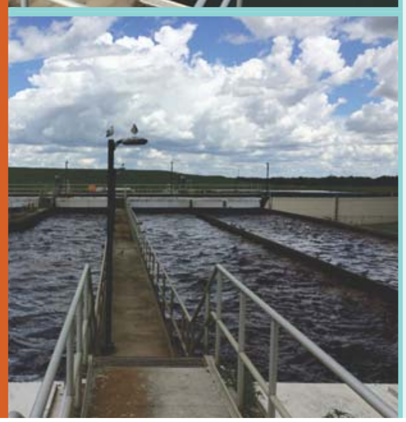
Manatee County
FLORIDA

WATER RECLAMATION

Facilities-Master Plan

August 2017



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MANATEE COUNTY

WATER RECLAMATION FACILITIES
MASTER PLAN

FINAL
August 2017

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MANATEE COUNTY

WATER RECLAMATION FACILITIES
MASTER PLAN

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EXECUTIVE SUMMARY

INTRODUCTION

Manatee County owns and operates three regional water reclamation facilities (WRFs): the Southwest WRF (SWWRF), Southeast WRF (SEWRF), and North Regional WRF (NRWRF). All three facilities are Type I biological nutrient removal (BNR) facilities designed to treat effluent to public access reuse (PAR) water quality requirements in accordance with Chapter 62-610, Florida Administrative Code (FAC). SWWRF is permitted for 15 million gallons per day (mgd) annual average daily flow (AADF), SEWRF is permitted for 11 mgd three-month rolling average daily flow (TMRADF), and NRWRF is permitted for 7.5 mgd TMRADF.

The purpose of technical memorandum (TM) 6 is to provide an executive summary of the findings in the five prior TMs for each of these facilities. TMs 1 through 5 (attached as appendices) are referenced throughout this executive summary and are summarized below:

- <u>TM1 (Existing WRFs - Summary Document):</u> Provides a summary of the existing facilities. This TM provides the following for each facility:
  - design criteria,
  - permit requirements,
  - equipment inventory,
  - historical flows and peaking factors,
  - influent and effluent quality,
  - existing treatment performance.
- TM2 (Design/Standby Criteria and Capacity Rating): Summarizes the Class 1 reliability criteria, hydraulic evaluation, and evaluates the treatment capacity for the individual unit processes at each WRFs.
- TM3 (Evaluation of Future Needs): Presents a summary of the projected population and wastewater flows, historical and projected reuse demands, an evaluation of the existing and anticipated regulatory requirements. An Asset Management Plan (AMP) assessment methodology, facility inspections, and observations were performed at each facility and documented within this TM. This TM also evaluated future treatment requirements, flow implementation triggers, and a future hydraulic analysis at each WRF. The TM includes an asset condition, replacement timing, and cost estimate summary for each facility.
- TM4 (WRF Treatment Alternatives Analysis): Provides a summary of alternative technologies available for the different unit processes. TM 4 includes evaluation of the alternative process technologies with recommendations for further evaluation for

the facilities. The TM also includes an evaluation on the biosolids dewatering systems and recommendation for each facility.

- TM5 (Near-Term and Long-Term Facilities Improvements Plan): Summarizes the implementation plan to correct deficiencies, provide process improvements, and repair end of life equipment. The TM identifies capital improvement projects the County will initiate throughout the planning period.

SOUTHWEST WATER RECLAMATION FACILITY

Evaluation of Existing Facility

At the beginning of the master planning activities SWWRF had several ongoing construction projects including:

- conversion of the existing conventional activated sludge process to a Modified Ludzack-Ettinger (MLE) process
- conversion of the existing anaerobic digesters to aerated sludge holding tanks

Those projects were completed near the end of 2016 and in early 2017. The ShouldMLE process modifications affected both the hydraulic and treatment capacity of the facility. The evaluations presented in the master planning efforts assumed those modifications were completed.

A detailed description of the hydraulic and treatment capacity evaluations for the SWWRF is presented in TM2.

Hydraulic Evaluation

The following summarizes the findings of the existing hydraulic conditions at the SWWRF:

- The headworks with all units in service can handle the peak hour flow (PHF) condition; however, the effluent weir at the preliminary treatment structure is submerged.
- Secondary treatment units can handle peak flow conditions without submergence of any weirs.
- The velocities in the pipes from the headworks to secondary process tanks are between 2.0 to 6.0 feet per second (fps), which is an acceptable velocity range for this piping system.
- The tertiary treatment units (filters, and chlorine contact chambers) have the hydraulic capacity for the PHF with all units in service. Note that the flash mixers/flocculators are bypassed and not in use.

Treatment Capacity Evaluation

The overall capacity of SWWRF is summarized in Table ES.1 with all units in service. As shown, the anoxic/aeration biological treatment is the limiting unit process at SWWRF.

**Table ES.1 SWWRF Treatment Process Capacity Summary
Water Reclamation Facilities – Master Plan Development
Manatee County**

Unit Process	Capacity (1)	AADF Capacity
Influent Screens	48.0 mgd PHF	22 mgd
Influent Grit Removal	48.0 mgd PHF	22 mgd
Anoxic/Aeration Tanks	15.9 mgd MMADF	13.5 mgd
Secondary Clarifiers	49.7 mgd PHF	22.8 mgd
Filters	69.2 mgd	31.7 mgd
Chlorine Disinfection	42.8 mgd	19.6 mgd

Notes:
(1) Assuming all units in service.

While no regulatory changes are expected to impact SWWRF in terms of effluent quality, the Class 1 reliability of the facility was evaluated in TM2. Two items that were evaluated to not meet Class 1 reliability standards include the aeration system blowers and the tertiary filters.

- The aeration system blower evaluation is based on the design demand proposed in the CH2M Hill Preliminary Engineering Report (PER) for the nitrogen removal upgrades. As with the capacity of the biological treatment processes, the aeration demands can be evaluated once the MLE system is operational to determine if there is a need for additional blower capacity to meet Class 1 reliability.

- The hydraulic capacity of the tertiary filters was assessed in TM2 assuming a peak hydraulic loading rate of 2.0 gpm/sf, which is based on knowledge of similar ABW filtration facilities in Florida. 10 State Standards allows higher (5.0 gpm/sf) peak hydraulic loading rates for granular media filters. In addition, the AADF capacity was calculated using the PHF peaking factor. The actual loading capacity of the filters can be evaluated by stress testing the filters and monitoring performance.

Future Requirements

Based on the projected flows and loads displayed in from TM3, the future capacity expansions were developed for the SWWRF. Table ES.2 summarizes the design criteria for the liquid stream processes and solids handling processes that will be required for the SWWRF to be able to treat 15.7 mgd AADF in 2035, which is the Level of Service (LOS) projection.

Table ES.2 SWWRF - Expansion Summary of Existing Treatment Processes Water Reclamation Facilities – Master Plan Development Manatee County		
	Current Facilities 13.5 mgd (AADF)(1)	**2035 Facilities 15.7 mgd (AADF)(1)**
Headworks		
Total No. of Screens	2	2
Capacity (Peak), Each	24 mgd	24 mgd
Total No. of Grit Removal	2	2
Capacity (Peak), Each	24 mgd	24 mgd
Secondary Treatment		
Total No. of Anoxic/Aeration Basins	4	5
Volume, Total	5.65 MG	6.65 MG(2)
Total No. of Secondary Clarifiers	5	5
Surface Area, Total	49,720 ft^2	49,720 ft^2
Tertiary Treatment		
Total No. of Filters	7	7
Surface Area, Total	9,040 ft^2	9,040 ft^2
Total No. of Chlorine Contact Basin	3	3
Volume, Total	0.4457 MG	0.4457 MG
Solids Thickening and Dewatering		
Total No. of Aerated Sludge Holding Tanks	4	4
Storage, Total	18 (43) days(3)	16 (31) days(3)
Total No. of Belt Filter Press	6	6(4)

Notes:

(1) Assumes all units in service for peak flows. Unit sizes for existing processes are given in TM1. Proposed unit processes sizes are similar unless otherwise noted.
(2) Based on one 1 MG sized Aeration Basin with min 100 hp blower, based on CH2M Hill's PER for Phase 2 requirements.
(3) Storage days are based on 0.8% (3%) solids. Existing and future capacity of ASHTs is based on CH2M HILL PER.
(4) Based on 24/7 operation, 0.116 mgd of WAS flow and 26,170 lb/day WAS load.

The dewatering technology evaluation conducted in TM4 identified no immediate financial driver or incentive for upgrading to a new dewatering technology. The existing BFPs have remaining useful life, and the dewatering buildings are already constructed to house BFP equipment.

Trigger Curves

Trigger curves based on the future flows and loads were developed for the individual treatment processes at SWWRF. The results are presented in Appendix B of TM3. These curves show the projected flow (AADF LOS) and the projected treatment capacity of SWWRF.

The indicated project phasing shows the recommended sizing and timing of the treatment process expansions. The timing represents the year in which the process expansion becomes operational, so the trigger point for start of design precedes the year indicated by the estimated time needed for design, bidding, construction, and start-up. The anoxic/aeration treatment will require additional capacity to meet LOS projected flow (TM3, Appendix B, Figure B.2). The new MLE process was put on-line in July 2017 and it is recommended the County reevaluate the anoxic/aeration treatment performance to assess the rated capacity and timing for any needed process expansions.

Future Hydraulic Evaluation

As summarized in TM2, the hydraulic capacity at SWWRF is 48 mgd PHF, which will be sufficient through the 2035 planning period. The only constraints identified in TM2 are the effluent weir at the headworks structure which submerges at PHF and the flash mix/flocculation tanks which have only 6-inches of freeboard at PHF:

- The headworks facility is being replaced in an upcoming CIP project, which will take into account the hydraulics and elevations required to meet the PHF capacity rating of 48 mgd.
- Flash mix/flocculation tanks are bypassed and not in service.

Asset Management Needs

The purpose of the Asset Replacement Plan is to evaluate the needs for asset replacement based on existing condition and estimated remaining useful life. The results developed in TM3 were used to coordinate and develop projects over the planning period until year 2037.

The assets to be replaced are coordinate with potential process improvements or needs by the County and incorporated into either capital improvement or renewal and replacement projects.

Summary

Combining the results of the subsequent TMs and developing succinct projects that will provide necessary improvements and asset replacement is developed as part of TM5. The proposed CIP projects that are anticipated as part of the planning period to improve and upgrade the SWWRF to maintain the future LOS are summarized in Table ES.3.

Table ES.3 CIP Projects for SWWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

CIP Project Number	Project Name	Description of General Work	Project Start	Project Costs(1)
6083381	SWWRF Headworks	New headworks facility with screens, grit collection, odor control, yard piping, electrical, and controls. Demolition of existing headworks and associated equipment and appurtenances. Electrical upgrades to HW1 and HW2 MCCs.	FY 2017	$10,000,000
WW01251/ WW01371	SWWRF Belt Filter System Improvements	Various improvements to the existing belt filter presses and related equipment for sludge dewatering, demolition of equipment associated with the shuttered anaerobic digestion system, and recommended improvements from the SWWRF Electrical Master Plan. The project combines previously established CIP projects WW01251 and WW01371.	FY 2018	$3,450,000
WW01222	Chlorine Contact Chamber Rehabilitation and DIW Booster Station	Various modifications and improvements to the existing chlorine contact chambers (CCC) and addition of a new booster pump station to facilitate pumping of reuse water to the on-site recharge well.	FY 2018	$6,670,000
WW01254	SWWRF Equalization Tank Improvements	Install two new equalization tanks with mixing systems, odor control system, and return pumping station. Includes demolition of existing EQ tank and pump station, nearby DAF facilities, and other miscellaneous facilities.	FY 2019	$8,410,000
WW01256	Bleach Tank Roof Over	New chemical storage and feed facility to accommodate five sodium hypochlorite storage tanks. Add overhead canopy to existing containment structure for the ammonium sulfate tank.	FY 2019	$902,000

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Table ES.3 CIP Projects for SWWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

WW01370	Electrical Distribution System Rehabilitation and Enhancement	Modifications, rehabilitations, and enhancements to components of the electrical distribution system.	FY 2019	$3,905,900
WW01423	SWWRF Second Cloth Filter	Conversion of Automatic Backwash (ABW) Filer No. 2 to a diamond cloth filter and installation of a canopy with bridge crane and trolley.	FY 2020	$4,710,000
TBD	Anoxic and Aeration Basins	Addition of Anoxic Basin No. 5 and Aeration Basin No. 5	FY 2022	$8,200,000
WW01627	Stormwater System Modifications	Rehabilitation, modifications, and improvements to the stormwater drainage, collection, and storage system to eliminate on-site flooding	FY 2022	$520,000
TBD	Secondary Clarifiers and WAS Improvements	Various improvements to existing equipment for Secondary Clarifiers Nos. 1 and 2 and WAS Pumps Nos. 3 and 4.	FY 2028	$200,000
TBD	Effluent System Electrical/I&C Improvements	Improvements to various electrical and instrumentation and control components for the effluent system.	FY 2030	$1,200,000

Notes:

(1) Project costs including engineering design and construction. The construction costs were based on Class 4 cost estimates according to the definitions of AACE International. Value represent the expected costs in the Project Start year Original estimates were in August 2013 dollars and escalated to the Project Start year assuming an escalation factor of 2.7%/year.

It is recommended to re-assess the design criteria, assumptions and projections used to develop the conclusions and update the master plan on a five-year continuing basis. The five-year CIP will provide improvements that will need to be taken into consideration for the subsequent master plan period.

SOUTHEAST WATER RECLAMATION FACILITY

Evaluation of Existing Facility

Below is a summary of the hydraulic and treatment capacity evaluations for the SEWRF. Further details are included in TM2.

Hydraulic Evaluation

The hydraulic profile evaluation found the following constraints:

- The effluent weir at the headworks is submerged at PHF due to hydraulic constraints in the piping between the headworks and the splitter box.
- The effluent weir at the flash mix/flocculation tanks is submerged at PHF and freeboard is limited. Noted that this unit process is bypassed and not currently in service.

Treatment Capacity Evaluation

The overall capacity of SEWRF is summarized in Table ES.4 assuming all units in service and not accounting for the reliability criteria discussed in TM2. As shown, the filters are the limiting unit process at SEWRF.

Table ES.4 SEWRF Capacity Rating Summary
Water Reclamation Facilities – Master Plan Development
Manatee County

Unit Process	Capacity (1)	AADF Capacity
Influent Screens	36.0 mgd PHF	18 mgd
Influent Grit Removal	40.0 mgd PHF	18 mgd
Anoxic Tanks	14.6 MMADF	13.4 mgd (2)
Aeration Tanks	11.8 mgd MMADF	10.8 mgd (2)
Secondary Clarifiers	38.0 mgd PHF	15.2 mgd (3)
Filters	16.6 mgd PHF	6.6 mgd (3)
Chlorine Disinfection	34.1 mgd PHF	13.6 mgd (3)

Notes:
(1) Assuming all units in service.
(2) Assumed historical MMF:AADF peaking factor from TM 1 of 1.09.
(3) Assumed design PHF:AADF peaking factor from TM 1 of 2.5.

Future Treatment Requirements

Table ES.5 details the design criteria for the liquid stream processes and solids handling processes that will be required for the SEWRF to be able to treat 12.1 mgd AADF. A conceptual process flow diagram for the major liquid stream process facilities is provided in TM3.

Table ES.5 SEWRF - Expansion Summary of Existing Treatment Processes Water Reclamation Facilities – Master Plan Development Manatee County

	Current Facilities 11 mgd (AADF)(1)	**2035 Facilities 12.1 mgd (AADF)(1)**
Headworks		
Total No. of Screens	3	3
Capacity (Peak), Each	12 mgd	12 mgd
Total No. of Grit Removal	2	2
Capacity (Peak), Each	20 mgd	20 mgd
Secondary Treatment		
Total No. of Aeration Basins	3	4(2)
Volume, Total	11.03 MG	16.04 MG
Total No. of Secondary Clarifiers	4	4
Surface Area, Total	38,010 ft^2	38,010 ft^2
Tertiary Treatment		
Total No. of Filters	4	6
Surface Area, Total(3)	5,760 ft^2	7,180 ft^2
Total No. of Chlorine Contact Basin	4	4(4)
Volume, Total	0.36 MG	0.36 MG

Table ES.5 SEWRF - Expansion Summary of Existing Treatment Processes Water Reclamation Facilities – Master Plan Development Manatee County		
	Current Facilities 11 mgd (AADF)(1)	**2035 Facilities 12.1 mgd (AADF)(1)**
Solids Thickening and Dewatering		
Total No. of Aerated Sludge Holding Tanks	2	2
Storage, Total(5)	72 days	45 days
Total No. of Gravity Belt Thickeners	2	2
Total No. of Belt Filter Press	6	6(6)

Notes:
(1) Assumes all units in service for peak flows. Unit sizes for existing processes are given in TM1. Proposed unit processes sizes are similar unless otherwise noted.
(2) Additional volume of Anoxic/Aeration Basin is required. Either two small basins (2.5 MG each) or one large basin (5.0 MG, 3-150 hp aerators).
(3) Based on existing filter surface area of 1,440 ft^2 each and peak loading rate of 2.0 gpm/ft^2. Actual capacity may vary. The proposed new filters are 2 cloth media filters with a peak hydraulic loading rate of 6.5 gpm/sf and surface area of 710 ft^2 each.
(4) Based on 15 minutes at peak flow of contact time and assumed that adequate chlorine dosage is available to meet disinfection requirements.
(5) Storage days are based on 4% solids.
(6) Based on 24/7 operation, 0.032 mgd of WAS flow and 12,950 lb/day WAS load.

As shown in Table ES.5, additional anoxic/aeration capacity and filtration capacity is proposed based on the LOS flow projections at SEWRF. The existing capacity analysis for these treatment units was presented in TM3.

The dewatering technology evaluation conducted in TM4 showed no immediate financial driver or incentive for upgrading to a new dewatering technology. The existing BFPs have remaining useful life, and the dewatering buildings are currently constructed to house and operate BFP equipment.

Trigger Curves

Trigger curves for the individual treatment processes at SEWRF are presented in Appendix D of TM3. These curves show the projected LOS flow (AADF) and the estimated and projected treatment capacity of SEWRF.

Additional aeration tank capacity to meet LOS projected flows should be operational by 2028 (Figure D.2, Appendix D, TM3). The trigger curves are based on LOS projected flows and not the actual flow SEWRF is experiencing. Also, several recycle flows (loadings) were included to evaluate the existing treatment capacities. The recycle streams include County landfill leachate, dryer recycle, and neutralized chemical cleaning waster from the future ultra-filtration (UF) facilities at the Lake Manatee Water Treatment Plant. Further evaluation of the secondary treatment capacity is underway by the County to determine additional loads being treated at SEWRF including the septage, grease, and any other loads not being quantified in the influent sampling.

Additional tertiary filters are needed to meet LOS projected flows currently (Figure D.4, Appendix D, TM3). The hydraulic capacity of the tertiary filters was calculated assuming a peak hydraulic loading rate of 2.0 gpm/sf, which is based on knowledge of similar ABW filtration facilities in Florida. 10 State Standards allows higher (5.0 gpm/sf) peak hydraulic loading rates for granular media filters. In addition, the AADF capacity was calculated using the PHF peaking factor of 2.5. Carollo recommends further hydraulic testing of the existing filter installation to determine the actual peak hydraulic loading rate of the existing filters before expansion is pursued.

Future Hydraulic Evaluation

The hydraulic capacity analysis for SEWRF, presented in TM2, evaluated the capacity of structures and pipes at design peak flow of 29.9 mgd. The secondary treatment was evaluated for total flow of 41.6 mgd (includes influent flow of 29.9 mgd and RAS flow rate of 11.7 mgd). These flows are adequate for the facility flows through the planning period year of 2035.

Based on these flows, modifications will be necessary for the Headworks effluent box weir and upsizing of the 24-inch effluent piping. No other modifications are identified as part of the hydraulic evaluation.

Asset Management Needs

The purpose of the Asset Replacement Plan is to evaluate the needs for asset replacement based on existing condition and estimated remaining useful life. The results for the SEWRF developed in TM3 were used to coordinate and develop projects over the planning period until year 2037.

The assets to be replaced are coordinate with potential process improvements or needs by the County and incorporated into either capital improvement or renewal and replacement projects.

Summary

Combining the results of the subsequent TMs and developing succinct projects that will provide necessary improvements and asset replacement is developed as part of TM5. The proposed CIP projects that are anticipated as part of the planning period to improve and upgrade the SEWRF to maintain the future LOS are summarized in Table ES.6.

Table ES.6 CIP Projects for SEWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

CIP Project Number	Project Name[(1)]	Description of General Work	Project Start	Project Costs[(1)]
WW01249	RAS and WAS System Rehabilitation	Various upgrades to the RAS and WAS systems including replacement of existing RAS and WAS pumps, piping valves and slide gates, and installation of new scum pumping and screening system.	FY 2018	$2,832,000
WW01248	Dedicated Plant Drain Stations	New plant drain stations for the biosolids dryer and septage receiving facilities, interconnection of existing drain stations for redundancy, and other improvements.	FY 2018	$1,776,000
WW01250	Storage Lakes and Pump Back Station Improvements	Improvements and modifications to the reuse water storage lakes and pump stations including: reduce the side slopes on East Lake and South Lake II berms, erosion control at existing pump stations, increase pump back capacity at each lake to 10 mgd, installation of emergency overflows.	FY 2018	$7,780,000
WW01420	Arc Flash Mitigation	Upgrades to existing power distribution system components to mitigate arc flash hazards and improve operation staff safety.	FY 2019	$400,000
WW01417	Anoxic Basins Mixer Replacement	Various improvements to the existing anoxic basins including replacement of existing anoxic mixers and aerators in Anoxic/Aerobic Basins Nos. 1, 2 and 3, structural inspection and repairs or modifications as required, replacement of existing sluice and weir gates, removal of existing return mixed liquor pumps and replacement with concrete channel and slide gates.	FY 2020	$6,265,000
WW01418	Automatic Backwash Filters Refurbishment	Conversion of ABWs Nos. 3 and 4 to diamond cloth filters.	FY 2020	$7,560,000

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Table ES.6 CIP Projects for SEWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

WW01416	Replacement of Slide and Sluice Gates	Improvements at the CCCs including replacement of existing slide and sluice gates, new chlorine mixing system, addition of FRP covers and a protection system for buried chlorine feed piping.	FY 2020	$1,723,000
	Flow Equalization Tanks and Mixed Liquor Splitter Box Rehabilitation	Various rehabilitation items at the FEQ tanks and mixed liquor splitter box including cleaning, evaluation and repair of FEQ tanks, replacement of submersible pumps, piping and valves, and odor control ducting at the mixed liquor box, painting, and upgrading of existing lighting to LEDs.	FY 2021	$1,385,000
TBD	Headworks Hydraulic Improvements	Redesign and replacement of yard piping downstream of the headworks (from headworks to flow splitter box) and modification to headworks structure and/or equipment to increase the hydraulic capacity.	FY 2021	$700,000
WW01622	Administration Building Rehabilitation	Rehabilitation of the existing Administration building including replacement of roof, AC and air handling units, exterior repairs, and interior improvements.	FY 2022	$205,000
WW01623	Belt Filter Presses Rehabilitation	Rehabilitation of existing BFP No. 2 and installation of a new BFP system including control panel, sludge feed pump, washwater booster pumps, dry polymer mixing system and polymer storage tanks. Relocate existing booster pumps and water heater and replace sludge feed piping.	FY 2022	$3,190,000
WW01624	Secondary Clarifiers Rehabilitation	Various refurbishment items on Secondary Clarifiers Nos. 1 and 2 including replacement of mechanical equipment, V-notch weirs and scum baffles, new full-radius skimmers and scum beaches. Re-grout clarifier floors.	FY 2022	$1,570,000
WW01626	Second 10 MG Reclaimed Water GST	New 10 MG reclaimed water ground storage tank and sodium hypochlorite storage and feed system.	FY 2022	$4,410,000

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Table ES.6 CIP Projects for SEWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

	and MCMRS Chlorination System			
TBD	Rehabilitate Gravity Belt Thickener No. 1	Rehabilitation of Gravity Belt Thickener No. 1. Replace existing control panel, Sludge Transfer Pump No. 7 and piping, and appurtenances.	FY 2024	$1,270,000
TBD	Flow Equalization Tanks Diffuser System Replacement	Evaluation, design, and replacement of the diffuser/mixing systems in the existing FEQ tanks. Includes replacement of existing exterior piping and appurtenances.	FY 2024	$850,000
TBD	SEWRF Improvements	Addition of one Anoxic/Aeration Basin and one sludge holding tank, yard piping, electrical, and instrumentation & controls.	FY 2026	$12,600,000
TBD	Electrical System Upgrades	Replacement of power distribution equipment in the main electrical room including main switchgear, generator breakers, MCCs and isolation transformers. Also includes replacement of MCCs in the dewatering building.	FY 2029	$11,500,000
TBD	ABW Filters Nos. 1 and 2 Rehabilitation	Complete rehabilitation of ABW filters Nos. 1 and 2	FY 2034	$4,300,000

Notes:

(1) Project costs including engineering design and construction. The construction costs were based on Class 4 cost estimates according to the definitions of AACE International. Value represent the expected costs in the Project Start year Original estimates were in July 2015 dollars and escalated to the Project Start year assuming an escalation factor of 2.7%/year.

It is recommended to re-assess the design criteria, assumptions and projections used to develop the conclusions and update the master plan on a five-year continuous basis. The five-year CIP will provide improvements that will need to be taken into consideration for the subsequent master plan period.

NORTH REGIONAL WATER RECLAMATION FACILITY

Evaluation of Existing Facility

Below is a summary of the hydraulic and treatment capacity evaluations for the NRWRF. Further details are included in TM2.

Hydraulic Evaluation

The hydraulic profile evaluation found the following constraints:

- The anoxic/aeration basins were shown to have limited freeboard during PHF conditions.
- The effluent weir at the flash mix/flocculation tanks is submerged at PHF. Notice this this unit process is not currently in service.

Treatment Capacity Evaluation

The overall capacity of NRWRF is summarized in Table ES.7, assuming all units in service and not accounting for the reliability criteria discussed in TM2. As shown, the secondary treatment is the limiting unit process at NRWRF.

Table ES.7 NRWRF Capacity Rating
Water Reclamation Facilities – Master Plan Development
Manatee County

Unit Process	Capacity (1)	AADF Capacity
Influent Screens	40.0 mgd PHF	15.6 mgd
Influent Grit Removal	40.0 mgd PHF	15.6 mgd
Anoxic Tanks	12.4 mgd MMADF	11.0 mgd (2)
Aeration Tanks	8.3 mgd MMADF	7.3 mgd (2)
Secondary Clarifiers	28.5 mgd PHF	11.4 mgd (3)
Filters	32.5 mgd PHF	13.0 mgd (3)
Chlorine Disinfection	30.9 mgd PHF	12.4 mgd (4)

Notes:
(1) Assuming all units in service.
(2) Assumed historical MMF:AADF peaking factor from TM 1 of 1.13.
(3) Assumed design PHF:AADF peaking factor from TM 1 of 2.5.

Future Treatment Requirements

Table ES.8 details the design criteria for the liquid stream processes and solids handling processes that will be required for the NRWRF to be able to treat 7.5 mgd AADF (projected 2035 LOS flows). A conceptual site plan for the layout of the major liquid stream process facilities is included in TM2. As shown, no treatment capacity expansions are required during the planning period.

Table ES.8 NRWRF - Expansion Summary of Existing Treatment Processes
Water Reclamation Facilities – Master Plan Development
Manatee County

	Current Facilities 7.5 mgd (AADF)(1)	2035 Facilities 7.5 mgd (AADF)(1)
Headworks		
Total No. of Screens	2	2
Capacity (Peak), Each	20 mgd	20 mgd
Total No. of Grit Removal	2	2
Capacity (Peak), Each	20 mgd	20 mgd
Secondary Treatment		
Total No. of Aeration Basins	2	2
Volume, Total	7.35 MG	7.35 MG
Total No. of Secondary Clarifiers	3	3
Surface Area, Total	28,510 ft^2	28,510 ft^2
Tertiary Treatment		
Total No. of Filters	4	4
Surface Area, Total	2,880 ft^2	2,880 ft^2
Total No. of Chlorine Contact Basin	4	4
Volume, Total	0.32 MG	0.32 MG
Solids Thickening and Dewatering		
Total No. of Aerated Sludge Holding Tanks	2	2
Storage, Total(2)	40 days	28 days
Total No. of Belt Filter Press	3	3(3)

Notes:
(1) Assumes all units in service for peak flows. Unit sizes for existing unit processes are given in TM1. Proposed unit processes sizes are similar unless otherwise noted.
(2) Storage days are based on 4% solids.
(3) Based on 24/7 operation, 0.061 mgd of WAS flow and 8,600 lb/day WAS load.

The dewatering technology evaluation conducted in this TM showed no immediate financial driver or incentive for upgrading to a new dewatering technology. The existing BFPs have remaining useful life, and the dewatering buildings are already constructed to house and operate the BFP equipment.

Trigger Curves

Trigger curves for the individual treatment processes at NRWRF are presented in Appendix F of TM3. These curves show the projected LOS flow (AADF) and the estimated and projected treatment capacity of NRWRF. Based on the trigger curves, treatment processes have a sufficient total capacity to meet planning period flow.

Future Hydraulic Evaluation

The hydraulic capacity analysis for NRWRF, presented in TM2, evaluated the capacity of structures and pipes at design peak flow of 18.75 mgd. The secondary treatment was evaluated for total flow of 26.25 mgd (includes influent flow of 18.75 mgd + RAS flow rate of 7.5 mgd). These flows are adequate for the facility flows through the planning period year of 2035.

The recommendation is to provide additional freeboard on the peripheral walls of the aeration basins using stainless steel curbs in critical areas to reduce potential splashing issues.

Asset Management Needs

The purpose of the Asset Replacement Plan is to evaluate the needs for asset replacement based on existing condition and estimated remaining useful life at the NRWRF. The results developed in TM3 were used to coordinate and develop projects over the planning period until year 2035.

The assets to be replaced are coordinate with potential process improvements or needs by the County and incorporated into either capital improvement or renewal and replacement projects.

Summary

Combining the results of the subsequent TMs and developing succinct projects that will provide necessary improvements and asset replacement is developed as part of TM5. The proposed CIP projects that are anticipated as part of the planning period to improve and upgrade the NRWRF to maintain the future LOS are summarized in Table ES.9.

Table ES.9 CIP Projects for NRWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

CIP Project Number	Project Name(1)	Description of General Work	Project Start	Project Costs(1)
WW01245	NRWRF Headworks Second Grit Removal	Add a second grit removal unit (Eutek HeadCell to the headworks to match existing equipment) including grit pumps, grit cyclone and classifier, slide gates, associated valves and piping, and control panels.	FY 2018	$1,720,000
WW01246	Secondary Clarifiers Nos. 1 and 2 Refurbishment	Various refurbishment items on Secondary Clarifiers Nos. 1 and 2 including replacement of mechanical equipment, V-notch weirs and scum baffles, scum skimmers and control panels. Re-grout clarifier floors. Provide new scum removal and screening system.	FY 2018	$1,860,000
WW01247	Chlorine Contact Chamber Refurbishment	Various refurbishment items on the CCCs including replacement of expansion strips and inlet slide gates, new seal coating, new chlorine mixing system, Install 36" isolation valve, addition of FRP covers, and a protection system for buried chlorine feed piping.	FY 2018	$1,760,000
WW01244	Belt Filter Press No. 4 and Automation	Various improvements to the existing belt filter presses and related equipment including new BFP system including control panel, sludge feed pump, washwater booster pumps, dry polymer mixing system and polymer storage tanks, Modify and expand sludge conveyor, truck loading system and existing canopy. Rehabilitate existing BFPs and install cameras for remote visual monitoring.	FY 2019	$3,155,000
WW01421	NRWRF Reclaimed Water Storage Lake Improvements	Improvements to the reclaimed water storage lakes including modifications to the lake berms slopes and elevations, removal of peninsulas to create additional lake volume, rehabilitation of outfall structures, and installation of emergency overflows.	FY 2020	$5,940,000

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Table ES.9 CIP Projects for NRWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

WW01422	NRWRF 10 MG Reclaimed Water Storage Tank & HSPS	New 10 MG reclaimed water storage tank and HSPS to feed the MRS and plant reuse water system. Includes demolition of the existing storage tanks, and conversion of the existing effluent pump station to a low pressure transfer station to convey effluent to the storage lakes and the new 10 MG tank.	FY 2021	$4,410,000
WW01621	NRWRF Maintenance Building Addition -	Construction of a new maintenance building with mechanical and electrical shops, offices, and restroom facilities.	FY 2022	$250,000
TBD	NRWRF Electrical Upgrades	Upgrades to existing MCCs and control panels.	FY 2029	$3,700,000
TBD	Anoxic/Aeration Basin Upgrades	Upgrades to the existing anoxic/aeration basins including replacement of mixers, weir gates, and sluice gates.	FY 2029	$500,000

Notes:

(1) Project costs including engineering design and construction. The construction costs were based on Class 4 cost estimates according to the definitions of AACE International. Value represent the expected costs in the Project Start year Original estimates were in July 2015 dollars and escalated to the Project Start year assuming an escalation factor of 2.7%/year

It is recommended to re-assess the design criteria, assumptions and projections used to develop the conclusions and update the master plan on a five-year continuous basis. The five-year CIP will provide improvements that will need to be taken into consideration for the subsequent master plan period.

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM NO. 1
EXISTING WATER RECLAMATION FACILITIES – SUMMARY DOCUMENT

FINAL
March 2016

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM
NO. 1

EXISTING WATER RECLAMATION FACILITIES – SUMMARY DOCUMENT

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EXISTING WATER RECLAMATION FACILITIES SUMMARY DOCUMENT

1.0 INTRODUCTION

Manatee County owns and operates three regional water reclamation facilities (WRFs): Southwest WRF (SWWRF), Southeast WRF (SEWRF), and North Regional WRF (NRWRF). This technical memorandum (TM) is part of the development of the Facilities Master Plans for each of these WRFs. As such, the TM summarizes the existing facilities, historical wastewater quality and quantity, and the existing treatment plant performance.

2.0 SERVICE AREA

The Manatee County Utility System serves the Manatee County area surrounded by Sarasota County to the south, the Gulf of Mexico to the west, Hillsborough County to the north, and a future development area boundary to the east roughly in line with Lake Manatee. In addition, Manatee County provides wastewater services to wholesale customers, including the Town of Longboat Key, the City of Palmetto, the City of Bradenton, and Sarasota County.

Figure 1.1 shows the service areas and locations of Manatee County's three WRFs. These WRFs have a combined permitted capacity of 33.5 million gallons per day (mgd) annual average daily flow (AADF). Each WRF operates under a non-discharge permit. To dispose of treated effluent, the facilities connect to a slow-rate public access reuse (PAR) system known as the Manatee County Master Reuse System (MCMRS). The County also has a Class 1 underground injection well on Cortez Road with a permitted capacity of 15 mgd maximum daily flow (MDF) or 10 mgd AADF to dispose of treated effluent.

3.0 SOUTHWEST WATER RECLAMATION FACILITY

The following sections summarize the design criteria, unit sizes, and capacities for SWWRF, including plant site layouts and process flow schematics. Also included are the historical influent wastewater flows and loads, historical effluent quality, and the existing performance of each major unit process at SWWRF.

3.1 Existing Facilities

SWWRF is located in southwest Manatee County at 5101 65th Street West in Bradenton, Florida, north of Sarasota Bay. Currently, it is permitted for a treatment capacity of 15.0 mgd AADF. The facility's treatment process includes preliminary screening and grit removal, flow equalization, secondary biological nutrient removal (BNR) activated sludge, and tertiary filtration and high-level disinfection. Although the SWWRF Digester Modifications and SWWRF Nitrogen Removal projects are both under construction, the description of these facilities was written assuming these projects were completed.

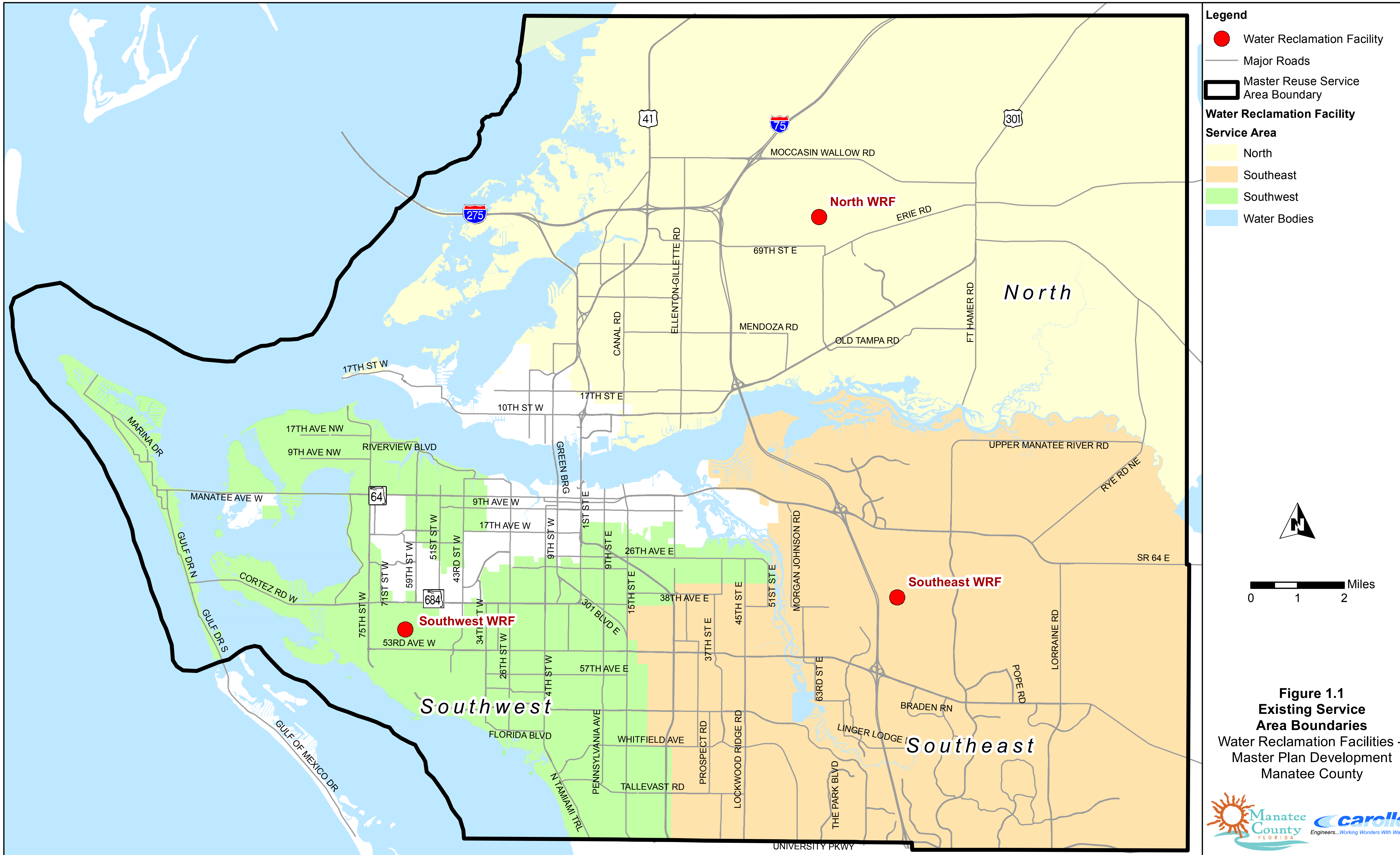


Figure 1.1
Existing Service Area Boundaries
Water Reclamation Facilities – Master Plan Development
Manatee County

Preliminary treatment consists of screening and grit removal. This process begins with pumping raw wastewater into the headworks facility, which is equipped with an influent flow meter, two mechanically cleaned screens, one manual bar screen, and two forced flow vortex de-gritting units. In addition, SWWRF has an off-line flow equalization basin that can divert a portion of the flow after it leaves the headworks and return it to the flow stream before entering the anoxic basins.

Secondary treatment is achieved with a BNR activated sludge process in a Modified Ludzack-Ettinger (MLE) configuration. At a common structure, screened and de-gritted wastewater flow from the headworks is combined with return activated sludge (RAS), return from the flow equalization tanks, and mixed liquor recycle (MLR) from the aeration basins to split the combined flow to the anoxic basins. From the anoxic basins, flow is split to the aeration basins.

To reduce effluent total nitrogen, the MLE process incorporates $cBOD_5$ removal and nitrification/denitrification. The $cBOD_5$ removal and nitrification occurs in the aeration basins, and denitrification occurs in the anoxic basins when the nitrate formed in the aeration basins is recycled to the anoxic basins and converted to nitrogen gas. Each anoxic basin is equipped with vertical mixers to keep the basin's contents suspended. Each aeration basins is equipped with fine bubble aeration and submersible pumps for MLR. Secondary treatment finishes in five circular secondary clarifiers that provide final clarification. RAS is then collected from the clarifiers and returned to the anoxic basins via the splitter box to maintain the organisms needed for treatment.

For tertiary treatment, effluent from the secondary clarifiers flows to six granular media traveling bridge automatic backwash filters and one cloth media filter. Filtered effluent is then disinfected with sodium hypochlorite in three chlorine contact chambers.

Following the chlorine contact chambers, the treated effluent, which meets the requirements of PAR, is pumped to two 10-MG storage tanks by a transfer pump station or to onsite ponds for storage. The storage tanks and subsequent high service pump station are part of the MCMRS.

Three storage ponds store reclaimed water: a 66-MG capacity lined reuse storage pond, a 142.3-MG unlined storage pond, and a 49.2-MG capacity unlined storage pond. Conversely, an 18-MG capacity lined storage pond stores reject water. Reclaimed water in the storage ponds is returned to the transfer pump station wet well via the lake return pump stations at the reuse ponds, and returned water from the ponds is treated with disk filters.

To begin solids processing, waste activated sludge (WAS) pumps remove WAS from the final clarifiers. The WAS flow is then pumped to four aerated sludge holding tanks, each with a jet aeration system that contains a sludge recycle pump and a rotary blower. Afterward, the sludge is dewatered with six belt filter presses, and residuals are transported to the County's thermal dryer facility located near SEWRF and the County landfill. There, the dewatered sludge is converted to a Class AA product in the thermal dryer, which uses landfill gas as its primary fuel.

Figure 1.2 shows a process flow diagram of the existing SWWRF liquid treatment stream, and Figure 1.3 shows a process flow diagram of the existing SWWRF solids handling stream. Figure 1.4 shows SWWRF's site plan.

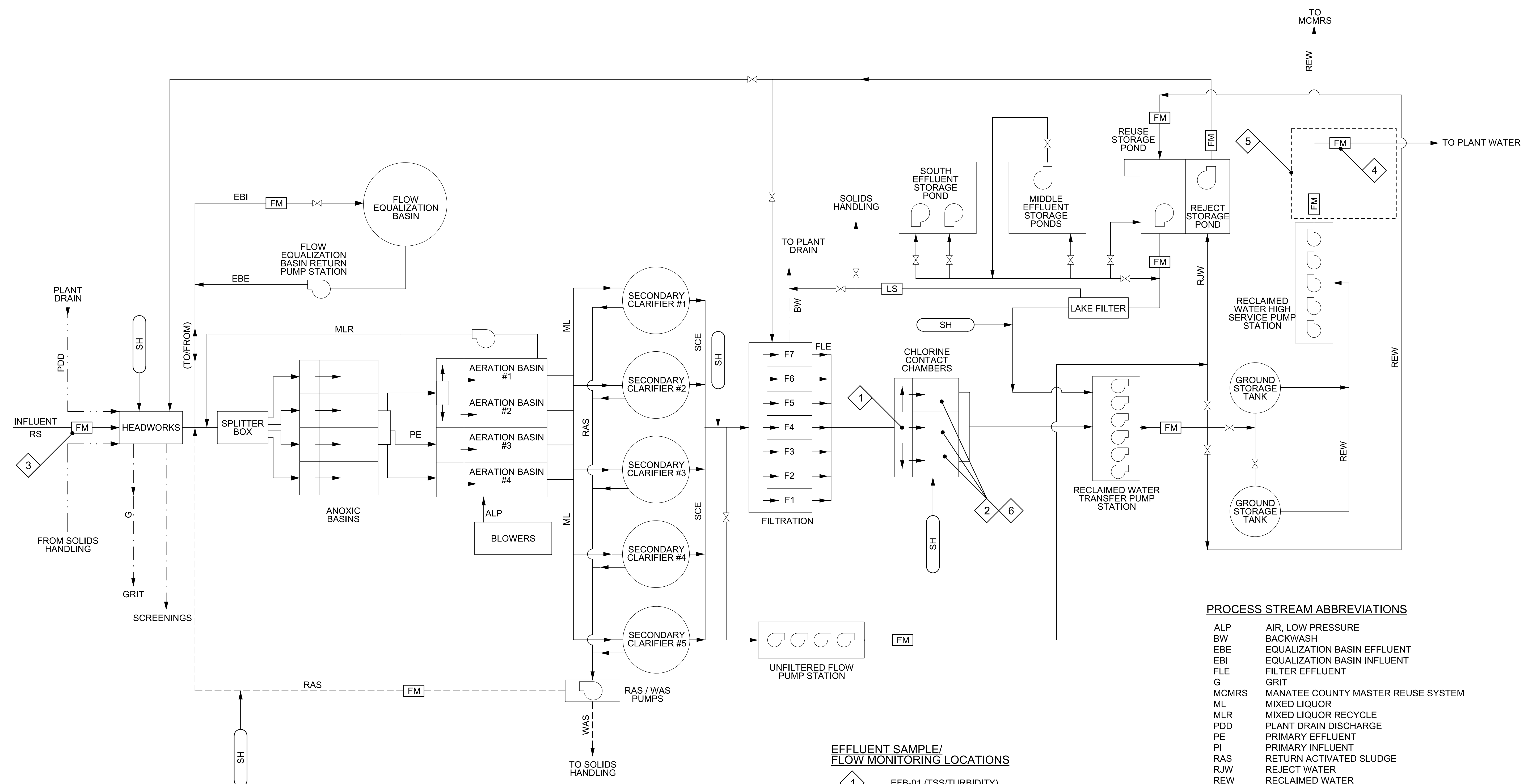
3.1.1 Design Criteria

SWWRF is designed for 13.5 mgd AADF to meet PAR water quality requirements per Ch. 62-610, Florida Administrative Code (FAC). Table 1.1 summarizes the influent flows and loads established for SWWRF's design. This table includes the design AADF, maximum month average daily flow (MMADF), MDF, peak hour flow (PHF), influent carbonaceous five-day biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN) concentrations and loads at AADF.

Table 1.1 SWWRF Influent Design Criteria
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	Units	Value [(1)]
Flow, AADF	mgd	13.5
Flow, MMADF	mgd	15.9
Flow, MDF	mgd	23.0
Flow, PHF	mgd	48.0
$cBOD_5$	mg/L	132
$cBOD_5$ (at AADF)	lb/d	16,510
TSS	mg/L	141
TSS (at AADF)	lb/d	17,640
TKN	mg/L	34
TKN (at AADF)	lb/d	4,250

Notes:
(1) Design values based on SWWRF Process Modifications for Nitrogen Removal Preliminary Engineering Report (CH2M Hill, 2012).



PROCESS STREAM ABBREVIATIONS

ALP	AIR, LOW PRESSURE
BW	BACKWASH
EBE	EQUALIZATION BASIN EFFLUENT
EBI	EQUALIZATION BASIN INFLUENT
FLE	FILTER EFFLUENT
G	GRIT
MCMRS	MANATEE COUNTY MASTER REUSE SYSTEM
ML	MIXED LIQUOR
MLR	MIXED LIQUOR RECYCLE
PDD	PLANT DRAIN DISCHARGE
PE	PRIMARY EFFLUENT
PI	PRIMARY INFLUENT
RAS	RETURN ACTIVATED SLUDGE
RJW	REJECT WATER
REW	RECLAIMED WATER
RS	RAW SEWAGE
SCE	SECONDARY EFFLUENT
WAS	WASTE ACTIVATED SLUDGE

EFFLUENT SAMPLE/
FLOW MONITORING LOCATIONS

1	EFB-01 (TSS/TURBIDITY)
2	EFA-01 (FILTERED EFFLUENT SAMPLING)
3	FLW-01 (METERED TOTAL PLANT FLOW)
4	FLW-04 (METERED FLOW FOR PLANT WATER)
5	FLW-05 (METERED FLOW TO PARS) = HIGH SERVICE PUMPSTATION FLOW - PLANT WATER FLOW)
6	FLW-10 (METERED FLOW FROM R-001 TO THE STORAGE PONDS OR TANKS)

FLOW STREAM LEGEND

- LIQUID WW STREAM
- RECYCLE STREAM
- SLUDGE STREAM
- SCREENINGS/GRIT
- FM — FLOW METER
- SH — SODIUM HYPOCHLORITE FEED POINT

FIGURE NO. 1.2

SWWRF LIQUID STREAM PROCESS SCHEMATIC

WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT

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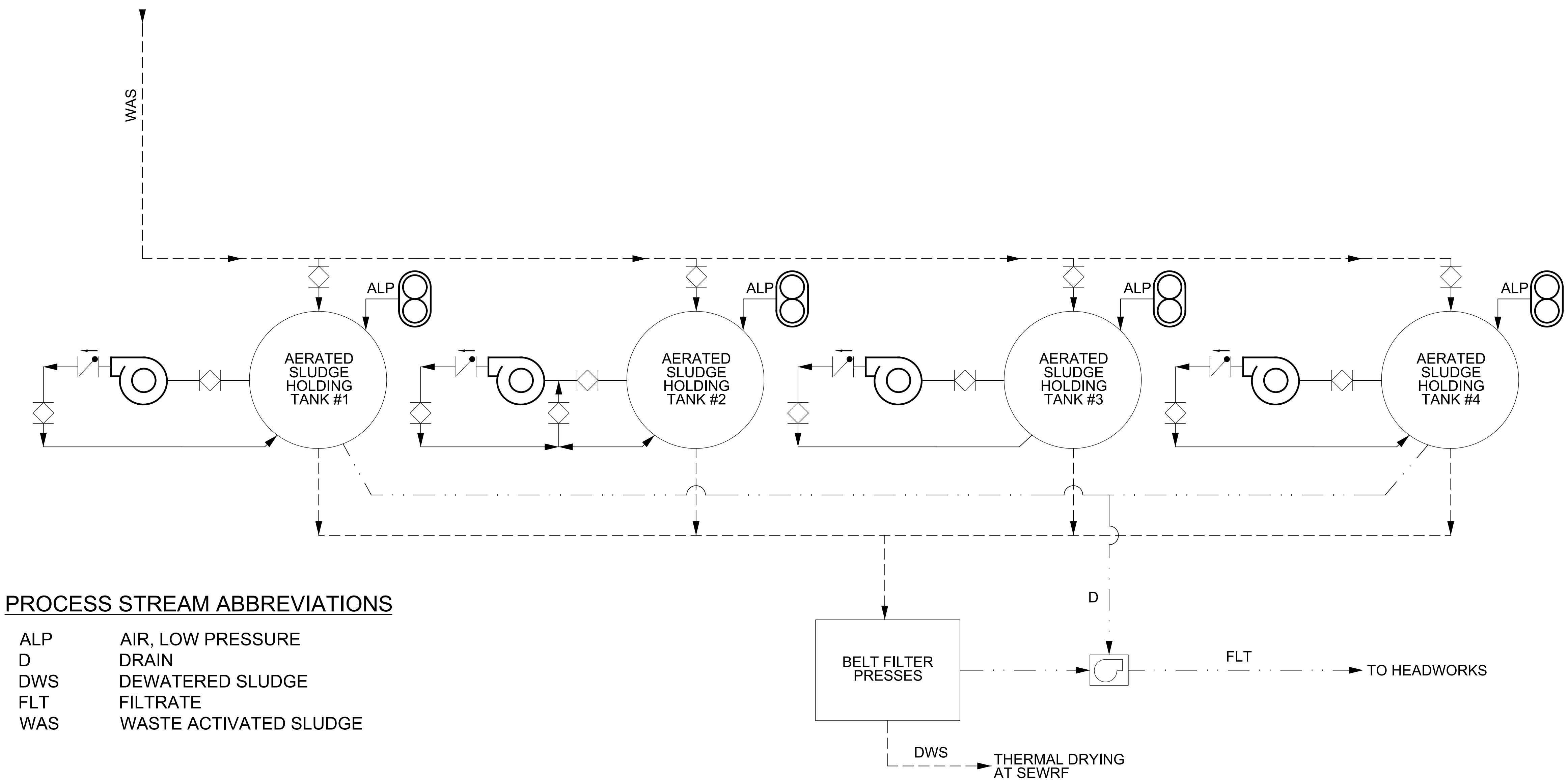

PROCESS STREAM ABBREVIATIONS

ALP	AIR, LOW PRESSURE
D	DRAIN
DWS	DEWATERED SLUDGE
FLT	FILTRATE
WAS	WASTE ACTIVATED SLUDGE

FLOW STREAM LEGEND

— · · — · · — RECYCLE STREAM

– – – – – – – SLUDGE STREAM

FIGURE NO. 1.3

SWWRF SOLID HANDLING PROCESS SCHEMATIC

WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT

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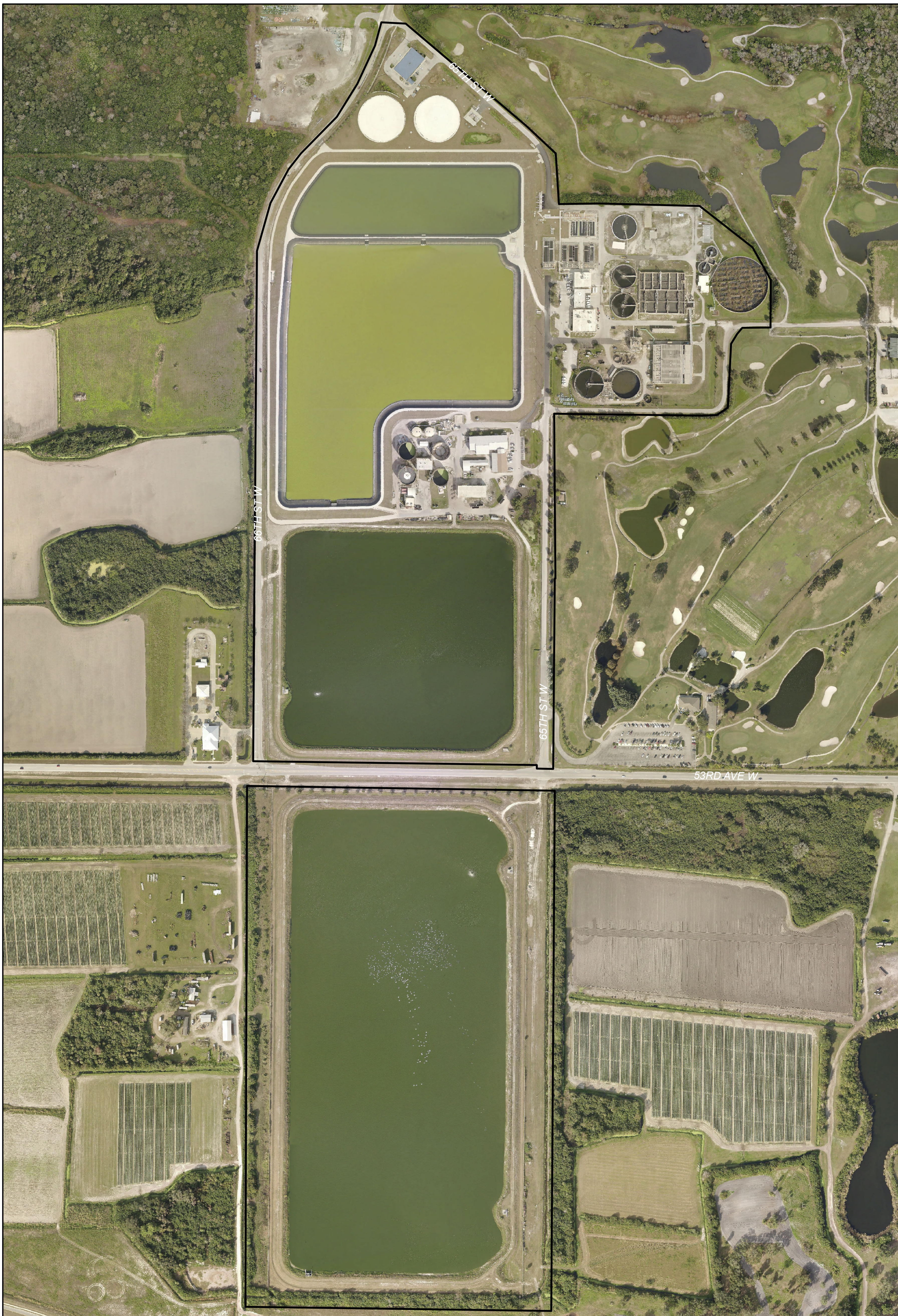

Legend

Parcels

Feet
0 300 600

Figure 1.4
Southwest Water Reclamation Facility
Water Reclamation Facilities – Master Plan Development
Manatee County

Manatee County FLORIDA

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Table 1.2 summarizes the effluent permit requirements.

Table 1.2 SWWRF Effluent Permit Requirements
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	Units	Max/Min	Annual Average	Monthly Average	Weekly Average	Single Sample
Flow	mgd	Maximum	15.0	-	-	-
$cBOD_5$	mg/L	Maximum	20.0	30.0	45.0	60.0
TSS	mg/L	Maximum	-	-	-	5.0
pH	std. units	Range	-	-	-	6.0 – 8.5
Fecal coliform	% < detection	Minimum	-	75	-	-
Fecal coliform	#/ 100 mL	Maximum	-	-	-	25
TRC	mg/L	Minimum	-	-	-	1.0

3.1.2 Inventory of Processes, Equipment, and Capacities

The following tables summarize SWWRF's inventory of processes and equipment. Table 1.3 shows the inventory of the liquid treatment facilities, Table 1.4 shows the inventory of the effluent and reuse facilities, and Table 1.5 shows the inventory of the solids handling facilities.

Table 1.3 SWWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Headworks flow measurement	Number Type Size Capacity	1 Strap-on, transit time 36 in 0 to 50 mgd
Bar screens	Number Type Screen opening Number Type Screen opening Channel width Channel depth	2 Mechanically cleaned 6 mm 1 Manually cleaned 1 inch 4 ft 4.5 ft

Table 1.3 SWWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Grit removal	Number Type Diameter Removal efficiency	2 Forced vortex 18 ft 95% of 50 mesh and larger
Flow equalization tank	Number Type Diameter SWD Volume No. of return pumps Type Capacity, total	1 Offline 244 ft 11 ft 3.8 MG 5 Submersible 9.6 mgd
Anoxic basins	Number Trains Number Zones Length Width Side water depth (SWD) Volume, each Volume, total <u>Mixer</u> Type Motor power (each) Number (per zone)	4 2 per train (8 total) 150 ft 20 ft 12.5 ft 0.54 MG 2.15 MG Vertical, Hyperbolic 2 hp 4

Table 1.3 SWWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Aeration basins	Number	4
	Length (No. 1 & 2)	192 ft
	Width (No. 1 & 2)	36 ft
	SWD (No. 1 & 2)	14.5
	Volume, each (No. 1 & 2)	0.75 MG
	Length (No. 3 & 4)	192 ft
	Width (No. 3 & 4)	48 ft
	SWD (No. 3 & 4)	14.5
	Volume, each (No. 3 & 4)	1.0 MG
	Volume, total	3.5 MG
	Aeration type	Fine bubble diffusers
Aeration blowers	Number	5
	Type	Centrifugal
	Capacity, each	3,075 scfm
	Discharge pressure	8.0 psi
	Motor power, each	200 hp
	Number	2
	Type	High speed, turbo
	Capacity (each)	6,600 scfm
	Discharge pressure	8.7 psi
	Motor power (each)	300 hp
Secondary clarifiers	Number	5
	Type	Center feed, peripheral weir
	Sludge withdrawal	Draft tube
	Diameter (No. 1 & 2)	105 ft
	SWD (No. 1 & 2)	12 ft
	Diameter (No. 3 & 4)	125 ft
	SWD (No. 3 & 4)	14 ft
	Diameter (No. 5)	100 ft
	SWD (No. 5)	14 ft
	Surface area, total	49,720 ft^2
	Scum handling (No. 1- 5)	Full radius scum trough

Table 1.3 SWWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
RAS pumps	Number	8
	Type	Non-clog, centrifugal
	Control	Variable speed, level control
	Capacity, each	3,500 gpm
	Motor power, each	30 hp
Filters	Number	7
	Type	1 – AquaDiamond
		6 – Automatic backwash, traveling bridge
	Surface area, each (No. 1)	1,920 ft^2
	Surface area, each (No. 2-5)	1,060 ft^2
	Surface area, each (No. 6 & 7)	1,440 ft^2
	Surface area, total	9,040 ft^2
	Media type (No. 1)	Pile cloth
	Media type (No. 2-7)	12-inch sand, 12-inch anthracite
Chlorine contact basins	Number	3
	Type	Sodium hypochlorite
	Length	61.4 ft
	Width	30 ft
	SWD	10 ft
	Volume, each	138,000 gal
	Volume, total	414,000 gal
Sodium hypochlorite system	Number tanks	3
	Capacity, each	6,000 gal
	Number pumps	4
	Type	Metering
	Capacity, each	25 gph

Table 1.4 SWWRF Inventory of Effluent and Reuse Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Reuse transfer pumps	Number Type Control Capacity, each Motor power, each	6 Vertical turbine Variable speed 6,000 gpm 100 hp
Reuse storage	Number Type Area North Pond Capacity North Pond Area Middle Pond Capacity Middle Pond Area South Pond Capacity South Pond Number Type Capacity storage tank	3 Pond 12.5 acres (Lined) 66 MG (Lined) 19.5 acres (Unlined) 48 MG (Unlined) 45.9 acres (Unlined) 142 MG (Unlined) 2 Ground storage tank 10 MG
Lake return filters	Number Type Mesh opening size Filtration area (per unit) Capacity	3 Circular disc w/ steel mesh 25 micron 352 ft^2 7.5 mgd (ADF), 15 mgd (PHF)
Reject storage	Number Type Area Capacity	1 Lined Pond 4.5 acres 18 MG
High service pumps	Number Pumps Type Control Capacity, each Motor power (each)	5 Vertical Turbine Variable speed 6,000 gpm 350 hp
Deep Well	Number Capacity Depth Casing diameter	1 10 mgd AADF, 15 mgd MDF 1,659 ft 24 in

Table 1.5 SWWRF Inventory of Solids Handling Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
WAS pumps	Number Type Control Capacity, each Motor power, each	3 Positive displacement Variable speed 100 gpm 5 hp
Aerated sludge holding tanks	Number Type Diameter SWD Volume, each Volume, total Aeration/Mixing system <u>Sludge Recirculation Pumps</u> Number Type Control Capacity, each Motor power (each) <u>Aeration Blowers</u> Number Type Capacity (each) Discharge pressure Motor power (each)	4 Prestressed concrete 75 ft 25 ft 0.83 MG 3.30 MG Jet aeration 4 Horizontal, centrifugal, end suction Constant speed 6,600 gpm 50 hp 4 Rotary, positive displacement 940 scfm 10.8 psi 75 hp
Dewatering	Number Type Width Loading rate, each Capture Cake solids	6 Belt filter presses 2 m 1,200 lb/hr 95% 18 to 20%
Dewatering feed pumps	Number Type Capacity, each	6 Progressive cavity 150 gpm

3.2 Influent Flows and Loads

Table 1.6 summarizes SWWRF's historical influent flows and peaking factors, and Figure 1.5 shows the annual average, monthly average, and 3-month average flows. As shown in the figure, flows to SWWRF vary seasonally and have been relatively stable over the past 5 years.

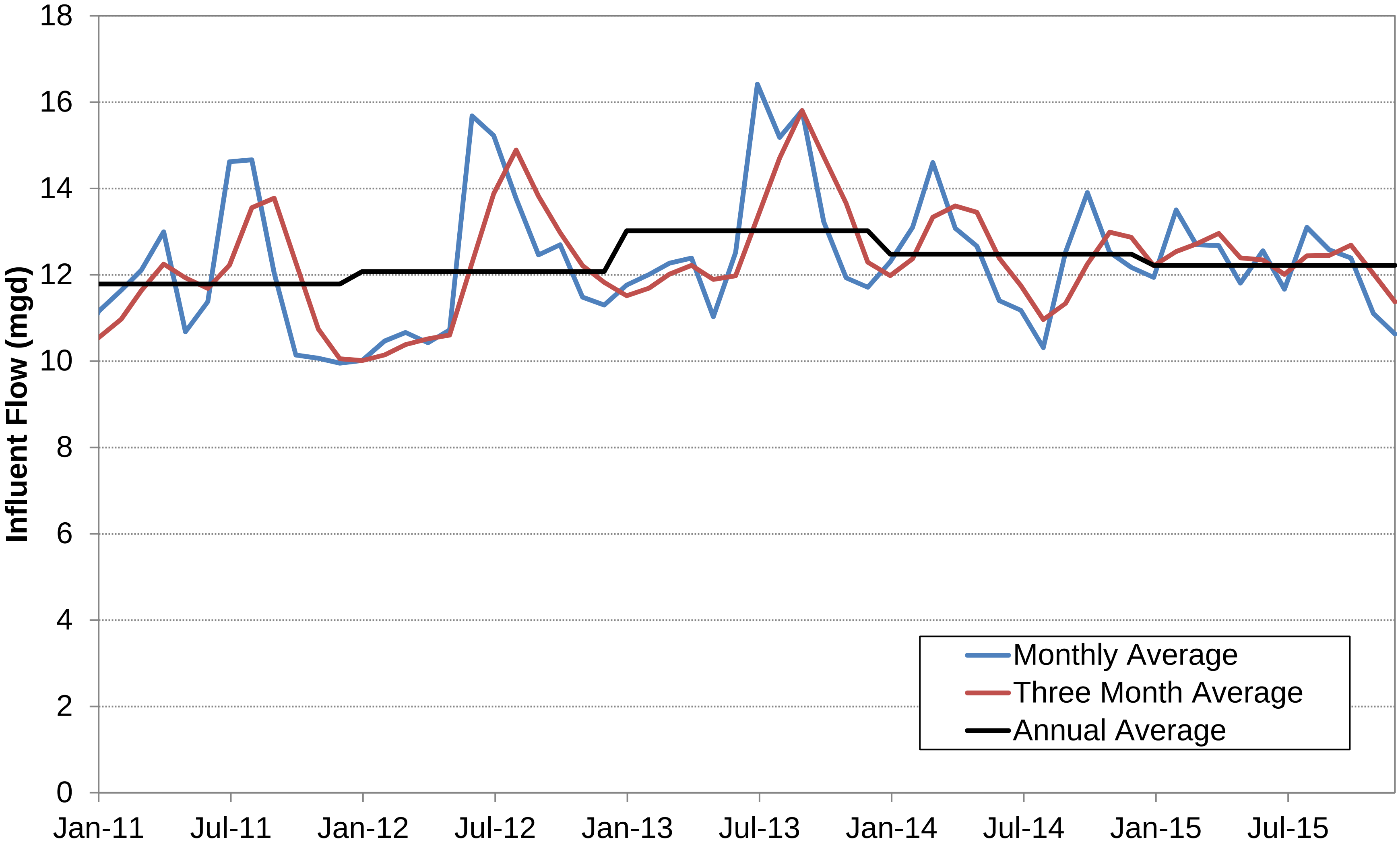
Table 1.6 SWWRF Historical Influent Flows and Peaking Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

Flow Condition (1)	2011	2012	2013	2014	2015	Average
AADF (mgd)	11.8	12.1	13.0	12.5	12.2	**12.3**
M3MADF (mgd)	13.8	14.9	15.8	13.6	13.0	**14.2**
M3MADF: AADF PF	1.17	1.23	1.21	1.09	1.06	**1.15**
MMF (mgd)	14.7	15.7	16.4	14.6	13.5	**15.0**
MMF: AADF PF	1.24	1.30	1.26	1.17	1.10	**1.22**
MDF (mgd)	18.9	31.6	31.7	22.1	19.4	**24.7**
MDF: AADF PF	1.60	2.62	2.43	1.77	1.59	**2.00**

Notes:

(1) AADF = Annual average daily flow
M3MADF = Maximum three month average daily flow
MMF = Maximum monthly flow
MDF = Maximum daily flow
PF = Peaking factor

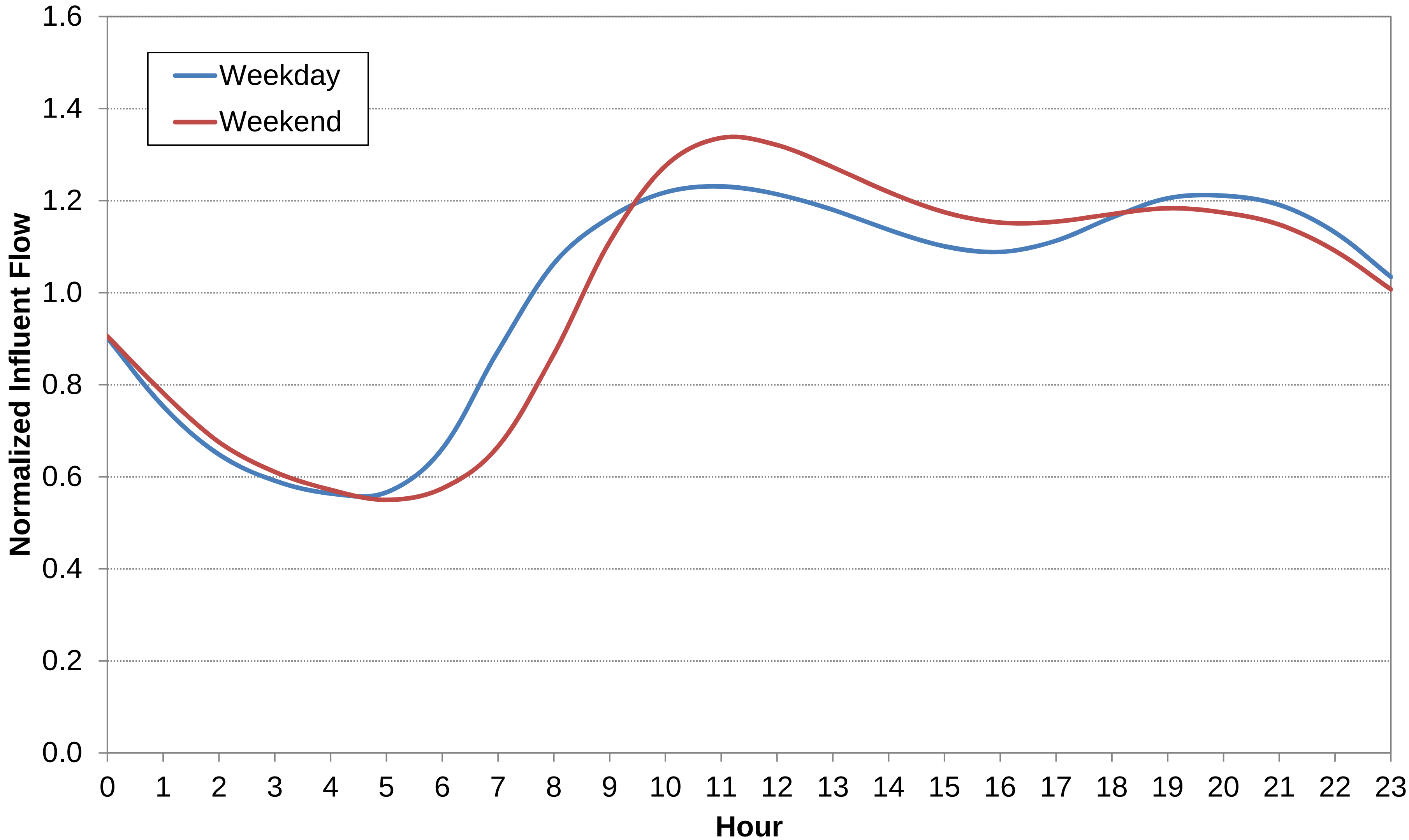
The average diurnal pattern from 2011 to 2013 was analyzed to determine the hourly variation in influent flow over a day. Figure 1.6 compares the typical diurnal pattern at SWWRF on a weekday with the typical diurnal pattern on a weekend. As shown, the patterns are similar, with the weekend daytime peak occurring approximately 1 hour later than the weekday peak, which is expected for this type of system.



SWWRF HISTORICAL INFLUENT FLOW

FIGURE 1.5

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



SWWRF DIURNAL FLOW PATTERN

FIGURE 1.6

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

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Historical influent loads to SWWRF were also analyzed to develop peaking factors for the constituents shown in Table 1.7. Appendix A provides chronological plots of the historical influent loads and concentrations. As shown in Table 1.7 and Appendix A, influent loads and peak factors to SWWRF have remained relatively stable over the past 5 years.

Table 1.7 SWWRF Historical Influent Loads and Peaking Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

Load Condition	2011	2012	2013	2014	2015	Average
Annual Average $cBOD_5$ (lb/d)	10,490	9,680	12,340	12,630	9,520	**10,930**
Maximum Month $cBOD_5$ (lb/d)	16,070	11,940	14,650	16,080	17,390	**15,230**
Maximum Month $cBOD_5$ PF	1.53	1.23	1.19	1.27	1.83	**1.41**
Annual Average TSS (lb/d)	11,830	10,370	14,030	21,490	12,140	**13,970**
Maximum Month TSS (lb/d)	17,560	13,290	18,650	37,400	25,030	**22,380**
Maximum Month TSS PF	1.48	1.28	1.33	1.74	2.06	**1.58**
Annual Average TKN (lb/d)	3,390	3,400	3,750	3,370	3,810	**3,540**
Maximum Month TKN (lb/d)	4,030	3,770	4,680	4,440	5,490	**4,480**
Maximum Month TKN PF	1.19	1.11	1.25	1.32	1.44	**1.26**
Annual Average TP (lb/d)	420	450	520	510	420	**460**
Maximum Month TP (lb/d)	500	550	700	730	540	**600**
Maximum Month TP PF	1.18	1.22	1.35	1.44	1.30	**1.30**

3.3 Effluent Quality

SWWRF's effluent water quality is regulated to meet PAR standards. Although effluent nutrients are not regulated, they are reported. Table 1.8 summarizes the effluent quality over the past 5 years, and Appendix B shows chronological plots of the effluent quality. As shown in Table 1.8 and Appendix B, the effluent $cBOD_5$ has remained below the permit requirement of 30 mg/L as a monthly average. Effluent TSS has also remained below the permit requirement of 5 mg/L. Effluent fecal coliform also remained below the requirement of 25 per 100 mL.

Table 1.8 SWWRF Historical Effluent Quality
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	2011	2012	2013	2014	2015	Average
Average Effluent $cBOD_5$ (mg/L)	1.2	0.4	0.2	0.3	0.2	**0.5**
Average Effluent TSS (mg/L)	1.9	1.7	1.7	0.9	0.9	**1.4**
Average Effluent TN (mg/L)	18.4	19.4	15.7	16.1	14.6	**16.8**
Average Effluent TP (mg/L)	2.1	2.0	1.8	1.7	1.4	**1.8**
Fecal Coliform (#/100 mL)	<1	<1	1.5	2.0	<1	**1.0**

Appendix C shows the annual analysis of the effluent for primary and secondary drinking water standards over the past 5 years.

3.4 Existing Treatment Plant Performance

Table 1.9 summarizes the performance of the treatment facilities at SWWRF in 2013. As shown, all existing equipment had sufficient capacity based on the design standards. Although the MLSS concentration for this type of treatment facility is slightly higher than normal, the concentration is not considered unreasonable.

Table 1.9 SWWRF Performance Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Unit Process	2013 Value	Design/Standard Value
Influent Flows	13.0 mgd AADF 16.4 mgd MMF 31.7 mgd MDF 39.4 mgd PHF	13.5 mgd AADF 15.9 mgd MMF 23.0 mgd MDF 48.0 mgd PHF
Influent Loads	12,630 lb/d $cBOD_5$ 14,060 lb/d TSS 3,750 lb/d TKN	31,280 lb/d $cBOD_5$ 31,280 lb/d TSS 5,000 lb/d TKN
Aeration basins	27.2 lb BOD/d/1,000 cf (3) 3.8 hrs HRT (3) 0.2 lb BOD/d/lb MLVSS (3) 3,200 mg/L MLSS	20-40 lb BOD/d/1,000 cf (2) 4-8 hr HRT (2) 0.2-0.4 lb BOD/d/lb MLVSS (2) 1,500-3,000 mg/L MLSS (2)
Aeration Blowers	8,300 scfm demand (2)	10,800 scfm capacity (5)
Secondary clarifiers	790 gpd/sf peak overflow (3) 26 lb/d/sf peak solids load (3) 22,400 gpd/ft peak weir load (3)	<1,000 gpd/sf (1) <50 lb/d/sf (1) <30,000 gpd/ft (1)
RAS pumps	2.3 to 6.9 mgd (2)(4)	35 mgd (5)
Filters	3.1 gpm/sf peak loading rate (3)	<6.5 gpm/sf (6), <2.0 gpm/sf (7)
Disinfection	15 min at PHF	>15 min at PHF (1)
Chlorination system	330 lb/d at PHF	2,900 lb/d capacity

Notes:
(1) Ten State Standards
(2) WEF MOP No. 8
(3) Assuming all units in service
(4) 25 to 75% of influent flow
(5) Capacity with one unit out of service
(6) Loading rate for cloth type filters
(7) Loading rate for ABW type filters.

4.0 SOUTHEAST WATER RECLAMATION FACILITY

The following sections summarize the design criteria, unit sizes, and capacities for SEWRF, including plant site layouts and process flow schematics. Also included are the historical influent wastewater flows and loads, the historical effluent quality, and the existing performance of each major unit process at SEWRF.

4.1 Existing Facilities

SEWRF is located in southeastern Manatee County at 3331 Lena Road in Bradenton, Florida off of Highway 64 south of the Manatee River. This facility has a permitted capacity of 11.0 mgd for a three month rolling average daily flow (TMRADF). At SEWRF, the treatment process consists of preliminary screening and grit removal, secondary BNR activated sludge, and tertiary filtration and high-level disinfection.

Similar to SWWRF, preliminary treatment at SEWRF begins with pumping raw wastewater to the headworks facility. This facility consists of two influent magnetic flow meters, three mechanically cleaned bar screens, and two forced flow vortex de-gritting units. Following preliminary treatment, wastewater flows to a splitter box, which directs peak flows to two flow equalization basins and splits them to the secondary treatment processes.

Secondary treatment is achieved with a BNR activated sludge process in an MLE configuration. Influent wastewater from the headworks combines with RAS and MLR flow pumped back from the aeration basins before reaching the anoxic basins. From the anoxic basins, flow enters the oxidation ditch aeration basins. Secondary treatment finishes in four circular secondary clarifiers that collect RAS through draft tubes and return it to the anoxic basins' influent.

From the secondary clarifiers, effluent flows to flash mix basins, flocculation tanks, and granular media traveling bridge automatic backwash filters for tertiary treatment. The filtered effluent is then disinfected with sodium hypochlorite in four chlorine contact chambers. From there, the chlorinated effluent enters either the effluent reuse system (MCMRS), a 10-MG reuse storage tank, or onsite lake storage. If the demand for reuse exceeds SEWRF's effluent, previously treated effluent from lake storage is pumped back to the plant filters or lake filters for re-treatment to meet the demand. Effluent not meeting reuse standards is diverted to a 6.3-MG or a 6.0-MG lined reject pond before returning to the plant headworks for treatment.

To begin solids processing, WAS pumps remove WAS from the final clarifiers. The WAS is then pumped to gravity belt thickeners (GBTs) and transferred to aerobic sludge holding tanks for further stabilization. At that point, the sludge is dewatered using three belt filter presses and then transferred to the biosolids treatment facility located onsite. There, the biosolids are either dried with an indirect dryer to produce a Class AA product or disposed of in a Class I solid waste landfill.

Figure 1.7 shows a process flow diagram of the existing SEWRF liquid treatment stream, and Figure 1.8 shows a process flow diagram of the existing SEWRF solids handling stream. Figure 1.9 shows SEWRF's site plan.

4.1.1 Design Criteria

SEWRF is designed for an 11 mgd TMRADF to meet PAR water quality requirements per Ch. 62-610, FAC. Table 1.10 summarizes the influent flows and loads established for the SEWRF design, and Table 1.11 summarizes the effluent permit requirements.

Table 1.10 SEWRF Influent Design Criteria
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	Units	Value
Flow, TMRADF	mgd	11.0
Flow, MDF	mgd	12.65
Flow, PHF	mgd	27.5
$cBOD_5$	mg/L	250
$cBOD_5$ (at TMRADF)	lb/d	22,940
TSS	mg/L	250
TSS (at TMRADF)	lb/d	22,940
TKN	mg/L	40
TKN (at TMRADF)	lb/d	3,670

Table 1.11 SEWRF Effluent Permit Requirements
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	Units	Max/Min	Annual Average	Monthly Average	Weekly Average	Single Sample
Flow	mgd	Maximum	11.0	-	-	-
$cBOD_5$	mg/L	Maximum	20.0	30.0	45.0	60.0
TSS	mg/L	Maximum	-	-	-	5.0
pH	std. units	Range	-	-	-	6.0 – 8.5
Fecal coliform	% < detection	Minimum	-	75	-	-
Fecal coliform	#/ 100 mL	Maximum	-	-	-	25
TRC	mg/L	Minimum	-	-	-	1.0
Nitrate-N	mg/L	Maximum	-	-	-	12.0

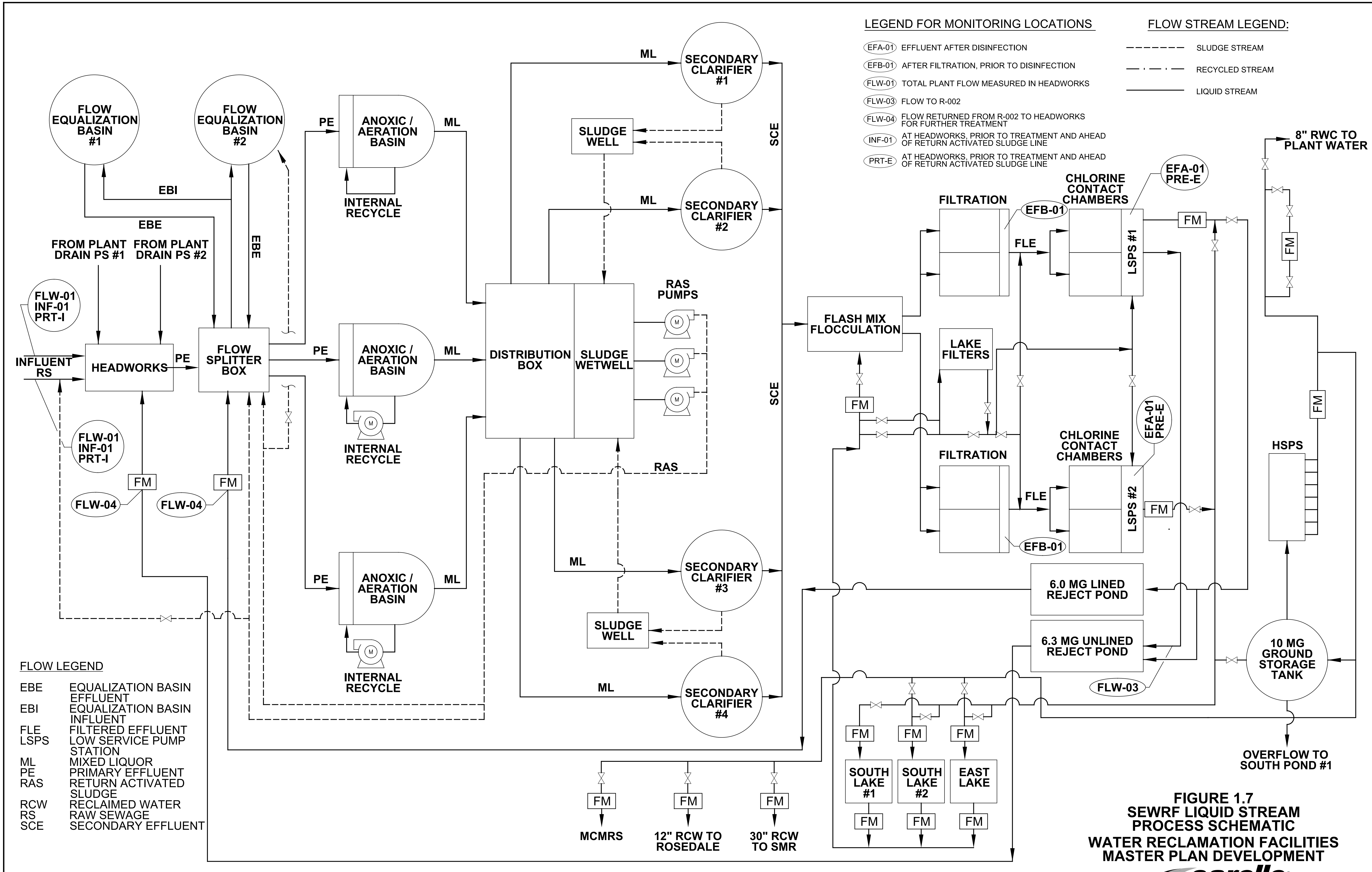

FIGURE 1.7
SEWRF LIQUID STREAM PROCESS SCHEMATIC
WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT
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LEGEND FOR MONITORING LOCATIONS

PRT-R AFTER FINAL TREATMENT AND BEFORE LAND APPLICATION

RMP-1 QUANTITY OF BIOSOLIDS TRANSFERRED TO BIOSOLIDS TREATMENT FACILITY

RMP-2 QUANTITY OF BIOSOLIDS TRANSFERRED TO LANDFILL

FLOW STREAM LEGEND:

SLUDGE STREAM

RECYCLED STREAM

LIQUID STREAM

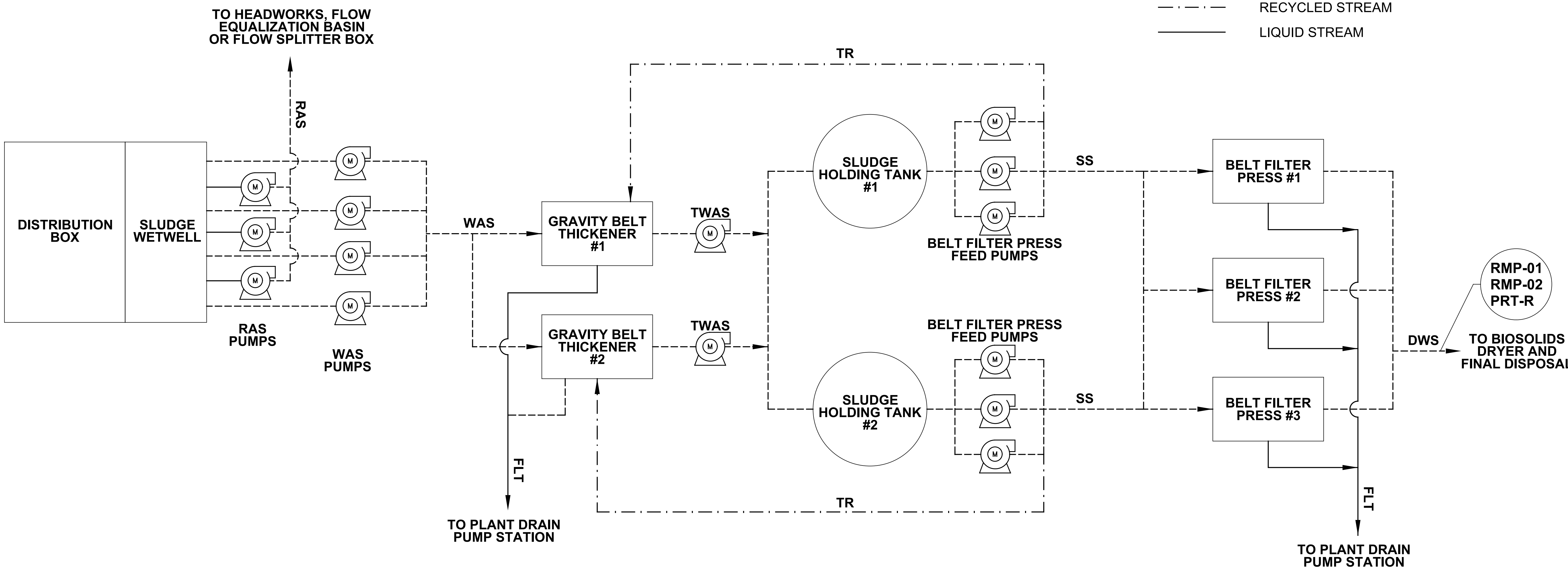

FIGURE 1.8
SEWRF SOLIDS HANDLING PROCESS SCHEMATIC

WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT

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Figure 1.9
Southeast Water Reclamation Facility
Water Reclamation Facilities – Master Plan Development
Manatee County

Manatee County FLORIDA

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4.1.2 Inventory of Processes, Equipment, and Capacities

The following tables summarize SEWRF's inventory of processes and equipment. Table 1.12 shows the inventory of the liquid treatment facilities, Table 1.13 shows the inventory of the effluent and reuse facilities, and Table 1.14 shows the inventory of the solids handling facilities.

Table 1.12 SEWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Headworks flow measurement	Number	2
	Type	Magnetic flow meter
	Size (Lakewood Ranch)	24 in
	Size (Main Influent)	30 in
	Capacity	3.6 to 32 mgd
Bar screens	Number	3
	Type	Mechanically cleaned
	Screen opening	6 mm
	Number	1
	Type	Manual
	Screen opening	1-inch
	Channel width	3.5 ft
	Channel depth	5.0 ft
Grit removal	Number	2
	Type	Forced vortex
	Diameter	16 ft
Flow equalization tank	Number	2
	Type	Offline
	Diameter	150 ft
	SWD	21.5 ft
	Volume	2.8 MG
	No. of return pumps	5
	Type	Submersible
	Capacity, each	2,000 gpm
	Motor power, each	2 @ 30 hp, 3 @ 15 hp
	Aeration system	Eduction

Table 1.12 SEWRF Inventory of Liquid Treatment Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
Anoxic basins	Number Length Width SWD Volume, each Volume, total Number of mixers, each Mixer type Motor power, each	3 48 ft 107 ft 15 ft 0.58 MG 1.73 MG 2 Mechanical 15 hp
Aeration basins	Number Length Width SWD Volume, each Volume, total	3 287 ft 107 ft 13.5 ft 3.10 MG 9.30 MG
Aeration system	Number Type Motor power, each	9 Mechanical surface aerators 125 hp
Secondary clarifiers	Number Type Sludge withdrawal Diameter SWD Surface area, each Surface area, total Scum handling	4 Center feed, peripheral weir Draft tube 110 ft 14 ft 9,500 ft^2 38,010 ft^2 Full radius scum trough
RAS pumps	Number Type Control Capacity, each Motor power, each	3 Centrifugal Variable speed 4,400 gpm 50 hp

Table 1.12 SEWRF Inventory of Liquid Treatment Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
Filters	Number	4
	Type	Automatic backwash, traveling bridge
	Length	90 ft
	Width	16 ft
	Surface area, each	1,440 ft^2
	Surface area, total	5,760 ft^2
	Media type and depth	12-inch sand, 12-inch anthracite
Chlorine contact basins	Number	4
	Type	Sodium hypochlorite
	Length (Nos. 1 & 2)	150 ft
	Width (Nos. 1 & 2)	8 ft
	SWD (Nos. 1 & 2)	9 ft
	Volume, each (No. 1 & 2)	80,780 gal
	Length (Nos. 3 & 4)	180
	Width (Nos. 3 & 4)	8
	SWD (Nos. 3 & 4)	9
	Volume, each (Nos. 3 & 4)	96,940 gal
	Volume, total	355,450 gal
Sodium hypochlorite system	Number tanks	4
	Capacity, each	2-5,400 gal and 2-5,600 gal
	Capacity, total	22,000 gal
	Number pumps	8
	Type	Metering
	Capacity, total	700 gph

Table 1.13 SEWRF Inventory of Effluent and Reuse Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
Reuse pumps	Number Type Control Capacity, each Motor power, each	5 Vertical turbine Variable speed 4,167 gpm 100 hp
Reuse storage	Number Type Area North Pond Capacity North Pond Area East Pond Capacity East Pond Area South Pond Capacity South Pond Number Type Capacity storage tank	3 Pond 16 acres 11.6 MG 63 acres 158.1 MG 86 acres 317.5 MG 1 Ground storage tank 10 MG
Reject storage	Number Type Area Capacity Type Area Capacity	2 Unlined Pond 3.4 acres 6.3 MG Lined Pond 3.2 acres 6.0 MG

Table 1.14 SEWRF Inventory of Solids Handling Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
WAS pumps	Number Type Control Capacity, each Motor power, each	4 Centrifugal Variable speed 250 gpm 2 hp
Thickeners	Number Type Width Feed solids (% TSS) Hydraulic capacity, each	2 Gravity belt 2 m 0.5 – 1.5% 250 gpm/m

Table 1.14 SEWRF Inventory of Solids Handling Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
	Solids loading rate, each Cake solids	1,000 – 3,000 lbs/hr 4 to 5%
Sludge transfer pumps	Number Type Control Capacity, each Motor power, each	2 Progressive cavity Variable speed 125 gpm 10 hp
Aerated sludge holding tanks	Number Type Diameter SWD Volume, each Volume, total SRT Aeration system Number blowers Capacity, each Motor power, each	2 Aerobic 94 ft 19.25 ft 1.0 MG 2.0 MG 26 days Coarse bubble diffusers 3 4,000 scfm 250 hp
Dewatering	Number Type Width Loading rate, each Capture Cake solids	3 Belt filter presses 2 m 1,200 lb/hr 95% 18 to 20%
Dewatering feed pumps	Number Type Control Capacity, each Motor power, each	6 Progressive cavity Variable speed 125 gpm 10 hp

4.2 Influent Flows and Loads

Table 1.15 summaries historical influent flows and peaking factors for SEWRF. Figure 1.10 shows the annual average, monthly average, and 3-month average flows. As shown in the figure, flows to SEWRF have been relatively stable over the past five years.

