. Under wet weather conditions, the Hillsboro WRRF would use the RS pipeline to transfer solids and peak flows to the Rock Creek WRRF.

Figure 11.12 depicts the trigger plots for the RS and RWR pipelines leaving the HHPS for the limiting flow conditions when transfer is anticipated (MHWWF, MDWWF, and MDDWF). As shown:

- The MHWWF and MDWWF are less than the 10 mgd maximum for the RS line leaving the HHPS (panels A and C) to Rock Creek WRRF. Peak wet weather flows would not need to be transferred in both lines (panels B and D).
- MHWWF would not need to be transferred from the Hillsboro WRRF to the Rock Creek WRRF until 2046 (panel A). MDWWF would need to be transferred starting in 2060 (panel C).
- The 7.1 mgd capacity is reached under the MDDWF condition by 2039 (panels E and F). With the current flow transfer system capacity limitations, transferring the screened and degritted sewage to the Forest Grove WRRF beyond this point will require the use of both pipelines. This would prevent the transfer of solids from the Forest Grove WRRF to the Rock Creek WRRF for treatment.

[21] Brown and Caldwell (April 1993). Forest Grove – Rock Creek Pipelines Volume 2 of 2. Unified Sewerage Agency of Washington County, Oregon.
Brown and Caldwell (December 1995). Forest Grove/Hillsboro Improvements. Contract Documents Volume 5 of 5. Unified Sewerage Agency of Washington County.