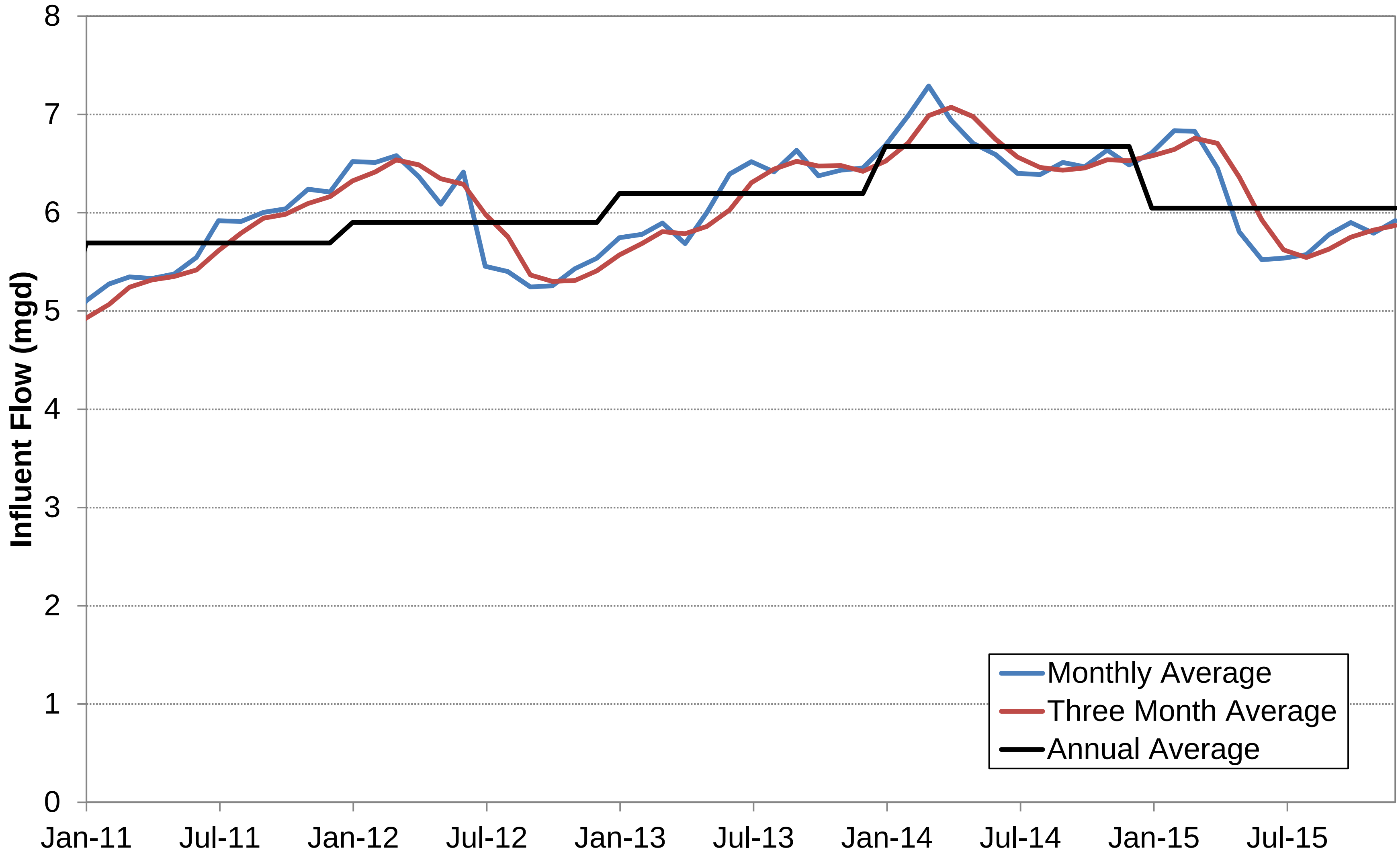
Table 1.15 SEWRF Historical Influent Flows and Peaking Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

Flow Condition (1)	2011	2012	2013	2014	2015	Average
AADF (mgd)	5.7	5.9	6.2	6.7	6.0	**5.8**
M3MADF (mgd)	6.2	6.5	6.5	7.1	6.8	**6.2**
M3MADF: AADF PF	1.08	1.11	1.05	1.06	1.12	**1.07**
MMF (mgd)	6.2	6.6	6.6	7.3	6.8	**6.3**
MMF: AADF PF	1.10	1.12	1.07	1.09	1.13	**1.09**
MDF (mgd)	6.9	9.3	9.3	8.4	7.6	**8.0**
MDF: AADF PF	1.22	1.58	1.51	1.25	1.26	**1.38**

Notes:

(1) AADF = Annual average daily flow
M3MADF = Maximum three month average daily flow
MMF = Maximum monthly flow
MDF = Maximum daily flow
PF = Peaking factor

The average diurnal pattern from 2011 to 2013 was analyzed to determine the hourly variation in influent flow over a day. Figure 1.11 shows the typical diurnal pattern at SEWRF on a weekday compared with the typical diurnal pattern on a weekend. As shown in the figure, the patterns are similar, with the weekend daytime peak occurring about 2 hours later than the weekday peak, which is expected for this type of system.



SEWRF HISTORICAL INFLUENT FLOW

FIGURE 1.10

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

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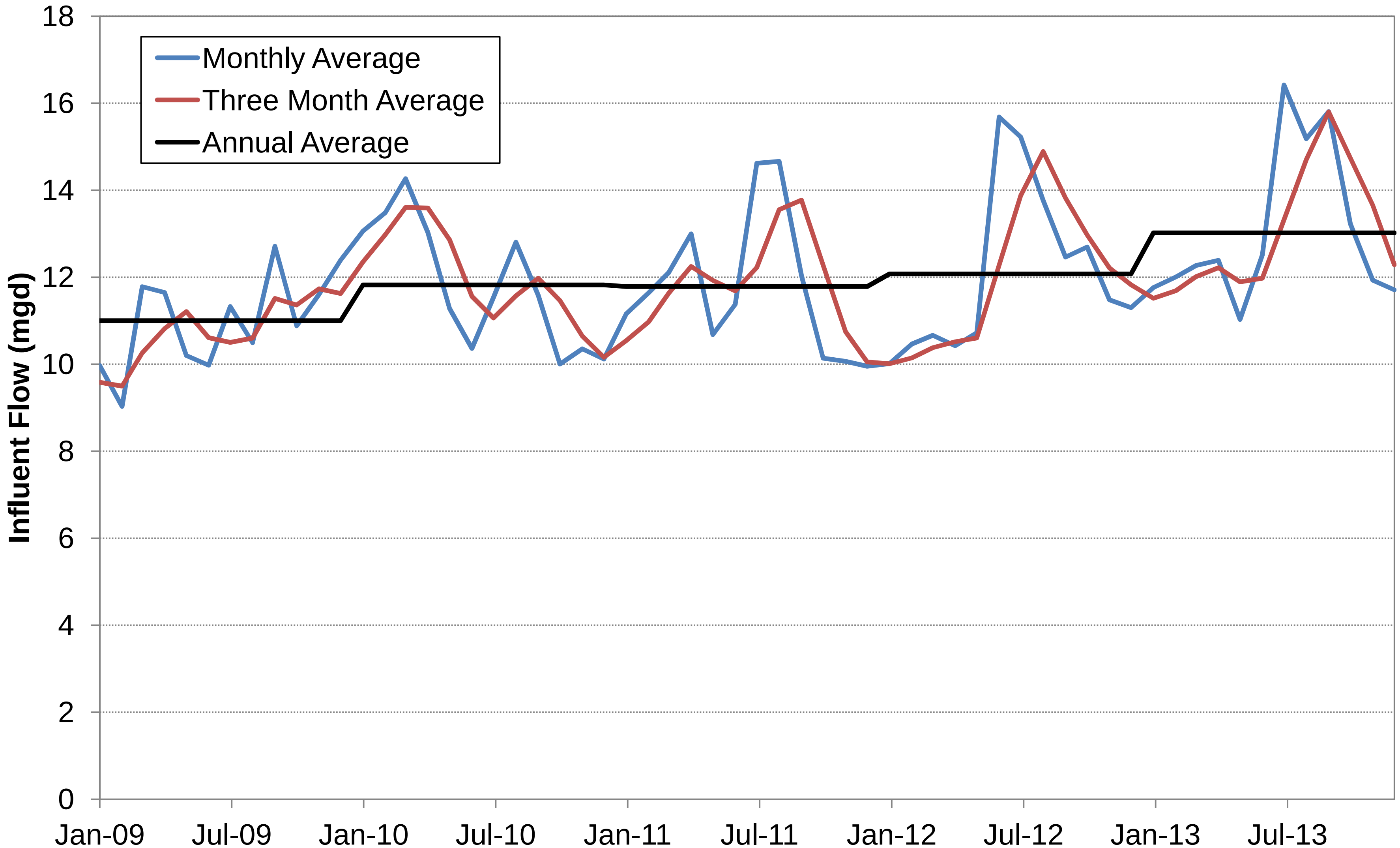

SWWRF HISTORICAL INFLUENT FLOW

FIGURE 1.11

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

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Historical influent loads to SEWRF were also analyzed to develop peaking factors for the constituents shown in Table 1.16. Appendix A provides chronological plots of the historical influent loads and concentrations. As shown in Table 1.16 and Appendix A, influent loads and peak factors to SEWRF have remained relatively steady over the past 5 years.

Table 1.16 SEWRF Historical Influent Loads and Peaking Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

Load Condition	2011	2012	2013	2014	2015	Average
Annual Average $cBOD_5$ (lb/d)	10,490	10,470	9,150	11,690	8,630	**10,080**
Maximum Month $cBOD_5$ (lb/d)	12,590	15,860	11,230	20,930	12,900	**14,700**
Maximum Month $cBOD_5$ PF	1.20	1.51	1.23	1.79	1.50	**1.45**
Annual Average TSS (lb/d)	12,650	14,350	11,220	12,460	8,240	**11,780**
Maximum Month TSS (lb/d)	15,040	27,500	14,620	32,160	11,190	**20,100**
Maximum Month TSS PF	1.19	1.92	1.30	2.58	1.36	**1.67**
Annual Average TKN (lb/d)	2,490	2,660	2,390	2,940	2,480	**2,590**
Maximum Month TKN (lb/d)	2,770	3,500	2,730	5,070	3,040	**3,420**
Maximum Month TKN PF	1.12	1.32	1.14	1.72	1.23	**1.31**
Annual Average TP (lb/d)	290	340	350	400	340	**340**
Maximum Month TP (lb/d)	370	480	580	560	430	**480**
Maximum Month TP PF	1.27	1.42	1.67	1.41	1.25	**1.40**

Notes:

(1) Data summarized in this table represents the influent composite sample collected at the headworks. According to County staff, this data represents the influent from the collection system as well as leachate fed to the collection system from the County landfill. The plant also treats recycle flows from the onsite biosolids dryer and septage, which are discussed and evaluated further in subsequent TMs.

4.3 Effluent Quality

SEWRF's effluent water quality is regulated to meet PAR standards. Although effluent nutrients are not regulated, they are reported. Table 1.17 summarizes the effluent quality over the past 5 years. Appendix B provides chronological plots of the effluent quality. As shown in Table 1.17 and Appendix B, the effluent $cBOD_5$ has remained below the permit requirement of 30 mg/L as a monthly average, and the effluent TSS has remained below the permit requirement of 5 mg/L. Effluent fecal coliform also remained below the requirement of 25 per 100 mL.

Table 1.17	SEWRF Historical Effluent Quality Water Reclamation Facilities – Master Plan Development Manatee County					
Parameter	**2011**	**2012**	**2013**	**2014**	**2015**	**Average**
Average Effluent $cBOD_5$ (mg/L)	2.0	1.4	0.1	0.1	0.2	**0.8**
Average Effluent TSS (mg/L)	1.0	0.8	0.6	0.5	0.5	**0.7**
Average Effluent TN (mg/L)	9.1	9.1	8.4	7.6	7.5	**8.3**
Average Effluent TP (mg/L)	0.9	2.2	2.5	2.1	1.2	**1.8**
Fecal Coliform (#/100 mL)	<1	<1	<1	<1	<1	**<1**

Appendix C shows the annual effluent analysis for primary and secondary drinking water standards over the past 5 years.

4.4 Existing Treatment Plant Performance

Table 1.18 summarizes the performance of SEWRF's treatment facilities in 2013. As shown, all existing equipment had sufficient capacity for the design standards noted. Assuming all three aeration basins were in operation in 2013, the F/M was somewhat low and the SRT was somewhat high for this type of treatment process.

Table 1.18	SEWRF Performance Treatment Facilities Water Reclamation Facilities – Master Plan Development Manatee County	
Unit Process	**2013 Value**	**Design/Standard Value**
Influent Flows	6.2 mgd AADF 9.3 mgd MDF 15.0 mgd PHF	11 mgd AADF 12.65 mgd MDF 27.5 mgd PHF
Influent Loads	9,080 lb/d $cBOD_5$ 11,140 lb/d TSS 2,370 lb/d TKN	22,940 lb/d $cBOD_5$ 22,940 lb/d TSS 3,670 lb/d TKN
Anoxic basins	1.6 hr HRT (3)	1-3 hr HRT (2)
Aeration basins	7.4 lb BOD/d/1,000 cf (4) 8.5 hrs HRT (3)(4) 0.03 lb BOD/d/lb MLVSS (4) 5,100 mg/L MLSS 41 days SRT	5-30 lb BOD/d/1,000 cf (2) 8-36 hr HRT (2) 0.05-0.30 lb BOD/d/lb MLVSS (2) 3,000-6,000 mg/L MLSS (2) 10-30 days SRT (2)
Aerators	17,100 lb/d demand	94,500 lb/d capacity (4)

Table 1.18 SEWRF Performance Treatment Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Unit Process	**2013 Value**	**Design/Standard Value**
Secondary clarifiers	330 gpd/sf peak overflow (4) 23 lb/d/sf peak solids load (4) 9,100 gpd/ft peak weir load (4)	<1,000 gpd/sf (1) <35 lb/d/sf (1) <30,000 gpd/ft (1)
RAS pumps	4.6 to 9.3 mgd (2)(5)	12.7 mgd (6)
Filters	1.5 gpm/sf peak loading rate (4)	<2.0 gpm/sf (7)
Disinfection	41 min at PHF	>15 min at PHF (1)
Chlorination system	1,050 lb/d at PHF	4,000 lb/d capacity
Sludge holding	8,000 scfm air required (1)	8,000 scfm capacity (6)

Notes:
(1) Ten State Standards
(2) WEF MOP No. 8
(3) Assuming 2Q internal recycle
(4) Assuming all units in service
(5) 75 to 150% of influent flow
(6) Capacity with one unit out of service
(7) Loading rate for ABW type filters

5.0 NORTH REGIONAL WATER RECLAMATION FACILITY

The following sections summarize the design criteria, unit sizes, and capacities for NRWRF including plant site layouts and process flow schematics. Also included are the historical influent wastewater flows and loads, the historical effluent quality, and the existing performance of each major unit process at NRWRF.

5.1 Existing Facilities

NRWRF is located in northern Manatee County at 8500 69th Street East in Palmetto, Florida, north of the Manatee River. The facility has a permitted capacity of 7.5 mgd TMRADF and a treatment process consisting of preliminary screening and grit removal, secondary BNR activated sludge, and tertiary filtration and high-level disinfection.

Similar to the other facilities, preliminary treatment begins with pumping raw wastewater to the headworks facility, which consists of an influent magnetic flow meter, two mechanically cleaned bar screens, one manually cleaned bar screen, and two forced flow vortex de-gritting units.

Secondary treatment is achieved with a BNR activated sludge process in an MLE configuration. Influent wastewater from the headworks combines with RAS and MLR flow from the aeration basins before discharging into the anoxic basins. From the anoxic basins, flow enters the oxidation ditch aeration basins. Secondary treatment finishes in three circular secondary clarifier that collect the RAS through draft tubes and return it to the influent of the anoxic basins.

From the secondary clarifiers, effluent flows to two granular media traveling bridge automatic backwash filters and two cloth media disk filters for tertiary treatment. Filtered effluent is then disinfected with sodium hypochlorite in four chlorine contact chambers before entering the effluent reuse system (MCMRS) or onsite lake storage. If reuse demand exceeds the NRWRF effluent flow, previously treated effluent from lake storage is pumped back to the plant to be retreated with lake filters to meet the demand.

To begin solids processing, WAS pumps remove WAS from the final clarifiers. WAS is then transferred to aerobic sludge holding tanks. Using three belt filter presses, the sludge is dewatered and transferred to a County-owned biosolids treatment facility at SEWRF. There, the biosolids are either dried with an indirect dryer to produce a Class AA product or disposed of in a Class I solid waste landfill.

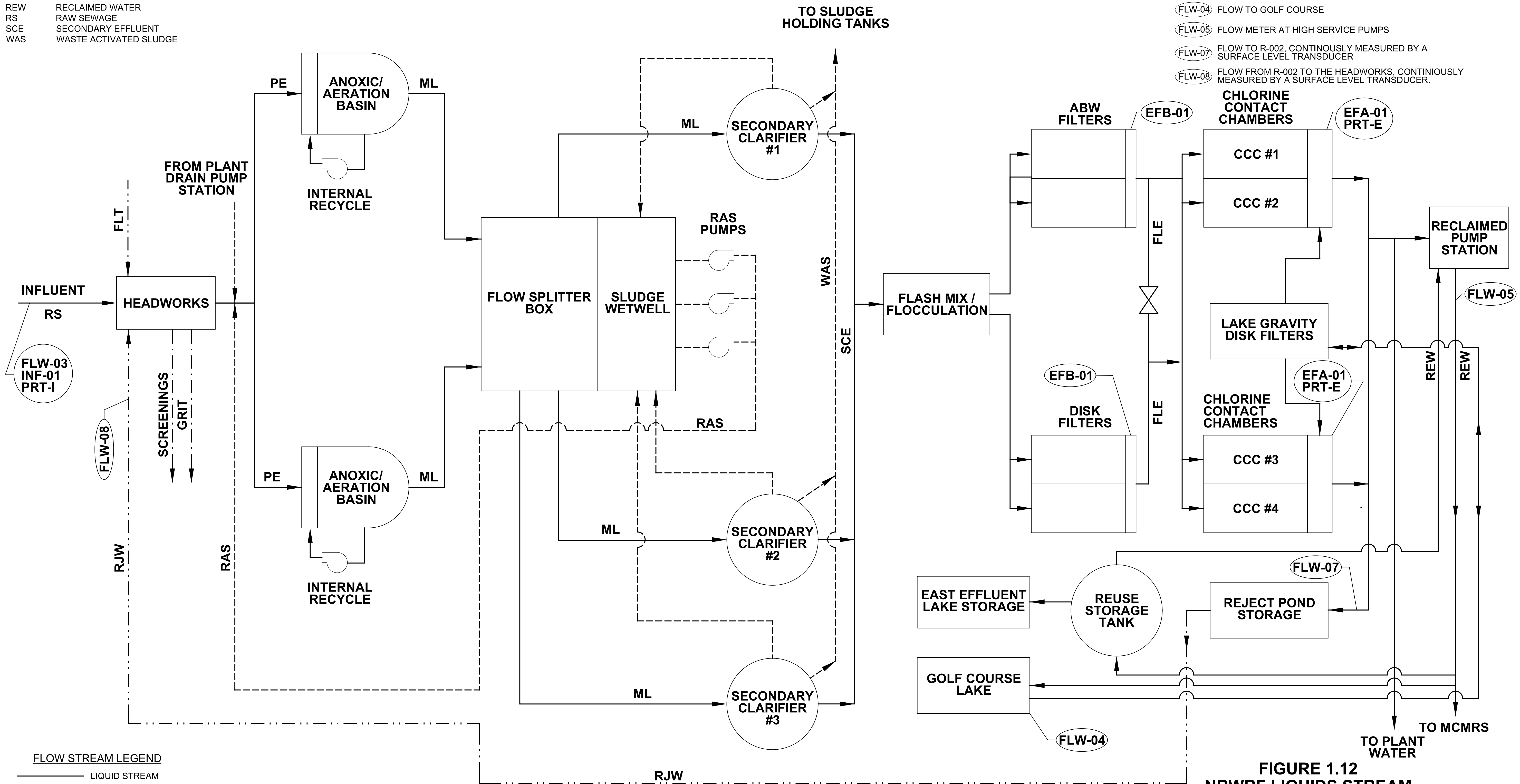
Figure 1.12 shows a process flow diagram of the existing NRWRF liquid treatment stream, and Figure 1.13 shows a process flow diagram of the existing NRWRF solids handling stream. Figure 1.14 shows NRWRF's site plan.

PROCESS STREAM ABBREVIATIONS

CCC	CHLORINE CONTACT CHAMBER
FLE	FILTER EFFLUENT
MCMRS	MANATEE COUNTY MASTER REUSE SYSTEM
ML	MIXED LIQUOR
PE	PRELIMINARY EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
REW	RECLAIMED WATER
RS	RAW SEWAGE
SCE	SECONDARY EFFLUENT
WAS	WASTE ACTIVATED SLUDGE

LEGEND FOR MONITORING LOCATIONS

EFA-01	EFFLUENT SAMPLING POINT AFTER DISINFECTION AND PRIOR TO DISCHARGE TO R-001/R-002
EFB-01	TURBIDITY AND TSS MONITORING LOCATION AFTER FILTRATION AND PRIOR TO DISINFECTION
FLW-03	TOTAL PLANT FLOW MEASURED AT HEADWORKS
FLW-04	FLOW TO GOLF COURSE
FLW-05	FLOW METER AT HIGH SERVICE PUMPS
FLW-07	FLOW TO R-002, CONTINOUSLY MEASURED BY A SURFACE LEVEL TRANSDUCER
FLW-08	FLOW FROM R-002 TO THE HEADWORKS, CONTINIOUSLY MEASURED BY A SURFACE LEVEL TRANSDUCER.



FLOW STREAM LEGEND

- LIQUID STREAM
- RECYCLE STREAM
- SLUDGE STREAM
- SCREENINGS/GRIT

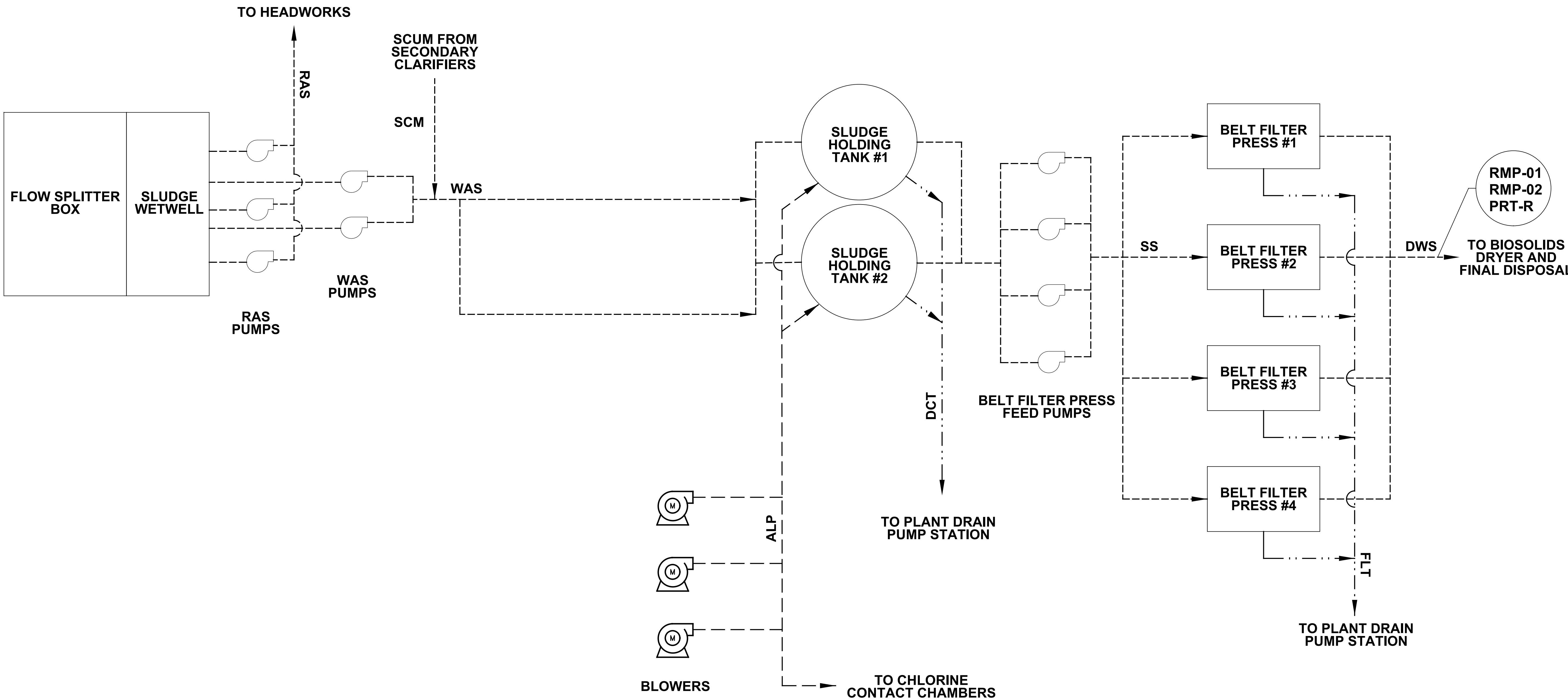
FIGURE 1.12
NRWRF LIQUIDS STREAM PROCESS SCHEMATIC

WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT

User: svcPW

PROCESS STREAM ABBREVIATIONS

ALP	AIR LOW PRESSURE
DCT	DECANT
DWS	DEWATERED SLUDGE
FLT	FILTRATE
RAS	RETURN ACTIVATED SLUDGE
SCM	SCUM
SS	STABILIZED SLUDGE
WAS	WASTE ACTIVATED SLUDGE

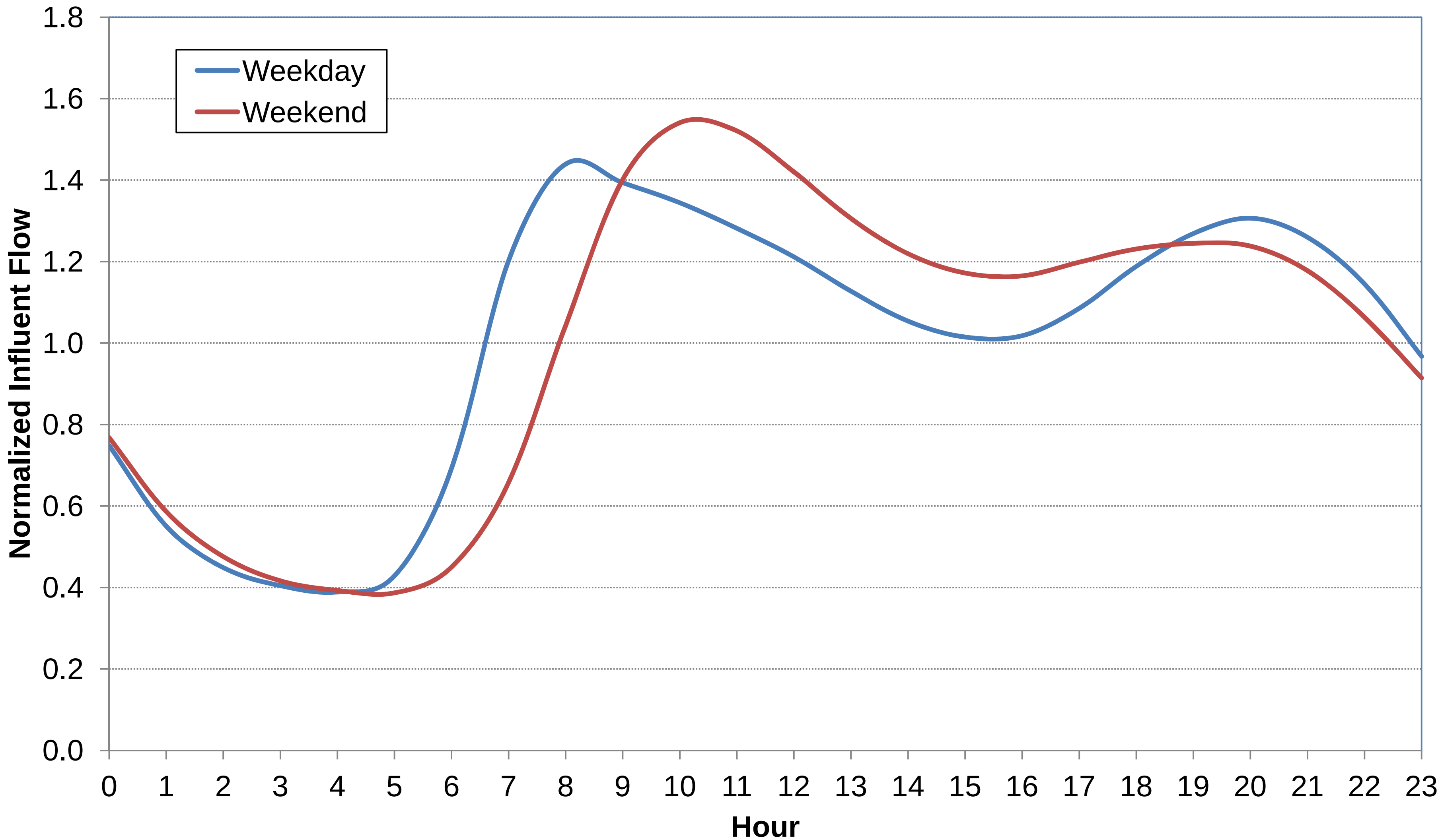


FLOW STREAM LEGEND

- RECYCLE STREAM
- SLUDGE STREAM
- AIR

FIGURE 1.13
NRWRF SOLIDS HANDLING PROCESS SCHEMATIC

WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT



SEWRF DIURNAL FLOW PATTERN

FIGURE 1.14

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

5.1.1 Design Criteria

NRWRF is designed for 7.5 mgd TMRADF to meet PAR water quality requirements per Ch. 62-610, FAC. Table 1.19 summarizes the influent flows and loads established for the design for NRWRF's design, and Table 1.20 summarizes the effluent permit requirements.

Table 1.19 NRWRF Influent Design Criteria
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	Units	Value
Flow, TMRADF	mgd	7.5
Flow, MDF	mgd	10.1
Flow, PHF	mgd	18.75
$cBOD_5$	mg/L	250
$cBOD_5$ (at TMRADF)	lb/d	15,640
TSS	mg/L	250
TSS (at TMRADF)	lb/d	15,640
TKN	mg/L	40
TKN (at TMRADF)	lb/d	2,500

Table 1.20 NRWRF Effluent Permit Requirements
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	Units	Max/Min	Annual Average	Monthly Average	Weekly Average	Single Sample
Flow	mgd	Maximum	7.5	-	-	-
$cBOD_5$	mg/L	Maximum	20.0	30.0	45.0	60.0
TSS	mg/L	Maximum	-	-	-	5.0
pH	std. units	Range	-	-	-	6.0 – 8.5
Fecal coliform	% < detection	Minimum	-	75	-	-
Fecal coliform	#/ 100 mL	Maximum	-	-	-	25
TRC	mg/L	Minimum	-	-	-	1.0
Nitrate-N	mg/L	Maximum				12.0

5.1.2 Inventory of Processes, Equipment, and Capacities

The following tables summarize NRWRF's inventory of processes and equipment. Table 1.21 shows the inventory of the liquid treatment facilities, Table 1.22 shows the inventory of the effluent and reuse facilities, and Table 1.23 shows the inventory of the solids handling facilities.

Table 1.21 NRWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Headworks flow measurement	Number Type Size Capacity	1 Magnetic flow meter 30 in 0 to 22 mgd
Bar screens	Number Type Screen opening Number Type Screen opening Channel width Channel depth	2 Mechanically cleaned 6 mm 1 Manually cleaned 6 mm 4 ft 5 ft
Grit removal	Number Type Diameter	1 Forced vortex 16 ft
Anoxic basins	Number Length Width SWD Volume, each Volume, total Number of mixers, each Mixer type Motor power, each	2 48 ft 107 ft 15 ft 0.58 MG 1.15 MG 2 Mechanical 15 hp
Aeration basins	Number Length Width SWD Volume, each Volume, total	2 287 ft 107 ft 13.5 ft 3.10 MG 6.20 MG

Table 1.21 NRWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Aeration system	Number	6
	Type	Mechanical surface aerators
	Motor power, each	125 hp
Secondary clarifiers	Number	3
	Type	Center feed, peripheral weir
	Sludge withdrawal	Draft tube
	Diameter	110 ft
	SWD	14 ft
	Surface area, each	9,500 ft^2
	Surface area, total	28,510 ft^2
	Scum handling	Ducking skimmers
RAS pumps	Number	3
	Type	Centrifugal
	Control	VFD
	Capacity, each	2,400 gpm
	Motor power, each	25 hp
Filters	Number	4
	Type	2 – Automatic backwash, traveling bridge
	Length	90 ft
	Width	16 ft
	Surface area, each	1,440 ft^2
	Surface area, total	2,880 ft^2
	Media type and depth	12-inch sand, 12-inch anthracite
	Type	2 – Cloth disk
	Surface area, each	1,291 ft^2
	Surface area, total	2,582 ft^2
	Media type	Pile cloth

Table 1.21 NRWRF Inventory of Liquid Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Chlorine contact	Number	4
	Type	Sodium hypochlorite
	Length (Nos. 1 & 2)	50 ft
	Width (Nos. 1 & 2)	24 ft
	SWD (Nos. 1 & 2)	8 ft
	Volume, each (Nos. 1 & 2)	71,810 gal
	Length (Nos. 3 & 4)	48 ft
	Width (Nos. 3 & 4)	27 ft
	SWD (Nos. 3 & 4)	9.3 ft
	Volume, each (Nos. 3 & 4)	89,180 gal
	Volume, total	321,980 gal
Sodium hypochlorite system	Number tanks	2
	Capacity, each	6,000 gal
	Number pumps	4
	Type	Metering
	Capacity, each	70 gph

Table 1.22 NRWRF Inventory of Effluent and Reuse Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Reuse pumps	Number	5
	Type	Vertical turbine
	Control	VFD
	Capacity, each	2,600 gpm
	Motor power, each	150
Reuse storage	Number	2
	Type	Ponds
	Area	127 acres
	Capacity	466 MG
	Number	1
	Type	Storage tank
	Capacity	0.75 MG
Reject storage	Number	1
	Type	Pond
	Area	8 acres
	Capacity	8 MG

Table 1.23 NRWRF Inventory of Solids Handling Facilities Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
WAS pumps	Number Type Control Capacity, each Motor power, each	4 Centrifugal Constant speed 250 gpm 10 hp
Sludge storage	Number Type Diameter SWD Volume, each Volume, total Aeration system Number blowers Capacity, each Motor power, each	2 Aerobic 100 ft 16 ft 0.94 MG 1.88 MG Coarse bubble diffusers (2) Fine bubble diffusers (1) 3 1,100 - 4,045 scfm 250 hp
Dewatering	Number Type Width Loading rate, each Capture Cake solids	3 Belt filter presses 2 m 1,200 lb/hr 95% 18 to 20%
Dewatering feed pumps	Number Type Control Capacity, each Motor power, each	4 Positive displacement VFD 125 gpm 10 hp

5.2 Influent Flows and Loads

Table 1.24 summarizes NRWRF's historical influent flows and peaking factors, and Figure 1.15 shows the annual average, monthly average, and 3-month average flows. As shown in the figure, flows to NRWRF have been stable over the past 5 years.

Table 1.24 NRWRF Historical Influent Flows and Peaking Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

Flow Condition (1)	2011	2012	2013	2014	2015	Average
AADF (mgd)	3.5	3.4	3.5	3.6	3.7	**3.6**
M3MADF (mgd)	4.1	3.7	4.0	3.8	3.9	**3.9**
M3MADF: AADF PF	1.16	1.06	1.15	1.05	1.04	**1.09**
MMF (mgd)	4.2	3.7	4.2	3.9	4.2	**4.0**
MMF: AADF PF	1.18	1.07	1.20	1.08	1.14	**1.13**
MDF (mgd)	6.8	6.8	8.3	7.5	6.9	**7.2**
MDF: AADF PF	1.91	1.98	2.37	2.06	1.85	**2.03**

Notes:

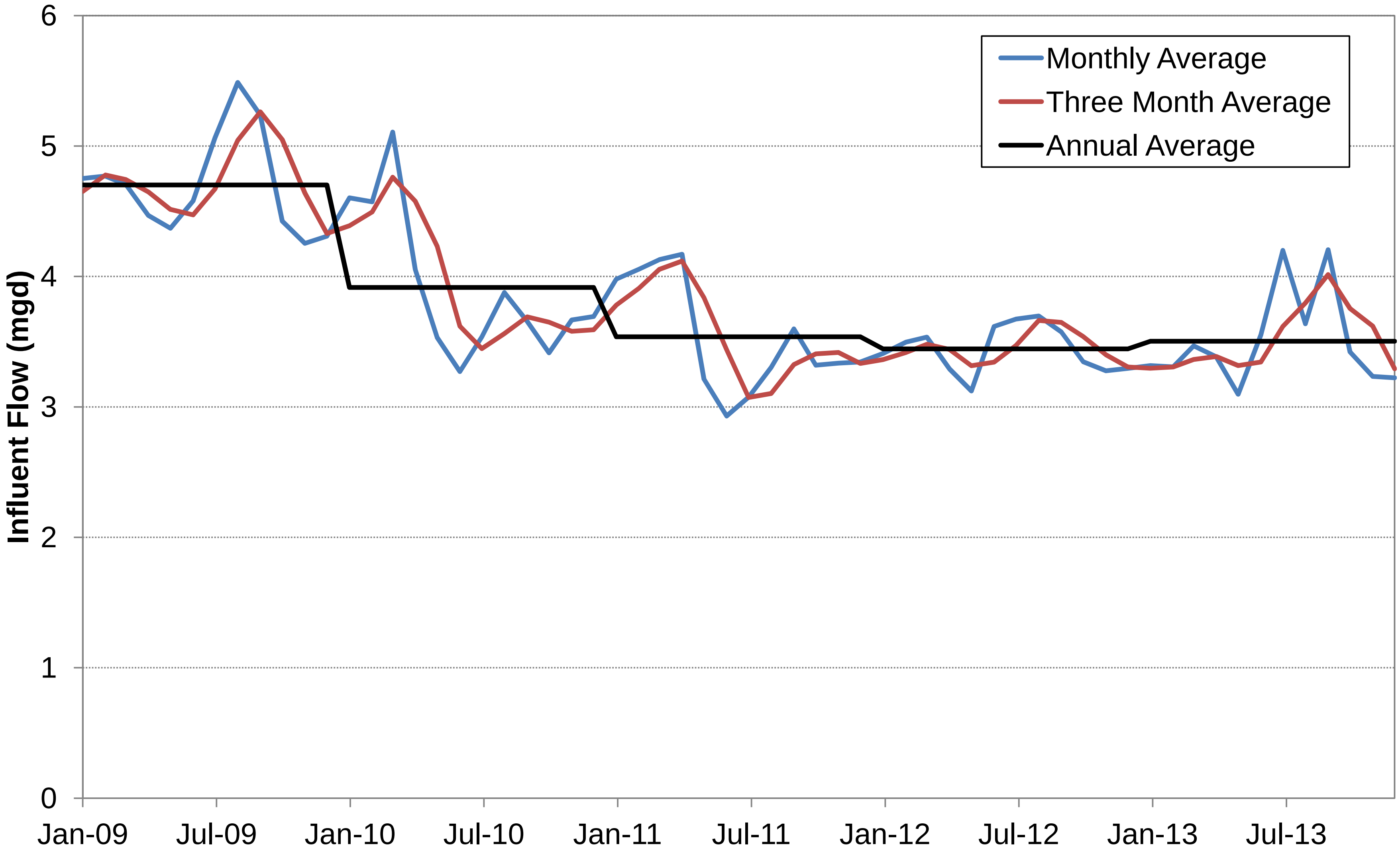
(1) AADF = Annual average daily flow
M3MADF = Maximum three month average daily flow
MMF = Maximum monthly flow
MDF = Maximum daily flow
PF = Peaking factor

The average diurnal pattern from 2011 to 2015 was analyzed to determine the hourly variation in influent flow over a day. Figure 1.16 compares NRWRF's typical diurnal pattern on a weekday with the typical diurnal pattern on a weekend. As shown in the figure, the patterns are similar with the weekend daytime peak occurring about 2 hours later than the weekday peak, which is expected for this type of system.

To develop peaking factors for various constituents, historical influent loads to NRWRF were analyzed. Table 1.25 shows these loads, and Appendix A provides chronological plots of the historical influent loads and concentrations.

Table 1.25 NRWRF Historical Influent Loads and Peaking Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

Load Condition	2011	2012	2013	2014	2015	Average
Annual Average $cBOD_5$ (lb/d)	5,170	4,820	5,010	5,320	5,480	**5,160**
Maximum Month $cBOD_5$ (lb/d)	7,130	6,310	6,320	6,750	8,030	**6,910**
Maximum Month $cBOD_5$ PF	1.38	1.31	1.26	1.27	1.46	**1.34**
Annual Average TSS (lb/d)	5,570	5,010	5,100	5,240	5,910	**5,370**
Maximum Month TSS (lb/d)	8,200	6,010	6,130	6,430	7,310	**6,820**
Maximum Month TSS PF	1.47	1.20	1.20	1.23	1.24	**1.27**



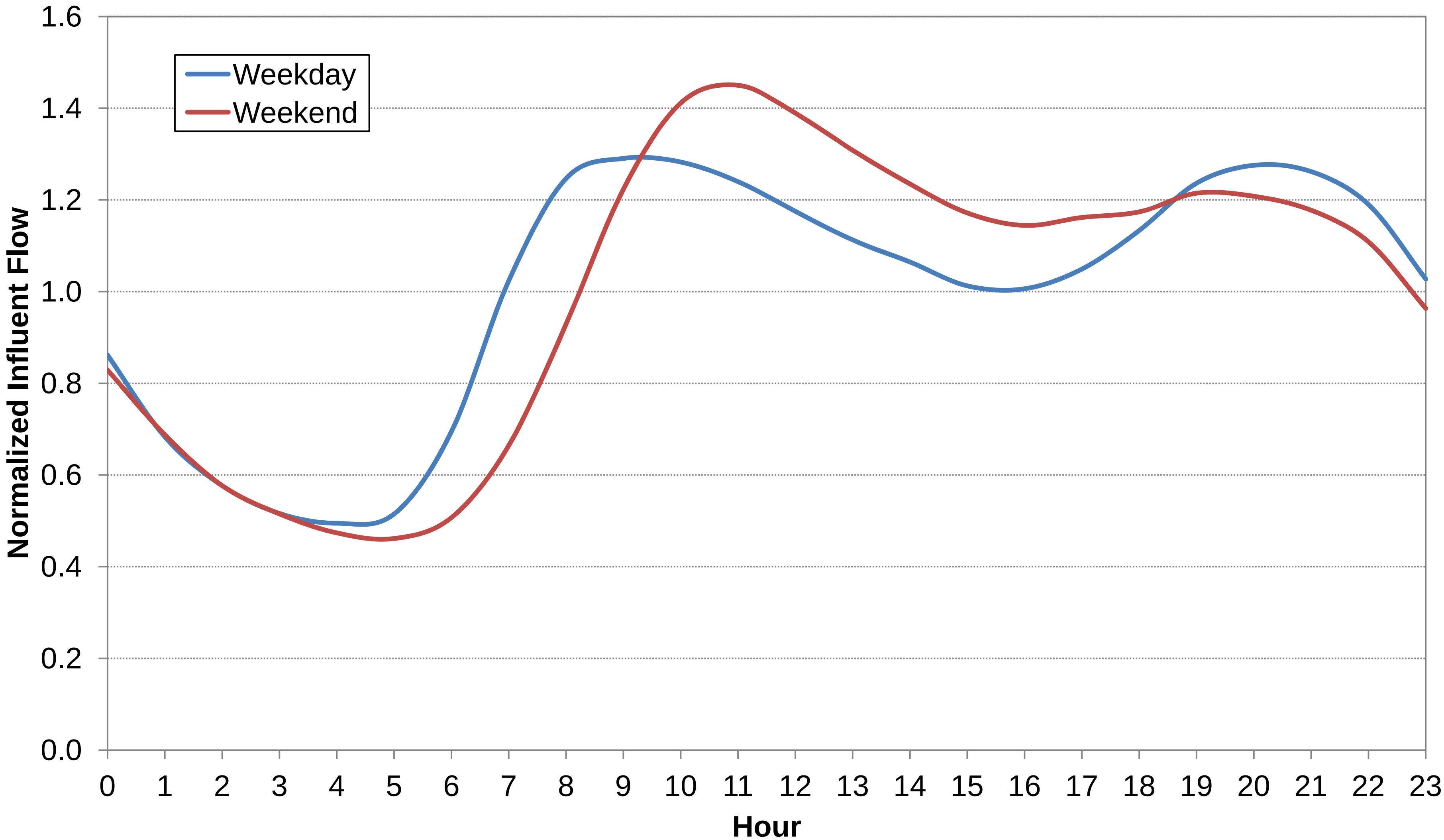
NWRF HISTORICAL INFLUENT FLOW

FIGURE 1.15

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo



NWRF DIURNAL FLOW PATTERN

FIGURE 1.16

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

5.3 Effluent Quality

NRWRF's effluent water quality is regulated to meet PAR standards. Although effluent nutrients are not regulated, they are reported. Table 1.26 summarizes the effluent quality over the past 5 years, and Appendix B provides chronological plots of the effluent quality. As shown in Table 1.26 and Appendix B, the effluent $cBOD_5$ has remained below the permit requirement of 30 mg/L as a monthly average, and the effluent TSS has remained below the permit requirement of 5 mg/L. Effluent fecal coliform also remained below the requirement of 25 per 100 mL.

Table 1.26 NRWRF Historical Effluent Quality
Water Reclamation Facilities – Master Plan Development
Manatee County

Parameter	2011	2012	2013	2014	2015	Average
Average Effluent $cBOD_5$ (mg/L)	2.0	0.6	0.2	0.2	0.3	**0.7**
Average Effluent TSS (mg/L)	1.0	1.0	1.0	1.0	1.0	**1.0**
Average Effluent NO_3-N (mg/L)	9.1	6.5	8.0	6.0	3.4	**6.6**
Average Effluent TP (mg/L)	9.6	2.3	2.3	2.5	2.5	**3.9**
Fecal Coliform (#/100 mL)	<1	<1	<1	<1	<1	**<1**

Appendix C shows the annual analysis of the effluent for primary and secondary drinking water standards over the past 5 years.

5.4 Existing Treatment Plant Performance

Table 1.27 summarizes the performance of NRWRF's treatment facilities in 2013. As shown, all existing equipment had sufficient capacity based on the design standards. Assuming two aeration basins were in operation in 2013, the F/M was somewhat low and the SRT was somewhat high for this type of treatment process.

Table 1.27 NRWRF Performance Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Unit Process	2013 Value	Design/Standard Value
Influent Flows	3.5 mgd AADF 8.3 mgd MDF 10.9 mgd PHF	7.5 mgd AADF 10.1 mgd MDF 18.75 mgd PHF
Influent Loads	5,010 lb/d $cBOD_5$ 5,100 lb/d TSS	15,640 lb/d $cBOD_5$ 15,640 lb/d TSS

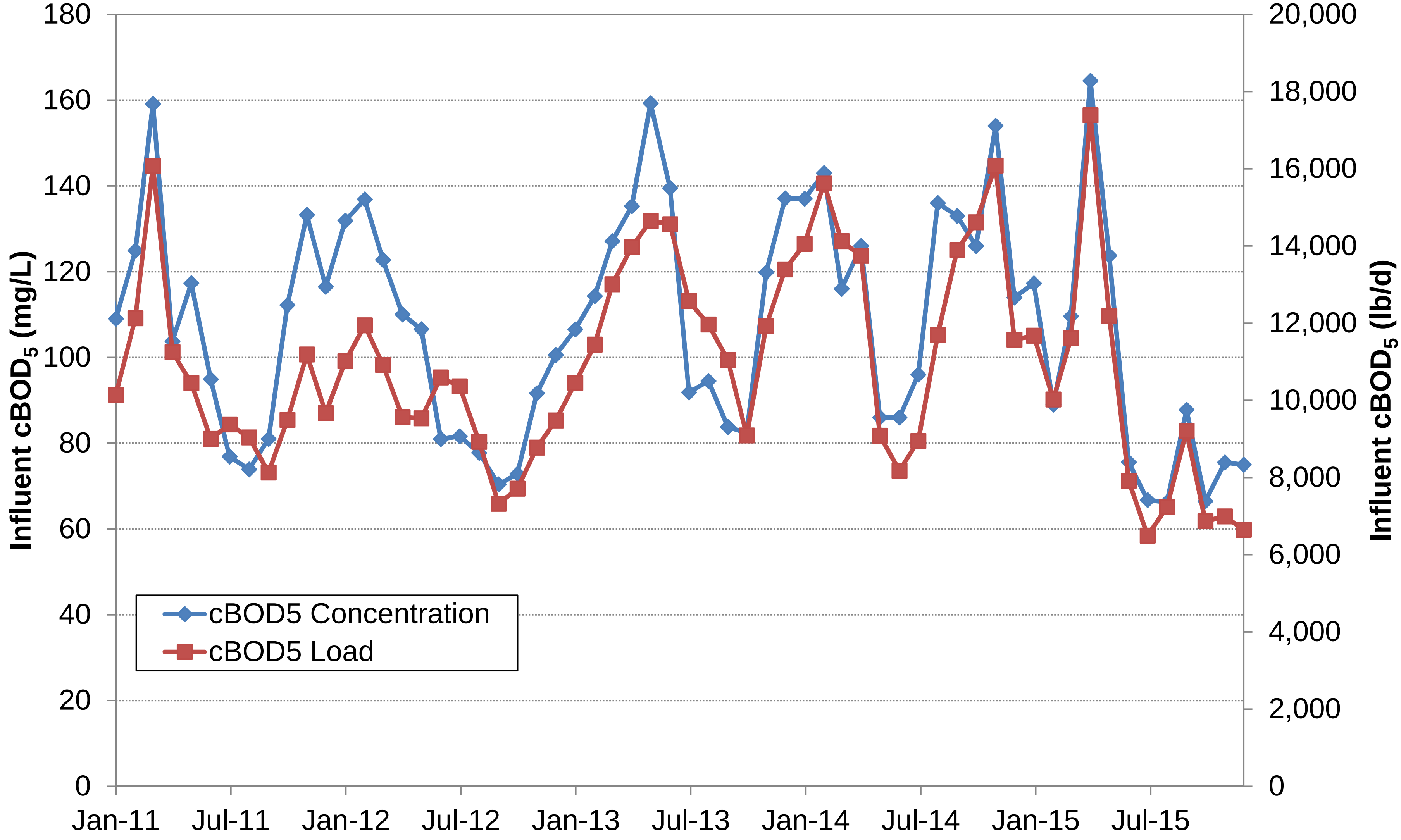
Table 1.27 NRWRF Performance Treatment Facilities
Water Reclamation Facilities – Master Plan Development
Manatee County

Unit Process	2013 Value	Design/Standard Value
Anoxic basins	1.9 hr HRT (3)	1-3 hr HRT (2)
Aeration basins	6.1 lb BOD/d/1,000 cf (4) 10.4 hrs HRT (3)(4) 0.03 lb BOD/d/lb MLVSS (4) 4,400 mg/L MLSS 49 days SRT	5-30 lb BOD/d/1,000 cf (2) 8-36 hr HRT (2) 0.05-0.30 lb BOD/d/lb MLVSS (2) 3,000-6,000 mg/L MLSS (2) 10-30 days SRT (2)
Aerators	9,100 lb/d demand	63,000 lb/d capacity (4)
Secondary clarifiers	380 gpd/sf peak overflow (4) 19 lb/d/sf peak solids load (4) 10,500 gpd/ft peak weir load (4)	<1,000 gpd/sf (1) <35 lb/d/sf (1) <30,000 gpd/ft (1)
RAS pumps	2.9 to 5.8 mgd (2)(5)	6.9 mgd (6)
Filters	2.6 gpm/sf peak loading rate	<6.5 gpm/sf (7), <2.0 gpm/sf (8)
Disinfection	43 min at PHF	>15 min at PHF (1)
Chlorination system	910 lb/d at PHF	3,000 lb/d capacity
Sludge holding	9,000 scfm air required (1)	9,200 scfm capacity (4)

Notes:

(1) Ten State Standards.
(2) WEF MOP No. 8.
(3) Assuming 2Q internal recycle.
(4) Assuming all units in service.
(5) 75 to 150% of influent flow.
(6) Capacity with one unit out of service.
(7) Loading rate for cloth disk filters.
(8) Loading rate for ABW type filters.

APPENDIX A – HISTORICAL INFLUENT LOAD PLOTS

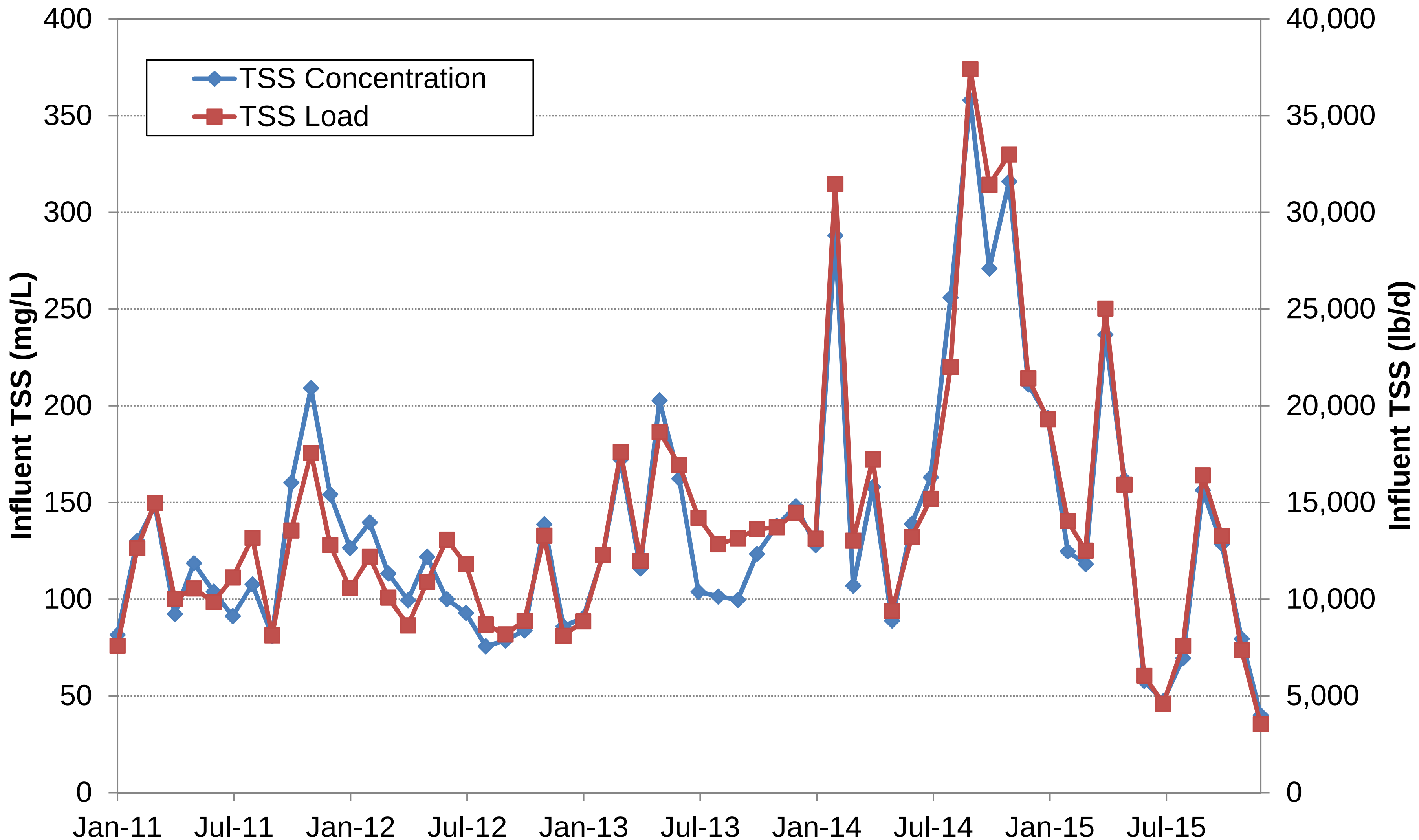


SWWRF INFLUENT CBOD5

FIGURE A.1

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

carollo

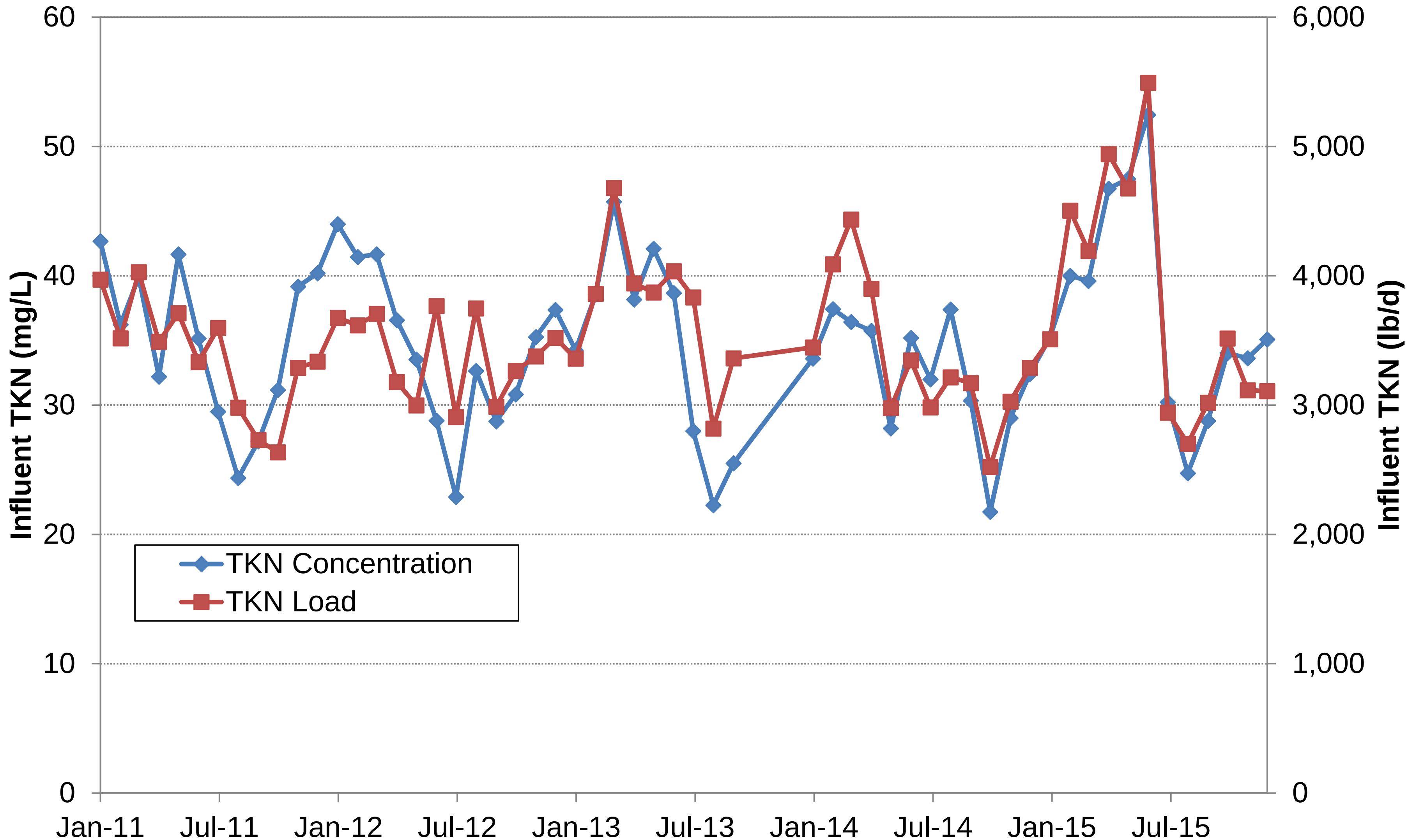


SWWRF INFLUENT TSS

FIGURE A.2

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

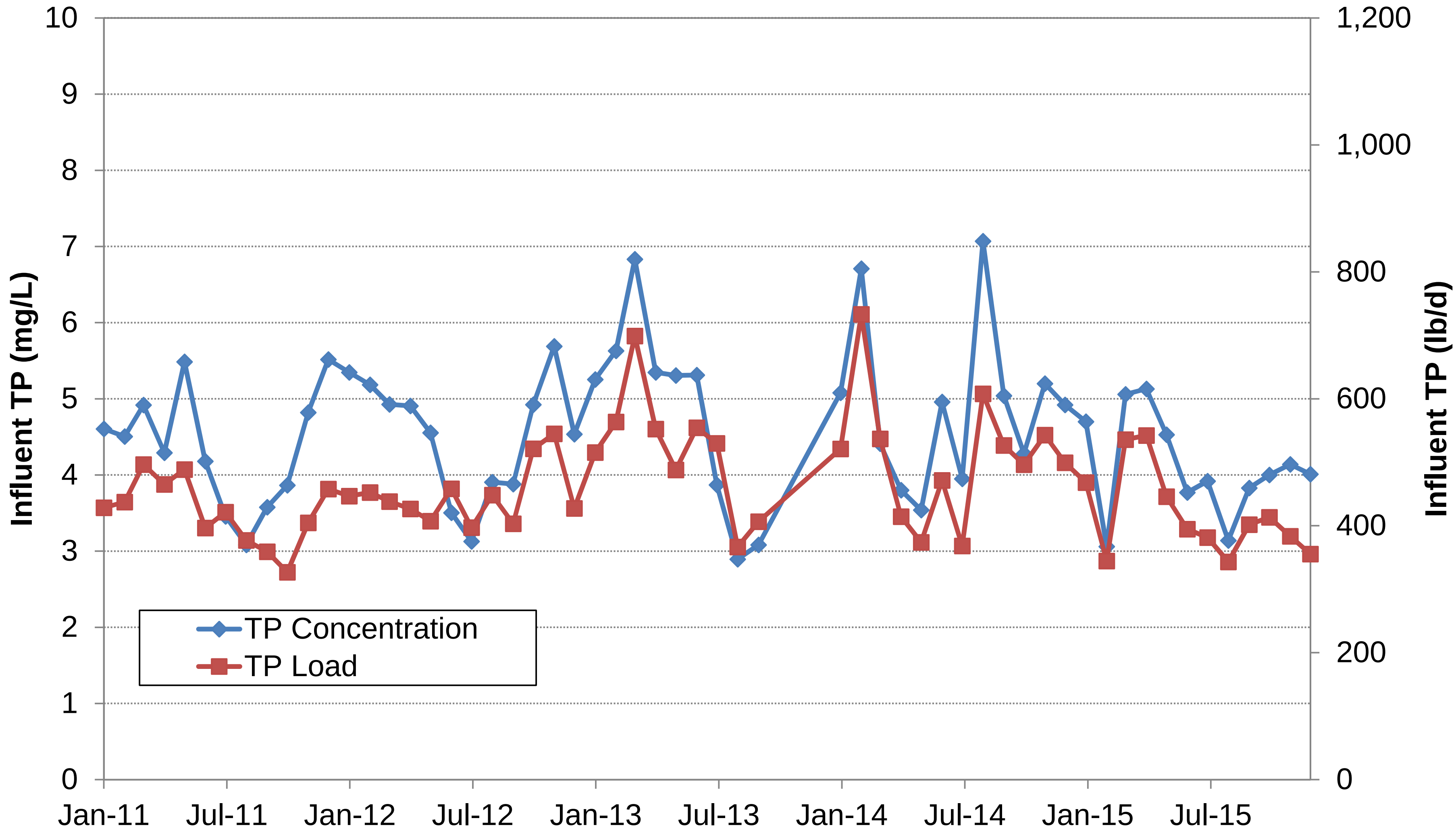
carollo



SWWRF INFLUENT TKN

FIGURE A.3

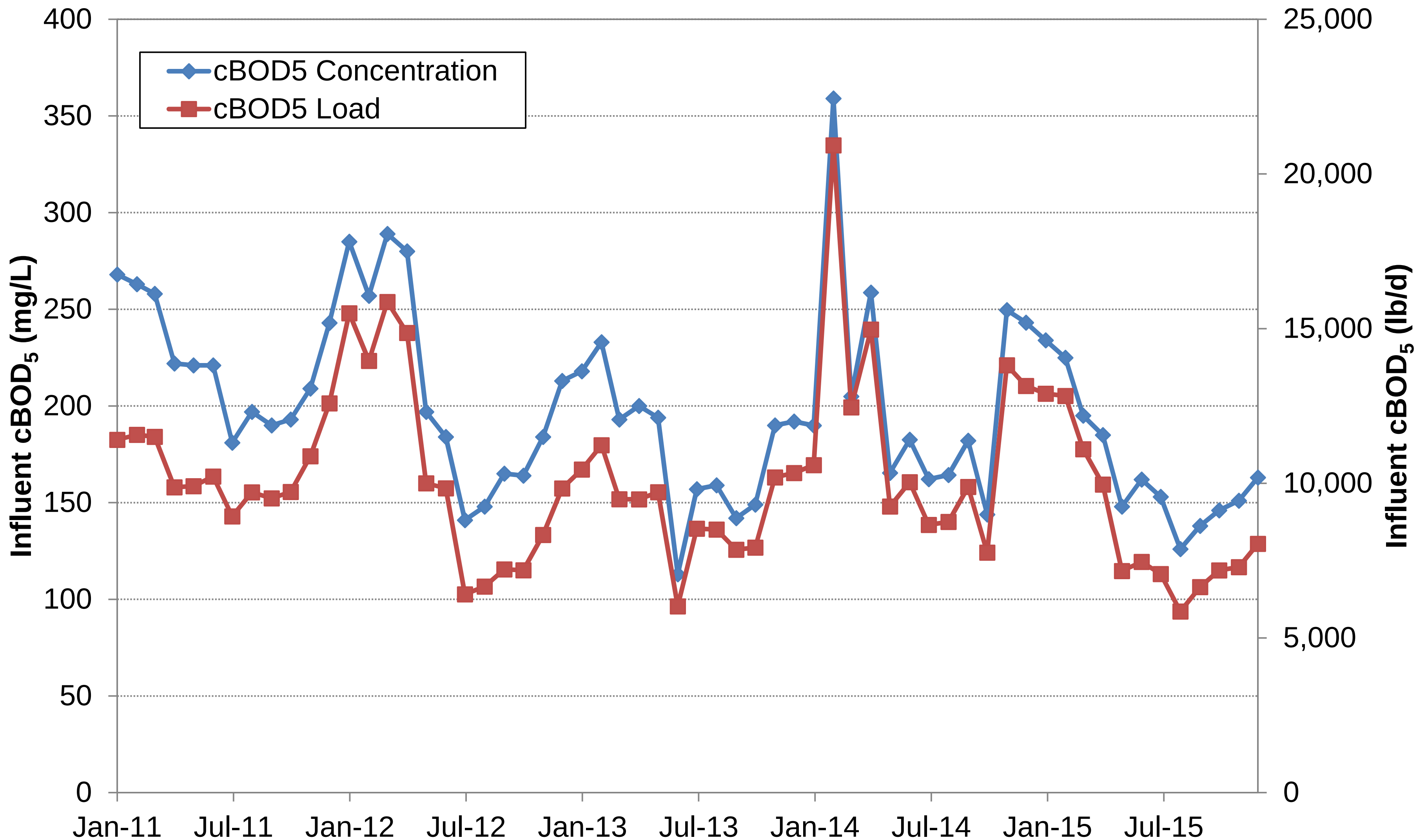
MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT



SWWRF INFLUENT TP

FIGURE A.4

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

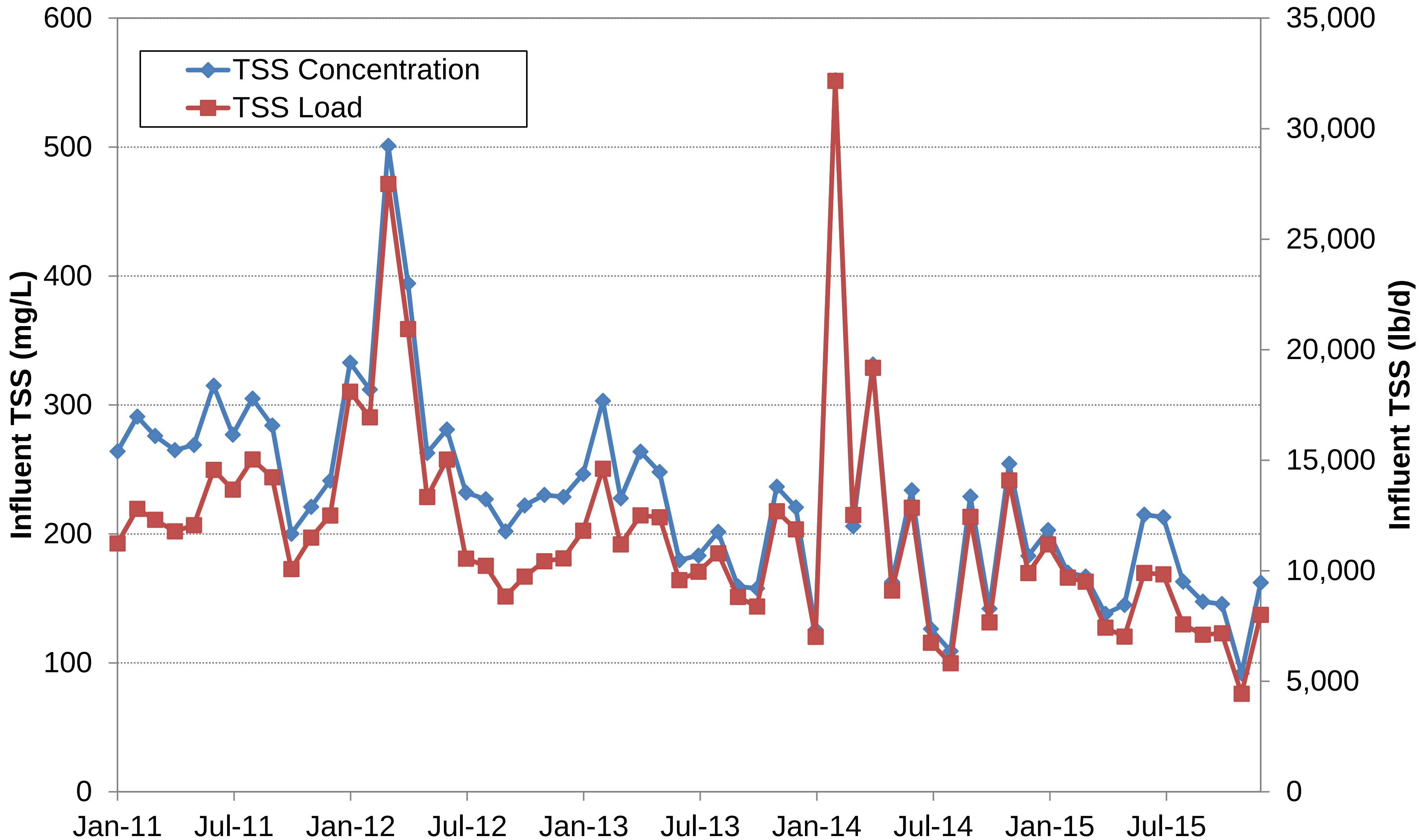


SEWRF INFLUENT CBOD5

FIGURE A.5

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

carollo

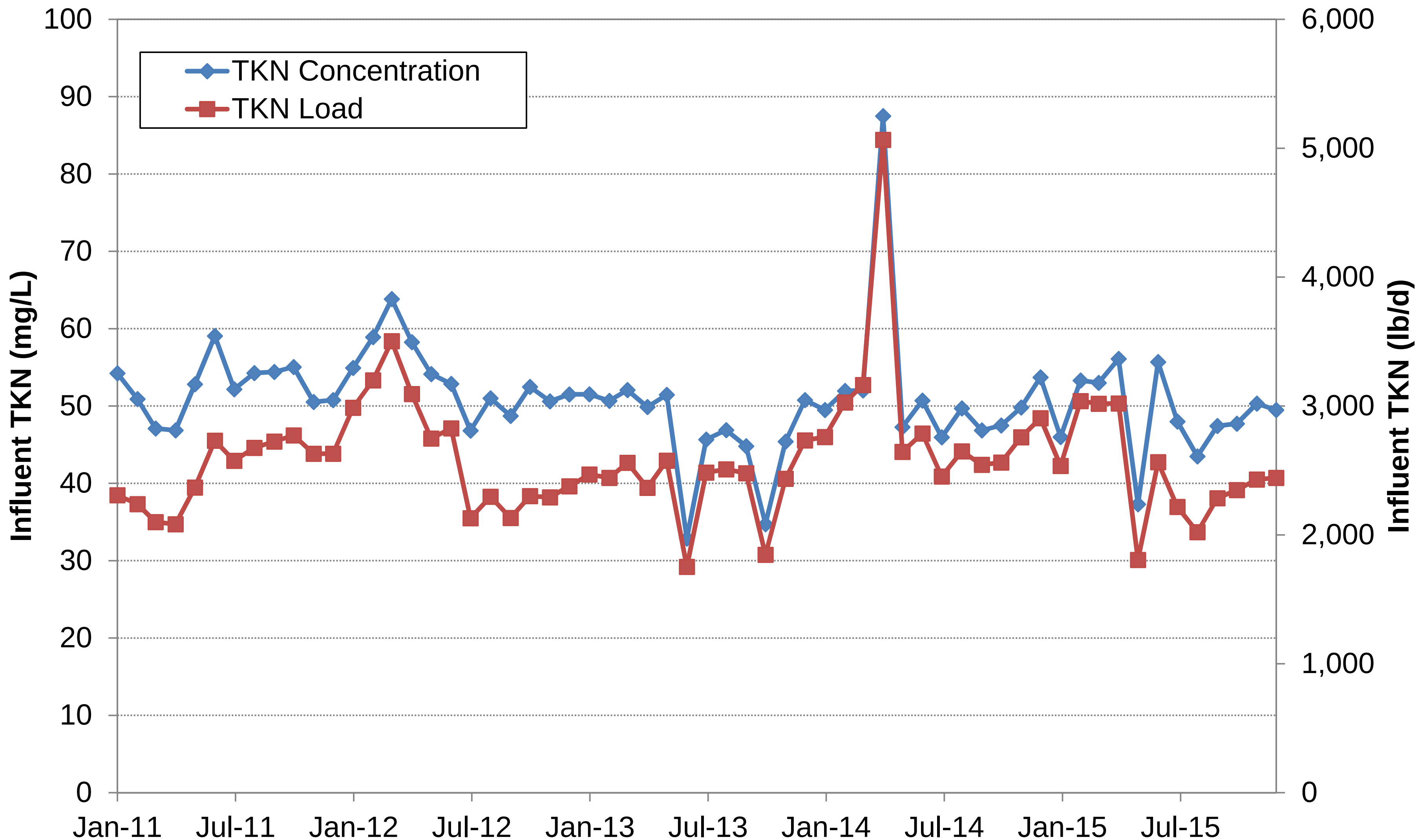


SEWRF INFLUENT TSS

FIGURE A.6

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

carollo



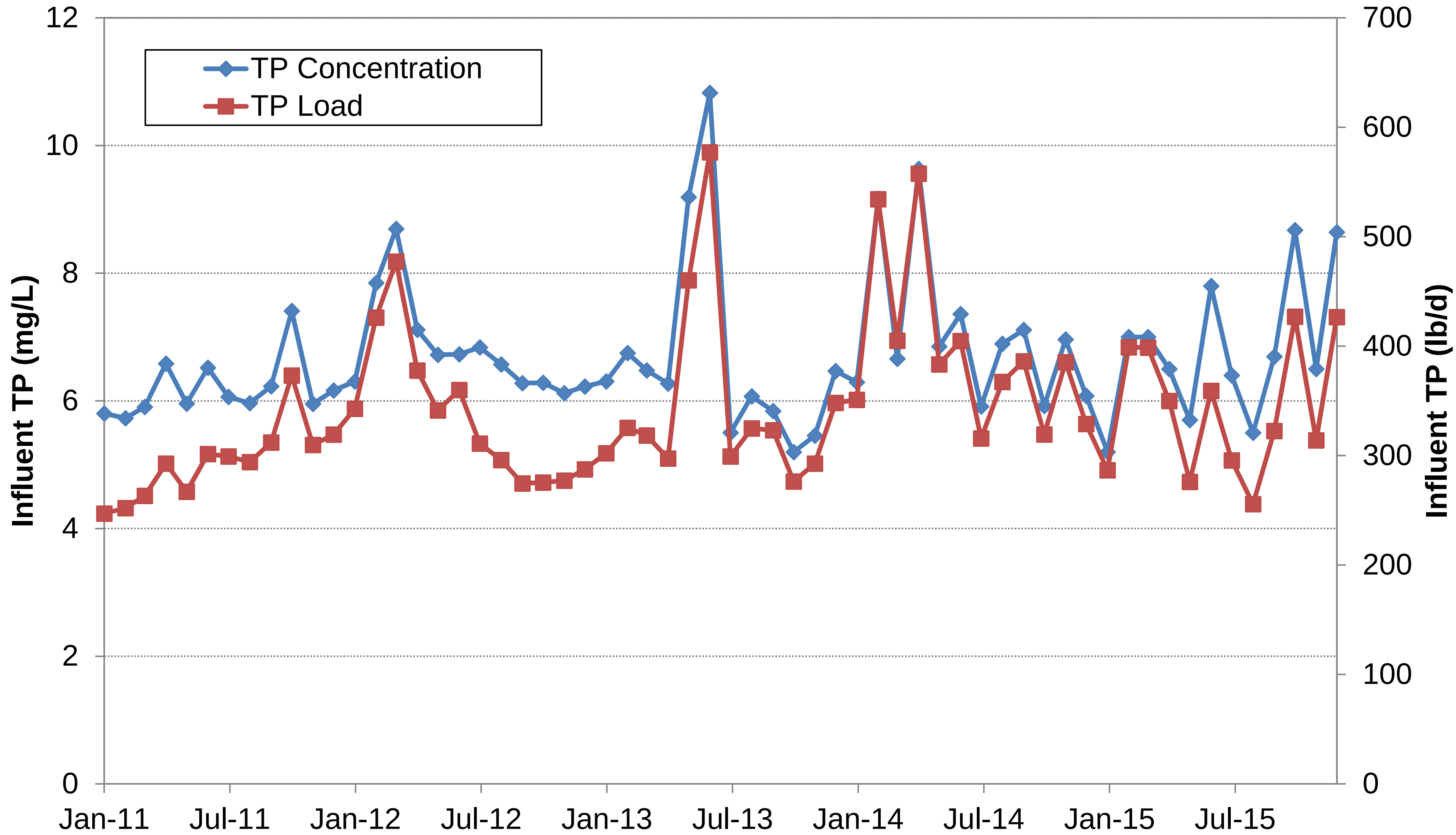
SEWRF INFLUENT TKN

FIGURE A.7

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

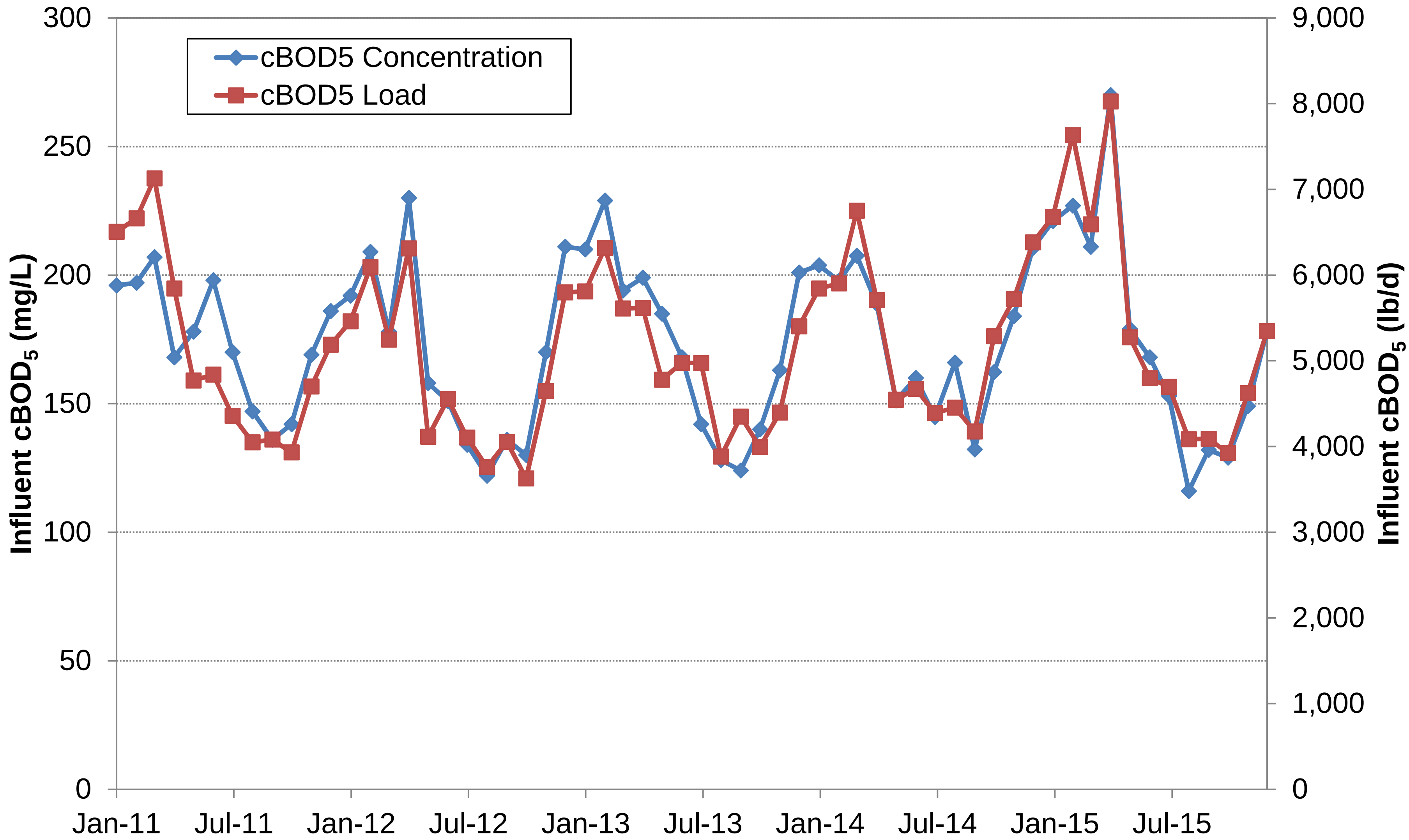
carollo



SEWRF INFLUENT TP

FIGURE A.8

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

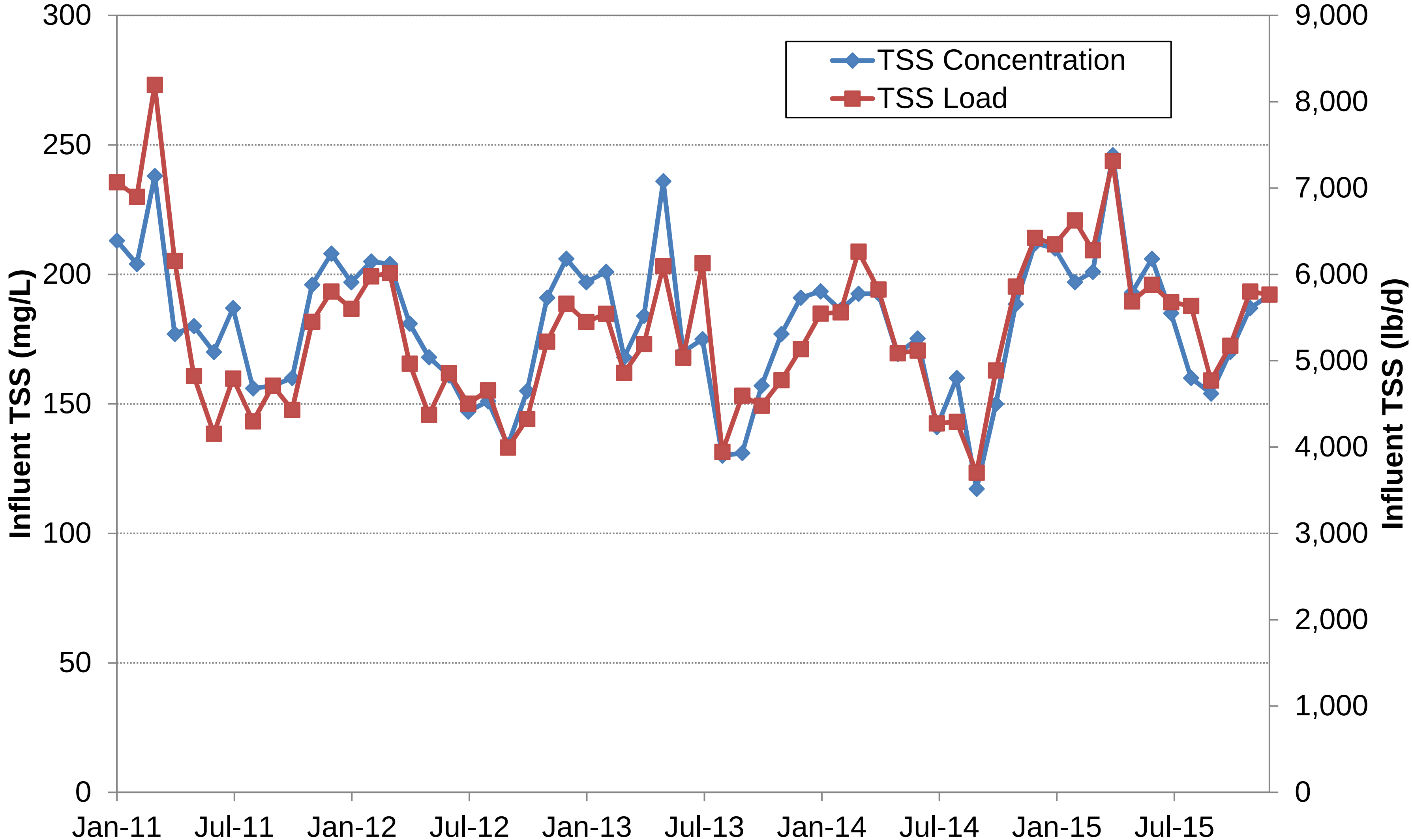


NWRF INFLUENT CBOD5

FIGURE A.9

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

carollo

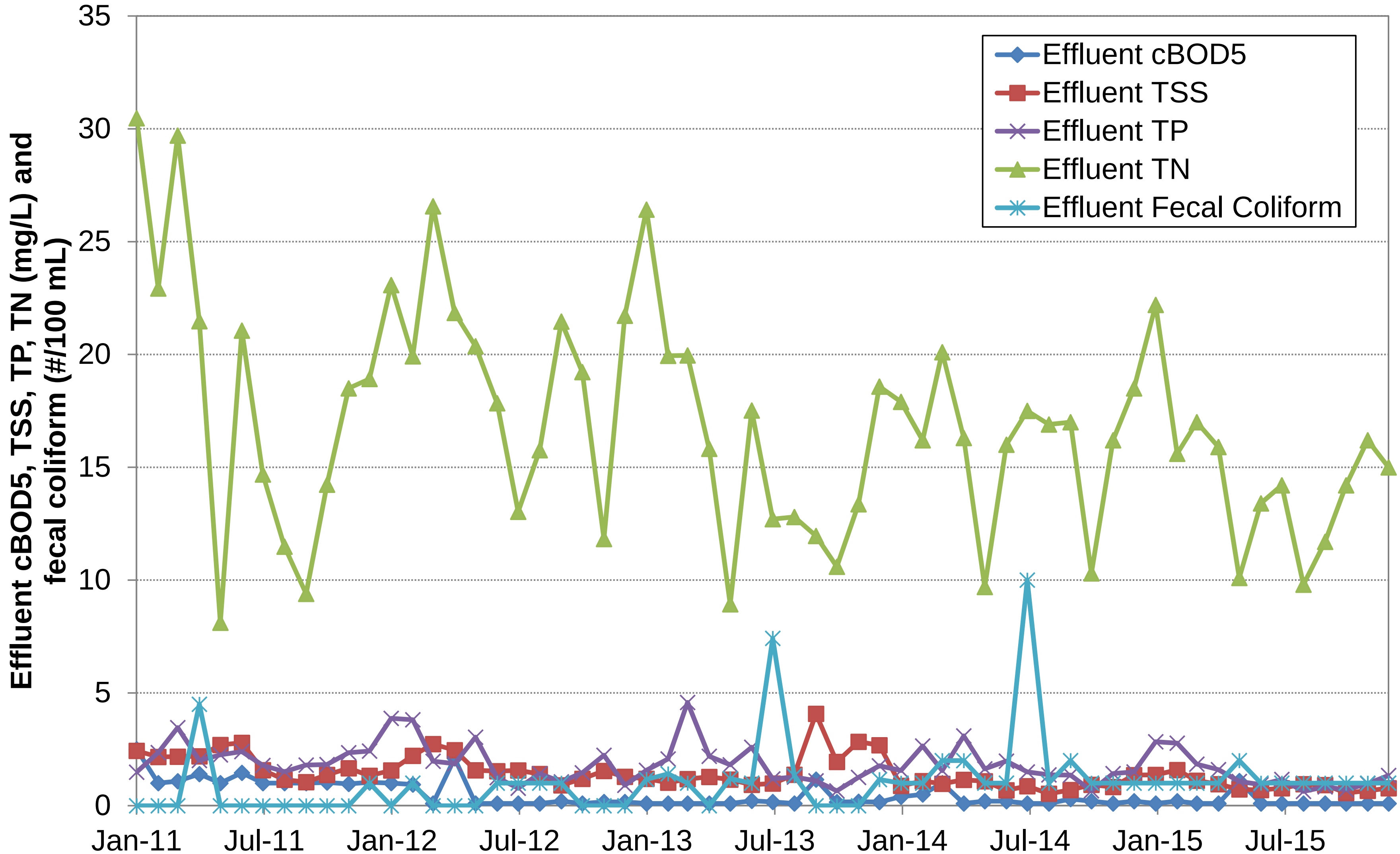


NWRF INFLUENT TSS

FIGURE A.10

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

APPENDIX B – HISTORICAL EFFLUENT WATER QUALITY PLOTS

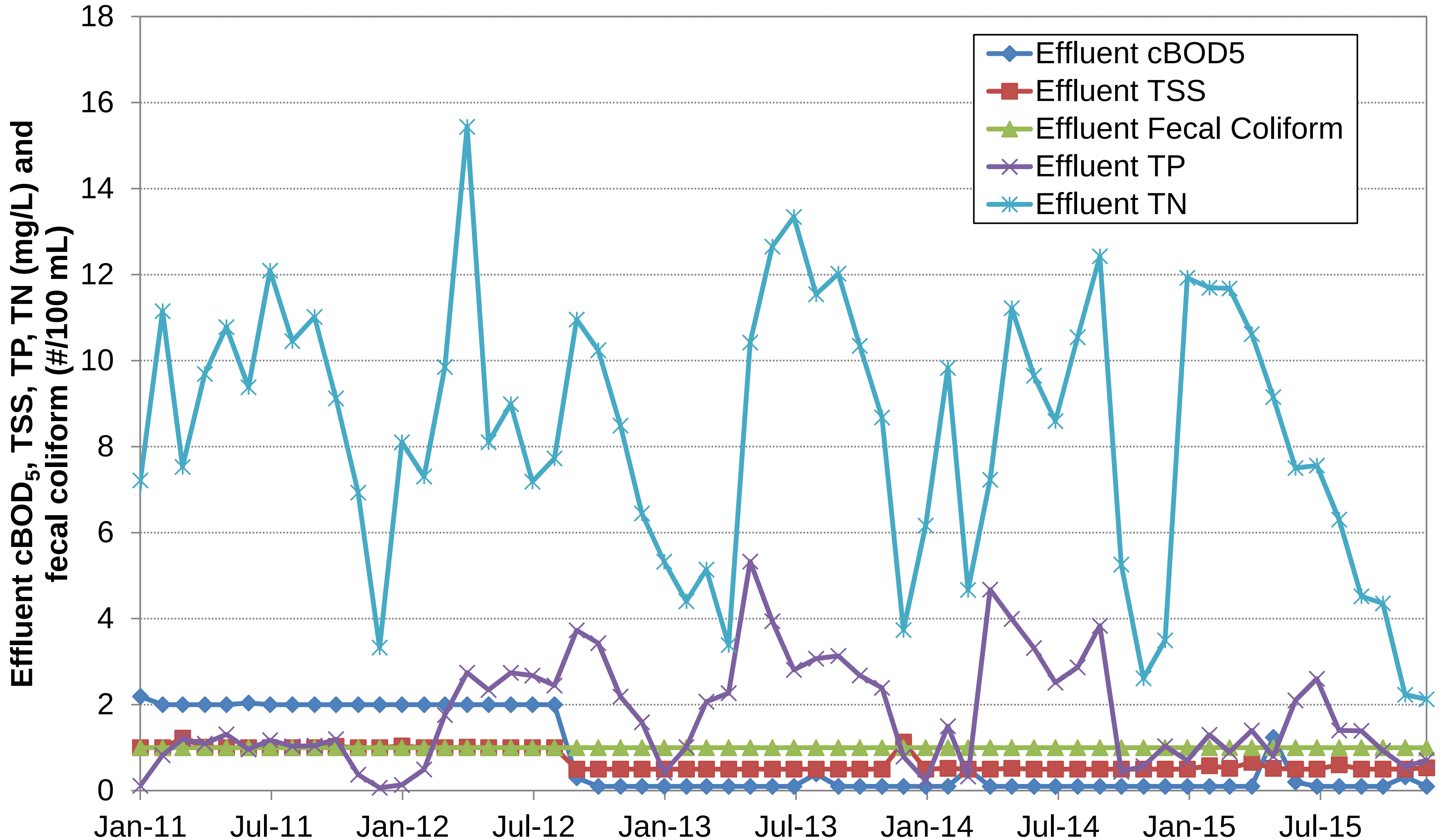


SWWRF EFFLUENT PARAMETERS

FIGURE B.1

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

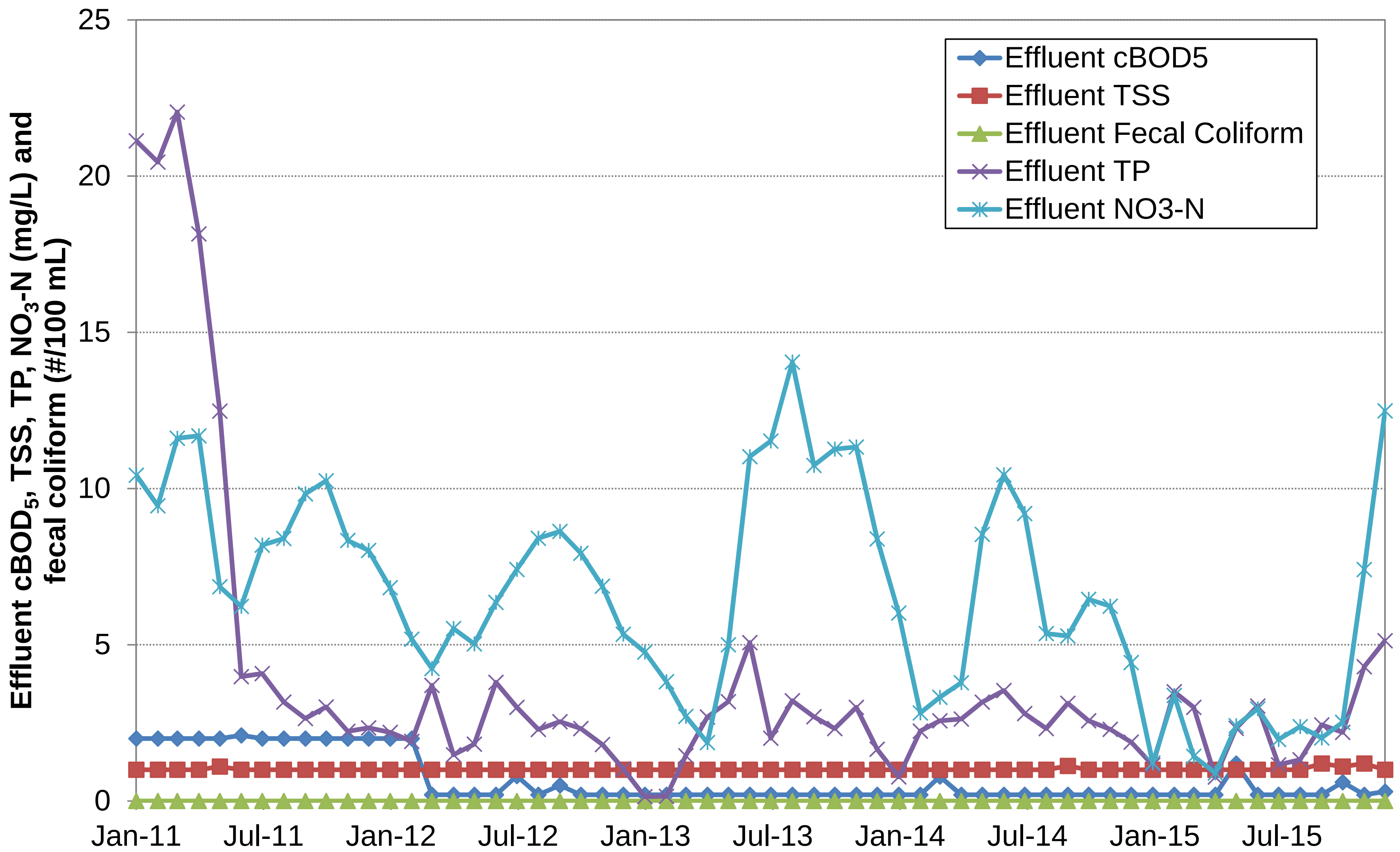


SEWRF EFFLUENT PARAMETERS

FIGURE B.2

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo



NWRF EFFLUENT PARAMETERS

FIGURE B.3

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

APPENDIX C – ANNUAL EFFLUENT MONITORING REPORTS

Parameter	Units	Year				
		2011	2012	2013	2014	2015
Antimony	mg/L	<0.0039	<0.0039	<0.0039	<0.0039	0.018
Arsenic	mg/L	0.008	0.032	<0.0038	0.0005	0.0015
Barium	mg/L	0.0047	0.007	0.01	0.006	0.0076
Beryllium	mg/L	0.0004	<0.00004	0.0024	<0.00004	<0.00045
Cadmium	mg/L	<0.0004	<0.0004	0.001	<0.0004	<0.001
Chromium	mg/L	<0.0007	0.0025	0.0022	<0.0007	<0.001
Cyanide	mg/L	0.008	0.016	0.003	0.0086	0.0052
Fluoride	mg/L	0.6	0.8	0.9	0.33	0.906
Lead	mg/L	<0.0017	<0.0017	<0.0017	<0.0017	<0.006
Mercury	mg/L	<0.000068	<0.000068	<0.000034	<0.000034	<0.000034
Nickel	mg/L	0.0022	0.005	0.0044	0.008	<0.0012
Nitrate	mg/L	0.8	1.3	0.5	0.096	0.262
Nitrite	mg/L	0.3	0.7	0.6	0.252	0.437
Nitrate&Nitrite	mg/L	0.4	2	1.1	0.348	0.699
Selenium	mg/L	<0.0046	<0.0046	0.005	<0.0046	0.048
Silver	mg/L	0.0009	<0.0007	0.001	0.0031	<0.0011
Sodium	mg/L	162	211	181	151	220
Chlorine	mg/L	4.4	5	5	1.4	5.94
Thallium	ug/L	<1.6	3	<0.6	<0.6	<5
Ethylene dibromide	ug/L	<0.0052	<0.0053	<0.0061	<0.0053	<0.0055
Para-dichlorobenzene	ug/L	<0.1	1.2	0.6	0.8	1.1
Vinyl Chloride	ug/L	<0.3	<0.3	<0.53	<0.3	<0.3
1, 1-dichloroethane	ug/L	<0.2	<0.2	<0.71	<0.2	<0.2
1, 2-dichloroethane	ug/L	<0.1	<0.1	<0.5	<0.01	<0.1
1, 1, 1-trichloroethane	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
1, 1, 2-trichloroethane	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
1, 2-dichloropropane	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
1, 2, 4-trichlorobenzene	ug/L	<0.3	<0.3	<0.78	<1.4	<0.3
Carbon tetrachloride	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
Cis-1, 2-Dichloroethylene	ug/L	<0.1	<0.09	<0.5	<0.09	<0.09
Dichloromethane	ug/L	<0.1	0.3	<2.5	0.3	5.1
Ethylbenzene	ug/L	<0.1	<0.08	<0.5	<0.08	<0.08
Monochlorobenzene	ug/L	<0.1	<0.1	<0.40	<0.1	<0.1
O-dichlorobenzene	ug/L	<0.1	<0.1	<0.5	<0.1	<0.1
Styrene	ug/L	<0.05	<0.05	<0.25	<0.05	<0.05
Tricholoethene	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
Tetrachloroethylene	ug/L	<0.2	<0.1	<0.5	<0.1	<0.1
Toluene	ug/L	<0.09	<0.09	<0.5	<0.09	0.1
Trans-1, 2-dichloroethylene	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
Xylene	ug/L	<0.1	<0.1	<1.0	<0.1	<0.1
Benzene	ug/L	<0.1	<0.1	<0.5	<0.1	<0.1
Total THM	ug/L	2	3.7	10.4	5.8	8.2
HAA5	ug/L	11	11	36.3	22	30
Endrin	ug/L	<0.011	<0.01	<0.0057	<0.01	<0.01
Lindane	ug/L	<0.009	<0.009	<0.0038	<0.009	<0.009

Parameter	Units	Year				
		2011	2012	2013	2014	2015
Methoxychlor	ug/L	<0.05	<0.048	<0.0066	<0.049	<0.047
Toxaphene	ug/L	<0.53	<0.51	<0.35	<0.52	<0.5
Dioxin	ug/L	<0.00001	<0.0000107	ND	<0.00000057	<0.00000201
2, 4-D	ug/L	<0.9	<0.89	<1.0	<0.88	<0.9
2, 4, 5-TP (Silvex)	ug/L	<0.15	<0.15	<0.14	<0.15	<0.15
Gross alpha	pCI/L	2.5	2.5	<2.74	<2.5	<2.5
Radium 226 & 228	pCI/L	0.6	0.8	<0.751	<0.6	<0.6
Aluminum	mg/L	<0.039	<0.039	<0.039	<0.039	<0.05
Chloride	mg/L	260	325	271	260	682
Copper	mg/L	0.0025	<0.0009	0.017	0.0016	<0.003
Iron	mg/L	0.1	0.2	0.1	0.159	<0.013
Manganese	mg/L	0.02	0.024	0.035	0.019	0.025
Sulfate	mg/L	150	154	135	130	242
Zinc	mg/L	0.007	0.012	0.012	0.006	0.008
pH	mg/L	7.3	7	7.1	7.4	7.4
TDS	mg/L	813	1000	881	836	1400
Foaming Agents	mg/L	<0.5	0.1	0.2	0.052	0.078
Odor	TON	24	<1	8	<1	8
Alachlor	ug/L	<0.06	<0.03	<0.033	<0.03	<0.03
Atrazine	ug/L	<0.08	0.1	<0.02	<0.02	0.05
Benzo(a)pyrene	ug/L	<0.06	<0.02	<0.54	<0.058	<0.67
Carbofuran	ug/L	<0.44	<0.60	<0.32	<0.06	<0.6
Chlordane	ug/L	<0.053	<0.051	<0.076	<0.052	<0.05
Dalapon	ug/L	<0.56	<0.56	<0.74	<0.65	<0.66
Di(2-ethylhexyl)adipate	ug/L	<0.06	<0.1	<0.37	<0.07	<0.07
Di(2-ethylhexyl)phthalate	ug/L	<0.6	0.7	<0.75	<1.2	<1.3
Dibromochloropropane	ug/L	<0.0052	<0.0053	<0.0049	<0.0053	<0.0055
Dinoseb	ug/L	<0.16	<0.16	<0.18	<0.16	<0.16
Diquat	ug/L	<0.0011	<0.46	<0.15	<0.37	<0.34
Endothall	ug/L	<12	<6.7	<2.7	<6.8	<6.6
Glyphosate	ug/L	<0.0065	<0.0027	<0.0027	<0.0027	<0.0027
Heptachlor	ug/L	<0.008	<0.008	<0.0057	<0.008	<0.008
Heptachlor epoxide	ug/L	<0.01	<0.01	<0.0057	<0.01	<0.01
Hexachlorobenzene	ug/L	<0.08	<0.04	<0.75	<1.3	<1.5
Hexachlorocyclopentadiene	ug/L	<0.02	<0.06	<1.2	<2.5	<2.8
Oxamyl	ug/L	<0.98	<0.88	<0.41	<0.88	<0.88
Pentachlorophenol	ug/L	<0.11	<0.11	<0.12	<0.11	<0.11
Picloram	ug/L	<0.3	<0.3	<0.34	<0.29	<0.3
Polychlorinated Biphenyls	ug/L	<0.21	<0.20	<0.26	<0.21	<0.2
Simazine	ug/L	<0.08	<0.03	<0.042	<0.03	<0.03

Parameter	Units	Year				
		2011	2012	2013	2014	2015
Antimony	mg/L	<0.0039	<0.0039	<0.0039	<0.0039	0.015
Arsenic	mg/L	0.008	0.025	<0.0038	0.0006	0.001
Barium	mg/L	0.0042	0.0045	0.0036	0.0032	0.006
Beryllium	mg/L	<0.00004	<0.00004	<0.00004	0.0016	<0.000096
Cadmium	mg/L	<0.0004	<0.0004	0.0008	<0.0004	0.0015
Chromium	mg/L	<0.0007	0.0012	<0.0007	<0.0007	<0.004
Cyanide	mg/L	0.006	<0.005	<0.0028	0.003	<0.005
Fluoride	mg/L	0.62	0.721	0.5	0.6	0.489
Lead	mg/L	<0.0017	<0.0017	<0.0017	<0.0017	<0.01
Mercury	mg/L	<0.000068	<0.000068	<0.000034	<0.000034	<0.000034
Nickel	mg/L	0.0036	0.006	0.0038	0.0021	<0.0012
Nitrate	mg/L	2.99	6.68	12.5	9.32	0.108
Nitrite	mg/L	<0.0006	<0.003	<0.003	<0.003	0.13
Nitrate&Nitrite	mg/L	2.99	6.68	12.5	9.32	0.238
Selenium	mg/L	<0.0046	0.008	0.0046	<0.0046	<0.05
Silver	mg/L	<0.0007	<0.0007	<0.0007	0.0026	<0.0011
Sodium	mg/L	71.9	67.9	72.5	84.3	77
Chlorine	mg/L	3.74	5	5.84	4.8	-
Thallium	ug/L	<1.6	<0.3	<0.6	<0.6	<5
Ethylene dibromide	ug/L	<0.005	<0.0054	<0.0054	<0.0055	<0.0056
Para-dichlorobenzene	ug/L	<0.1	<0.2	<0.50	<0.2	<0.2
Vinyl Chloride	ug/L	<0.3	<0.3	<0.53	<0.3	<0.3
1, 1-dichloroethane	ug/L	<0.1	<0.2	<0.71	<0.2	<0.2
1, 2-dichloroethane	ug/L	<0.1	<0.1	<0.50	<0.1	<0.1
1, 1, 1-trichloroethane	ug/L	<0.2	<0.2	<0.50	<0.2	<0.2
1, 1, 2-trichloroethane	ug/L	<0.2	<0.2	<0.50	<0.2	<0.2
1, 2-dichloropropane	ug/L	<0.2	<0.2	<0.50	<0.2	<0.2
1, 2, 4-trichlorobenzene	ug/L	<0.3	<0.3	<0.81	<1.4	<0.3
Carbon tetrachloride	ug/L	<0.2	<0.2	<0.50	<0.2	<0.2
Cis-1, 2-Dichloroethylene	ug/L	<0.9	<0.09	<0.50	<0.09	<0.09
Dichloromethane	ug/L	<0.1	<0.2	<2.5	<0.2	<0.2
Ethylbenzene	ug/L	<0.08	<0.08	<0.50	<0.08	<0.08
Monochlorobenzene	ug/L	<0.1	<0.1	<0.40	<0.1	<0.1
O-dichlorobenzene	ug/L	<0.1	<0.1	<0.50	<0.1	<0.1
Styrene	ug/L	<0.05	<0.05	<0.25	<0.05	<0.05
Tricholoethene	ug/L	<0.2	<0.1	<0.50	<0.2	<0.2
Tetrachloroethylene	ug/L	<0.1	<0.2	<0.50	<0.1	<0.1
Toluene	ug/L	<0.09	<0.09	<0.50	<0.09	<0.09
Trans-1, 2-dichloroethylene	ug/L	<0.2	<0.2	<0.50	<0.2	<0.2
Xylene	ug/L	<0.1	<0.1	<1.0	<0.1	<0.1
Benzene	ug/L	<0.1	<0.1	<0.50	<0.1	<0.1
Total THM	ug/L	47	90.5	141	116	6.5
HAA5	ug/L	59	130	130	210	28
Endrin	ug/L	<0.01	<0.011	<0.0057	<0.01	<0.01
Lindane	ug/L	<0.009	<0.009	<0.0038	<0.088	<0.009

Parameter	Units	Year				
		2011	2012	2013	2014	2015
Methoxychlor	ug/L	<0.049	<0.05	<0.0066	<0.48	<0.048
Toxaphene	ug/L	<0.53	<0.53	<0.35	<0.52	<0.51
Dioxin	ug/L	0.00001	<0.0000103	<0.00098	<0.00000057	<0.00000201
2, 4-D	ug/L	<0.9	<0.88	<0.96	<0.89	<0.88
2, 4, 5-TP (Silvex)	ug/L	<0.15	<0.15	<0.16	<0.15	<0.15
Gross alpha	pCI/L	<2.5	<2.5	<2.5	<2.5	<2.5
Radium 226 & 228	pCI/L	<0.6	<0.6	<0.882	0.6	<0.8
Aluminum	mg/L	<0.039	<0.039	<0.039	<0.039	<0.05
Chloride	mg/L	87	82.4	89.6	85	48.5
Copper	mg/L	0.001	<0.0009	0.0014	0.002	<0.003
Iron	mg/L	0.062	<0.046	<0.046	<0.046	0.19
Manganese	mg/L	0.028	0.0007	0.0014	0.0036	0.043
Sulfate	mg/L	130	124	99.8	100	65.2
Zinc	mg/L	0.029	0.039	0.037	0.04	0.019
pH	mg/L	7.12	7.23	7.1	7.25	7.5
TDS	mg/L	455	501	514	541	508
Foaming Agents	mg/L	<0.05	0.14	0.13	0.11	0.086
Odor	TON	8	70	<1.0	2	4
Alachlor	ug/L	<0.06	<0.03	<0.033	<0.03	<0.03
Atrazine	ug/L	<0.08	0.05	<0.02	<0.02	0.08
Benzo(a)pyrene	ug/L	<0.07	<0.02	<0.56	<0.02	<0.6
Carbofuran	ug/L	<0.44	<0.60	<0.32	<0.60	<0.6
Chlordane	ug/L	<0.053	<0.053	<0.076	<0.052	<0.051
Dalapon	ug/L	0.76	3.9	5.5	3.8	0.7
Di(2-ethylhexyl)adipate	ug/L	0.6	<0.1	<0.37	<0.07	<0.07
Di(2-ethylhexyl)phthalate	ug/L	13	41	28.8	52	6.5
Dibromochloropropane	ug/L	<0.005	<0.0054	<0.0052	<0.0055	<0.0056
Dinoseb	ug/L	<0.16	<0.16	<0.17	<0.16	<0.16
Diquat	ug/L	<1.5	<0.47	<0.15	<0.44	<0.37
Endothall	ug/L	<12	<6.7	<2.7	<6.8	<6.4
Glyphosate	ug/L	<6.5	<0.0027	<0.0021	<0.0027	<0.0027
Heptachlor	ug/L	<0.008	<0.008	<0.0057	<0.078	<0.008
Heptachlor epoxide	ug/L	<0.01	<0.010	<0.0057	<0.098	<0.01
Hexachlorobenzene	ug/L	<0.08	<0.04	<0.78	<0.04	<1.3
Hexachlorocyclopentadiene	ug/L	<0.02	0.4	<1.2	<2.5	<2.6
Oxamyl	ug/L	<0.98	<0.88	<0.41	<0.88	<0.88
Pentachlorophenol	ug/L	<0.11	<0.11	<0.12	<0.11	<0.11
Picloram	ug/L	<0.30	<0.29	<0.32	<0.3	<0.29
Polychlorinated Biphenyls	ug/L	<0.21	<0.021	<0.26	<0.21	<0.2
Simazine	ug/L	<0.08	<0.03	<0.042	<0.03	<0.03

Parameter	Units	Year				
		2011	2012	2013	2014	2015
Antimony	mg/L	<0.0039	<0.0039	<0.0039	<0.0039	0.017
Arsenic	mg/L	0.017	0.023	<0.0038	0.002	0.0025
Barium	mg/L	0.0024	0.0041	0.0041	0.0046	0.0056
Beryllium	mg/L	<0.00004	<0.00004	<0.0004	0.0015	<0.00045
Cadmium	mg/L	<0.0004	<0.0004	0.0007	0.0005	0.0011
Chromium	mg/L	0.0013	0.0013	<0.0007	<0.0007	<0.001
Cyanide	mg/L	<0.005	<0.0054	<0.0025	0.006	<0.005
Fluoride	mg/L	1.7	0.546	0.53	0.37	0.937
Lead	mg/L	<0.0017	<0.0017	<0.0017	<0.0017	<0.006
Mercury	mg/L	<0.000068	<0.000068	<0.000034	<0.000034	<0.000034
Nickel	mg/L	0.009	0.006	0.0032	0.0019	<0.0012
Nitrate	mg/L	11.8	4.82	11.7	7.43	0.858
Nitrite	mg/L	0.011	<0.003	<0.003	<0.003	0.126
Nitrate&Nitrite	mg/L	11.8	4.82	11.8	7.43	0.984
Selenium	mg/L	<0.0046	<0.0046	0.0046	<0.0046	0.036
Silver	mg/L	<0.0007	<0.0007	<0.0007	0.0026	<0.0011
Sodium	mg/L	121	76.9	78.7	71.3	75
Chlorine	mg/L	5	5	5	8.8	5
Thallium	ug/L	<1.6	<0.3	<0.6	<0.6	<5.0
Ethylene dibromide	ug/L	<0.005	<0.0053	<0.0063	<0.056	<0.0055
Para-dichlorobenzene	ug/L	<0.1	<0.2	<0.5	<0.5	<0.2
Vinyl Chloride	ug/L	<0.3	<0.3	<0.53	<0.3	<0.3
1, 1-dichloroethane	ug/L	<0.1	<0.2	<0.71	<0.2	<0.2
1, 2-dichloroethane	ug/L	<0.1	<0.1	<0.5	<0.2	<0.1
1, 1, 1-trichloroethane	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
1, 1, 2-trichloroethane	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
1, 2-dichloropropane	ug/L	<0.2	<0.2	<0.5	<0.1	<0.2
1, 2, 4-trichlorobenzene	ug/L	<0.3	<0.3	<0.81	<1.4	<0.3
Carbon tetrachloride	ug/L	<0.2	<0.2	<0.5	<0.2	<0.2
Cis-1, 2-Dichloroethylene	ug/L	<0.9	<0.09	<0.5	<0.09	<0.09
Dichloromethane	ug/L	<0.1	<0.2	<2.5	<2.5	<0.2
Ethylbenzene	ug/L	<0.08	<0.08	<0.5	<0.5	<0.08
Monochlorobenzene	ug/L	<0.1	<0.1	<0.4	<0.4	<0.1
O-dichlorobenzene	ug/L	<0.1	<0.1	<0.5	<0.5	<0.1
Styrene	ug/L	<0.05	<0.05	<0.25	<0.25	<0.05
Tricholoethene	ug/L	<0.2	<0.2	<0.5	<0.5	<0.2
Tetrachloroethylene	ug/L	<0.1	<0.1	<0.5	<0.5	<0.1
Toluene	ug/L	<0.09	<0.09	<0.5	<0.5	<0.09
Trans-1, 2-dichloroethylene	ug/L	<0.2	<0.2	<0.5	<0.5	<0.2
Xylene	ug/L	<0.1	<0.1	<1.0	<0.1	<0.1
Benzene	ug/L	<0.1	<0.1	<0.5	<0.1	<0.1
Total THM	ug/L	9.7	74.6	155	147	110
HAA5	ug/L	37	132	89	290	97
Endrin	ug/L	<0.01	<0.01	<0.0059	<0.01	<0.01
Lindane	ug/L	<0.009	<0.009	<0.0039	<0.009	<0.009

Parameter	Units	Year				
		2011	2012	2013	2014	2015
Methoxychlor	ug/L	<0.049	<0.048	<0.0069	<0.05	<0.049
Toxaphene	ug/L	<0.52	<0.51	<0.36	<0.53	<0.52
Dioxin	ug/L	<0.1	<0.01	ND	<0.00000057	<0.00000576
2, 4-D	ug/L	<0.9	<0.89	<0.96	<0.89	<0.87
2, 4, 5-TP (Silvex)	ug/L	<0.15	<0.15	<0.16	<0.15	<0.15
Gross alpha	pCI/L	<2.5	<2.5	<2.3	<2.5	<2.5
Radium 226 & 228	pCI/L	<0.7	<0.6	<0.893	<0.6	<0.8
Aluminum	mg/L	<0.039	<0.039	<0.039	<0.039	<0.05
Chloride	mg/L	130	47.2	89	84	98.2
Copper	mg/L	0.0016	<0.0009	<0.0009	0.0012	<0.003
Iron	mg/L	<0.46	<0.046	<0.046	<0.046	61
Manganese	mg/L	0.015	0.0015	0.046	0.0028	0.037
Sulfate	mg/L	250	69.8	111	110	133
Zinc	mg/L	0.054	0.037	0.028	0.024	0.026
pH	mg/L	6.29	7.12	7.3	7.5	7.6
TDS	mg/L	683	509	539	542	460
Foaming Agents	mg/L	0.069	0.086	0.26	0.16	0.07
Odor	TON	12	3	2	<1	<1
Alachlor	ug/L	<0.06	<0.03	<0.034	<0.04	<0.03
Atrazine	ug/L	0.1	0.09	<0.021	0.1	0.2
Benzo(a)pyrene	ug/L	<0.07	<0.02	<0.56	<0.02	<0.57
Carbofuran	ug/L	<0.44	<0.60	<0.32	<0.6	<0.60
Chlordane	ug/L	<0.052	<0.051	<0.079	<0.053	<0.052
Dalapon	ug/L	<0.56	2.8	5.5	4.2	4.9
Di(2-ethylhexyl)adipate	ug/L	<0.6	<0.1	<0.38	<0.09	<0.07
Di(2-ethylhexyl)phthalate	ug/L	3	20	18.3	16	3.1
Dibromochloropropane	ug/L	<0.005	<0.0053	<0.50	<0.0056	<0.0055
Dinoseb	ug/L	<0.16	<0.16	<0.17	<0.16	<0.16
Diquat	ug/L	<1.5	<0.45	<0.15	<0.25	<0.46
Endothall	ug/L	<12	<6.7	<2.7	<6.8	<6.7
Glyphosate	ug/L	<6.5	<2.7	<2.1	<2.7	<2.7
Heptachlor	ug/L	<0.008	<0.008	<0.0059	<0.008	<0.008
Heptachlor epoxide	ug/L	<0.01	<0.01	<0.0059	<0.01	<0.01
Hexachlorobenzene	ug/L	<0.02	<0.04	<0.78	<1.3	<1.2
Hexachlorocyclopentadiene	ug/L	<0.02	<0.05	<1.2	<2.5	<2.4
Oxamyl	ug/L	<0.98	<0.88	<0.41	<0.88	<0.88
Pentachlorophenol	ug/L	<0.11	<0.11	<0.12	<0.11	<0.11
Picloram	ug/L	<0.30	<0.30	<0.32	<0.03	<0.29
Polychlorinated Biphenyls	ug/L	<0.21	<0.20	<0.27	<0.21	<0.21
Simazine	ug/L	<0.02	<0.03	<0.044	<0.04	<0.03

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM NO. 2
DESIGN/STANDBY CRITERIA AND CAPACITY RATING

FINAL
November 2016

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MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM
NO. 2

DESIGN/STANDBY CRITERIA AND CAPACITY RATING

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1.0 INTRODUCTION

Manatee County owns and operates three regional water reclamation facilities (WRFs): the Southwest Water Reclamation Facility (SWWRF), Southeast Water Reclamation Facility (SEWRF), and North Regional Water Reclamation Facility (NRWRF). All three facilities are Type I biological nutrient removal (BNR) facilities designed to treat effluent to public access reuse (PAR) water quality requirements in accordance with Chapter 62-610, Florida Administrative Code (FAC). SWWRF is permitted for 15 million gallons per day (mgd) annual average daily flow (AADF), SEWRF is permitted for 11 mgd three-month rolling average daily flow (TMRADF), and NRWRF is permitted for 7.5 mgd TMRADF.

This technical memorandum (TM) is part of the development of the Facilities Master Plans for each of these WRFs. As such, the TM summarizes the design and reliability criteria and evaluates the design hydraulic and treatment capacity for each of the WRFs.

2.0 RELIABILITY CRITERIA

Each of the WRFs operates under a non-discharge permit. To dispose of treated effluent, the facilities connect to a slow-rate PAR system known as the Manatee County Master Reuse System (MCMRS). The County also has a Class 1 underground injection well on Cortez Road with a permitted capacity of 15 mgd maximum daily flow (MDF) and 10 mgd AADF to dispose of treated effluent.

In accordance with Ch. 62-610.462, FAC, facilities providing PAR water must provide Environmental Protection Agency (EPA) Class I treatment reliability. The requirements for Class I reliability are summarized in Table 2.1.

Table 2.1 Summary of Class I Reliability Standards
Water Reclamation Facilities – Master Plan Development
Manatee County

Component	Requirement
Mechanically-Cleaned Bar Screens	Provide manual back-up bar screen.
Pumps	Provide back-up pump.
Sedimentation Basins and Filters	With largest unit out of service, remaining units have capacity of 75% of total design capacity.
Aeration Basins	Provide at least two equal volume basins.
Mechanical Aerators/ Blowers	Provide sufficient number of units to satisfy design oxygen with largest unit out of service.

Table 2.1 Summary of Class I Reliability Standards Water Reclamation Facilities – Master Plan Development Manatee County	
Component	**Requirement**
Air Diffusers	Design such that largest section of diffusers can be isolated without measurably impairing oxygen transfer capability of the system.
Disinfectant Contact Basin	With largest unit out of service, remaining unit shall have capacity of 50% of total design capacity.
Biosolids Facilities	
• Mechanical Aerators/ Blowers	Provide at least two units
• Dewatering	Provide sufficient units to provide design capacity with largest unit out (unless operating time of existing units can be extended to provide similar capacity)
Backup Power Source	Sufficient to operate all vital components during peak wastewater flow conditions, together with critical lighting and ventilation.

Each of the facilities was evaluated in the following sections for hydraulic and treatment capacity with respect to permitted capacity, level of service, and the reliability criteria presented in Table 2.1. Hydraulic profiles, unless otherwise noted, were developed using Hydraulix®, which is a proprietary model developed and maintained by Carollo Engineers for analyzing the hydraulic profile through the WRFs.

3.0 SOUTHWEST WATER RECLAMATION FACILITY

SWWRF has several ongoing construction projects including converting the existing conventional activated sludge process to a Modified Ludzack-Ettinger (MLE) process and converting the existing anaerobic digesters to aerated sludge holding tanks scheduled to be completed by the end of 2016. These process modifications will affect both the hydraulic and treatment capacity of the facility. The following evaluation assumes these modifications have been completed.

3.1 Hydraulic Evaluation

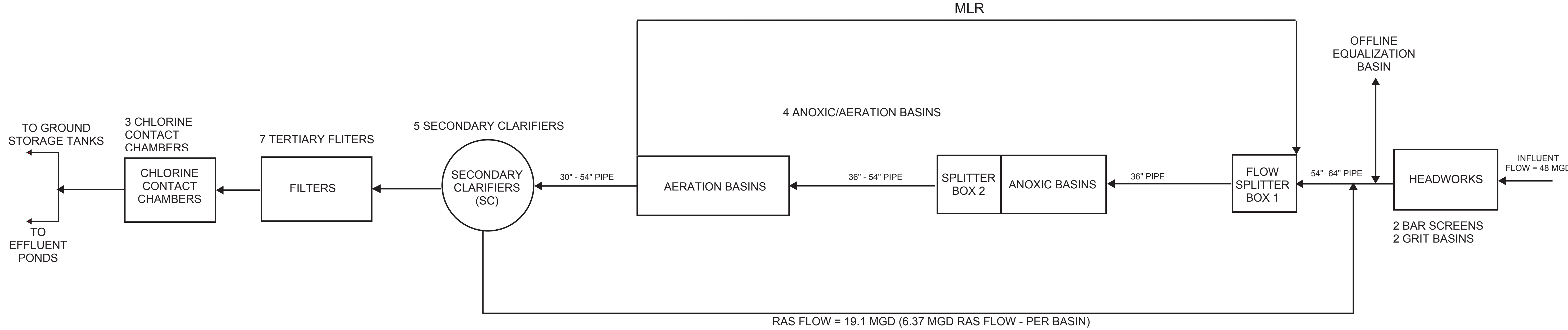
The ongoing process modifications described above were designed by CH2M Hill. Therefore, the hydraulic profile developed by CH2M Hill is the primary source of information for this evaluation. CH2M Hill's design includes the hydraulic profile of SWWRF from the headworks to the aeration basins as documented in Preliminary Engineering Report (PER), Volume 1 Report, Project # 457133, October 2012 (CH2M Hill). The hydraulic profile from the secondary clarifiers to chlorine contact chamber was modelled using Carollo's Hydraulix® model. The structural information (such as weir elevations, top of wall, floor elevations, etc.) was obtained from the record drawings of the CDM Tertiary Filter

Upgrades project (December 6, 1988, Drawing Sheet C-19: Hydraulic Profile) and the record drawings of the URS Filter Piping Improvements project (February 21, 2012, Drawing Sheet C-2). Figure 2.1 illustrates the hydraulic profile for SWWRF at peak hour flow (PHF) with all units in service. The flow rates through the individual basins assume an influent PHF through the facility. It was assumed that the equalization basin was not in service, therefore, the attenuation of the peaks was not considered. The following assumptions were used to develop Figure 2.1:

- PHF = 48.0 mgd
- Return activated sludge (RAS) flow = 19.1 mgd (CH2M Hill PER)
- Mixed liquor recycle (MLR) flow = 47.9 mgd (CH2M Hill PER)
- All units in service, except equalization basin

The following summarizes the findings of the hydraulic evaluation:

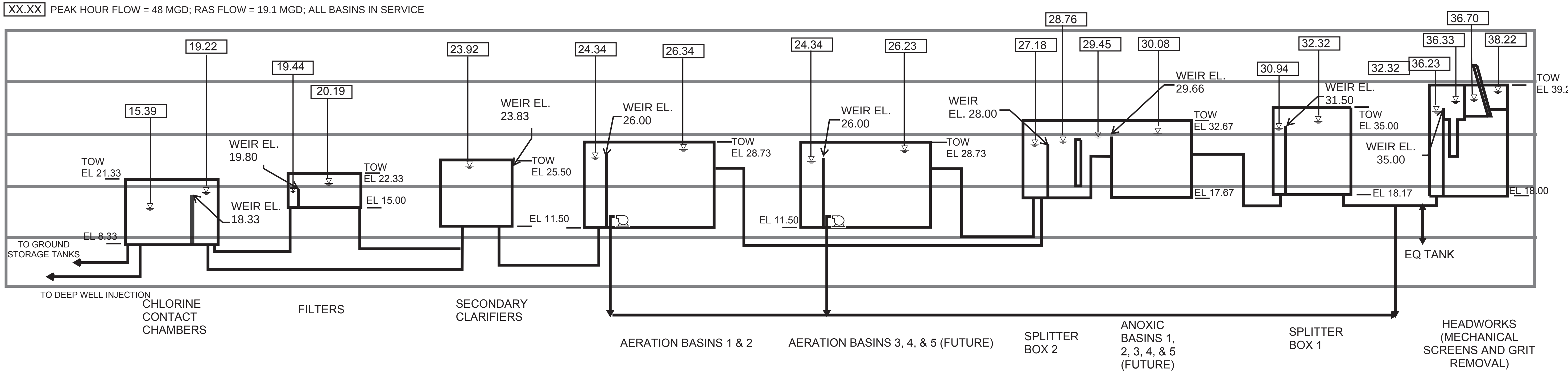
- The headworks with all units in service can handle the PHF condition; however, the effluent weir at the preliminary treatment structure is submerged.
- Secondary treatment units can handle peak flow conditions without submergence of any weirs.
- The velocities in the pipes from the headworks to secondary process tanks are between 2.0 to 6.0 feet per second (fps), which is an acceptable velocity range for this piping system.
- The tertiary treatment units (filters and chlorine contact chambers) have the hydraulic capacity for the PHF with all units in service. Note that the flash mixers/flocculators are bypassed and not in use.



PROCESS SCHEMATIC

LEGEND

XX.XX PEAK HOUR FLOW = 48 MGD; RAS FLOW = 19.1 MGD; ALL BASINS IN SERVICE



HYDRAULIC PROFILE PEAK FLOW

NOTES:

1. HYDRAULIC PROFILE THROUGH HEADWORKS TO SECONDARY CLARIFIERS IS ADOPTED FROM DWG 001-G-1701 OF CH2MHILL "SWWRF NITROGEN REMOVAL MODIFICATIONS DUE TO ON-GOING MODIFICATIONS TO THESE PROCESSES.

2. HYDRAULIC PROFILE FROM FILTERS THROUGH CHLORINE CONTACT CHAMBER IS MODELLED FOR THIS FACILITY PLAN

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SWWRF - HYDRAULIC PROFILE

FIGURE 2.1

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

3.2 Treatment Capacity Evaluation

The following sections summarize the estimated capacity of each unit process at SWWRF. The assumptions used in completing this analysis (influent wastewater characteristics, peaking factors, and effluent water quality) are identified in TM 1. Additional assumptions include:

- The preliminary treatment units at the headworks will treat PHF.
- The flow equalization basin was assumed to be offline and the remaining processes are designed to treat PHF.
- The biological processes are designed to treat maximum month flows (TKN) and loads.
- It is assumed that the preliminary and tertiary treatment processes will not have any significant changes during the ongoing modifications to be completed in 2016.

3.2.1 Headworks Capacity Rating

The headworks facility consists of two influent screening units followed by two grit removal units. It also has one manual backup screen meeting the requirements for Class I reliability. Each of the influent screens and grit removal units are designed to treat 24 mgd PHF and 11 mgd AADF per manufacturers' ratings. Therefore, the headworks facility is designed for a total of 48 mgd PHF and 22 mgd AADF and meets Class I reliability. This is consistent with the PHF rated capacity of SWWRF. A summary of the capacity of the headworks equipment is provided in Table 2.2

Table 2.2 SWWRF Headworks Capacity Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
Mechanically cleaned screens	Number Screen opening Peak capacity, each Average capacity, each Peak capacity, total Average capacity, total	2 6 mm 24 mgd PHF 11 mgd AADF 48 mgd PHF 22 mgd AADF
Manual Bar Screen(1)	Number Screen opening	1 1 in.
Grit removal	Number Type Diameter Peak capacity, each Average capacity, each Peak capacity, total Average capacity, total	2 Forced vortex 18 ft 24 mgd PHF 11 mgd AADF 48 mgd PHF 22 mgd AADF

Notes:
(1) Meets EPA Class I reliability.

3.2.2 Secondary Treatment Capacity Rating

The BNR process modifications have not yet been constructed; therefore, performance data is not available. After these process modifications are implemented, the treatment performance should be monitored in order to provide more precise biological treatment capacity evaluation. Capacity of the anoxic and aeration tanks was estimated from the CH2M Hill PER.

The modeling performed in the PER indicated that sufficient anoxic and aerobic volume exists for the design flow of 13.5 mgd AADF. Each anoxic zones was modeled as two zones and aeration basins were modeled as three zones in series. A dissolved oxygen (DO) concentration of 2.0 mg/L was used for the first two zones of the aeration basins and 1.0 mg/L was used for the final zone to reduce the amount of DO recycled to the anoxic basins. A MLR rate of 250 percent of the influent flow provides sufficient nitrogen removal and is within the typical range of recycle rates (100 percent to 400 percent) used in an MLE process. Modeling these conditions indicated that the SWWRF could meet the TN target of 10 mg/L for the design AADF and MMADF. Table 2.3 summarizes the treatment capacities of the anoxic and aerations basins based on the modeling results from the PER. As shown, the anoxic and aeration basins have a capacity of 13.5 mgd AADF and meet Class I reliability by design with multiple basins. After startup of the new process, analysis and confirmation of capacity should be conducted.

Table 2.3 SWWRF BNR Treatment Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Anoxic/Aeration Basins	Number, each	4
	Aerobic SRT	4.4 days
	Overall SRT	7.0 days
	MLSS	3,100 to 3,300 mg/L
	MDF capacity, total	23 mgd
	Maximum Month Average Daily (MMAD) capacity, total	15.9 mgd
	AADF capacity, total	13.5 mgd

3.2.3 Aeration System Capacity Rating

SWWRF has five existing 200-horsepower (hp) blowers. The blower curves indicate a design point of 3,075 standard cubic feet per minute (scfm) at 8 pounds per square inch gauge (psig). Based on the PER, an additional 10,725 scfm installed capacity is required to meet MDF conditions. Class I reliability requires MDF air demands are met with the largest unit out of service. Based on the design aeration system capacity, the proposed aeration system will not meet Class I reliability at the proposed design loads. It is recommended that the system performance be further evaluated and tested to confirm if additional blower capacity is required because Class I reliability is met under current loads. Table 2.4 illustrates existing capacity and estimated design airflow capacities for SWWRF.

Table 2.4 SWWRF Aeration System Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Aeration System	Existing blower number	5
	Existing capacity installed, total	15,375 scfm
	New blower number	2
	New capacity installed, total	13,200 scfm
	Total installed capacity	28,575 scfm
	Total firm capacity(1)	21,975 scfm
	Design capacity required at AADF	12,600 scfm
	Design capacity required at MDF	26,100 scfm

Notes:
(1) Largest unit out of service.

3.2.4 Secondary Clarifier Capacity Rating

The secondary clarifier capacity was calculated based on 10 State Standards, which are incorporated by reference into Florida Department of Environmental Protection (FDEP) rules (Ch. 62.600, FAC). The governing standard for this analysis was the standard for peak hydraulic overflow rate, which resulted in a PHF capacity of 49.7 mgd. Class I reliability standards require the secondary clarifiers to treat 75 percent of the PHF with the largest unit out of service, which is 36 mgd at SWWRF. The clarifiers can treat 78 percent of the SWWRF PHF capacity with the largest unit out of service; therefore, Class I reliability requirements are met. Table 2.5 provides a summary of the secondary clarifier capacity at SWWRF.

Table 2.5 SWWRF Secondary Clarifier Treatment Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Process	Criteria	Description
Secondary Clarifiers	Number	5
	Type	Center feed, peripheral weir
	Surface area, total	49,720 ft^2
	Hydraulic loading at MDF	462 gpd/ft^2
	Solids loading at MDF	23 $lb/d/ft^2$
	Weir loading at MDF	13,100 gpd/ft
	PHF capacity, total(1)	49.7 mgd
	PHF capacity, Class I reliability(1)(2)	37.4 mgd

Notes:
(1) Based on 10 State Standards for peak hydraulic overflow rate of 1,000 gpd/ft^2.
(2) Calculated with the largest unit out of service.

3.2.5 Filtration Capacity Rating

There are seven tertiary filter units at SWWRF. One of the filters is an AquaDiamond filter with pile cloth media. The remaining filters are automatic backwash (ABW) filters with granular media. The overall PHF design capacity of the filters is 38.5 mgd. Class I reliability requires filters to treat 75 percent of the PHF with the largest unit out of service, which is 36 mgd at SWWRF. The ABW filters provide only 43 percent of the SWWRF PHF capacity when the AquaDiamond is out of service, therefore, Class I reliability is not met. It is recommended that an additional cloth filter be installed in order to meet Class I reliability. In addition, the existing ABW filters should be stress tested to identify the actual peak hydraulic loading capacity. The estimate used here is based on knowledge of similar ABW filters operating in Florida. A summary of the filtration capacity at SWWRF is provided in Table 2.6.

Table 2.6 SWWRF Filtration Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number	7
Type	No. 1 – AquaDiamond No. 2-7 – Automatic backwash, traveling bridge
Media type and depth	No. 1 – Pile cloth No. 2-7 – 12-in sand, 12-in anthracite
Surface area, each	No. 1 – 1,920 sq ft No. 2-5 – 1,060 sq ft No. 6-7 – 1,440 sq ft
Surface area, total	9,040 sq ft
Peak loading rate	No. 1 – < 6.5 gpm/sq ft No. 2-7 – < 2.0 gpm/sq ft(1)
Peak capacity, total Peak capacity, Class I Reliability(2)	38.5 mgd 20.5 mgd

Notes:

(1) Maximum loading rate allowed by 10 State Standards is 5.0 gpm/sq ft. Actual loading may vary from the assumed value. 2.0 gpm/sq ft was used for this analysis based on knowledge of similar ABW filters operating in the state of FL.

(2) Class I reliability requires 75% of peak flow treatment capacity with the largest unit out of service. Given the AquaDiamond filter (No. 1) has the largest flow capacity, only 43% of peak capacity is provided when it is out of service.

3.2.6 Disinfection Capacity Rating

There are currently three, equal-sized chlorine contact chambers (CCCs) at SWWRF. SWWRF has enough CCCs volume to provide required CT at 1.7 mg/L chlorine residual. Class I reliability requires CCCs to treat 50 percent of the PHF with the largest unit out of service, which is 24 mgd at SWWRF. The CCCs provide 55 percent of the SWWRF PHF capacity when one CCC is out of service. Therefore, Class I reliability is met. A summary of the disinfection capacity at SWWRF is provided in Table 2.7.

Table 2.7 SWWRF Disinfection Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number of Chlorine Contact Chamber	3
Type	Sodium hypochlorite contact chambers
Dimensions Length Width Side Water Depth	 61.4 ft 30.0 ft 10 ft
Volume, each	138,000 gal
Volume, total	414,000 gal
Minimum CT at Peak Flow(1)	25.0 mg/L-min
Peak Capacity, Total(2) Peak Capacity, Class I Reliability(3)	39.7 mgd 26.5 mgd
Number of Chlorine Pumps	4
Total Capacity Available	100 gph
Capacity required to achieve min CT(4)	22.5 gph

Notes:
(1) Per Ch. 62-600.440, FAC for high level disinfection.
(2) All units in service and provide required CT at 1.7 mg/L chlorine residual and minimum of 15 minutes contact time per 10 State Standards.
(3) Class I reliability requires 50% of peak flow treatment capacity with the largest unit out of service. 55% of the peak flow capacity is provided at SWWRF.
(4) Based on 1.7 mg/L chlorine dose, peak flow of 39.7 mgd, and 12.5% chlorine solution.

3.2.7 Solids Handling Capacity

3.2.7.1 Aerated Sludge Holding Tanks

Currently four anaerobic digesters are being converted to aerated sludge holding tanks (ASHTs). These ASHTs will be aerated and mixed by four jet aeration-mixing systems and recirculation pumps. The total sludge holding volume is approximately 3.8 MG. The four blowers are sized to deliver a minimum of 940 scfm each. Based on the PER (CH_2M Hill), aeration/mixing systems are designed to provide adequate air and mixing in the ASHTs. For detailed modifications to the existing anaerobic digester, refer to the PER.

The modifications to the existing treatment process will be affecting the amount of sludge produced at the facility. Based on the modeling results from the PER, the available sludge storage capacity at 15.9 mgd MMADF and WAS solids content of 0.8 percent (unthickened WAS) will be 18 days with all four ASHTs in service and 13.5 days with one ASHT out of service.

The ASHTs each have dedicated aeration and recirculation equipment. Each of these systems acts as a full redundant backup to each other. The ASHTs provide enough volume to hold solids should any dewatering equipment need to be offline for repair or maintenance, which meets Class I reliability criteria.

3.2.7.2 Belt Filter Press Dewatering

The solids dewatering capacity evaluation was performed using the design criteria for belt filter presses (BFP) from (TM1) and solids data provided by the County (2009 to 2013). Evaluations also included capacity for EPA Class I reliability criteria. Table 2.8 presents the estimated existing solids dewatering capacity.

Table 2.8 SWWRF Dewatering (Belt Filter Press) Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Element	Value
Number of Units	6 (2 meter each)
Solids Loading Rate (SLR), each(1)	1,200 lbs/hr
Total SLR	7,200 lbs/hr (172,800 lbs/day)
Class I Capacity(3), SLR	6,000 lbs/hr (144,000 lbs/day)
SLR Capacity Utilization(2)	12%
SLR, EPA Class I Capacity Utilization(2)	14%
Hydraulic Loading Rate (HLR), each	80 gpm
HLR, Total	460 gpm
Class I Capacity, HLR	380 gpm
HLR Capacity Utilization	12%
HLR, EPA Class I Capacity Utilization	14%

Notes:
(1) Based on design criteria and all calculations assume 24 hours per day, 7 days per week of operation.
(2) Based on 0.09 mgd of WAS flow and 20,200 lbs/day of WAS Solids Load.
(3) Multiple units, design sludge flow should be able to be dewatered with largest unit out of service.

3.3 Summary of Treatment Processes

The overall capacity of SWWRF is summarized in Table 2.9 assuming the peaking factors from TM1 all units in service, and not accounting for the reliability criteria discussed in the previous sections. As shown, the anoxic/aeration biological treatment is the limiting unit process at SWWRF. The biological treatment train is designed assuming an effluent TN of 10 mg/L, which is not part of the existing permit. The actual biological capacity should be reevaluated once the process changes are online and operating accounting for various effluent TN concentrations.

Class I reliability compliance was identified as a potential problem area for the aeration system blowers and tertiary filters. It is recommended that the aeration system blower capacity be reevaluated during the biological system capacity evaluation since the blowers do meet Class I reliability requirements under existing loads. For the tertiary filters, it is recommended that the existing ABW filters be stress tested to identify the actual hydraulic loading capacity. One of the ABW filters should be considered for conversion to a cloth media filter similar to Filter No. 1 to allow the facility to meet Class I reliability.

**Table 2.9 SWWRF Treatment Process Capacity Summary
Water Reclamation Facilities – Master Plan Development
Manatee County**

Unit Process	Capacity[1]	AADF Capacity
Influent Screens	48.0 mgd PHF	22 mgd
Influent Grit Removal	48.0 mgd PHF	22 mgd
Anoxic/Aeration Tanks	15.9 mgd MMADF	13.5 mgd
Secondary Clarifiers	49.7 mgd PHF	22.8 mgd
Filters	38.5 mgd PHF	17.7 mgd
Chlorine Disinfection	39.7 mgd PHF	18.2 mgd

Notes:
(1) Assuming all units in service.

4.0 SOUTHEAST WATER RECLAMATION FACILITY

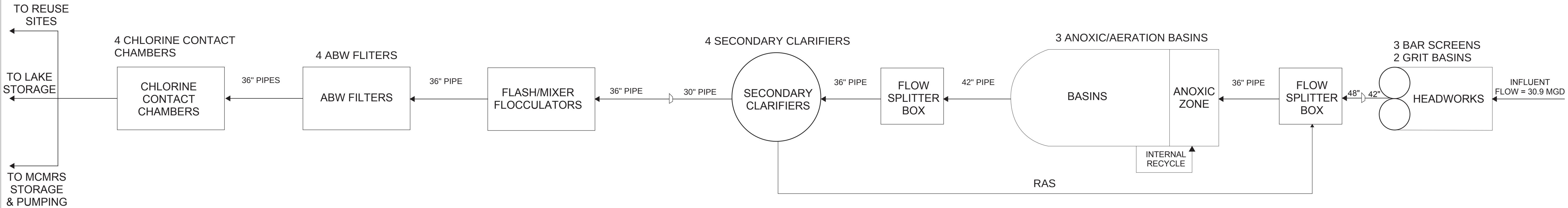
4.1 Hydraulic Evaluation

The hydraulic calculations for SEWRF represent the flow the path through the entire plant for one process unit. The SEWRF hydraulic profile and liquid flow schematic is shown in Figure 2.2. Water surface elevations are indicated at PHF of 29.87 mgd (includes 29.15 mgd of influent flow in 2035 and 0.72 mgd from future water treatment plant) and RAS flow of 11.7.

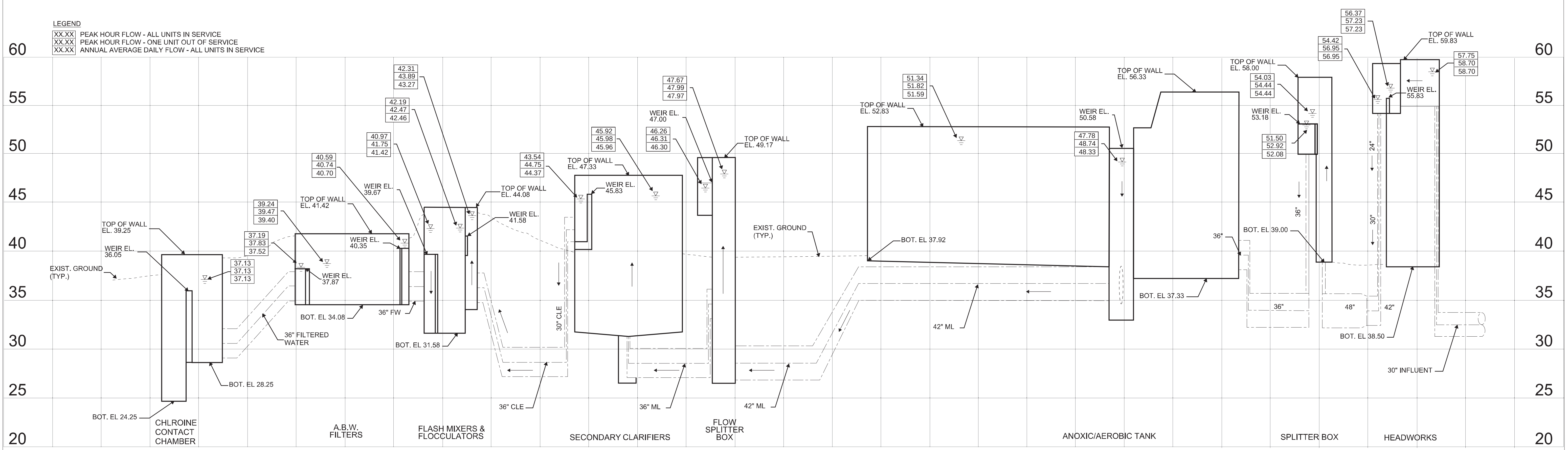
All referenced elevations, dimensions for existing structures, and existing pipe sizes are based on the following documents and assumed to be accurate:

- Existing hydraulic profile in the record drawings for the Manatee County Southwest Wastewater Treatment Plant Expansion (drawings dated 5/2002)

- Drawing set titled Design Survey Manatee WRF for Manatee County (drawing dated 4/2010) was assumed to be accurate.



PROCESS SCHEMATIC



HYDRAULIC PROFILE AT PEAK AND AVERAGE FLOWS

SEWRF - HYDRAULIC PROFILE

FIGURE 2.2

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

carollo

The assumptions are summarized in Table 2.10.

**Table 2.10 SEWRF Assumptions for Hydraulic Calculations
Water Reclamation Facilities – Master Plan Development
Manatee County**

Process Unit	Assumption(s)
Pipes	Hazen-Williams Friction Factor ~ 120
Secondary Clarifiers	Effluent launder width = 3 ft 6 in between v-notches Head loss = 4 in. Total RAS flow = 11.7 mgd
Bioreactors	Head loss = 6 in.
Grit Basins	Head loss = 8 in.
Bar screens	Head loss = 8 in.

4.1.1 Headworks Hydraulics

The headworks structure is designed with three mechanically cleaned screens each with a rated capacity of 12 mgd. The headworks structure also includes two grit removal units sized for 20.0 mgd capacity, each. The headworks effluent piping is not adequate to handle the PHF without submerging the discharge weir at the structure. During PHF condition, the two 24-inch pipes connecting the headworks effluent weir to 42 inch secondary influent pipe produces excessive head loss creating a hydraulic bottleneck. The 24-inch piping needs to be modified to reduce the head loss caused during a PHF condition.

4.1.2 Flow Equalization (EQ) Tanks

The existing EQ tanks are offline from the main liquid stream and are used to attenuate PHFs. The existing EQ basin is located between the existing headworks and bioreactors to attenuate peak flow events downstream of the headworks. However, for the hydraulic calculation purposes EQ tanks were not included in the profile. The processes (from headworks to chlorine contact chamber) are modelled for PHF of 29.87 mgd. The current existing total EQ capacity is estimated to be 2.8 MG (two EQ tanks, each with 1.4 MG capacity).

4.1.3 Secondary Treatment Hydraulics

The secondary treatment facilities are designed as Modified Ludzack-Ettinger (MLE) process to provide BNR. Therefore, the current secondary treatment facilities hydraulics was modeled with a PHF of 41.57 mgd (PHF of 29.87 mgd plus 11.7 mgd of RAS) with all units in service. The model shows the facility can hydraulically handle PHF of 41.57 mgd without significant issues. During PHF condition, the piping connecting the secondary treatment basins maintains velocities within acceptable ranges.

4.1.4 Tertiary Treatment Hydraulics

The tertiary treatment facilities (tertiary filters and chlorine contact chamber) can handle peak flow of 29.87 mgd with all units in service. The influent and effluent weirs at the filters and chlorine tank can handle peak hydraulic flow without submergence. However, the hydraulic calculations resulted in the submergence of the flash mixers and flocculator effluent weir. Based on the available freeboard in the flash mixer/flocculator at PHF, there is a possibility of splashing overtop of the walls. Carollo recommends further evaluation should be performed to eliminate possible splashing overtop of walls at flash mixers/flocculator. The velocities within all pipes related to tertiary treatment ranged from 3.0 to 4.0 fps with all units in service.

4.2 Treatment Capacity Evaluation

4.2.1 Introduction

The following sections summarize the estimated capacity for each unit process at the SEWRF. The assumptions made in completing this analysis are summarized in this section. It is assumed that the flow and load peaking factors to SEWRF are the same as those presented in the TM 1. The flow equalization tanks are assumed to be offline, therefore all treatment processes (preliminary and tertiary treatment) will need to treat the PHF. However, when online, the flow equalization tanks can be used to equalize the PHF to the MDF. The biological processes are designed to treat maximum month flows and loads. Capacities are based on mentioned wastewater characteristics and peaking and loading factors. Any changes in influent wastewater characteristics, recycle streams, and loading factors will require reevaluation of treatment capacity.

4.2.2 Headworks Capacity Rating

The headworks facility consists of three influent screening units followed by two grit removal units. Each of the influent screens and grit removal units are designed to treat 12 mgd and 20 mgd PHF, respectively, per manufacturers' ratings. Therefore, the headworks facility is designed for a total of 36 mgd PHF. A summary of the capacity of the headworks facility equipment is provided in Table 2.11.

Table 2.11 SEWRF Headworks Capacity Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
Mechanically Cleaned Bar screens	Number	3
	Screen opening	6 mm
	Peak capacity, each	12 mgd PHF
	Average capacity, each	6 mgd AADF
	Peak capacity, total	36 mgd PHF
	Average capacity, total	18 mgd AADF
	Peak capacity, total (1 OOS)(1)	24 mgd PHF
Manual Bar Screen	Number	1
	Screen opening	1 in.
Grit removal	Number	2
	Type	Forced vortex
	Diameter	16 ft
	Peak capacity, each	20 mgd PHF
	Average capacity, each	9 mgd AADF
	Peak capacity, total	40 mgd PHF
	Average capacity, total	18 mgd AADF
	Peak capacity, total (1 OOS)(1)	20 mgd PHF

Notes:

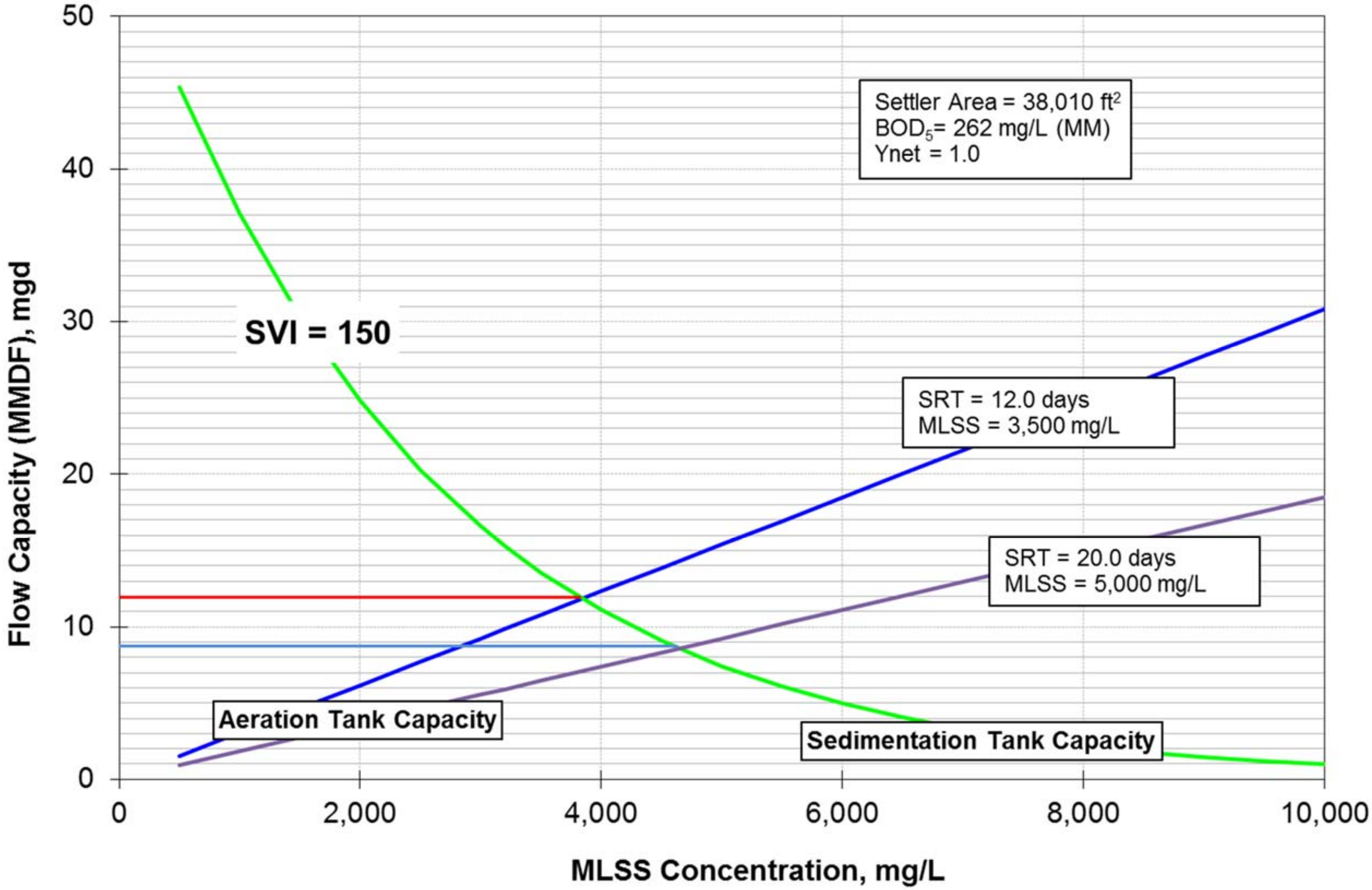
(1) Class I reliability requires demand (peak hour flow) to be met with largest unit out of service. Based on available capacities both bar screens and grit removal does not meet Class I reliability.

4.2.3 Biological Capacity Rating

The following sections summarize the biological processes capacity rating including the aeration tanks and secondary clarifiers.

4.2.3.1 Aeration-Clarification Capacity

The volume of the aeration tanks in conjunction with the number and size of the secondary clarifiers in operation establishes the treatment capacity as a function of the influent flow and influent loads, effluent treatment limits, mixed liquor suspended solids (MLSS) concentration, solids retention time (SRT), and the sludge volume index (SVI). Figure 2.3 displays a range of the biological treatment capacity based on a function of the MLSS concentration in the biological system. The capacity range is based on a MLSS of 3,500 mg/L with an SRT of 12 days and a MLSS of 5,000 mg/L with a SRT of 20 days. This range was developed from both anticipated facility design and the currently operated conditions, respectively. The range displays the capacity variation assuming a nominal settling velocity within the clarifier of 150 SVI.



SEWRF - AERATION - CLARIFICATION CAPACITY

FIGURE 2.3

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

The treatment capacity is calculated based on the design influent loads from TM 1. The influent loads to this facility are assumed to include:

- Influent municipal wastewater
- Leachate from two separate County operated landfills
- Hauled septage waste
- Sidestream return waste streams from the facility including the biosolids and sludge dryer systems

The County has provided data on the influent wastewater quality and sidestream return waste of the biosolids and sludge dryer systems. The County has limited data from the hauled septage waste and landfill leachate to document the specific impact to the facility biological loading. The current understanding is that the biological treatment is operated at a MLSS range of 5,000 mg/L corresponding to an SRT of 20 days. This operation is explained by the County as a means to minimize shock loading from the hauled septage waste. The concern with continued operation at this MLSS level and SRT has a drawback in that the original treatment capacity is reduced below the permitted capacity. This capacity reduction will reflect on future expansion needs as the flows to the facility increase.

The County's SEWRF biological treatment capacity is reduced based on current operations. The recommendation for this process prior to construction of new biological treatment is to evaluate the operational and influent loading conditions.

Evaluation of the loading condition is recommended to begin and continuously sample the septage waste, landfill leachate waste and sidestream return flows. This process is included in the County's current capital improvement plans.

For this evaluation, the County is recommended to identify sample points at the entry locations of each prior to mixing into the influent wastewater flows and begin a weekly sampling of these items. Minimum sampling and results should include:

- VSS
- COD (filtered and unfiltered)
- $cBOD_5$ (filtered and unfiltered)
- BOD5
- TOX (EPA 9020)
- pH

- Temperature
- Total Dissolved Solids
- Alkalinity
- TRPH (FLPRO method)
- BTEX

Included with the sampling is an anticipated daily volume for each waste stream identified as well as the current flow path of these flows entering the plant. The sampling plan should be evaluated with the County staff and engineer of record. Sampling is recommended to begin immediately and continue as the County receives these other waste streams.

As part of the evaluation analysis, it is recommended to evaluate operational aspects of the facility to understand the intermittent waste loading impacts, seasonal and diurnal variations of the flows. Potential adjustments and improvements can be discussed and then incorporated into the alternatives analysis evaluation. Some of the alternatives to consider are as follows:

- Relocation of waste stream flow in the process
- Development of a sidestream process treatment
- Expansion of the facility with an increased MLSS concentration

For purposes of the master plan recommendation, it is recommended to continue with the assumption of continued normal operation and the expansion of the facility identified based on a 3,500 mg/L MLSS and a SRT of 12 days.

4.2.3.2 Anoxic System Capacity Rating

The anoxic capacity was estimated based on maximum month conditions, 3,500 mg/L MLSS, and effluent ammonia and nitrate concentration of less than 1 and 12 mg/L, respectively. The influent nitrogen load is estimated based on design influent load from TM 1 (assumed to include County landfill leachate) plus the recycle load from the biosolids dryer. Septage and Duette landfill leachate are not included in the analysis because there is limited data available. Depending on the wastewater temperature, the maximum month treatment capacity of SEWRF is about 14.6 MMADF mgd at temperature of 22 degrees Celsius. This capacity is calculated assuming all three basins and all four clarifiers are in service.

4.2.3.3 Aeration System Capacity Rating

The aeration system consists of three existing mechanical aerators for each basin, total of 9 aerators. The mechanical aerators provide the oxygen demand exerted by the biological mass within the aeration tanks. The evaluation includes removing the largest aerator within one aeration basin to see, if the oxygen demand could be maintained with the remaining units in service. This evaluation is in accordance with Class I Reliability requirements. This evaluation did not consider location effects of the aerator taken off line and how this affects flow movement of mixing within each basin.

Table 2.12 summarizes the treatment capacity evaluation of the biological system. As shown, the aerators meet Class I reliability which requires demands to be met with one aerator out of service.

Table 2.12 SEWRF Biological System Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Criteria	Description
Number of Aerators	9
Type of Aerators	Mechanical
Horsepower, each Unit Aeration Capacity Horsepower, total	125 3.2 lb O_2/hr/HP(1) 1,125
Aerator capacity, maximum month(2) Aerator capacity, Class I Reliability(3)	14.1 mgd 12.5 mgd

Notes:
(1) Based on manufacturer's equipment information.
(2) Treatment capacity assuming effluent $cBOD_5$ of 5 mg/L, effluent ammonia of 1 mg/L, and oxygen use coefficient of 1.1 lb of O_2/lb $cBOD_5$. Oxygen transfer efficiency varies with the temperature. Provided capacity is at 22^{o}C.
(3) Class I reliability requires demand to be met with largest unit out of service. Based on calculation, with one aerator out of service meets Class I Reliability criteria.

4.2.4 Secondary Clarifier Capacity Rating

The existing secondary clarification at SEWRF consists of four clarifiers with a total surface area of 38,010 square feet. The secondary clarifiers were evaluated up to PHF conditions (29.87 mgd includes 29.15 mgd of influent flow in 2035 and 0.72 mgd from future water treatment plant) and RAS flow of 11.7 mgd. The capacity was calculated based on 10 State Standards, which are incorporated by reference into FDEP rules (Ch. 62.600, FAC). The governing standard for this analysis was the standard for peak hydraulic overflow rate, which resulted in a PHF capacity of 38.0 mgd, which is above the 2035 projected PHF. Class I reliability standards require the secondary clarifiers to treat 75 percent of the PHF with the largest unit out of service, which is 22.4 mgd at SEWRF. The clarifiers can treat 95 percent of the SEWRF PHF capacity with the largest unit out of service; therefore, Class I reliability requirements are met at 2035 PHFs. Table 2.13 provides a summary of the secondary clarifier capacity at SEWRF.

Table 2.13 SEWRF Secondary Clarification Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number	4
Type	Center feed, peripheral weir
Surface area, total	38,010 ft^2
Hydraulic loading at PHF	786 gpd/sq ft
Solids loading at MDF	19.3 lb/d/ft^2
Weir loading at PHF	21,610 gpd/ft
PHF capacity, total(1)	38.0 mgd
PHF capacity, Class I reliability(1)(2)	28.5 mgd

Notes:
(1) Based on 10 State Standards for peak hydraulic overflow rate of 1,000 gpd/ft^2.
(2) Calculated with one unit out of service.

4.2.5 Filtration Capacity Rating

There are currently 4 tertiary filter units at SEWRF that are all automatic backwash (ABW) filters with granular media. The overall PHF design capacity of the filters is 16.6 mgd, which is below the 2035 PHF capacity of 29.87 mgd. Class I reliability requires filters to treat 75 percent of the PHF with the largest unit out of service, which is 22.4 mgd at SEWRF. The ABW filters provide only 42 percent of the SEWRF PHF capacity when one unit is out of service. Therefore, the existing filters do not provide for Class I Reliability. A summary of the filtration capacity at SEWRF is provided in Table 2.14.

Table 2.14 SEWRF Filtration Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number	4
Type	Automatic backwash, traveling bridge
Surface area, each	1,440 sq ft
Surface area, total	5,760 sq ft
Peak loading rate(1)	2.0 gpm/sq ft
Peak capacity, total Peak capacity, Class I Reliability(2)	16.6 mgd 12.4 mgd

Notes:
(1) Maximum loading rate allowed by 10 State Standards is 5.0 gpm/sq ft. Actual loading may vary from assumed value. 2.0 gpm/sq ft was used for this analysis based on knowledge of similar ABW filters operating in the state of FL.
(2) Class I reliability requires 75% of peak flow treatment capacity with the largest unit out of service. Given one largest filter out of service, only 42% of peak capacity (29.87 mgd) is provided when it is out of service.

4.2.6 Disinfection Capacity Rating

There are four chlorine contact chambers at SEWRF. The disinfection volume installed at SEWRF has a peak capacity of 34.1 mgd with 1.7 mg/L chlorine residual. Class I reliability requires CCCs to treat 50 percent of the PHF with the largest unit out of service, which is 22.4 mgd in 2035. The CCCs provide 83 percent of the PHF capacity of 29.87 mgd; therefore, Class I reliability is met. Table 2.15 summarizes the disinfection capacity at SEWRF.

Table 2.15 SEWRF Disinfection Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number of Chlorine Contact Chamber	4
Type	Sodium hypochlorite contact chambers
Volume, total	355,450 gal
Minimum CT at Peak Flow(1)	25 mg/L-min
Peak Capacity, Total(2) Peak Capacity, Class I Reliability(3)	34.1 mgd 24.8 mgd
Number of Chorine Pumps	8
Total Capacity Available	700 gph
Capacity required to achieve min CT(4)	17.3 gph

Notes:
(1) Per Ch. 62-600.440, FAC for high level disinfection.
(2) All units in service and provide required CT at 1.7 mg/L chlorine residual and minimum of 15 minutes contact time per 10 State Standards.
(3) Class I reliability requires 50% of peak flow treatment capacity with the largest unit out of service. 83% of the peak flow (29.87 mgd) capacity is provided.
(4) Based on 1.7 mg/L chlorine dose, peak flow of 29.87 mgd, and 12.5% chlorine solution.

4.2.7 Solids Handling Capacity

4.2.7.1 Gravity Belt Thickener

The solids thickening at the SEWRF is provided by two gravity belt thickeners (GBTs). The capacity evaluation was performed using the design criteria for GBT from TM1 and solids data provided by the County (2009 to 2013). Evaluations also included capacity for EPA Class I reliability criteria. The filtrate from the GBTs is captured and drains into one of two different plant return pump stations to discharge back to the headworks for retreatment. Table 2.16 presents the estimated existing solids dewatering capacity.

Table 2.16 SEWRF Gravity Belt Thickeners Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Element	**Value**
Number of Units	2 (2 meter each)
Solids Loading Rate (SLR), each(1)	500 to 3,000 lbs/hr
Total SLR at 1.0% solids	4,000 lbs/hr (96,000 lbs/day)
Class I Capacity(3), SLR	2,000 lbs/hr (48,000 lbs/day)
SLR Capacity Utilization(4), %	12

Table 2.16 SEWRF Gravity Belt Thickeners Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Element	**Value**
SLR, EPA Class I Capacity Utilization(4), %	24
Hydraulic Loading Rate, each(2)	200 gpm
Hydraulic Loading Rate (HLR), total(2)	400 gpm
Class I Capacity, HLR	200 gpm
HLR Capacity Utilization(5), %	19
HLR, EPA Class I Capacity Utilization(5), %	39

Notes:
(1) Based on design criteria at feed solids of 0.5% and 1.5% respectively. And all calculations assume 24 hours per day/7 days per week of operation.
(2) Based on SLR of 2,000 lbs/hr and solid contents of 1.0%.
(3) Multiple units, design sludge flow should be able to be dewatered with largest unit out of service.
(4) Based on 0.20 mgd of WAS flow and solid contents of 1.0%.
(5) Based on 0.2 mgd of WAS flow rate, 1% solids content, and SLR of 2000 lbs/hr.

4.2.7.2 Aerated Sludge Holding Tanks

The ASHTs are mixed by three coarse bubble aeration systems. The total sludge holding volume is 2,000,000 gallons and the three available blowers are sized to deliver a maximum of 4,000 scfm each or 12,000 scfm combined. This corresponds to 15,094 pounds of oxygen per day per blower or 45,280 pound of oxygen per day in total, under standard conditions and assuming 15 percent standard oxygen transfer efficiency (SOTE). The air supply to the ASHTs are properly sized as documented by the following calculation check that show that Ten State Standards aeration sizing criteria is satisfied and can meet EPA Class I reliability criteria.

The supplied air divided by the total sludge volume equals 45 scfm/1,000 cu ft which exceeds the minimum of 30 cubic feet per minute (cfm) per 1,000 cu ft of sludge volume recommended in the Ten State Standards (2004). If we consider each ASHT with its dedicated blower aerating it (i.e. either one blower standby or out of service), its mixing input is approximately 30.0 scfm/1,000 cubic feet of sludge volume, meeting the minimum recommended guideline values.

Based on existing average WAS flow rate of 0.028 mgd at 4.0 percent solids from gravity belt thickeners to ASHTs (total storage volume of 2.0 million gallons, two ASHT), the available sludge storage capacity is 72 days (both ASHT in service) and 36 days with one ASHT out of service.

4.2.7.3 *Belt Filter Press Dewatering*

The solids dewatering capacity evaluation was performed using the design criteria for belt filter presses (BFPs) from TM1 and solids data provided by the County (2009 to 2013). Evaluations also included capacity for EPA Class I reliability criteria. The filtrate from the BFPs is captured and drains into one of two different plant return pump stations to discharge back to the headworks for retreatment. Table 2.17 presents the estimated existing solids dewatering capacity.

Table 2.17 SEWRF Dewatering (Belt Filter Press) Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Element	Value
Number of Units	3 (2 meter each)
Solids Loading Rate (SLR), each(1)	1200 lbs/hr
Total SLR	2,400 lbs/hr (57,600 lbs/day)
Class I Capacity(5), SLR	1,200 lbs/hr (28,800 lbs/day)
SLR Capacity Utilization(3), %	16
SLR, EPA Class I Capacity Utilization(3), %	32
Hydraulic Loading Rate, each(2)	60 gpm
Hydraulic Loading Rate (HLR), total(2)	120 gpm
Class I Capacity, HLR	60 gpm
HLR Capacity Utilization(4), %	17
HLR, EPA Class I Capacity Utilization(4), %	34

Notes:
(1) Based on design criteria and all calculations assume 24 hours per day/7 days per week of operation.
(2) Based on SLR of 1200 lbs/hr and 4% waste sludge solids.
(3) Based on 0.023 mgd of WAS flow and 9,300 lbs/day of WAS Solids Load.
(4) Based on 0.023 mgd of WAS flow rate, 4% solids content, and SLR of 1200 lbs/hr.
(5) Multiple units, design sludge flow should be able to be dewatered with largest unit out of service.

4.2.8 Summary of Treatment Processes

The overall capacity of SEWRF is summarized in Table 2.18 assuming all units in service and not accounting for the reliability criteria discussed in the previous sections. As shown, the filters are the limiting unit treatment process at SEWRF. The hydraulically limiting process is the effluent piping from the Headworks structure.

Table 2.18 SEWRF Capacity Rating Summary Water Reclamation Facilities – Master Plan Development Manatee County		
Unit Process	**Capacity(1)**	**AADF Capacity**
Influent Screens(2)	36.0 mgd PHF	18 mgd
Influent Grit Removal(2)	40.0 mgd PHF	18 mgd
Anoxic Tanks	14.6 MMADF	13.4 mgd(3)
Aeration Tanks	11.8 mgd MMADF	10.8 mgd(3)
Secondary Clarifiers	38.0 mgd PHF	15.2 mgd(4)
Filters	16.6 mgd PHF	6.6 mgd(4)
Chlorine Disinfection	34.1 mgd PHF	13.6 mgd(4)

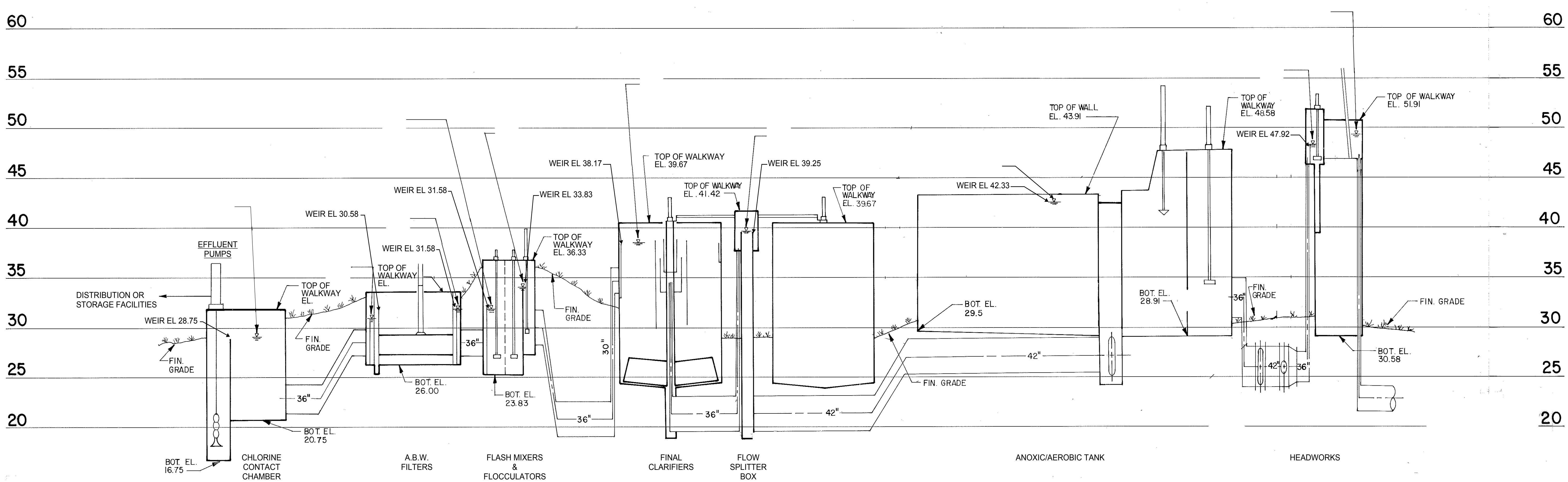
Notes:
(1) Assuming all units in service.
(2) Does not include hydraulic limits of the effluent piping assembly.
(3) Assumed historical MMF:AADF peaking factor from TM 1 of 1.09.
(4) Assumed design PHF:AADF peaking factor from TM 1 of 2.5.

5.0 NORTH REGIONAL WATER RECLAMATION FACILITY

5.1 Hydraulic Evaluation

5.1.1 Assumptions

The hydraulic profile was evaluated from the headworks through the effluent transfer station after the chlorine contact tanks. The hydraulic profile was modeled using Carollo's Hydraulic® model. The facility hydraulic profile and liquid flow schematic for NRWRF is shown in Figure 2.4. Water surface elevations are indicated for design PHF of 18.75 mgd (peak flow used is based on Level of Service report). Two scenarios were modeled at PHF, (1) All units in service and (2) One unit from each process out of service (OOS).



60
55
50
45
40
35
30
25
20
EFFLUENT PUMPS
DISTRIBUTION OR STORAGE FACILITIES
WEIR EL 28.75
FIN. GRADE
TOP OF WALKWAY EL.
FIN. GRADE
BOT. EL. 16.75
BOT. EL. 20.75
36"
CHLORINE CONTACT CHAMBER
WEIR EL 30.58
WEIR EL 31.58
WEIR EL 31.58
TOP OF WALKWAY EL.
BOT. EL. 26.00
36"
A.B.W. FILTERS
WEIR EL 33.83
TOP OF WALKWAY EL. 36.33
FIN. GRADE
BOT. EL. 23.83
FLASH MIXERS & FLOCCULATORS
36"
30"
WEIR EL 38.17
TOP OF WALKWAY EL. 39.67
36"
FINAL CLARIFIERS
TOP OF WALKWAY EL. 41.42
WEIR EL 39.25
FLOW SPLITTER BOX
TOP OF WALKWAY EL. 39.67
42"
FIN. GRADE
WEIR EL 42.33
TOP OF WALL EL. 43.91
BOT. EL. 29.5
42"
ANOXIC/AEROBIC TANK
BOT. EL. 28.91
36"
FIN. GRADE
TOP OF WALKWAY EL. 48.58
WEIR EL 47.92
42"
36"
TOP OF WALKWAY EL. 51.91
FIN. GRADE
BOT. EL. 30.58
HEADWORKS

carollo

Referenced elevations, dimensions for existing structures, and existing pipe sizes from the existing hydraulic profile in the record drawings for the latest Manatee County North Wastewater Treatment Plant Expansion (drawings dated 3/1985) and drawing set titled Design Survey Manatee WRF for Manatee County (drawing dated 4/2010) were assumed to be accurate. The assumptions are summarized in Table 2.19.

Table 2.19 NRWRF Assumptions for Hydraulic Calculations
Water Reclamation Facilities – Master Plan Development
Manatee County

Process Unit	Assumption(s)[1]
Pipes	Absolute Roughness = 0.0004
Tertiary Filters	Head loss = 1.0 ft
Secondary Clarifiers	Effluent launder width = 2 ft 6 in between v-notches Head loss = 4 in. Total RAS flow = 7.5 mgd
Bioreactors	Head loss = 6 in.
Grit Basin	Head loss = 8 in.
Bar screens	Head loss = 8 in.

Notes:
(1) Peak Flow of 18.75 mgd is used for hydraulic calculations (based on Level of Service report).

5.1.2 Preliminary Treatment Hydraulics

The bar screen and grit basin facilities can handle a peak flow of 18.75 mgd in both scenarios. The headworks effluent weir can handle the PHF of 18.75 mgd without submergence.

5.1.3 Secondary Treatment Hydraulics

The secondary treatment facility was modeled with (1) all units in service and (2) with one anoxic/aeration basin and one secondary clarifier out of service. In both scenarios, the secondary treatment facility can handle PHF of 26.25 mgd (Influent flow of 18.75 mgd plus RAS flow of 7.5 mgd). Although the secondary treatment facility can hydraulically handle the peak flow condition, extra attention must be given during high flows and units out of service to avoid splashing overtop of anoxic/aeration basin walls due to limited freeboard.

One recommendation to correct this concern is to provide additional freeboard on the peripheral walls of the aeration basins using stainless steel curbs in critical areas.

5.1.4 Tertiary Treatment Hydraulics

The existing four tertiary filters and chlorine contact chambers can handle proposed PHF of 18.75 mgd in both scenarios. However, the hydraulic calculations resulted in the submergence of the influent weir for the tertiary filters as well as the effluent weir for the flash mixers and flocculator. The velocities within all pipes related to tertiary treatment ranged from 1.5 to 3.7 fps with all units in service and 2.0 to 5.5 fps for one unit out of service (one filter and one chlorine tank). For calculating the hydraulic capacity with one unit out of service, it was assumed that one filter and one chlorine tank would be offline.

5.2 Treatment Capacity Evaluation

5.2.1 Introduction

The following sections summarize the estimated capacity for each unit process at NRWRF. The preliminary and tertiary treatment units (headworks, filters, and disinfection) are limited by their hydraulic treatment capacity, while the secondary treatment units (anoxic tanks and aeration tanks) are limited by their biological treatment capacity, and the secondary clarifiers are limited by hydraulic and solids loading.

5.2.2 Assumptions

The assumptions made in completing this analysis are summarized in this section. It is assumed that the flow and load peaking factors and influent water quality to NRWRF are the same as those presented in TM1. The preliminary and tertiary treatment will need to treat peak hour flows and the biological processes are designed to treat maximum month flows and loads. Capacities are based on mentioned wastewater characteristics and peaking and loading factors. Any changes in influent wastewater characteristics and loading factors will cause a need for reevaluation of capacity.

5.2.3 Headworks Capacity Rating

The headworks facility consists of two influent mechanical screening units followed by one grit removal unit. A project is currently underway to install a second grit removal unit, and the following analysis assumes this unit is already in place. The headworks facility has one manual backup screen meeting the requirements for Class I reliability. A summary of the capacity of the headworks facility equipment is provided in Table 2.20.

Table 2.20 NRWRF Headworks Capacity Water Reclamation Facilities – Master Plan Development Manatee County		
Process	**Criteria**	**Description**
Bar screens	Number Type Screen opening Peak capacity, each Average capacity, each Peak capacity, total Average capacity, total Peak capacity, total (1 OOS)[(1)]	2 Mechanically cleaned 6 mm 20 mgd PHF 7.8 mgd AADF 40 mgd PHF 15.6 mgd AADF 20 mgd PHF
Grit removal	Number[(2)] Type Diameter Peak capacity, each Average capacity, each Peak capacity, total Average capacity, total Peak capacity, total (1 OOS)[(1)]	2 Forced vortex 16 ft 20 mgd PHF 7.8 mgd AADF 40 mgd PHF 15.6 mgd AADF 20 mgd PHF

Notes:
(1) Class I reliability requires demand (peak hour flow) to be met with largest unit out of service. Also, there is a by-pass channel with manual screen which provides Class I Reliability.
(2) Project is underway to design and install second grit removal unit

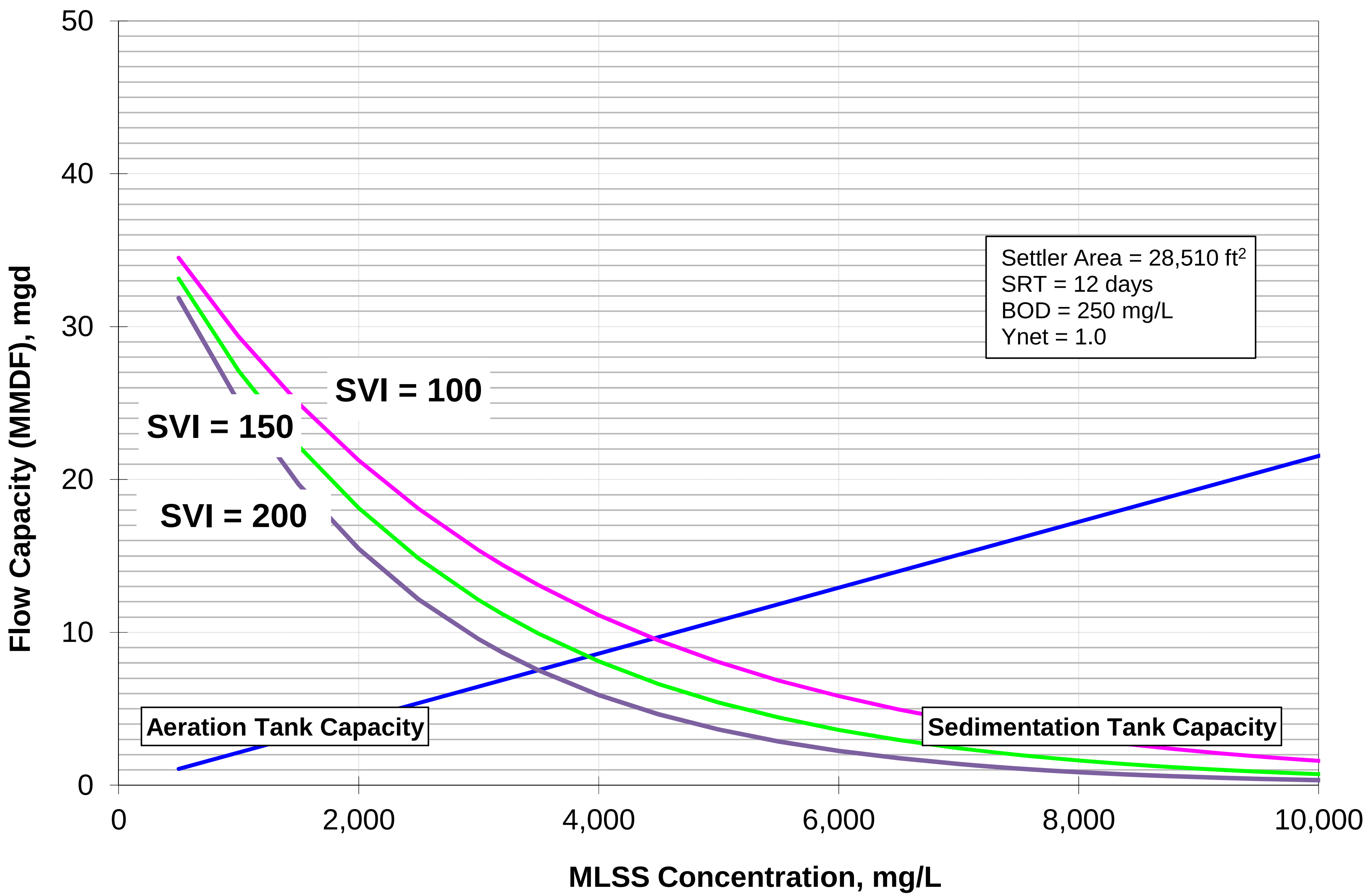
5.2.4 Biological Capacity Rating

The following sections summarize the biological processes capacity rating including the aeration tanks and secondary clarifiers. The capacity calculation is based on both basins and all three clarifiers in service.

5.2.4.1 Aeration-Clarification Capacity

The volume of the aeration tanks in conjunction with the number and size of the secondary clarifiers in operation establishes the treatment capacity as a function of the influent flow and pollutant loads, pollutant treatment goals, MLSS concentration, SRT, and SVI. An estimate of the capacity of NRWRF as a function of the MLSS concentration is provided in Figure 2.5. This figure was constructed assuming a net sludge yield of 1.0 lb total suspended solids (TSS) per lb of $cBOD_5$ removed, an aerobic SRT of 12.0 days, an max month BOD 250 mg/L, and using sludge settling coefficients in the Vesilind equation as measured by Daigger with all three clarifiers in service.

Depending on the sludge settling characteristics, the maximum month treatment capacity of NRWRF can vary from about 7.5 mgd for an SVI of 200 mL/g to 9.5 mgd for an SVI of 100 mL/g with all other factors held constant (Figure 2.5).



NRWRF - AERATION – CLARIFICATION CAPACITY

FIGURE 2.5

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo

pw:\\Carollo/Documents\Client/FL/Manatee County/9520B00/Deliverables/TM 2\Fig 2.5

This capacity is calculated assuming both aeration tanks and all three clarifiers are in service. Historical SVI data varies significantly, but the typical design value for SVI is approximately 150 mL/g. At an SVI of 150 mL/g, the optimum MLSS concentration is about 3,500 mg/L and maximum month treatment capacity is estimated at 8.3 mgd.

5.2.4.2 Anoxic System Capacity Rating

The anoxic capacity was estimated based on maximum month conditions, 3,500 mg/L MLSS, and effluent ammonia and nitrate concentration of less than 1 and 12 mg/L, respectively. Depending on the wastewater temperature, the maximum month treatment capacity of NRWRF is about 12.4 mgd at temperature 22 degrees Celsius.

5.2.4.3 Aeration System Capacity Rating

The aeration system consists of three mechanical aerators for each basin, total of 6 aerators. Table 2.21 summarizes the treatment capacity of the aerators. As shown, the aerators meet Class I reliability which requires demands are met with one aerator out of service.

Table 2.21 NRWRF Aeration System Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Criteria	Description
Number of Aerators	6
Type of Aerators	Mechanical
Horsepower, each Unit Aeration Capacity Horsepower, total	125 3.2 lb O_2/hr/HP 750
Treatment capacity, maximum month(1) Treatment capacity, Class I Reliability(2)(3)	10.2 mgd 8.5 mgd

Notes:
(1) Treatment capacity assuming effluent $cBOD_5$ of 5 mg/L, effluent ammonia of 1 mg/L, and oxygen use coefficient of 1.1 lb of O_2/lb $cBOD_5$. Oxygen transfer efficiency varies with the temperature. Provided capacity is at 22^{o}C.
(2) Class I reliability requires demand to be met with largest unit out of service. Based on the estimated capacity, the existing aeration system does meet Class I Reliability Criteria.
(3) Assumes, that only one aerator is out of service and not three at a time. Also, assumes out of service for short period of time.