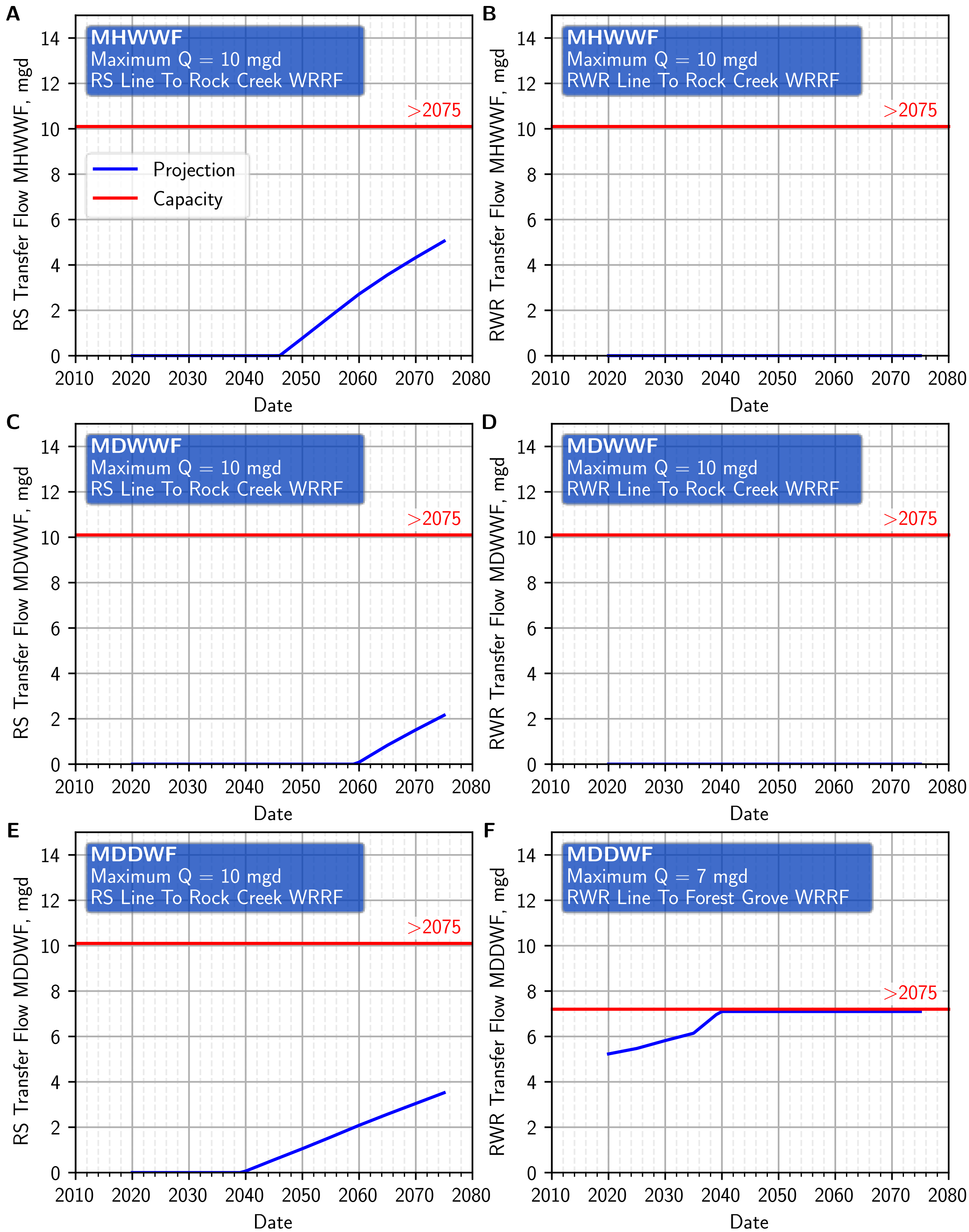

Figure 11.12 Flow Transfer System Trigger Plot, Hillsboro WRRF

The capacity of the two flow transfer pipelines between the Christmas Tree and the Rock Creek WRRF was also evaluated. The capacity of these lines depends on the operation of the Forest Grove WRRF and details specific to that facility are discussed in the Forest Grove WRRF Capacity Evaluation. The resulting capacity of the flow transfer system is depicted in Figure 11.13. As shown:

- Both facilities will need to discharge to the RS pipeline by 2037 to transfer MHWWF to the Rock Creek WRRF (panels A and B). At this year, the Forest Grove WRRF HHPS requires the use of both the RS and RWR lines to transfer peak wet weather flows (8.1 mgd) to the Rock Creek WRRF. As noted above, the Hillsboro WRRF uses the RS line to convey solids to the Rock Creek WRRF under wet weather conditions.
- MDWWF will need to be transferred to the Rock Creek WRRF from the Hillsboro WRRF starting in 2059 (panel C) and from the Forest Grove WRRF in 2054 (panel D).
- The RS line from the Christmas Tree to the Rock Creek WRRF will reach capacity in 2057 (panel E). At this year the combined MDDWF transferred from the Hillsboro WRRF (flow greater than the transfer capacity of 7.1 mgd) and the Forest Grove WRRFs (flow greater than the natural treatment system capacity of 12 mgd) will exceed the 12 mgd capacity. Additional flow could be conveyed from the Hillsboro WRRF to the Rock Creek WRRF via the RWR line. However, this line could not be used for reuse from the Rock Creek WRRF (as shown in Figure 11.11C). Additionally, this would require either the entire flow from the Hillsboro WRRF to be sent to the Rock Creek WRRF or an upgrade to the Christmas Tree to control the flow split between the Forest Grove and Rock Creek WRRFs.

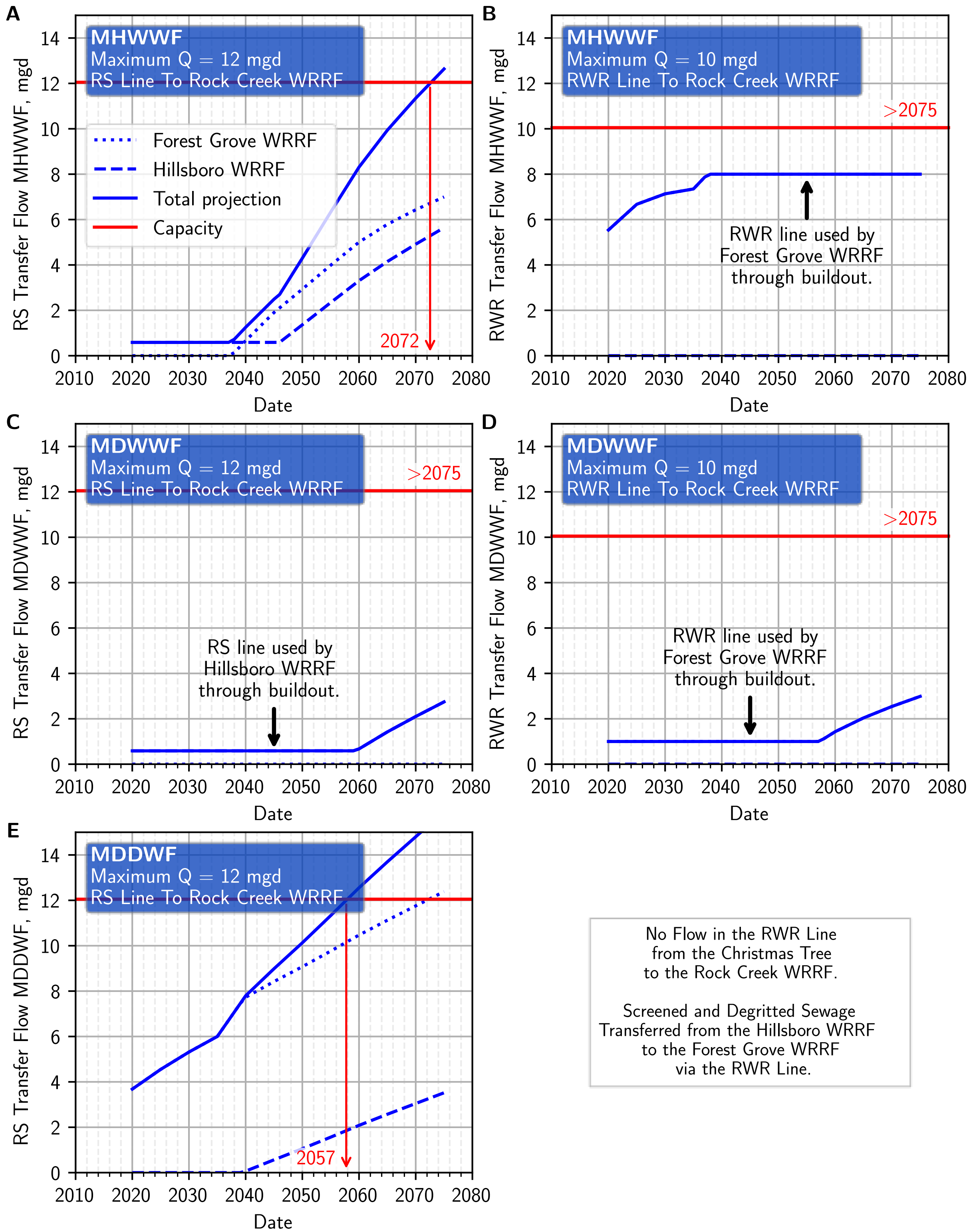

Figure 11.13 Flow Transfer Trigger Plot, Christmas Tree to the Rock Creek WRRF

Both the shared pipeline limitation and the 7.1 mgd limitation are driven by the capacity limitations in the HHPS. As such the HHPS at the Hillsboro WRRF has trigger years between 2037 and 2039 as summarized in Figure 11.14.