5.2.5 Secondary Clarifier Capacity Rating

The existing secondary clarification at NRWRF consists of three clarifiers with a total surface area of 28,510 square feet. The secondary clarifiers were evaluated up to PHF conditions (18.75 mgd) and RAS flow of 7.5 mgd. The capacity was calculated based on

10 State Standards, which are incorporated by reference into FDEP rules (Ch. 62.600, FAC). The governing standard for this analysis was the standard for peak hydraulic overflow rate, which resulted in a PHF capacity of 28.5 mgd, which is above the design PHF. Class I reliability standards require the secondary clarifiers to treat 75 percent of the PHF with the largest unit out of service, which is 14.1 mgd at NRWRF. The clarifiers can treat over 100 percent of the NRWRF PHF capacity with the largest unit out of service; therefore, Class I reliability requirements are met at design PHFs. Table 2.22 provides a summary of the secondary clarifier capacity at NRWRF.

Table 2.22 NRWRF Secondary Clarification Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Criteria	Description
Number	3
Type	Center feed, peripheral weir
Surface area, total	28,510 ft^2
Hydraulic loading at PHF	658 gpd/sq ft
Solids loading at MDF	18.0 $lb/d/ft^2$
Weir loading at PHF	18,090 gpd/ft
PHF capacity, total(1)	28.5 mgd
PHF capacity, Class I reliability(1)(2)	19.0 mgd

Notes:
(1) Based on 10 State Standards for peak hydraulic overflow rate of 1,000 gpd/ft^2.
(2) Calculated with one unit out of service.

5.2.6 Filtration Capacity Rating

There are currently 4 tertiary filter units at NRWRF. Two are cloth disk filters with pile cloth media and the remaining two filters are ABW filters with granular media. The overall PHF design capacity of the filters is 32.5 mgd, which is above the design NRWRF PHF of 18.75 mgd. Class I reliability requires filters to treat 75 percent of the PHF with the largest unit out of service, which is 14.1 mgd at NRWRF. The ABW filters provide 100 percent of the NRWRF PHF capacity when the largest unit is out of service. A summary of the filtration capacity at NRWRF is provided in Table 2.23

Table 2.23 NRWRF Filtration Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number of Automatic Backwash (ABW) Filters	2
Type	ABW, traveling bridge
Surface area, each	1,440 sq ft
Surface area, total	2,880 sq ft
Peak loading rate(1)	< 2.0 gpm/sq ft
Number of Disk Filters	2
Type	Cloth Disk
Surface area, each	1,291 sq ft
Surface area, total	2,582 sq ft
Peak loading rate	< 6.5 gpm/sq ft
Total Number of Filters (Both Types)	4
Peak capacity, total Peak capacity, Class I Reliability(2)	32.5 mgd 20.4 mgd

Notes:

(1) Maximum loading rate allowed by Ten State Standards is 5.0 gpm/sq ft. Actual loading may vary from assumed value. 2.0 gpm/ sq ft was used for this analysis based on knowledge of similar ABW filters operating in the state of FL.

(2) Class I reliability requires 75% of design peak flow treatment capacity with the largest unit out of service. Given one largest filter out of service, 100% of peak capacity (18.75) is provided when it is out of service.

5.2.7 Disinfection Capacity Rating

There are currently four chlorine contact chambers at NRWRF. The disinfection volume installed at NRWRF has a peak capacity of 30.9 mgd with 1.0 mg/L chlorine residual. Class I reliability requires CCCs to treat 50 percent of the PHF with the largest units out of service, which is 14.1 mgd at NRWRF. The CCCs provide 100 percent of the PHF capacity of 18.75 mgd; therefore, Class I reliability is met. Table 2.24 summarizes the disinfection capacity at NRWRF.

Table 2.24 NRWRF Disinfection Capacity Water Reclamation Facilities – Master Plan Development Manatee County	
Criteria	**Description**
Number of Chlorine Contact Chamber	4
Type	Chlorine contact chambers (CCCs)
CCC No. 1 and 2 Length Width SWD CCC No. 3 and 4 Length Width SWD	 50 ft 24 ft 8 ft' 48 ft 27 ft 9.3 ft
Volume, each (for CCC No. 1 and 2) Volume, each (for CCC No. 3 and 4)	71,810 gal 89,180 gal
Volume, total	321,980 gal
Minimum CT at Peak Flow(1)	25 mg/L-min
Peak capacity, total(2) Peak capacity, Class I Reliability(3)	30.9 mgd 22.3 mgd
Number of Chorine Pumps	4
Total Capacity Available	280 gph
Capacity required to achieve min CT(4)	27.2 gph

Notes:

(1) Per Ch. 62-600.440, FAC for high level disinfection.
(2) All units in service and provide required CT at 1.0 mg/L chlorine residual and minimum of 15 minutes contact time per 10 State Standards.
(3) Class I reliability requires 50% of peak flow treatment capacity with the largest unit out of service. 100% of the peak flow (18.75 mgd) capacity is provided with one unit out of service.
(4) Based on 1.0 mg/L chlorine dose, peak flow of 18.75 mgd, and 12.5% chlorine solution.

5.2.8 Solids Handling Capacity

5.2.8.1 Aerated Sludge Holding Tanks

The ASHTs are mixed by two coarse bubble aeration systems and one fine bubble aeration system. The total sludge holding volume is 2.93 MG and the three available blowers are sized to deliver a maximum of 4,000 scfm each or 12,000 scfm combined. This corresponds to 15,094 pounds of oxygen per day per blower or 45,280 pounds of oxygen per day in total, under standard conditions and assuming
15 percent standard oxygen transfer efficiency (SOTE). The air supply to the ASHTs are

properly sized as documented by the following calculation check that show that Ten State Standards aeration sizing criteria is satisfied and can meet EPA Class I reliability criteria.

The supplied air divided by the total sludge volume equals 48 scfm/1,000 cu ft, which exceeds the minimum of 30 cfm /1,000 cu ft of sludge volume recommended in the Ten State Standards (2004). If we consider each ASHT with its dedicated blower aerating it (i.e. either one blower standby or out of service), its mixing input is approximately 31.8 scfm/1,000 cu ft of sludge volume, which is still over the minimum recommended guideline values.

Based on existing average WAS flow rate of 0.028 mgd at 4.0 percent solids and total storage volume of 1.88 million gallons (two ASHT), the available sludge storage capacity is approximately 40 days (both ASHT in service) and 20 days with one ASHT out of service.

5.2.8.2 Belt Filter Press Dewatering

The solids dewatering capacity evaluation was performed using the design criteria for belt filter presses (BFP) from TM1 and solids data provided by the County (2009 to 2013). Evaluations also included capacity for EPA Class I reliability criteria. Table 2.25 presents the estimated existing solids dewatering capacity.

Table 2.25 NRWRF Dewatering (Belt Filter Press) Capacity
Water Reclamation Facilities – Master Plan Development
Manatee County

Element	Value
Number of Units	3 (2 meter each)
Solids Loading Rate (SLR), each(1)	1200 lbs/hr
Total SLR	3,600 lbs/hr (86,400 lbs/day)
Class I Capacity(5), SLR	2,400 lbs/hr (57,600 lbs/day)
SLR Capacity Utilization(3), %	9
SLR, EPA Class I Capacity Utilization(3), %	12
Hydraulic Loading Rate, each(2)	120 gpm
Hydraulic Loading Rate (HLR), total(2)	360 gpm
Class I Capacity, HLR	240 gpm
HLR Capacity Utilization(4), %	10
HLR, EPA Class I Capacity Utilization(4), %	15

Notes:
(1) Based on design criteria and all calculations assume 24 hours per day/7 days per week of operation.
(2) Based on SLR of 1200 lbs/hr and 2.0% solids.
(3) Based on 0.0473 mgd of WAS flow and 6,700 lbs/day of WAS Solids Load.
(4) Based on 0.0473 mgd of WAS flow rate, 2% solids content, and SLR of 1200 lbs/hr.
(5) Multiple units, design sludge flow should be able to be dewatered with largest unit out of service.

5.2.9 Summary

The overall capacity of NRWRF is summarized in Table 2.26, all units in service, and not accounting for the reliability criteria discussed in the previous sections. As shown, the secondary treatment is the limiting unit process at NRWRF.

Table 2.26 NRWRF Capacity Rating
Water Reclamation Facilities – Master Plan Development
Manatee County

Unit Process	Capacity(1)	AADF Capacity
Influent Screens	40.0 mgd PHF	15.6 mgd
Influent Grit Removal	40.0 mgd PHF	15.6 mgd
Anoxic Tanks	12.4 mgd MMADF	11.0 mgd(2)
Aeration Tanks	8.3 mgd MMADF	7.3 mgd(2)
Secondary Clarifiers	28.5 mgd PHF	11.4 mgd(3)
Filters	32.5 mgd PHF	13.0 mgd(3)
Chlorine Disinfection	30.9 mgd PHF	12.4 mgd(3)

Notes:
(1) Assuming all units in service.
(2) Assumed historical MMF:AADF peaking factor from TM 1 of 1.13.
(3) Assumed design PHF:AADF peaking factor from TM 1 of 2.5.

6.0 SUMMARY

The following sections summarize the results of reliability and capacity evaluation for each of the WRFs.

6.1 Southwest Water Reclamation Facility

The hydraulic profile evaluation found the following constraints:

- The effluent weir at the headworks is submerged at PHF conditions.

The treatment capacity evaluation found the following constraints:

- Based on the design capacity, the proposed aeration system (5 existing and 2 new blowers) does not meet Class I reliability (meet MDF air demands with largest unit out of service). An additional 10,725 scfm is required to meet MDF conditions.
- The filters only provide 43 percent of the PHF capacity when the AquaDiamond filter is out of service, which does not meet the Class I reliability (75 percent of PHF with largest unit out of service).
- Recommend installation of new biological treatment train and perform influent loading evaluation of the facility.

6.2 Southeast Water Reclamation Facility

The hydraulic profile evaluation found the following constraints:

- The effluent weir at the headworks is submerged at PHF due to hydraulic constraints in the piping between the headworks and the splitter box.
- The effluent weir at the flash mix/flocculation tanks is submerged at PHF and freeboard is limited.

The treatment capacity evaluation found the following constraints:

- Filters have a limiting capacity of 16.6 mgd PHF due to the lower hydraulic loading capacity assumed with ABW type filters.
- The biological capacity is the limiting treatment process at approximately 10.8 mgd AADF due to the current influent loadings. An influent loadings and biological treatment evaluation is recommended. .

6.3 North Regional Water Reclamation Facility

The hydraulic profile evaluation found the following constraints:

- The anoxic/aeration basins were shown to have limited freeboard during PHF conditions.

The treatment capacity evaluation found the following constraints:

- The aeration tank biological capacity is the limiting treatment process at a 7.3 mgd AADF amount assuming a SRT of 12 days.

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM NO. 3
EVALUATION OF FUTURE NEEDS
FINAL
May 2017

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM
NO. 3

EVALUATION OF FUTURE NEEDS

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EVALUATION OF FUTURE NEEDS

1.0 INTRODUCTION

As part of development of the Facilities Master Plans for each of the three water reclamation facilities (WRFs), this technical memorandum (TM) summarizes the population and flow projections based on Level of Service (LOS) requirements, reuse demands, regulatory requirements, asset management, and future treatment needs for all three WRFs.

2.0 POPULATION AND WASTEWATER FLOW PROJECTIONS

2.1 Population Projections

Population projections were provided by the County in the form of Traffic Analysis Zone (TAZ) GIS shapefiles. Population projections were given in 5-year increments through 2040. Future scenarios to be included in the master plan are the 5-year (2020), 10-year (2025), and 20-year (2035) planning periods.

Table 3.1 summarizes the population projections provided by the County broken down by service area. The population projections provided by the County include the population served by septic tanks. The projected population in this section will be used to project planning period (2035) influent flows to each service areas.

Table 3.1 Population Projections Provided By County (Including Population Served by Septic Tanks)
Water Reclamation Facilities – Master Plan Development
Manatee County

Year	North	Southeast	Southwest	Total
2015	59,535	96,950	117,434	273,919
2020	66,140	106,990	122,222	295,352
2025	72,772	117,077	127,053	316,902
2030	79,364	127,086	131,816	338,266
2035	85,988	137,152	136,624	359,764

2.2 Level of Service

The County recently revised the LOS from their previous established LOS for the North and Southeast Service Areas based on the results of a concurrent project completed by Carollo (LOS Evaluation Report, 2015). The revised LOS values for the North and Southeast more accurately represent the current conditions. Using the previous LOS values could have led to premature or unnecessary capital improvement projects. The Southwest Service Area

LOS was not changed since the actual flow per person was much closer to the LOS. The revised LOS will be used for projecting flows through the planning period (2035) and are illustrated in Table 3.2.

Table 3.2 Level of Service
Water Reclamation Facilities – Master Plan Development
Manatee County

Service Area	Historical 5-Year Average Flow per Person (gpcd)	Previous LOS (gpcd)	Revised LOS(1) (gpcd)
North	73.6	95	80
Southeast	69.3	95	85
Southwest	108.7	115	115

Notes:
(1) The County revised the LOS for the North and Southeast Service areas in May 2015 as a result of the LOS Evaluation Report, 2015.

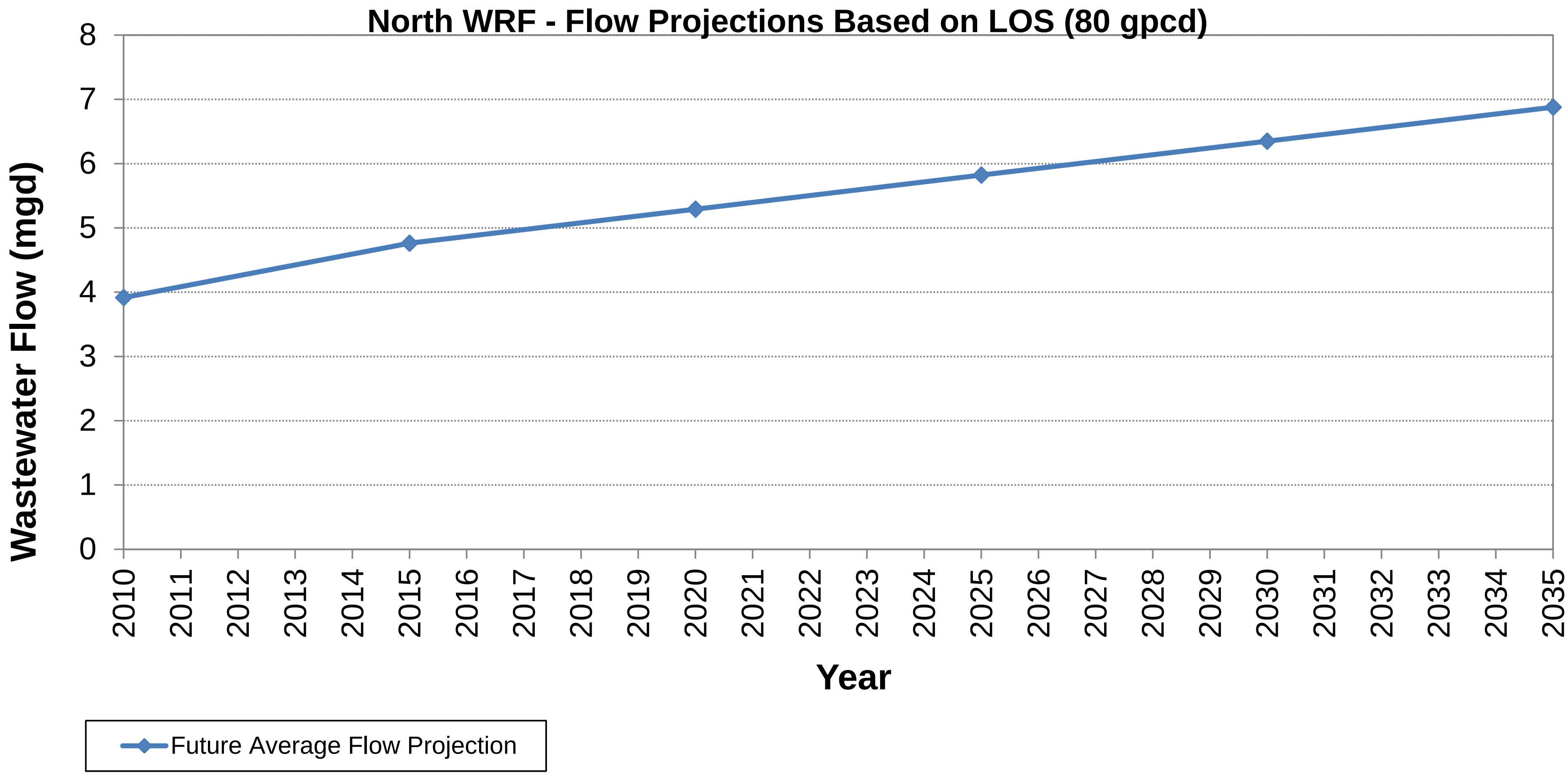
2.3 Projected Wastewater Flows

Figure 3.1, Figure 3.2 and Figure 3.3 show the projected wastewater flows for each service area. Table 3.3 summarizes the projected annual average wastewater flows for each planning period for the North, Southeast, and Southwest Service Areas. The annual average flows were developed using the per capita wastewater flow LOS values revised in May 2015.

Table 3.3 Projected Wastewater Flows
Water Reclamation Facilities – Master Plan Development
Manatee County

	Annual Average Wastewater Flow (mgd)		
Year	North Service Area(1)	Southeast Service Area(2)	Southwest Service Area(3)
2014 (Current)	3.63	6.68	12.48
2015	4.76	8.24	13.50
2020	5.29	9.09	14.06
2025	5.82	9.95	14.61
2030	6.35	10.80	15.16
2035	6.88	11.66	15.71

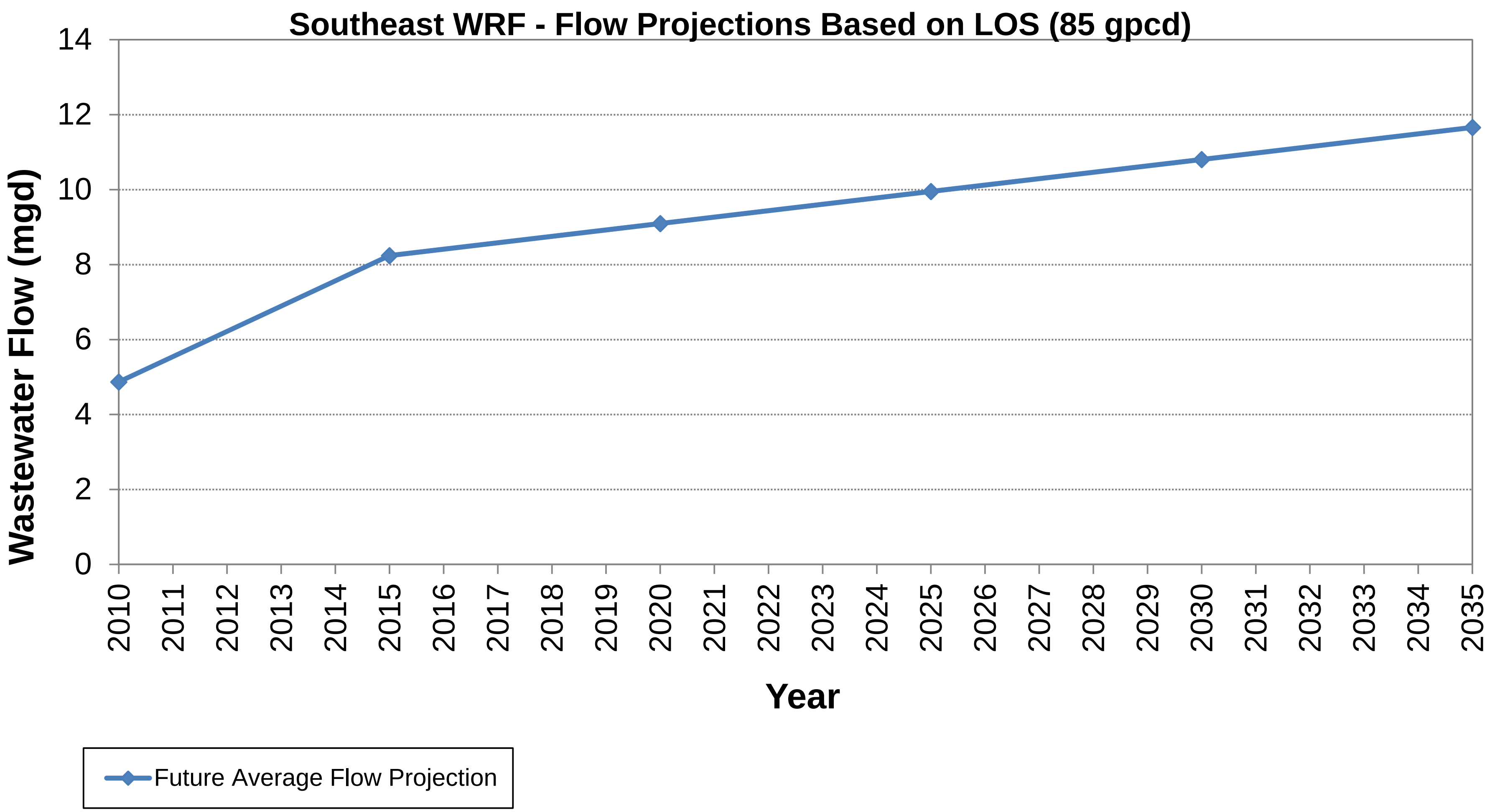
Notes:
(1) Based on estimated populations presented in Table 3.1 and a future average flow per person of 80 gpcd.
(2) Based on estimated populations presented in Table 3.1 and a future average flow per person of 85 gpcd.
(3) Based on estimated populations presented in Table 3.1 and a future average flow per person of 115 gpcd.



NORTH WRF - FLOW PROJECTION BASED ON LOS (80 GPCD)

FIGURE 3.1

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

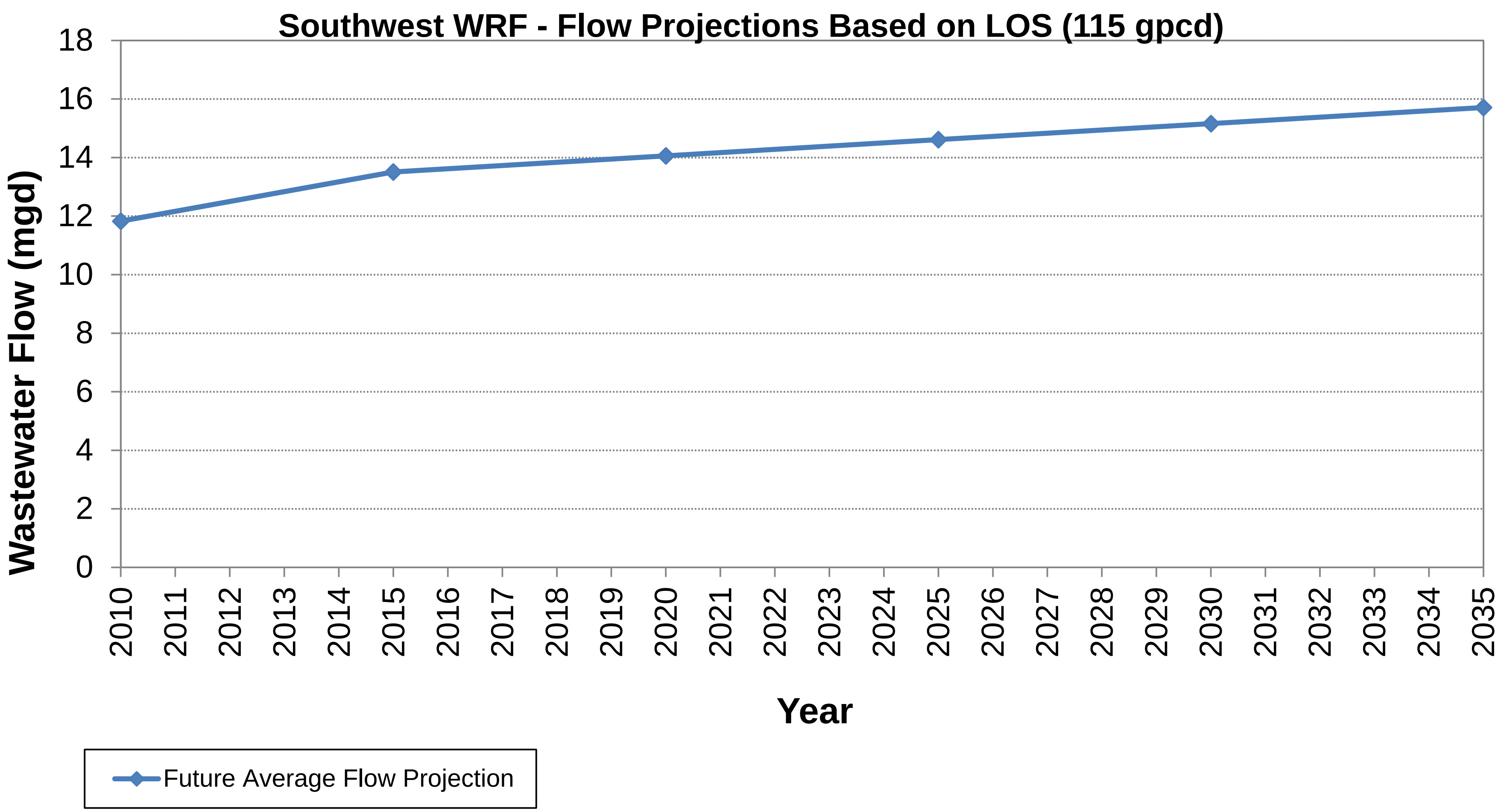


SOUTHEAST WRF - FLOW PROJECTION BASED ON LOS (85 GPCD)

FIGURE 3.2

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

carollo



SOUTHWEST WRF - FLOW PROJECTION BASED ON LOS (115 GPCD)

FIGURE 3.3

MANATEE COUNTY
WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

Table 3.3 shows that the annual average flows within the North Service Area are not expected to exceed the North Regional Water Reclamation Facility (NRWRF) existing permitted capacity of 7.5 million gallons per day (mgd) three-month rolling average daily flow (TMRADF) through 2035. The annual average daily flows are expected to approach the existing Southeast Water Reclamation Facility (SEWRF) permitted capacity of 11 mgd (TMRADF) by 2035. It should be noted the average ratio between the County's annual average daily flow (AADF) and the 3MRADF was determined to be essentially 1 for this evaluation. The AADF are expected to remain below the existing 15 mgd AADF capacity of the Southwest Water Reclamation Facility (SWWRF) through 2030 and begin to exceed the capacity by 2035.

3.0 HISTORICAL AND PROJECTED REUSE DEMANDS

Manatee County's WRFs are not permitted for surface water discharge; consequently, deep well injection and reuse are the only effluent disposal options available to the County. Manatee County actively promotes the use of reclaimed water throughout its service areas. The majority of the County's reclaimed water demand comes from agricultural users, located throughout the County. In response to the New Water Source Initiative (NWSI) developed by the Southwest Florida Water Management District (SWFWMD), the County developed the Manatee County Agricultural Reuse System (MARS). The intent of the MARS was to provide reclaimed water to agricultural customers in order to reduce the groundwater withdrawals from the potable water supply aquifer. The majority of the County's wastewater is generated in the Southwest service area. However, most of the reclaimed water demand is in the agricultural areas, chiefly situated in the northern portion of the County. The SWWRF, SEWRF, and NRWRF are all linked via the MARS transmission pipes that transfer the excess effluent in the southwest to the agricultural demand in the southeast and north.

Construction of the MARS system was completed in 2006. Completion of the system also coincided with numerous changes to the regional water resource landscape including changing land use patterns in eastern Manatee County, regulatory changes, water use conditions, and financial conditions. The Manatee County Utilities Department (MCUD) is faced with needs related to growth and development of its reclaimed water program into the future.

3.1 Historical Reuse Demand

Based on the Reclaimed Water System Master Plan Update (2013), in 2008, the County provided approximately 15 mgd AADF of reclaimed water to users throughout the County. The agricultural operations of the Manatee Fruit Company, Schroeder-Manatee Ranch, and McClure Farms represent the largest reclaimed water customers. These users are located in the Southwest, Southeast, and North service areas, respectively. Table 3.4 presents a summary of existing reclaimed water demand in each service areas.

Table 3.4 Summary of Existing Reuse Demand Water Reclamation Facilities – Master Plan Development Manatee County		
Service Area	**Customer Type(1)**	**Est. Total Annual Average Day Reclaimed Water Demand (MGD)(2)**
North	Ag/Re/GC	2.52
Southeast	Ag/Re/GC/Co	4.91
Southwest	Ag/Re/GC/Co	7.41
TOTAL DEMAND		**14.84 mgd**

Notes:
(1) Ag = Agricultural; Re = Residential; GC = Golf Course; Co = Commercial.
(2) Total reuse demand taken from Reclaimed Water System Master Plan Update (2013), Table 3.2. Numbers are rounded to two decimal points.

3.2 Future Reuse Demand Projection

To meet the County's need of disposing of treated effluent per the operating permits of the WRFs, the focus of growth for the County's reclaimed water system will be to serve the planned residential developments in closest proximity to the reclaimed water transmission mains as they are constructed throughout the planning period. These potential users are divided into four groups as summarized in Table 3.5. The County's decision to actively pursue more new residential customers than new agricultural customers results from the need to have a stable customer base receiving reclaimed water.

Table 3.5 Additional Projected Demand by Potential User Type Water Reclamation Facilities – Master Plan Development Manatee County		
Type[1]	**Total Acres**	**Demand (gpd)**
Priority Potential Users with Dry Lines	627	730,000
Potential Users Adjacent to an Existing Reclaimed Water Line	8,399	9,996,000
Potential Users Requiring a New Transmission Pipe Within a Future Improved Roadway	12,200	8,861,000
Potential users Requiring a New Transmission Pipe Not Within a Future Improved Roadway	1,890	3,478,000
TOTAL	**23,116**	**23,065,000**

Notes:
(1) Total projected reuse demand taken from Reclaimed Water System Master Plan Update (2013), Table 3.6, Table 3.7, Table 3.8, and Table 3.9.

Currently the county's reclaimed water use is approximately 15 mgd. An additional 0.73 mgd of potential reclaimed water demand has been identified from properties with dry lines (currently have dry reclaimed water distribution piping installed). These properties have been categorized as priority users to be provided reclaimed water. All of these potential users are residential developments.

There is approximately 10 mgd of reclaimed water demand for potential users adjacent to existing reclaimed water lines. A majority of these users require minor improvements to start using reclaimed water. Approximately 86 percent of these users are residential. The majority of the users are in North with the remainder in the Southeast Service Areas.

There is approximately 8.86 mgd of reclaimed water demand form potential users that need a new transmission pipe within a future roadway, as identified in the County's transportation master plan. A majority of these potential users are found to be residential development. The demand is found to be near several clusters of planned developments within the North and Southeast Service Areas.

The final projected reclaimed demand totaling approximately 3.48 mgd requires a new transmission main and is not within a future improved roadway area. These projected demands represent the most cost intensive projects to expand reclaimed water and will need to be evaluated on a cost benefit ratio related to the project cost and amount of total reclaimed disposal.

4.0 EXISTING AND ANTICIPATED REGULATORY REQUIREMENTS

The purpose of the regulatory review task is to identify existing and potential future regulations including applicable federal, state, and local requirements that may affect or constrain the choice of treatment technologies for improvements and expansion, or affect the timing of these improvements. A range of probable regulatory alternatives were developed to determine the effect of differing requirements on treatment/disposal facilities, including descriptions of which regulations will likely change and which may be promulgated predominantly unchanged. Regulatory requirements from the Florida Department of Environmental Protection (FDEP) and the Tampa Bay Nitrogen Management Consortium (TBNMC) were reviewed as part of this task.

4.1 Current Regulatory Requirements

All of the County's WRFs are regulated through FDEP, which primarily deals with the quality of effluent discharged from the facilities, disposal of biosolids generated by the facilities, and the nature of waste material in the collection facilities. In addition, the County is issued a combined Master Reuse System permit (FDEP Permit No. FLA474029). The existing permit expires in September if 2017. This permit treats the reclaimed water system as a single entity and authorizes Manatee County to distribute up to 33.5 mgd of public access treated reuse water from the County's three WRFs throughout the wastewater service areas to designated users. System capacity can be increased as needed with permit revisions.

Manatee County's three WRFs have a combined permitted capacity of approximately 33.5 mgd AADF. SWWRF (FDEP Permit No. FLA012619) is currently permitted for 15.0 mgd AADF, SEWRF (FDEP Permit No. FLA012681) has a permitted capacity of 11.0 mgd TMRADF, and NRWRF (FDEP Permit No. FLA012617) has a permitted capacity of 7.5 mgd TMRADF. For detailed information of discharge permits refer TM 1.

Further, Chapter 62-600 (Domestic Wastewater Facilities), Chapter 62-610 (Reuse of reclaimed Water and Land Application), and Chapter 62-650 (Water Quality Based Effluent Limitations) were reviewed for any potential changes in regulations. Currently there are no changes to Chapter 62-600 and Chapter 62-650, however, Chapter 62-610 is currently under revision.

4.2 Nitrogen Reasonable Assurance

As part of developing the Nitrogen TMDL for Tampa Bay and its tributary watersheds, the Tampa Bay Nitrogen Management Consortium (NMC) published the *2009 Reasonable Assurance Addendum: Allocation and Assessment Report* (RA), which sets nitrogen allocations for the EPA's TMDL for Tampa Bay. The NMC is a group of more than 40 local governments and industries who have voluntarily committed to cap their nitrogen loads at average annual levels recorded in 2003 through 2007. These levels also meet the 1998 FDEP TMDL for nitrogen. These capped allocations have been adopted by the State of Florida as Water Quality Based Effluent Limits (WQBELS), and have been incorporated into a number of facility surface water discharge permits. The allocations are also defined and grouped by bay segment (Lower Tampa Bay, Upper Tampa Bay, Old Tampa Bay, and Hillsborough Bay). The allocations are based on previous years of data and are, in most cases, more stringent than the nitrogen limits currently specified in the National Pollutant Discharge Elimination System (NPDES) permits for the individual facilities that have them.

The three Manatee County facilities rely primarily on reclaimed water customers for treated effluent disposal. Manatee County has a general FDEP permit for the MCMRS (Permit No. FLA474029). The MCMRS indirectly impacts the Middle and Lower Tampa Bay segments through watershed impacts from both the slow rate irrigation and non-lined storage pond filtration into the groundwater.

The RA defines set a five-year annual average discharge allocation for total nitrogen of 6.6 tons/year from the MCMRS to Middle Tampa Bay (3.9 tons/year from North Reuse discharge allocation) and Lower Tampa Bay (2.7 tons/year from Southeast Reuse discharge allocation). This allocation is a 5-year average and represents the sum of the total nitrogen discharge from two Manatee County WRF's wastewater treatment facilities into the Tampa Bay watershed area. Loads for an individual year may be higher, as long as the average over a 5-year period does not exceed 6.6 tons/year.

The nitrogen allocation in the RA for each wastewater treatment facility is subdivided into a surface water discharge allocation (point source), when applicable, and a reclaimed water discharge allocation (non-point source). Surface water discharges are assumed to contribute the full nitrogen load from the effluent of the treatment facility to Tampa Bay. Reclaimed water discharges (both slow rate irrigation and rapid rate infiltration) are assumed to contribute 10 to 30 percent of the total effluent nitrogen load. This reduction in loading is assumed due to attenuation/uptake of nitrogen in the irrigation/groundwater process prior to reaching Tampa Bay.

For residential irrigation, an attenuation of 90 percent is assumed, while for infiltration basins (unlined storage ponds) the allowed attenuation is 70 percent. The MCMRS TN load allocation and attenuation factors are summarized in Table 3.6.

Table 3.6 Reuse TN Load Allocation and Attenuation Factors
Water Reclamation Facilities – Master Plan Development
Manatee County

System	**Nitrogen Allocation**
MCMRS	6.6 tons/year (5-year average)
Effluent Destination	**TN Load Attenuation Factor**
Residential Irrigation	0.9
Percolation Ponds (RIBs)	0.7

4.3 Regulatory Conclusion

The evaluation of the future regulatory issues found no significant impact to Manatee County's WRF permits in the near future. The main regulatory issue on the horizon is to minimize nutrients from each of the wastewater facilities, mainly nitrogen, based on the surrounding issues with Tampa Bay. The main concerns for the regulatory agencies are the facilities that have surface water discharges. Manatee County does not have a surface water discharge and has committed to disposal of through reclaimed water irrigation.

Recently, the County has been pro-active at reducing nutrients, mainly nitrogen, from their effluent for each of the facilities including the recent upgrades to the SWWRF. The County is compliant with the current permit effluent limits. The County should to continue to look for further cost effective alternatives to minimize nitrogen from their effluent at each of the facilities and implement as these items present benefit. It is recommended that the County evaluate the regulatory items during the next permit renewal for each individual wastewater facility and incorporate any benefitting items at this time. Other steps for reducing nitrogen to Tampa Bay could include reducing reclaimed water sent to the RA impacted area and studying the actual nitrogen load that makes its way to Tampa Bay.

5.0 ASSET MANAGEMENT PLAN (AMP) ASSESSMENT

5.1 Background and Objectives

This section discusses the asset replacement needs at the three WRFs and outlines the framework used for developing a 40-year Asset Management Plan (AMP) that documents asset condition and estimates asset replacement funding requirements and timing through 2054. The overall goal of the AMP is to provide Manatee County with a review of the condition of the existing assets.

The primary objectives of the AMP are to:

- Document current asset condition.
- Determine the service lives and remaining useful lives of the assets.
- Estimate replacement costs of the assets.

This Master Plan Development work assignment included the AMP development for the NRWRF and the SEWRF. An AMP for the SWWRF was previously developed under a separate work assignment, but for the sake completeness the results from that plan are repeated herein.

5.2 Assumptions and Methodology

This section describes the approach used to compile the asset inventory for each WRF, evaluate the assets and assign a condition score, determine the original useful lives of the assets, and estimate replacement costs and timing.

5.2.1 Asset Inventory and Condition Assessment

An asset inventory was developed for each WRF using existing as-built drawings, operation and maintenance manuals, construction document (drawings and specifications) and other available facility information. An “asset” is defined as a complete physical component of a facility that enables service to be provided, is critical to facility operation, and generally has high replacement costs (greater than $5,000). Underground assets were not included in this assessment.

Carollo conducted a visual condition assessment only, which included a field evaluation of the aboveground assets. Facility staff interviews, review of historical maintenance and performance documentation, design criteria, and installation date were used to estimate the condition of the equipment that was not visible at the time of the inspection. The visual condition assessment was performed by a multi-disciplinary team experienced in various fields of engineering.

The condition of each asset was evaluated using a 1 through 5 ranking scale based on the International Infrastructure Management Manual (IIMM). In the IIMM, condition is expressed in terms of the amount of repair needed to bring an asset to “like new” condition. Definitions for the 1 through 5 condition ranking system are presented in Table 3.7.

Table 3.7 Asset Condition Score Descriptions
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Ranking(1)	Description(1)	Percent of Asset Requiring Repair(1) (2)
1	Very Good Condition	0%
2	Minor Defects	0 - 10%
3	Maintenance Required to Return to Accepted Level Service; Backlog of Maintenance Required	11 - 20%
4	Requires Rehabilitation; Major Renewal Required	21 - 49%
5	Asset Unserviceable or Obsolete	50% and above

Notes:
(1) Adapted from the International Infrastructure Management Manual (IIMM).
(2) “Percentage of asset requiring repair” is that percentage of the value of the asset needed to return the asset to a condition ranking of one.

5.2.2 Replacement Timing

The following sections describe the methodology used to determine asset remaining useful life as well as the replacement timing.

5.2.2.1 Original Useful Life

The original useful life (OUL) of an asset is the number of years the asset is expected to be in service as a function of asset type (i.e., mechanical, structural, or electrical). This value is used to develop different estimates of remaining useful life, as described in subsequent sections. The OUL estimates for different types of assets are presented in Table 3.8.

Table 3.8 Estimated Original Useful Life Based on Asset Type Water Reclamation Facilities – Master Plan Development Manatee County Utilities	
Asset Category	**Original Useful Life(1)**
Civil/Site Work	50
Structural	
General/Other	50
Concrete	50
Fiberglass	25
Steel	25
Plastic	10
Mechanical	
General/Other	20
Pumps – Water	20
Pumps – Wastewater	15
Chemical Equipment	15
Raw Sewage Bar Screens	10
Electrical	30
Instrumentation	15
Computer Systems/SCADA	7

Notes:
(1) These values were estimated based on a combination of the IIMM, AWWA, WEF ASCE guides, other industry references, and Carollo experience.

The OUL was estimated based on industry standard guidelines (e.g., American Water Works Association (AWWA), Water Environment Federation (WEF), American Society of Civil Engineers (ASCE), and the IIMM) and Carollo's internal discipline-specific experience.

5.2.2.2 Remaining Useful Life

An asset's remaining useful life (RUL) is defined as the original service life or OUL minus the number of years the asset has been in service (calculated from the installation year).

$$RUL = OUL - \text{Years in Service}$$

5.2.2.3 Evaluated Remaining Useful Life

The evaluated remaining useful life (EvRUL) is based on the current condition of the asset. The EvRUL is calculated based on the estimated remaining number of years until the physical failure of the asset based on its condition. The EvRUL does not consider the actual age of the asset; rather, it reflects an estimate of the remaining useful life based on the observed condition alone. The EvRUL is the parameter used to determine vulnerability and risk of failure of an asset. This value is calculated as follows:

$$\text{EvRUL} = (1 - \text{Condition Fraction}) * \text{OUL}$$

The condition fractions are determined based on the condition scores given to the asset at the time of inspection and are listed in Table 3.9. The relationship between condition score and condition fraction reflects the logic that once an asset deteriorates to a below-average condition, its probability of failure increases and its remaining years in service decline more rapidly than for assets that are maintained in good condition.

Table 3.9 Asset Condition Fraction
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Condition Score (As Defined in Table 1)	Condition Fraction(1)
1	0.0
2	0.2
3	0.5
4	0.7
5	0.9

Notes:
(1) Estimate of the percentage of useful life consumed. For example, a condition fraction of 0.2 means 20 percent of the useful life has been consumed, and 80 percent is remaining.

5.2.2.4 Replacement Timing Evaluations

The remaining life of each asset was calculated using the two methods described above. The EvRUL values were used to estimate the replacement timing for all visually inspected assets, and RUL values (calculated based on OUL and years in service) were used for assets whose physical conditions are unknown (i.e., submersible pumps, gates). For discussion purposes, the term “selected remaining life” will be used when referring to the EvRUL or RUL used for estimating asset replacement timing.

In general, the selected remaining life determines the number of years the asset is expected to remain in service. For visually inspected assets noted as being in good condition, a large percent of its useful life can be assumed to be remaining, regardless of how long ago it was installed. Once an asset reaches a below-average condition, its probability of failure increases and remaining years in service declines. The non-inspected assets are expected to have a remaining useful life based on the installation year and exclude consideration of the current asset condition.

The number of replacements for each asset was estimated within the 40-year Asset Replacement Plan period. The first replacement year was calculated using the selected remaining life, and consecutive replacement years were estimated based on an asset's specific OUL. This calculation allows for identification of the number of replacements required per asset during the 40-year period. For example, the replacement years for the NRWRF RAS pumps 1 - 3 are 2022, 2037, and 2052. These estimated replacement years are based on a life of 8 years and an OUL of 15 years.

5.2.3 Replacement Cost Methodology

The replacement values/costs presented are replacement cost estimates to purchase and install individual assets in today's dollars. Final replacement (or project) costs will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, renewal schedules, and other variable factors. As a result, the final replacement values (or project cost) may vary from the estimates presented herein. Because of these factors, funding needs of the County must be carefully reviewed before making final financial decisions.

The assumptions used for the replacement cost estimates are as follows:

- Replacement project costs are presented as current-value based on an Engineering News Record Construction Cost Index (ENR CCI) number of 10037 (20-Cities Average Index, July 2015).
- The estimates of probable replacement costs were prepared in accordance with the guidelines of AACE International (the Association for the Advancement of Cost Engineering) for a Class 4 estimate. According to the definitions of AACE International, the "Class 4 Estimate" is defined as:

  "Generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, conceptual evaluation, and preliminary budget approval. Typically, engineering is from 1 to 15 percent complete. Class 4 estimates are prepared for a number of purposes, such as but not limited to detailed strategic planning,…confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage. The typical expected accuracy range for this class estimate is –15 percent to –30 percent on the low side and +30 percent to +50 percent on the high side."

Replacement costs are comprised of both direct and indirect costs. The following sections provide a description of both types of costs as well as a summary the methodology used to develop the cost estimates.

5.2.3.1 Direct Costs

Direct costs are those directly attributed to the physical make-up of the assets (e.g., site development, materials, site dewatering, facilities, equipment, piping, electrical/instrumentation/controls, installation and labor, etc.). Direct costs for each asset were estimated from a variety of sources and categorized based on the asset type. Unit costs for each asset were estimated based on various sources. Where possible, the cost from a 100 percent design estimate or a schedule of values pertaining to the actual asset (i.e., developed as part of a recent project) was used and brought into current dollars using the CCI index. Other cost sources utilized include Carollo reference projects, vendor quotes for identical or similar equipment, RS Means price catalog, and Carollo's cost estimating database.

Whenever needed, direct costs were adjusted to be representative of the area where the project is located, in this case Manatee County. This is required when the unit cost of an asset is obtained from a project located outside the area of the project. The location factors utilized to make this adjustment were obtained from RS Means Building Construction Cost Data City Cost Index, Edition 2013. Finally, direct costs were also adjusted to include an installation factor and inflation using the appropriate ENR CCI.

5.2.3.1.1 Ancillary Support Costs

Because the asset inventory is comprised only of important and significant cost assets, remaining components are accounted for in a cost multiplier termed "ancillary support." This category encompasses items such as seal water pumps, small valves, service-air piping, and small electrical/instrumentation components, etc. The lumped value of these assets usually amounts to approximately 10 percent of the sum of the direct project costs.

5.2.3.2 Indirect Costs

Indirect costs consist of contingency factors, including demolition, general conditions, contractor overhead and profit, sales tax, engineering/legal/administration, construction management, and ancillary support. These indirect costs, based on the asset type, are incorporated to develop the total project cost.

5.2.3.3 Project Cost Estimates

Project cost estimates to replace each asset were calculated from the direct costs and several indirect project cost factors. The total project cost was adjusted with the use of indirect multipliers that include demolition, ancillary support, engineering contingency, general conditions, contractor overhead and profit, sales tax, and a factor to account for engineering, legal, administrative, and construction management costs. The magnitude of these adjustments depends on whether the asset is considered “simple” or “complex.” Project cost and contingency multipliers are summarized in Table 3.10.

5.2.3.3.1 Project Complexity

All asset replacement projects were assumed to require outside (contracted) labor. The projects are classified as either “simple” or “complex” depending on the relative complexity to complete the asset replacement.

“Simple” assets are not part of major process equipment or larger systems, are not buried deep in ground, and/or are not excessively large or bulky. These assets are more discrete than complex assets as they do not create synergistic effects on other assets when they are taken offline and do not require significant effort to fit or install. Example assets in this category include HVAC equipment, chemical feed pumps, pumps smaller than 50-horsepower (hp), and odor control systems.

“Complex” assets have a slightly higher demolition, contingency and general condition adjustment. Examples of complex assets include large pumps and process equipment, most structural assets (including buildings, basins, headworks, and wet wells), and electrical assets such as PLCs, transformers, and switchgears.

Table 3.10 Cost and Contingency Factors
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Factor	Description	Simple	Complex
Demolition	This is a lumped cost to estimate any minor demolition or removal of existing assets. Major demolition would be estimated as a separate item.	5%	10%
Ancillary Support	Lumped cost of low value items not included as individual assets such as sump pumps, seal water pumps, small valves, service-air piping, hoses, etc.	10%	10%
Construction and Estimating Contingency	Unforeseen or unanticipated project costs involved in the design details and installation of the new asset.	10%	15%
	Subtotal	**25%**	**35%**

Table 3.10 Cost and Contingency Factors Water Reclamation Facilities – Master Plan Development Manatee County Utilities			
Factor	**Description**	**Simple**	**Complex**
General Conditions	All items contained within Division 01 of most project specifications including mobilization and demobilization, contractor temporary facilities, contractor's field supervision, and bonds and insurance.	10%	15%
	Subtotal	**38%**	**55%**
Contractor Overhead and Profit Margin	This value includes general contractor home office overhead and profit.	12%	12%
	Subtotal	**54%**	**74%**
Sales Tax Rate	Sales tax of 6.5%	6.5%	6.5%
Engineering, Legal, Administrative, and Project Contingencies	Engineering (design and services during construction), legal, and administrative costs reflect assistance with permitting and financing.	25%	25%
	Subtotal	**103%**	**129%**
	Total Multiplier Applied to Direct Cost	**2.03**	**2.29**

The project costs were developed under the assumption that all the assets evaluated will be replaced in kind and does not consider rehabilitation costs required to return the assets to original condition. When rehabilitation is an option, the cost may be less than the stated replacement costs, but it can vary significantly depending on the scope of work to be performed. In addition, rehabilitation can be limited to parts available and whether or not the equipment is current or obsolete. The County can optimize asset replacement and renewal by evaluating rehabilitation versus replacement as projects approach.

6.0 SWWRF FUTURE EVALUATION

6.1 Facility Inspection and Field Observations

Carollo completed walk-through facility inspections of each WRF with a team of engineers and County staff to visually assess the condition of assets and equipment at this facility. The SWWRF was inspected on August 9, 2013.

The following information was obtained from Manatee County during the site visit and was incorporated into the condition scores and Asset Replacement Plan. Appendix A provides the full list of assets and assigned condition scoring for the SWWRF.

- Headworks: The headworks structure was rehabilitated in 2015, including concrete repair and the replacement of the cyclones, grit classifiers, conveyors, and associated control panels. Some additional equipment, such as gates and grit pumps, has also been replaced.

  Due to recent events and failures of part of the structure, the County has decided to replace the headworks structure and equipment in its entirety. This project is scheduled for completion in 2018. As part of this project, it is recommended that the County replace the existing manual and mechanical screens as it was reported by staff that these pieces of equipment are obsolete and do not work properly.

- Primary Clarifiers: The structures show signs of corrosion on the top deck, but no other significant damage was observed. Gates also show corrosion damage. Staff reported that all gates were installed approximately at the same time; some of these gates might be obsolete after the completion of the nitrogen removal project, which is currently under construction. As part of this project, the primary clarifier basins will be repaired and repurposed to new anoxic basins and will include a total of 32 new mixers and 2 splitter boxes.

- Flow Equalization Tank: Facility staff reported that this tank has been repainted but no structural repairs were performed. During the inspection, no major structural damage was observed, but it was noted that vegetation is growing in the tank so maintenance of the tank is recommended.

- Aeration Basins: These basins were reported to be in good operational condition and the aeration blowers have been refurbished.

- Final Clarifiers: There are five secondary clarifiers. Clarifier No. 5 was installed in 2011 and Clarifier Nos. 1 through 4 were recently rehabilitated and included new clarifier mechanisms, effluent launders, and RAS/WAS pumps.

- Filters: Filters 2, 6, and 7 were rehabilitated in 2012 and Filters 3, 4, and 5 were rehabilitated in 2016 (including but not limited to media replacement and rehabilitation of carriage, porous plates, backwash pumps, washwater pumps, and railing). The cloth media for Filter No. 1 was replaced in 2014. The gates were reported to be from the original installation and are in need of replacement; some of the slide gates are difficult to operate.

  During rain events, Filter 1 has to be shut down because the carriage mechanism is unable to travel along the filter because the rain causes the mechanism to spin in-place. Since Filter 1 has the largest treatment capacity (9 mgd), as compared to

Filters 2 through 7, the process interruption creates operational issues and should be addressed to prevent future incidents.

During the inspection staff reported that the backwash pumps for Filters 2 through 7 are replaced a couple of times a year; the replacement pumps are usually refurbished and not new pumps. Because these pumps have been refurbished several times, replacement is recommended. The submersible washwater pumps, flash mixers, flocculators, and polymer diffusers were reported to be no longer in use, so they were not included in this evaluation.

- Chlorine Contact Basins: The interior of the concrete structures show signs of corrosion. No leaks or cracks were visible or reported. Some of the aluminum gates have been replaced with fiberglass gates. The fiberglass in these gates is wearing off, and replacement in the near future should be considered. The majority of the gates were submerged so visible inspection was not possible. Per interviews with staff, these gates are in need of replacement since they are difficult to operate and the frames and gear are rusted. New residual chlorine sample pumps and piping was installed (one pump at the discharge end of each chlorine contact basin).

- Chlorine Feed Pumps: Sodium Hypochlorite Pump Nos. 5 and 6 were replaced in 2013 and Pump Nos. 1, 2, 3, and 4 were replaced in 2016. Facility staff indicated the control panels were replaced around 2008 and are in good condition. Overall, the chlorine feed room is in good condition with some corrosion around the floor drains. The chlorine feed piping was recently replaced and three new residual chlorine analyzers were installed, for a total of five (one for each chlorine contact basin, a spare, and one for the NOVA Filters). The four sodium hypochlorite storage tanks are relatively new (installed since 2013).

- DAF Equipment: The DAF system has not been in use since the new aerated sludge holding tanks were placed online; however, the staff was unsure whether or not the DAF equipment was going to be kept. All of the DAF equipment including air compressors, pressurization pumps, and retention tanks are included in this evaluation. Air Compressors 1 and 2, Pressurization Pumps 3 and 4, and Retention Tank 2 were recently installed.

- DAF Polymer System: The polymer feed system for the DAF has also been offline since the anaerobic digesters were converted to new aerated sludge holding tanks. The existing DAF facilities and supporting system will not be used in the future and will be demolished through various CIP projects. However, the equipment is included in the evaluation. Polymer Feed Pumps 1 through 3 require continuous maintenance. They have been rebuilt previously. The control panel for the pumps shows some rust, and the speed controllers mounted to the control panel are significantly corroded. The control panel for the mixers appears outdated, and some of the options in the panel were no longer working. The dry chemical hopper needs replacement, as the inspection team was unable to open the lid and it had visible corrosion damage.

- Solids Handling: The digester feed pumps are no longer in service; therefore, these were not included as part of this evaluation.

  WAS Pumps 5 and 6 and associated control panels were replaced in 2011 and WAS Pumps 3 and 4 were replaced in 2015. WAS Pumps 1 and 2 were removed and are not in use. Use of the thickened WAS pumps has been discontinued; however, these pumps were inspected and included in the evaluation.

  The sludge transfer pumps (1-3) have been rebuilt several times and replacement will be needed in the near future. The belt filter presses were also rehabilitated twice, but they were reported to be in good operational condition, except for Belt Filter Press 3, which has been out of service and needs to be rehabilitated before being brought online. The control panel cabinets for the belt filter presses show some corrosion damage; however, the interior of the panels did not show any significant damage. The access door for Control Panel 4 is broken and does not lock. The belt filter press feed pumps have been rebuilt several times. Facility staff indicated that the augers follow a continuous maintenance routine, and the units are workable.

  The solids handling area has a separate polymer feed system that includes eight pumps, all of which were in service, except the pump serving Belt Filter Press 3, which is off-line. Operations staff indicated these pumps still run, but are continuously being rebuilt. The polymer mixing tanks are stainless steel tanks and have been in service for approximately 10 years.

- Facility Drain Pump Stations: The SWWRF has three facility drain pump stations. The Supernatant Pump Station receives decant from Aerated Sludge Holding Tanks 1 and 2. The BFP Pump Station receives decant from Aerated Sludge Holding Tanks 3 and 4 and filtrate from the belt filter presses. The Plant Drain Pump Station receives flow from multiple locations throughout the facility. Each one of these stations has three submersible pumps. Because these pumps were submerged, the condition was not able to be inspected. The Supernatant Pump Station was recently rehabilitated in 2010 and the BPF and Plant Drain pump stations were rehabilitated in 2015, and included pump replacements.

- Effluent Storage Ponds: The middle pond was re-permitted from Class 2 to Class 3. The original north pond was recently divided into two ponds during the SWWRF Lake Filtration and North Pond Improvements. The first pond is a lined reject storage pond and the second is a reclaimed water storage pond (still called the north pond). Included with this project was a new pump station for the north reclaimed water storage pond, which has three pumps. The original north pond return pump station now serves the reject pond. SCADA integration was completed at this pump station.

The other three existing effluent pond pump stations (serving the middle and south ponds) are equipped with two pumps per station.

- Low Service Wet Well: The gates in the effluent clearwell, many of which are no longer needed, were reported to be in poor condition and are in need of replacement or to be filled in. As part of the SWWRF Lake Filtration and North Pond Improvements project, the existing 350 hp vertical turbine pumps at the effluent wet well were removed, rehabilitated and moved to the new high service pump station. The 350 hp pumps at the effluent wet well were replaced with five new 100 hp pumps (low service pumps).

6.2 Asset Condition, Replacement Timing, and Cost

The following sections outline the asset condition, replacement timing, and estimated cost for replacement of the SWWRF assets. All estimated costs presented in this Section are shown in 2015 dollars. Where applicable the current or future replacement status of the asset was provided, which may include recently replaced assets, assets currently be replaced or those identified for future evaluation. Assets that have already been placed in planned CIP projects were noted along with the Fiscal Year (FY) that the CIP project was to occur. Any assets that were small enough to be addressed by County staff through the individual WRF repair and replacement (R&R) budgets were also noted. Any assets that showed replacement beyond this master planning period (FY 2035) were noted for future considerations.

6.2.1 Mechanical Assets

Mechanical assets were inspected and condition scores were assigned based on visual inspection and staff input. Table 3.11 provides a summary of the assets with condition scores 4 or greater, since these assets are most susceptible to failure. Table 3.11 also includes the estimated first year of replacement and total project costs for the first replacement. The condition score for mechanical equipment was assigned based on visual inspection and staff input (recent rehabilitation, operability, etc.); therefore, the replacement timing was calculated based on the EvRUL.

Condition scores of mechanical equipment located within the SWWRF were recorded during the visual inspection of the assets. In general, there is an evident relationship between the asset condition score and the number of years in service. The majority of the equipment installed in the SWWRF was installed at different years and was at some point refurnished at least once since the original date of installation.

The County decided, after a separate engineering evaluation, to replace the entire headworks structure, including all mechanical equipment. The completion of this project is scheduled for 2018, so for purposes of this assessment all of the headworks components were assigned a condition score of 5.

Table 3.11	SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Assets with Condition Scores of 4 and Greater(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Headworks	Headworks System(2)	5	2018 (3)	CIP Project (FY17)	$6,296,000
Equalization Tank	Equalization Tank Improvements Project	5	2020 (3)	CIP Project (FY 19)	$8,410,000
Filters	Backwash Pumps (Filters 5-7)	5	2013	Complete	$190,000
DAF System	Air Compressor 3(4)	5	2015	To be Demolished	$15,000
DAF System	Retention Tank #1 (DAF 1)(4)	5	2015	To be Demolished	$94,000
Chemical Feed	Polymer Dry Feed Hopper 1(4)	5	2015	To be Demolished	$23,000
Solids Handling	Thickened WAS Pump 1(4)	5	2015	To be Demolished	$204,000
Solids Handling	Thickened WAS Pump 2(4)	5	2015	To be Demolished	$204,000
Solids Handling	Belt Filter Press Feed Pump 1	5	2015	CIP Project (FY18)	$107,000
Solids Handling	Belt Filter Press Feed Pump 2	5	2015	CIP Project (FY18)	$107,000
Solids Handling	Belt Filter Press Feed Pump 3	5	2015	CIP Project (FY18)	$107,000
BFP Pump Station	Submersible Pump 1	5	2013	Complete (2015)	$110,000
BFP Pump Station	Submersible Pump 2	5	2013	Complete (2015)	$110,000
BFP Pump Station	Submersible Pump 3	5	2013	Complete (2015)	$110,000
Supernatant Pump Station	Submersible Pumps 1 - 3	5	2013	Complete (2010)	$332,000
Irrigation & Reuse	Effluent Wet Well Gates (7 Total)	5	2015	CIP Project (FY18-19)	$364,000
Underground Assets	42-inch Reinforced Concrete Pipe	5	2018	CIP Project (FY18)	$148,000

Table 3.11	SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Assets with Condition Scores of 4 and Greater(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
	(Headworks Bypass)				
Chlorine Contact Basin	Sodium Hypochlorite Metering Pump 1 (CC)	4	2018	Complete (2016)	$26,000
Chlorine Contact Basin	Sodium Hypochlorite Metering Pump 2 (CC)	4	2018	Complete (2016)	$26,000
Chlorine Contact Basin	Sodium Hypochlorite Metering Pump 3 (CC)	4	2018	Complete (2016)	$26,000
Chlorine Contact Basin	Sodium Hypochlorite Metering Pump 4 (CC)	4	2018	Complete (2016)	$26,000
Chlorine Contact Basin	Sodium Hypochlorite Metering Pump 5 (RAS, Missile, Headworks)	4	2018	Complete (2013)	$26,000
Chlorine Contact Basin	Sodium Hypochlorite Metering Pump 6 (NOVA Lake Filters)	4	2018	Complete (2013)	$26,000
DAF System	Pressurization Pump 1 & 2 (DAF 1)(4)	4	2018	CIP Project (FY18)	$220,000
Chemical Feed	Polymer Feed Pump 1(4)	4	2018	CIP Project (FY18)	$18,000
Chemical Feed	Polymer Feed Pump 2(4)	4	2018	CIP Project (FY18)	$18,000
Chemical Feed	Polymer Feed Pump 3(4)	4	2018	CIP Project (FY18)	$18,000
Chemical Feed	Polymer Mixing Tank 1(4)	4	2018	CIP Project (FY18)	$8,000
Chemical Feed	Polymer Mixing Tank 2(4)	4	2018	CIP Project (FY18)	$8,000
Solids Handling	Sludge Transfer Pump 1	4	2018	CIP Project (FY18)	$45,000

Table 3.11 SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Assets with Condition Scores of 4 and Greater(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities					
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Solids Handling	Sludge Transfer Pump 2	4	2018	CIP Project (FY18)	$45,000
Solids Handling	Sludge Transfer Pump 3	4	2018	CIP Project (FY18)	$45,000
Solids Handling	Augers (4 units)	4	2019	CIP Project (FY18)	$2,381,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars, 20-Cities Average Index of 10037, July 2015.
(2) Cost for headworks includes mechanical, electrical equipment, and structure.
(3) This date represents the first replacement year as identified by the County in the proposed CIP.
(4) Equipment associated with the DAF system. This equipment is not in use and will be demolished in future CIP project. It is included in TM3 for informational purposes.

This evaluation showed that the first replacement year for the assets within the headworks varied depending on the process component; however, this replacement year was set at 2018 to accommodate the County's proposed Capital Improvements Plan (CIP).

In a similar manner, the County will implement a gate improvement project for the Chlorine Contact Basins, where some of the existing gates will be removed and those in great need of replacement will be replaced by 2019. The gate improvement project components were grouped on to one item with a condition score 4. For purposes of this evaluation, 2018 was used as the first replacement year.

The County is also performing a separate improvements project for the equalization tank. This project will replace the existing FRP cover with a fixed aluminum cover, add an internal tank mixing system, provide an odor control system, and rehabilitate the existing equalization return pump station. This project is schedule to be completed in 2020. As a result of these improvements, the condition scores for the equalization tank, odor control unit, return pumps, and pump station structure were adjusted to 1. By modifying the condition score, the subsequent replacement years for these assets are adjusted based on the anticipated useful life and the replacement costs can be incorporated into plans for future replacement.

The Air Compressor 3 and Retention Tank 1 (associated with the DAF system) were included in this evaluation and assigned a condition score of 5. However, it is unlikely that the County will replace this equipment since upgrades are underway to provide biological nutrient treatment to remove nitrogen from the effluent. Due to these changes the DAF system and associated components will remain unchanged.

The chemical system equipment, such as sodium hypochlorite pumps, was assigned a condition score of 4 and the estimated first year of replacement is 2018. The polymer pumps located in the chemical feed and storage facilities were also assigned a condition score of 4 and the estimated replacement year is 2018. Facility staff indicated these pumps have been refurbished several times, so the County should consider investing in the full replacement of these pumps.

Although the automatic backwash filters are part of the mechanical equipment, these were evaluated as separate assets. Based on information provided by facility staff during the inspection, different filters have gone through improvements and/or upgrades at different times. In addition, these upgrades in some cases were limited to specific components of the system. For these reasons, different assets within a particular filter might or might not have the same condition score, as shown in Table 3.12. The County has identified projects for improvements of Filters 2, 3, and 4; thus, these assets were assigned condition scores of 5.

The cost included in Table 3.12, represents the replacement of all the mechanical components listed for each filter. These costs were provided by Aqua Aerobic Systems, Inc. and adjusted to include the installation, direct, and indirect costs as described in previous sections. The County could select to perform the asset replacement of the filters as whole or individual assets. Some of the assets that were identified with the highest condition scores are the cloth media and carriage at Filter 1, mechanical assets for Filter 5, and carriages for Filters 6 and 7.

Table 3.12 SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Automatic Backwash Filters Mechanical Assets[1]
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Carriage 1	4	2019	Complete (2010)	$3,023,000
ABW 1 Cloth Media	5	2018	Complete (2014)	
Backwash Pump (Filter 1)	5	2015	Complete (2014)	
Backwash on Cloth Filter	3	2023	Complete (2014)	
Carriage 2	5	2015	Complete (2012)	$1,396,000
Porous Plates 2	5	2015	Complete (2012)	
Rail on ABW 2	5	2015	Complete (2016)	
ABW 2 Mixed Media	5	2015	Complete (2012)	
Carriage 3	5	2015	Complete (2016)	$1,396,000
Porous Plates 3	5	2015		
Rail on ABW 3	5	2015		
ABW 3 Mixed Media	5	2015		
Carriage 4	5	2015	Complete (2016)	$1,396,000
Porous Plates 4	5	2015		
Rail on ABW 4	5	2015		
ABW 4 Mixed Media	5	2015		
Carriage 5	5	2015	Complete (2016)	$1,396,000
Porous Plates 5	5	2013		
Rail on ABW 5	5	2015		
ABW 5 Mixed Media	5	2013		
Carriage 6	5	2015	Evaluate yearly [2]	$1,717,000
Porous Plates 6	2	2029	Last replaced in 2012[3]	
Rail on ABW 6	3	2023	Future	
ABW 6 Mixed Media	2	2029	Complete 2012 [2]	

Table 3.12	SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Automatic Backwash Filters Mechanical Assets(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities			
Asset Description	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Carriage 7	5	2015	Evaluate yearly (2)	$1,717,000
Porous Plates 7	2	2029	(Last replaced in 2012(3)	
Rail on ABW 7	3	2023	Future	
ABW 7 Mixed Media	2	2029	Last replaced in 2012 (3)	
Backwash Pumps (Filters 2-4)	5	2015	Complete (Filter 2 in 2012 and Filters 3 and 4 in 2016)	$100,000

Notes:
(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current (2015) dollars, 20-Cities Average Index of 10037, July 2015.
(2) County currently has no operational or maintenance problems with the carriages on Filters 6 & 7 and will evaluate them yearly to determine an ultimate replacement schedule
(3) The media and porous plates on Filters 6 & 7 were replaced in 2012, however repair and replacement activities are currently underway due to failures resulting from poor installation.

Table 3.13 provides a summary of the gates with condition scores 5 and 4, first replacement years, and replacement costs (refer to Appendix A for information on all gates). All gates (except for one) have conditions scores between 5 and 3, which indicate they are operational, but require some rehabilitation or replacement work. The first replacement years vary from 2014 and 2022 regardless of the condition score; this attributed to the use of the RUL to estimate the replacement year.

Table 3.13 SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates with Condition Scores of 4 and Greater(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chlorine Contact Basin	Gate Improvement Project: - 12 Removed Gates - 10 Sealed Openings - 4 Replaced Gates (Slide Gates 6,7,9 and Weir Gate 1)	4	2019(2)	CIP Project (FY18)	$400,000
Filters	Stop Gate 1	5	2015	CIP Project (FY 20)	$52,000
Filters	Stop Gate 2	5	2015	CIP Project (FY 20)	$52,000
Filters	Stop Gate 3	5	2015	CIP Project (FY 20)	$52,000
Filters	Stop Gate 4	5	2015	CIP Project (FY 20)	$52,000
Filters	Stop Gate 5	5	2015	CIP Project (FY 20)	$52,000
Filters	Stop Gate 6	5	2015	CIP Project (FY 20)	$52,000
Filters	Stop Gate 7	5	2015	CIP Project (FY 20)	$52,000
Filters	Slide Gate 1	4	2019	CIP Project (FY 20)	$52,000
Filters	Slide Gate 5	4	2019	CIP Project (FY 20)	$52,000
Filters	Slide Gate 6	4	2019	CIP Project (FY 20)	$52,000
Filters	Slide Gate 7	4	2019	CIP Project (FY 20)	$52,000

Notes:
(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars, 20-Cities Average Index of 10037, July 2015.
(2) This date represents the first replacement year as identified by the County in the proposed CIP.

6.2.2 Structural Assets

Overall, the SWWRF has structural assets that have been in service for approximately 25 years since construction of the facility in 1988. However, other structures were added as part of expansion projects at different times and or rehabilitation projects. Table 3.14 is a summary of all the structural assets and the results of their evaluation; the replacement date was estimated based on the RUL method described in Section 5.2.2. For example if Filter 3 was built in 1988, this structure has been in service for approximately 26 years. Then the RUL is calculated by subtracting this value from the recommended life of the asset (50 years); thus, the calculated RUL for Filter 3 is 24 years.

Filters 3, 4, and 5 were the only structural assets with a condition score of 5. Even though these assets still have a RUL between 24 and 29 years. The remaining useful life of these structures was calculated based on the number of years in service and the industry standard recommended life shown in Table 3.8. In depth, structural inspections are recommended to evaluate if the visual corrosion damage has compromised the structure itself or if this can be address with simple maintenance activities.

Table 3.14 SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets(1)
Water Reclamation Facilities – Master Plan Development
Manatee County

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Filters	Filter 2	2	2037	Future	$198,000
Filters	Filter 3	5	2037	Future	$198,000
Filters	Filter 4	5	2037	Future	$198,000
Filters	Filter 5	5	2042	Future	$198,000
Chemical Feed	Chemical Building	4	2037	Future	$262,000
Filters	Filter 1	4	2037	Future	$198,000
Anoxic Basin	Anoxic Basin 1(2)	3	2037	Future	$1,103,000
Anoxic Basin	Anoxic Basin 2(2)	3	2037	Future	$1,103,000
Anoxic Basin	Anoxic Basin 3 (2)	3	2037	Future	$1,103,000
Anoxic Basin	Anoxic Basin 4(2)	3	2037	Future	$1,103,000

Table 3.14 SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets(1)
Water Reclamation Facilities – Master Plan Development
Manatee County

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Secondary Clarifiers	Skimming Pumps Flow Control Structure and Wet Well	3	2037	Future	$64,000
Chlorine Contact Basins	Chlorine Contact Basin 1	3	2037	Future	$184,000
Chlorine Contact Basins	Chlorine Contact Basin 2	3	2037	Future	$184,000
Chlorine Contact Basins	Chlorine Contact Basin 3	3	2037	Future	$184,000
Solids Handling	Anaerobic Digester Building	3	2037	Future	$2,272,000
Solids Handling	Dewatering Building	3	2037	Future	$1,918,000
Supernatant Pump Station	Supernatant Pump Station Structure# 1 (Circular Wet Well, Valve Vault)	3	2037	Future	$39,000
Non-process Building	Electrical Building	3	2037	Future	$1,897,000
Irrigation & Reuse	Unfiltered Water Rate of Flow Controller	3	2037	Future	$217,000
Irrigation & Reuse	EQ Rate of Flow Controller	3	2041	Future	$52,000
Irrigation & Reuse	Deep Injection Well Rate of Flow Controller	3	2041	Future	$52,000

Table 3.14	SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets(1) Water Reclamation Facilities – Master Plan Development Manatee County				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Irrigation & Reuse	Deep Well Injection Wet Well (Combined with Irrigation Wet Well)	3	2037	Future	$157,000
Odor Control	Concrete Structure	2	2037	To be Demolished	$25,000
Aeration Basins	Aeration Basin 1	2	2023	Future Evaluation	$901,000
Aeration Basins	Aeration Basin 2	2	2023	Future Evaluation	$901,000
Aeration Basins	Aeration Basin 3	2	2023	Future Evaluation	$1,202,000
Aeration Basins	Aeration Basin 4	2	2023	Future Evaluation	$1,202,000
Final Clarifiers	WAS/RAS Pump Station Concrete Pad @ Clarifier 1 & 2	2	2023	Future Evaluation	$21,000
Filters	Filter 6	2	2061	Future	$250,000
Filters	Filter 7	2	2061	Future	$250,000
Blower & DAF Building	Building Structure	2	2023	Future	$984,000
Solids Handling	Thickened WAS Pump Station	2	2037	Future	$58,000
Supernatant Pump Station	Supernatant Pump Station Structure 2 (Circular Wet Well, Valve Vault)	2	2037	Future	$50,000
Non-process Building	Administration Building	2	2037	Future	$2,824,000

Table 3.14 SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets(1)
Water Reclamation Facilities – Master Plan Development
Manatee County

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Equalization Tank	Flow Equalization Tank	1	2037	Future	$4,568,000
Return Pump Station	Pump Station Structure	1	2037	Future	$108,000
Non-process Building	Blowers Building	1	2051	Future	$984,000
Non-process Building	Laboratory Building	1	2057	Future	$3,491,000
Non-process Building	Maintenance Building	1	2057	Future	$1,141,000
Secondary Clarifiers	Final Clarifier 1	1	2063	Future	$3,003,000
Secondary Clarifiers	Final Clarifier 2	1	2063	Future	$3,003,000
Secondary Clarifiers	Final Clarifier 3	1	2063	Future	$4,181,000
Secondary Clarifiers	Final Clarifier 4	1	2063	Future	$4,181,000
Secondary Clarifiers	Final Clarifier 5	1	2061	Future	$3,688,000
Secondary Clarifiers	WAS/RAS Pump Station Concrete Pad @ Clarifier 5	1	2061	Future	$21,000
Effluent Pump Station	Reject Pump Station Precast Concrete Manhole	1	2063	Future	$17,000
Splitter Box	Splitter Box 1	1	2063	Future	$284,000
Splitter Box	Splitter Box 2	1	2063	Future	$374,000

Table 3.14	SWWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets(1) Water Reclamation Facilities – Master Plan Development Manatee County				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Reclaim Pump Station	Pump Station Concrete Slab on Grade	1	2063	Future	$12,000
Reclaim Pump Station	Precast Concrete Wet Well	1	2063	Future	$79,000
Unfiltered Pump Station	Precast Concrete Wet Well	1	2063	Future	$28,000
Unfiltered Pump Station	Pump Station Concrete Slab on Grade	1	2063	Future	$4,000
Waste Backwash	Precast Concrete Wet Well	1	2063	Future	$7,000

Notes:
(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current (2015) dollars, 20-Cities Average Index of 10037, July 2015.
(2) The primary clarifiers are currently being converted to anoxic basins.

The majority of the structural assets have condition scores of 1 or 2, meaning that only minor defects were identified during the inspection. The remaining assets will require some improvements to return to original conditions and eventual replacement. It is estimated that most structural assets would require a one-time replacement during the 40-year period with the closest replacement being in 2037.

6.2.3 Electrical, Instrumentation and Controls Assets

The SWWRF main electrical switchgear and the generators for standby power are rated to operate at 4,160 volts (4.16 kV) and they distribute electric power throughout the plant, to substation dry type transformers in electric rooms located adjacent to buildings in process areas. The (indoor type) transformers step down the voltage from 4.16 kilovolts (kV) to 480 volts switchboards and motor control centers, which supply power to motorized wastewater process equipment.

The majority of electrical equipment for power distribution is located in electrical rooms without air conditioning; therefore, the cooling of electrical equipment depends on ventilation from outdoor air, which is humid and may contain corrosive elements (ex.

hydrogen sulfide) from wastewater process areas such as the headworks, dewatering building, and other process areas. The physical condition of electrical equipment enclosures show substantial progressive decaying due to corrosion and perhaps the expected useful life of internal electrical components have been decreased due to both corrosion and high environmental humidity.

Most of the original electrical equipment for power distribution that has been in service since the facility construction in 1988 is approximately 25 years old and is reaching the end of its useful and reliable life.

However, there are numerous electrical equipment units that were installed at later dates, such as Generator No. 2 for standby power, two 4.16 kV motor control centers for aeration blowers, and two substation transformers of 4.16 kV to 480 volts for the effluent pump station, which were added as part of expansion projects at different times and/or rehabilitation projects.

The enclosures of electrical equipment that are located in electrical rooms with air conditioning appear in much better physical condition, and perhaps their useful life could continue to deliver reliable service for another five to ten years.

The enclosures of SCADA panels located throughout the SWWRF process areas were installed in recent years using stainless steel enclosures, and they appear in reasonable durable condition. The Allen Bradley electronic programmable logic controllers (PLCs) in SCADA panels also appear to be in good condition and their technology version will be supported with spare parts for at least five more years, even though the County has been updating the PLC equipment with current models.

Table 3.15 shows the asset condition scores for the key electrical and control equipment associated with the wastewater treatment process, with anticipated year of first replacement and the respective cost for replacement.

Table 3.15	**SWWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical, Instrumentation, and Control Assets[1] Water Reclamation Facilities – Master Plan Development Manatee County Utilities**				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Headworks	Grit Unit 1 Driver [2]	5	2018	CIP Project (FY17)	$54,000
Headworks	Grit Unit 2 Driver [2]	5	2018	CIP Project (FY17)	$54,000
Headworks	New Classifier Control Panel 1[2]	5	2018	CIP Project (FY17)	$50,000
Headworks	New Classifier Control Panel 2[2]	5	2018	CIP Project (FY17)	$50,000
Headworks	SCADA Panel SP-4[2]	5	2018	CIP Project (FY17)	$180,000
Blower & DAF Building	Compressor 3 Control Panel[3]	5	2016	To be Demolished	$12,000
Chemical Feed	Mixer Control Panel[3]	5	2016	CIP Project (FY18-19)	$12,000
Solids Handling	Belt Filter Press Pumps Control Panel 4	5	2016	CIP Project (FY18-19)	$60,000
Electrical	MCC - HW1 (North) & HW2 (East)	5	2016	CIP Project (FY17)	$1,082,000
Electrical	Main Distribution Switch Gear[4]	5	2018	CIP Project (FY19	$2,645,000
Electrical	Existing Effluent Pump Controls[4]	5	2018	Future	$1,202,000
Electrical	Ventilation System[5]	5	2018	CIP Project (FY19)	$120,000
Electrical	Generator Control Panel 1[4]	5	2018	CIP Project (FY19	$301,000
Electrical	Generator Control Panel 2[4]	5	2018	CIP Project (FY19	$301,000
Electrical	Substation 10[4]	5	2018	CIP Project (FY20	$301,000

Table 3.15 SWWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical, Instrumentation, and Control Assets[1] Water Reclamation Facilities – Master Plan Development Manatee County Utilities					
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Electrical	Substation 9[4]	5	2018	CIP Project (FY 20	$301,000
Electrical	Substation 11[4]	5	2018	CIP Project (FY 20	$433,000
Electrical	Substation 12[4]	5	2018	CIP Project (FY 20	$433,000
Electrical	MCC - B4[4]	5	2018	CIP Project (FY19)	$301,000
Electrical	MCC - B2[4]	5	2018	CIP Project (FY19)	$301,000
Electrical	MCC – BC[4]	5	2018	Future	$228,000
Electrical	Substation 6[4]	5	2018	CIP Project (FY19)	$301,000
Electrical	Substation 5[4]	5	2018	CIP Project (FY19)	$301,000
Electrical	MCC-B1[4]	5	2018	CIP Project (FY19)	$301,000
Electrical	Substation 7 & 8[4]	5	2018	CIP Project (FY19)	$601,000
Electrical	MCC - D1[4]	5	2018	CIP Project (FY19)	$265,000
Electrical	MCC - D2[4]	5	2018	CIP Project (FY19)	$265,000
Solids Handling	Reuse Water Control Panel	4	2022	Future R&R	$15,000
Secondary Clarifiers	Control Panel	3	2028	Future R&R	$36,000
Secondary Clarifiers	Skimming Pump Control Panel	3	2028	Future R&R	$11,000
Chemical Feed	Polymer Feed Pumps Control Panel[3]	3	2028	CIP Project (FY18)	$36,000

Table 3.15	SWWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical, Instrumentation, and Control Assets(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Solids Handling	WAS Pump 3 VFD	3	2028	Future Evaluation	$43,000
Solids Handling	WAS Pump 4 VFD	3	2028	Future Evaluation	$43,000
Solids Handling	Belt Filter Press Control Panel #1-3, 5-7	3	2028	CIP Project (FY18)	$180,000
Solids Handling	Augers Control Panel	3	2028	CIP Project (FY18)	$18,000
Solids Handling	Polymer Feed Pumps Control Panel	3	2028	CIP Project (FY18)	$36,000
Electrical	Communications System	3	2021	SCADA System Evaluation underway	$180,000
Filters	Stainless Steel Control Panel	2	2037	Future	$36,000
Filters	Electrical Cable Tray System	2	2037	Future	$12,000
Filters	Motor Operated Sluice Gates Control Panel	2	2037	Future	$19,000
Chemical Feed	Miscellaneous Control Panels and Instrumentation (Panel SP-2)(3)	2	2037	Current CIP Project (FY18)	$120,000
Solids Handling	Belt Filter Press Pumps Control Panels #1-6	2	2037	CIP Project (FY18)	$120,000
Electrical	Generator and Exhaust #1	2	2037	Future	$1,803,000
Electrical	Vault (Power Company)	2	2037	Future	$73,000

Table 3.15 SWWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical, Instrumentation, and Control Assets(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Electrical	5KV Blower Switchgear	2	2037	Future	$ 601,000
Electrical	MCC -1	2	2037	Future	$ 96,000
Electrical	Blower Building SCADA Panel	2	2037	Future	$180,000
Secondary Clarifiers	RAS Pump 1 VFD	1	2043	Future	$34,000
Secondary Clarifiers	RAS Pump 2 VFD	1	2043	Future	$34,000
Secondary Clarifiers	RAS Pump 3 VFD	1	2043	Future	$34,000
Secondary Clarifiers	New Clarifier 3 Control Panel	1	2043	Future	$37,000
Secondary Clarifiers	New Clarifier 4 Control Panel	1	2043	Future	$37,000
Secondary Clarifiers	RAS Pump 4 VFD	1	2043	Future	$34,000
Secondary Clarifiers	RAS Pump 5 VFD	1	2043	Future	$34,000
Secondary Clarifiers	RAS Pump 6 VFD	1	2043	Future	$34,000
Chlorine Contact Basins	Chlorine Pumps Control Panel	1	2028	Future	$12,000
DAF System	Air Blower 6 Control Panel	1	2043	Future	$43,000
DAF System	Air Blower 7 Control Panel	1	2043	Future	$43,000
Solids Handling	WAS Pump 3 VFD	1	2043	Future	$43,000
Solids Handling	WAS Pump 4 VFD	1	2043	Future	$43,000

Table 3.15	SWWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical, Instrumentation, and Control Assets(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Solids Handling	WAS Pump 5 VFD	1	2043	Future	$43,000
Solids Handling	WAS Pump 6 VFD	1	2043	Future	$43,000
Solids Handling	WAS Pumps 3 & 4 Control Panels	1	2043	Future	$12,000
Solids Handling	WAS Pumps 5 & 6 Control Panels	1	2043	Future	$12,000
Electrical	Generator and Exhaust #2	1	2043	Future	$1,803,000
Electrical	Substation 13	1	2043	Future	$385,000
Electrical	Substation 14	1	2043	Future	$385,000
Electrical	SCADA Panel SP-3	1	2043	Future	$180,000
Irrigation & Reuse	Control Panel 1	1	2043	Future	$180,000
Irrigation & Reuse	Control Panel 2	1	2043	Future	$180,000
Effluent Pump Station	New Transfer Pumps VFDs (5 total)	1	2033	Future	$721,000
Effluent Pump Station	Pond Outlet Instrumentation and Controls	1	2043	Future	$96,000
Effluent Pump Station	Middle Pond Slide Gates (Electric Operator)	1	2033	Future Evaluation	$12,000

Table 3.15	SWWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical, Instrumentation, and Control Assets(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Effluent Pump Station	Local Instrumentation	1	2028	Future Evaluation	$73,000
Unfiltered Pump Station	Vertical Turbine Pumps VFDs (4 units)	1	2043	Future	$385,000
Lake Filtration System	Local Instrumentation	1	2028	Future Evaluation	$73,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars (2015), 20-Cities Average Index of 10037, July 2015.

(2) To be replaced as part of the headworks replacement project already identified by the County. For this reason, these assets were assigned a condition score of 5 with an assumed installation date of 2018.

(3) Equipment associated with the DAF system. Although staff has indicated that this equipment is not in use and not anticipated to be used in the future, it is included in TM3 for informational purposes.

(4) The improvement/replacement of these assets will be done as part of the Phase II Electrical Improvement Projects already identified by the County. For this reason, these assets were assigned a condition score of 5 with an assumed installation date of 2018.

(5) The improvement/replacement of these assets will be done as part of the Phase I Electrical Urgent Improvement Projects already identified by the County. For this reason, this asset was assigned a condition score of 5 with an assumed installation date of 2018.

6.3 Future Treatment Requirements

Based on the projected flows and loads from TM1 and TM2, the future capacity expansions were developed. Consideration for future expansion was also given to existing capacity, any future regulatory scenarios, and projected water reuse demands.

Table 3.16 details the design criteria for the liquid stream processes and solids handling processes that will be required for the SWWRF to be able to treat 15.7 mgd AADF in 2035 (LOS projection). A conceptual process flow diagram for the major liquid stream process facilities is depicted in Figure 3.4. The existing facility biological treatment upgrades are designed for 13.5 mgd AADF.

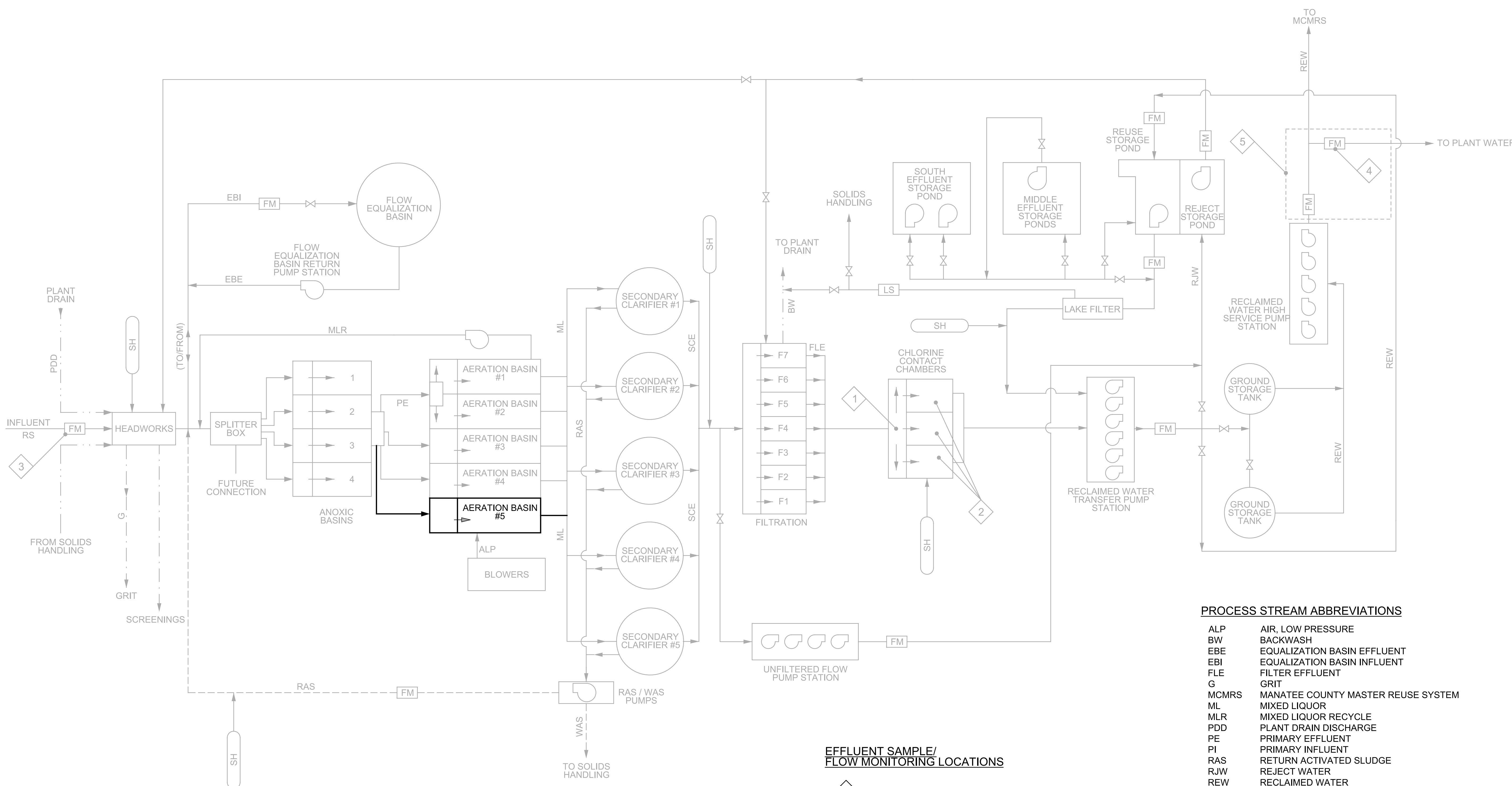
Table 3.16 SWWRF - Expansion Summary of Existing Treatment Processes Water Reclamation Facilities – Master Plan Development Manatee County		
	Current Facilities 13.5 mgd (AADF)(1)	**2035 Facilities 15.7 mgd (AADF)(1)**
Headworks		
Total No. of Screens	2	2
Capacity (Peak), Each	24 mgd	24 mgd
Total No. of Grit Removal	2	2
Capacity (Peak), Each	24 mgd	24 mgd
Secondary Treatment		
Total No. of Anoxic/Aeration Basins	4	5
Volume, Total	5.65 MG	6.65 MG(2)
Total No. of Secondary Clarifiers	5	5
Surface Area, Total	49,720 ft^2	49,720 ft^2
Tertiary Treatment		
Total No. of Filters	7	8
Surface Area, Total	9,040 ft^2	10,960 ft^2
Total No. of Chlorine Contact Basin	3	3
Volume, Total	0.414 MG	0.414 MG
Solids Thickening and Dewatering		
Total No. of Aerated Sludge Holding Tanks	4	4
Storage, Total	18 days(3)	16 days(3)
Total No. of Belt Filter Press	6	6(4)

Notes:

(1) Assumes all units in service for peak flows. All unit sizes for existing unit processes are given in TM1. Proposed unit processes sizes are similar unless otherwise noted.
(2) Based on one 1 MG sized Aeration Basin with min 100 hp blower, based on CH2M Hill's PER for Phase 2 requirements.
(3) Storage days are based on unthickened WAS with 0.8% solids. Existing and future capacity of ASHTs is based on CH2M HILL PER.
(4) Based on 24/7 operation, 0.116 mgd of WAS flow and 26,170 lb/day WAS load.

As shown in Figure 3.4 and Table 3.16, one additional aeration basin is proposed based on the LOS flow projections at SWWRF and the existing design treatment capacity of the aeration system defined for the current nutrient removal upgrades project (CH2M Hill PER).

User: svcPW Plot Date: 14-JUL-2016 12:21:23 PM File: \\phx-pw-cfs-2\ICS\Model\14243\174150_711\9520D00-FIG-3-4.dgn



PROCESS STREAM ABBREVIATIONS

ALP	AIR, LOW PRESSURE
BW	BACKWASH
EBE	EQUALIZATION BASIN EFFLUENT
EBI	EQUALIZATION BASIN INFLUENT
FLE	FILTER EFFLUENT
G	GRIT
MCMRS	MANATEE COUNTY MASTER REUSE SYSTEM
ML	MIXED LIQUOR
MLR	MIXED LIQUOR RECYCLE
PDD	PLANT DRAIN DISCHARGE
PE	PRIMARY EFFLUENT
PI	PRIMARY INFLUENT
RAS	RETURN ACTIVATED SLUDGE
RJW	REJECT WATER
REW	RECLAIMED WATER
RS	RAW SEWAGE
SCE	SECONDARY EFFLUENT
WAS	WASTE ACTIVATED SLUDGE

EFFLUENT SAMPLE/
FLOW MONITORING LOCATIONS

1 EFB-01 (TSS/TURBIDITY)

2 EFA-01 (FILTERED EFFLUENT SAMPLING)

3 FLW-01 (METERED TOTAL PLANT FLOW)

4 FLW-04 (METERED FLOW FOR PLANT WATER)

5 FLW-05 (METERED FLOW TO PARS) = HIGH SERVICE PUMPSTATION FLOW - PLANT WATER FLOW)

FLOW STREAM LEGEND

- LIQUID WW STREAM
- RECYCLE STREAM
- SLUDGE STREAM
- SCREENINGS/GRIT
- FM FLOW METER
- SH SODIUM HYPOCHLORITE FEED POINT

FIGURE NO. 3.4

SWWRF LIQUID STREAM PROCESS SCHEMATIC

WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT

carollo®

6.4 Implementation Triggers

For the purposes of this Master Plan, phased implementation for expansion is developed assuming the future flows and loads match the projected values. However, as has occurred in the past, future conditions could affect the actual wastewater flows and loads. Therefore, actual flows and loads should be compared to the projections regularly so that facilities are constructed as needed in accordance with the actual increases in wastewater flow. Using this approach, planning and facility construction can be adjusted to respond to actual growth.

Initiating the design and construction of new facilities using actual growth conditions means that new facilities should be implemented based on flow and load “triggers.” These flow and load triggers are established by considering the lead-time required for design and construction of new facilities. Using the required lead-time and the projected rate of growth, a trigger flow value can be established, which when reached, “triggers” the design of new facilities. The trigger established for a treatment expansion will provide the required lead-time only if the actual rate of growth is equal to the assumed rate of growth. If the growth rate is slower than projected, the construction of an increment of treatment capacity can be delayed until it is required. Conversely, if the growth rate is faster than projected, the increment of treatment capacity needs to be constructed earlier than anticipated.

6.4.1 Trigger Curves

Trigger curves for the individual treatment processes at SWWRF are presented in Appendix B. These curves show the projected flow (AADF LOS) and the estimated and projected treatment capacity of SWWRF.

The indicated project phasing shows the recommended sizing and timing of the treatment process expansions. The timing represents the year in which the process expansion becomes operational, so the trigger point for start of design precedes the year indicated by the estimated time needed for design, bidding, construction, and start-up. Based on the trigger curves, all treatment processes have a sufficient total capacity to meet planning period flow, except the anoxic/aeration treatment. The anoxic/aeration treatment needs additional capacity to meet LOS projected flow (Figure B.2, Appendix B). Due to several ongoing construction projects at SWWRF, it is recommended the County reevaluate the anoxic/aeration treatment capacity once the new MLE process is online. Once the MLE process is operational, performance can be evaluated to assess the rated capacity, and timing for any needed process expansions can be confirmed.

6.5 Future Hydraulics

As summarized in TM2, the hydraulic capacity at SWWRF is 48 mgd PHF, which will be sufficient through the 2035 planning period. The only constraints identified in TM 2 are the effluent weir at the preliminary treatment structure submerges at PHF and the flash mix/flocculation tanks have 6-inches of freeboard at PHF.

- The preliminary treatment structure is being replaced in an upcoming CIP project, which will take into account the hydraulics and elevations required to meet the PHF capacity rating of 48 mgd.
- Limited free board in the flash mix/flocculation tanks is not considered a concern since they are currently used as a splitter box rather than a treatment unit at SWWRF. If future issues arise at this structure, it can be evaluated and modified to fit the facility's needs.

6.6 Summary

6.6.1 Asset Management Needs

The purpose of the Asset Replacement Plan is to evaluate the needs for asset replacement on existing condition and estimated remaining service life. Based on the results presented in the tables above, a summary of all the assets needing replacement in the next 5 years that have project replacement costs greater than $50,000 is provided:

Mechanical assets:

- Chlorine basin gates
- Vortex grit removal units 1 and 2
- Headworks mechanical assets
- Equalization tank improvements
- Belt filter press pumps 1, 2, and 3
- Supernatant pumps 1, 2, and 3 located at pump station 1
- Supernatant pumps 1, 2, and 3 located at pump station 2
- Automatic backwash filter components

Structural assets:

- Headworks structure
- Unfiltered water rate of flow controller structure

Electrical assets:

- Belt filter press control panel 4
- MCC- HW1 (North) and HW2 (East)

6.6.2 Treatment Capacity Needs

Based on the projected LOS flows, the only expansion required by 2035 is of the anoxic/aeration basins. As noted previously, capacity of the MLE process should be reevaluated once the process is operational to assess the timing and confirm the specific needs at SWWRF in terms of biological treatment capacity.

6.6.3 Regulatory Driven Needs

While no regulatory changes are expected to impact SWWRF in terms of effluent quality, the Class 1 reliability of the facility was evaluated in TM2. Two items that were evaluated to not meet Class 1 reliability standards include the aeration system blowers and the tertiary filters.

- The aeration system blower evaluation is based on the design demand proposed in the CH2M Hill PER for the nitrogen removal upgrades. As with the capacity of the biological treatment processes, the aeration demands can be evaluated once the system is operational to determine if there is a need for additional blower capacity to meet Class I reliability.

- The tertiary filters were assessed in TM2 based on experience with similar installations. The actual loading capacity of the filters can be evaluated by stress testing the filters and monitoring performance.

7.0 SEWRF FUTURE EVALUATION

7.1 Facility Inspection and Field Observations

Carollo completed walk-through facility inspections of each WRF with a team of engineers and County staff to visually assess the condition of assets and equipment at this facility Carollo inspected the SEWRF on September 5, 2014.

This section documents repair or replacement of some of the equipment over the last few years and summarizes current issues with facility processes and equipment. This information was taken into consideration when assigning assets condition scores and during the development of the Asset Replacement Plan. Overall, the facility has been well maintained and operations staff continues to work on enhancements to the process and equipment to achieve better facility performance. Before replacing some of the major assets at the SEWRF when they near the end of their useful lives, the County should conduct detailed evaluations to compare and select the best available technology at the appropriate time.

The following paragraph summarizes the condition information obtained from construction documents from Manatee County as well as information collected during the site visit. All this information was incorporated into the condition scores and Asset Management Plan timing. Appendix C provides the full list of assets and assigned condition scoring for the SEWRF.

- Headworks: The overall condition of the structure at the time of the inspection was good. The screen channels were recently rehabilitated as part of the SEWRF Headworks and Internal Recycle Pump Rehabilitation project. In addition, this rehabilitation project included the replacement of the existing cyclone/classifiers, grit units, screw conveyors, mechanical bar screens, and associated control panels.

- Odor Control: the odor control and chemical containment structures were found to be in acceptable condition. The chemical containment structure is not currently used; since this structure is exposed to rainfall, the rainwater accumulates and creates conditions that promote the breeding of mosquitoes.

  The odor control equipment currently installed is not County property. The County has an agreement with Evoqua (formerly Siemens) and pays a monthly fee for the rental and service of this equipment. Odor control scrubbers and fans were found to be in good condition. However, the odor control piping is in need of replacement.

- Influent Splitter Box: The overall structure was found to be in good condition, however, the gates are in poor condition and need to be replaced. Staff reported that the gates are exercised on an annual basis but are difficult to operate. Submersible Pump 1 was rebuilt in 2014 and the remaining four were operational at the time of inspection. At the time of inspection, the hoist and monorail were absent and the support structure showed severe signs of corrosion.

- Anoxic/Aerobic System: This system is comprised of three basins. Basin Nos. 1 and 2 were recently rehabilitated as part of the SEWRF Headworks and Internal Recycle Pump Rehabilitation project, however, the lower impellers need to be updated. The four internal recycle pumps were also replaced as part of this project. Basin No. 3 needs to be taken offline and cleaned. Aerators were found to be in overall good condition with corrosion mainly present at base plates. The aerator motors and gearboxes for Nos. 1 and 2 are planned to be replaced in a current CIP project. Blowers installed in the building near the equalization tank are not currently being used. Mixer 2A in Anoxic/Aerobic Basin No. 2 was out of service at the time of inspection and replacement is recommended.

- Secondary Clarifiers and RAS/WAS Pump Stations: All four structures were found to be in good condition. Scum ejectors 3 and 4 were reported to have insufficient air due to continuous problems with the air valves, which plug with frequency. The WAS pumps were severely corroded. The RAS and WAS pumps are scheduled to be replaced in a future CIP project.

- Flash Mixing and Flocculation: The structure was found to be in good condition with no visible signs of corrosion or leaks. Mixers and flocculator were reported to be operational and in acceptable conditions. Gates are not operated frequently and the handles do not work.

- Filters: During the inspection, it was found the filter basins show sign of corrosion. The presence of algae was also noted specially in Filter No. 3. In addition, staff reported that the Basins 3 and 4 have leaks at the air pipe penetrations. County should consider repairing these leaks. All troughs were reported to leak at the joints and the presence of algae growth was visible. High loss of filter media and the need for replacement or addition was also reported by the facility staff. The underdrain systems are also in poor condition and need to be replaced.

  Filter No. 1 carriage and backwash system was recently replaced and was found to be in good condition. The carriage and backwash system for Filter No. 2 was recently rebuilt. The traveling bridge and backwash equipment for Filters Nos. 3 and 4 was reported to be in good operational conditions and are planned to be rehabilitated in 5 years.

- Reject and Plant Drain Pump Stations: The reject and drain pump stations were placed in service in 2002, the structures for both pump stations were reported to be good condition. Visual inspection of the pumps was not possible; however, they were operational. Facility staff indicated that the check valve inside the reject pump station valve vault does not close all the way and leaks within the vault. The County should consider the replacement of this valve.

- Leachate Pump Station and Equalization Tank: During the inspection, it was noted the landfill has four pump stations across the site. These pump stations discharge to the headworks and the combined flow is monitored by a single flowmeter. Therefore, the leachate pump stations were not inspected.

  Both equalization tanks were found in good condition with no visible cracks and/or leaks. Facility staff noted that the diffuser systems in both tanks were corroded, so further evaluation and inspection should be performed to determine the need for replacement. The blowers associated with the equalization tanks were in good operational condition.

- Chlorine Contact Basins: Chlorine Contact Basins Nos. 1 and 2 were rehabilitated in 2012, which included pressure washing, re-coating, and structural repairs such as expansion joint replacements. Chlorine Contact Basins Nos. 3 and 4 have some visible cracks on walls; however, no leaks were reported. Pressure washing and recoating of Basins 3 and 4 is recommended, as well as a structural evaluation. The gates in all the basins were reported to be difficult to operate or exercise. For the most part, these gates are kept in the same positions. All the gates were submerged at the time of inspection, so condition scores and inspection notes were based on staff's knowledge and experience.

- Chlorine Storage and Feed: the structure was found to be in good condition with the need for minor housekeeping. All chlorine pumps were recently replaced. The four bulk storage tanks are in good condition with no issues reported. Skid No. 4 and its associated control panel were installed and placed in service in 2014; this feed system is dedicated to the new lake filtration system.

- Polymer and Alum Feed Systems: The polymer system consists of a Polyblend system with two mixing tanks and dry polymer mixing skid. This equipment was found to be in good condition with some signs of corrosion, especially on the dry polymer dispenser housing. The polymer pumps and control panels serving Filter Presses No. 1 and No. 2 were recently replaced. A third pump will be required once Filter Press No. 2 is back in service.

  The alum feed system consists of one feed pump that is never used, so the staff was not sure if the pump is operational. The alum storage tank was onsite but not connected to the feed pump.

- Sludge Handling System: The two sludge holding tanks were found to be in good condition. The sludge pumps were reported to be installed around 2002, the staff performs regular maintenance and repairs on these pumps. The coarse bubble diffusers were recently replaced as part of the Sludge Holding Tank Improvements project. This project also included a new gravity belt thickener (Gravity Belt Thickener No. 2) as well as two additional sludge pumps.

- On-site Stand-by Power Generation: From a mechanical perspective, the stand-by power generation system consists of two diesel storage tanks and three diesel engine-generators. Overall, all system components were found in good condition, and staff indicated that this is a reliable system. The engine-generators No. 1 and No. 2 were installed in 1988 and after 25 years on duty, their diesel engine exhaust emissions may not comply with endless changes in strict federal regulations for exhaust emissions. The engine-generator No. 3 is approximately 14 years old and the engine-exhaust emission may comply for another five to ten years with the imminent adjustments of federal regulations.

  Staff indicated that a different County division provides maintenance services for both diesel storage tanks. In addition, the County has a maintenance contract with Paramount Power to provide annual maintenance on the generators.

- Dewatering System: The current dewatering system consists of three filter presses. At the time of inspection Filter Press No. 2 was out of service and process was handled by only Filter Press Nos. 1 and 3, which were rehabilitated in 2014 prior to the inspection. This included the replacement of all the internal components and maintaining the original frame. Filter Press No. 2 should be rehabilitated before being brought back to service. The system also includes three booster pumps, which were also replaced.

- Non-Process Building: The administration and electrical building were found in good structural condition. Although there were no visible cracks or leaks at the time of inspection, staff has reported that currently there are leaks in the roof and the east control room wall. The women's restroom and locker room was also reported to be in bad condition and needs to be upgraded. The plumbing in the administration building has recently been replaced.

- Lake Filtering System: Installation of the lake filtration system was completed this year and it was placed in service approximately three months before the inspection. Staff indicated that system operates well. The system is comprised of three gravity disk filters, a backwash system, and associated electrical equipment.

- Effluent Storage Tank: A new 10 MG onsite storage tank was recently installed at this facility.

- Electrical System: Switchgear No. 1 has been in service for approximately 25 years and electrical equipment technology has been rapidly evolving to state of the art products with safer features and more reliable properties, then parts for critical equipment over 25 years old becomes difficult to obtain and it is reaching the end of its useful and reliable life.

- During the SEWRF expansion constructed in year 2000 -2001, a second Florida Power and Light (FPL) utility transformer service and Switchgear No. 2 was installed with a third 2000 kW standby power generator. Also, the 480 volts switchgear No. 2 distributes power to a second group of effluent pumps and multiple motor control centers located near the motorized equipment and wastewater treatment process.

- The two main switchgears (Nos. 1 and 2), the three generators for standby power and their designed interconnection assigns the function of one 2000 KW generator to work in conjunction with one of the two switchgear(s); then the third 2000 KW generator is available as redundant backup for either of the two generators on duty. Such switchgear’s and generator’s interconnection does not synchronize the generators among themselves, for proportional equipment loading and higher energy efficiency; consequently when two generators are supplying power to the facility, each generator may be partially loaded and there might be a substantial non-efficiency in generator use and a considerable operating cost in non-utilized diesel fuel.

- The future replacement of the older Switchgear No. 1 and the older generators should not be done for the same type of equipment configuration, and/or without evaluating further the current interconnected scheme of the two service switchgears and the three generators, for a configuration with higher system efficiency and use of state of the art switchgear equipment, with preferable features like synchronized generators. Said evaluation might be done during a future electrical master planning for facility improvements.

- Overall, the two main power distribution switchgears and the three generators for standby power system and their components appeared in good condition from a reliability perspective.

- Additional electrical equipment supply power and control to process equipment, consisting of motor control centers (MCCs), which are in electrical rooms located throughout the facility. Two original MCCs have been in service for approximately 25 years and other MCCs have been in service for about 14 years. Parts for MCCs are still available and the average condition of their components is good. However, the technology of the MCC equipment has been rapidly evolving with more electronic protective features that facilitate troubleshooting and future maintenance; therefore, the planning for future replacement of MCCs and pertinent wiring should be considered as further recommended in subsequent sections of the assessment report.

- <u>SCADA Network and Instrumentation System:</u> The SCADA network consists of the following three key component groups: the computers and display monitors located at the operations building command center, the network of multiple programmable logic controllers (PLCs) located at electrical / control rooms near the process areas, and the miscellaneous field instrumentation with sensors and transmitters that communicate the continuous process operation and status goals through the PLCs to the Operations center.

The core technology of SCADA network and instrumentation

7.2 Asset Condition, Replacement Timing, and Cost

The following sections outline the asset condition, replacement timing, and estimated cost for replacement of the WRF assets. All estimated costs presented in this Section are shown in 2015 dollars. Where applicable the current or future replacement status of the asset was provided, which may include recently replaced assets, assets currently be replaced or those identified for future evaluation. Assets that have already been placed in planned CIP projects were noted along with the Fiscal Year (FY) that the CIP project was to occur. Any assets that were small enough to be addressed by County staff through the individual WRF repair and replacement (R&R) budgets were also noted. Any assets that showed replacement beyond this master planning period (FY 2035) were noted for future considerations.

7.2.1 Mechanical Assets

Mechanical assets were inspected and condition scores were assigned based on visual inspection and staff input. Because of the number of gates installed in the different facility processes, the evaluation of the mechanical assets was divided between gates and mechanical equipment.

The tables in this section provide a summary of all of the assets with condition scores 4 or greater, since these assets are most susceptible to failure. These tables also include the estimated first year of replacement and total project cost for one replacement. The condition score for mechanical equipment was assigned based on visual inspection and staff input (recent rehabilitation, operability, etc.); therefore, the replacement timing was calculated based on the EvRUL.

Condition scores of mechanical equipment located within the SEWRF were recorded during the visual inspection of the assets. The equipment was installed, replaced, and /or rehabilitated at different times, but in general, they are in good operating conditions. Only two pieces of equipment were assigned a condition score of 5 and a few had a condition score of 4, all these assets are summarized in Table 3.17.

Table 3.17 was developed to summarize all of the assets with condition scores 4 or greater, since these assets are most susceptible to failure. Table 3.17 also includes the estimated first year of replacement and total project cost for one replacement. Mixer 2A at Aeration Basin 2 was not in service due to a broken shaft and therefore a condition score of 5 was assigned. All replacement years were calculated based on the condition score assigned to each asset. For example, mixer 2A was given a condition score of 5, which corresponds to a condition fraction of 0.9. Thus, the EvRUL is calculated as follows:

$$EvRUL = (1 - 0.9) * 20 = 2\ years$$

This means that the remaining useful life of the asset is two years and it should be replaced/rehabilitated within this period. However, because this item is out of service, the County should consider a replacement before the estimated date.

Table 3.17 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Equipment with Condition Scores of 4 and Greater(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities					
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Anoxic/Aerobic Basin	Basin 2 - Mixer 2A	5	2016	CIP Project (FY20)	$148,000
Headworks	Manual Screen	4	2017	Future	$90,000
Anoxic/Aerobic Basin	Basin 1 - Mixer 1A	4	2020	CIP Project (FY20)	$148,000
Anoxic/Aerobic Basin	Basin 1 - Mixer 1B	4	2020	CIP Project (FY20)	$148,000
Anoxic/Aerobic Basin	Basin 2 - Mixer 2B	4	2020	CIP Project (FY20)	$148,000
Secondary Clarifiers	Scum Ejector 3	4	2019	CIP Project (FY18)	$43,000
Secondary Clarifiers	Scum Ejector 4	4	2019	CIP Project (FY18)	$43,000
Filters	Washwater Troughs 1	4	2020	Future	$29,000
Filters	Porous Plates (Underdrain) 1	4	2014	In Progress	$457,000
Filters	Porous Plates (Underdrain) 2	4	2014	In Progress	$457,000
Equalization Tank	Diffuser System 1	4	2022	CIP Project (FY25)	$219,000
Equalization Tank	Diffuser System 2	4	2025	CIP Project (FY25)	$219,000
Chlorine Feed System	Metering Pump Skid 3 (To Filters, RAS, Clarifiers)	4	2019	R&R	$97,000

Table 3.17 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Equipment with Condition Scores of 4 and Greater[1]
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chemical Feed Systems	Alum Feed Pump 1	4	2019	R&R	$16,000
Sludge Handling	Sludge Pump 1	4	2019	R&R	$89,000
Sludge Handling	Sludge Pump 2	4	2019	R&R	$89,000
Sludge Handling	Sludge Pump 3	4	2019	R&R	$89,000
Sludge Handling	Sludge Pump 4	4	2019	R&R	$89,000
Sludge Handling	Sludge Pump 6	4	2019	R&R	$121,000
Sludge Handling	Sludge Pump 7	4	2019	R&R	$121,000
Sludge Handling	Polymer Feed System 2	4	2019	CIP Project (FY 20)	$58,000
Sludge Handling	Gravity Belt Thickener 1	3	2024	CIP Project (FY 24)	$816,000
Dewatering System	Belt Filter Press & Power Unit 2	4	2020	CIP Project (FY 20)	$925,000
Dewatering System	Booster Pump 1	4	2019	CIP Project (FY 20)	$10,000
Dewatering System	Booster Pump 2 & Stand-By (Total of 2)	4	2019	CIP Project (FY 20)	$20,000

Notes:
(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars, 20-Cities Average Index of 10037, July 2015.
(2) Replacement is in progress.

In general, it was reported the gates installed in the different structures are usually kept in the same positions. In addition, these gates are not exercised regularly and overall are very difficult to operate. Condition scores were assigned based on visual inspections and staff input. However, because most gates were submerged, the first replacement year was estimated based on the installation year.

Table 3.18 provides a summary of the gates with condition scores 5 and 4, first replacement years, and replacement costs (refer to Appendix C for information on all gates). All gates (except for one) have conditions scores between 5 and 3, which indicate they are operational, but require some rehabilitation or replacement work. The first replacement years vary from 2014 and 2022 regardless of the condition score; this attributed to the use of the RUL to estimate the replacement year.

Table 3.18 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates with Condition Scores of 4 and Greater(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Headworks	Slide Gate 5	5	2014	CIP Project (FY18)	$52,000
Influent Splitter Box	Weir Gates 1-11	4	2020	CIP Project (FY 20)	$583,000
Chlorine Contact Basins	Slide Gate 1 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 2 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 3 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 4 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 5 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Sluice Gate 1 (Basins 1 & 2)	5	2014	CIP Project	$48,000

Table 3.18 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates with Condition Scores of 4 and Greater(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities					
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
				(FY 20)	
Chlorine Contact Basins	Sluice Gate 2 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$48,000
Chlorine Contact Basins	Sluice Gate 3 (Basins 1 & 2)	5	2014	CIP Project (FY 20)	$48,000
Chlorine Contact Basins	Slide Gate 1 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 2 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 3 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Slide Gate 4 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$48,000
Chlorine Contact Basins	Slide Gate 5 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$48,000
Chlorine Contact Basins	Sluice Gate 1 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Sluice Gate 2 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Sluice Gate 3 (Basins 3 & 4)	5	2022	CIP Project (FY 20)	$30,000
Anoxic/Aerobic Basin	Sluice Gate 1	4	2014	CIP Project (FY 20)	$30,000

Table 3.18 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates with Condition Scores of 4 and Greater[1]
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Anoxic/Aerobic Basin	Sluice Gate 2	4	2014	CIP Project (FY 20)	$30,000
Anoxic/Aerobic Basin	Sluice Gate 3	4	2014	CIP Project (FY 20)	$30,000
Anoxic/Aerobic Basin	Sluice Gate 4	4	2014	CIP Project (FY 20)	$30,000
Mixing/Flocculation Basin	Slide Gate 1	4	2014	CIP Project (FY 20)	$48,000
Mixing/Flocculation Basin	Slide Gate 2	4	2014	CIP Project (FY 20)	$48,000
Mixing/Flocculation Basin	Slide Gate 3	4	2014	CIP Project (FY 20)	$48,000
Mixing/Flocculation Basin	Slide Gate 4	4	2014	CIP Project (FY 20)	$27,000
Mixing/Flocculation Basin	Slide Gate 5	4	2014	CIP Project (FY 20)	$30,000
Mixing/Flocculation Basin	Slide Gate 6	4	2014	CIP Project (FY 20)	$30,000
Chlorine Contact Basins	Effluent Slide Gates Basins 1&2 (Total of 3)	4	2014	CIP Project (FY 20)	$91,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars, 20-Cities Average Index of 10037, July 2015.

7.2.2 Structural Assets

The majority of the structures at the SEWRF have been in service since the facility's original construction in 1989, or since the 2002 expansion. Some of these structures have been rehabilitated and repair to maintain good structural conditions. In general, most of the structures were reported and found to be in acceptable conditions. Table 3.19 summarizes all the structural assets and the results of their evaluation. The calculation of the first replacement date was performed using the EvRUL method for remaining useful life (as described in section 5.2.2). For example, the headworks structure was built in 1989 and was given a condition score of 3, which corresponds to a condition fraction of 0.5. Thus, the EvRUL is calculated as follows:

$$EvRUL = (1 - 0.5) * 50 = 25\ years$$

The EvRUL was selected to calculate the remaining useful life and replacement timing because this number takes into consideration the condition of the structure as reported by staff and based on visual inspection. On the other hand, the RUL would only consider the time that the structure has been in service and not its actual condition. Therefore, if the RUL method were to be used, the structures that have been in service for approximately 50 years (which is the recommended life expectancy of a concrete structure) would have to be fully rehabilitated or replaced, which might not be necessary based on the actual conditions.

There were no structures with a condition score of 5, and as shown in Table 3.19 there are only a few structures with a condition score of 4. Leaks were reported at Filter Basins 3 and 4 at the location were the air pipe penetrates the structure; this issue should be further evaluated and addressed. Chlorine Contact Basins 3 and 4 had some cracks at walls, and staff reported these are more evident when basins are empty. Since this evaluation was only based on visual inspection, a thorough structural evaluation of these structures can be useful to determine their actual structural condition.

Table 3.19 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Filters	Filter 1	4	2029	Future Evaluation	$287,000
Filters	Filter 3	4	2029	Future Evaluation	$287,000
Filters	Filter 4	4	2029	Future Evaluation	$287,000

Table 3.19 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chlorine Contact Basins	Chlorine Contact Basin 3	4	2029	Future Evaluation	$159,000
Chlorine Contact Basins	Chlorine Contact Basin 4	4	2029	Future Evaluation	$159,000
Non-Process Buildings	Administration Building	4	2029	Rehabilitation project (FY 22)	$1,288,000
Headworks	Headworks Structure	3	2039	Future	$935,000
Odor Control Facilities	Odor Control	3	2039	Future	$5,000
Odor Control Facilities	Chemical Structure	3	2039	Future	$10,000
Influent Splitter Box	Splitter Box Structure	3	2039	Future	$446,000
Anoxic/Aerobic Basin	Anoxic/Aerobic Basin 1	3	2039	Future	$10,257,000
Anoxic/Aerobic Basin	Anoxic/Aerobic Basin 2	3	2039	Future	$10,257,000
Secondary Clarifiers	Secondary Clarifier 1	3	2039	Future	$1,317,000
Secondary Clarifiers	Secondary Clarifier 2	3	2039	Future	$1,317,000
Secondary Clarifiers	Secondary Clarifier 3	3	2039	Future	$1,317,000
Secondary Clarifiers	Secondary Clarifier 4	3	2039	Future	$1,317,000
Secondary Clarifiers & RAS/WAS Pump Stations	Sludge Box 1	3	2039	Future	$11,000

Table 3.19	**SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets Water Reclamation Facilities – Master Plan Development Manatee County Utilities**				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Secondary Clarifiers & RAS/WAS Pump Stations	Sludge Box 2	3	2039	Future	$11,000
Secondary Clarifiers & RAS/WAS Pump Stations	Distribution Box	3	2039	Future	$48,000
Secondary Clarifiers & RAS/WAS Pump Stations	Sludge Wet Well	3	2039	Future	$1042,000
RAS/WAS Pump Stations	RAS/WAS Pump Station	3	2039	Future	$116,000
Flash Mixers & Flocculator	Mixing/Flocculation Basin	3	2039	Future	$166,000
Filters	Filter 2	3	2039	Future	$287,000
Reject Pump Station	Concrete Wet Well	3	2039	Future	$23,000
Plant Drain Pump Station	Valve Vault	3	2039	Future	$31,000
Anoxic/Aerobic Basin	Anoxic/Aerobic Basin 3	2	2054	Future	$7,383,000
Filters	Blower Building 4	2	2054	Future	$181,000
Reject Pump Station	Valve Vault	2	2054	Future	$22,000
Plant Drain Pump Station	Concrete Wet Well	2	2054	Future	$32,000
Equalization Tank	Equalization Tank 1	2	2054	Future	$2,972,000
Equalization Tank	Equalization Tank 2	2	2054	Future	$2,972,000
Equalization Tank	Blower Building 2	2	2054	Future	$432,000

Table 3.19 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chlorine Contact Basins	Chlorine Contact Basin 1	2	2054	Future	$156,000
Chlorine Contact Basins	Chlorine Contact Basin 2	2	2054	Future	$156,000
Chlorine Storage and Feed System	Chlorination Building	2	2054	Future	$541,000
Effluent & Reuse Pump Station	Wet Well 1	2	2054	Future	$123,000
Effluent & Reuse Pump Station	Wet Well 2	2	2054	Future	$123,000
Effluent & Reuse Pump Station	Wet Well 3	2	2054	Future	$123,000
Effluent & Reuse Pump Station	Wet Well 4	2	2054	Future	$123,000
Sludge Handling System	Sludge Holding Tank 1	2	2054	Future	$2,497,000
Sludge Handling System	Sludge Holding Tank 2	2	2054	Future	$2,497,000
Sludge Handling System	Gravity Belt Thickener Structure 1	2	2054	Future	$53,000
Sludge Handling System	Blower Building 3	2	2054	Future	$407,000
Dewatering System	Dewatering Building	2	2054	Future	$1,821,000
Non-Process Buildings	Electrical Building	2	2054	Future	$1,264,000

Table 3.19 SEWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets Water Reclamation Facilities – Master Plan Development Manatee County Utilities					
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Effluent & Reuse Pump Station	HSPS Concrete Structure	1	2064	Future	$65,000
Sludge Handling System	Gravity Belt Thickener Structure 2	1	2064	Future	$53,000
Lake Filtering System	Concrete Slab On-Grade	1	2064	Future	$74,000
Lake Filtering System	Backwash Wet Well	1	2039	Future	$67,000
Lake Filtering System	Backwash Vault	1	2039	Future	$8,000
Reuse Storage	10 MG Reuse Storage Tank	1	2064	Future	$6,004,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current (2014) dollars, 20-Cities Average Index of 10037, July 2015.

Approximately 50 percent of the structures inspected had condition scores of 1 and 2 and around 40 percent had a condition score of 3. This indicates that most of these assets are in acceptable working conditions and no significant defects were identified during the inspection. The remaining assets will require some improvements to return to original conditions and eventual replacement or rehabilitation. It is estimated that most structural assets would require a one-time replacement during the 40-year period with the closest replacement being in 2029.

7.2.3 Electrical, Instrumentation and Controls Assets

The SEWRF receives electric power service from FPL. The voltage is stepped down from 23 kV to 480 volts (V) by two separate service transformers, which are located within a utility vault room. The 480 V from each transformer is supplied to two main switchgears (Switchgear Nos. 1 and 2) located in the main electrical room (adjacent to the FPL utility vault).

One FPL service transformer and Switchgear No. 1 were initially constructed in 1988 and interconnected with two standby generators, each rated with a power capacity of 2000 kW. The 480 volt Switchgear No. 1 distributes power to multiple MCCs located near the wastewater treatment processes. During the major expansion constructed in year 2000 - 2001, the second FPL service utility transformer, Switchgear No. 2 and a third 2000 kW standby power generator were installed. Also, Switchgear No. 2 distributes power to multiple MCCs located near the motorized equipment and wastewater treatment processes.

The two main switchgears, the three generators for standby power and their designed interconnection assigns the function of one 2000 KW generator to work in conjunction with one of the two switchgear(s); then the third 2000 KW generator is available as redundant backup for either of the two generators on duty. Such switchgear's and generator's interconnection does not synchronize the generators among themselves, for proportional equipment loading and higher energy efficiency; consequently when two generators are supplying power to the facility, each generator may be partially loaded and there might be a substantial non-efficiency in generator use and a considerable operating cost in non-utilized diesel fuel.

Since the original electrical equipment has been in service for approximately 25 years, and electrical equipment technology has been rapidly evolving to state of the art products with safer features and more reliable properties, then parts for critical equipment difficult to obtain and it is reaching the end of its useful and reliable life. The replacement of the older Switchgear No. 1 should not be done in the same equipment configuration. The current interconnected scheme of the two service switchgears and the three generators should be evaluated further, for an alternative configuration that will provide higher system efficiency and use of state of the art switchgear equipment, with preferable features like synchronized generators. This evaluation will be performed during the future electrical master planning for the facility.

The enclosures of electrical equipment that are located in electrical rooms with air conditioning appear in good physical condition, and perhaps their useful life could continue to deliver reliable service for another five to ten years.

The enclosures of SCADA panels located throughout the SEWRF process areas were installed in recent years using stainless steel enclosures, and they appear in reasonable durable condition. The Allen Bradley electronic programmable logic controllers (PLCs) in SCADA panels also appear to be in good condition and their technology version has been recently upgraded with current models. Other miscellaneous SCADA control parts like relays, surge protectors and spare parts for similar devices are available from multiple manufactures and they can be replaced as needed.

Table 3.20 and Table 3.21 shows the asset condition scores for the key electrical and control equipment associated with the wastewater treatment process, with conditions scores between 5 and 3 as well as anticipated year of first replacement and the respective cost for replacement. The replacement costs for Switchgear Nos. 1 and No. 2 and the generator's controls are based on the current equipment configuration. The switchgear replacement cost will be higher, if the County prefers to improve the service switchgear and generators interconnection scheme with higher energy efficiency, greater safety features and more reliable products. The pertinent opinion of cost for future improvements of the power distribution system is not included, because it is beyond the scope of this asset replacement report.

Table 3.20 SEWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical Assets with Condition Score of 3 and Higher(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Main Electrical Room	Switchgear 1(2)	3	2029	CIP Project FY 29	$1,399,000
Main Electrical Room	Switchgear 2(2)	3	2029	CIP Project FY 29	$2,797,000
Main Electrical Room	Generator Breaker 1(2)	3	2029	CIP Project FY 29	$503,000
Main Electrical Room	Generator Breaker 2A(2)	3	2029	CIP Project FY 29	$503,000
Main Electrical Room	Generator Breaker 3(2)	3	2029	CIP Project FY 29	$503,000
Main Electrical Room	Generator Breaker No 2B(2)	3	2029	CIP Project FY 29	$503,000
Main Electrical Room	Panel - LE	3	2022	R&R	$11,000
Dewatering System	MCC - 5	3	2029	CIP Project FY 29	$416,000
Dewatering System	MCC - 6	3	2029	CIP Project FY 29	$430,000
Main Electrical Room	MCC - 9	3	2029	CIP Project FY 29	$327,000

Table 3.20 SEWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical Assets with Condition Score of 3 and Higher(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Main Electrical Room	MCC - 10	3	2029	CIP Project FY 29	$395,000
Main Electrical Room	Sub-Panel - LE (Main Electrical Room)	3	2022	R&R	$11,000
Main Electrical Room	Panel - L4 (Main Electrical Room)	3	2022	R&R	$14,000
Main Electrical Room	Panel - PC-TC1 (Main Electrical Room)	3	2022	R&R	$17,000
Dewatering System	Panel - LDA (Dewatering Building)	3	2022	CIP Project FY 20	$17,000
Control Building	Panel - LMS	3	2022	R&R	$17,000
Main Electrical Building	Isolation Transformer 1	3	2029	CIP Project FY 29	$53,000
Main Electrical Building	Isolation Transformer 2	3	2029	CIP Project FY 29	$53,000
Main Electrical Building	Isolation Transformer 3	3	2029	CIP Project FY 29	$53,000

Notes:
(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars (2014) dollars, 20-Cities Average Index of 10037, July 2015.
(2) Switchgears and Stand By Power Control should not be replaced as separate assets, They should be treated as a System and be replaced all together with a new more efficient scheme.

Table 3.21	SEWRF Asset Condition, Replacement Timing, and Cost Summary of Instrumentation and Control Assets with Condition Score of 3 and Higher(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Reject Pump	Submersible Pump Control Panel	3	2017	Replaced (2016)	$73,000
Plant Drain	Control Panel	3	2017	Replacement Underway	$64,000
Plant Drain	Control Panel	3	2014	Replacement Underway	$64,000
Solids Handling	Gravity Belt Thickener 1 Control Panel	3	2022	CIP Project (FY 24)	$60,000
Effluent & Reuse Pump Station	Equipment Control Panel	5	2016	Future	$62,000
Effluent & Reuse Pump Station	Equipment Control Panel	5	2016	Future	$62,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars (2014) dollars, 20-Cities Average Index of 10037, July 2015.

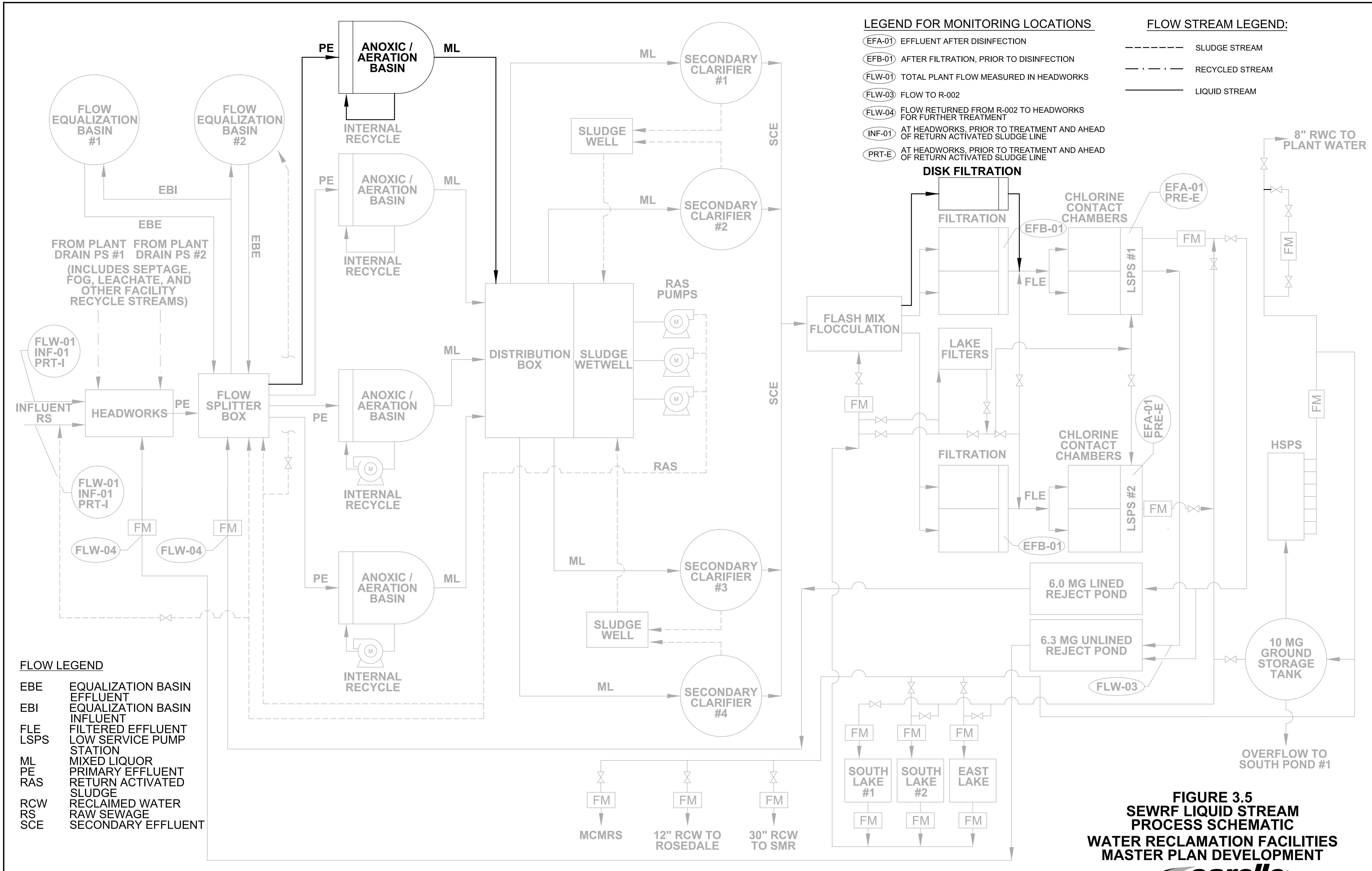
7.3 Future Treatment Requirements

Table 3.22 details the design criteria for the liquid stream processes and solids handling processes that will be required for the SEWRF to be able to treat 12.1 mgd AADF (the projected LOS flow of 11.66 mgd plus 0.42 mgd from future water treatment plant). A conceptual process flow diagram for the major liquid stream process facilities is depicted in Figure 3.5

Table 3.22 SEWRF - Expansion Summary of Existing Treatment Processes Water Reclamation Facilities – Master Plan Development Manatee County		
	Current Facilities 11 mgd (AADF)[(1)]	2035 Facilities 12.1 mgd (AADF)[(1)]
Headworks		
Total No. of Screens	3	3
Capacity (Peak), Each	12 mgd	12 mgd
Total No. of Grit Removal	2	2
Capacity (Peak), Each	20 mgd	20 mgd
Secondary Treatment		
Total No. of Aeration Basins	3	4[(2)]
Volume, Total	11.03 MG	16.04 MG
Total No. of Secondary Clarifiers	4	4
Surface Area, Total	38,010 ft^2	38,010 ft^2
Tertiary Treatment		
Total No. of Filters	4	6
Surface Area, Total[(3)]	5,760 ft^2	7,180 ft^2
Total No. of Chlorine Contact Basin	4	4[(4)]
Volume, Total	0.36 MG	0.36 MG
Solids Thickening and Dewatering		
Total No. of Aerated Sludge Holding Tanks	2	2
Storage, Total[(5)]	72 days	45 days
Total No. of Gravity Belt Thickeners	2	2
Total No. of Belt Filter Press	6	6[(6)]

Notes:

(1) Assumes all units in service for peak flows. All unit sizes for existing unit processes are given in TM1. Proposed unit processes sizes are similar unless otherwise noted.
(2) Additional volume of Anoxic/Aeration Basin is required. Evaluation of influent loadings and biological changes requires a separate study based on TM 2. Current expansion is based on design MLSS and upgrades from current project flows and influent loadings.
(3) Based on existing filter surface area of 1,440 ft^2 each and peak loading rate of 2.0 gpm/ft^2. Actual capacity may vary. The proposed new filters are 2 cloth media filters with a peak hydraulic loading rate of 6.5 gpm/sf and surface area of 710 ft^2 each.
(4) Based on 15 minutes at peak flow of contact time and assumed that adequate chlorine dosage is available to meet disinfection requirements.
(5) Storage days are based on 4% solids.
(6) Based on 24/7 operation, 0.032 mgd of WAS flow and 12,950 lb/day WAS load.



FLOW LEGEND

EBE	EQUALIZATION BASIN EFFLUENT
EBI	EQUALIZATION BASIN INFLUENT
FLE	FILTERED EFFLUENT
LSPS	LOW SERVICE PUMP STATION
ML	MIXED LIQUOR
PE	PRIMARY EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
RCW	RECLAIMED WATER
RS	RAW SEWAGE
SCE	SECONDARY EFFLUENT

FIGURE 3.5
SEWRF LIQUID STREAM PROCESS SCHEMATIC
WATER RECLAMATION FACILITIES MASTER PLAN DEVELOPMENT

User: svcPW

As shown in Figure 3.5 and Table 3.22, additional anoxic/aeration capacity and filtration capacity is proposed based on the LOS flow projections at SEWRF. The existing capacity analysis for these treatment units was presented in TM2.

7.3.1 Trigger Curves

Trigger curves for the individual treatment processes at SEWRF are presented in Appendix D. These curves show the projected LOS flow (AADF) and the estimated and projected treatment capacity of SEWRF.

The indicated project phasing shows the recommended sizing and timing of the treatment process expansions. The timing represents the year in which the process expansion becomes operational, so the trigger point for start of design precedes the year indicated by the estimated time needed for design, bidding, construction, and start-up. Based on the trigger curves, all treatment processes have a sufficient total capacity to meet planning period flow, except the aeration tanks and tertiary filters.

Additional aeration tanks capacity to meet LOS projected flows and should be operational by 2028 (Figure D.2, Appendix D). The trigger curves are based on LOS projected flows and not the actual flow SEWRF is experiencing. Also, several recycle flows (loadings) were included to evaluate the existing treatment capacities.

The recycle streams include County landfill leachate, dryer recycle, and reject from future water treatment plant. It is recommended a further detailed evaluation of secondary treatment capacity should be conducted by the County to determine additional loads being treated at SEWRF including the Duette landfill leachate, septage, grease, and any other loads not being quantified in the influent sampling.

Additional tertiary filters are needed to meet LOS projected flows currently (Figure D.4, Appendix D). The hydraulic capacity of the tertiary filters was calculated assuming a peak hydraulic loading of 2.0 gpm/sf, which is based on knowledge of similar ABW filtration facilities in Florida. 10 State Standards allows higher (5.0 gpm/sf) peak hydraulic loading rates for granular media filters. In addition, the AADF capacity was calculated using the PHF peaking factor of 2.5. Carollo recommends further hydraulic testing of the existing filter installation to determine the actual peak hydraulic loading rate of the existing filters before expansion is pursued.

7.3.2 Future Hydraulic Evaluation

The hydraulic capacity analysis for SEWRF was performed in TM2 to evaluate capacity of structures and pipes at design peak flow of 29.9 mgd (includes 0.72 mgd of flow from the Lake Manatee Water Treatment Plant). The secondary treatment was evaluated for total flow of 41.6 mgd (includes influent flow of 29.9 mgd + RAS flow rate of 11.7 mgd).

No modifications are required to the headworks channels to convey peak flow of 29.9 mgd. However, the headworks effluent weir will not able to handle the peak flow of 29.9 mgd without submergence. Also, the Headworks piping from effluent box (two 24 inch and two-30 inch diameter pipes) to 42 inch diameter piping will have high velocities exceeding 5 ft/sec. Therefore, expansion of Headworks effluent box and weir, along with upsizing of 24 inch and 30 inch diameter piping is recommended.

Based on the proposed expansion, secondary treatment structures and weirs can handle peak flow of 29.9 mgd without any submergence. Tertiary treatment structures, along with the influent and effluent weirs can handle peak hydraulic flow without submergence. However, the hydraulic calculations resulted in the submergence of the influent and effluent weirs for the flash mixers and flocculators. Before allowing the peak flow condition (29.9 mgd) to run through the flash mixing facility, Carollo recommends further investigation to be done for the weir elevations as well as their current operating conditions. In general, velocities through pipes will range between 2.4 ft/sec to 7.7 ft/sec during peak flow of 29.9 mgd.

7.4 Summary

7.4.1 Asset Management Needs

The purpose of the Asset Replacement Plan is to evaluate the needs for asset replacement based on existing condition and estimated remaining service life. Based on the results presented, below is a summary of all the assets needing replacement in the next 5 years that have project replacement costs greater than $50,000.

Mechanical Assets requiring replacement within the next 5 years:

- Anoxic/Aeration basins mixers
- Headworks Manual Screen
- Scum ejectors
- Sludge pumps

Structural Assets:

- Closest replacement costs were estimated to be 2029.

Electrical Assets:

- Belt Filter Press Control Panel #4
- MCC - HW1 (North) and HW2 (East)

7.4.2 Treatment Capacity Needs

Based on the projected flow for planning period 2035, the expansion of anoxic/aeration basins will be required. Based on the trigger curve the proposed anoxic/aeration treatment should be operational in 2028. In addition, the tertiary filtration facilities need to be expanded currently. Both systems should be further evaluated to determine specific timing and design criteria.

The hydraulic capacity constraints identified include the effluent piping from the headworks structure and the flash mix/flocculation tanks, which should be evaluated and corrected as necessary.

8.0 NRWRF FUTURE EVALUATION

8.1 Facility Inspection and Field Observations

Carollo completed walk-through facility inspections of each WRF with a team of engineers and County staff to visually assess the condition of assets and equipment at this facility Carollo inspected the NRWRF on September 5, 2014.

This section documents repair or replacement of some of the equipment over the last few years and summarizes current issues with facility processes and equipment. This information was taken into consideration when assigning condition scores of the assets and during the development of the Asset Management Plan. Overall, the facility has been well maintained and operations staff continues to work on enhancements to the process and equipment to achieve better facility performance. Before replacing some of the major assets at the NRWRF when they near the end of their useful lives, the County should conduct detailed evaluations to compare and select the best available technology at the appropriate time.

The following information was obtained from Manatee County during the site visit and was incorporated into the condition scores and Asset Management Plan timing. Appendix E provides the full list of assets and assigned condition scoring for the NRWRF.

- Headworks: The structure was found to be in very good condition, as well as the gates, grit removal system, conveyors, and screens. The pumps at the influent drain pump station are taken out of service frequently because they cannot handle the solids loads, so staff must clean the pumps approximately once every three months.

- Anoxic/Aerobic System: This process includes two basins (north and south). The north basin was out of service at the time of the inspection; however, it was reported by facility staff that both structures are in good condition and were recently cleaned in 2013. In addition, during inspection it was noted that Mixer 3 at the north basin was missing and the staff had plans to replace the unit. Mixers 1 and 2 have gearboxes that were recently rebuilt. The aerators and gates were all reported to be in acceptable condition. The recycle (RML) pumps were placed in service during 2013.

- Secondary Clarifiers: All structures were found to be in good condition. Clarifiers 1 and 2 were recently taken out of service and drivers rebuilt. RAS 1, 2, and 3 were in acceptable operating conditions and WAS pumps 1 and 2 were recently replaced.

- Flow Splitter Box: The flash mixers and flocculators are no longer used as this structure was converted into a flow splitter box. The structure itself and the associated gates were reported to be in good condition.

- Filters: The filtration at this facility is achieved with four filters. Two of the filters (Filters 1 and 2) are media filters with automatic backwash system and the remaining two (Filters 3 and 4) are disk filter with cloth media system. The rehabilitation of Filters 1 and 2 would begin during 2014. This rehabilitation project includes improvements to the basin structures and replacement of media, troughs, backwash system, porous plates, carriage, and effluent ports. The gates in Filters 1 and 2 were reported to be from original installation and are in acceptable working condition.

  Filters 3 and 4 were recently maintained and the system was found to be in good condition. The cloth media did not show any damage, and the facility staff keeps replacement cloth media on site in the event these need require replacement.

- Plant Drain Pump Station: The pump station was found to be in good condition. The wet well and the valve vault were recoated in 2013. The pumps were submerged, so visual inspection was not possible, and a condition score was given based on staff input.

- Chlorine Contact Basins: The facility has four chlorine contact basins, Basins Nos. 1 and 2 are from the original construction of the facility and Basins Nos. 3 and 4 were added in 2004 during a facility expansion. All the basins were found to be in good condition with no visual structural damage, cracks, or leaks. In general, the coating was coming off in some areas on the walls and also the growth of algae and some corrosion were visible.

  The influent gates in Basins Nos. 1 and 2 have cracks at the operator; this was reported to happen every time the gates are exercised. In addition, the stems are crooked which makes the gates very difficult to operate.

- Chlorine Storage and Feed System: The sodium hypochlorite storage and feed system consists of two bulk storage tanks and four metering pump skids. The tanks, skids, and control panels were all found in acceptable operational conditions.

- Effluent and Reuse Pump Station: Wet Wells Nos. 1 and 2 were reported to be from the original facility construction in the 1980s. Staff was not aware of any previous inspections performed to determine the structural integrity of these clearwells, so the actual condition cannot be easily determined. Even though, no cracks or leaks were evident or reported at the time of the inspection, the County should consider performing a more thorough structural investigation of these structures. The pump station includes five vertical turbine pumps all of which were installed or rehabilitated at different times. All pumps were operational at the time of inspection; however, staff reported that Pump 4 is not in good operational condition and its replacement or rehabilitation is required.

- Transfer Pump Stations: The facility has three transfer pump stations, all wet wells were rehabilitated approximately two years before the date of inspection and were found to be in good condition. All pumps and associated panels were also operational at the time of inspection.

- Polymer and Alum Feed Systems: The polymer system consists of a Polyblend system with two mixing tanks and dry polymer mixing skid. This equipment was found to be in good operational condition but with some signs of corrosion, especially on the dry polymer dispenser housing. The system also includes two polymer feed pumps that feed to the belt filter presses. Pumps were operational showing some signs of corrosion at base plates and pump housing. In addition, the control panels associated with the polymer feed pumps are obsolete and require replacements. The alum feed system consists of two feed pumps that have never been used, according to facility staff. The pumps did not have discharge pipe connected.

- Sludge Handling System: This system includes three sludge-holding tanks with diffuser systems, four sludge transfer pumps, and three blowers. A new project will replace existing Sludge Holding Tanks Nos. 1 and 2 with two glass-lined steel tanks similar to Sludge Holding Tank No. 3 (installed in 2007). New diffuser assemblies will also be installed in Sludge Holding Tanks Nos. 1 and 2. In addition, the four sludge transfer pumps will be retrofitted and the existing blowers will be replaced and installed in the existing DAF structure. Tank No. 3 was reported to be in good condition and staff suspect rags are present in the tank, which affects the performance of the diffusers.

- Standby Power Generation: All system components were found in good operational conditions. The generators and associated day tanks and pumps are serviced on a set schedule by a third party.

- Dewatering System: The dewatering system consists of three belt filter presses, but at the time of inspection only two were in service. Belt Filter Press No. 2 was out of service and in need of rehabilitation. The horizontal screw conveyor showed severe corrosion damage of internal parts, while troughs were found to be in good condition. Staff reported the horizontal and inclined conveyors for Belt Filter Press No. 2 were tested and leak-free. On the other hand, the trough for the incline conveyor dedicated to Belt Filter Presses Nos. 1 and 3 was reported to have continuous leak problems at the joints. Facility staff continues to fix these issues; so the County should consider replacing or rehabilitating the trough. The system also includes four booster pumps, which were reported to have cavitation problems causing wear of the pump impellers.

- Lake Filtering System: the facility has two lake filtration systems. The original system is comprised of five STAKfilter™ manufactured by Everfilt and installed around 2005. Each of these units has a capacity of 1,800 gpm and they are still under operation. The new lake filtration system was installed around 2011 and includes three DiscFilters and associated controls. Mechanical and instrumentation equipment were all found in good condition.

8.2 Asset Condition, Replacement Timing, and Cost

The following sections outline the asset condition, replacement timing, and estimated cost for replacement of the WRF assets. The estimated costs presented in this Section are shown in 2015 dollars. Where applicable the current or future replacement status of the asset was provided, which may include recently replaced assets, assets currently be replaced or those identified for future evaluation. Assets that have already been placed in planned CIP projects were noted along with the Fiscal Year (FY) that the CIP project was to occur. Any assets that were small enough to be addressed by County staff through the individual WRF repair and replacement (R&R) budgets were also noted. Any assets that showed replacement beyond this master planning period (FY 2035) were noted for future considerations.

8.2.1 Mechanical Assets

Mechanical assets were inspected and condition scores were assigned based on visual inspection and staff input. Because of the number of gates installed in the different facility processes, the evaluation of the mechanical assets was divided between gates and mechanical equipment.

The tables in this section (Table 3.23 and Table 3.24) provide a summary of all of the assets with condition scores 4 or greater, since these assets are most susceptible to failure. These tables also include the estimated first year of replacement and total project cost for one replacement. The condition score for mechanical equipment was assigned based on visual inspection and staff input (recent rehabilitation, operability, etc.); therefore, the replacement timing was calculated based on the EvRUL.

Table 3.23 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Assets with Condition Scores of 4 and Greater(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chemical Systems	Polymer - Belt Filter Press Feed Pump 1	5	2016	CIP Project FY 19	$16,000
Chemical Systems	Alum Feed Pump 1	5	2016	R&R	$16,000
Chemical Systems	Alum Feed Pump 2	5	2016	R&R	$16,000
Dewatering System	Belt Filter Press & Power Unit 2 (Standby)	5	2016	CIP Project FY 19	$1,044,000
Dewatering System	Horizontal Screw Conveyor 2	5	2016	CIP Project FY 19	$210,000
Effluent & Reuse Pump Station	Distribution Pump 4 (WW1) VFD	5	2025	CIP Project FY 21	$111,000
Anoxic/Aerobic Basin 1	Anoxic Mixer 1 (South)	4	2029	CIP Project FY 29	$136,000
Effluent & Reuse Pump Station	Distribution Pump 1 (WW1) VFD	4	2020	CIP Project FY 21	$111,000
Headworks	Vertical Centrifugal Pump 1	4	2019	In current CIP project	$36,000
Headworks	Vertical Centrifugal Pump 2	4	2019	In current CIP project	$36,000
Filter Basin 1	Carriage 1	4	2020	Recently replaced	$65,000
Filter Basin 2	Carriage 2	4	2020	Recently replaced	$65,000

Table 3.23 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Mechanical Assets with Condition Scores of 4 and Greater(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Dewatering System	Belt Filter Press & Power Unit 1	4	2020	CIP Project FY 19	$1,044,000
Dewatering System	Belt Filter Press & Power Unit 3	4	2020	CIP Project FY 19	$1,044,000
Dewatering System	Inclined Screw Conveyor 1	4	2020	CIP Project FY 19	$305,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars, 20-Cities Average Index of 10037, July 2015.

Table 3.24 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chlorine Contact Basins 1 & 2	Slide Gate 3	5	2014	CIP Project FY 18	$30,000
Chlorine Contact Basins 1 & 2	Slide Gate 4 (Bypass Channel)	5	2014	CIP Project FY 18	$30,000
Chlorine Contact Basins 1 & 2	Slide Gate 5	5	2014	CIP Project FY 18	$30,000
Chlorine Contact Basins 1 & 2	Sluice Gate 1	4	2014	CIP Project FY 18	$30,000

Table 3.24 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates(1)
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chlorine Contact Basins 1 & 2	Sluice Gate 2	4	2014	CIP Project FY 18	$30,000
Chlorine Contact Basins 1 & 2	Sluice Gate 3	4	2014	CIP Project FY 18	$30,000
Anoxic/Aerobic Basin 1	Sluice Gate 5	3	2014	Future	$27,000
Secondary Clarifiers	Weir Gates (Total of 4)	3	2014	CIP Project FY 18	$254,000
Secondary Clarifiers	Slide Gate	3	2014	CIP Project FY 18	$30,000
Filters 1 & 2	Slide Gate 1 (Common Influent Channel)	3	2014	R&R	$30,000
Filters 1 & 2	Slide Gate 2 (Common Influent Channel)	3	2014	CIP Project FY 18	$30,000
Filters 1 & 2	Slide Gate 3 (Common Influent Channel)	3	2014	CIP Project FY 18	$30,000
Filters 1 & 2	Slide Gate 4 (Common Influent Channel)	3	2014	CIP Project FY 18	$30,000
Chlorine Contact Basins 1 & 2	Slide Gate 6 (Wet Well Chamber 1)	3	2014	CIP Project FY 18	$30,000
Chlorine Contact Basins 1 & 2	Slide Gate 7 (Wet Well Chamber 2)	3	2014	CIP Project FY 18	$30,000

Table 3.24	NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates(1) Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Chlorine Contact Basins	Basins 3 & 4 Influent Gates (Total of 2)	3	2019	CIP Project FY 18	$228,000
Anoxic/ Aerobic Basin 2	Sluice Gate 3	3	2031	CIP Project FY 29	$30,000
Anoxic/ Aerobic Basin 2	Sluice Gate 4	3	2031	CIP Project FY 29	$30,000
Flow Splitter (Former Mixing/Flocculation Basin)	Slide Gate 3	2	2014	R&R	$36,000
Flow Splitter (Former Mixing/Flocculation Basin)	Slide Gate 4	2	2014	R&R	$30,000
Flow Splitter (Former Mixing/Flocculation Basin)	Slide Gate 5	2	2014	R&R	$27,000
Flow Splitter (Former Mixing/Flocculation Basin)	Slide Gate 6	2	2014	R&R	$27,000
Flow Splitter (Former Mixing/Flocculation Basin)	Weir Gate 1	2	2014	R&R	$72,000
Flow Splitter (Former Mixing/Flocculation Basin)	Weir Gate 2	2	2014	R&R	$72,000
Headworks	Isolation Slide Gate 1 (Grit Unit 1)	2	2020	Future	$36,000

Table 3.24	**NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Gates(1)** **Water Reclamation Facilities – Master Plan Development** **Manatee County Utilities**				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Headworks	Stop Gate (Grit Unit Separation)	2	2020	Future	$81,000
Headworks	Isolation Slide Gate 1 (Grit Unit 1)	2	2020	Future	$36,000
Headworks	Effluent Weir Gates 1 - (Oxidation Ditch Split, Total of 8)	2	2020	Future	$382,000
Headworks	Effluent Weir Gates 2 - (RAS Split, Total of 6)	2	2020	Future	$217,000
Headworks	Effluent Weir Gates 3 - (Total of 2)	2	2020	Future	$72,000
Headworks	Influent Slide Gates (Total of 3)	1	2020	Future	$108,000
Anoxic/Aerobic Basin 1	Motorized Weir Type Gate 1	1	2032	CIP Project FY 29	$72,000
Anoxic/Aerobic Basin 2	Motorized Weir Type Gate 2	1	2032	CIP Project FY 29	$72,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars, 20-Cities Average Index of 10037, July 2015.

As part of one of the improvement projects, two new sludge-holding tanks with new diffuser assemblies will be installed and all the sludge transfer pumps will be rehabilitated. In addition, three new blowers will be installed at the structure previously used foe the DAF system. Filter Basins Nos. 1 and 2 will also undergo some improvements; these improvements include the rehabilitation of the structures, replacement of troughs, filter media, porous plates, and backwash system.

On the other hand, the pieces of equipment with a condition score of 5 include the polymer and alum feed pumps. The alum pumps are installed to meet regulatory requirements; however, these pumps have never been used and operators are not sure if these pumps are actually operable. The anoxic mixer installed in basin 2 was missing and needs to be replaced. Belt Filter Press 2 was out of service at the time of inspection and operators indicated that it required rehabilitation to be operational. Screw Conveyor 2 also needs to be rehabilitated before Belt Filter Press 2 is brought back to service.

Finally, the carriages in Filter Basins Nos. 1 and 2 were assigned a condition score of 4 because they were reported to get off track often and this was going to be evaluated during the filter improvements project. The vertical centrifugal pumps Nos. 1 and 2 located at the headworks drain pump station also assigned a condition score of 4 due to the severe corrosion observed and because it was reported that these pumps cannot handle solids and need to be taken out service of a frequent basis.

Even though most of the pieces of equipment within the facility are in acceptable operating conditions, during discussions with manufacturers it was noted that some pieces of equipment are obsolete. This is the case of the ejectors, which were reported to be obsolete but spare parts are still available and rehabilitation costs will be dependent upon the parts requiring replacement. The estimated replacement year for these pieces of equipment is 2022, if the County desires to replace the ejectors with brand new units then further evaluation of available technologies will be required.

The condition score for each gate was assigned based on staff input and ease of operation. Some gates have remain in the same position for extended periods of time, others have been submerged for a long time and their actual condition is unknown, and the majority were reported to be difficult to operate. Table 3.24 provides a summary of all the gates at the NRWRF with a condition score of 3 or greater as well as first replacement year, and estimated replacement cost (refer to Appendix E for information on all gates). Replacement timing for gates was calculated based on the installation date and the estimated remaining useful life, this because the full integrity of the gates is difficult to assess when fully or partially submerged.

For example, Slide Gate 5 (Chlorine Contact Basins Nos. 1 and 2) has a condition score of 5 and the first replacement year is 2014. However, Slide Gates 6 and 7 also have a first replacement year of 2014; however, the condition score for these two gates is 3. This means that regardless of the condition, the gates have exceeded the recommended OUL and need to be replaced. As indicated in Section 5.2.1, the gates at Chlorine Basins 1 and 2 were reported to be difficult to operate because the stems are crooked, which has also caused the operator connections to break during exercising of the gates.

8.2.2 Structural Assets

The NRWRF has structures that have been in place since the 1980s when the facility was originally constructed. Throughout the years, some of these structures have been rehabilitated or replaced and others have been added as part of different plant expansion projects. Table 3.25 provides a summary of all the structural assets and the results of their evaluation; the replacement date was estimated based on the EvRUL method described in Section 5.2.2. For example, the headworks structure was built in 2010 and was given a condition score of 2, which corresponds to a condition fraction of 0.2. Thus, the EvRUL is calculated as follows:

$$EvRUL = (1 - 0.2) * 50 = 40\ years$$

The EvRUL was selected to calculate the remaining useful life and replacement timing because this number takes into consideration the condition of the structure as reported by staff and based on visual inspection. On the other hand, the RUL would only consider the time that the structure has been in service. Therefore, if the RUL method were to be used, the structures that have been in service for approximately 50 years (which is the recommended life expectancy of a concrete structure) would have to be fully rehabilitated or replaced, which might not be the case base on the actual conditions.

Table 3.25 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Effluent and Reuse Pump Station	Wet Well 1	5	2019	Evaluation and possible R&R in FY 18	$114,000
Effluent and Reuse Pump Station	Wet Well 2	5	2019	Evaluation and possible R&R in FY 18	$114,000
Reuse Storage	Reuse Storage Tank 1	3	2027	Future Evaluation	$1,249,000
Chlorine Contact Basins	Chlorine Contact Basin 1	3	2039	Future	$221,000
Chlorine Contact Basins	Chlorine Contact Basin 2	3	2039	Future	$221,000

Table 3.25 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Chlorine Contact Basins	Chlorine Contact Basin 3	3	2039	Future	$221,000
Chlorine Contact Basins	Chlorine Contact Basin 4	3	2039	Future	$221,000
Headworks	Headworks Structure	2	2054	Future	$2,098,000
Headworks	Influent Drain Pump Station Wet Well	2	2054	Future	$9,000
Anoxic/Aerobic Basins	Anoxic/Aerobic Basin 1	2	2054	Future	$7,211,000
Anoxic/Aerobic Basins	Anoxic/Aerobic Basin 2	2	2054	Future	$7,211,000
Secondary Clarifiers & RAS/WAS Pump Station	Flow Splitter Box	2	2054	Future	$108,000
Secondary Clarifiers & RAS/WAS Pump Station	Secondary Clarifier 1	2	2054	Future	$1,521,000
Secondary Clarifiers & RAS/WAS Pump Station	Secondary Clarifier 2	2	2054	Future	$1,521,000
Secondary Clarifiers & RAS/WAS Pump Station	Secondary Clarifier 3	2	2054	Future	$1,521,000
Secondary Clarifiers & RAS/WAS Pump Station	Pump Station Structure w/ Canopy	2	2054	Future	$116,000
Flash Mixers and Flocculators	Flash Mixers and Flocculators	2	2054	Future	$140,000

Table 3.25 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets
Water Reclamation Facilities – Master Plan Development
Manatee County Utilities

Location	Asset Description	Condition Score	First Replacement Year	Status	Estimated Total Project Cost
Filters	Filters 3 & 4	2	2054	Future	$55,000
Plant Drain Pump Station	Pump Station Top Slab	2	2054	Future	$7,000
Chlorine Feed	Chemical Building	2	2054	Future	$545,000
Effluent & Reuse Pump Stations	Reuse Pump Station PAD	2	2034	Evaluation and R&R in FY 30	$4,000
Effluent Transfer Pump Stations	Pump Back Station 1 - Wet Well	2	2054	Future	$40,000
Effluent Transfer Pump Stations	Pump Back Station 1 - Valve Box	2	2054	Future	$50,000
Effluent Transfer Pump Stations	Pump Back Station 2 - Wet Well	2	2054	Future	$40,000
Effluent Transfer Pump Stations	Pump Back Station 2 - Valve Box	2	2054	Future	$48,000
Effluent Transfer Pump Stations	Transfer Pump Station - Wet Well	2	2054	Future	$40,000
Effluent Transfer Pump Stations	Transfer Pump Station - Valve Box	2	2054	Future	$41,000
Sludge Holding	Sludge Pump Structure 1	2	2054	Future	$36,000
Sludge Holding	Sludge Pump Structure 2	2	2054	Future	$36,000
Dewatering System	Dewatering Building	2	2054	Future	$1,864,000

Table 3.25 NRWRF Asset Condition, Replacement Timing, and Cost Estimate for Structural Assets Water Reclamation Facilities – Master Plan Development Manatee County Utilities					
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Lake Filtering System	Concrete Slab on Grade	2	2030	Evaluation and R&R in FY 30	$46,000
Non-Process Buildings	Control Building	2	2054	Future	$1,224,000
Non-Process Buildings	Electrical Building	2	2054	Future	$1,196,000
Non-Process Buildings	Maintenance Building	2	2054	Future	$1,101,000
Sludge Holding	Sludge Holding Tank 1	1	2039	Future	$1,818,000
Sludge Holding	Sludge Holding Tanks 2	1	2039	Future	$1,818,000
Sludge Holding	Sludge Holding Tank 3	1	2039	Future	$1,818,000
Lake Filtering System	Backwash Wet Well	1	2039	Future	$45,000
Lake Filtering System	Backwash Vault	1	2039	Future	$10,000
Lake Filtering System	Concrete Slab on Grade	1	2061	Future	$28,000
Filters	Filter 1	1	2064	Future	$283,000
Filters	Filter 2	1	2064	Future	$283,000
Plant Drain Pump Station	Plant Drain Wet Well	1	2064	Future	$45,000
Plant Drain Pump Station	Plant Drain Valve Vault	1	2064	Future	$37,000
Sludge Holding	Blower Structure	1	2064	Future	$94,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current (2014) dollars, 20-Cities Average Index of 10037, July 2015.

Wet Wells 1 and 2 located at the Effluent and Reuse Pump Station were assigned a condition score of 5 because the actual structural condition of these two structures was unknown. Staff was unaware of any inspection, cleaning, or rehabilitation of these structures since they were originally constructed in 1984. A thorough structural evaluation of these clearwells can be useful to determine the actual condition and provide any maintenance or repairs if necessary.

The majority of the structural assets have condition scores of 1 or 2, meaning that only minor defects were identified during the inspection. The remaining assets will require some improvements to return to original conditions and eventual replacement. It is estimated that most structural assets would require a one-time replacement during the 40-year period with the closest replacement being in 2019.

8.2.3 Electrical, Instrumentation and Controls Assets

The NRWRF receives electric power service from Peace River Electric Cooperative, Inc. The main electrical switchgear and the generators for standby power are rated to operate at 480 volts and distribute electric power to MCCs in electric rooms located adjacent to buildings in process areas. The MCCs supply power to motorized wastewater process equipment. The majority of electrical equipment for power distribution is located in electrical rooms with air conditioning, and the physical condition of enclosures show a fair condition.

A majority of the original power distribution equipment has been in service since the original facility construction in 1988. This equipment is approximately 25 years old and is reaching the end of its useful and reliable life. However, numerous pieces of electrical equipment were installed at later dates, such as Generator No. 2 for standby power, two 4.16 kV MCCs for aeration blowers, and two substation transformers of 4.16 kV to 480 volts for the effluent pump station, which were added as part of subsequent expansion projects and/or rehabilitation projects.

The enclosures of electrical equipment located in electrical rooms with air conditioning appear in much better physical condition, and perhaps their useful life could continue to deliver reliable service for another five to ten years.

The enclosures of SCADA panels located throughout the NRWRF process areas were installed in recent years using stainless steel enclosures, and they appear in reasonable durable condition. The Allen Bradley electronic programmable logic controllers (PLCs) in SCADA panels also appear to be in good condition and their technology version will be supported with spare parts for at least five more years, even though the County has been updating the PLC equipment with current models.

Table 3.26 shows the asset condition scores for the key electrical and control equipment associated with the wastewater treatment process, with anticipated year of first replacement and the respective cost for replacement.

Table 3.26	NRWRF Asset Condition, Replacement Timing, and Cost Summary of Electrical with Condition Score of 3 and Higher[(1)] Water Reclamation Facilities – Master Plan Development Manatee County Utilities				
Location	**Asset Description**	**Condition Score**	**First Replacement Year**	**Status**	**Estimated Total Project Cost**
Main Electrical Room	MCC - 1	3	2029	CIP Project FY 29	$588,000
Main Electrical Room	MCC - 2	3	2029	CIP Project FY 29	$99,000
Main Electrical Room	MCC - 3	3	2029	CIP Project FY 29	$533,000
Main Electrical Room	MCC - 4	3	2029	CIP Project FY 29	$546,000
Dewatering System	MCC - 5	3	2029	CIP Project FY 29	$401,000
Dewatering System	MCC - 6	3	2029	CIP Project FY 29	$365,000
Main Electrical Room	PANEL PC/TC	3	2029	CIP Project FY 29	$17,000
Generator Room	Panel LE	3	2022	R&R	$17,000
Main Electrical Room	Panel LE	3	2022	R&R	$17,000
Secondary Clarifiers	Panel LFC	3	2022	R&R	$17,000
Secondary Clarifiers	Panel PFC	3	2022	R&R	$17,000

Notes:

(1) Estimated total project costs reflect Class 4 estimates of the first asset replacement in current dollars (2014) dollars, 20-Cities Average Index of 10037, July 2015.

8.3 North Water Reclamation Facility

Table 3.27 details the design criteria for the liquid stream processes and solids handling processes that will be required for the NRWRF to be able to treat 7.5 mgd AADF. A conceptual site plan for the layout of the major liquid stream process facilities is depicted in

Figure 3.6. As shown, no treatment capacity expansions are required during the planning period.

Table 3.27 NRWRF - Expansion Summary of Existing Treatment Processes
Water Reclamation Facilities – Master Plan Development
Manatee County

	Current Facilities 7.5 mgd (AADF)$^{(1)}$	2035 Facilities 7.5 mgd (AADF)$^{(1)}$
Headworks		
Total No. of Screens	2	2
Capacity (Peak), Each	20 mgd	20 mgd
Total No. of Grit Removal	2	2
Capacity (Peak), Each	20 mgd	20 mgd
Secondary Treatment		
Total No. of Aeration Basins	2	2
Volume, Total	7.35 MG	7.35 MG
Total No. of Secondary Clarifiers	3	3
Surface Area, Total	28,510 ft^2	28,510 ft^2
Tertiary Treatment		
Total No. of Filters	4	4
Surface Area, Total	2,880 ft^2	2,880 ft^2
Total No. of Chlorine Contact Basin	4	4
Volume, Total	0.32 MG	0.32 MG
Solids Thickening and Dewatering		
Total No. of Aerated Sludge Holding Tanks	2	2
Storage, Total$^{(2)}$	40 days	28 days
Total No. of Belt Filter Press	3	3$^{(3)}$

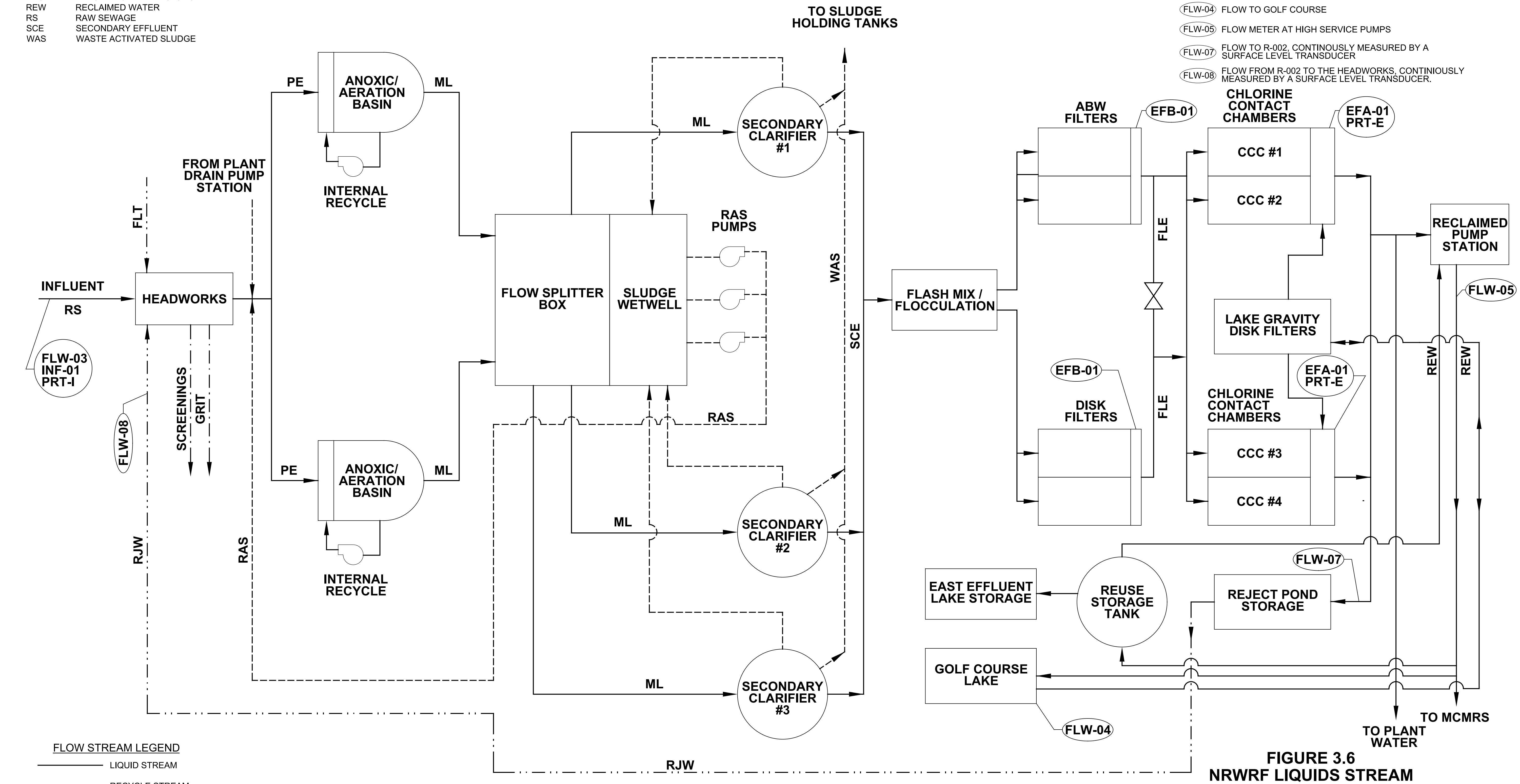
Notes:
(1) Assumes all units in service for peak flows. All unit sizes for existing unit processes are given in TM1. Proposed unit processes sizes are similar unless otherwise noted.
(2) Storage days are based on 4% solids.
(3) Based on 24/7 operation, 0.061 mgd of WAS flow and 8,600 lb/day WAS load.

PROCESS STREAM ABBREVIATIONS

CCC	CHLORINE CONTACT CHAMBER
FLE	FILTER EFFLUENT
MCMRS	MANATEE COUNTY MASTER REUSE SYSTEM
ML	MIXED LIQUOR
PE	PRELIMINARY EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
REW	RECLAIMED WATER
RS	RAW SEWAGE
SCE	SECONDARY EFFLUENT
WAS	WASTE ACTIVATED SLUDGE

LEGEND FOR MONITORING LOCATIONS

EFA-01	EFFLUENT SAMPLING POINT AFTER DISINFECTION AND PRIOR TO DISCHARGE TO R-001/R-002
EFB-01	TURBIDITY AND TSS MONITORING LOCATION AFTER FILTRATION AND PRIOR TO DISINFECTION
FLW-03	TOTAL PLANT FLOW MEASURED AT HEADWORKS
FLW-04	FLOW TO GOLF COURSE
FLW-05	FLOW METER AT HIGH SERVICE PUMPS
FLW-07	FLOW TO R-002, CONTINOUSLY MEASURED BY A SURFACE LEVEL TRANSDUCER
FLW-08	FLOW FROM R-002 TO THE HEADWORKS, CONTINIOUSLY MEASURED BY A SURFACE LEVEL TRANSDUCER.



FLOW STREAM LEGEND

- LIQUID STREAM
- RECYCLE STREAM
- SLUDGE STREAM
- SCREENINGS/GRIT

**FIGURE 3.6
NRWRF LIQUIDS STREAM
PROCESS SCHEMATIC**

**WATER RECLAMATION FACILITIES
MASTER PLAN DEVELOPMENT**

carollo

User: svcPW

8.3.1 Trigger Curves

Trigger curves for the individual treatment processes at NRWRF are presented in Appendix F. These curves show the projected LOS flow AADF and the estimated and projected treatment capacity of NRWRF.

The indicated project phasing shows the recommended sizing and timing of the treatment process expansions. The timing represents the year in which the process expansion becomes operational, so the trigger point for start of design precedes the year indicated by the estimated time needed for design, bidding, construction, and start-up. Based on the trigger curves, all treatment processes have a sufficient total capacity to meet planning period flow.

8.3.2 Future Treatment Plant Hydraulic Needs

The hydraulic profile for North Regional WRF was evaluated in TM2. The following summarizes additional expansions required for structures to meet design peak flow hydraulic capacities. Hydraulic analysis assumed all units in service. The hydraulic capacity analysis for NRWRF was performed to evaluate capacity of structures and pipes at design peak flow of 18.75 mgd. The secondary treatment was evaluated for total flow of 26.25 mgd (includes influent flow of 18.75 mgd + RAS flow rate of 7.5 mgd).

Based on the existing and proposed facilities, all structures and weirs can handle design peak flow of 18.75 mgd without any submergences, except the effluent weir at the flash mix/flocculation tanks. Before any expansion of these structures, Carollo recommends further investigation to be done for the weir elevations as well as their current operating conditions.

8.4 Summary

8.4.1 Asset Management Needs

The purpose of the Asset Replacement Plan is to evaluate the needs for asset replacement based on existing condition and estimated remaining service life. Based on the results presented, below is a summary of all the assets needing replacement in the next 5 years that have project replacement costs greater than $50,000.

Mechanical Assets requiring replacement within the next 5 years:

- Anoxic mixers 1 and 3
- Filter press and power unit 1, 2, and 3
- Horizontal screw conveyor 2
- Inclined screw conveyor 1

- Distribution pump 1 and 4
- Filter carriages 1 and 2

Structural Assets:

- Effluent and reuse pump station wet well 1 and 2

Electrical Assets:

- Closest replacement costs were estimated to be in 2022.

8.4.2 Treatment Capacity Needs

Based on the projected flow for planning period 2035, no treatment capacity expansions are anticipated for NRWRF.

The hydraulic capacity constraints identified include the flash mix/flocculation tanks, which should be evaluated and corrected as necessary.