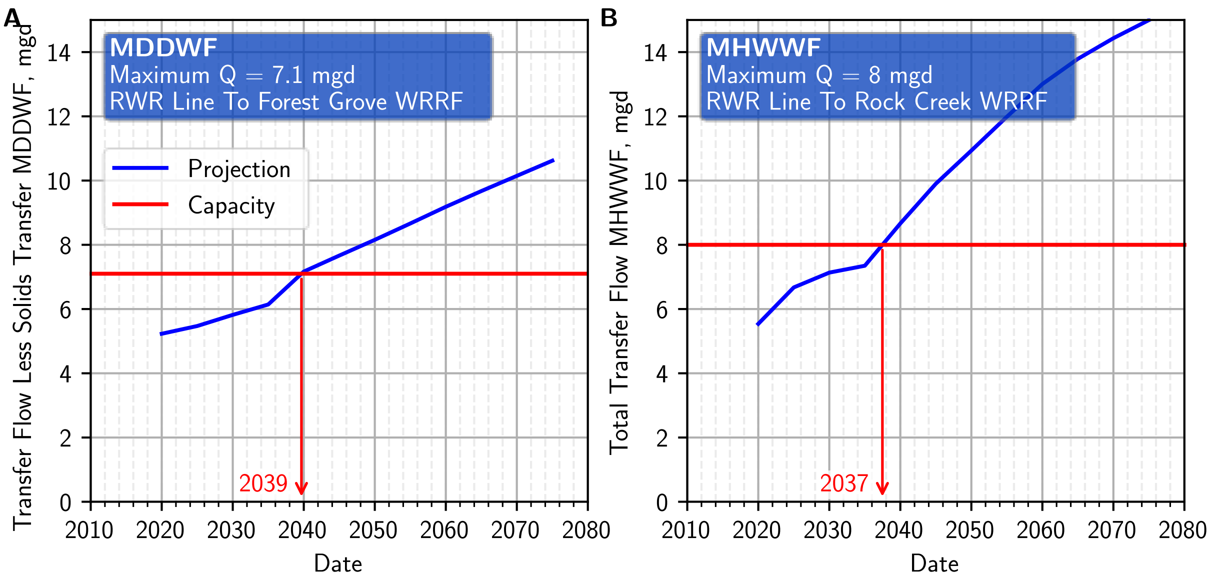

Figure 11.14 Hillsboro WRRF High-Head Pump Station Trigger Years

11.3 Capacity Results

Table 11.13 summarizes the treatment process capacity trigger years at the Hillsboro WRRF. Trigger years occurring in the next ten years (between 2024 and 2034) are set in **bold** and include primary clarification which is out of capacity currently. Screening and the high-head pump station will be out of capacity in the last half of the planning period (set in *blue italic*). The influent pump station, disinfection, and the RS line are out of capacity before buildout. Effluent pumping and the outfall were not considered limited in the current analysis as their hydraulic limitations will continue to be alleviated by transferring flows to the Rock Creek WRRF via the flow transfer system. The years shown in Table 11.13 for these two processes denote the years when flow transfer will be required. The remaining processes evaluated (grit removal and secondary treatment) have sufficient capacity through buildout.

Table 11.13 Capacity Summary

Unit Process	MDDW	MMWW	MWWW	MDWW	MHWW
Influent Pump Station	N/A	N/A	N/A	2073	>2075
Influent Screening	N/A	N/A	N/A	N/A	*2039*
Grit Removal	N/A	N/A	N/A	N/A	>2075
Primary Clarification	N/A	**<2020**	N/A	N/A	>2075
Secondary Treatment	N/A	>2075	N/A	N/A	N/A
Disinfection	N/A	N/A	>2075	N/A	>2075
Effluent Pump Station(2)	N/A	N/A	*2041*	**2028**	**<2020**
Outfall(2)	N/A	N/A	N/A	2060	2046
High Head Pump Station	*2039*	N/A	N/A	N/A	*2037*
RS and RWR Pipelines	2057	N/A	N/A	N/A	N/A

Notes:
(1) Values set in **bold** occur in the next ten years (2024 to 2034). Values set in *blue italic* occur after the next 10 years, but within the planning period (2035 to 2045).
(2) Years when flow must be transferred to the Rock Creek WRRF to accommodate the effluent pump station capacity with one unit out of service.
(3) Years when flow must be transferred to the Rock Creek WRRF to accommodate hydraulic capacity of the outfall.