APPENDIX A - SWWRF ASSET CONDITION SCORES, REPLACEMENT TIMING, AND PROJECT COSTS

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
LIQUID PROCESS									
1. HEADWORKS	1.001	STRUC	HEADWORKS STRUCTURE	5	5	7/31/2018	7/18/2068	7/7/2118	$ 25,000
	1.002	MECH	VORTEX GRIT UNIT #1	5	2	7/31/2018	7/26/2038	7/21/2058	$ 743,000
	1.003	ELEC/I&C	GRIT UNIT #1 DRIVER	5	3	7/31/2018	7/23/2048	7/16/2078	$ 54,000
	1.004	MECH	VORTEX GRIT UNIT #2	5	2	7/31/2018	7/26/2038	7/21/2058	$ 743,000
	1.005	ELEC/I&C	GRIT UNIT #2 DRIVER	5	3	7/31/2018	7/23/2048	7/16/2078	$ 54,000
	1.006	MECH	SLIDE GATE #1 (Model 553957)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 47,000
	1.007	MECH	SLIDE GATE #2 (Model 553946)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 50,000
	1.008	MECH	SLIDE GATE #3 (Model 553946)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 50,000
	1.009	MECH	SLIDE GATE #4 (Model 553946)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 50,000
	1.010	MECH	SLIDE GATE #5 (Model 553946)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 50,000
	1.011	MECH	SLIDE GATE #6 (Model 553951)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 52,000
	1.012	MECH	SLIDE GATE #7 (Model 553951)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 52,000
	1.013	MECH	SLIDE GATE #8 (Model 553952)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 52,000
	1.014	MECH	SLIDE GATE #9 (Model 553952)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 52,000
	1.015	MECH	SLIDE GATE #10 (Model 553952)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 52,000
	1.016	MECH	SLIDE GATE #11 (Model 553955)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 47,000
	1.017	MECH	SLIDE GATE #12 (Model 553957)	5	2	7/31/2018	7/26/2038	7/21/2058	$ 47,000
	1.018	MECH	MECHANICAL SCREEN #1	5	10	7/31/2018	7/28/2028	7/26/2038	$ 1,261,000
	1.019	MECH	MECHANICAL SCREEN #2	5	10	7/31/2018	7/28/2028	7/26/2038	$ 1,261,000
	1.020	MECH	MANUAL BAR SCREEN #3	5	10	7/31/2018	7/28/2028	7/26/2038	$ 90,000
	1.021	MECH	GRIT UNIT FLYGT PUMP #1	5	15	7/31/2018	7/27/2033	7/23/2048	$ 91,000
	1.022	MECH	GRIT UNIT FLYGT PUMP #2	5	15	7/31/2018	7/27/2033	7/23/2048	$ 91,000
	1.023	MECH	GRIT CLASSIFIER (CYCLONE) # 1	5	2	7/31/2018	7/26/2038	7/21/2058	$ 209,000
	1.024	ELEC/I&C	NEW CLASSIFIER CONTROL PANEL #1	5	3	7/31/2018	7/23/2048	7/16/2078	$ 50,000
	1.025	MECH	GRIT CLASSIFIER (CYCLONE) # 2	5	2	7/31/2018	7/26/2038	7/21/2058	$ 209,000
	1.026	ELEC/I&C	NEW CLASSIFIER CONTROL PANEL #2	5	3	7/31/2018	7/23/2048	7/16/2078	$ 50,000
	1.027	MECH	CONVEYOR #1	5	2	7/31/2018	7/26/2038	7/21/2058	$ 290,000
	1.028	MECH	CONVEYOR #2	5	2	7/31/2018	7/26/2038	7/21/2058	$ 290,000
	1.029	ELEC/I&C	SCADA PANEL SP-4	5	2	7/31/2018	7/27/2033	7/23/2048	$ 180,000
2. ODOR CONTROL FACILITIES	2.001	STRUC	CONCRETE STRUCTURE	2	24	12/5/2037	11/23/2087	11/11/2137	$ 25,000
	2.002	MECH	ODOR CONTROL UNIT	1	20	7/27/2033	7/22/2053	7/17/2073	$ 245,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
3. PRIMARY CLARIFIERS	3.001	STRUC	PRIMARY CLARIFIER #1 - NEW ANOXIC BASIN #1	3	24	12/5/2037	11/23/2087	11/11/2137	$ 1,103,000
	3.002	STRUC	PRIMARY CLARIFIER #2 - NEW ANOXIC BASIN #2	3	24	12/5/2037	11/23/2087	11/11/2137	$ 1,103,000
	3.003	STRUC	PRIMARY CLARIFIER #3 - NEW ANOXIC BASIN #3	3	24	12/5/2037	11/23/2087	11/11/2137	$ 1,103,000
	3.004	STRUC	PRIMARY CLARIFIER #4 - NEW ANOXIC BASIN #4	3	24	12/5/2037	11/23/2087	11/11/2137	$ 1,103,000
	3.005	MECH	SLIDE GATE #1	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.006	MECH	SLIDE GATE #2	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.007	MECH	SLIDE GATE #3	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.008	MECH	SLIDE GATE #4	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.009	MECH	SLIDE GATE #5	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.010	MECH	SLIDE GATE #6	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.011	MECH	SLIDE GATE #7	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.012	MECH	SLIDE GATE #8	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	3.013	MECH	STOP GATE #1	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.014	MECH	STOP GATE #2	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.015	MECH	STOP GATE #3	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.016	MECH	STOP GATE #4	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.017	MECH	STOP GATE #5	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.018	MECH	STOP GATE #6	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.019	MECH	STOP GATE #7	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	3.020	MECH	ANOXIC MIXERS (32)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 1,226,000
4. FLOW EQUALIZATION TANK	4.001	STRUC	FLOW EQUALIZATION TANK	1	24	12/5/2037	11/23/2087	11/11/2137	$ 4,568,000
	4.002	MECH	EQUALIZATION TANK IMPROVEMENTS	5	20	12/1/2019	11/26/2039	11/21/2059	$ 3,870,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
5. AERATION BASINS	5.001	STRUC	AERATION BASIN #1	2	10	12/6/2023	11/23/2073	11/12/2123	$ 901,000
	5.002	STRUC	AERATION BASIN #2	2	10	12/6/2023	11/23/2073	11/12/2123	$ 901,000
	5.003	STRUC	AERATION BASIN #3	2	10	12/6/2023	11/23/2073	11/12/2123	$ 1,202,000
	5.004	STRUC	AERATION BASIN #4	2	10	12/6/2023	11/23/2073	11/12/2123	$ 1,202,000
	5.005	MECH	AERATION BLOWER #1	2	16	7/28/2029	7/23/2049	7/18/2069	$ 417,000
	5.006	MECH	AERATION BLOWER #2	2	16	7/28/2029	7/23/2049	7/18/2069	$ 417,000
	5.007	MECH	AERATION BLOWER #3	2	16	7/28/2029	7/23/2049	7/18/2069	$ 417,000
	5.008	MECH	AERATION BLOWER #4	2	16	7/28/2029	7/23/2049	7/18/2069	$ 417,000
	5.010	MECH	SLIDE GATES #1 (AERATION TANK #3)	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	5.011	MECH	SLIDE GATES #2 (AERATION TANK #4)	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	5.012	MECH	SLIDE GATES EFFLUENT OF BASIN #3	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	5.013	MECH	SLIDE GATES EFFLUENT OF BASIN #1	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	5.014	MECH	SLIDE GATESAT INFLUENT TO BASINS (3 TOTAL)	3	10	7/30/2023	7/25/2043	7/20/2063	$ 156,000
	5.018	MECH	SLUICE GATES AT BASIN EFFLUENT	3	10	7/30/2023	7/25/2043	7/20/2063	$ 52,000
	5.019	STRUC	BLOWERS BUILDING	1	38	5/6/2051	4/24/2101	4/12/2151	$ 984,000
	5.020	MECH	FINE BUBBLE DIFFUSERS SYSTEM BASIN #1	1	20	7/27/2033	7/22/2053	7/17/2073	$ 730,000
	5.021	MECH	FINE BUBBLE DIFFUSERS SYSTEM BASIN #2	1	20	7/27/2033	7/22/2053	7/17/2073	$ 730,000
	5.022	MECH	FINE BUBBLE DIFFUSERS SYSTEM BASIN #3	1	20	7/27/2033	7/22/2053	7/17/2073	$ 730,000
	5.023	MECH	FINE BUBBLE DIFFUSERS SYSTEM BASIN #4	1	20	7/27/2033	7/22/2053	7/17/2073	$ 730,000
	5.024	MECH	SUBMERSIBLE PUMP #1	1	15	7/28/2028	7/25/2043	7/21/2058	$ 102,000
	5.025	MECH	SUBMERSIBLE PUMP #2	1	15	7/28/2028	7/25/2043	7/21/2058	$ 102,000
	5.026	MECH	SUBMERSIBLE PUMP #3	1	15	7/28/2028	7/25/2043	7/21/2058	$ 114,000
	5.027	MECH	SUBMERSIBLE PUMP #4	1	15	7/28/2028	7/25/2043	7/21/2058	$ 114,000
	5.028	MECH	SUBMERSIBLE PUMP #1 VFD	1	15	7/28/2028	7/25/2043	7/21/2058	$ 170,000
	5.029	MECH	SUBMERSIBLE PUMP #2 VFD	1	15	7/28/2028	7/25/2043	7/21/2058	$ 170,000
	5.030	MECH	SUBMERSIBLE PUMP #3 VFD	1	15	7/28/2028	7/25/2043	7/21/2058	$ 213,000
	5.031	MECH	SUBMERSIBLE PUMP #4 VFD	1	15	7/28/2028	7/25/2043	7/21/2058	$ 213,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
6. FINAL (SECONDARY) CLARIFIERS AREA	6.001	STRUC	FINAL CLARIFIER #1	1	50	5/6/2063	4/24/2113	4/12/2163	$ 3,003,000
	6.002	STRUC	FINAL CLARIFIER #2	1	50	5/6/2063	4/24/2113	4/12/2163	$ 3,003,000
	6.003	STRUC	FINAL CLARIFIER #3	1	50	7/20/2063	7/8/2113	6/26/2163	$ 4,181,000
	6.004	STRUC	FINAL CLARIFIER #4	1	50	7/20/2063	7/8/2113	6/26/2163	$ 4,181,000
	6.006	MECH	OVERHEAD JIB CRANE	2	16	7/28/2029	7/23/2049	7/18/2069	$ 37,000
	6.007	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #1	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.008	ELEC/I&C	RETURN ACTIVATED SLUDGE (RAS) PUMP #1 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 34,000
	6.009	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #2	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.010	ELEC/I&C	RETURN ACTIVATED SLUDGE (RAS) PUMP #2 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 34,000
	6.011	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #3	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.012	ELEC/I&C	RETURN ACTIVATED SLUDGE (RAS) PUMP #3 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 34,000
	6.013	MECH	SKIMMING PUMP #1	3	8	1/28/2021	1/25/2036	1/21/2051	$ 105,000
	6.014	MECH	SKIMMING PUMP #2	3	8	1/28/2021	1/25/2036	1/21/2051	$ 105,000
	6.015	STRUC	SKIMMING PUMPS FLOW CONTROL STRUCTURE AND WETWELL	3	24	12/5/2037	11/23/2087	11/11/2137	$ 64,000
	6.016	ELEC/I&C	CONTROL PANEL	3	15	7/28/2028	7/21/2058	7/13/2088	$ 36,000
	6.020	STRUC	FINAL CLARIFIER #5	1	48	5/5/2061	4/24/2111	4/11/2161	$ 3,688,000
	6.021	STRUC	WAS/RAS PUMP STATION CONCRETE PAD CLARIFIER 1 & 2	2	10	12/6/2023	11/23/2073	11/12/2123	$ 21,000
	6.022	MECH	MECHANICAL EQUIPMENT CLARIFIER #3	1	20	7/27/2033	7/22/2053	7/17/2073	$ 698,000
	6.023	ELEC/I&C	NEW CLARIFIER #3 CONTROL PANEL	1	30	7/25/2043	7/17/2073	7/11/2103	$ 37,000
	6.024	MECH	MECHANICAL EQUIPMENT CLARIFIER #4	1	20	7/27/2033	7/22/2053	7/17/2073	$ 698,000
	6.025	ELEC/I&C	NEW CLARIFIER #4 CONTROL PANEL	1	30	7/25/2043	7/17/2073	7/11/2103	$ 37,000
	6.026	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #4	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.027	ELEC/I&C	RETURN ACTIVATED SLUDGE (RAS) PUMP #4 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 34,000
	6.028	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #5	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.029	ELEC/I&C	RETURN ACTIVATED SLUDGE (RAS) PUMP #5 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 34,000
	6.030	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #6	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.031	ELEC/I&C	RETURN ACTIVATED SLUDGE (RAS) PUMP #6 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 34,000
	6.032	MECH	SCUM HOSE PUMP #1	1	15	7/28/2028	7/25/2043	7/21/2058	$ 78,000
	6.033	MECH	SCUM HOSE PUMP #2	1	15	7/28/2028	7/25/2043	7/21/2058	$ 78,000
	6.034	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #7	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.035	MECH	RETURN ACTIVATED SLUDGE (RAS) PUMP #8	1	15	7/28/2028	7/25/2043	7/21/2058	$ 105,000
	6.036	ELEC/I&C	SKIMMING PUMP CONTROL PANEL	3	15	7/28/2028	7/21/2058	7/13/2088	$ 11,000
	6.037	STRUC	WAS/RAS PUMP STATION CONCRETE PAD CLARIFIER 5	1	48	5/5/2061	4/24/2111	4/11/2161	$ 21,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
7. MIXERS/ FLOCCULATORS/ AUTOMATIC BACKWASH FILTERS	7.001	STRUC	FILTER #1	4	24	12/5/2037	11/23/2087	11/11/2137	$ 198,000
	7.002	STRUC	FILTER #2	5	24	12/6/2037	11/24/2087	11/12/2137	$ 198,000
	7.003	STRUC	FILTER #3	5	24	12/7/2037	11/25/2087	11/13/2137	$ 198,000
	7.004	STRUC	FILTER #4	5	24	12/8/2037	11/26/2087	11/14/2137	$ 198,000
	7.005	STRUC	FILTER #5	5	29	12/6/2042	11/23/2092	11/12/2142	$ 198,000
	7.006	STRUC	FILTER #6	2	48	12/5/2061	11/24/2111	11/11/2161	$ 250,000
	7.007	STRUC	FILTER #7	2	48	12/5/2061	11/24/2111	11/11/2161	$ 250,000
	7.008	MECH	STOP GATE #1	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.009	MECH	STOP GATE #2	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.010	MECH	STOP GATE #3	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.011	MECH	STOP GATE #4	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.012	MECH	STOP GATE #5	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.013	MECH	STOP GATE #6	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.014	MECH	STOP GATE #7	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.015	MECH	SLIDE GATE #1	4	6	7/31/2019	7/26/2039	7/21/2059	$ 52,000
	7.016	MECH	SLIDE GATE #2	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.017	MECH	SLIDE GATE #3	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.018	MECH	SLIDE GATE #4	5	2	8/1/2015	7/27/2035	7/22/2055	$ 52,000
	7.019	MECH	SLIDE GATE #5	4	6	7/31/2019	7/26/2039	7/21/2059	$ 52,000
	7.020	MECH	SLIDE GATE #6	4	6	7/31/2019	7/26/2039	7/21/2059	$ 52,000
	7.021	MECH	SLIDE GATE #7	4	6	7/31/2019	7/26/2039	7/21/2059	$ 52,000
	7.022	MECH	MOTOR OPERATED SLUICE GATE #1	2	16	7/28/2029	7/23/2049	7/18/2069	$ 239,000
	7.023	MECH	MOTOR OPERATED SLUICE GATE #2	2	16	7/28/2029	7/23/2049	7/18/2069	$ 239,000
	7.024	MECH	CARRIAGE #1	4	6	7/31/2019	7/26/2039	7/21/2059	$ 3,023,000
	7.031	ELEC/I&C	CARRIAGE GEAR MOTOR #1	3	15	7/28/2028	7/21/2058	7/13/2088	
	7.065	MECH	ABW #1 CLOTH MEDIA	5	5	12/16/2018	12/14/2025	12/12/2032	
	7.045	MECH	BACKWASH PUMP (FILTER 1)	5	2	1/30/2015	1/26/2030	1/22/2045	
	7.044	MECH	BACKWASH SYSTEM ON CLOTH FILTER	3	10	7/30/2023	7/25/2043	7/20/2063	
	7.025	MECH	CARRIAGE #2	5	2	8/1/2015	7/27/2035	7/22/2055	$ 1,396,000
	7.032	ELEC/I&C	CARRIAGE GEAR MOTOR #2	5	3	7/31/2016	7/24/2046	7/16/2076	
	7.053	MECH	POROUS PLATES #2	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.059	MECH	Rail on ABW #2	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.066	MECH	ABW #2 MIXED MEDIA	5	2	8/1/2015	7/27/2035	7/22/2055	$ -
	7.026	MECH	CARRIAGE #3	5	2	8/1/2015	7/27/2035	7/22/2055	$ 1,396,000
	7.033	ELEC/I&C	CARRIAGE GEAR MOTOR #3	5	3	7/31/2016	7/24/2046	7/16/2076	
	7.054	MECH	POROUS PLATES #3	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.060	MECH	Rail on ABW #3	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.067	MECH	ABW #3 MIXED MEDIA	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.027	MECH	CARRIAGE #4	5	2	8/1/2015	7/27/2035	7/22/2055	$ 1,396,000
	7.034	ELEC/I&C	CARRIAGE GEAR MOTOR #4	5	3	7/31/2016	7/24/2046	7/16/2076	
	7.055	MECH	POROUS PLATES #4	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.061	MECH	Rail on ABW #4	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.068	MECH	ABW #4 MIXED MEDIA	5	2	8/1/2015	7/27/2035	7/22/2055	
	7.028	MECH	CARRIAGE #5	5	2	8/1/2015	7/27/2035	7/22/2055	$ 1,396,000
	7.035	ELEC/I&C	CARRIAGE GEAR MOTOR #5	5	3	7/31/2016	7/24/2046	7/16/2076	
	7.056	MECH	POROUS PLATES #5	5	0	8/1/2013	7/27/2033	7/22/2053	
	7.062	MECH	Rail on ABW #5	5	2	8/1/2015	7/27/2035	7/22/2055	

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years			Estimated Total Project Cost (One Replacement)
						First Replac.	Second Replac.	Third Replac.	
7. MIXERS/ FLOCCULATORS/ AUTOMATIC BACKWASH FILTERS CONTINUED	7.069	MECH	ABW #5 MIXED MEDIA	5	0	8/1/2013	7/27/2033	7/22/2053	
	7.029	MECH	CARRIAGE #6	5	2	8/1/2015	7/27/2035	7/22/2055	$ 1,717,000
	7.036	ELEC/I&C	CARRIAGE GEAR MOTOR #6	5	3	7/31/2016	7/24/2046	7/16/2076	
	7.057	MECH	POROUS PLATES #6	2	16	7/28/2029	7/23/2049	7/18/2069	
	7.063	MECH	Rail on ABW #6	3	10	7/30/2023	7/25/2043	7/20/2063	
	7.070	MECH	ABW #6 MIXED MEDIA	2	16	7/28/2029	7/23/2049	7/18/2069	
	7.030	MECH	CARRIAGE #7	5	2	8/1/2015	7/27/2035	7/22/2055	$ 1,717,000
	7.037	ELEC/I&C	CARRIAGE GEAR MOTOR #7	5	3	7/31/2016	7/24/2046	7/16/2076	
	7.058	MECH	POROUS PLATES #7	2	16	7/28/2029	7/23/2049	7/18/2069	
	7.064	MECH	Rail on ABW #7	3	10	7/30/2023	7/25/2043	7/20/2063	
	7.071	MECH	ABW #7 MIXED MEDIA	2	16	7/28/2029	7/23/2049	7/18/2069	
	7.042	ELEC/I&C	STAINLESS STEEL CONTROL PANEL	2	24	7/26/2037	7/19/2067	7/11/2097	$ 36,000
	7.043	ELEC/I&C	ELECTRICAL CABLE RAIL SYSTEM	2	24	7/26/2037	7/19/2067	7/11/2097	$ 12,000
	7.072	ELEC/I&C	MOTOR OPERATED SLUICE GATES CONTROL PANEL	2	24	7/26/2037	7/19/2067	7/11/2097	$ 19,000
	7.073	MECH	BACKWASH PUMPS (FILTERS 2-4)	5	2	1/30/2015	1/26/2030	1/22/2045	$ 190,000
	7.074	MECH	BACKWASH PUMPS (FILTERS 5-7)	5	2	1/30/2015	1/26/2030	1/22/2045	$ 190,000
8. CHLORINE CONTACT BASINS & SODIUM HYPOCHLORITE FEED SYSTEM	8.001	STRUC	CHLORINE CONTACT BASIN #1	3	24	12/5/2037	11/23/2087	11/11/2137	$ 184,000
	8.002	STRUC	CHLORINE CONTACT BASIN #2	3	24	12/5/2037	11/23/2087	11/11/2137	$ 184,000
	8.003	STRUC	CHLORINE CONTACT BASIN #3	3	24	12/5/2037	11/23/2087	11/11/2137	$ 184,000
	8.014	MECH	SLIDE GATE #1 (BASIN 1 INFLUENT)	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	8.015	MECH	SLIDE GATE #2 (BASIN 2 INFLUENT)	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	8.017	MECH	SLIDE GATE #4 (BASIN 3 INFLUENT)	2	16	7/28/2029	7/23/2049	7/18/2069	$ 52,000
	8.019	MECH	SLIDE GATE #6 (EFFLUENT CHANNEL BETWEEN BASINS 2&3)	4	6	12/1/2019	11/26/2039	11/21/2059	$ 52,000
	8.020	MECH	SLIDE GATE #7 (EFFLUENT CHANNEL BETWEEN BASINS 1 &2)	4	6	12/1/2019	11/26/2039	11/21/2059	$ 52,000
	8.022	MECH	SLIDE GATE #9 (INFLUENT CHANNEL BETWEEN BASINS 2&3)	4	6	12/1/2019	11/26/2039	11/21/2059	$ 52,000
	8.023	MECH	SODIUM HYPOCHLORITE METERING PUMP #1 (CC)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 26,000
	8.024	MECH	SODIUM HYPOCHLORITE METERING PUMP #2 (CC)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 26,000
	8.025	MECH	SODIUM HYPOCHLORITE METERING PUMP #3 (CC)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 26,000
	8.026	MECH	SODIUM HYPOCHLORITE METERING PUMP #4 (SPARE)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 26,000
	8.027	MECH	SODIUM HYPOCHLORITE STORAGE TANK #1	1	15	7/28/2028	7/25/2043	7/21/2058	$ 183,000
	8.028	MECH	SODIUM HYPOCHLORITE STORAGE TANK #2	1	15	7/28/2028	7/25/2043	7/21/2058	$ 183,000
	8.029	MECH	SODIUM HYPOCHLORITE STORAGE TANK #3	3	8	1/28/2021	1/25/2036	1/21/2051	$ 183,000
	8.030	MECH	WEIR GATE #1 (INFLUENT CHANNEL BASINS 1-2)	4	6	12/1/2019	11/26/2039	11/21/2059	$ 52,000
	8.031	MECH	SODIUM HYPOCHLORITE METERING PUMP #1 (RAS)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 26,000
	8.032	MECH	SODIUM HYPOCHLORITE METERING PUMP #2 (MISSILE)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 26,000
	8.033	ELEC/I&C	CHLORINE PUMPS CONTROL PANEL	1	15	7/28/2028	7/25/2043	7/21/2058	$ 12,000
	8.034	MECH	SODIUM HYPOCHLORITE CHEMICAL FEED PUMP #5	1	15	12/20/2032	12/17/2047	12/13/2062	$ 26,000
	8.035	MECH	SODIUM HYPOCHLORITE CHEMICAL FEED PUMP #6	1	15	12/20/2032	12/17/2047	12/13/2062	$ 26,000
	8.036	MECH	GATE REMOVAL (12 GATES TOTAL)	4	6	12/1/2019	11/26/2039	11/21/2059	$ 25,000
	8.037	STRUC	SEALED GATE OPENINGS (10 OPENINGS TOTAL)	4	15	12/1/2019	11/18/2069	11/7/2119	$ 168,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
9. BLOWER AND DAF EQUIPMENT BUILDING	9.001	STRUC	BUILDING STRUCTURE	2	10	12/6/2023	11/23/2073	11/12/2123	$ 984,000
	9.002	MECH	AIR COMPRESSOR #1 & 2 (2 TOTAL)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 29,000
	9.003	MECH	AIR COMPRESSOR #3	5	2	8/1/2015	7/27/2035	7/22/2055	$ 15,000
	9.004	MECH	PRESSURIZATION PUMP #1 & 2 (DAF #1)	4	5	1/29/2018	1/25/2033	1/22/2048	$ 220,000
	9.005	MECH	PRESSURIZATION PUMP #3 (DAF #2)	3	8	1/28/2021	1/25/2036	1/21/2051	$ 220,000
	9.006	MECH	PRESSURIZATION PUMP #4 (DAF #2)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 220,000
	9.007	MECH	RETENTION TANK #1 (DAF #1)	5	2	8/1/2015	7/27/2035	7/22/2055	$ 94,000
	9.008	MECH	AIR BLOWER #6	1	20	7/27/2033	7/22/2053	7/17/2073	$ 279,000
	9.009	ELEC/I&C	AIR BLOWER #6 CONTROL PANEL	1	30	7/25/2043	7/17/2073	7/11/2103	$ 43,000
	9.010	MECH	AIR BLOWER #7	1	20	7/27/2033	7/22/2053	7/17/2073	$ 279,000
	9.011	ELEC/I&C	AIR BLOWER #7 CONTROL PANEL	1	30	7/25/2043	7/17/2073	7/11/2103	$ 43,000
	9.012	ELEC/I&C	COMPRESSOR #3 CONTROL PANEL	5	3	7/31/2016	7/24/2046	7/16/2076	$ 12,000
	9.013	MECH	RETENTION TANK #2 (DAF #2)	3	10	7/30/2023	7/25/2043	7/20/2063	$ 94,000
10. CHEMICAL FEED AND STORAGE FACILITIES	10.001	STRUC	CHEMICAL BUILDING	4	24	12/5/2037	11/23/2087	11/11/2137	$ 262,000
	10.002	MECH	POLYMER FEED PUMP #1	4	5	1/29/2018	1/25/2033	1/22/2048	$ 18,000
	10.003	MECH	POLYMER FEED PUMP #2	4	5	1/29/2018	1/25/2033	1/22/2048	$ 18,000
	10.004	MECH	POLYMER FEED PUMP #3	4	5	1/29/2018	1/25/2033	1/22/2048	$ 18,000
	10.005	MECH	POLYMER MIXING TANK #1	4	5	1/29/2018	1/25/2033	1/22/2048	$ 8,000
	10.006	MECH	POLYMER MIXING TANK #2	4	5	1/29/2018	1/25/2033	1/22/2048	$ 8,000
	10.007	MECH	POLYMER DRY FEED HOPPER #1	5	2	1/30/2015	1/26/2030	1/22/2045	$ 23,000
	10.012	MECH	CCC BLOWER #1	3	10	7/30/2023	7/25/2043	7/20/2063	$ 17,000
	10.013	MECH	CCC BLOWER #2	3	10	7/30/2023	7/25/2043	7/20/2063	$ 17,000
	10.014	ELEC/I&C	MISCELLANEOUS CONTROL PANELS AND INSTRUMENTATION (PANEL SP-2)	2	24	7/26/2037	7/19/2067	7/11/2097	$ 120,000
	10.015	ELEC/I&C	POLYMER FEED PUMPS CONTROL PANEL	3	15	7/28/2028	7/21/2058	7/13/2088	$ 36,000
	10.016	ELEC/I&C	MIXER CONTROL PANEL	5	3	7/31/2016	7/24/2046	7/16/2076	$ 12,000
11. SOLIDS HANDLING FACILITY	11.002	ELEC/I&C	REUSE WATER CONTROL PANEL	4	9	7/30/2022	7/22/2052	7/15/2082	$ 15,000
	11.008	MECH	WASTE ACTIVATED SLUDGE (WAS) PUMP #1	1	15	7/28/2028	7/25/2043	7/21/2058	$ 39,000
	11.009	ELEC/I&C	WASTE ACTIVATED SLUDGE (WAS) PUMP #1 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 43,000
	11.010	MECH	WASTE ACTIVATED SLUDGE (WAS) PUMP #2	1	15	7/28/2028	7/25/2043	7/21/2058	$ 39,000
	11.011	ELEC/I&C	WASTE ACTIVATED SLUDGE (WAS) PUMP #2 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 43,000
	11.012	MECH	WASTE ACTIVATED SLUDGE (WAS) PUMP #5	1	15	7/28/2028	7/25/2043	7/21/2058	$ 39,000
	11.013	ELEC/I&C	WASTE ACTIVATED SLUDGE (WAS) PUMP #5 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 43,000
	11.014	MECH	WASTE ACTIVATED SLUDGE (WAS) PUMP #6	1	15	7/28/2028	7/25/2043	7/21/2058	$ 39,000
	11.015	ELEC/I&C	WASTE ACTIVATED SLUDGE (WAS) PUMP #6 VFD	1	30	7/25/2043	7/17/2073	7/11/2103	$ 43,000
	11.018	STRUC	THICKENED WAS PUMP STATION	2	24	12/5/2037	11/23/2087	11/11/2137	$ 58,000
	11.019	MECH	THICKENED W.A.S PUMP #1	5	2	1/30/2015	1/26/2030	1/22/2045	$ 204,000
	11.020	MECH	THICKENED W.A.S PUMP #2	5	2	1/30/2015	1/26/2030	1/22/2045	$ 204,000
	11.021	MECH	THICKENED W.A.S PUMP #3	2	12	7/29/2025	7/25/2040	7/22/2055	$ 67,000
	11.022	MECH	THICKENED W.A.S PUMP #4	2	12	7/29/2025	7/25/2040	7/22/2055	$ 67,000
	11.023	STRUC	ANAEROBIC DIGESTER BUILDING	3	24	12/5/2037	11/23/2087	11/11/2137	$ 2,272,000
	11.024	MECH	SLUDGE TRANSFER PUMP #1	4	5	1/29/2018	1/25/2033	1/22/2048	$ 45,000
	11.025	MECH	SLUDGE TRANSFER PUMP #2	4	5	1/29/2018	1/25/2033	1/22/2048	$ 45,000
	11.026	MECH	SLUDGE TRANSFER PUMP #3	4	5	1/29/2018	1/25/2033	1/22/2048	$ 45,000
	11.032	STRUC	DEWATERING BUILDING	3	24	12/5/2037	11/23/2087	11/11/2137	$ 1,918,000
	11.033	MECH	BELT FILTER PRESS #1	2	16	7/28/2029	7/23/2049	7/18/2069	$ 532,000

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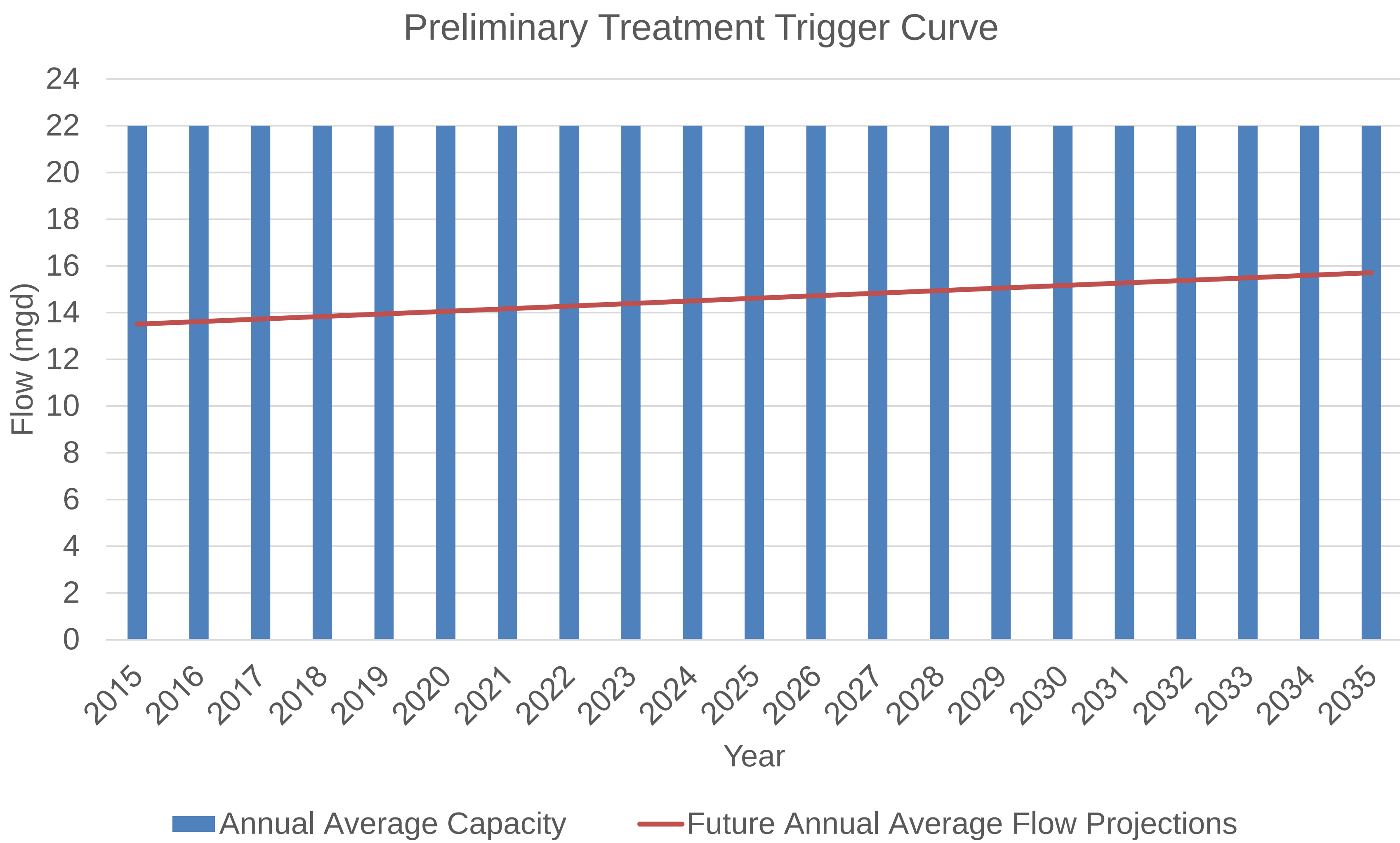
11. SOLIDS HANDLING FACILITY CONTINUED	11.034	MECH	BELT FILTER PRESS #2	2	16	7/28/2029	7/23/2049	7/18/2069	$ 532,000
	11.035	MECH	BELT FILTER PRESS #3	2	16	7/28/2029	7/23/2049	7/18/2069	$ 532,000
	11.036	MECH	BELT FILTER PRESS #4	2	16	7/28/2029	7/23/2049	7/18/2069	$ 532,000
	11.037	MECH	BELT FILTER PRESS #5	2	16	7/28/2029	7/23/2049	7/18/2069	$ 532,000
	11.038	MECH	BELT FILTER PRESS #6	2	16	7/28/2029	7/23/2049	7/18/2069	$ 532,000
	11.039	MECH	BELT FILTER PRESS FEED PUMP #1	5	2	1/30/2015	1/26/2030	1/22/2045	$ 107,000
	11.040	MECH	BELT FILTER PRESS FEED PUMP #2	5	2	1/30/2015	1/26/2030	1/22/2045	$ 107,000
	11.041	MECH	BELT FILTER PRESS FEED PUMP #3	5	2	1/30/2015	1/26/2030	1/22/2045	$ 107,000
	11.042	MECH	BELT FILTER PRESS FEED PUMP #4	3	8	1/28/2021	1/25/2036	1/21/2051	$ 107,000
	11.043	MECH	BELT FILTER PRESS FEED PUMP #5	3	8	1/28/2021	1/25/2036	1/21/2051	$ 107,000
	11.044	MECH	BELT FILTER PRESS FEED PUMP #6	3	8	1/28/2021	1/25/2036	1/21/2051	$ 107,000
	11.046	MECH	AUGERS (4 UNITS)	4	6	7/31/2019	7/26/2039	7/21/2059	$ 2,381,000
	11.047	MECH	POLYMER MIXING TANK #1	2	12	7/29/2025	7/25/2040	7/22/2055	$ 11,000
	11.048	MECH	POLYMER MIXING TANK #2	2	12	7/29/2025	7/25/2040	7/22/2055	$ 11,000
	11.049	MECH	POLYMER FEED PUMP #1	3	8	1/28/2021	1/25/2036	1/21/2051	$ 18,000
	11.050	MECH	POLYMER FEED PUMP #2	3	8	1/28/2021	1/25/2036	1/21/2051	$ 18,000
	11.051	MECH	POLYMER FEED PUMP #3	3	8	1/28/2021	1/25/2036	1/21/2051	$ 18,000
	11.052	MECH	POLYMER FEED PUMP #4	3	8	1/28/2021	1/25/2036	1/21/2051	$ 18,000
	11.053	MECH	POLYMER FEED PUMP #5	2	12	7/29/2025	7/25/2040	7/22/2055	$ 18,000
	11.054	MECH	POLYMER FEED PUMP #6	2	12	7/29/2025	7/25/2040	7/22/2055	$ 18,000
	11.056	MECH	WASTE ACTIVATED SLUDGE (WAS) PUMP #3	3	8	1/28/2021	1/25/2036	1/21/2051	$ 39,000
	11.057	ELEC/I&C	WASTE ACTIVATED SLUDGE (WAS) PUMP #3 VFD	3	15	7/28/2028	7/21/2058	7/13/2088	$ 43,000
	11.058	MECH	WASTE ACTIVATED SLUDGE (WAS) PUMP #4	3	8	1/28/2021	1/25/2036	1/21/2051	$ 39,000
	11.059	ELEC/I&C	WASTE ACTIVATED SLUDGE (WAS) PUMP #4 VFD	3	15	7/28/2028	7/21/2058	7/13/2088	$ 43,000
	11.062	ELEC/I&C	WAS PUMPS 1 & 2 CONTROL PANELS	1	30	7/25/2043	7/17/2073	7/11/2103	$ 12,000
	11.063	ELEC/I&C	WAS PUMPS 5 & 6 CONTROL PANELS	1	30	7/25/2043	7/17/2073	7/11/2103	$ 12,000
	11.064	ELEC/I&C	BELT FILTER PRESS CONTROL PANEL #1-3, 5-7	3	15	7/28/2028	7/21/2058	7/13/2088	$ 180,000
	11.065	ELEC/I&C	BELT FILTER PRESS CONTROL PANEL #4	5	3	7/31/2016	7/24/2046	7/16/2076	$ 60,000
	11.066	ELEC/I&C	BELT FILTER PRESS PUMPS CONTROL PANELS #1-6	2	24	7/26/2037	7/19/2067	7/11/2097	$ 120,000
	11.067	ELEC/I&C	AUGERS CONTROL PANEL	3	15	7/28/2028	7/21/2058	7/13/2088	$ 18,000
	11.068	MECH	POLYMER FEED PUMP 1 & 2 SPARE	3	8	1/28/2021	1/25/2036	1/21/2051	$ 18,000
	11.069	MECH	POLYMER FEED PUMP 5 & 6 SPARE	3	8	1/28/2021	1/25/2036	1/21/2051	$ 18,000
	11.070	ELEC/I&C	POLYMER FEED PUMPS CONTROL PANEL	3	15	7/28/2028	7/21/2058	7/13/2088	$ 36,000
	11.071	MECH	DRY CHEMICAL HOPPER	3	8	1/28/2021	1/25/2036	1/21/2051	$ 23,000
12. SUPERNATANT PUMP STATION (PLANT DRAIN)	12.001	STRUC	SUPERNATANT PUMP STATION STRUCTURE # 1 (ROUND WET WELL, VALVE VAULT)	3	24	12/5/2037	11/23/2087	11/11/2137	$ 39,000
	12.002	MECH	SUPERNATANT PUMP #1	5	0	8/1/2013	7/28/2028	7/25/2043	$ 110,000
	12.003	MECH	SUPERNATANT PUMP #2	5	0	8/1/2013	7/28/2028	7/25/2043	$ 110,000
	12.004	MECH	SUPERNATANT PUMP #3	5	0	8/1/2013	7/28/2028	7/25/2043	$ 110,000
	12.005	STRUC	SUPERNATANT PUMP STATION STRUCTURE # 2 (ROUND WET WELL, VALVE VAULT)	2	24	12/5/2037	11/23/2087	11/11/2137	$ 50,000
	12.006	MECH	SUPERNATANT PUMPS #1 - 3	5	0	8/1/2013	7/28/2028	7/25/2043	$ 332,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
13. RETURN PUMP STATION (TRANSFER)	13.001	STRUC	PUMP STATION STRUCTURE	1	24	12/5/2037	11/23/2087	11/11/2137	$ 108,000
	13.002	MECH	RETURN PUMP #1	1	15	7/28/2028	7/25/2043	7/21/2058	$ 47,000
	13.003	MECH	RETURN PUMP #2	1	15	7/28/2028	7/25/2043	7/21/2058	$ 47,000
	13.004	MECH	RETURN PUMP #3	1	15	7/28/2028	7/25/2043	7/21/2058	$ 47,000
	13.005	MECH	RETURN PUMP #4	1	15	7/28/2028	7/25/2043	7/21/2058	$ 47,000
	13.006	MECH	RETURN PUMP #5	1	15	7/28/2028	7/25/2043	7/21/2058	$ 47,000
17. NON-PROCESS BUILDINGS	17.001	STRUC	ADMINISTRATION BUILDING	2	24	12/5/2037	11/23/2087	11/11/2137	$ 2,824,000
	17.002	STRUC	LABORATORY BUILDING	1	44	5/5/2057	4/24/2107	4/11/2157	$ 3,491,000
	17.003	STRUC	MAINTENANCE BUILDING	1	44	5/5/2057	4/24/2107	4/11/2157	$ 1,141,000
	17.004	STRUC	ELECTRICAL BUILDING	3	40	11/4/2053	10/24/2103	10/11/2153	$ 1,897,000
18. ELECTRICAL	18.002	ELEC/I&C	MAIN DISTRIBUTION SWITCH GEAR	5	3	12/1/2018	11/23/2048	11/16/2078	$ 2,645,000
	18.004	ELEC/I&C	EXISTING EFFLUENT PUMP CONTROLS	5	2	12/1/2018	11/27/2033	11/23/2048	$ 1,202,000
	18.005	ELEC/I&C	GENERATOR AND EXHAUST #1	2	24	7/26/2037	7/19/2067	7/11/2097	$ 1,803,000
	18.006	ELEC/I&C	GENERATOR AND EXHAUST #2	1	30	7/25/2043	7/17/2073	7/11/2103	$ 1,803,000
	18.007	ELEC/I&C	VENTILATION SYSTEM	5	3	12/1/2018	11/23/2048	11/16/2078	$ 157,000
	18.008	ELEC/I&C	VAULT (POWER COMPANY)	2	24	7/26/2037	7/19/2067	7/11/2097	$ 73,000
	18.009	ELEC/I&C	COMMUNICATIONS SYSTEM	3	8	1/28/2021	1/25/2036	1/21/2051	$ 180,000
	18.010	ELEC/I&C	MCC - HW1 (NORTH) & HW2 (EAST)	5	3	7/31/2016	7/24/2046	7/16/2076	$ 1,082,000
	18.011	ELEC/I&C	GENERATOR CONTROL PANEL #1	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.012	ELEC/I&C	GENERATOR CONTROL PANEL #2	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.015	ELEC/I&C	SUBSTATION #10	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.016	ELEC/I&C	SUBSTATION #9	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.017	ELEC/I&C	SUBSTATION #11	5	3	12/1/2018	11/23/2048	11/16/2078	$ 433,000
	18.018	ELEC/I&C	SUBSTATION #12	5	3	12/1/2018	11/23/2048	11/16/2078	$ 433,000
	18.019	ELEC/I&C	SUBSTATION #13	1	30	7/25/2043	7/17/2073	7/11/2103	$ 385,000
	18.020	ELEC/I&C	SUBSTATION #14	1	30	7/25/2043	7/17/2073	7/11/2103	$ 385,000
	18.021	ELEC/I&C	MCC - B4	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.022	ELEC/I&C	MCC - B2	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.023	ELEC/I&C	MCC - BC	5	3	12/1/2018	11/23/2048	11/16/2078	$ 228,000
	18.024	ELEC/I&C	SUBSTATION #6	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.025	ELEC/I&C	SUBSTATION #5	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.026	ELEC/I&C	SCADA PANEL SP-3	1	15	7/28/2028	7/25/2043	7/21/2058	$ 180,000
	18.027	ELEC/I&C	MCC-B1	5	3	12/1/2018	11/23/2048	11/16/2078	$ 301,000
	18.028	ELEC/I&C	5KV BLOWER SWITCHGEAR	2	24	7/26/2037	7/19/2067	7/11/2097	$ 601,000
	18.029	ELEC/I&C	MCC -1	2	24	7/26/2037	7/19/2067	7/11/2097	$ 96,000
	18.030	ELEC/I&C	BLOWER BUILDING SCADA PANEL	2	24	7/26/2037	7/19/2067	7/11/2097	$ 180,000
	18.031	ELEC/I&C	SUBSTATION #7 & #8	5	3	12/1/2018	11/23/2048	11/16/2078	$ 601,000
	18.032	ELEC/I&C	MCC - D1	5	3	12/1/2018	11/23/2048	11/16/2078	$ 265,000
	18.033	ELEC/I&C	MCC - D2	5	3	12/1/2018	11/23/2048	11/16/2078	$ 265,000
	18.034	ELEC/I&C	SUBSTATION #1 (Phase II)	1	30	7/25/2043	7/17/2073	7/11/2103	$ 361,000
	18.035	ELEC/I&C	SUBSTATION #2 (Phase II)	1	30	7/25/2043	7/17/2073	7/11/2103	$ 361,000
19. FUEL STORAGE	19.001	MECH	FUEL DAY TANK #1	2	16	7/28/2029	7/23/2049	7/18/2069	$ 38,000
	19.002	MECH	FUEL DAY TANK #2	1	20	7/27/2033	7/22/2053	7/17/2073	$ 38,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
20. IRRIGATION AND REUSE	20.001	STRUC	UNFILTERED WATER RATE OF FLOW CONTROLLER	3	24	12/5/2037	11/23/2087	11/11/2137	$ 217,000
	20.003	MECH	MAGNETIC FLOW METER - IRRIGATION	1	20	7/27/2033	7/22/2053	7/17/2073	$ 26,000
	20.004	ELEC/I&C	CONTROL PANEL #1	1	30	7/25/2043	7/17/2073	7/11/2103	$ 180,000
	20.005	ELEC/I&C	CONTROL PANEL #2	1	30	7/25/2043	7/17/2073	7/11/2103	$ 180,000
	20.006	STRUC	EQ RATE OF FLOW CONTROLLER	3	28	1/24/2041	1/12/2091	12/31/2140	$ 52,000
	20.007	STRUC	DEEP WELL RATE OF FLOW CONTROLLER	3	28	1/24/2041	1/12/2091	12/31/2140	$ 52,000
	20.008	MECH	REUSE (PLANT WATER) FLOW METER	2	16	7/28/2029	7/23/2049	7/18/2069	$ 57,000
21. DEEP WELL	21.001	STRUC	DEEP WELL INJECTION WET WELL (COMBINED WITH IRRIGATION WET WELL)	3	24	12/5/2037	11/23/2087	11/11/2137	$ 157,000
	21.002	MECH	TRANSFER PUMP #1 (OLD DEEP WELL INJECTION)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 423,000
	21.003	MECH	TRANSFER PUMP #2 (OLD DEEP WELL INJECTION)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 423,000
	21.004	MECH	TRANSFER PUMP #3 (OLD DEEP WELL INJECTION)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 423,000
	21.005	MECH	TRANSFER PUMP #4 (OLD DEEP WELL INJECTION)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 423,000
	21.006	MECH	TRANSFER PUMP #5 (OLD DEEP WELL INJECTION)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 423,000
	21.008	MECH	DEEP WELL GATES (7 TOTAL)	5	2	8/1/2015	7/27/2035	7/22/2055	$ 364,000
	21.009	ELEC/I&C	NEW TRANSFER PUMPS VFDs (5 TOTAL)	1	30	7/25/2043	7/17/2073	7/11/2103	$ 721,000
22. EFFLUENT PUMP STATION	22.009	MECH	POND PUMP STATIONS (4 TOTAL / 2 PUMPS EACH)	3	8	1/28/2021	1/25/2036	1/21/2051	$ 443,000
	22.011	ELEC/I&C	POND OUTLET INSTRUMENTATION AND CONTROLS	1	30	7/25/2043	7/17/2073	7/11/2103	$ 96,000
	22.012	MECH	NORTH POND SLUICE GATES (2 UNITS)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 104,000
	22.013	MECH	MIDDLE POND SLIDE GATES (3 UNITS)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 156,000
	22.014	ELEC/I&C	MIDDLE POND SLIDE GATES (ELECTRIC OPERATOR)	1	30	7/25/2043	7/17/2073	7/11/2103	$ 12,000
	22.015	STRUC	REJECT PUMP STATION PRECAST CONCRETE MANHOLE	1	50	7/20/2063	7/8/2113	6/26/2163	$ 17,000
	22.016	ELEC/I&C	LOCAL INSTRUMENTATION	1	15	7/28/2028	7/25/2043	7/21/2058	$ 73,000
	22.017	MECH	REJECT SUBMERSIBLE PUMP STATION (2 TOTAL)	1	30	7/25/2043	7/17/2073	7/11/2103	$ 221,000
23. SPLITTER BOX	23.001	STRUC	SPLITTER BOX #1	1	50	7/20/2063	7/8/2113	6/26/2163	$ 284,000
	23.002	STRUC	SPLITTER BOX #2	1	50	7/20/2063	7/8/2113	6/26/2163	$ 374,000
	23.003	MECH	SLIDE GATE # 1 (SPLITTER BOX #1)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 68,000
	23.004	MECH	SLIDE GATE # 2 (SPLITTER BOX #1)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 68,000
	23.005	MECH	SLIDE GATE # 3 (SPLITTER BOX #1)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 68,000
	23.006	MECH	SLIDE GATE # 4 (SPLITTER BOX #1)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 68,000
	23.007	MECH	SLIDE GATE # 5 (SPLITTER BOX #1)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 68,000
	23.008	MECH	SLIDE GATE # 1 (SPLITTER BOX #2)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 107,000
	23.009	MECH	SLIDE GATE # 2 (SPLITTER BOX #2)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 83,000
	23.010	MECH	SLIDE GATE # 3 (SPLITTER BOX #2)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 107,000
	23.011	MECH	SLIDE GATE # 4 (SPLITTER BOX #2)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 83,000
	23.012	MECH	SLIDE GATE # 5 (SPLITTER BOX #2)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 107,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2053 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
24. RECLAIM WATER PUMP STATION	24.001	MECH	SUBMERSIBLE RECLAIM WATER PUMPS (3 UNITS)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 411,000
	24.002	STRUC	PUMP STATION CONCRETE SLAB ON GRADE	1	50	7/20/2063	7/8/2113	6/26/2163	$ 12,000
	24.003	STRUC	PRECAST CONCRETE WET WELL	1	50	7/20/2063	7/8/2113	6/26/2163	$ 79,000
25. UNFILTERED PUMP STATION	25.001	MECH	VERTICAL TURBINE PUMPS (4 UNITS) (FORMER DEEP WELL PUMPS)	1	15	7/28/2028	7/25/2043	7/21/2058	$ 3,655,000
	25.002	STRUC	PRECAST CONCRETE WET WELL	1	50	7/20/2063	7/8/2113	6/26/2163	$ 28,000
	25.003	STRUC	PUMP STATION CONCRETE SLAB ON GRADE	1	50	7/20/2063	7/8/2113	6/26/2163	$ 4,000
	25.004	ELEC/I&C	VERTICAL TURBINE PUMPS VFDs (4 UNITS)	1	30	7/25/2043	7/17/2073	7/11/2103	$ 385,000
26. NEW LAKE FILTRATION SYSTEM	26.001	MECH	GRAVITY DISK FILTER #1	1	20	7/27/2033	7/22/2053	7/17/2073	$ 1,506,000
	26.002	MECH	GRAVITY DISK FILTER #2	1	20	7/27/2033	7/22/2053	7/17/2073	$ 1,506,000
	26.003	MECH	GRAVITY DISK FILTER #3	1	20	7/27/2033	7/22/2053	7/17/2073	$ 1,506,000
	26.004	MECH	GRAVITY FILTER CONCRETE SLAB	1	20	7/27/2033	7/22/2053	7/17/2073	$ 28,000
	26.005	ELEC/I&C	LOCAL INSTRUMENTATION	1	15	7/28/2028	7/25/2043	7/21/2058	$ 73,000
27. WASTE BACKWASH PUMP	27.001	MECH	WASTE BACKWASH PUMPS (2 UNITS)	1	20	7/27/2033	7/22/2053	7/17/2073	$ 187,000
	27.002	STRUC	PRECAST CONCRETE WET WELL	1	50	7/20/2063	7/8/2113	6/26/2163	$ 7,000
28. UNDERGROUND ASSETS	28.001	MECH	42-INCH REINFORCED CONCRETE PIPE	5	5	7/31/2018	7/18/2068	7/7/2118	$ 148,000

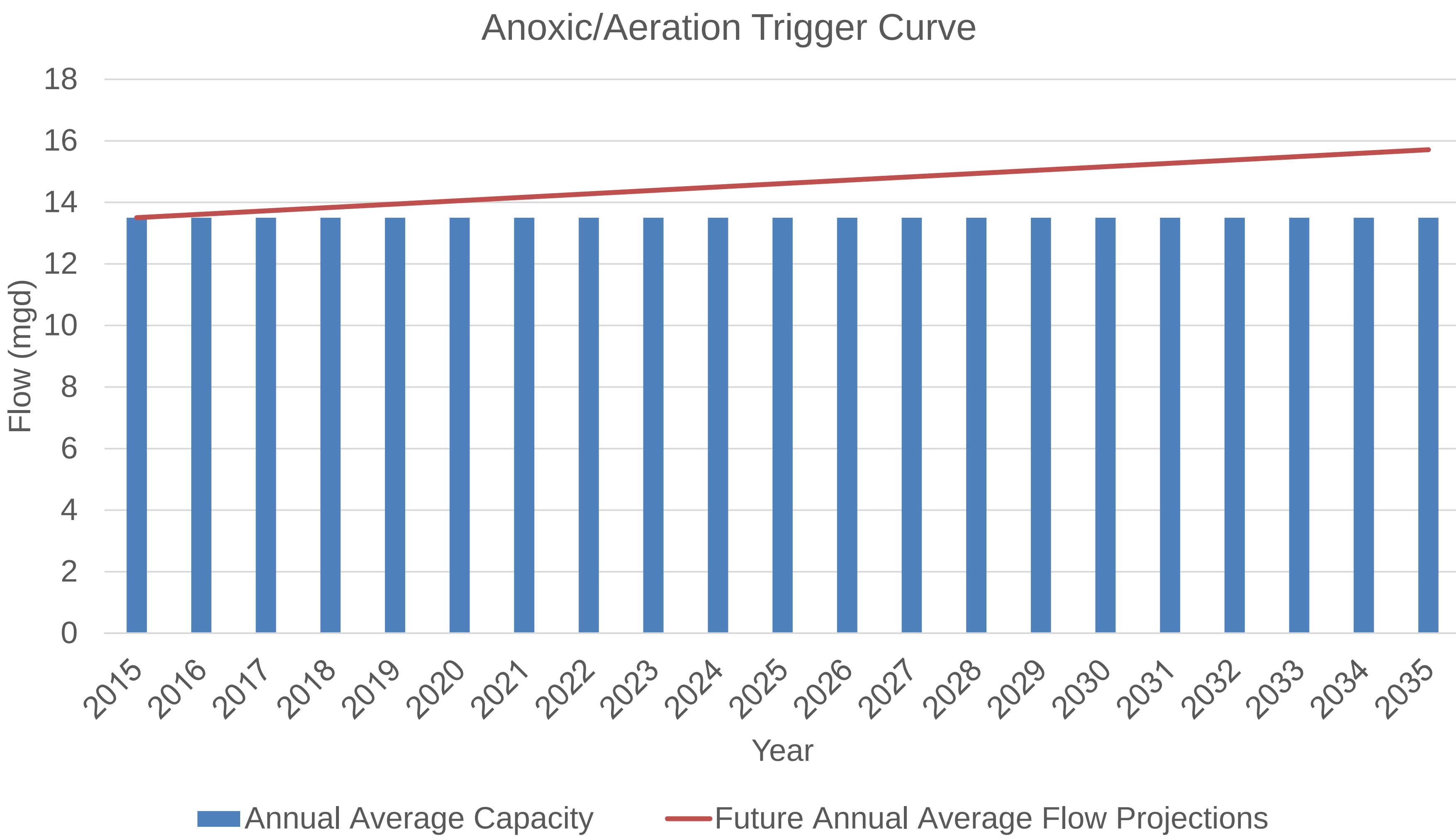
APPENDIX B - SWWRF TRIGGER CURVES



PHASED IMPLEMENTATION OF PROPOSED PRELIMINARY TREATMENT FACILITIES - SWWRF

FIGURE B.1

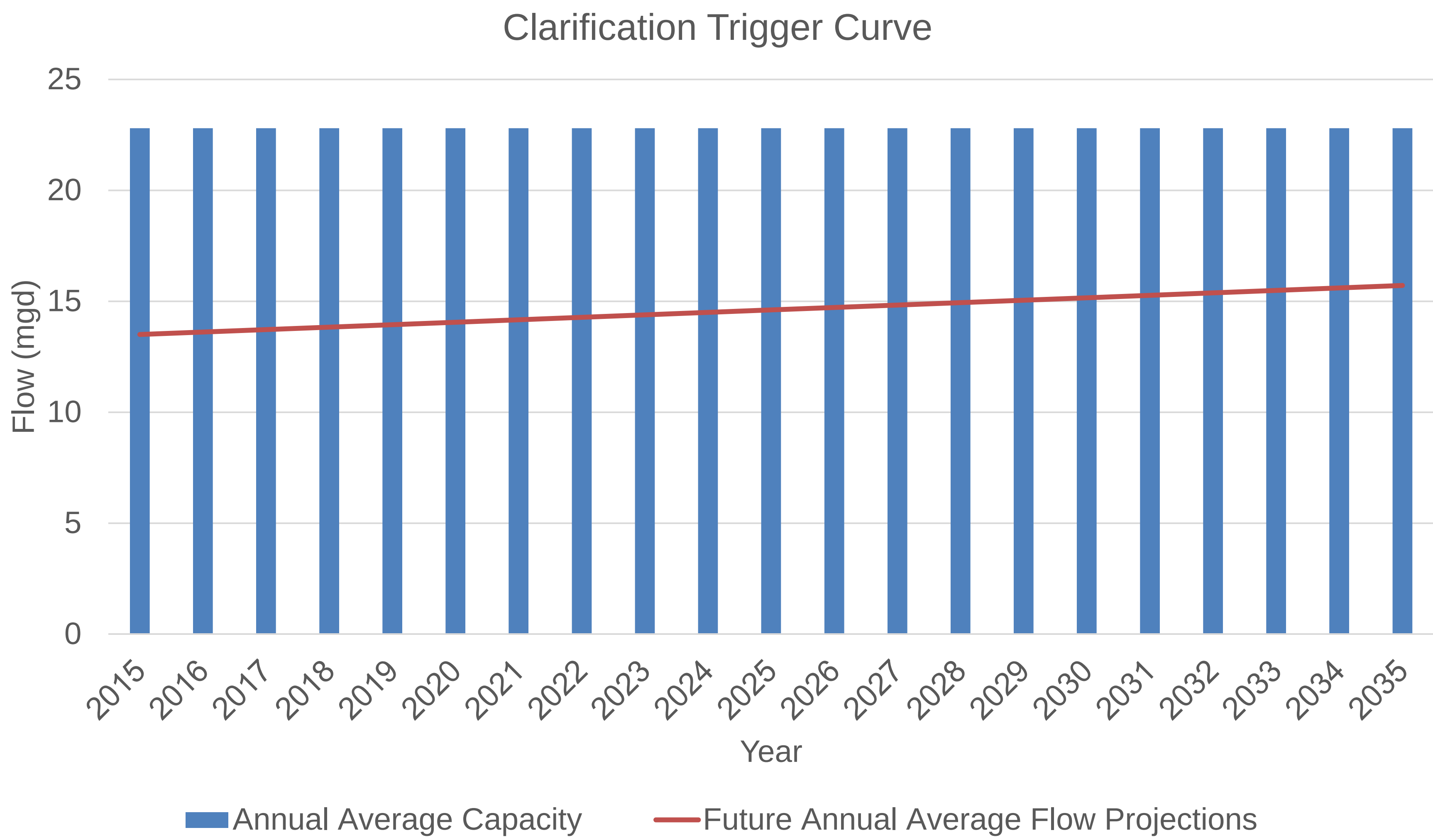
MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



PHASED IMPLEMENTATION OF PROPOSED ANOXIC/AERATION TREATMENT FACILITIES - SWWRF

FIGURE B.2

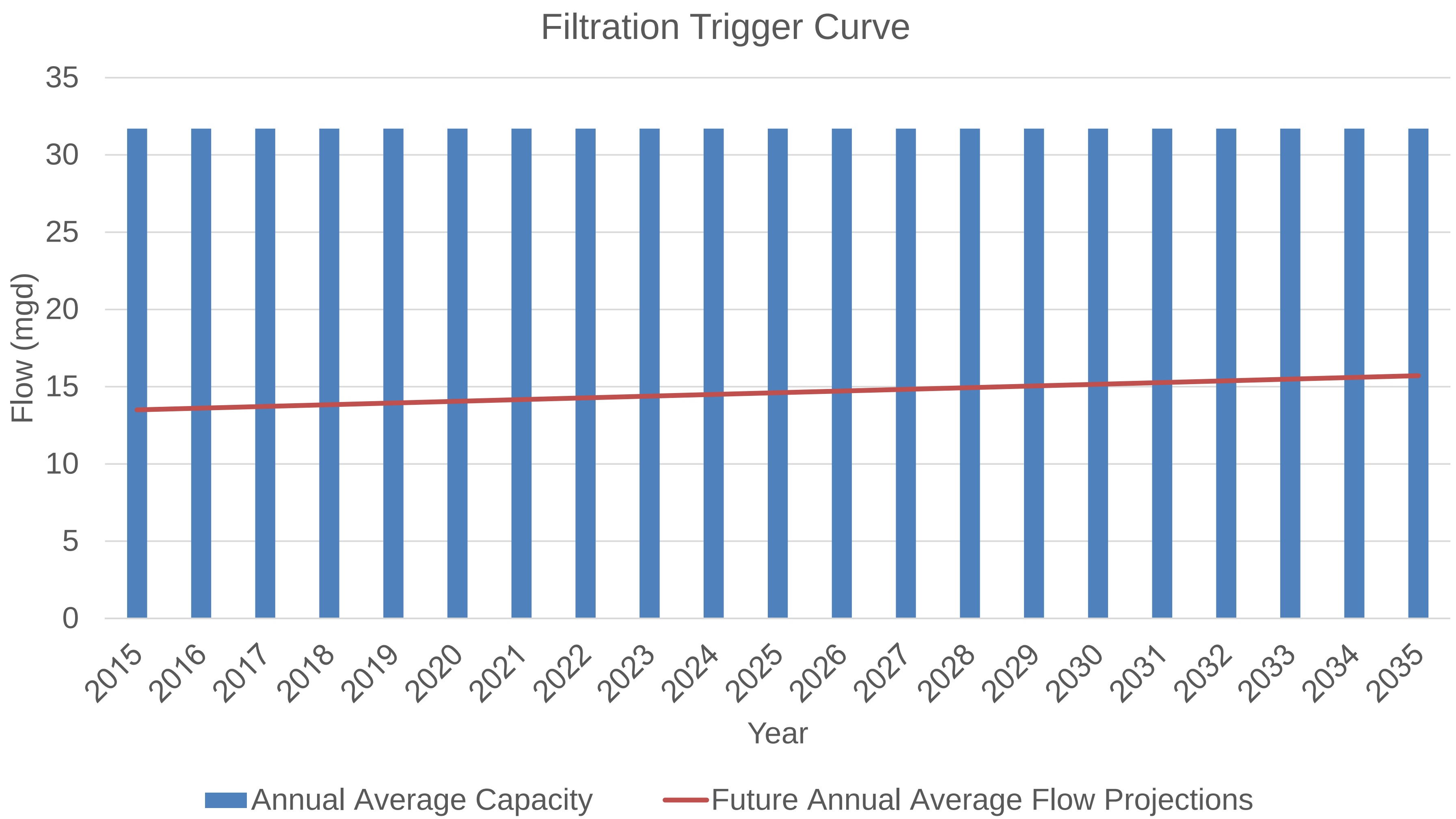
MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



PHASED IMPLEMENTATION OF PROPOSED CLARIFICATION TREATMENT FACILITIES - SWWRF

FIGURE B.3

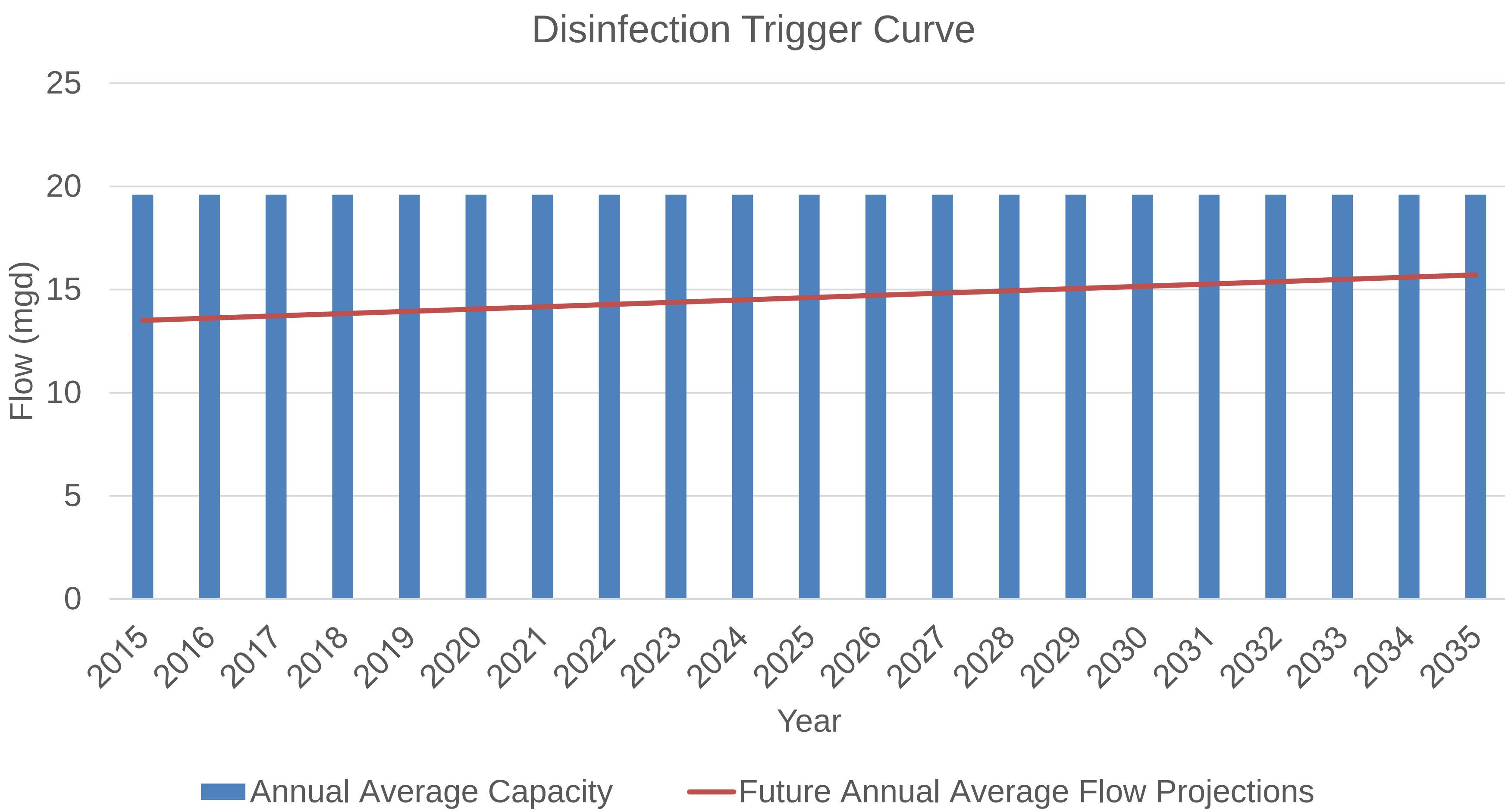
MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



PHASED IMPLEMENTATION OF FILTRATION TREATMENT FACILITIES - SWWRF

FIGURE B.4

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



PHASED IMPLEMENTATION OF DISINFECTION TREATMENT FACILITIES - SWWRF

FIGURE B.5

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo

APPENDIX C - SEWRF ASSET CONDITION SCORES, REPLACEMENT TIMING, AND PROJECT COSTS

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
1. HEADWORKS	1.001	STRUCT	HEADWORKS STRUCTURE	3	25	9/24/2039	9/11/2089	8/31/2139	$ 935,000
	1.002	MECH	CYCLONE/CLASSIFIER 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 503,000
	1.003	MECH	CYCLONE/CLASSIFIER 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 503,000
	1.004	MECH	SCREW CONVEYOR 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 432,000
	1.005	MECH	SCREW CONVEYOR 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 432,000
	1.006	MECH	MECHANICAL BAR SCREEN 1	1	10	9/27/2024	9/25/2034	9/22/2044	$ 510,000
	1.007	MECH	MECHANICAL BAR SCREEN 2	1	10	9/27/2024	9/25/2034	9/22/2044	$ 510,000
	1.008	MECH	MECHANICAL BAR SCREEN 3	1	10	9/27/2024	9/25/2034	9/22/2044	$ 510,000
	1.009	MECH	MANUAL SCREEN	4	3	9/29/2017	9/27/2027	9/24/2037	$ 90,000
	1.010	MECH	SLIDE GATE 1	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.011	MECH	SLIDE GATE 2	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.012	MECH	SLIDE GATE 3	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.013	MECH	SLIDE GATE 4	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.014	MECH	SLIDE GATE 5	5	0	9/30/2014	9/27/2024	9/25/2034	$ 52,000
	1.015	MECH	SLIDE GATE 6	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.016	MECH	SLIDE GATE 7	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.017	MECH	SLIDE GATE 8	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.018	MECH	SLIDE GATE 9	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.019	MECH	SLIDE GATE 10	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.020	MECH	SLIDE GATE 11	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.021	MECH	SLIDE GATE 12	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.022	MECH	SLIDE GATE 13	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.023	MECH	SLIDE GATE 14	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
	1.024	I&C	CONTROL PANELS	1	15	9/26/2029	9/22/2044	9/19/2059	$ 63,000
	1.025	MECH	GRIT PUMP 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 35,000
	1.026	MECH	GRIT PUMP 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 35,000
	1.027	MECH	SLIDE GATE	3	0	9/30/2014	9/27/2024	9/25/2034	$ 30,000
2. ODOR CONTROL FACILITIES	2.001	STRUCT	ODOR CONTROL	3	25	9/24/2039	9/11/2089	8/31/2139	$ 5,000
	2.002	STRUCT	CHEMICAL STRUCTURE	3	25	9/24/2039	9/11/2089	8/31/2139	$ 10,000
	2.003	MECH	SCRUBBER	3	10	9/27/2024	9/22/2044	9/17/2064	$ 516,000
	2.009	MECH	EXHAUST FAN	3	8	3/29/2022	3/25/2037	3/21/2052	
	2.010	I&C	OC CONTROL PANEL	3	8	3/29/2022	3/25/2037	3/21/2052	$ 84,000

						R&R Plan Through 2054 Replacement Years			
Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
3. INFLUENT SPLITTER BOX	3.001	STRUCT	SPLITTER BOX STRUCTURE	3	25	9/24/2039	9/11/2089	8/31/2139	$ 446,000
	3.002	MECH	SUBMERSIBLE PUMP 1	1	15	3/28/2029	3/24/2044	3/21/2059	$ 62,000
	3.003	MECH	SUBMERSIBLE PUMP 2	3	3	7/29/2017	7/25/2032	7/22/2047	$ 64,000
	3.004	MECH	SUBMERSIBLE PUMP 3	3	3	7/29/2017	7/25/2032	7/22/2047	$ 23,000
	3.005	MECH	SUBMERSIBLE PUMP 4	3	3	7/29/2017	7/25/2032	7/22/2047	$ 23,000
	3.006	MECH	SUBMERSIBLE PUMP 5	3	3	7/29/2017	7/25/2032	7/22/2047	$ 23,000
	3.007	MECH	WEIR GATE 1	3	8	7/28/2022	7/23/2042	7/18/2062	$ 36,000
	3.008	MECH	WEIR GATE 2	3	8	7/28/2022	7/23/2042	7/18/2062	$ 36,000
	3.009	MECH	WEIR GATE 3	3	8	7/28/2022	7/23/2042	7/18/2062	$ 36,000
	3.010	MECH	WEIR GATE 4	3	8	7/28/2022	7/23/2042	7/18/2062	$ 36,000
	3.011	MECH	WEIR GATE 5	3	8	7/28/2022	7/23/2042	7/18/2062	$ 49,000
	3.012	MECH	WEIR GATE 6	3	8	7/28/2022	7/23/2042	7/18/2062	$ 49,000
	3.013	MECH	WEIR GATE 7	3	8	7/28/2022	7/23/2042	7/18/2062	$ 49,000
	3.014	MECH	WEIR GATE 8	3	8	7/28/2022	7/23/2042	7/18/2062	$ 49,000
	3.015	MECH	WEIR GATE 9	3	8	7/28/2022	7/23/2042	7/18/2062	$ 81,000
	3.016	MECH	WEIR GATE 10	3	8	7/28/2022	7/23/2042	7/18/2062	$ 81,000
	3.017	MECH	WEIR GATE 11	3	8	7/28/2022	7/23/2042	7/18/2062	$ 81,000
	3.018	MECH	FM 214 - ULTRASONIC FLOW METER	3	8	3/29/2022	3/25/2037	3/21/2052	$ 47,000
	3.019	MECH	FM 211 - ULTRASONIC FLOW METER	3	8	3/29/2022	3/25/2037	3/21/2052	$ 47,000
4. ANOXIC/ AEROBIC SYSTEM	4.001	STRUCT	ANOXIC/AEROBIC BASIN 1	3	25	9/24/2039	9/11/2089	8/31/2139	$ 10,257,000
	4.002	STRUCT	ANOXIC/AEROBIC BASIN 2	3	25	9/24/2039	9/11/2089	8/31/2139	$ 10,257,000
	4.003	STRUCT	ANOXIC/AEROBIC BASIN 3	2	40	9/20/2054	9/8/2104	8/27/2154	$ 7,383,000
	4.004	MECH	BASIN 1 - MECHANICAL AERATOR 1A	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.005	MECH	BASIN 1 - MECHANICAL AERATOR 1B	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.006	MECH	BASIN 1 - MECHANICAL AERATOR 1C	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.007	MECH	BASIN 2 - MECHANICAL AERATOR 2A	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.008	MECH	BASIN 2 - MECHANICAL AERATOR 2B	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.009	MECH	BASIN 2 - MECHANICAL AERATOR 2C	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.010	MECH	BASIN 3 - MECHANICAL AERATOR 3A	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.011	MECH	BASIN 3 - MECHANICAL AERATOR 3B	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.012	MECH	BASIN 3 - MECHANICAL AERATOR 3C	3	10	9/27/2024	9/22/2044	9/17/2064	$ 288,000
	4.013	MECH	BASIN 1 - MIXER 1A	4	6	9/28/2020	9/23/2040	9/18/2060	$ 148,000
	4.014	MECH	BASIN 1 - MIXER 1B	4	6	9/28/2020	9/23/2040	9/18/2060	$ 148,000
	4.015	MECH	BASIN 2 - MIXER 2A	5	2	9/29/2016	9/24/2036	9/19/2056	$ 148,000
	4.016	MECH	BASIN 2 - MIXER 2B	4	6	9/28/2020	9/23/2040	9/18/2060	$ 148,000
	4.017	MECH	BASIN 3 - MIXER 3A	3	10	9/27/2024	9/22/2044	9/17/2064	$ 148,000
	4.018	MECH	BASIN 3 - MIXER 3B	3	10	9/27/2024	9/22/2044	9/17/2064	$ 148,000
	4.019	MECH	BASIN 1 - VELOCITY CONTROL WEIR GATE	3	0	9/30/2014	9/25/2034	9/20/2054	$ 93,000
	4.020	MECH	BASIN 2 - VELOCITY CONTROL WEIR GATE	3	0	9/30/2014	9/25/2034	9/20/2054	$ 93,000
	4.021	MECH	BASIN 3 - VELOCITY CONTROL WEIR GATE	3	8	7/28/2022	7/23/2042	7/18/2062	$ 93,000
	4.022	MECH	SLUICE GATE 1	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	4.023	MECH	SLUICE GATE 2	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	4.024	MECH	SLUICE GATE 3	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	4.025	MECH	SLUICE GATE 4	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	4.026	MECH	RML PUMP W/ VFD 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 400,000
	4.027	MECH	RML PUMP W/ VFD 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 400,000
	4.028	MECH	RML PUMP W/ VFD 3	1	15	9/26/2029	9/22/2044	9/19/2059	$ 400,000
	4.029	MECH	RML PUMP W/ VFD 4	1	15	9/26/2029	9/22/2044	9/19/2059	$ 400,000
	4.030	I&C	RMP PUMPS CONTROL PANEL	1	15	9/26/2029	9/22/2044	9/19/2059	$ 71,000

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5. SECONDARY CLARIFIERS & RAS/WAS PUMP STATIONS	5.001	STRUCT	CLARIFIER BASIN 1	3	25	9/24/2039	9/11/2089	8/31/2139	$ 1,317,000
	5.002	STRUCT	CLARIFIER BASIN 2	3	25	9/24/2039	9/11/2089	8/31/2139	$ 1,317,000
	5.003	STRUCT	CLARIFIER BASIN 3	3	25	9/24/2039	9/11/2089	8/31/2139	$ 1,317,000
	5.004	STRUCT	CLARIFIER BASIN 4	3	25	9/24/2039	9/11/2089	8/31/2139	$ 1,317,000
	5.005	STRUCT	SLUDGE BOX 1	3	25	9/24/2039	9/11/2089	8/31/2139	$ 11,000
	5.006	STRUCT	SLUDGE BOX 2	3	25	9/24/2039	9/11/2089	8/31/2139	$ 11,000
	5.007	MECH	SCUM EJECTOR 1	3	8	3/29/2022	3/25/2037	3/21/2052	$ 43,000
	5.008	MECH	SCUM EJECTOR 2	3	8	3/29/2022	3/25/2037	3/21/2052	$ 43,000
	5.009	MECH	SCUM EJECTOR 3	4	5	3/30/2019	3/26/2034	3/22/2049	$ 43,000
	5.010	MECH	SCUM EJECTOR 4	4	5	3/30/2019	3/26/2034	3/22/2049	$ 43,000
	5.011	STRUCT	DISTRIBUTION BOX	3	25	9/24/2039	9/11/2089	8/31/2139	$ 48,000
	5.012	STRUCT	SLUDGE WET WELL	3	25	9/24/2039	9/11/2089	8/31/2139	$ 104,000
	5.013	MECH	WAS PUMP 1	3	8	3/29/2022	3/25/2037	3/21/2052	$ 42,000
	5.014	MECH	WAS PUMP 2	3	8	3/29/2022	3/25/2037	3/21/2052	$ 42,000
	5.015	MECH	WAS PUMP 3	3	8	3/29/2022	3/25/2037	3/21/2052	$ 42,000
	5.016	MECH	WAS PUMP 4	3	8	3/29/2022	3/25/2037	3/21/2052	$ 42,000
	5.017	MECH	AIR COMPRESSORS (TOTAL OF 2)	3	10	9/27/2024	9/22/2044	9/17/2064	$ 10,000
	5.018	MECH	RAS PUMP 1	3	8	3/29/2022	3/25/2037	3/21/2052	$ 225,000
	5.019	MECH	RAS PUMP 2	3	8	3/29/2022	3/25/2037	3/21/2052	$ 225,000
	5.020	MECH	RAS PUMP 3	3	8	3/29/2022	3/25/2037	3/21/2052	$ 225,000
	5.021	STRUCT	RAS/WAS PUMP STATION	3	25	9/24/2039	9/11/2089	8/31/2139	$ 116,000
6. FLASH MIXERS AND FLOCCULATORS	6.001	STRUCT	MIXING/FLOCCULATION BASIN	3	25	9/24/2039	9/11/2089	8/31/2139	$ 165,000
	6.002	MECH	MIXER 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 72,000
	6.003	MECH	MIXER 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 72,000
	6.004	MECH	SLIDE GATE 1	4	0	9/30/2014	9/25/2034	9/20/2054	$ 48,000
	6.005	MECH	SLIDE GATE 2	4	0	9/30/2014	9/25/2034	9/20/2054	$ 48,000
	6.006	MECH	SLIDE GATE 3	4	0	9/30/2014	9/25/2034	9/20/2054	$ 48,000
	6.007	MECH	SLIDE GATE 4	4	0	9/30/2014	9/25/2034	9/20/2054	$ 27,000
	6.008	MECH	SLIDE GATE 5	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	6.009	MECH	SLIDE GATE 6	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	6.010	MECH	FLOCCULATOR 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 46,000
	6.011	MECH	FLOCCULATOR 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 46,000

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7. FILTERS	7.001	STRUCT	FILTER 1	4	15	9/26/2029	9/14/2079	9/2/2129	$ 287,000
	7.002	MECH	WASHWATER TROUGHS 1	4	6	9/28/2020	9/23/2040	9/18/2060	$ 29,000
	7.003	MECH	CARRIAGE 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 64,000
	7.004	MECH	FILTER MEDIA 1	3	8	5/27/2022	5/22/2042	5/17/2062	$ 101,000
	7.005	MECH	BACKWASH SYSTEM 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 640,000
	7.006	MECH	POROUS PLATES (UNDERDRAIN) 1	4	0	9/30/2014	9/25/2034	9/20/2054	$ 457,000
	7.007	MECH	INFLUENT & EFFLUENT PORTS 1	3	0	9/30/2014	9/25/2034	9/20/2054	$ 29,000
	7.008	STRUCT	FILTER 2	3	25	9/24/2039	9/11/2089	8/31/2139	$ 287,000
	7.009	MECH	WASHWATER TROUGHS 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 29,000
	7.010	MECH	CARRIAGE 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 64,000
	7.011	MECH	FILTER MEDIA 2	3	8	5/27/2022	5/22/2042	5/17/2062	$ 101,000
	7.012	MECH	BACKWASH SYSTEM 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 640,000
	7.013	MECH	POROUS PLATES (UNDERDRAIN) 2	4	0	9/30/2014	9/25/2034	9/20/2054	$ 457,000
	7.014	MECH	INFLUENT & EFFLUENT PORTS 2	3	0	9/30/2014	9/25/2034	9/20/2054	$ 29,000
	7.015	STRUCT	FILTER 3	4	15	9/26/2029	9/14/2079	9/2/2129	$ 287,000
	7.016	MECH	WASHWATER TROUGHS 3	3	10	9/27/2024	9/22/2044	9/17/2064	$ 29,000
	7.017	MECH	CARRIAGE 3	2	16	9/26/2030	9/21/2050	9/16/2070	$ 64,000
	7.018	MECH	FILTER MEDIA 3	3	8	7/28/2022	7/23/2042	7/18/2062	$ 101,000
	7.019	MECH	BACKWASH SYSTEM 3	2	16	9/26/2030	9/21/2050	9/16/2070	$ 640,000
	7.020	MECH	POROUS PLATES (UNDERDRAIN) 3	2	8	7/28/2022	7/23/2042	7/18/2062	$ 448,000
	7.021	MECH	INFLUENT & EFFLUENT PORTS 3	2	8	7/28/2022	7/23/2042	7/18/2062	$ 28,000
	7.022	STRUCT	FILTER 4	4	15	9/26/2029	9/14/2079	9/2/2129	$ 287,000
	7.023	MECH	WASHWATER TROUGHS 4	3	10	9/27/2024	9/22/2044	9/17/2064	$ 29,000
	7.024	MECH	CARRIAGE 4	2	16	9/26/2030	9/21/2050	9/16/2070	$ 64,000
	7.025	MECH	FILTER MEDIA 4	3	8	7/28/2022	7/23/2042	7/18/2062	$ 101,000
	7.026	MECH	BACKWASH SYSTEM 4	2	16	9/26/2030	9/21/2050	9/16/2070	$ 640,000
	7.027	MECH	POROUS PLATES (UNDERDRAIN) 4	2	8	7/28/2022	7/23/2042	7/18/2062	$ 448,000
	7.028	MECH	INFLUENT & EFFLUENT PORTS 4	2	8	7/28/2022	7/23/2042	7/18/2062	$ 28,000
	7.031	MECH	EFFLUENT SLIDE GATE 1 (BASINS 3 & 4)	3	8	7/28/2022	7/23/2042	7/18/2062	$ 27,000
	7.032	MECH	EFFLUENT SLIDE GATE 2 (BASINS 3 & 4)	3	8	7/28/2022	7/23/2042	7/18/2062	$ 27,000
	7.033	I&C	CONTROL PANEL FILTERS 3 & 4	2	12	9/27/2026	9/23/2041	9/19/2056	$ 82,000
	7.034	MECH	BLOWER 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 125,000
	7.035	STRUCT	BLOWER BUILDING 4	2	40	9/20/2054	9/8/2104	8/27/2154	$ 181,000
	7.036	MECH	AIR COMPRESSORS (TOTAL OF 2)	2	16	9/26/2030	9/21/2050	9/16/2070	$ 20,000
	7.037	MECH	INFLUENT SLIDE GATES (TOTAL OF 2)	3	8	7/28/2022	7/23/2042	7/18/2062	$ 27,000

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8. REJECT PUMP STATION	8.001	STRUCT	CONCRETE WET WELL	3	25	9/24/2039	9/11/2089	8/31/2139	$ 23,000
	8.002	MECH	SUBMERSIBLE PUMP 1	3	3	7/29/2017	7/25/2032	7/22/2047	$ 23,000
	8.003	MECH	SUBMERSIBLE PUMP 2	3	3	7/29/2017	7/25/2032	7/22/2047	$ 23,000
	8.004	I&C	SUBMERSIBLE PUMP CONTROL PANEL	3	3	7/29/2017	7/25/2032	7/22/2047	$ 74,000
	8.005	STRUCT	VALVE VAULT	2	40	9/20/2054	9/8/2104	8/27/2154	$ 22,000
9. PLANT DRAIN PUMP STATION	9.001	STRUCT	CONCRETE WET WELL	2	40	9/20/2054	9/8/2104	8/27/2154	$ 32,000
	9.002	MECH	SUBMERSIBLE PUMP 1	3	3	7/29/2017	7/25/2032	7/22/2047	$ 40,000
	9.003	MECH	SUBMERSIBLE PUMP 2	3	3	7/29/2017	7/25/2032	7/22/2047	$ 40,000
	9.004	MECH	SUBMERSIBLE PUMP 3	3	3	7/29/2017	7/25/2032	7/22/2047	$ 40,000
	9.005	I&C	CONTROL PANEL	3	3	7/29/2017	7/25/2032	7/22/2047	$ 64,000
	9.006	STRUCT	VALVE VAULT	3	25	9/24/2039	9/11/2089	8/31/2139	$ 31,000
10. LEACHATE PUMP STATION & EQUALIZATION TANK	10.006	STRUCT	EQUALIZATION TANK 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 2,972,000
	10.007	STRUCT	EQUALIZATION TANK 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 2,972,000
	10.008	MECH	DIFFUSER SYSTEM 1	4	8	7/28/2022	7/23/2042	7/18/2062	$ 219,000
	10.009	MECH	DIFFUSER SYSTEM 2	4	11	12/8/2025	12/3/2045	11/28/2065	$ 219,000
	10.010	STRUCT	BLOWER BUILDING 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 432,000
	10.011	MECH	BLOWER 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 166,000
	10.012	MECH	BLOWER 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 166,000

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11. CHLORINE CONTACT BASINS AND CHLORINE STORAGE AND FEED SYSTEM	11.001	STRUCT	CONTACT BASIN 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 156,000
	11.002	STRUCT	CONTACT BASIN 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 156,000
	11.003	STRUCT	CONTACT BASIN 3	4	15	9/26/2029	9/14/2079	9/2/2129	$ 159,000
	11.004	STRUCT	CONTACT BASIN 4	4	15	9/26/2029	N/A	N/A	$ 159,000
	11.005	MECH	SLIDE GATE 1 (BASINS 1 & 2)	5	0	9/30/2014	N/A	N/A	$ 30,000
	11.006	MECH	SLIDE GATE 2 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	11.007	MECH	SLIDE GATE 3 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	11.008	MECH	SLIDE GATE 4 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	11.009	MECH	SLIDE GATE 5 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	11.010	MECH	SLUICE GATE 1 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 48,000
	11.011	MECH	SLUICE GATE 2 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 48,000
	11.012	MECH	SLUICE GATE 3 (BASINS 1 & 2)	5	0	9/30/2014	9/25/2034	9/20/2054	$ 48,000
	11.013	MECH	SLIDE GATE 1 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 30,000
	11.014	MECH	SLIDE GATE 2 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 30,000
	11.015	MECH	SLIDE GATE 3 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 30,000
	11.016	MECH	SLIDE GATE 4 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 48,000
	11.017	MECH	SLIDE GATE 5 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 48,000
	11.018	MECH	SLUICE GATE 1 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 30,000
	11.019	MECH	SLUICE GATE 2 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 30,000
	11.020	MECH	SLUICE GATE 3 (BASINS 3 & 4)	5	8	7/28/2022	7/23/2042	7/18/2062	$ 30,000
	11.021	STRUCT	CHLORINATION BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 541,000
	11.024	MECH	REFRIGERATED SAMPLER	1	15	9/26/2029	9/22/2044	9/19/2059	$ 14,000
	11.025	MECH	METERING PUMP SKID 1 (TO CCC)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 97,000
	11.028	I&C	SKID 1 CONTROL PANEL	3	8	3/29/2022	3/25/2037	3/21/2052	$ 39,000
	11.026	MECH	METERING PUMP SKID 2 (TO CCC)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 97,000
	11.029	I&C	SKID 2 CONTROL PANEL	3	8	3/29/2022	3/25/2037	3/21/2052	$ 39,000
	11.027	MECH	METERING PUMP SKID 3 (TO FILTERS, RAS, CLARIF)	4	5	3/30/2019	3/26/2034	3/22/2049	$ 97,000
	11.030	MECH	BULK STORAGE TANK 1	2	20	9/25/2034	9/19/2059	9/12/2084	$ 75,000
	11.031	MECH	BULK STORAGE TANK 2	2	20	9/25/2034	9/19/2059	9/12/2084	$ 75,000
	11.032	MECH	METERING PUMP SKID 4 (TO LAKE FILTERS)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 95,000
	11.033	I&C	SKID 4 CONTROL PANEL	1	15	9/26/2029	9/22/2044	9/19/2059	
	11.034	MECH	BULK STORAGE TANK 3	1	25	9/24/2039	9/17/2064	9/11/2089	$ 74,000
	11.035	MECH	EFFLUENT SLIDE GATES BASINS 1&2 (TOTAL OF 3)	4	0	9/30/2014	9/25/2034	9/20/2054	$ 91,000
	11.036	MECH	EFFLUENT SLIDE GATE BASINS 1&2	1	20	7/27/2034	7/22/2054	7/17/2074	$ 30,000

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12. EFFLUENT & REUSE PUMP STATION	12.001	STRUCT	WET WELL 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 123,000
	12.002	STRUCT	WET WELL 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 123,000
	12.003	STRUCT	WET WELL 3	2	40	9/20/2054	9/8/2104	8/27/2154	$ 123,000
	12.004	STRUCT	WET WELL 4	2	40	9/20/2054	9/8/2104	8/27/2154	$ 123,000
	12.005	MECH	LOW SERVICE EFFLUENT PUMP 1 (WW2)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 222,000
	12.006	MECH	LOW SERVICE EFFLUENT PUMP 2 (WW2)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 222,000
	12.007	MECH	LOW SERVICE EFFLUENT PUMP 3 (WW2)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 222,000
	12.008	I&C	EQUIPMENT CONTROL PANEL	5	2	3/30/2016	3/27/2031	3/23/2046	$ 62,000
	12.009	MECH	LOW SERVICE EFFLUENT PUMP 4 (WW3)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 222,000
	12.010	MECH	LOW SERVICE EFFLUENT PUMP 5 (WW3)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 222,000
	12.011	I&C	EQUIPMENT CONTROL PANELS	5	2	3/30/2016	3/27/2031	3/23/2046	$ 62,000
	12.012	STRUCT	HSPS CONCRETE STRUCTURE	1	50	9/17/2064	9/6/2114	8/24/2164	$ 65,000
	12.013	MECH	HS DUTY PUMPS - TOTAL OF 4	1	15	9/26/2029	9/22/2044	9/19/2059	$ 1,722,000
	12.014	MECH	HS JOCKEY PUMPS - TOTAL OF 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 528,000
	12.015	I&C	EQUIPMENT CONTROL PANELS	1	15	9/26/2029	9/22/2044	9/19/2059	$ 60,000
13. CHEMICAL SYSTEMS	13.001	MECH	POLYMER - MIX TANK 1	2	12	9/27/2026	9/23/2041	9/19/2056	$ 233,000
	13.002	MECH	POLYMER - MIX TANK 2	2	12	9/27/2026	9/23/2041	9/19/2056	
	13.003	MECH	POLYMER - MIXING SKID	2	12	9/27/2026	9/23/2041	9/19/2056	
	13.004	MECH	POLYMER - FILTER PRESS FEED PUMP 1	4	5	3/30/2019	3/26/2034	3/22/2049	$ 16,000
	13.005	MECH	POLYMER - FILTER PRESS FEED PUMP 2	4	5	3/30/2019	3/26/2034	3/22/2049	$ 16,000
	13.006	I&C	POLYMER CONTROL PANEL	5	2	3/30/2016	3/27/2031	3/23/2046	$ 20,000
	13.009	MECH	ALUM - FEED PUMP 1	4	5	3/30/2019	3/26/2034	3/22/2049	$ 16,000

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14. SLUDGE HANDLING SYSTEM	14.001	STRUCT	SLUDGE HOLDING TANK 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 2,497,000
	14.002	STRUCT	SLUDGE HOLDING TANK 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 2,497,000
	14.003	MECH	DIFFUSER ASSEMBLY TANK 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 171,000
	14.004	MECH	DIFFUSER ASSEMBLY TANK 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 171,000
	14.005	MECH	SLUDGE PUMP 1	4	5	3/30/2019	3/26/2034	3/22/2049	$ 89,000
	14.006	MECH	SLUDGE PUMP 2	4	5	3/30/2019	3/26/2034	3/22/2049	$ 89,000
	14.007	MECH	SLUDGE PUMP 3	4	5	3/30/2019	3/26/2034	3/22/2049	$ 89,000
	14.008	MECH	SLUDGE PUMP 4	4	5	3/30/2019	3/26/2034	3/22/2049	$ 89,000
	14.009	MECH	SLUDGE PUMP 5	1	15	9/26/2029	9/22/2044	9/19/2059	$ 119,000
	14.010	MECH	SLUDGE PUMP 6	4	5	3/30/2019	3/26/2034	3/22/2049	$ 121,000
	14.011	MECH	SLUDGE PUMP 7	4	5	3/30/2019	3/26/2034	3/22/2049	$ 121,000
	14.012	MECH	SLUDGE PUMP 8	1	15	9/26/2029	9/22/2044	9/19/2059	$ 119,000
	14.013	MECH	GRAVITY BELT THICKENER 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 816,000
	14.014	I&C	GRAVITY BELT THICKENER CONTROL PANEL 1	3	8	3/29/2022	3/25/2037	3/21/2052	
	14.015	MECH	GRAVITY BELT THICKENER 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 800,000
	14.016	I&C	GRAVITY BELT THICKENER CONTROL PANEL 2	1	15	9/26/2029	9/22/2044	9/19/2059	
	14.017	STRUCT	GRAVITY BELT THICKENER STRUCTURE 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 53,000
	14.018	STRUCT	GRAVITY BELT THICKENER STRUCTURE 2	1	50	9/17/2064	9/6/2114	8/24/2164	$ 53,000
	14.019	MECH	POLYMER FEED SYSTEM 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 57,000
	14.020	MECH	POLYMER FEED SYSTEM 2	4	5	3/30/2019	3/26/2034	3/22/2049	$ 58,000
	14.021	MECH	BLOWER 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 183,000
	14.022	MECH	BLOWER 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 179,000
	14.023	MECH	BLOWER 3	3	10	9/27/2024	9/22/2044	9/17/2064	$ 183,000
	14.024	STRUCT	BLOWER BUILDING 3	2	40	9/20/2054	9/8/2104	8/27/2154	$ 407,000
15. STANDBY POWER GENERATION	15.001	MECH	ABOVEGROUND FUEL STORAGE TANK 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 139,000
	15.002	MECH	ABOVEGROUND FUEL STORAGE TANK 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 139,000
	15.003	MECH	STANDBY GENERATOR 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 1,981,000
	15.004	MECH	STANDBY GENERATOR 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 1,981,000
	15.005	MECH	STANDBY GENERATOR 3	2	16	9/26/2030	9/21/2050	9/16/2070	$ 1,944,000
	15.006	MECH	DAY TANK & FEED PUMP 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 50,000
	15.007	MECH	DAY TANK & FEED PUMP 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 50,000
	15.008	MECH	DAY TANK & FEED PUMP 3	2	16	9/26/2030	9/21/2050	9/16/2070	$ 49,000
	15.009	MECH	GENERATOR FUEL RETURN TANK & PUMP	3	10	9/27/2024	9/22/2044	9/17/2064	$ 50,000

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16. DEWATERING SYSTEM	16.001	STRUCT	DEWATERING BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,821,000
	16.002	MECH	FILTER PRESS & POWER UNIT 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 907,000
	16.003	MECH	FILTER PRESS & POWER UNIT 2	4	6	9/28/2020	9/23/2040	9/18/2060	$ 925,000
	16.004	MECH	FILTER PRESS & POWER UNIT 3	1	20	9/25/2034	9/20/2054	9/15/2074	$ 907,000
	16.006	MECH	BOOSTER PUMPS 1 (TOTAL OF 1)	4	5	3/30/2019	3/26/2034	3/22/2049	$ 10,000
	16.007	MECH	BOOSTER PUMPS 2 & STAND-BY (TOTAL OF 2)	4	5	3/30/2019	3/26/2034	3/22/2049	$ 20,000
	16.008	MECH	HORIZONTAL SCREW CONVEYOR 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 206,000
	16.009	MECH	HORIZONTAL SCREW CONVEYOR 2	2	16	9/26/2030	9/21/2050	9/16/2070	$ 206,000
	16.010	MECH	MOTORIZED REVERSIBLE HORIZONTAL SCREW CONVEYOR	2	16	9/26/2030	9/21/2050	9/16/2070	$ 191,000
	16.011	MECH	INCLINED SCREW CONVEYOR 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 299,000
	16.012	MECH	INCLINED SCREW CONVEYOR 2	2	16	9/26/2030	9/21/2050	9/16/2070	$ 299,000
	16.013	I&C	REMOTE CONTROL PANELS	4	5	3/30/2019	3/26/2034	3/22/2049	$ 84,000
	16.014	I&C	CONVEYORS CONTROL PANEL	5	2	3/30/2016	3/27/2031	3/23/2046	$ 84,000
17. NON-PROCESS BUILDINGS	17.001	STRUCT	ADMINISTRATION BUILDING	4	15	9/26/2029	9/14/2079	9/2/2129	$ 1,288,000
	17.002	STRUCT	ELECTRICAL BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,264,000
18. LAKE FILTERING SYSTEM	18.001	MECH	GRAVITY DISK FILTERS - TOTAL OF 3	1	20	9/25/2034	9/20/2054	9/15/2074	$ 3,572,000
	18.002	I&C	GRAVITY DISK FILTER CONTROL PANELS-TOTAL OF 3	1	15				
	18.003	STRUCT	CONCRETE SLAB-ON-GRADE	1	50	9/17/2064	9/6/2114	8/24/2164	$ 74,000
	18.004	I&C	SCADA PANEL 5	1	15	9/26/2029	9/22/2044	9/19/2059	$ 165,000
	18.005	MECH	BACKWASH PUMPS - TOTAL OF 2	1	15	7/28/2029	7/24/2044	7/21/2059	$ 31,000
	18.006	STRUCT	BACKWASH WET WELL	1	25	9/24/2039	9/17/2064	9/11/2089	$ 67,000
	18.007	STRUCT	BACKWASH VAULT	1	25	9/24/2039	9/17/2064	9/11/2089	$ 8,000
	18.008	I&C	BW PUMP STATION CONTROL PANEL	1	15	9/26/2029	9/22/2044	9/19/2059	$ 82,000
19. EFFLUENT STORAGE	19.001	STRUCT	10 MG RCW STORAGE TANK	1	50	9/17/2064	9/6/2114	8/24/2164	$ 6,004,000

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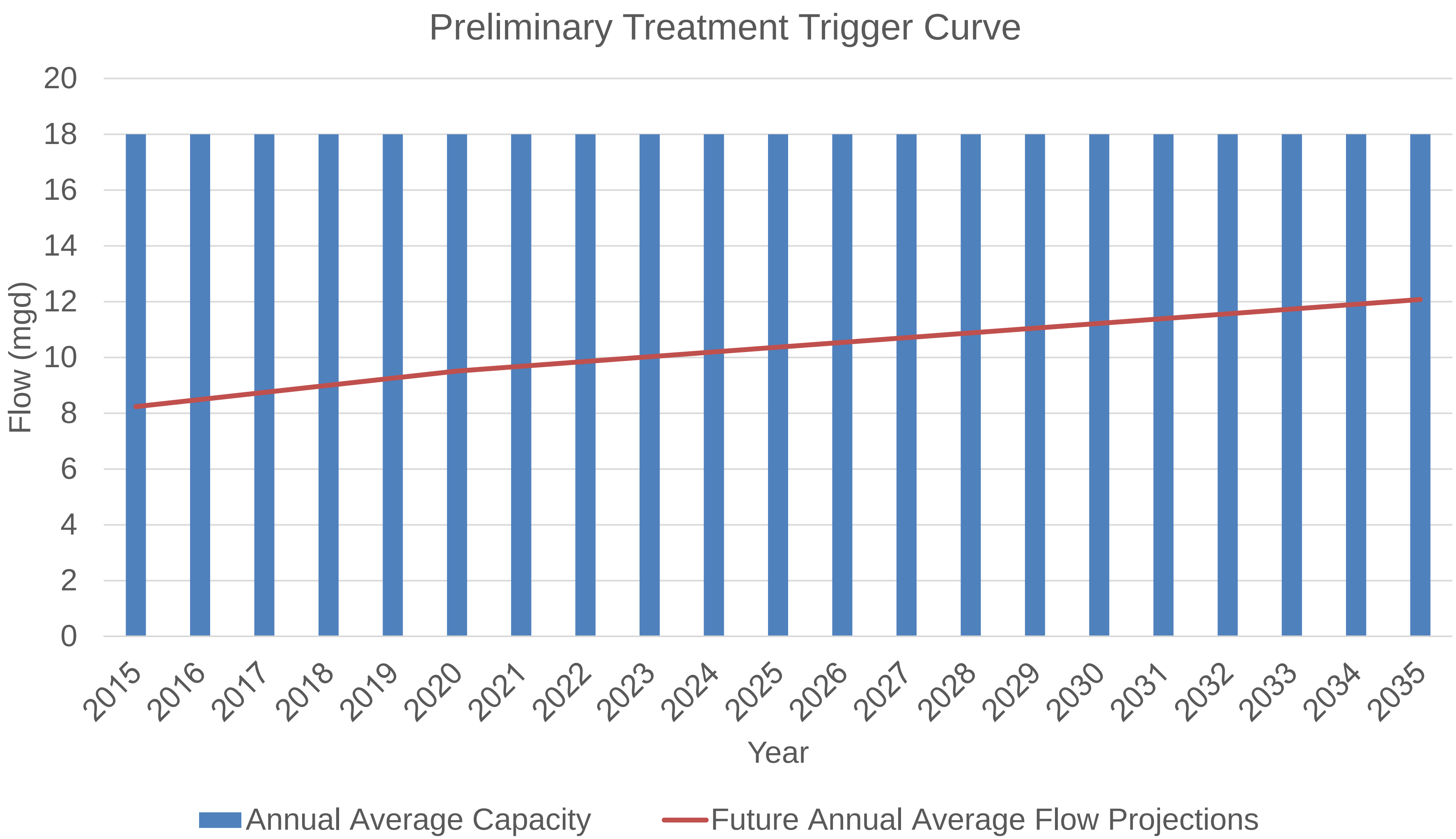
20. ELETRICAL & IC	20.001	ELEC	MCC - 1	2	24	9/24/2038	9/16/2068	9/9/2098	$ 636,000
	20.002	ELEC	MCC - 1A	1	30	9/22/2044	9/15/2074	9/8/2104	$ 552,000
	20.003	ELEC	MCC - 2	2	24	9/24/2038	9/16/2068	9/9/2098	$ 248,000
	20.004	ELEC	MCC - 2A	1	30	9/22/2044	9/15/2074	9/8/2104	$ 232,000
	20.005	ELEC	MCC - 3	2	24	9/24/2038	9/16/2068	9/9/2098	$ 563,000
	20.006	ELEC	MCC - 4	2	24	9/24/2038	9/16/2068	9/9/2098	$ 355,000
	20.007	ELEC	MCC - 5	3	15	9/26/2029	9/19/2059	9/11/2089	$ 416,000
	20.008	ELEC	MCC - 6	3	15	9/26/2029	9/19/2059	9/11/2089	$ 430,000
	20.009	ELEC	MCC - 7	2	24	9/24/2038	9/16/2068	9/9/2098	$ 509,000
	20.010	ELEC	MCC - 8	2	24	9/24/2038	9/16/2068	9/9/2098	$ 375,000
	20.011	ELEC	MCC - 9	3	15	9/26/2029	9/19/2059	9/11/2089	$ 327,000
	20.012	ELEC	MCC - 10	3	15	9/26/2029	9/19/2059	9/11/2089	$ 395,000
	20.013	ELEC	MCC - 11	2	24	9/24/2038	9/16/2068	9/9/2098	$ 484,000
	20.014	ELEC	MCC - 12	2	24	9/24/2038	9/16/2068	9/9/2098	$ 408,000
	20.015	ELEC	SWITCHGEAR 1	3	15	9/26/2029	9/19/2059	9/11/2089	$ 1,399,000
	20.016	ELEC	SWITCHGEAR 2	3	15	9/26/2029	9/19/2059	9/11/2089	$ 2,797,000
	20.017	ELEC	GENERATOR BREAKER 1	3	15	9/26/2029	9/19/2059	9/11/2089	$ 503,000
	20.018	ELEC	GENERATOR BREAKER 2A	3	15	9/26/2029	9/19/2059	9/11/2089	$ 503,000
	20.019	ELEC	GENERATOR BREAKER 3	3	15	9/26/2029	9/19/2059	9/11/2089	$ 503,000
	20.020	ELEC	GENERATOR BREAKER 2B	3	15	9/26/2029	9/19/2059	9/11/2089	$ 503,000
	20.021	ELEC	PANEL - LE (MAIN ELECTRICAL ROOM)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	20.022	ELEC	SUB-PANEL - LE (MAIN ELECTRICAL ROOM)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 11,000
	20.023	ELEC	PANEL - L4 (MAIN ELECTRICAL ROOM)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 14,000
	20.024	ELEC	PANEL - PC-TC1 (MAIN ELECTRICAL ROOM)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	20.025	ELEC	PANEL - LDA (DEWATERING BUILDING)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	20.026		PANEL - P4 (MAIN ELECTRICAL ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 15,000
	20.027	I&C	SCADA PANEL SP-1 (ELECTRICAL BLDG.)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 165,000
	20.028	I&C	SCADA PANEL SP-2 (BLOWER BLDG. 2)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 165,000
	20.029	I&C	SCADA PANEL SP-3 (BLOWER BLDG. 3)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 165,000
	20.030	I&C	SCADA PANEL SP-4 (DEWATERING BLDG.)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 165,000
	20.031	ELEC	PANEL - LCH (CHLORINE ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 16,000
	20.032	ELEC	PANEL - LC (CONTROL ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 19,000
	20.033	ELEC	PANEL - P1 (CONTROL ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 16,000
	20.034	ELEC	PANEL - LMS (CONTROL BUILDING)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	20.035	ELEC	PANEL - LD (DEWATERING)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 16,000
	20.036	ELEC	PANEL - L2 (MCC/BLOWER BLDG. 2)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 14,000
	20.037	ELEC	PANEL - L3 (ELEC/BLOWER BLDG. 3)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 14,000
	20.038	ELEC	PANEL - PC/TC 2 (BLOWER BLDG.)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 16,000
	20.039	ELEC	PANEL - PC/TC-3 (BLOWER BLDG 3)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 16,000
	20.040	ELEC	PANEL - LHW	1	15	9/26/2029	9/22/2044	9/19/2059	$ 16,000
	20.041	I&C	BFP CONTROL PANEL 1 (DEWATERING BLDG.)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 154,000
	20.042	I&C	BFP CONTROL PANEL 2 (DEWATERING BLDG.)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 154,000
	20.043	I&C	BFP CONTROL PANEL 3 (DEWATERING BLDG.)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 154,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
20. ELETRICAL & IC CONTINUED	20.044	ELEC	ISOLATION TRANSFORMER 1 (OUTSIDE MAIN ELECTRICAL BLDG.)	3	15	9/26/2029	9/19/2059	9/11/2089	$ 53,000
	20.045	ELEC	ISOLATION TRANSFORMER 2 (OUTSIDE MAIN ELECTRICAL BLDG.)	3	15	9/26/2029	9/19/2059	9/11/2089	$ 53,000
	20.046	ELEC	ISOLATION TRANSFORMER 3 (OUTSIDE MAIN ELECTRICAL BLDG.)	3	15	9/26/2029	9/19/2059	9/11/2089	$ 53,000
	20.047	ELEC	WAS PUMP VFD 1 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.048	ELEC	WAS PUMP VFD 2 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.049	ELEC	WAS PUMP VFD 3 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.050	ELEC	WAS PUMP VFD 4 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.051	ELEC	RAS PUMP VFD 1 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.052	ELEC	RAS PUMP VFD 2 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.053	ELEC	RAS PUMP VFD 3 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.054	ELEC	EFFLUENT PUMP VFD 108 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 543,000
	20.055	ELEC	EFFLUENT PUMP VFD 109 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 543,000
	20.056	ELEC	EFFLUENT PUMP VFD 110 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 543,000
	20.057	ELEC	EFFLUENT PUMP VFD 112 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 543,000
	20.058	ELEC	EFFLUENT PUMP VFD 113 (MAIN ELECTRICAL BLDG.)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 543,000
	20.059	ELEC	SLUDGE PUMP VFD 1 (BLOWER BLDG. 3)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.060	ELEC	SLUDGE PUMP VFD 2 (BLOWER BLDG. 3)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.061	ELEC	SLUDGE PUMP VFD 3 (BLOWER BLDG. 3)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.062	ELEC	SLUDGE PUMP VFD 4 (BLOWER BLDG. 3)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.063	ELEC	SLUDGE PUMP VFD 5 (BLOWER BLDG. 3)	1	30	9/22/2044	9/15/2074	9/8/2104	$ 18,000
	20.064	ELEC	SLUDGE PUMP VFD 6 (BLOWER BLDG. 3)	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.065	ELEC	SLUDGE PUMP VFD 7	2	24	9/24/2038	9/16/2068	9/9/2098	$ 18,000
	20.066	ELEC	SLUDGE PUMP VFD 8	1	30	9/22/2044	9/15/2074	9/8/2104	$ 18,000

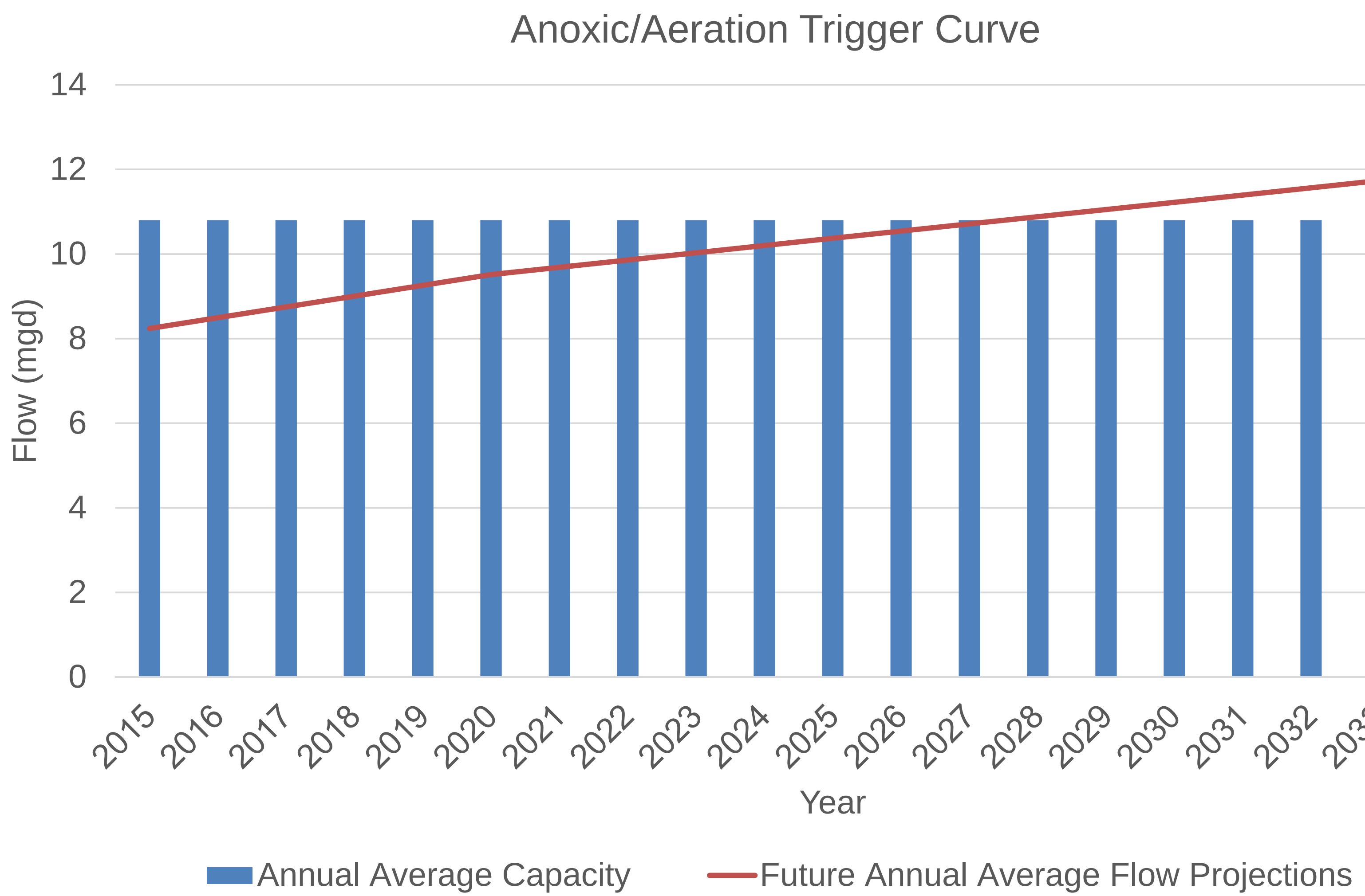
APPENDIX D - SEWRF TRIGGER CURVES



PHASED IMPLEMENTATION OF PROPOSED PRELIMINARY TREATMENT FACILITIES - SEWRF

FIGURE D.1

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

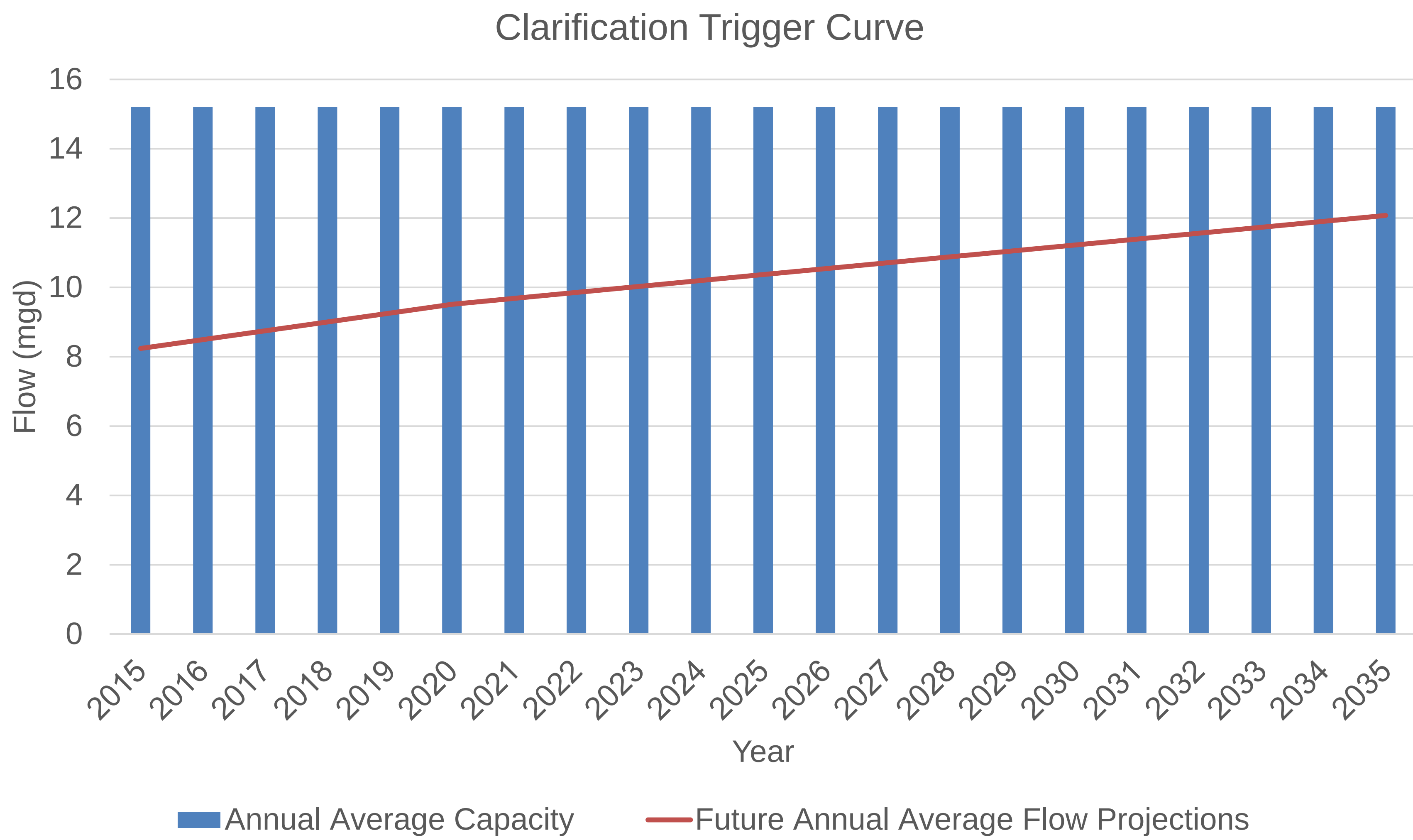


PHASED IMPLEMENTATION OF PROPOSED ANOXIC/AERATION TREATMENT FACILITIES - SEWRF

FIGURE D.2

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

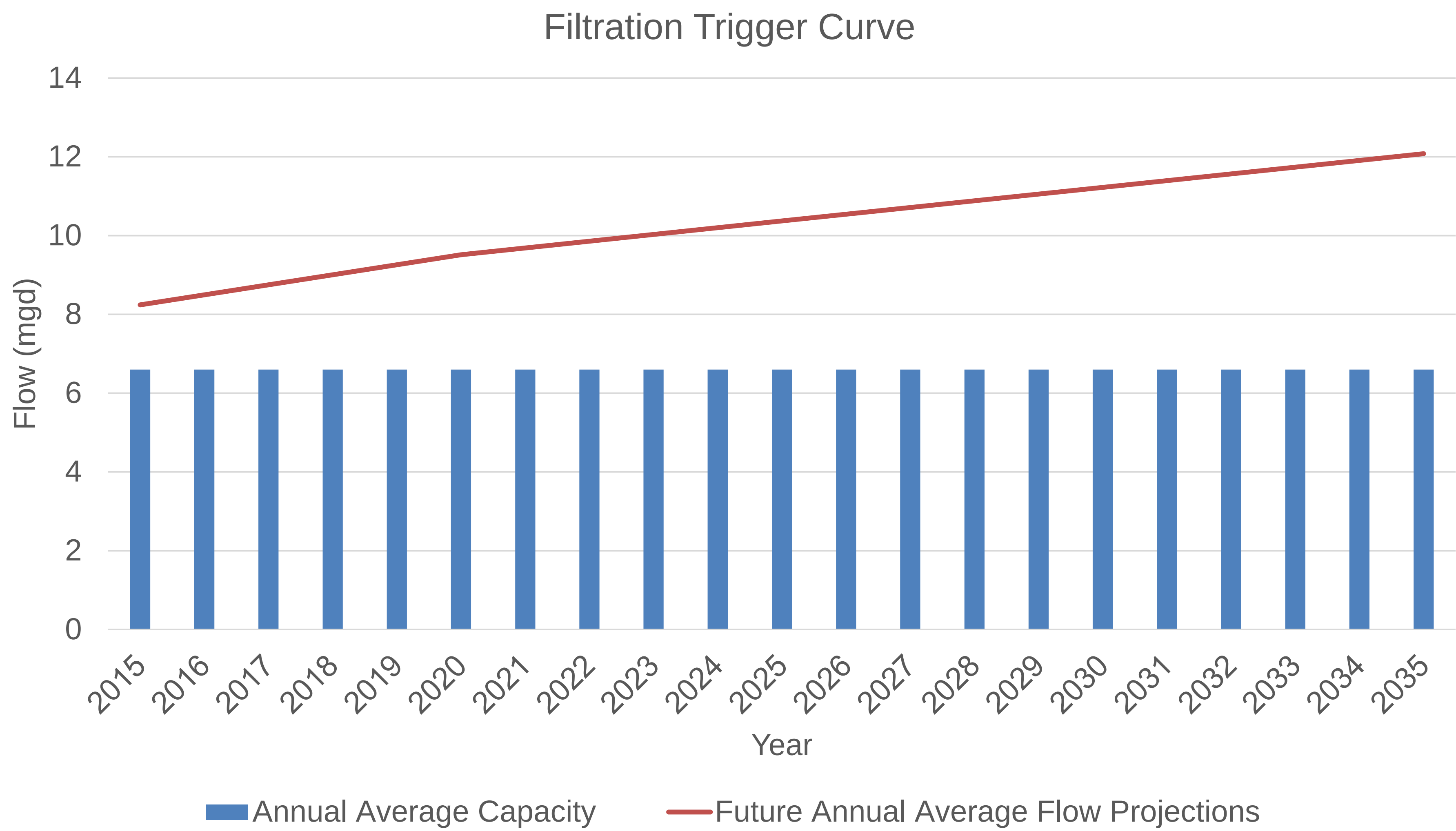
carollo



PHASED IMPLEMENTATION OF PROPOSED CLARIFICATION TREATMENT FACILITIES - SEWRF

FIGURE D.3

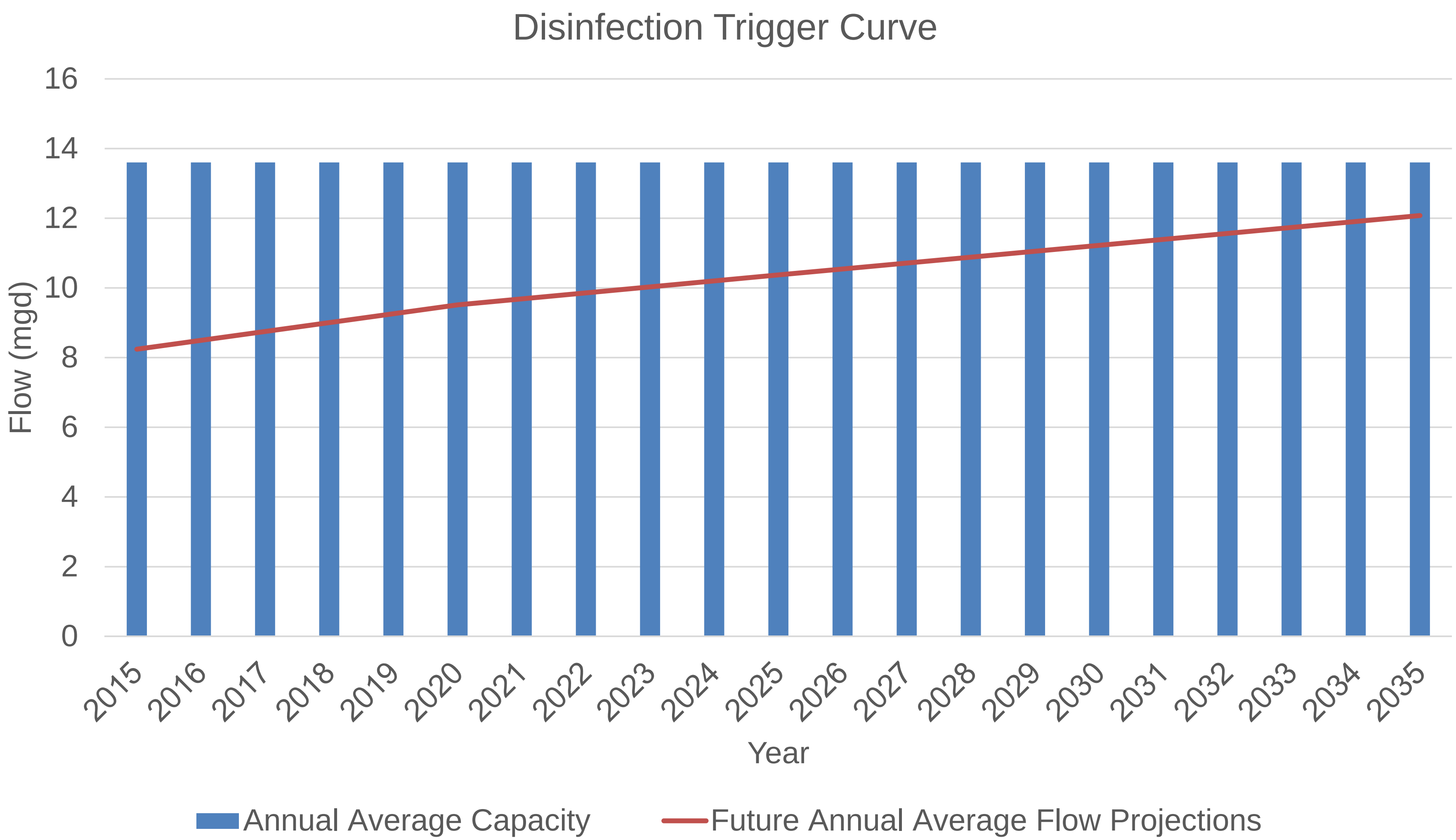
MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



PHASED IMPLEMENTATION OF FILTRATION TREATMENT FACILITIES - SEWRF

FIGURE D.4

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT



PHASED IMPLEMENTATION OF DISINFECTION TREATMENT FACILITIES - SEWRF

FIGURE D.5

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo

APPENDIX E - NRWRF ASSET CONDITION SCORES, REPLACEMENT TIMING, AND PROJECT COSTS

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years			Estimated Total Project Cost (One Replacement)
						First Replac.	Second Replac.	Third Replac.	
1. HEADWORKS	1.001	STRUCT	HEADWORKS STRUCTURE	2	40	9/20/2054	9/8/2104	8/27/2154	$ 2,098,000
	1.002	MECH	INFLUENT SLIDE GATES (TOTAL OF 3)	1	6	5/22/2020	5/20/2030	5/17/2040	$ 108,000
	1.003	MECH	ISOLATION SLIDE GATE 1	2	6	5/22/2020	5/20/2030	5/17/2040	$ 36,000
	1.004	MECH	SLIDE GATE (MANUAL SCREEN EFFLUENT)	2	6	5/22/2020	5/20/2030	5/17/2040	$ 81,000
	1.005	MECH	ISOLATION SLIDE GATE 1	2	6	5/22/2020	5/20/2030	5/17/2040	$ 36,000
	1.006	MECH	EFFLUENT WEIR GATES 1 - TOTAL OF 8	2	6	5/22/2020	5/20/2030	5/17/2040	$ 382,000
	1.007	MECH	EFFLUENT WEIR GATES 2 - TOTAL OF 6	2	6	5/22/2020	5/20/2030	5/17/2040	$ 217,000
	1.008	MECH	EFFLUENT WEIR GATES 3 - TOTAL OF 2	2	6	5/22/2020	5/20/2030	5/17/2040	$ 72,000
	1.009	MECH	GRIT REMOVAL SYSTEM - SLURRYCUP	2	16	9/26/2030	9/21/2050	9/16/2070	$ 1,273,000
	1.010	I&C	GRIT REMOVAL SYSTEM CONTROL PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ -
	1.011	MECH	AUTOMATIC SCREEN 1	1	10	9/27/2024	9/25/2034	9/22/2044	$ 865,000
	1.012	I&C	AUTOMATIC SCREEN CONTROL PANEL 1	1	15	9/26/2029	9/22/2044	9/19/2059	
	1.013	MECH	AUTOMATIC SCREEN 2	1	10	9/27/2024	9/25/2034	9/22/2044	$ 865,000
	1.014	I&C	AUTOMATIC SCREEN CONTROL PANEL 2	1	15	9/26/2029	9/22/2044	9/19/2059	
	1.015	MECH	SCREW CONVEYOR 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 121,000
	1.016	MECH	SCREW CONVEYOR 2	2	16	9/26/2030	9/21/2050	9/16/2070	$ 457,000
	1.017	MECH	MANUAL BAR SCREEN	1	10	9/27/2024	9/25/2034	9/22/2044	$ 90,000
	1.018	STRUCT	INFLUENT DRAIN PUMP STATION WETWELL	2	40	9/20/2054	9/8/2104	8/27/2154	$ 9,000
	1.019	MECH	VERTICAL CENTRIFUGAL PUMP 1	4	5	3/30/2019	3/26/2034	3/22/2049	$ 36,000
	1.020	MECH	VERTICAL CENTRIFUGAL PUMP 2	4	5	3/30/2019	3/26/2034	3/22/2049	$ 36,000
	1.021	I&C	PUMP STATION CONTROL PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ 73,000
	1.022	MECH	GRIT PUMP 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 49,000
	1.023	MECH	GRIT PUMP 2	3	8	3/29/2022	3/25/2037	3/21/2052	$ 49,000
2. ODOR CONTROL FACILITIES	2.002	MECH	BIO TRICKLING FILTER	2	16	9/26/2030	9/21/2050	9/16/2070	$ 356,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years			Estimated Total Project Cost (One Replacement)
						First Replac.	Second Replac.	Third Replac.	
3. ANOXIC/ AEROBIC SYSTEM	3.001	STRUCT	ANOXIC / AEROBIC TANK 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 7,211,000
	3.002	STRUCT	ANOXIC / AEROBIC TANK 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 7,211,000
	3.003	MECH	ANOXIC MIXER #4 (NORTH)	3	0	9/30/2014	9/26/2029	9/22/2044	$ 136,000
	3.004	MECH	ANOXIC MIXER #3 (NORTH)	5	0	9/30/2014	9/26/2029	9/22/2044	$ 136,000
	3.005	MECH	ANOXIC MIXER #2 (SOUTH)	3	0	9/30/2014	9/26/2029	9/22/2044	$ 136,000
	3.006	MECH	ANOXIC MIXER #1 (SOUTH)	4	0	9/30/2014	9/26/2029	9/22/2044	$ 136,000
	3.007	MECH	AERATORS #1 (SOUTH BASIN - NE END)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 288,000
	3.008	MECH	AERATORS #2 (SOUTH BASIN - SE END)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 288,000
	3.009	MECH	AERATORS #3 (SOUTH BASIN - W END)	2	11	10/25/2025	10/20/2045	10/15/2065	$ 288,000
	3.010	MECH	AERATORS #4 (NORTH BASIN - SE END)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 288,000
	3.011	MECH	AERATORS #5 (NORTH BASIN - NE END)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 288,000
	3.012	MECH	AERATORS #6 (NORTH BASIN - W END)	2	11	10/25/2025	10/20/2045	10/15/2065	$ 288,000
	3.015	MECH	SLUICE GATE 3	3	17	11/26/2031	11/21/2051	11/16/2071	$ 30,000
	3.016	MECH	SLUICE GATE 4	3	17	11/26/2031	11/21/2051	11/16/2071	$ 30,000
	3.017	MECH	SLUICE GATE 5	3	0	9/30/2014	9/25/2034	9/20/2054	$ 27,000
	3.020	MECH	MOTORIZED WEIR-TYPE GATE 1	1	17	11/26/2031	11/21/2051	11/16/2071	$ 72,000
	3.021	MECH	MOTORIZED WEIR-TYPE GATE 2	1	17	11/26/2031	11/21/2051	11/16/2071	$ 72,000
	3.022	MECH	RML PUMP 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 408,000
	3.023	MECH	RML PUMP 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 408,000
	3.024	MECH	RML PUMP 3	1	15	9/26/2029	9/22/2044	9/19/2059	$ 408,000
	3.025	MECH	RML PUMP 4	1	15	9/26/2029	9/22/2044	9/19/2059	$ 408,000
4. FINAL CLARIFIERS & RAS/WAS PUMP STATION	4.001	STRUCT	FLOW SPLITTER BOX	2	40	9/20/2054	9/8/2104	8/27/2154	$ 108,000
	4.002	STRUCT	FINAL CLARIFIER 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,521,000
	4.003	STRUCT	FINAL CLARIFIER 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,521,000
	4.004	STRUCT	FINAL CLARIFIER 3	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,521,000
	4.005	MECH	SCUM EJECTOR 1	3	8	3/29/2022	3/25/2037	3/21/2052	$ -
	4.006	MECH	SCUM EJECTOR 2	3	8	3/29/2022	3/25/2037	3/21/2052	$ -
	4.007	MECH	SCUM PUMP 3	2	12	9/27/2026	9/23/2041	9/19/2056	$ -
	4.008	MECH	AIR COMPRESSOR (FOR BOTH EJECTORS)	3	10	9/27/2024	9/22/2044	9/17/2064	$ 10,000
	4.009	MECH	AIR STORAGE TANK FOR EJECTORS	3	10	9/27/2024	9/22/2044	9/17/2064	$ -
	4.011	STRUCT	PUMP STATION STRUCTURE W/ CANOPY	2	40	9/20/2054	9/8/2104	8/27/2154	$ 116,000
	4.012	MECH	RAS PUMP 1 W/ VFD	3	8	3/29/2022	3/25/2037	3/21/2052	$ 186,000
	4.013	MECH	RAS PUMP 2 W/ VFD	3	8	3/29/2022	3/25/2037	3/21/2052	$ 186,000
	4.014	MECH	RAS PUMP 3 W/ VFD	3	8	3/29/2022	3/25/2037	3/21/2052	$ 186,000
	4.015	MECH	WAS PUMP 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 69,000
	4.016	MECH	WAS PUMP 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 61,000
	4.017	MECH	WAS PUMP 3	2	12	9/27/2026	9/23/2041	9/19/2056	$ 61,000
	4.018	MECH	WAS PUMP 4	1	15	9/26/2029	9/22/2044	9/19/2059	$ 61,000
	4.019	MECH	WEIR GATES (TOTAL OF 4)	3	0	9/30/2014	9/26/2029	9/22/2044	$ 254,000
	4.020	MECH	SLIDE GATE	3	0	9/30/2014	9/26/2029	9/22/2044	$ 30,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
5. FLASH MIXERS AND FLOCCULATORS	5.001	STRUCT	FLOW SPLITTER STRUCTURE	2	40	9/20/2054	9/8/2104	8/27/2154	$ 140,000
	5.002	MECH	SLIDE GATE 1	2	0	9/30/2014	9/25/2034	9/20/2054	$ 36,000
	5.003	MECH	SLIDE GATE 2	2	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	5.004	MECH	SLIDE GATE 3	2	0	9/30/2014	9/25/2034	9/20/2054	$ 27,000
	5.005	MECH	SLIDE GATE 4	2	0	9/30/2014	9/25/2034	9/20/2054	$ 27,000
	5.006	MECH	WEIR GATE 1	2	0	9/30/2014	9/25/2034	9/20/2054	$ 72,000
	5.007	MECH	WEIR GATE 2	2	0	9/30/2014	9/25/2034	9/20/2054	$ 72,000
6. FILTERS	6.001	STRUCT	FILTER 1	1	50	9/17/2064	9/6/2114	8/24/2164	$ 283,000
	6.002	MECH	WASHWATER TROUGHS 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 29,000
	6.003	MECH	CARRIAGE 1	4	6	9/28/2020	9/23/2040	9/18/2060	$ 65,000
	6.004	MECH	FILTER MEDIA 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 101,000
	6.005	MECH	POROUS PLATES (UNDERDRAIN) 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 457,000
	6.006	MECH	INFLUENT & EFFLUENT PORTS 1	3	0	9/30/2014	9/25/2034	9/20/2054	$ 29,000
	6.007	MECH	BACKWASH SYSTEM (BRIDGE) 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 653,000
	6.008	STRUCT	FILTER 2	1	50	9/17/2064	9/6/2114	8/24/2164	$ 283,000
	6.009	MECH	WASHWATER TROUGHS 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 29,000
	6.010	MECH	CARRIAGE 2	4	6	9/28/2020	9/23/2040	9/18/2060	$ 65,000
	6.011	MECH	FILTER MEDIA 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 101,000
	6.012	MECH	POROUS PLATES 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 457,000
	6.013	MECH	EFFLUENT PORTS 2	3	0	9/30/2014	9/25/2034	9/20/2054	$ 29,000
	6.014	MECH	BACKWASH SYSTEM 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 653,000
	6.015	MECH	SLIDE GATE 1 (COMMON INFLUENT CHANNEL)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	6.016	MECH	SLIDE GATE 2 (COMMON INFLUENT CHANNEL)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	6.017	MECH	SLIDE GATE 3 (COMMON INFLUENT CHANNEL)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	6.018	MECH	SLIDE GATE 4 (COMMON INFLUENT CHANNEL)	3	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	6.023	STRUCT	FILTER 3 & 4	2	40	9/20/2054	9/8/2104	8/27/2154	$ 55,000
	6.024	MECH	DISK FILTERS 3 & 4	2	16	9/26/2030	9/21/2050	9/16/2070	$ 1,958,000
	6.025	MECH	FILTERS 3 & 4 GATES (TOTAL OF 4)	2	16	9/26/2030	9/21/2050	9/16/2070	$ 121,000
	6.026	MECH	DISK FILTERS 3 & 4 BACKWASH PUMPS (TOTAL OF 4)	3	10	9/27/2024	9/22/2044	9/17/2064	$ 69,000
	6.027	I&C	DISK FILTERS 3 & 4 CONTROL PANELS (TOTAL OF 2)	2	16	9/26/2030	9/21/2050	9/16/2070	$ 168,000
7. PLANT DRAIN PUMP STATION	7.001	STRUCT	PLANT DRAIN WET WELL	1	50	9/17/2064	9/6/2114	8/24/2164	$ 45,000
	7.002	MECH	PLANT DRAIN PUMP 1	3	10	5/28/2024	5/25/2039	5/21/2054	$ 40,000
	7.003	MECH	PLANT DRAIN PUMP 2	3	10	5/28/2024	5/25/2039	5/21/2054	$ 40,000
	7.004	MECH	PLANT DRAIN PUMP 3	3	10	5/28/2024	5/25/2039	5/21/2054	$ 40,000
	7.005	STRUCT	PLANT DRAIN VALVE VAULT	1	50	9/17/2064	9/6/2114	8/24/2164	$ 37,000
	7.006	STRUCT	PUMP STATION TOP SLAB	2	40	9/20/2054	9/8/2104	8/27/2154	$ 7,000
	7.007	I&C	PUMP STATION CONTROL PANEL	1	50	9/17/2064	9/6/2114	8/24/2164	$ 73,000

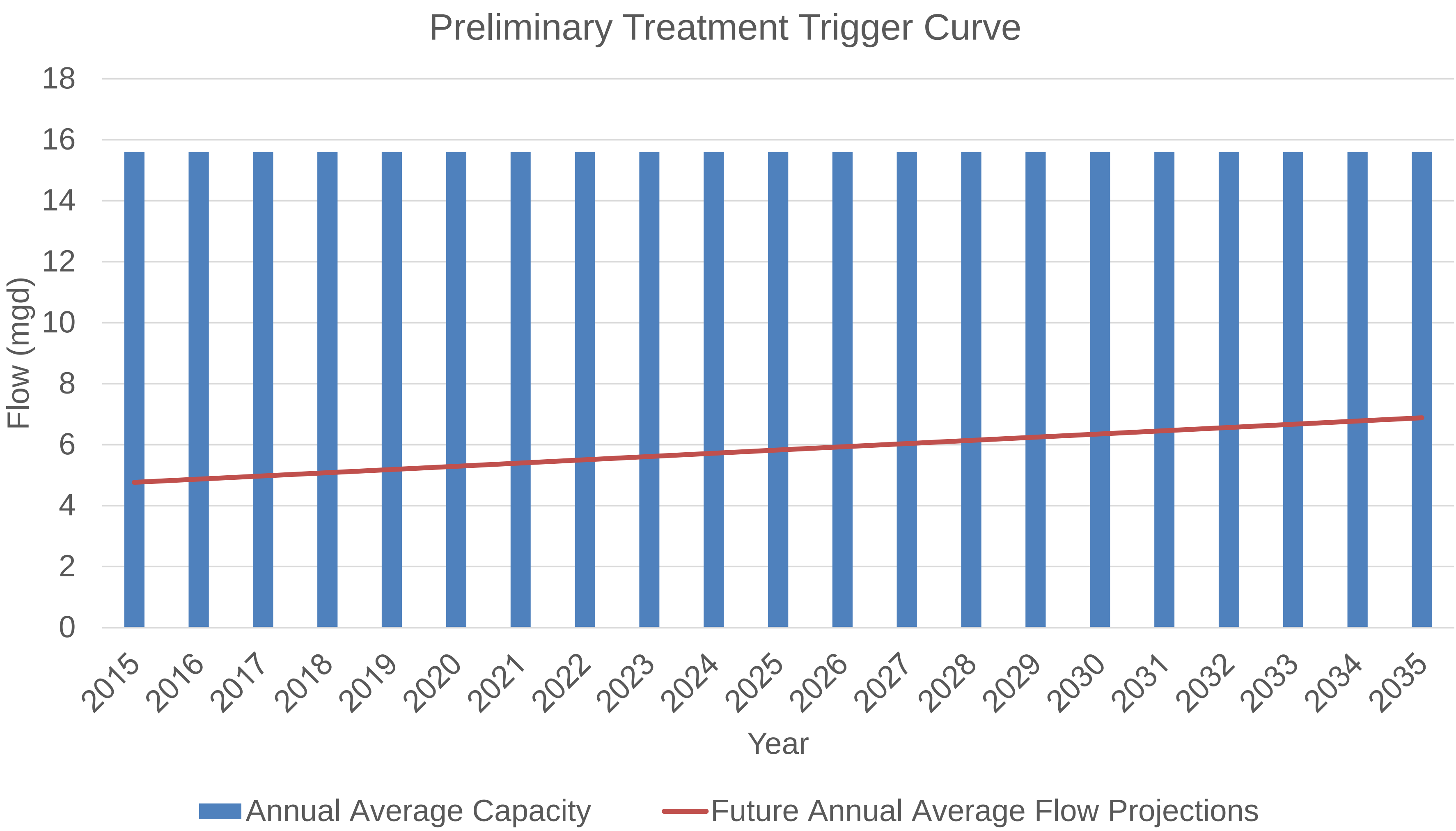
Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
8. CHLORINATION	8.001	STRUCT	CONTACT BASIN 1	3	25	9/24/2039	9/11/2089	8/31/2139	$ 221,000
	8.002	STRUCT	CONTACT BASIN 2	3	25	9/24/2039	9/11/2089	8/31/2139	$ 221,000
	8.005	MECH	SLIDE GATE 3	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.006	MECH	SLIDE GATE 4	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.007	MECH	SLIDE GATE 5	5	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.008	MECH	SLIDE GATE 6	3	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.009	MECH	SLIDE GATE 7	3	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.010	MECH	SLUICE GATE 1	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.011	MECH	SLUICE GATE 2	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.012	MECH	SLUICE GATE 3	4	0	9/30/2014	9/25/2034	9/20/2054	$ 30,000
	8.013	STRUCT	CHEMICAL BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 545,000
	8.014	MECH	HYPOCHLORITE STORAGE TANK 1 (DEWATERING BUILDING)	2	20	9/25/2034	9/19/2059	9/12/2084	$ 75,000
	8.015	MECH	HYPOCHLORITE STORAGE TANK 2 (DEWATERING BUILDING)	2	20	9/25/2034	9/19/2059	9/12/2084	$ 75,000
	8.016	MECH	METERING PUMP SKID 1 (TO CCC)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 97,000
	8.017	MECH	METERING PUMP SKID 2 (TO CCC)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 97,000
	8.018	MECH	METERING PUMP SKID 3 (TO LAKE FILTER)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 97,000
	8.019	MECH	METERING PUMP SKID 4 (TO LAKE FILTER BACKWASH)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 49,000
	8.021	MECH	REFRIGERATED SAMPLER	3	8	3/29/2022	3/25/2037	3/21/2052	$ 14,000
	8.022	I&C	CONTROL PANEL 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 45,000
	8.023	I&C	CONTROL PANEL 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 45,000
	8.024	I&C	CONTROL PANEL SKIDS 3 & 4	1	15	9/26/2029	9/22/2044	9/19/2059	$ 90,000
	8.025	STRUCT	CONTACT BASIN 3	3	25	9/24/2039	9/11/2089	8/31/2139	$ 221,000
	8.026	STRUCT	CONTACT BASIN 4	3	25	9/24/2039	9/11/2089	8/31/2139	$ 221,000
	8.027	MECH	BASINS 3 & 4 INFLUENT GATES (TOTAL OF 2)	3	5	5/30/2019	5/26/2034	5/22/2049	$ 228,000
9. EFFLUENT & REUSE PUMP STATION	9.001	STRUCT	WET WELL 1	5	5	9/29/2019	9/16/2069	9/5/2119	$ 114,000
	9.002	STRUCT	WET WELL 2	5	5	9/29/2019	9/16/2069	9/5/2119	$ 114,000
	9.003	MECH	DISTRIBUTION PUMP 1 (WW1) VFD	4	0	9/30/2014	9/26/2029	9/22/2044	$ 111,000
	9.004	MECH	DISTRIBUTION PUMP 2 (WW1) VFD	2	14	2/25/2029	2/22/2044	2/18/2059	$ 111,000
	9.005	MECH	DISTRIBUTION PUMP 3 (WW1) VFD	3	12	5/28/2026	5/24/2041	5/20/2056	$ 111,000
	9.006	MECH	DISTRIBUTION PUMP 4 (WW1) VFD	5	11	5/28/2025	5/24/2040	5/21/2055	$ 111,000
	9.007	MECH	DISTRIBUTION PUMP 5 (WW2) (VFD)	3	4	5/28/2018	5/24/2033	5/20/2048	$ 111,000
	9.010	I&C	EQUIPMENT CONTROL PANEL	3	0	9/30/2014	9/26/2029	9/22/2044	$ 62,000
	9.011	STRUCT	REUSE PUMP STATION PAD	2	40	9/20/2054	9/8/2104	8/27/2154	$ 4,000
10. EFFLUENT TRANSFER PUMP STATIONS	10.001	STRUCT	PUMPBACK STATION 1 - WET WELL	2	40	9/20/2054	9/8/2104	8/27/2154	$ 40,000
	10.002	MECH	PUMPBACK STATION 1 - PUMP 60HP	2	1	9/30/2015	9/26/2030	9/22/2045	$ 92,000
	10.003	MECH	PUMPBACK STATION 1 - PUMP 30HP (TOTAL OF 2)	2	1	9/30/2015	9/26/2030	9/22/2045	$ 127,000
	10.004	I&C	PUMPBACK STATION 1 - CONTROL PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ 73,000
	10.005	STRUCT	PUMPBACK STATION 1 - VALVE BOX	2	40	9/20/2054	9/8/2104	8/27/2154	$ 50,000
	10.006	STRUCT	PUMPBACK STATION 2 - WET WELL	2	40	9/20/2054	9/8/2104	8/27/2154	$ 40,000
	10.007	MECH	PUMPBACK STATION 2 - PUMP 60HP	2	1	9/30/2015	9/26/2030	9/22/2045	$ 92,000
	10.008	MECH	PUMPBACK STATION 2 - PUMP 30HP	2	1	9/30/2015	9/26/2030	9/22/2045	$ 64,000
	10.009	I&C	PUMPBACK STATION 2 - CONTROL PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ 73,000
	10.010	STRUCT	PUMPBACK STATION 2 - VALVE BOX	2	40	9/20/2054	9/8/2104	8/27/2154	$ 48,000
	10.011	STRUCT	TRANSFER PUMP STATION - WET WELL	2	40	9/20/2054	9/8/2104	8/27/2154	$ 40,000
	10.012	MECH	TRANSFER PUMP STATION PUMPS - TOTAL OF 2	2	1	9/30/2015	9/26/2030	9/22/2045	$ 64,000
	10.013	I&C	TRANSFER PUMP STATION - CONTROL PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ 73,000
	10.014	STRUCT	TRANSFER PUMP STATION - VALVE BOX	2	40	9/20/2054	9/8/2104	8/27/2154	$ 41,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years: First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
11. CHEMICAL SYSTEMS	11.001	MECH	POLYMER - MIX TANK 1	3	5	9/29/2019	9/26/2029	9/24/2039	$ 237,000
	11.002	MECH	POLYMER - MIX TANK 2	3	5	9/29/2019	9/26/2029	9/24/2039	
	11.003	MECH	POLYMER - MIXING SKID	3	8	3/29/2022	3/25/2037	3/21/2052	
	11.004	MECH	POLYMER - FILTER PRESS FEED PUMP 1	5	2	3/30/2016	3/27/2031	3/23/2046	$ 16,000
	11.005	MECH	POLYMER - FILTER PRESS FEED PUMP 2	3	8	3/29/2022	3/25/2037	3/21/2052	$ 16,000
	11.006	I&C	POLYMER CONTROL PANELS	5	2	3/30/2016	3/27/2031	3/23/2046	$ 20,000
	11.009	MECH	ALUM - FEED PUMP 1	5	2	3/30/2016	3/27/2031	3/23/2046	$ 16,000
	11.010	MECH	ALUM - FEED PUMP 2	5	2	3/30/2016	3/27/2031	3/23/2046	$ 16,000
12. AEROBIC DIGESTER SYSTEM	12.001	STRUCT	SLUDGE HOLDING TANK 1	1	25	9/24/2039	9/17/2064	9/11/2089	$ 1,818,000
	12.002	STRUCT	SLUDGE HOLDING TANK 2	1	25	9/24/2039	9/17/2064	9/11/2089	$ 1,818,000
	12.003	STRUCT	SLUDGE HOLDING TANK 3	1	25	9/24/2039	9/17/2064	9/11/2089	$ 1,818,000
	12.004	MECH	SLUDGE TRANSFER PUMP 1	1	15	9/26/2029	9/22/2044	9/19/2059	$ 89,000
	12.005	MECH	SLUDGE TRANSFER PUMP 2	1	15	9/26/2029	9/22/2044	9/19/2059	$ 89,000
	12.006	MECH	SLUDGE TRANSFER PUMP 3	1	15	9/26/2029	9/22/2044	9/19/2059	$ 89,000
	12.007	MECH	SLUDGE TRANSFER PUMP 4	1	15	9/26/2029	9/22/2044	9/19/2059	$ 89,000
	12.008	MECH	DIFFUSER ASSEMBLY TANK 1	1	20	9/25/2034	9/20/2054	9/15/2074	$ 125,000
	12.009	MECH	DIFFUSER ASSEMBLY TANK 2	1	20	9/25/2034	9/20/2054	9/15/2074	$ 174,000
	12.010	MECH	DIFFUSER ASSEMBLY TANK 3	3	12	12/27/2026	12/22/2046	12/17/2066	$ 174,000
	12.011	STRUCT	SLUDGE PUMP STRUCTURE 1	2	40	9/20/2054	9/8/2104	8/27/2154	$ 36,000
	12.012	STRUCT	SLUDGE PUMP STRUCTURE 2	2	40	9/20/2054	9/8/2104	8/27/2154	$ 36,000
	12.013	MECH	BLOWERS - TOTAL OF 3	1	20	9/25/2034	9/20/2054	9/15/2074	$ 620,000
	12.018	I&C	BLOWER CONTROL PANELS - TOTAL OF 3	1	15	9/26/2029	9/22/2044	9/19/2059	
	12.019	STRUCT	BLOWER STRUCTURE	1	50	9/17/2064	9/6/2114	8/24/2164	$ 94,000
13. STANDBY POWER GENERATION	13.001	MECH	ABOVEGROUND FUEL STORAGE TANK	2	20	9/25/2034	9/19/2059	9/12/2084	$ 212,000
	13.002	MECH	STANDBY GENERATOR 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 1,981,000
	13.003	MECH	STANDBY GENERATOR 2	2	16	9/26/2030	9/21/2050	9/16/2070	$ 1,981,000
	13.004	MECH	DAY TANK & PUMPS 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 50,000
	13.005	MECH	DAY TANK & PUMPS 2	2	16	9/26/2030	9/21/2050	9/16/2070	$ 50,000
14. DEWATERING SYSTEM	14.001	STRUCT	DEWATERING BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,864,000
	14.002	MECH	FILTER PRESS & POWER UNIT 1	4	6	9/28/2020	9/23/2040	9/18/2060	$ 1,044,000
	14.003	MECH	FILTER PRESS & POWER UNIT 2 (STANDBY)	5	2	9/29/2016	9/24/2036	9/19/2056	$ 1,044,000
	14.004	MECH	FILTER PRESS & POWER UNIT 3	4	6	9/28/2020	9/23/2040	9/18/2060	$ 1,044,000
	14.005	MECH	BOOSTER PUMPS 1 (PRESS 1 - TOTAL OF 2)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 20,000
	14.006	MECH	BOOSTER PUMPS 2 (PRESS 2 - TOTAL OF 2)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 20,000
	14.007	MECH	HORIZONTAL SCREW CONVEYOR 1	3	10	9/27/2024	9/22/2044	9/17/2064	$ 210,000
	14.008	MECH	HORIZONTAL SCREW CONVEYOR 2	5	2	9/29/2016	9/24/2036	9/19/2056	$ 210,000
	14.009	MECH	INCLINED SCREW CONVEYOR 1	4	6	9/28/2020	9/23/2040	9/18/2060	$ 305,000
	14.010	MECH	INCLINED SCREW CONVEYOR 2	3	10	9/27/2024	9/22/2044	9/17/2064	$ 305,000
	14.011	I&C	REMOTE CONTROL PANELS	4	5	3/30/2019	3/26/2034	3/22/2049	$ 84,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years			Estimated Total Project Cost (One Replacement)
						First Replac.	Second Replac.	Third Replac.	
15. LAKE FILTERING SYSTEM	15.001	MECH	SYSTEM 2 - DISKFILTER 1	1	17	5/27/2031	5/22/2051	5/17/2071	$ 1,371,000
	15.002	I&C	SYSTEM 2 - DISKFILTER CONTROL PANEL 1	1	12	5/28/2026	5/24/2041	5/20/2056	
	15.003	MECH	SYSTEM 2 - DISKFILTER 2	1	17	5/27/2031	5/22/2051	5/17/2071	$ 1,371,000
	15.004	I&C	SYSTEM 2 - DISKFILTER CONTROL PANEL 2	1	12	5/28/2026	5/24/2041	5/20/2056	
	15.005	MECH	SYSTEM 2 - DISKFILTER 3	1	17	5/27/2031	5/22/2051	5/17/2071	$ 1,371,000
	15.006	I&C	SYSTEM 2 - DISKFILTER CONTROL PANEL 3	1	12	5/28/2026	5/24/2041	5/20/2056	
	15.007	STRUCT	CONCRETE SLAB-ON-GRADE	1	47	5/19/2061	5/8/2111	4/25/2161	$ 28,000
	15.008	MECH	BACKWASH PUMP 1	2	12	5/28/2026	5/24/2041	5/20/2056	$ 16,000
	15.009	MECH	BACKWASH PUMP 2	2	12	9/27/2026	9/23/2041	9/19/2056	$ 16,000
	15.010	STRUCT	BACKWASH WET WELL	1	25	9/24/2039	9/17/2064	9/11/2089	$ 45,000
	15.011	STRUCT	BACKWASH VAULT	1	25	9/24/2039	9/17/2064	9/11/2089	$ 10,000
	15.015	MECH	SYSTEM 1 - STAKFILTER 1	2	16	9/26/2030	9/21/2050	9/16/2070	$ 96,000
	15.016	MECH	SYSTEM 1 - STAKFILTER 2	2	16	9/26/2030	9/21/2050	9/16/2070	$ 96,000
	15.017	MECH	SYSTEM 1 - STAKFILTER 3	2	16	9/26/2030	9/21/2050	9/16/2070	$ 96,000
	15.018	MECH	SYSTEM 1 - STAKFILTER 4	2	16	9/26/2030	9/21/2050	9/16/2070	$ 96,000
	15.019	MECH	SYSTEM 1 - STAKFILTER 5	2	16	9/26/2030	9/21/2050	9/16/2070	$ 96,000
	15.020	STRUCT	CONCRETE SLAB	2	40	9/20/2054	9/8/2104	8/27/2154	$ 46,000
	15.018	I&C	STAKFILTERS CONTROL PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ 45,000
	15.022	ELEC	STAKFILTERS DISTRIBUTION PANEL	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000
16. EFFLUENT STORAGE	16.001	STRUCT	EFFLUENT STORAGE TANK 1	3	13	3/28/2027	3/21/2052	3/15/2077	$ 1,249,000
17. NON-PROCESS BUILDINGS	17.001	STRUCT	CONTROL BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,224,000
	17.002	STRUCT	ELECTRICAL BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,196,000
	17.003	STRUCT	MAINTENANCE BUILDING	2	40	9/20/2054	9/8/2104	8/27/2154	$ 1,101,000
18. ELECTRICAL & INSTRUMENTATION	18.001	ELEC	GENERATOR BREAKER 1	1	30	9/22/2044	9/15/2074	9/8/2104	$ 503,000
	18.002	ELEC	GENERATOR BREAKER 2	1	30	9/22/2044	9/15/2074	9/8/2104	$ 503,000
	18.003	ELEC	GENERATOR TIE BREAKER	1	30	9/22/2044	9/15/2074	9/8/2104	$ 503,000
	18.004	ELEC	MAIN SWITCHBOARD	1	30	9/22/2044	9/15/2074	9/8/2104	$ 699,000
	18.005	ELEC	MCC - 1	3	15	9/26/2029	9/19/2059	9/11/2089	$ 588,000
	18.006	ELEC	MCC - 2	3	15	9/26/2029	9/19/2059	9/11/2089	$ 599,000
	18.007	ELEC	MCC - 3	3	15	9/26/2029	9/19/2059	9/11/2089	$ 533,000
	18.008	ELEC	MCC - 4	3	15	9/26/2029	9/19/2059	9/11/2089	$ 546,000
	18.009	ELEC	MCC - 5	3	15	9/26/2029	9/19/2059	9/11/2089	$ 401,000
	18.010	ELEC	MCC - 6	3	15	9/26/2029	9/19/2059	9/11/2089	$ 365,000
	18.011	ELEC	PANEL PC/TC- MAIN ELECTRICAL ROOM	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	18.012	ELEC	PANEL LE - GENERATOR ROOM	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	18.013	ELEC	PANEL LD - DEWATERING BLDG.	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000
	18.014	ELEC	PANEL LE - MAIN ELECTRICAL ROOM	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	18.015	ELEC	PANEL LCH - CHLORINE BLDG	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000
	18.016	ELEC	PANEL HWL - HEADWORKS	1	15	9/26/2029	9/22/2044	9/19/2059	$ 17,000
	18.017	ELEC	PANEL LP-701 (DISKFILTER AREA)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 22,000
	18.018	ELEC	PANEL LP-702	1	15	9/26/2029	9/22/2044	9/19/2059	$ 17,000
	18.019	I&C	PANEL BFP 1 (DEWATERING CONTROL ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 157,000
	18.020	I&C	PANEL BFP 2 (DEWATERING CONTROL ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 157,000
	18.021	I&C	PANEL BFP 3 (DEWATERING CONTROL ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 157,000
	18.022	ELEC	PANEL P1 (CONTROL BUILDING)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000
	18.023	ELEC	PANEL LC (CONTROL BUILDING)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000

Asset ID Group/Asset ID		Asset Class ID	Asset Description	Condition Score	Selected Remaining Life (Years)	R&R Plan Through 2054 Replacement Years First Replac.	Second Replac.	Third Replac.	Estimated Total Project Cost (One Replacement)
	18.024	ELEC	PANEL CP (CONTROL BUILDING)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000
	18.025	ELEC	PANEL LEA (GENERATOR ROOM)	2	12	9/27/2026	9/23/2041	9/19/2056	$ 17,000
	18.026	ELEC	PANEL LA (MAINTENANCE BUILDING)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 17,000
	18.027	ELEC	PANEL LFC (FINAL CLARIFIERS AREA)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	18.028	ELEC	PANEL PFC (FINAL CLARIFIERS AREA)	3	8	3/29/2022	3/25/2037	3/21/2052	$ 17,000
	18.029	ELEC	PANEL 1B (HEADWORKS)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 34,000
	18.030	ELEC	PANEL 2B (HEADWORKS)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 34,000
	18.031	I&C	SCADA PANEL SP-9 (DISKFILTERS)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 168,000
	18.032	I&C	SCADA PANEL SP-4 (GENERATOR ROOM)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 168,000
	18.033	I&C	SCADA PANEL SP-3 (DEWATERING BUILDING)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 168,000
	18.034	I&C	SCADA PANEL SP-3 (HEADWORKS BUILDING)	1	15	9/26/2029	9/22/2044	9/19/2059	$ 168,000

APPENDIX F - NRWRF TRIGGER CURVES

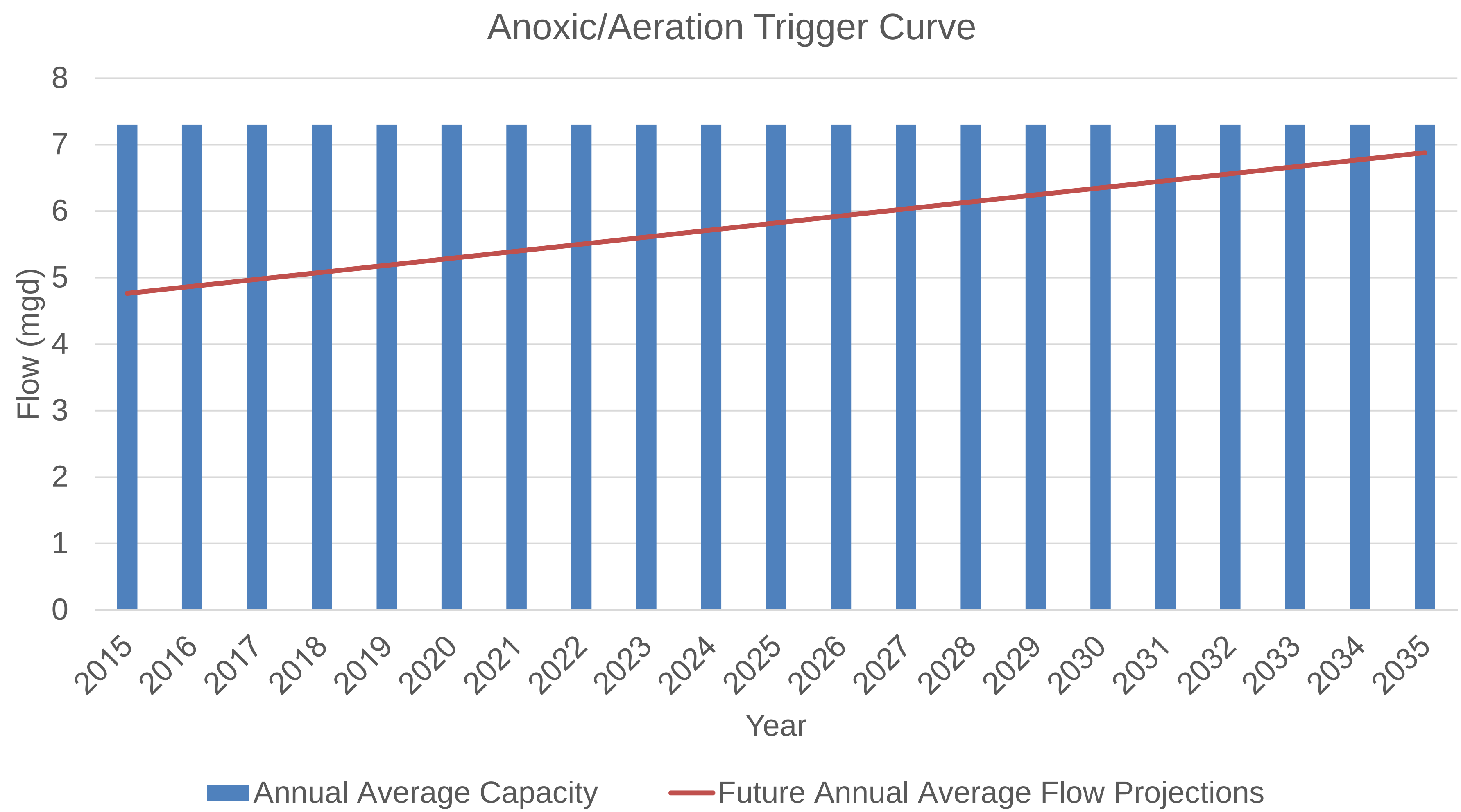


PHASED IMPLEMENTATION OF PROPOSED PRELIMINARY TREATMENT FACILITIES - NRWRF

FIGURE F.1

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo

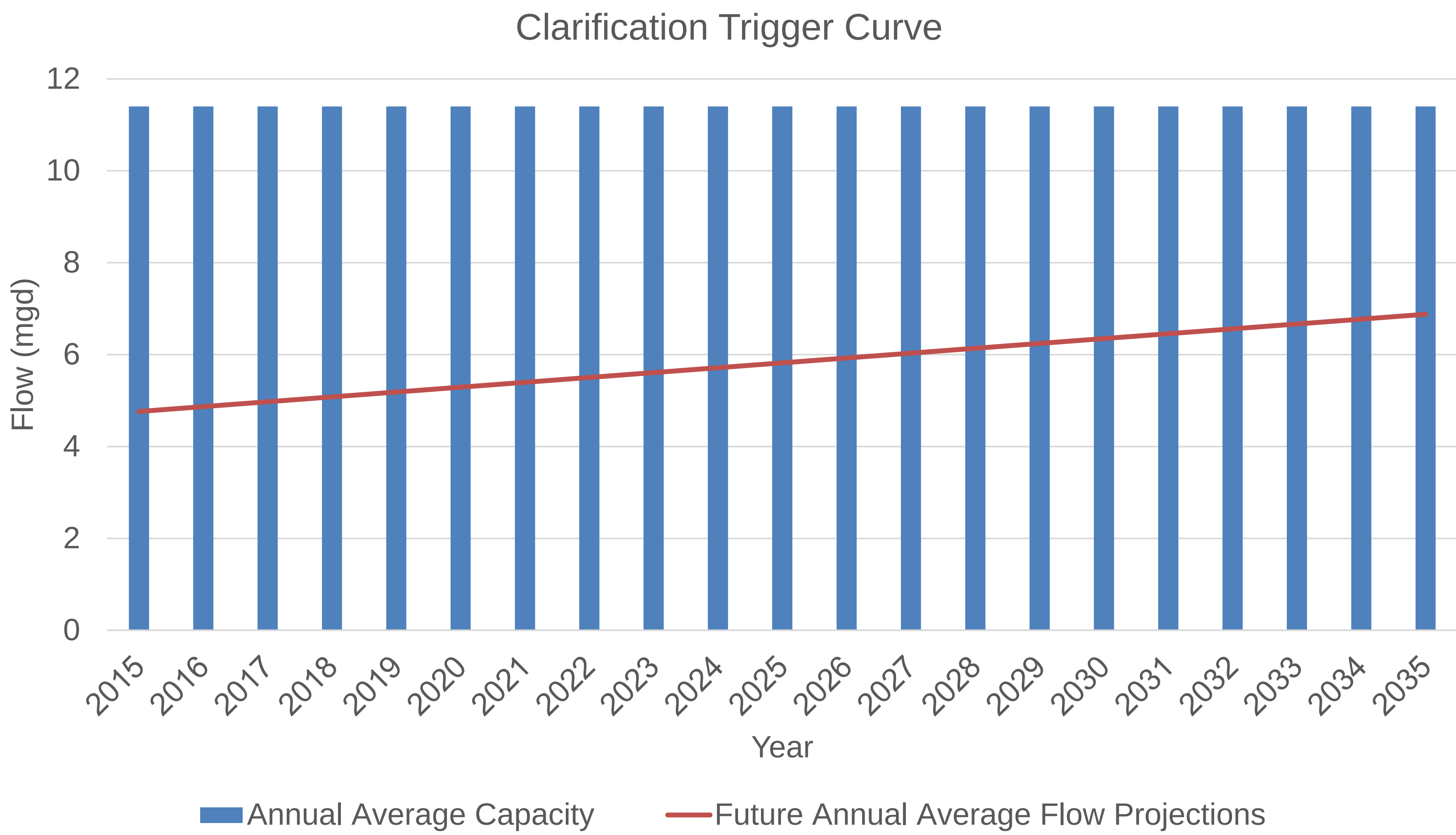


PHASED IMPLEMENTATION OF PROPOSED ANOXIC/AERATION TREATMENT FACILITIES - NRWRF

FIGURE F.2

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo



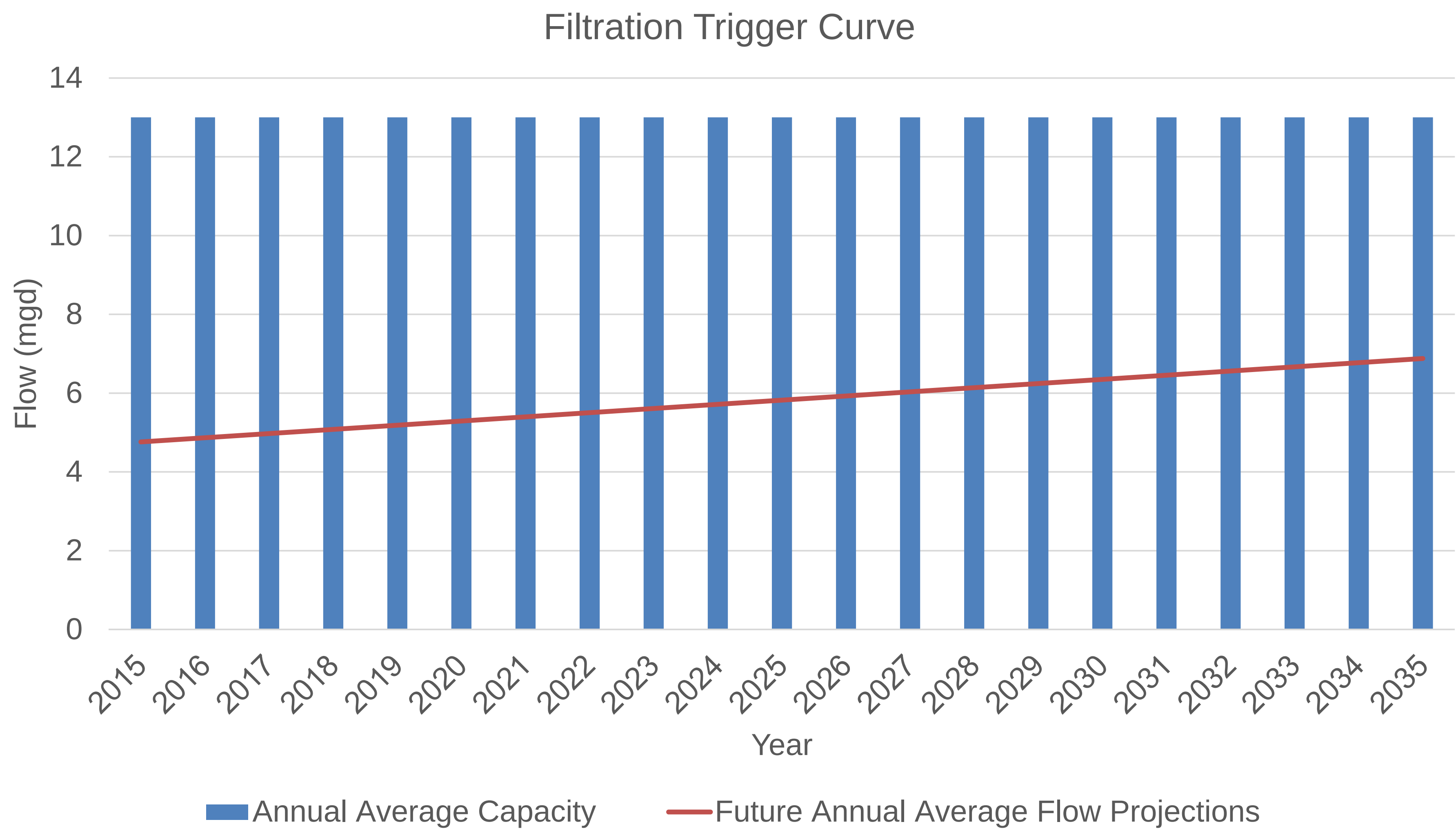
PHASED IMPLEMENTATION OF PROPOSED CLARIFICATION TREATMENT FACILITIES - NRWRF

FIGURE F.3

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo

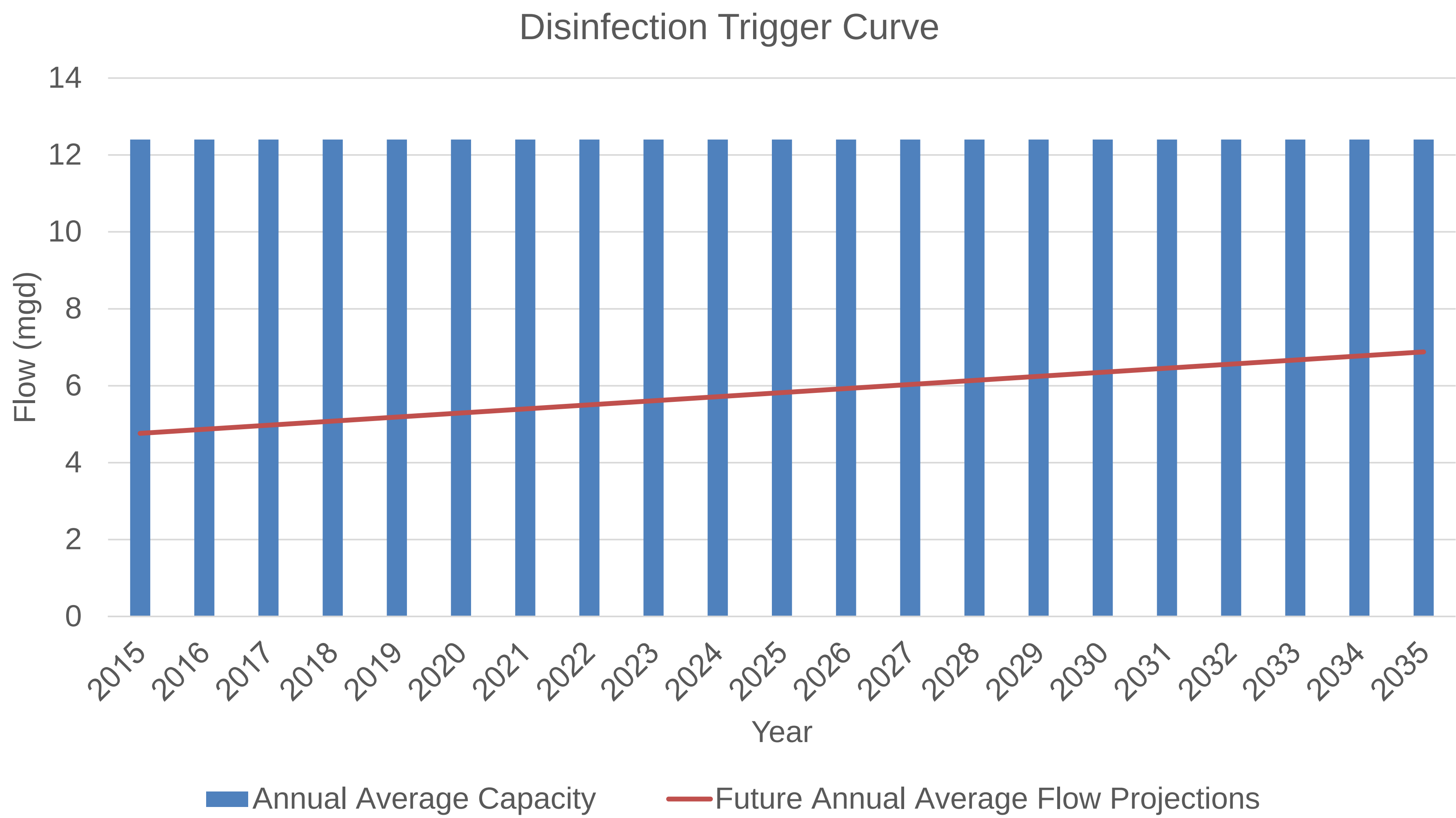


PHASED IMPLEMENTATION OF FILTRATION TREATMENT FACILITIES - NRWRF

FIGURE F.4

MANATEE COUNTY
WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo



PHASED IMPLEMENTATION OF DISINFECTION TREATMENT FACILITIES - NRWRF

FIGURE F.5

MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

carollo

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM NO. 4
WRF TREATMENT ALTERNATIVES ANALYSIS

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MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

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1.0 INTRODUCTION

The purpose of this Technical Memorandum (TM) is to develop liquid and solids treatment alternatives to address the future needs for each water reclamation facility (WRF). The selection of the different alternatives is based on discussions with the County and a workshop held on January 20, 2016. The alternatives represent technologies that the County is already in the process of evaluating, or emerging technologies within the Florida region.

2.0 LIQUID TREATMENT ALTERNATIVES

2.1 Preliminary Treatment

2.1.1 Influent Screening

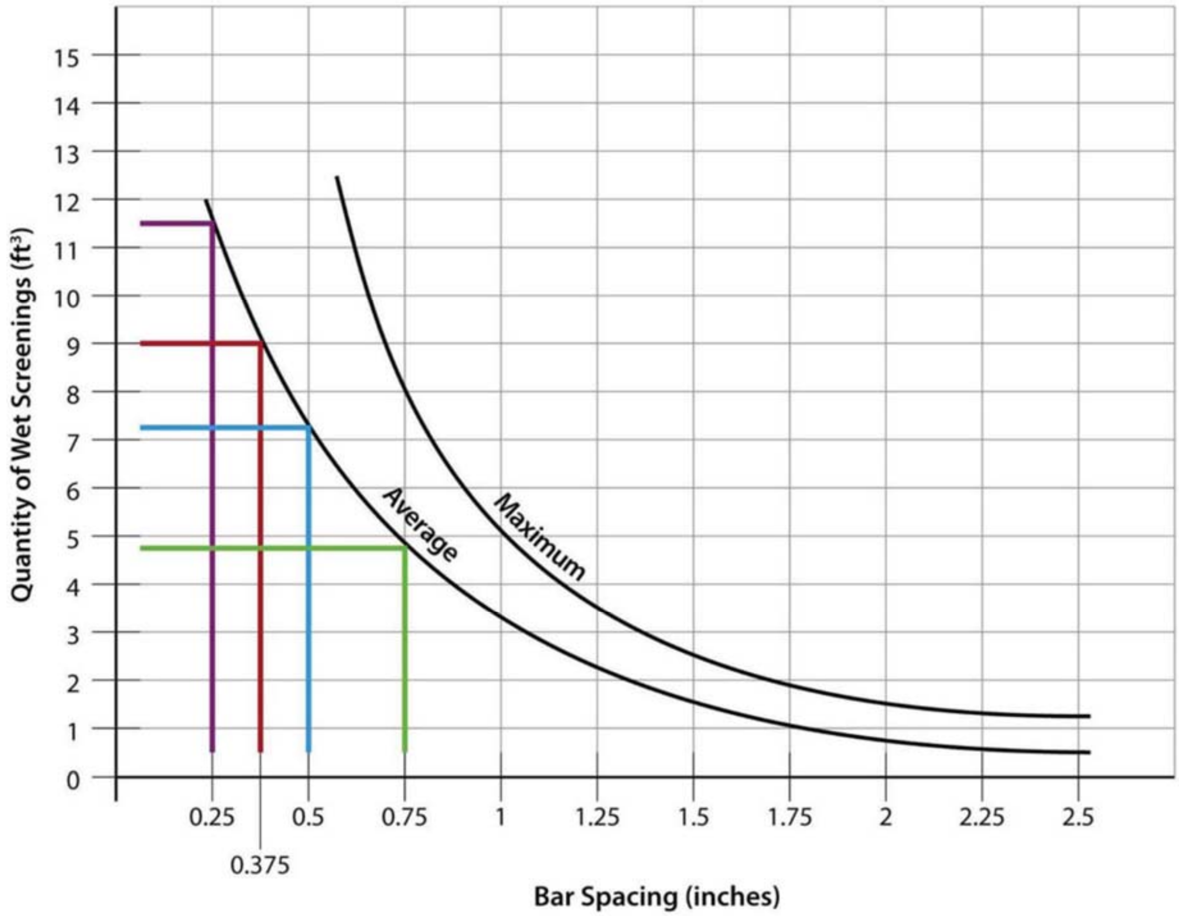
The first treatment process that wastewater undergoes at a wastewater treatment facility is raw influent screening. This step is intended to remove coarse debris such as plastics, gravel, or rags, which will detrimentally impact downstream equipment. There are a large variety of screening technologies available, and the technologies discussed in this section are considered the most relevant to Manatee County.

2.1.1.1 Screen Opening Size and Level of Capture

Selecting an opening size is important in establishing the design criteria for the screenings facilities. Screen opening size impacts screenings removal efficiency, dictates the size of screens, and affects plant hydraulics.

Figure 4.1 illustrates how level of screenings capture increases with smaller clear screen openings. The graph reflects a sharp increase in removal rates that is experienced as screen openings decrease below 3/4-inch.

Table 4.1 describes the levels of capture normally achieved with screen opening/bar spacing most commonly implemented at municipal wastewater treatment facilities. Smaller opening sizes (or closer bar spacing) remove more solids; however, smaller openings are more susceptible to blinding. Smaller openings also capture more organic material, which increase washing requirements and increase the risk of odor generation.



Screenings Capture

Source: Design of Municipal Wastewater Treatment Plants, Fourth Edition, WEF Manual of Practice, Volume 2.

SCREENINGS REMOVAL VOLUME AS A FUNCTION OF BAR SPACING

FIGURE 4.1

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Table 4.1 Screen Bar Spacing and Level of Capture Water Reclamation Facilities – Master Plan Development Manatee County		
Screen Bar Spacing, Inches	**Level of Capture(1)**	**Operation and Maintenance Impacts(1)**
1/2”	• Removes rags and trash	• Less prone to blinding than finer screens
3/8"	• Removes most plastics and some disposable wipes • Removes some organics	• Some screenings washing recommended
1/4”	• Removes most plastics and disposable wipes • Removes a lot of organics	• High-level of screenings washing recommended • Screenings generate odors
Notes: (1) General guidelines. Capture and O&M impacts vary from facility to facility.		

Removing more inert solids provides greater protection of downstream equipment and reduces downstream maintenance. Potential reductions in maintenance include reduced ragging of downstream pumps including influent pumps, primary sludge pumps, digester mixing pumps, and heat exchangers. Removing inert material at the headworks also reduces the buildup of inert material in the solids holding tanks, reducing the frequency of cleaning. Removing plastic material at the headworks reduces plastic material in the solids stream and improves the quality of biosolids for reuse.

Use of 1/4-inch screens does provide for greater removal of disposable wipes, which are increasingly prevalent in municipal wastewater and can clog pumps. However, these screens also remove significantly more organic material, which require larger screenings handling and odor control facilities, and increased operations and maintenance (O&M) attention at the headworks.

The current industry trend is to install screens with 3/8-inch or 1/4-inch openings in order to capture a sufficient amount of solids at the headworks and reduce downstream maintenance costs. Smaller screening openings (or bar spacing) typically require the units coupled with washers and compactors to remove captured organics for return into the liquid flow stream as well as reduce solids volume. The use of washers and compactors assist with reducing odors in the final disposal product and return the organics back into the biological system.

2.1.1.2 Link Driven Multi-Rake Catenary Screen

A catenary screen (Figure 4.2) is a stationary bar rack with a mechanical rake mechanism to remove captured debris.

ILLUSTRATION OF A CATENARY SCREEN (DUPERON)

FIGURE 4.2

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The screen does not have lower chain sprockets and bearings within the wastewater channel but instead has special chain links that prevent the chain from collapsing on itself. This design reduces the number of wear components on the screen. This type of screen has many advantages such as:

- No submerged wear parts.
- Low head loss.
- Low maintenance.
- Front cleaning and return.
- Pivots out of channel.

The Duperon screens currently installed at the Southeast Water Reclamation Facility (SEWRF) are a type of catenary screen. Although typically a coarse screen (50 mm size spacing), new screen technology is available that can reduce removal size to the fine screen range (less than 6 mm size spacing).

2.1.1.3 Perforated Plate Screen

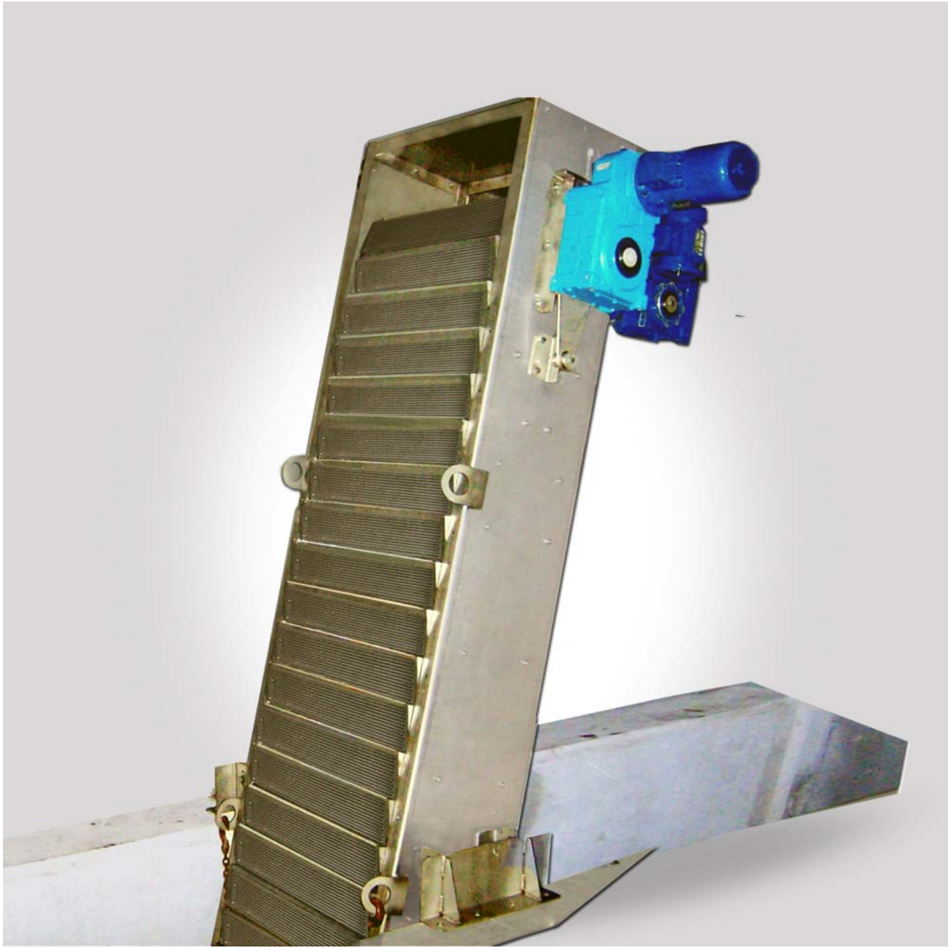
Perforated plate screens (Figure 4.3) feature a revolving screen that moves past a stationary cleaning device. Perforated plate screens are considered a fine screen and remove small debris from the wastewater. The screen conveyor is made out of "L" shaped stamped stainless slats with perforated hole diameters as small as 3 mm. The screen resembles an escalator in operation, and this escalator-like conveyor shape helps transport solids larger than the screen diameter up to the solids discharge chute. In emergency situations, perforated plate screens can pivot out of the influent channel. A mechanical brush or water jet cleaning mechanism is needed to remove smaller debris from the plate.

Some of the advantages of this type of screen:

- Typically better screening capture than other flow through mechanical screens
- Popular type of fine mechanical screening in Florida

2.1.1.4 Continuous Link Filter Element Belt Screen

An element belt screen (Figure 4.4) is formed with special hook-shaped chain links (Figure 4.5) which serve a dual purpose. The hooks help convey material larger than the screen up and out of the channel. At the same time, they press enmeshed material out of the spaces between the chain links when the belt goes around a sprocket. Like the perforated plate screen, the element belt screen needs a brush/water jet cleaning mechanism. This type of fine screening is considered a more antiquated technology when compared to perforated or band type screen technology.



PHOTOGRAPH OF A PERFORATED PLATE SCREEN (FRANKLIN MILLER)

FIGURE 4.3

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PHOTOGRAPH OF AN ELEMENT BELT SCREEN (PARKSON CORP.)

FIGURE 4.4

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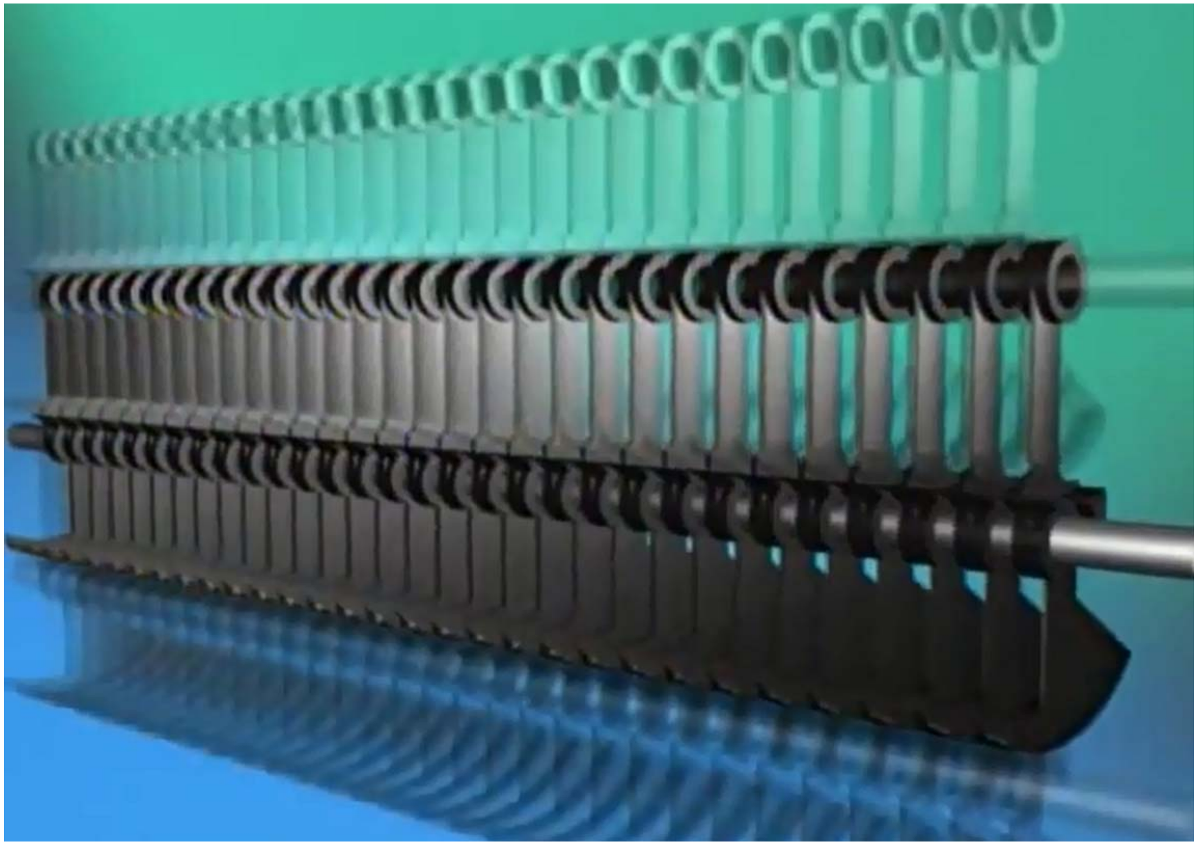

ILLUSTRATION OF THE LINKS USED IN AN ELEMENT BELT SCREEN (PARKSON CORP.)

FIGURE 4.5

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Advantages of this screen include available screening sizes down to 1 mm and ability to pivot the unit out of the channel for repairs. Disadvantages include difficult link replacement, submerged moving parts, potential for solids carryover, and high head loss. The Parkson Aquaguard screens currently installed at the Southwest Water Reclamation Facility (SWWRF) and North Regional Water Reclamation Facility (NRWRF) are the filter element belt type.

2.1.1.5 Band Screen

Band screens are similar to perforated plate screens in general operation, and the designs can use either mesh screens or perforated plates. However, rather than a traditional direct pass through flow pattern, band screens usually employ either an "inside-out" or an "outside-in" flow pattern Figure 4.6). They can be constructed with a minimum screen size of 1.5 mm to 2.0 mm, which provides a fine screening of the wastewater. Advantages include fine screening down to 0.25 mm and solids removal in three dimensions as opposed to two dimensions with traditional design. In addition, debris pass through is virtually eliminated with a band screen, but operational complications are introduced with this design. A water jet/brush assembly keeps the screen open. Disadvantages include inability to pivot screen out of the influent channel, high head loss, lighter duty construction, and removing large, entrapped, foreign objects can be difficult.

2.1.2 Grit Removal

Grit removal is one of the most overlooked processes of a wastewater treatment facility, but poor grit removal can result in chronic loss of treatment volume (in anoxic and aeration tanks) as well as shorter downstream equipment life as a result of excessive abrasion. Grit accumulation in aeration basins can cover floor-mounted diffusers and reduce oxygen transfer capacity, and damage the diffusers or air supply grid piping due to excessive weight. There are two general types of grit removal systems: horizontal flow chambers and vortex chambers. The vortex chambers are separated into two technology types: mechanically induced vortex and hydraulically induced vortex. Each technology for grit removal uses gravity to settle grit out of the wastewater.

When selecting a grit removal system, it is equally as important to have a properly designed grit classifier because grit removed from the influent can be returned to the facility by the grit wash water from a poorly functioning classifier.

2.1.2.1 Horizontal Flow Chambers

Horizontal flow chambers can remove grit particles as small as 0.15 to 0.21 mm in diameter and may be aerated or not. The advantage to a horizontal grit chamber is that it has the simplest method of operation. However, the tanks require a significantly larger footprint than the vortex grit chambers.

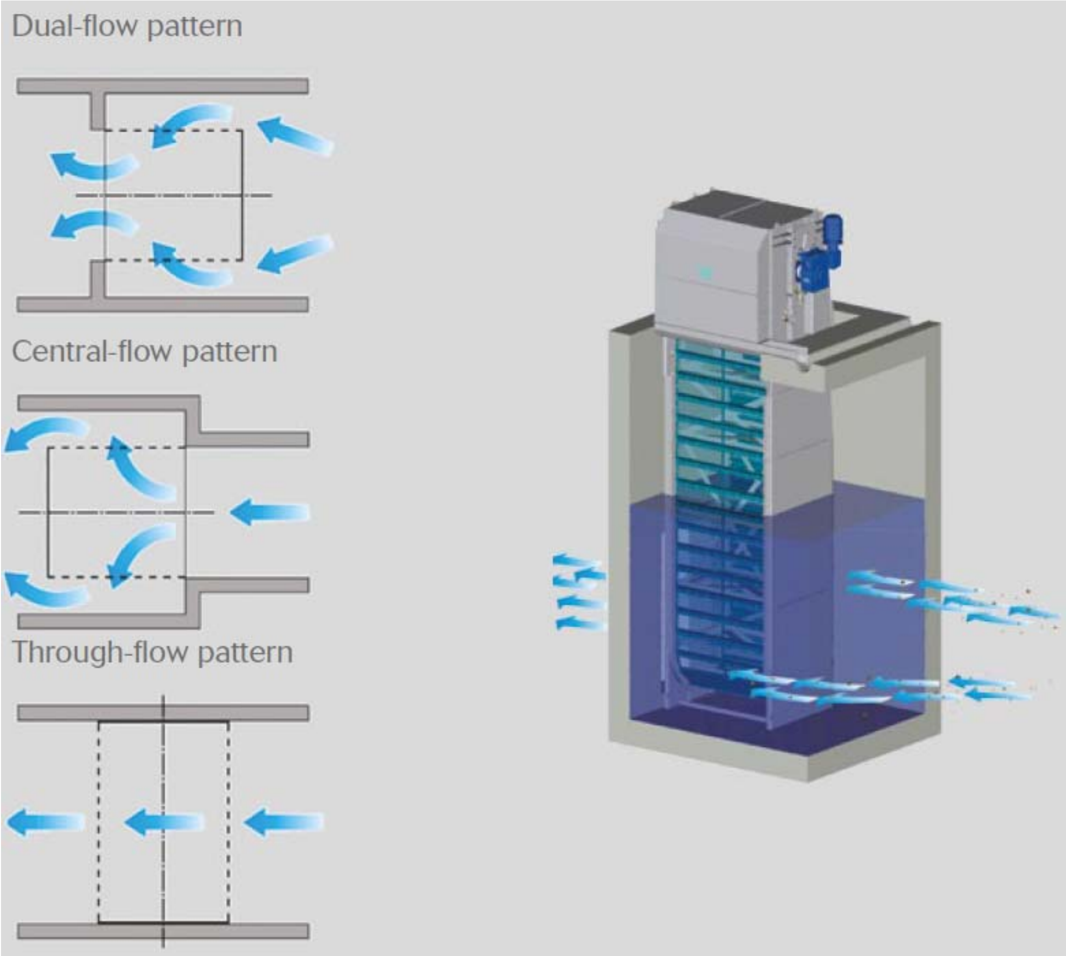

ILLUSTRATION OF AVAILABLE FLOW PATTERNS AND BAND SCREEN APPEARANCE (OVIVO)

FIGURE 4.6

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2.1.2.2 Vortex Grit Separator

2.1.2.2.1 Mechanically Induced Vortex

A vortex grit chamber induces a cyclonic flow pattern in a vertical cylindrical tank. This accelerates the downward settling velocity of the dense grit particles while the lighter organics are forced out of the top of the cyclone. The mechanically induced vortex chambers use an impeller (typically motor driven) to form a cyclone and can be designed to remove around 90 percent of the grit with an effective size of 0.21 to 0.3 mm diameter and around 65 percent of grit with an effective size of 0.15 mm diameter. Figure 4.7 illustrates the typical layout for a mechanically inducted vortex grit unit.

2.1.2.2.2 Hydraulically Induced Vortex

Hydraulically induced vortex chambers use inlet velocity to form a cyclone within the equipment. The Eutek HeadCell® (Figure 4.8) is a multi-tray hydraulically induced vortex grit separation unit. The trays in this design are roughly shaped like funnels, and because they are stacked, surface area is high and effective settling distance is low. HeadCells® offer the lowest footprint option for grit removal to date with many well-performing full scale installations. One key factor to consider when installing a HeadCell® is the grit sump pumping equipment must be appropriate to keep the sump clear. If the grit sump becomes packed with grit, the unit must be taken out of service to clear out the unit. One Eutek HeadCell® unit is installed at the NRWRF headworks, and a second unit is planned.

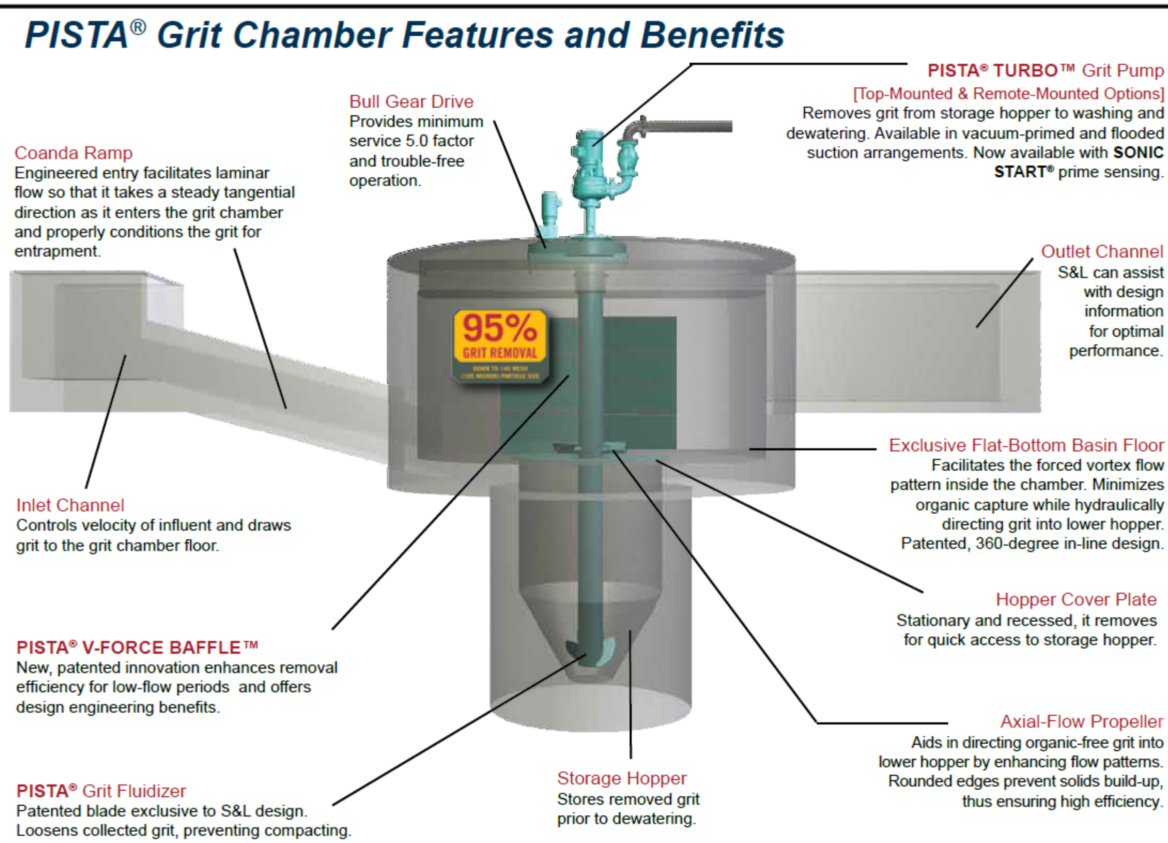
2.1.2.3 Grit Removal Technology Performance and Design Criteria

Relative performance of the grit removal technologies is summarized in Table 4.2.

Table 4.2 Grit Removal Design Values
Water Reclamation Facilities – Master Plan Development
Manatee County

Grit Removal Technology	Effective Particle Size Removal(1)	Head loss(2)	Grit Pumping Required
Horizontal Flow Chambers	95% >0.15 - 0.21 mm	12 - 18 in	Yes
Mechanically Induced Vortex	90% >21 - 0.3 mm 65% of 0.15 mm	< 1 in	Yes
Hydraulically Induced Vortex			
• Grit King	95% > 0.2 mm	6 in	Optional
• Head Cell	95% > 0.075 mm	12 in	Yes

Notes:
(1) Based on data provided from the manufacturer's typical advertised removal. Specific designs can be developed for each system for the particular plant design.
(2) Based on typical manufacturer's values.



PISTA® 360 VORTEX GRIT CHAMBER (SMITH AND LOVELESS, INC.)

FIGURE 4.7

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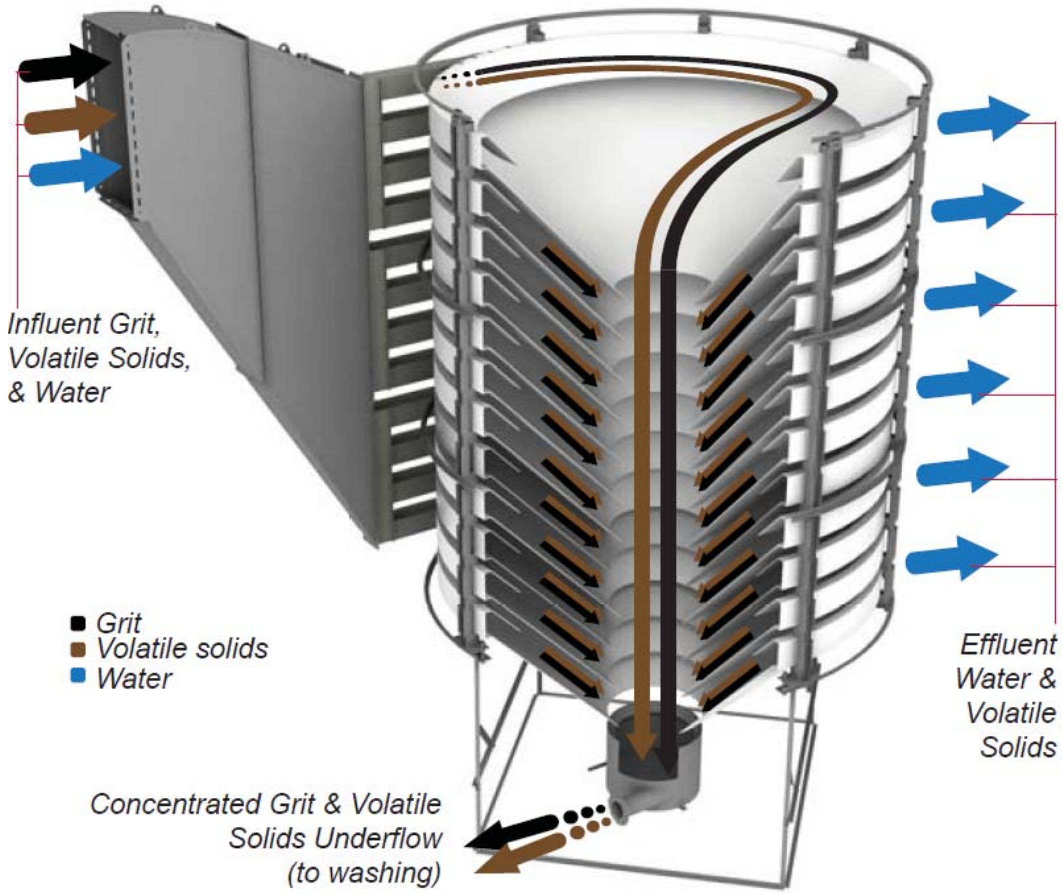

ILLUSTRATION OF THE FLOW PATTERN WITHIN A EUTEK HEADCELL® (HYDRO INTERNATIONAL)

FIGURE 4.8

2.1.3 Odor Control

Odor control in wastewater treatment is typically used reduce public complaint of the objectionable smells that are inherent to raw wastewater and wastewater treatment. The most prevalent odor compounds in wastewater include sulfides and nitrogen compounds like ammonia. Two general types of odor control technologies are discussed in this TM: wet chemical and biological. This section presents information regarding those systems.

2.1.3.1 Wet Chemical Scrubbing

Wet chemical scrubbing is a flexible and reliable technology for odor control. In addition to hydrogen sulfide (H_2S) and "organic" odors, wet scrubbing is very effective for ammonia removal. The systems typically contain multi-stage scrubbers (tanks with media) to provide contact between the odorous air and the scrubbing solution. Using multi-stage scrubbers allows the utilization of a different chemical solution in each stage to target either ammonia or sulfide compounds. Chemicals typically used in wet chemical scrubbing include sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl). NaOH is typically used to reduce the H_2S when it is present in high concentrations in the gas phase. NaOCl is typically used in the second stage for oxidizing H2S as well as other odorous compounds (like ammonia, sulfur dioxide, mercaptans, etc.).

The chemical balance in the system is continuously maintained by monitoring the scrubbing solution and adding chemical from bulk storage tanks. A major challenge in the design and operation of these systems is to minimize chemical use and cost. A multi-stage scrubbing system can optimize the effectiveness of the chemicals and minimize consumption rate for the chemicals in the odor control process.

2.1.3.2 Biological Filters (Biofilters)

This technology can be used to treat a variety of biodegradable, water-soluble contaminants. These systems generally include a tank with media (for attached growth) and a water recirculation system to keep the media moist, and can have multi-stage units for absorption, adsorption, and biological treatment of organic and inorganic odors. Biofilters are very effective at removing sulfur-based odor compounds such as H_2S, organic sulfides, and mercaptans. However, they are not as effective as the chemical scrubbers on ammonia based compounds. In contrast to the wet chemical systems, biological filtration systems have a lower operating cost and are simpler to operate. However, they require a larger footprint.

2.1.4 Flow Equalization

Flow equalization is the damping of influent wastewater in order to attenuate high flow events and provide for a more constant flow and load to the downstream processes. Typically, the wastewater is screened and degritted prior to entering the equalization process to keep materials from settling in the equalization tanks. The equalization process can be designed in two flow schemes:

- In-line equalization, which is designed to receive all of the influent wastewater with a volume to dampen and provide a constant downstream flow rate.

- Off-line equalization, which is designed to receive and attenuate a predetermined flow rate that is diverted from the main influent flow. The flow from this process is then returned into the main facility flow rate during lower flow periods.

The flow equalization basin designs for the SWWRF and SEWRF are based on the off-line flow equalization schemes (the NRWRF does not currently have flow equalization). This method typically reduces the equalization volume required and the size of the pumping system. Proper operation of the equalization system requires proper mixing to blend the contents and prevent settling of solids within the basin.

Depending on basin geometry, typical mixing for equalization basins includes:

- Coarse bubble diffusers, which provide air into the process to help maintain stability of the wastewater.

- Jet aeration, which also can be used to introduce air into the wastewater.

- Submersible mixers, which are mounted on a rail system and lowered into the tank. Typically these units only provide mixing of the tank contents.

Another mixing technology that is emerging in the Florida market is the use of compressed air pushed through nozzles fixed to the floor of the tank. Air is pushed through the nozzles intermittently and produces a large bubble. This large bubble has negligible oxygen transfer to the water allowing this mixing system to operate in oxygen sensitive environments (i.e. anaerobic and anoxic zones). This type of mixing technology has been developed by EnviroMix as an energy efficient means of mixing for multiple tank geometries called BioMix™. This system keeps the solids suspended within the water. Figure 4.9 shows a typical arrangement with this type of system.

To be a good neighbor, odor control is recommended for most flow equalization facilities. Typical odor control includes a cover with a compressor that evacuates the volume of air under the cover into a treatment unit. This odorous air is passed within a treatment system such as the units discussed for the preliminary treatment units.

Another, more passive odor control method is to add a portion of the return activated sludge (RAS) into the equalization tank, which will mix with raw wastewater. This combining of the flow streams and mixing within the tank produces mixed liquor similar to the biological process. This action will help stabilize the raw wastewater and assist in reducing odors developed during anaerobic conditions. The combined use of RAS and a mixing device should be evaluated together.

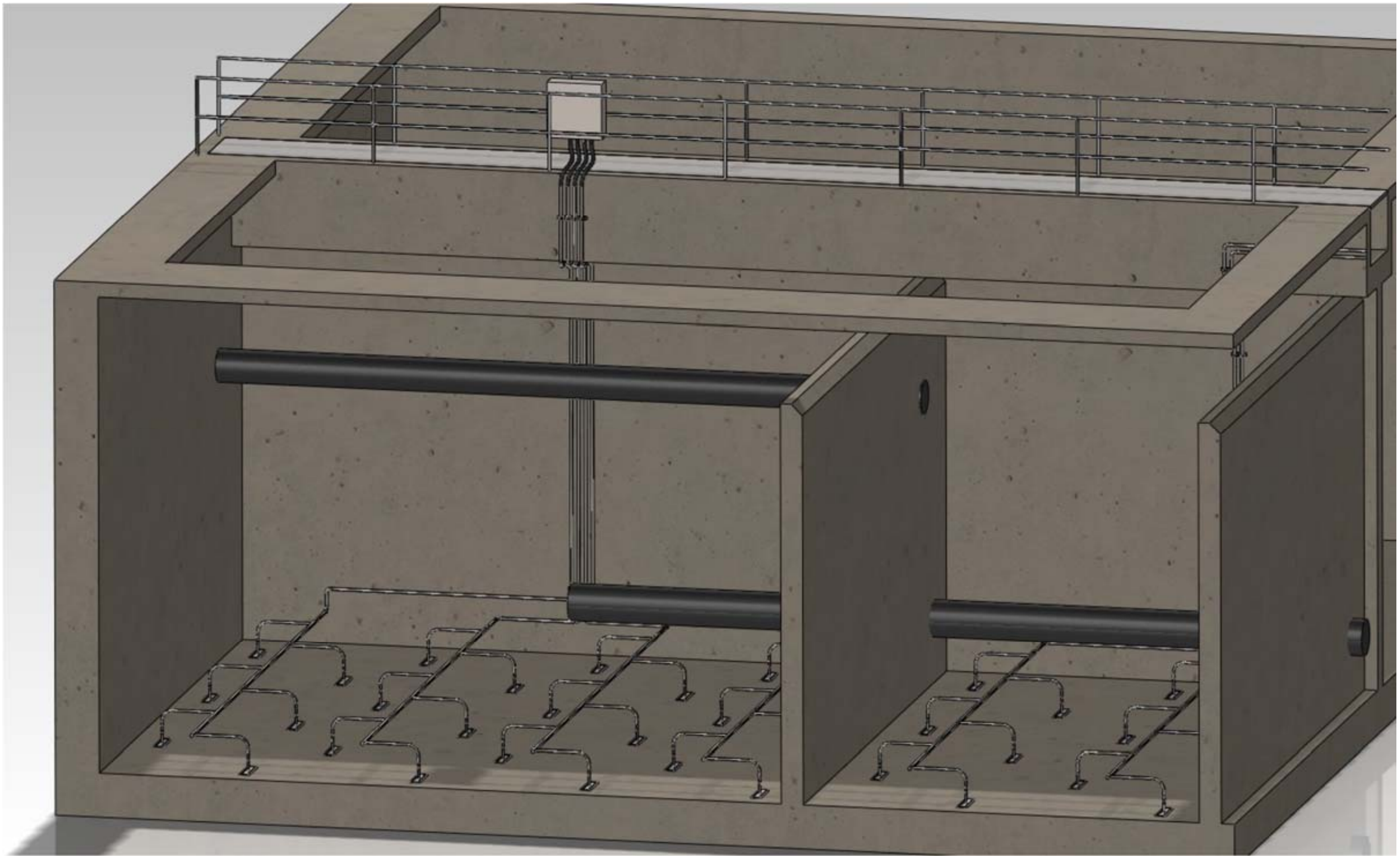

ILLUSTRATION OF A BIOMIX^{TM} TANK (ENVIROMIX)

FIGURE 4.9

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Use of air for mixing with the RAS, such as diffusers and jet aeration, may reduce the carbon in the flow to the biological system. This reduction of carbon could be a detriment to the nutrient removal capacity of the biological system. If the use of RAS is considered for odor control, it is recommended to use mixing technologies that do not introduce oxygen into the water such as submersible mixers or the BioMix™ system.

2.2 Secondary Treatment

2.2.1 Conventional Concepts

2.2.1.1 Aeration Capacity

Modification of the current aeration systems to increase the oxygen transfer rate is one method of increasing treatment capacity. This type of upgrade will increase BOD oxidation and nitrification performance. However, hydraulic capacity to handle the physical volume of increased flows throughout a treatment facility would have to be considered separately.

The layout of the existing aeration system determines the availability of the system upgrade options. For facilities such as the SEWRF and NRWRF that use surface aeration, two methods are available to achieve a greater oxygen transfer rate: upgrading the existing surface aerators to a more efficient design or adding supplemental blowers and diffusers.

Replacing the impellers with newer, more efficient units is possible to perform without affecting facility operations and tank shut down. No major structural modifications for this option are likely to be necessary. If more horsepower is required to achieve the desired aeration capacity with surface aerators, replacing existing motors with new inverter duty motors and adding variable frequency drives (VFDs) to the aerators will allow automated control of aeration to optimize process performance while reducing energy costs.

The second option to increase treatment capacity is to retain the existing mechanical surface aerators and supplement the existing aeration system using diffusers and blowers. The diffusers and blowers will be designed to satisfy only the fraction of the air demand not provided by the aerators.

Both coarse bubble and fine bubble aeration could be considered for supplemental air options. Although fine bubble aeration is more efficient and less expensive to operate than coarse bubble aeration, fine bubble aeration may not be feasible in all conditions. Screening and grit removal will need to be considered prior to the diffuser selection. Typically, fine screening and separation of grit is needed to help maintain fine diffuser operation, especially if it is only needed intermittently. This additional level of preliminary treatment helps to reduce operation and maintenance issues with fine bubble diffusers.

For facilities that currently only use diffused air like the SWWRF, modifications to the diffuser system are typically the only option to increase capacity in combination with blower modifications. Some options that may be available are to evaluate denser diffusers grids or diffusers that can mount lower to the tank floor.

Blower selection should to be considered for a diffuser system upgrade. Four blower types are primarily used for aeration: (1) positive displacement (PD) blowers, (2) multi-stage centrifugal (MSC) blowers, (3) High-speed turbo (HST) blowers, and (4) single-stage centrifugal (SSC) blowers.

The PD blower is the oldest and most popular type in the industry. Equipment noise is a major concern, but adding a sound enclosure and/or constructing a blower building with acoustics can overcome this drawback. Major upgrades from the older designs allow for better sound attenuation and inclusion of VFDs provide for operational turndown.

The MSC blowers have also been used for several decades. Though turndown capacity is limited, MSC blowers can meet low aeration demands during certain times of the day or year. Typically MSC blower operating curves have a relatively flat slope such that a large change (reduction) in the required air from the design point (during periods of low air demand) can result in the blower operating near the "surge-point." Adding VFDs is not beneficial in most cases to achieve operational turndown of this type of blower. A common design technique employed by engineers to meet a wide range of air demands is to provide a combination of blower sizes, typically a smaller and large size.

The HST blower is the newest blower technology in the industry. These blowers tend to have higher performance efficiency and are noted to have good turndown capabilities when combined with VFDs. However, these blowers have had some recent issues at several installations in the Central Florida region and elsewhere in the US. The issues are related to the turndown capability (causing burnout of VFDs) and with failures related to electrical power to the units due to the poor quality of the power supply in several locations. With the recent concerns with this equipment, it is recommended to do a thorough evaluation if these types of blowers are included in future upgrades.

The SSC blowers, like the PD blowers, have long standing use in the industry and offer the best turndown capability. However, the controls on this machine can become complicated, and the units are typically the most expensive of the different blower types.

Blower controls have been implemented to automatically provide only the needed oxygen demand with the incoming wastewater flows. This method can reduce energy consumption of the blowers as well as help with minimizing oxygen transfer in the anoxic or aerobic zones. Several methods are available to assist with automating this process.

One method of control is the use of dissolved oxygen (DO) controls within the aeration basins. This method is typically better suited to control systems of complete nitrification. The use of a DO meter coupled with motorized valves on the blower headers or variable frequency drives on surface aerators can more precisely control oxygen demand of the influent wastewater. This method has provided to be cost effective for reducing overall energy consumption of electricity during the change in oxygen demand over the diurnal wastewater flow cycles.

Systems requiring additional denitrification or other nutrient removal in the absence of oxygen can use both oxidation reduction potential (ORP) or nutrient chemical analyzers. Both options provide analysis of the nitrogen species within the biological system. These methods can more accurately define the oxygen delivery in the low DO regions where DO control is not as effective. Typically, ORP control is shown to be effective and less expensive over the nutrient analyzer systems.

Controls for blower systems can be more substantial and accurate process by including thermal mass flow meters to determine air flow rates. These meters can be installed on both the blower discharge and the diffuser header drops. More advanced control systems can use Venturi technology with motorized valves to provide a more precise control without the head loss or length of piping needed for accurate measurement of more current control systems.

Individual evaluation of a biological system with the different control systems to determine the cost benefit that best fits the end product.

2.2.1.2 Denitrification Capacity

If future conditions require the County to reduce effluent nitrogen concentrations to 3 mg/L or less, the existing water reclamation facilities (WRFs) will require treatment modifications. The existing Modified Ludzack-Ettinger (MLE) configuration used at the three WRFs is able to achieve effluent total nitrogen (TN) concentrations as low as 8 mg/L. Two conventional options for upgrading an MLE process to achieve effluent total nitrogen of 3 mg/L include addition of denitrification filters or second anoxic tanks.

2.2.1.2.1 Denitrification Filters

Denitrification filters are currently available in two configurations: deep-bed downflow filters or upflow filters. Denitrification filters, or biologically active filters (BAFs), are multimedia filters that operate at a low enough flow rate to allow bacteria to form a biofilm on the filter media. The bacteria in the biofilm convert the nitrate (NO_3) from the wastewater to nitrogen gas (N_2), which is released to the atmosphere. In denitrification filters, methanol (or another carbon source) is required in the filter influent stream to provide a carbon source for the denitrification process since little carbon remains in the wastewater stream after secondary treatment. Denitrifying filters are typically placed after the secondary treatment and provide both effluent tertiary filtration and nitrogen removal.

Addition of denitrification filters to the SEWRF was evaluated by Carollo in the TM *Southeast Water Reclamation Facility Denitrification Filters Evaluation* (September, 2015). There were several factors inherent to the design that affected implementation of the technology at the facility, including:

- Hydraulics: The hydraulic profile at the existing facilities does not have the elevation required for installation of denitrification filters after the secondary clarifiers. An intermediate pump station sized for the entire facility flow would be required between the secondary clarifiers and the denitrification filters to accommodate the filter depths. This would create a single point of failure in the overall facility flow.

- Additional Carbon Source: Carbon (typically in the form of methanol) is required for operation of denitrification filters. Little carbon remains after secondary treatment, but is required for the biology on the filter media to carry out the denitrification reaction. The chemical feed and storage is an added capital and operating expense. In addition, use of methanol introduces an explosion hazard so additional safety equipment, detection, and operator training is required.

- Location: Limited space for new construction of large denitrification filters with an intermediate pump station is available.

A similar analysis would be applicable to both SWWRF and NRWRF. Implementation at SWWRF would be significantly challenging since the existing site is severely limited for both above ground and underground space and located adjacent to a golf course. This would affect the sizing and location of a new intermediate pump station, filters, and methanol storage facility.

2.2.1.2.2 Second Anoxic Tanks

An alternative method of reducing effluent total nitrogen concentrations is addition of second anoxic tanks after the aeration zones at each WRF. Heterotrophic bacteria in the second anoxic tanks convert the remaining nitrate to nitrogen gas. Carbon remaining in the wastewater is used to carry out the denitrification. However, as with denitrification filters, if the remaining carbon is not sufficient in the second anoxic tanks, or if very low effluent nitrogen levels are required, a supplemental carbon may be added, though it is not always required for successful operation.

Addition of second anoxic tanks offers several advantages over denitrification filters, including:

- Hydraulics: The hydraulic profile at the existing facilities would not be significantly impacted by addition of second anoxic tanks between the aeration tanks and the secondary clarifiers.

- Carbon Source: Carbon is not required for operation of second anoxic tanks, though it may help to improve performance when needed.

- Location: Space is available onsite between the aeration tanks and secondary clarifiers for addition of second anoxic tanks at both SEWRF and NRWRF, but not at SWWRF.

2.2.1.2.3 Sidestream Treatment

Advancement of the understanding of the biology of the nitrogen cycle lead to advancements to treat a facility's high nutrient sidestream flows. These new technologies offer the opportunity to evaluate other innovative treatment options that may prove to be economically viable and to optimize facility performance. This treatment does not provide for full treatment of the liquid train but available to help reduce nutrient loads that are typically returned from sludge dewatering or leachate system.

Several new technologies have been developed which offer sidestream treatment of high nutrient loads. These new technologies allow for removal of nitrogen with limited oxygen and carbon by modifying the method of the nitrification - denitrification cycle.

Although, not originally analyzed for the different County facilities, this option may present a future evaluation as part of the biological evaluation for the SEWRF.

2.2.1.2.4 Denitrification Summary

Between the option of adding a denitrifying BAF or a second anoxic tank to the existing Manatee County WRFs, the second anoxic tank would be the simplest option. Second anoxic tanks would also likely save significant supplemental carbon costs and electrical costs from the additional pump station needed with the BAF. However at this time, there is not a regulatory driver for the County to consider moving toward lower effluent nitrogen concentrations.

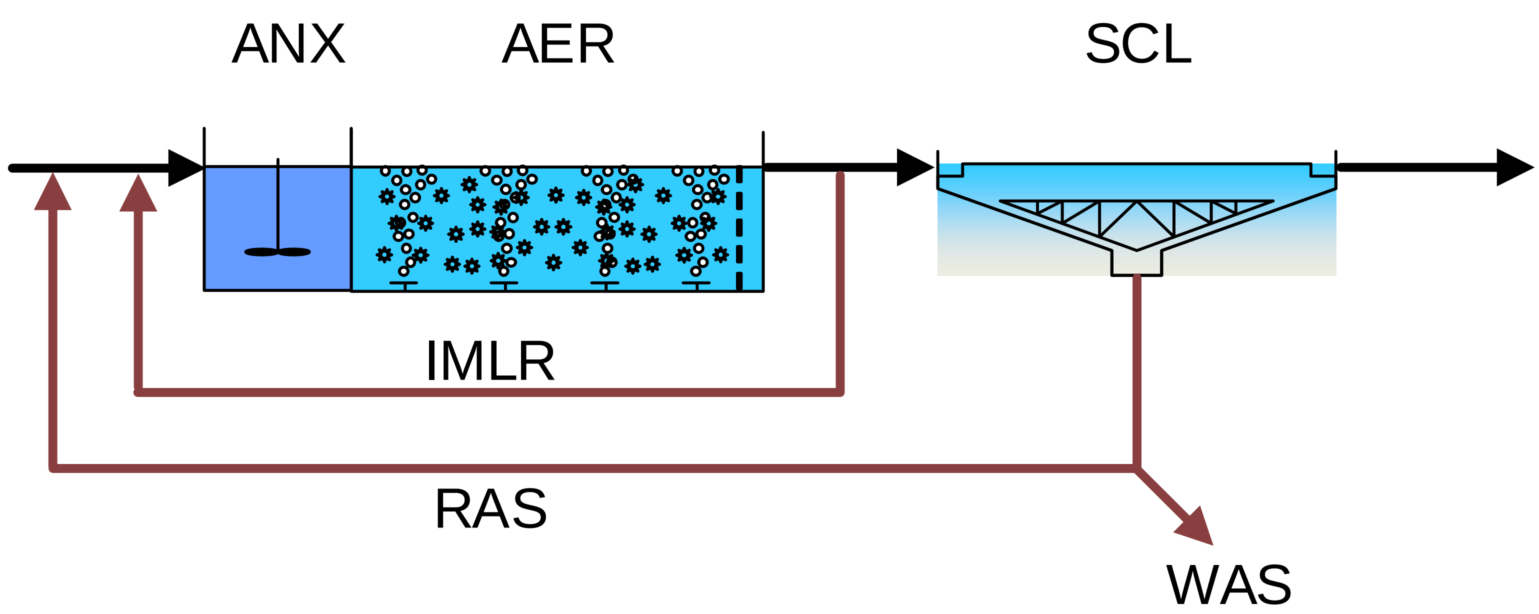
As mentioned in TM 2 for the SEWRF, the potential for review of sidestream treatment to assist with nutrient loads to the facility liquid stream will be included in a future evaluation scheduled in.

2.2.2 Innovative Concepts

There are a number of innovative processes on the market a utility may choose to use to retrofit their existing treatment processes to increase treatment capacity without additional tank volume. Three of these options discussed below have been implemented successfully at full-scale installations.

2.2.2.1 IFAS

The integrated fixed-film activated sludge (IFAS) process combines a moving bed bioreactor (MBBR) fixed film process with the activated sludge process (Figure 4.10). To achieve this, a portion of an existing activated sludge aeration tank is filled with plastic media and retention screens.



SCHEMATIC OF AN IFAS MLE PROCESS

FIGURE 4.10

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The advantage of an IFAS retrofit is that a relatively high culture of biomass may be maintained in the aeration basin to allow for a considerable increase in loading capacity. Since the increase is due to the fixed-film culture, there is not a significant increase in solids loading to the downstream clarifiers.

The IFAS process does have some inherent disadvantages.

- Aeration and mixing requirements are high due to the increase in oxygen uptake rate (OUR) induced by the increased biomass population and the need to circulate the media within the tank. A retrofitted facility using IFAS will see an increase in power consumption.
- Filling an aeration tank with the plastic media severely limits access to the air diffusers at the bottom. Removal of some or all of the media may be required for significant repairs or maintenance.
- Head loss across the tank is increased.

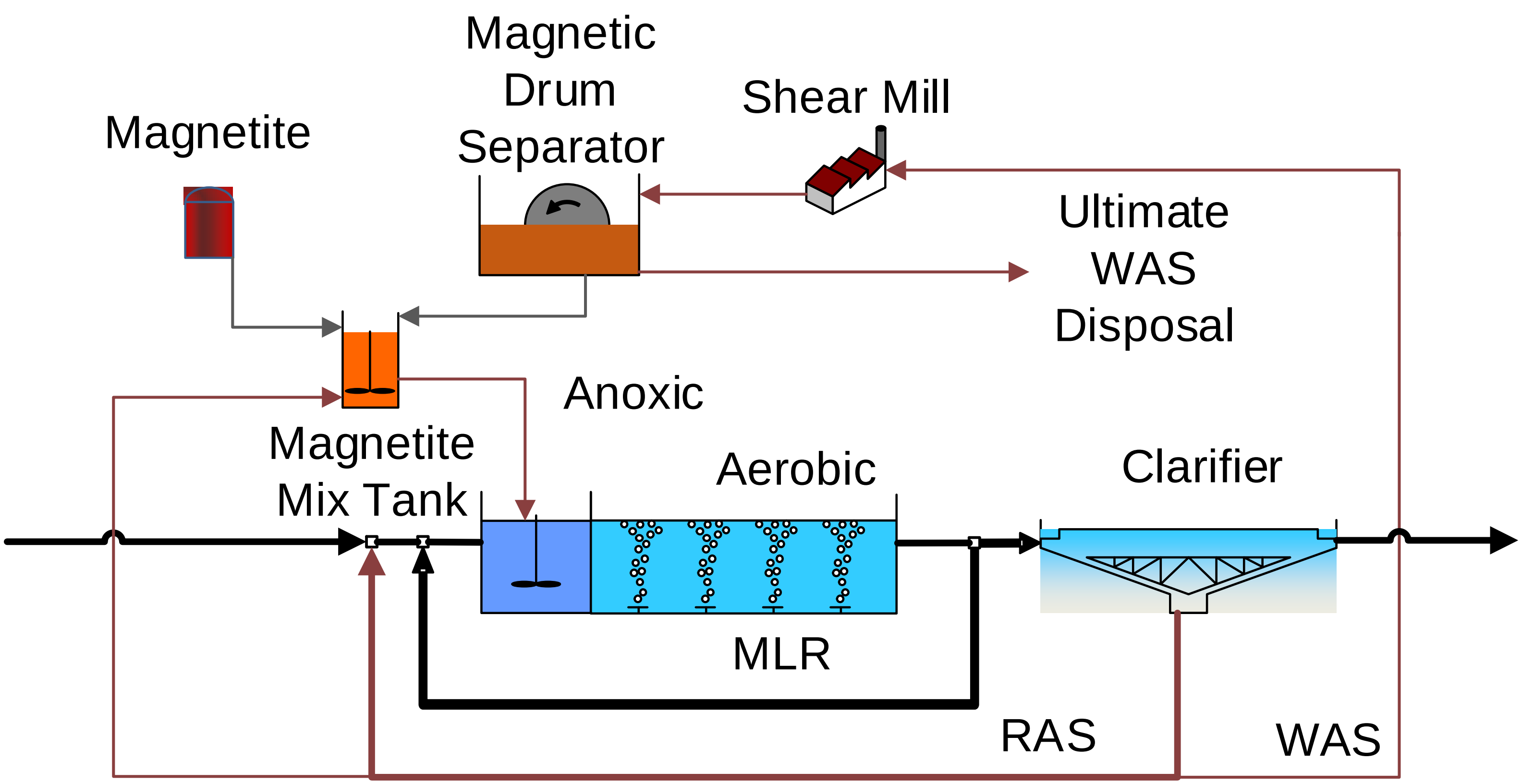
Even though increased energy demand, decreased tank access, and head loss are important considerations, many utilities have opted to use the IFAS process in the United States. There are a large number of proprietary equipment vendors for this process, so the exact number of installations is difficult to quantify, but is on the order of 75 to 100 and possibly more. There are two IFAS installations in the state of Florida at Cocoa Beach, FL and Green Cove Springs, FL.

IFAS technology is typically implemented at facilities with limited space for expansion or treatment upgrades within existing tank volume. The Manatee County WRFs have sufficient land space available for capacity expansion when needed, and do not have any regulatory drivers for upgrading their treatment processes at this time.

2.2.2.2 BioMag®

The BioMag® process (Figure 4.11) represents the most advanced ballasted activated sludge process to date. Ballasted activated sludge processes, like IFAS, increase the biomass inventory of a plant to increase overall treatment capacity. Unlike IFAS, ballasted systems achieve the biomass increase purely by raising the solids retention time (SRT). Ordinarily, an excessive SRT can promote bulking and overload the secondary clarifiers. However, bulking is neutralized by using a ballasting agent to weigh down activated sludge and improve settling performance. Traditionally, the ballasting agent was sand or clay.

The BioMag® process uses powdered magnetite which is a readily available waste product from the mining industry. Magnetite is superior to sand in a couple of ways. The first is that its specific gravity is around 5.17, which is nearly double that of sand. The higher density of magnetite relative to sand means that it can exert a stronger down-force on flocs.



SCHEMATIC OF A BIOMAG® MLE PROCESS

FIGURE 4.11

MANATEE COUNTY

WRF TREATMENT ALTERNATIVES ANALYSIS

Secondly, magnetite is a magnetic compound so it has extremely high recovery rates using relatively low maintenance hammer mill/magnetic drum separator equipment on the WAS line.

BioMag® is a simpler process to retrofit in a facility than IFAS because all that is required is magnetite addition and a small magnetite recovery facility.

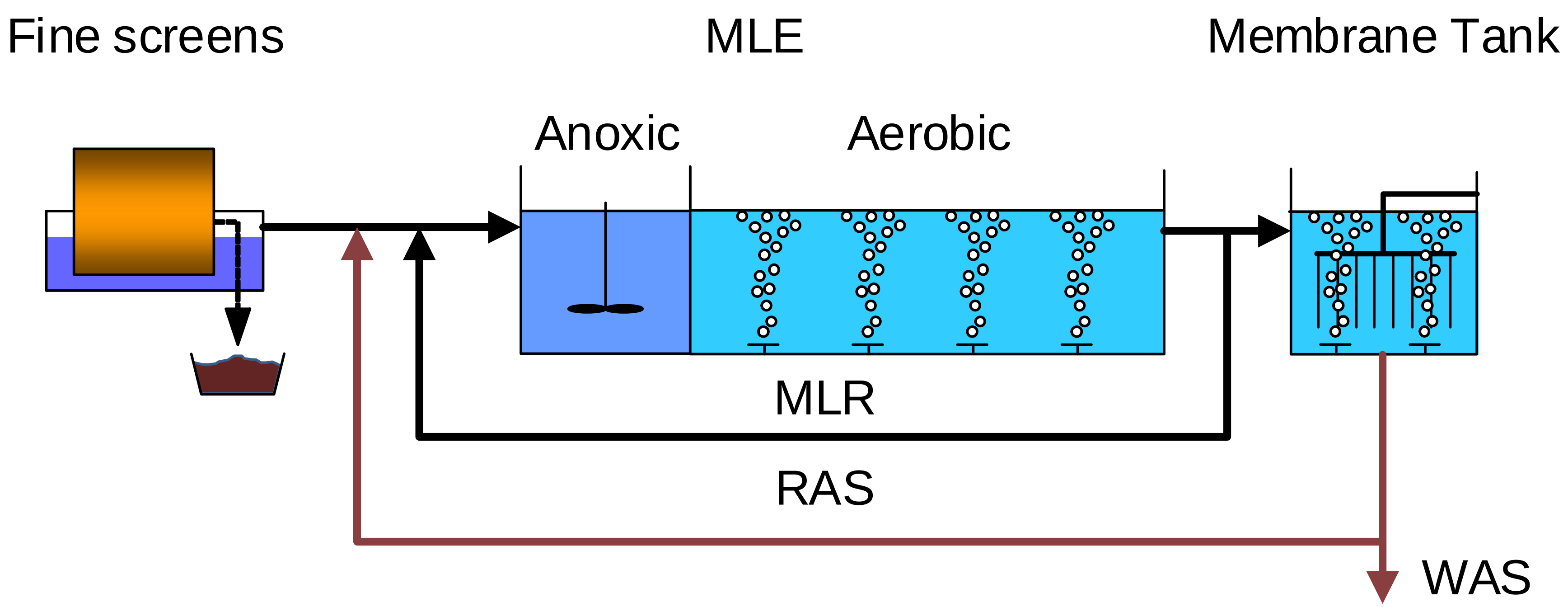
The disadvantage to using BioMag® is the inorganic solids content in the process trains are doubled because magnetite is typically added near to a 1:1 ratio with the mixed liquor suspended solids (MLSS). Aeration and mixing energy demands increase, but access to the diffusers in the bottom of a tank is maintained. There are fewer installations of BioMag® than IFAS since it is a newer process, but the number of BioMag® installations seems to be increasing exponentially in the United States. There are three operational full scale facilities, one in startup, six in construction, and many more in design. There are also six operational full scale CoMag® facilities which are mechanically identical to BioMag® and are used for tertiary phosphorus removal.

Similar to IFAS, BioMag® technology is typically implemented at facilities with limited space for expansion or treatment upgrades within existing tank volume. The Manatee County WRFs have sufficient land space available for capacity expansion when needed, and do not have any regulatory drivers for upgrading their treatment processes at this time.

2.2.2.3 Membrane Bioreactor

Membrane bioreactors (MBR) allow elevated SRTs because using a membrane rather than a clarifier for liquid/solid separation eliminates the critical need for settling performance (although thickening/dewatering may be impacted in solids handling). MBRs use low pressure membranes typically on the finer side of the microfiltration (MF) range (0.04 to 0.20 μm), or in the coarser side of the ultrafiltration (UF) range (0.001 to 0.020 μm). See Figure 4.12 for a process schematic.

MBRs create a consistent, high quality effluent, but their operation is different from a conventional activated sludge process with secondary clarification and tertiary filtration. Membranes operate much like filters and require periodic backwashing or surface air scouring to prevent fouling, which is typically based on a transmembrane pressure (TMP) setpoint. This need for backwashing can significantly increase process energy draw and makes the presence of redundant units more important. MBRs also require finer and more efficient headworks screening and grit removal to prevent damage to the membranes caused by grit particles and foreign objects. The membrane also periodically require chemically cleaning which requires chemical storage and feed systems, chemical cleaning tanks, chemical handling, and other appurtenances.



SCHEMATIC OF A MLE MBR PROCESS

FIGURE 4.12

MANATEE COUNTY
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MBR processes are considered when there are site constraints for multiple process units or if a utility needs to greatly expand an existing facility's treatment capacity within a fixed site. Also MBRs can become especially attractive when higher effluent quality is needed for discharge purposes or further potable effluent reuse is being considered for a facility. There are at least 16 full scale MBRs in Florida and 247 nationwide. Given the Manatee County WRFs have sufficient land space available for capacity expansion when needed and do not have any regulatory or internal drivers for higher quality effluent, MBR technology is not recommended to Manatee County for further consideration at this time.

2.3 Tertiary Treatment

2.3.1 Filtration

The purpose of this section is to provide basic information on the different types of filtration technologies currently available. Information is provided on the filtration mechanisms, their capabilities to remove total suspended solids (TSS), turbidity, and microbial species, and basic design criteria. The County WRF filters must reduce the secondary effluent TSS to less than 5 mg/L to meet the requirements for high level disinfection. The commercially available filtration technologies that are used for tertiary filtration of wastewater and can meet the TSS requirements fall under one of the three categories: depth filtration, surface filtration, and membrane filtration. A list of the types of filtration technologies that can be found within each of these three categories is presented in Table 4.3.

Manatee County currently uses both automatic backwash sand filters and cloth media filters at the three WRFs. Most new filter installations in the state of Florida are moving toward cloth media technologies because they are relatively inexpensive and meet regulatory needs. Some utilities are opting for deep-bed granular media filters as a more robust filtration technology.

Table 4.3 Description of Wastewater Filtration Categories
Water Reclamation Facilities – Master Plan Development
Manatee County

Depth Filtration	Surface Filtration	Membrane Filtration
Conventional Deep Bed	Cloth medium	Submerged (or immersed)
Continuous Backwash	Microscreen and metal cloth medium	Pressurized
Pulsed Bed	---	---
Automatic Backwash	---	---
Fuzzy Filter®	---	---

2.3.1.1 Depth Filtration

There are five different types of depth filtration technologies: conventional deep bed, continuous backwash, pulsed bed, automatic backwash, and the Fuzzy Filter®. A description of all of the depth technologies filtration except the pulsed bed filter will be presented below.

2.3.1.1.1 Deep Bed Filters

There are many types of deep bed filters commercially available. Deep bed filters can use mono, dual, or multi-media. Typically, the sand depth in deep bed filters ranges from 3 to 6 feet and they operate at 4 to 9 feet of head loss. In deep bed filters, secondary effluent enters the filter cell, flows through the sand bed and leaves via an underdrain system. For backwashing, the filtered effluent is pumped back through the underdrains and is distributed in the filter bed. Air scour is also typically applied to help clean the sand. Backwash water is collected in troughs and discharged to a holding tank, the facility drain system, or to a dedicated pump station that will send it back to the facility headworks or prior to the secondary treatment process. Three examples of commercially available deep bed filter systems are the TETRA DeepBed™ Filter, the Leopold Tertiary Filter System, and the Roberts Deep Bed Filtration System. See Figure 4.13.

Installation of deep bed filters at the Manatee WRFs would require significant space for both the filters and an intermediate pump station between the secondary clarifiers and the filters to accommodate the filter depth and hydraulics. Therefore, deep bed filters are not recommended to Manatee County for further consideration at this time.

2.3.1.1.2 Continuous Backwash Filters

There are many different manufacturers of continuous backwash filters. A schematic representation of one type of continuous backwash filter is presented in Figure 4.14. Water continuously flows through a recirculating bed of sand that is being continuously backwashed. In the case of the Parkson DynaSand® filter shown in Figure 4.14 the sand is constantly moving in a downward direction. Secondary effluent is introduced approximately two thirds of the way down the bed of sand where the sand is the dirtiest, and passes up through the sand. As the water flows through the sand, particles are captured by the sand. Most of the filtered water flows over the effluent weir after it leaves the bed of sand. A portion of the filtered water, ranging from 5 to 20 percent of the feed, flows through the sand washer. A continuous backwash occurs as air is introduced at the bottom of the airlift pipe. The introduction of air causes an air/water/sand mixture, that has a density less than water, to travel up the airlift and spill into the reject water compartment. The dirty sand falls down into the sand washer, and as it falls through the sand washer, it meets clean filtrate water flowing upwards. As the sand passes through the sand washer, the accumulated solids are removed from the sand particles.

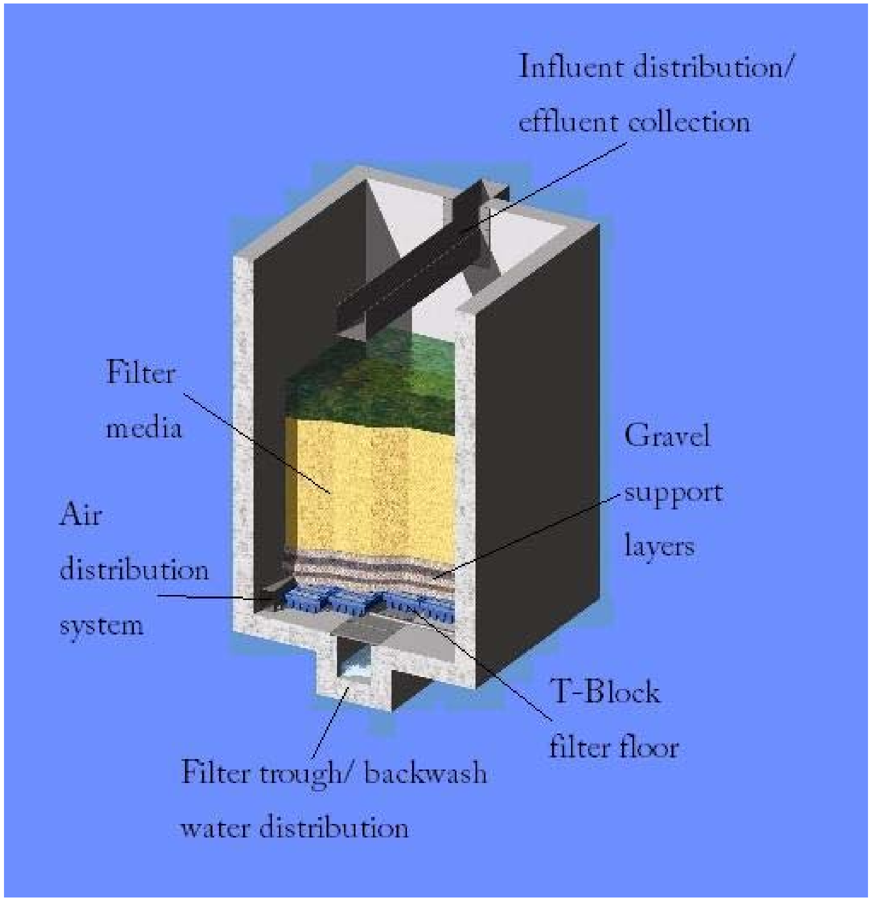

ILLUSTRATION OF A TETRA DEEPBED^{TM} FILTER (SEVERN TRENT SERVICES)

FIGURE 4.13

MANATEE COUNTY
WRF TREATMENT ALTERNATIVES ANALYSIS

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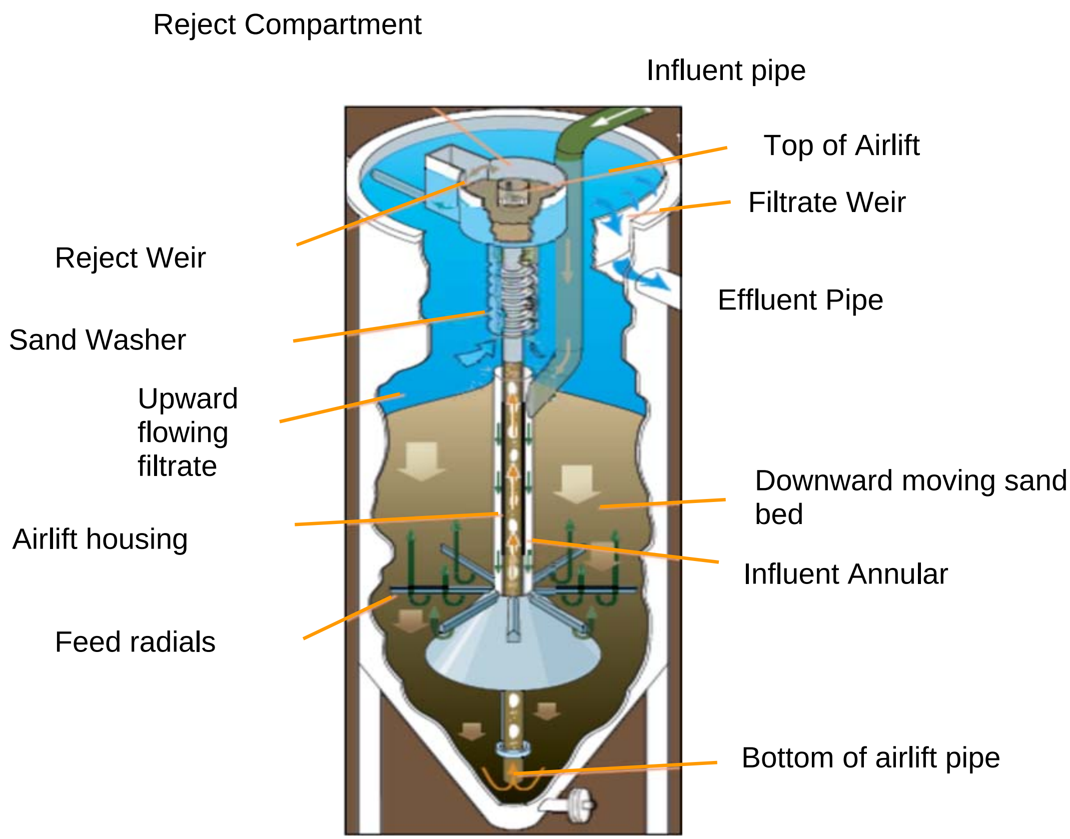

ILLUSTRATION OF A CONTINUOUS BACKWASH FILTER (PARKSON CORP.)

FIGURE 4.14

The solids then flow up and over the backwash weir into the reject line while the clean sand falls down onto the filter bed and begins its downward migration through the filter again.

Continuous backwash filters are an older filter technology and not recommended to Manatee County for further consideration at this time.

2.3.1.1.3 Automatic Backwash Filters

Automatic backwash (ABW) filters use a shallow sand bed that is ten to twelve inches in depth. The sand bed is divided into individual cells to allow backwashing of each cell while all other cells remain in operation. Secondary effluent enters the filter through an influent chamber and passes downward through the sand. The effluent is collected under the sand support and is discharged to an effluent channel. For backwashing, a traveling device (also known as a bridge, platform, carriage, or hood) attaches to the individual cell and backwashes with a wash pump using the filtered effluent. Backwash water is returned back to the head of the plant. ABW filters are considered low-head filters because they typically require only 3 to 4 feet of total head, so facilities that have ABW filters typically have lower hydraulic profiles particularly at the tail end of the facility process. This can limit options for retrofitting with a different filtering technology. ABW filters are currently used at all three County WRFs. An illustration of a typical travelling bridge ABW is in Figure 4.15.

2.3.1.1.4 Pulsed Bed Filtration

Pulsed bed filters (PBFs) are conventional down-flow media filters which typically use fine sand in a relatively shallow layer. To overcome the shortcomings of a traditional slow sand filter which tends to plug frequently with a surface dirt layer, PBFs introduce short air blasts to turn over the surface material. The air blast serves to both present fresh sand to the surface of the filter and store the majority of the surface solids from the previous pulse cycle in the depths of the filter. A properly tuned pulse air cycle will extend the cycle time between backwashes which are performed the same as in every other traditional media filter after reaching a predetermined head loss. Typical loadings for PBFs are 2 to 6 gpm/ft^2 with a backwash requirement of 4 8 percent of the influent flow

PBFs are an older filter technology and not recommended to Manatee County for further consideration at this time.

2.3.1.1.5 Fuzzy Filter®

The Fuzzy Filter® is different from most other filtration technologies in several ways. First, the medium for the Fuzzy Filter® is pink compressible balls made of synthetic fibers. Second, the water that is to be treated flows through the medium instead of around it. Third, this filter has been found to be able to treat water at hydraulic loading rates up to 30 gpm/ft^2. A schematic of flow through the Fuzzy Filter® during a typical operational cycle is presented in Figure 4.16.

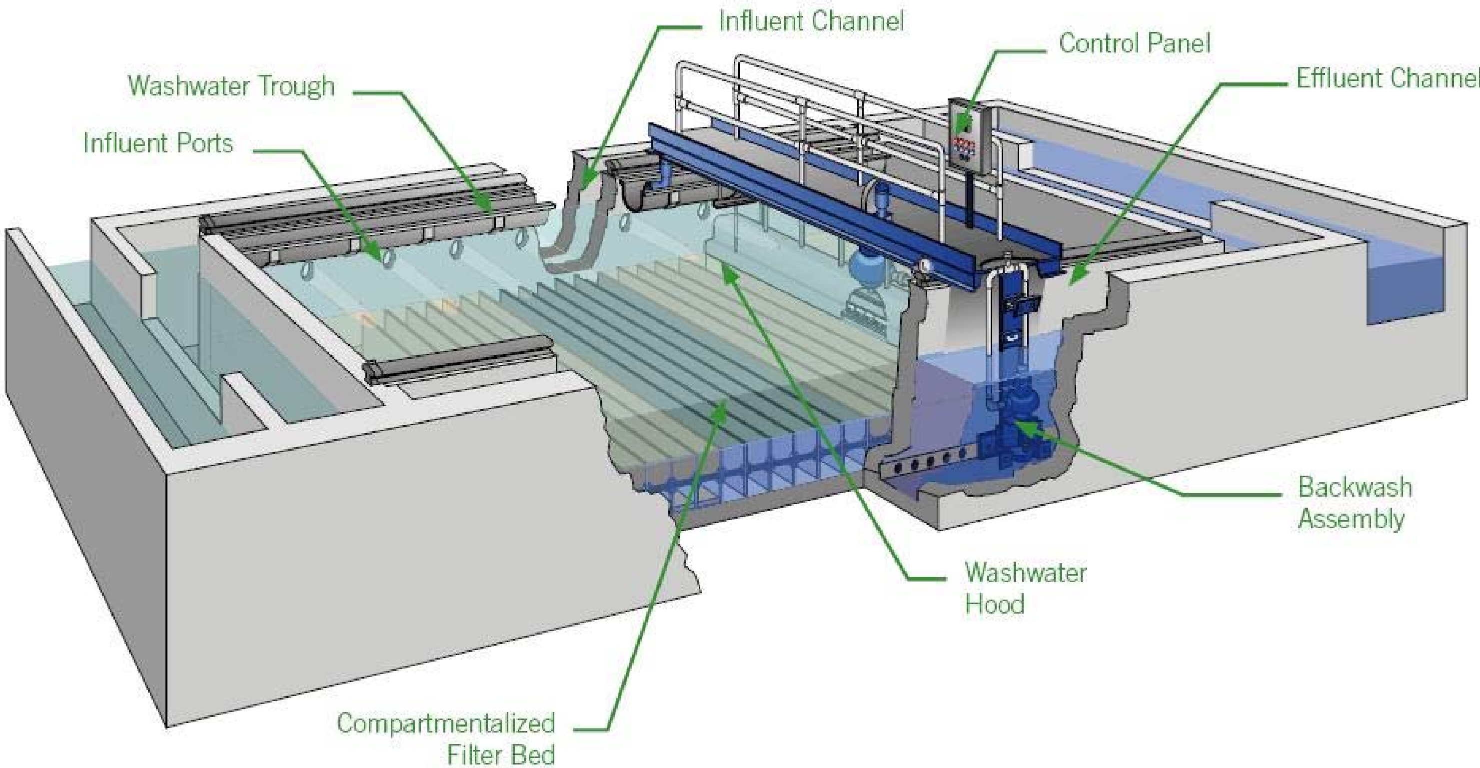

ILLUSTRATION OF AN AUTOMATIC BACKWASH FILTER (DEGRÉMONT TECHNOLOGIES - INFILCO)

FIGURE 4.15

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WRF TREATMENT ALTERNATIVES ANALYSIS

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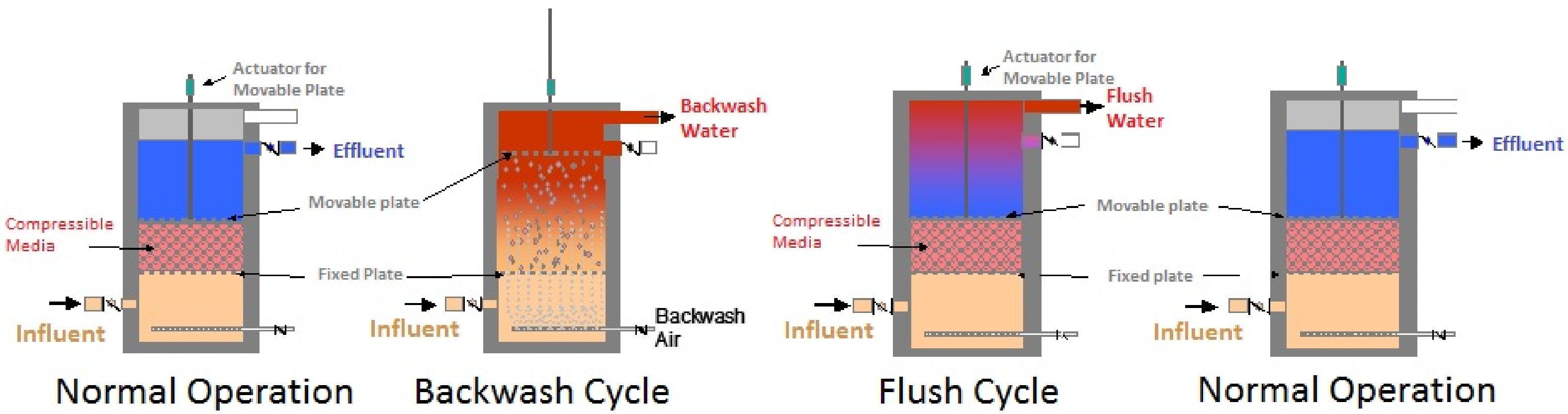

ILLUSTRATION OF THE FLOW PATH THROUGH A FUZZY FILTER®

FIGURE 4.16

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WRF TREATMENT ALTERNATIVES ANALYSIS

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During normal operation, water flows up through the Fuzzy Filter® medium that has been compressed by a movable plate to a desired compression ratio. As the secondary effluent flows through the medium, the solids are removed. The effluent then passes through the effluent line. After the head loss through the filter reaches a certain level, a backwash cycle is initiated. During the backwash cycle, the effluent valve is closed while the influent valve remains open.

The moveable plate decompresses the medium, an air scour is introduced, and the filter medium is cleaned with filter influent (secondary effluent) water. After the accumulated solids have been removed from the medium by the backwash process, the moveable plate compresses the medium to the desired compression ratio, and a flush cycle begins. The purpose of the flush cycle is to remove the backwash water from the effluent side of the filter. Once the backwash water has been flushed from the effluent side of the compartment, the effluent valve opens and the filter begins producing effluent. The backwash cycle typically runs one to two times per day. The maximum head loss through a dirty filter is 70 inches and 2 percent of the water is rejected. The medium has been in service for 17 years without replacement and has shown removals down to 5 micron.

Fuzzy Filters® are an emerging filtration technology. While they have a small footprint and appear to be a robust filtration technology, they are typically costly and not recommended to Manatee County for further consideration at this time.

2.3.1.2 Surface Filtration

There are two types of filtration groups in the surface filtration category. These include cloth medium (cloth fiber) and microscreen wire fabric or cloth disks. There are two major differences in these filters. First, the cloth fiber medium filters use a filter medium that is approximately 13 mm thick. The microscreen medium is a wire fabric approximately 150 μm thick. Second, the cloth fiber medium filters flow in an outside-in flow path, while for the microscreen wire fabric or cloth disk medium the flow follows an inside-out flow path. Head loss through these filters will vary depending on how they are configured. However, total head loss will typically not exceed 3 feet.

2.3.1.2.1 Cloth Media Filters

Cloth media filters (CMFs) come in a number of specific orientations. However, the two most common are the disk (Figure 4.17) and the lateral layout (Figure 4.18). Other types include a drum, an inclined conveyor, and a pressurized cartridge CMF. Cloth is a loosely used term to describe woven synthetic or stainless steel material which may be flat or pleated to increase surface area. Secondary effluent is either introduced outside of the filter plates with filtrate collected from within the filter plates, or vice versa. CMFs using a stainless steel weave are also called screen filters but work the same way.

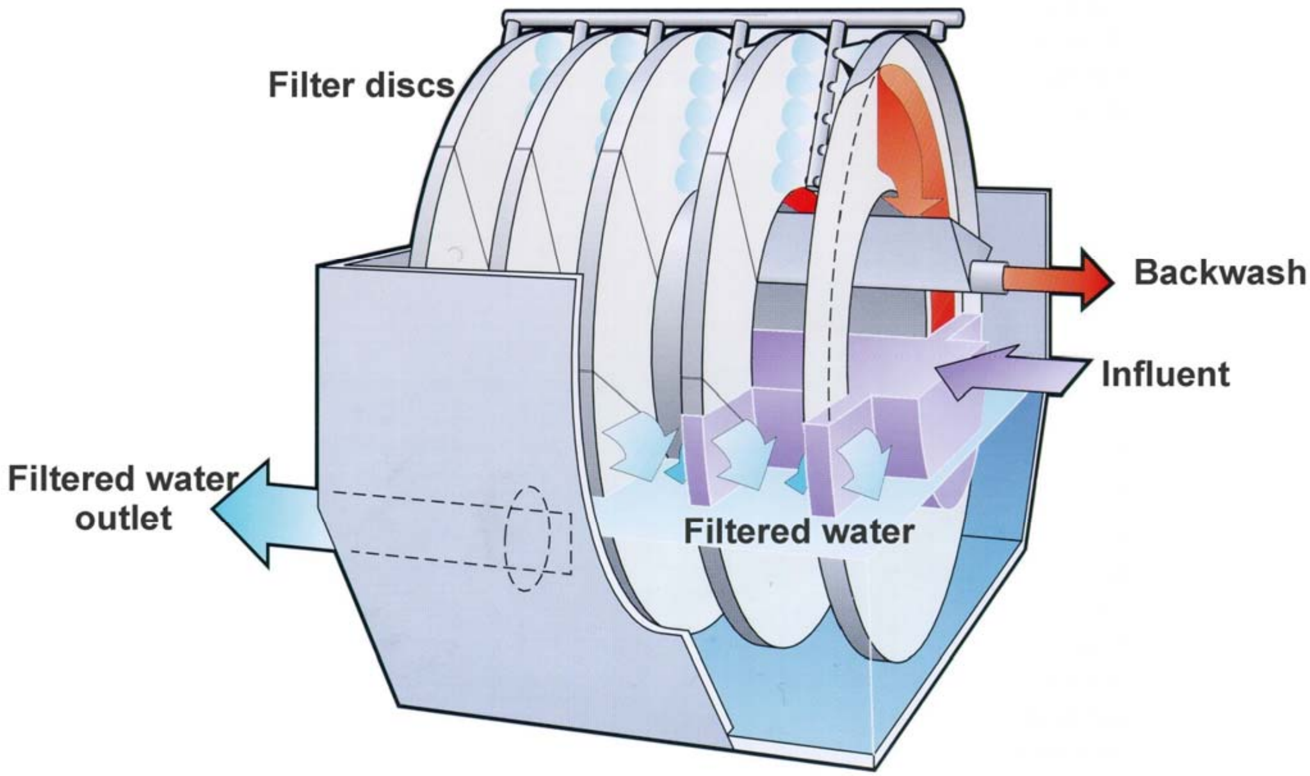

ILLUSTRATION OF A DISK CLOTH MEDIA FILTER (HYDROTECH)

FIGURE 4.17

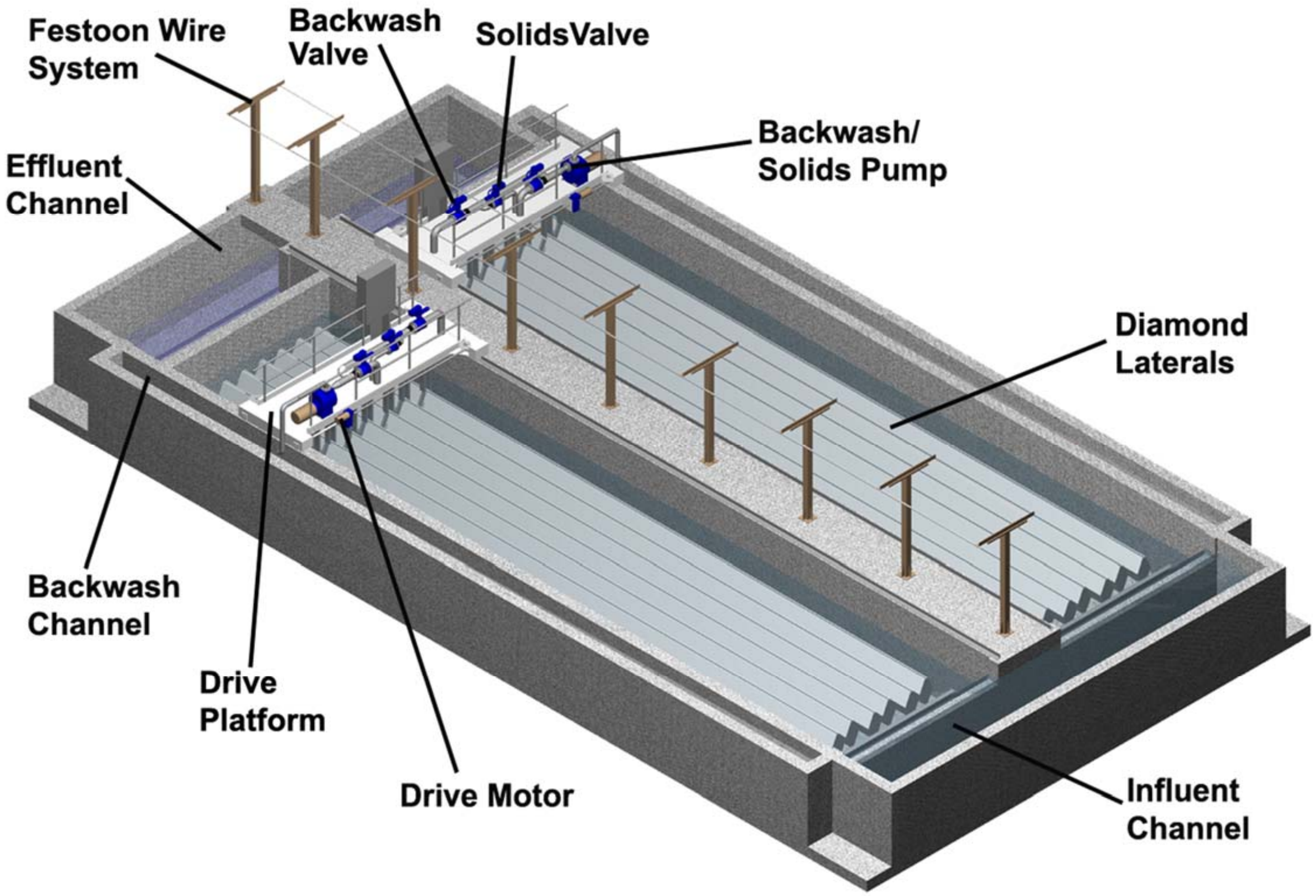

ILLUSTRATION OF A LATERAL CLOTH MEDIA FILTER (AQUA-AEROBIC SYSTEMS, INC.)

FIGURE 4.18

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Performance of the various CMF designs varies by pore size of individual units, which can be had anywhere from 5 to 40 µm. Hydraulic throughput also varies by design. California Department of Public Health throughput limits on various CMF units ranges from 6 to 16 gpm/ft^{2}. Most CMF designs including the disk layout typically require a custom design basin, but the lateral types can be retrofitted into an existing media filter tank with a long, narrow geometry.

Retrofitted media filtration basins with CMF technology can significantly increase filtration capacity of an existing basin. Backwash for a disk filter is typically performed via rotating the disk past high pressure water jets. Lateral-style CMFs use a traveling bridge mechanism carrying a "backwash shoe" to clean the filter element along its length.

The County currently utilizes lateral-style CMFs at the SWWRF and disk style CMFs at the NRWRF.

2.3.1.3 Membrane Filtration

Low-pressure membranes use microfiltration (MF) and ultrafiltration (UF) membrane materials to separate solids from the wastewater. The commercially available low-pressure membranes can be grouped into two categories: submerged and pressurized. The submerged membranes have cassettes or modules that are placed in a tank and water flows by gravity into the tank and a filtrate is pulled through the membrane by applying a small vacuum by means of a pump on the membrane (Figure 4.19). Pressurized membranes use a feed pump, which pushes the water across the membranes installed inside a pressure vessel (Figure 4.20). The water is typically applied parallel to the surface of the membrane. A small amount of reject is recycled back to the feed tank. Gravity flow through low-pressure membranes is possible if sufficient head is available. Cleaning of the membrane is accomplished by applying an air scour or reversing flow to the membranes. The membranes also require periodic chemical cleaning (acid and sodium hypochlorite) which requires additional chemical storage and feed system, chemical cleaning tanks, chemical handling, and other appurtenances.

Similar to an MBR, tertiary membrane filtration is most useful when high quality effluent is required. Given there are no regulatory or internal drivers for Manatee County to achieve a higher effluent quality, this technology is not recommended for further consideration at this time.

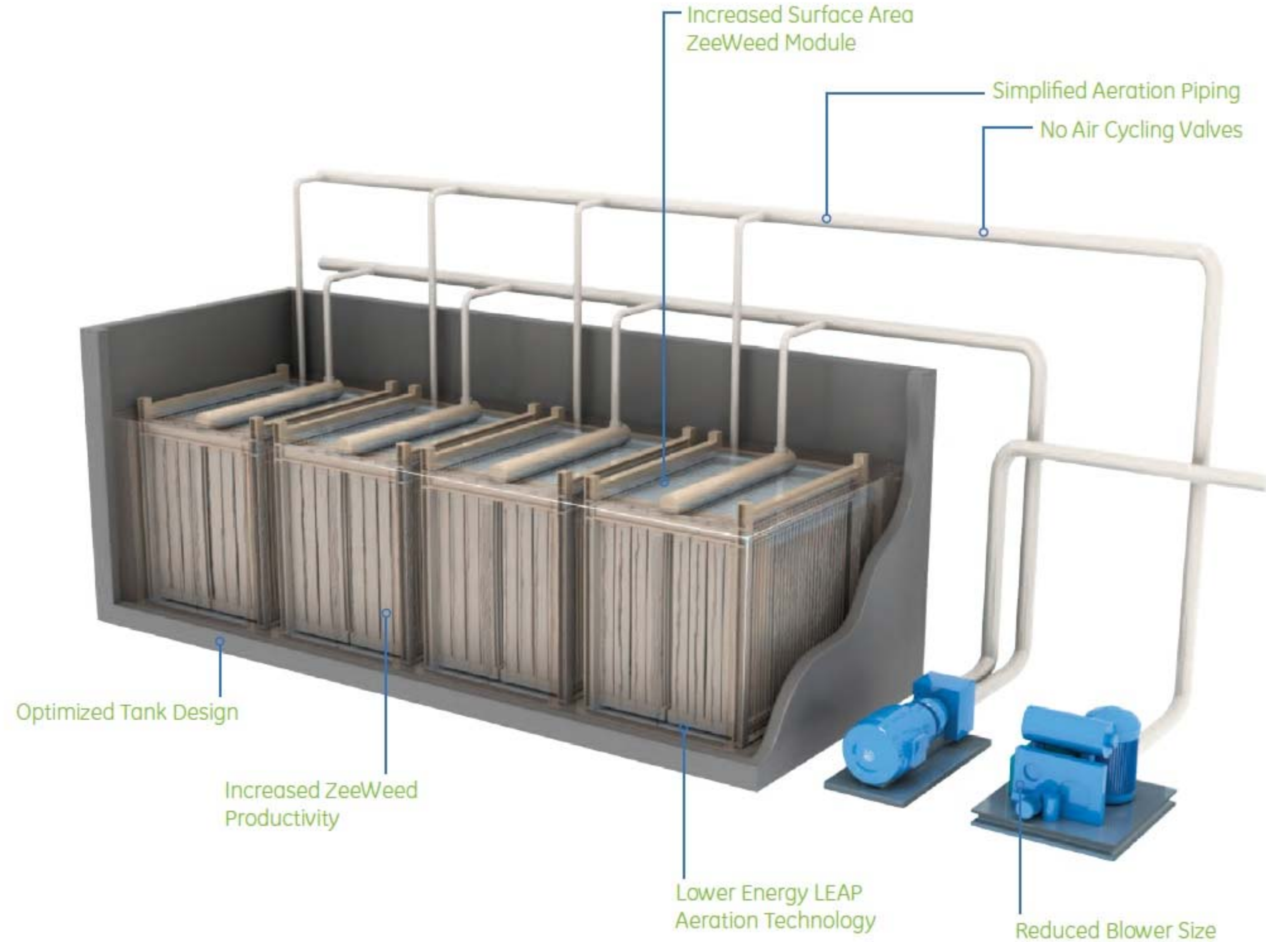

ILLUSTRATION OF A SUBMERGED MEMBRANE FILTER (GENERAL ELECTRIC)

FIGURE 4.19

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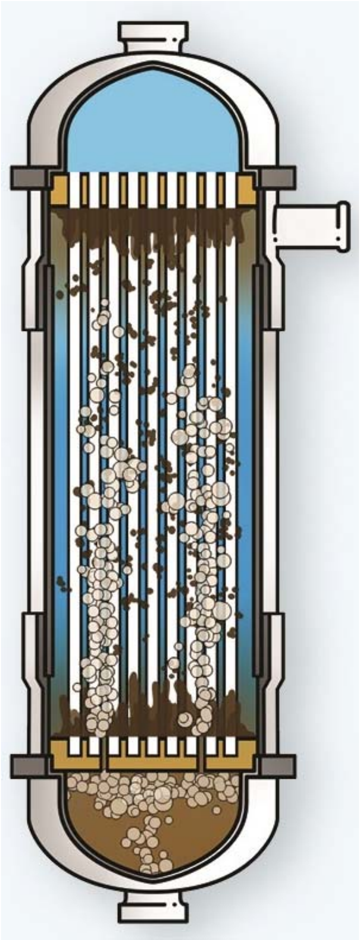

ILLUSTRATION OF A PRESSURIZED MEMBRANE MODULE (KOCH MEMBRANE SYSTEMS, INC.)

FIGURE 4.20

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WRF TREATMENT ALTERNATIVES ANALYSIS

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2.3.1.4 Filtration Technology Performance and Design Criteria

Relative performance of the various filtration technologies is summarized in Table 4.4. The data was extracted from various studies and evaluations (references provided). Because testing conditions (i.e., filter loading rates, influent turbidity, TSS, particle size distribution, *Giardia* concentrations, and *Cryptosporidium* concentration) vary widely, the data should be used only for broad relative comparisons.

The values shown in Table 4.4 are for specific wastewater treatment plants treating specific secondary effluents. Tertiary filtration performance is strongly dependent upon the secondary process conditions and effluent quality. Based on research conducted by Carollo Engineers, it has been determined that the type of biological treatment process and or mode of operation of this process will affect the particle size distribution of the secondary effluent.

Table 4.4 Filter Technology Performance Comparison for Removal of Contaminants
Water Reclamation Facilities – Master Plan Development
Manatee County

Technology	TSS(1)	Turbidity	Giarida	Cryptosporidium
Deep Bed Downflow	95%, 87%; ~75%(1,2)	85-90%; 97%; ~77%(2,4,5)	67% < detect, 27% > 5(8)	~99%(2)
Continuous Backwash Upflow or Downflow	78%, 66%(1)	88%; 98%(6,7)	50% < detect, 50% > 5(8)	No Data
Automatic Backwashing Filters	~67% loading rate of 1.28 gpm/sf (10)	~50% loading rate of 1.28 gpm/sf (10)	No Data	No Data
Pulsed Bed Filtration				
Fuzzy Filter	50%(12) (raw sewage) a higher TSS removal of a secondary effluent would be expected	40 to 85% at max rate =30 gpm/sf(13)	No Data	No Data
Cloth Media Disk	83%, 94%(3)	87%(3)	24%(9)	33%(9)
Membrane Microfiltration	88%(9)	99%(11)	non-detect levels (9)	non-detect levels (9)

Table 4.4 Filter Technology Performance Comparison for Removal of Contaminants Water Reclamation Facilities – Master Plan Development Manatee County				
Technology	**TSS(1)**	**Turbidity**	**Giarida**	**Cryptosporidium**

Notes:

(1) D. Kobler, M. Boller. "Particle Removal in Different Filtration Systems for Tertiary Wastewater Treatment - A Comparison".

(2) L. Walker-Coleman. "Removal of *Cryptosporidium* and *Giardia* at a Central Florida Water Reclamation Facility".

(3) M. Davis, S. Beck, R. Warner, J. Collins. "Performance of Cloth-Membrane Filters on Wastewater Secondary Effluent Blended with Surface Water for Unrestricted Reuse."

(4) B. Farizoglu. "The Performance of Pumice as a Filter Bed Material under Rapid Filtration Conditions".

(5) S. Hatukai et al. "Particle Counts and Size Distribution in System Design for Removal of Turbidity by Granular Deep Bed Filtration."

(6) D. Jolis et al. "Assessment of Tertiary Treatment Technology for Water Reclamation in San Francisco, Ca."

(7) J. A. Miele, W.N. Stasiuk / NYCDEP. "Village of Stamford / NYCDEP Tertiary Wastewater Treatment Demonstration Project Comparing Continuously Backwashed Upflow Dual and Filtration and Microfiltration Technologies".

(8) D.W. York, L. Walker-Coleman, L. Williams, P. Menendez. "Monitoring for Protozoan Pathogens in Reclaimed Water: Florida's Requirements and Experience."

(9) L. Holmes, C. Williams, C. Acker, B. Narayanan, G. Juby, H.S. McDonald. "Side-By-Side Comparison of Membrane and Conventional Filtration Technologies with UV Disinfection to Meet Existing and Future Regulations".

(10) K. Eberle. "Pilot Study in Durham County Compares Disk Filtration with Traveling Bridge Low-Head Sand Filtration."

(11) R.B. Chalmers et al. "Selection of a Microfiltration Process for the Groundwater Replenishment System, the Largest Advanced Recycled Water Treatment Plant in the World."

(12) B. Jimenez et al. "Sand and Synthetic Medium Filtration of Advanced Primary Treatment Effluent from Mexico City".

(13) O. Caliskaner, G. Tchobanoglous. "Evaluation of the Fuzzy Filter for the Filtration of Secondary Effluent".

Table 4.5 summarizes typical design criteria for each filtration technology. As stated in the individual technology descriptions, the filter design criteria were based on standard reference, literature review, and design experience.

Table 4.5 Filter Technology Design Criteria
Water Reclamation Facilities – Master Plan Development
Manatee County

	Filter Technology						
Parameter[(1)]	**Deep Bed**	**Continuous Backwash**	**Automatic Backwash**	**Pulsed Bed**	**Fuzzy Filter**	**Cloth Disk**	**Membrane[(1)]**
Maximum Hydraulic Loading rate (gpm/ft2)	5	3.5	2	6	30	4	15-45 (gfd/ft^2)
Backwash Production (% of total flow)[(3)]	2-3	12-25	2-6	2-6	5	3	5-10
Head loss (ft)	6-8	1	2	4-8	5.7	1	8-16

Notes
(1) Parameters are variable depending on the manufacturer
(2) Loading rate variable depending on the manufacturer and the configuration (pressurized or submerged)
(3) Rates listed are those claimed by manufacturers. Actual rate is highly dependent on filter influent water quality and filter operation

2.3.2 Disinfection

2.3.2.1 Chlorination

Conventionally, disinfection is accomplished with chlorine applied to the filtered effluent in either a gas or liquid form. Chlorine gas disinfection has largely given way to a wider use of the much less dangerous liquid sodium hypochlorite disinfection systems, which the County currently uses at the WRFs. There has been discussion within the County on upgrading to the use of chloramine (NH_2Cl). Chloramines produce fewer disinfection byproducts (DBPs) than sodium hypochlorite, and none of the DBPs produced by chloramines are currently regulated by the Florida Department of Environmental Protection (FDEP). However, chloramine does still produce harmful DPBs such as N-nitrosodimethylamine (NDMA) which is a carcinogen, as well as cyanogen-chloride and -bromide which are both acutely toxic.

The FDEP indicated that there may be some new regulation on the use of chloramines as a disinfection agent spurred on by the findings of the SB536 study. The County must also assess the impact that the additional nitrogen found in chloramines will have on their WRFs' effluent qualities. Currently, there is limited use to date in Florida of chloramine disinfection for reclaimed water.

2.3.2.1.1 Chlorine Feed

Sodium hypochlorite is typically introduced into chlorine contact chamber using chemical feed pumps, such as diaphragm metering pumps, peristaltic pumps, or centrifugal, magnetic drive pumps. Elevated storage tanks with manual or actuated valves have also been used but this is a highly inaccurate chemical feed method. Each type of feed pump has advantages and disadvantages and their selection can be highly driven by operator and maintenance staff preference, but diaphragm metering pumps are the most popular because of their ability to meet various dosing ranges and their accuracy for flow pacing.

The sodium hypochlorite is normally introduced through a plain end or perforated feed pipe at the head of the chlorine contact chambers. The chemical is then mixed into the flow by mechanical and non-mechanical means. Mechanical devices include flash mixers, simple propeller mixers, diffused air, and recirculation pumps. Non-mechanical means include baffle walls, perforated walls, or overflow weirs. Some facilities are able to take advantage of naturally occurring turbulent flow conditions for mixing, but this is not recommended since the efficiency of the overall disinfection process is highly dependent on complete mixing of the chemical with the flow stream. Mechanical mixing is recommended whenever possible.

The County currently uses diffused air which is an effective form of mixing but typically uses more energy than other mechanical methods and has the potential for chlorine loss due to dispersion. Flash mixers or simple propeller mixers are just as effective for mixing, may use less energy, and have similar operation and maintenance attention.

2.3.2.1.2 Chlorine Residual Loss

Loss of chlorine residual in contact chambers can be a problem in Florida water reclamation facilities due to higher water temperatures. Operators have used various methods to control this including increased starting residual concentration, residual boosting (i.e. additional chemical feed points downstream in the contact chamber with mixing) and covering of the chambers to reduce water temperatures. Increasing the starting residual or residual boosting increases capital and chemical costs, and can require more complexity in the chemical dosing strategy, particularly for the boosting option. Covering the chambers to reduce water temperature has been successful for some utilities, such as Lee and Polk County who use the floating, black polyethylene balls in their filter clearwells and/or their chlorine contact chambers. Others options for covering including hard covers (aluminum, fiber glass, or PVC) or floating tarps. If chlorine residual loss is a significant problem for the County, Carollo recommends an evaluation of the existing chlorine contact scheme which could include the overall chemical dosing system design and field studies.

2.3.2.2 Ozonation

Ozonation is an alternative disinfection method to chlorination in which onsite ozone generation equipment produces a suitable amount of ozone gas to bubble into the disinfection chamber. Ozone produces fewer DBPs than chlorine and most of those have a life span of only a few minutes before they decay into stable, less harmful compounds. The disadvantage to ozone disinfection is the cost and complexity of the associated equipment. For this reason, it is not recommended that the County invest in ozone technology for their reclaimed system at this time.

2.3.2.3 UV

UV radiation has the distinction of producing no DBPs. It uses an array of powerful UV lamps to immobilize bacteria, protozoa, and viruses. UV radiation has been used successfully for disinfection in reclaimed water systems around the state of Florida and is safer with a smaller footprint than most chemical disinfection system. However, UV systems are costly in both capital and energy expenses, sensitive to system hydraulics, and can require more maintenance than a chemical system. For these reasons, it is not recommended that the County invest in a UV disinfection technology for their reclaimed system at this time.

3.0 EFFLUENT AND REUSE ALTERNATIVES

Each of the WRFs operates under a non-discharge permit and disposes of treated effluent to the County's slow-rate Public Access Reuse (PAR) system, known as the Manatee County Master Reuse System (MCMRS). The County also has a Class 1 deep injection well (DIW) on Cortez Road with a permitted capacity of 15 million gallons per day (mgd) maximum daily flow (MDF) to dispose of treated effluent. A total seasonal (wet weather) storage capacity of more than 1.2 billion gallons is available between the storage ponds and ground storage tanks located at the three WRFs. During wet weather periods, excess effluent from the facilities is first pumped to the storage ponds, and then any excess is sent to the DIW. During the wet seasons, the storage pond volume and disposal well injection rate must provide sufficient capacity to receive unused treated effluent during periods of low irrigation demand. During times when irrigation demand exceeds daily reclaimed water supply, water is withdrawn from the seasonal storage ponds, filtered, blended with WRF effluent, and distributed by the MCMRS when irrigation demand exceeds daily reclaimed water supply.

The County is currently pursuing the permitting, design and construction of additional effluent disposal options including recharge wells and additional DIWs. This water is currently used for non-potable purposes. Should the recharge system be upgraded to include potable reuse, this would be considered an indirect potable reuse system and is currently regulated under FAC 62-610.

There has been discussion about direct potable reuse (DPR) which would entail reclaimed water being directly pumped into a potable water distribution system. There are not currently any motions in the FDEP to create regulations for DPR, nor do any currently exist. However, the FDEP indicated that at some point in the future, should DPR regulations need to be drafted, the reclaimed water would be treated as a source water in the water treatment regulations where all subsequent water quality requirements are found.

4.0 BIOSOLIDS HANDLING ALTERNATIVES

4.1 Biosolids Management

Once the biosolids are produced from the biological system, the wastewater facility will be required by permit to treat and legally dispose. The most common methods of biosolids management are:

- Sludge holding with aeration with subsequent off-site treatment.
- Sludge digestion (aerobic or anaerobic).

The use of sludge digestion provides means of treating the facilities biosolids by use of either the addition of oxygen (aerobic) or absence of oxygen (anaerobic). Both digestion methods require significant capital costs to provide equipment and volume to ensure treatment at the design level capacity. Aerobic digestion typically induces significant operations costs with no side benefits. Anaerobic digestion can provide side benefits such as bio-gas to help sustain the process operation. This operation typically is maintenance intensive rarely provides substantial payback of the effort.

The use of sludge holding with aeration is typically to provide volume to allow for operations adequate storage to dewater the biosolids and haul the sludge to another facility for further treatment. Each of the facilities currently operates in this fashion with the County's biosolids dryer provides the alternative from of treatment.

The sludge holding option for the County seems to be optimal option at this time against the digestion alternatives identified above.

4.2 Thickening

Solids thickening refers to increasing the solids content of waste activated sludge (WAS) from about 0.5 percent solids to about 2.0 percent solids. This is typically of interest to a utility either lacking WAS holding capacity, dewatering process hydraulic capacity, or one which has anaerobic digestion to reduce digester tank volume requirements. As shown in TM 2, the County has neither a deficiency in WAS holding volume or dewatering process hydraulic capacity nor do they employ anaerobic digestion. Therefore, adding thickening to the biosolids handling processes at each WRF is not recommended at this time.

4.3 Dewatering

Three technologies were evaluated for replacement of the existing dewatering belt filter presses (BFPs) at the WRFs. These included new BFPs, centrifuges, and screw presses. Typical process feed solids, polymer usage, and dewatered cake solids are shown in Table 4.6 for each dewatering technology.

Table 4.6 Typical Dewatering Process Performance by Feed Sludge Type Water Reclamation Facilities - Master Plan Development Manatee County

	Feed Solids %	Polymer Dose lb/ton	Cake Solids %	Solids Capture %
BFP	1-2	10-20	12-20	90
Centrifuge	1-2	15-30	16-25	95
Screw Press	1-2	17-22	15-22	90

Notes:
(1) Source: Metcalf and Eddy, 5th Ed., 2014.

BFP and screw presses are less operator intensive and more energy efficient than a centrifuge. Usually, a centrifuge is justified only when hauling costs are high because producing a dryer cake leads to significant solids disposal savings. The County pays a low hauling rate so a centrifuge will not likely be an attractive option. Between the BFPs and screw presses, the BFP is usually less expensive and uses a less polymer. However, the cake is wetter than that from a screw press. Screw presses have an operational advantage of being a contained unit for odor abatement and there are no external moving parts which is preferred from a safety standpoint.

A planning level life-cycle cost analysis between these three technologies is summarized in Section 4.3.

4.3.1 Belt Filter Presses

BFPs use a gravity drainage section through which water freely drains through porous belts to thicken the feed sludge. This is followed by a wedge zone where increasing pressure and shearing forces are applied via tensioning rollers and belts to release additional water from the biosolids. Polymer is typically added to the feed sludge to increase the effectiveness of the dewatering steps, and washwater is required for continuous washing of the belt. The final dewatered cake is then discharged and conveyed for disposal or further treatment. The filtrate is collected and recycled back to the secondary treatment process for further treatment. Typical cake solids from a BFP range between 15 and 18 percent which is in line with the County's current BFP units producing approximately 16 percent cake solids.

Operation of BFPs requires observation and management of several key variables, including feed sludge characteristics, polymer feed rate, sludge conditioning with polymer, and belt speed and tensioning. If one or more of these variables is less than ideal, the dewatering process may suffer, resulting in wetter cake and increased hauling costs. BFPs can operate continuously or intermittently if required and can be purchased in two or three belt designs.

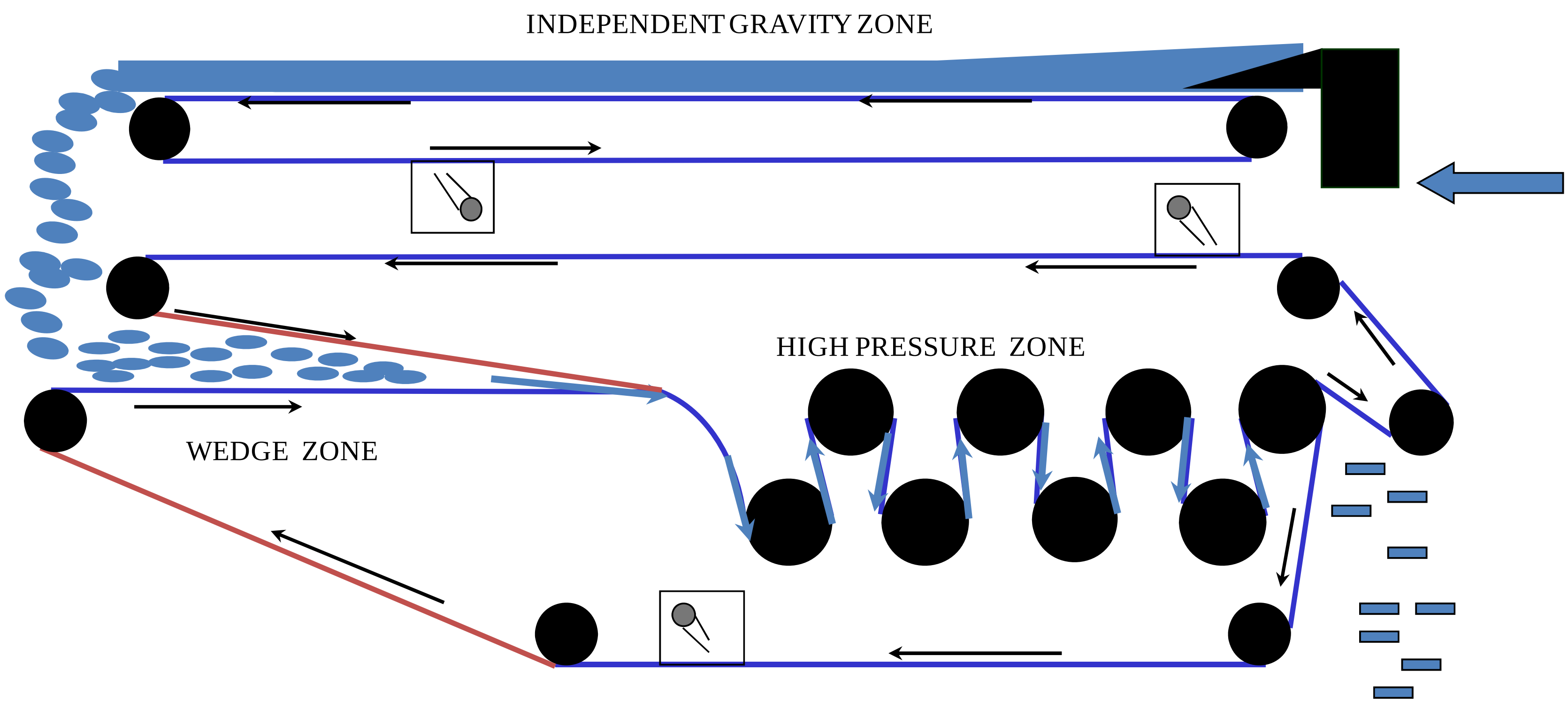
The 3-belt Klampress shown in Figure 4.21 is has eight rollers of the same diameter oriented horizontally. The wedge zone is also oriented horizontally. The third belt acts as a gravity thickener bolted to the top of the 2-belt unit. Solids are thickened to about 4 percent at the end of the gravity thickening zone prior to entering the wedge zone. These units have a hydraulic system for belt tensioning and steering, an independent gravity section that is manually tensioned, and a frame, chicane rods, and holders of hot dipped galvanized carbon steel and sheet metal components of 316/316L stainless steel.

The enclosed 2-belt design Winklepress (Figure 4.22) has eight rollers of decreasing diameter oriented on an incline allowing for shear of the solids in addition to pressure. The wedge zone on the Winklepress is oriented vertically so dewatering occurs on two surfaces. The unit has a hydraulic system for belt tensioning and steering; a frame, chicane rods, and holders of hot dipped galvanized carbon steel; and sheet metal components of 316/316L stainless steel. This design has eight pressure rollers and a 316 stainless steel dandy roller as well as a fiber-reinforced plastic (FRP) odor enclosure.

4.3.2 Decanter Centrifuges

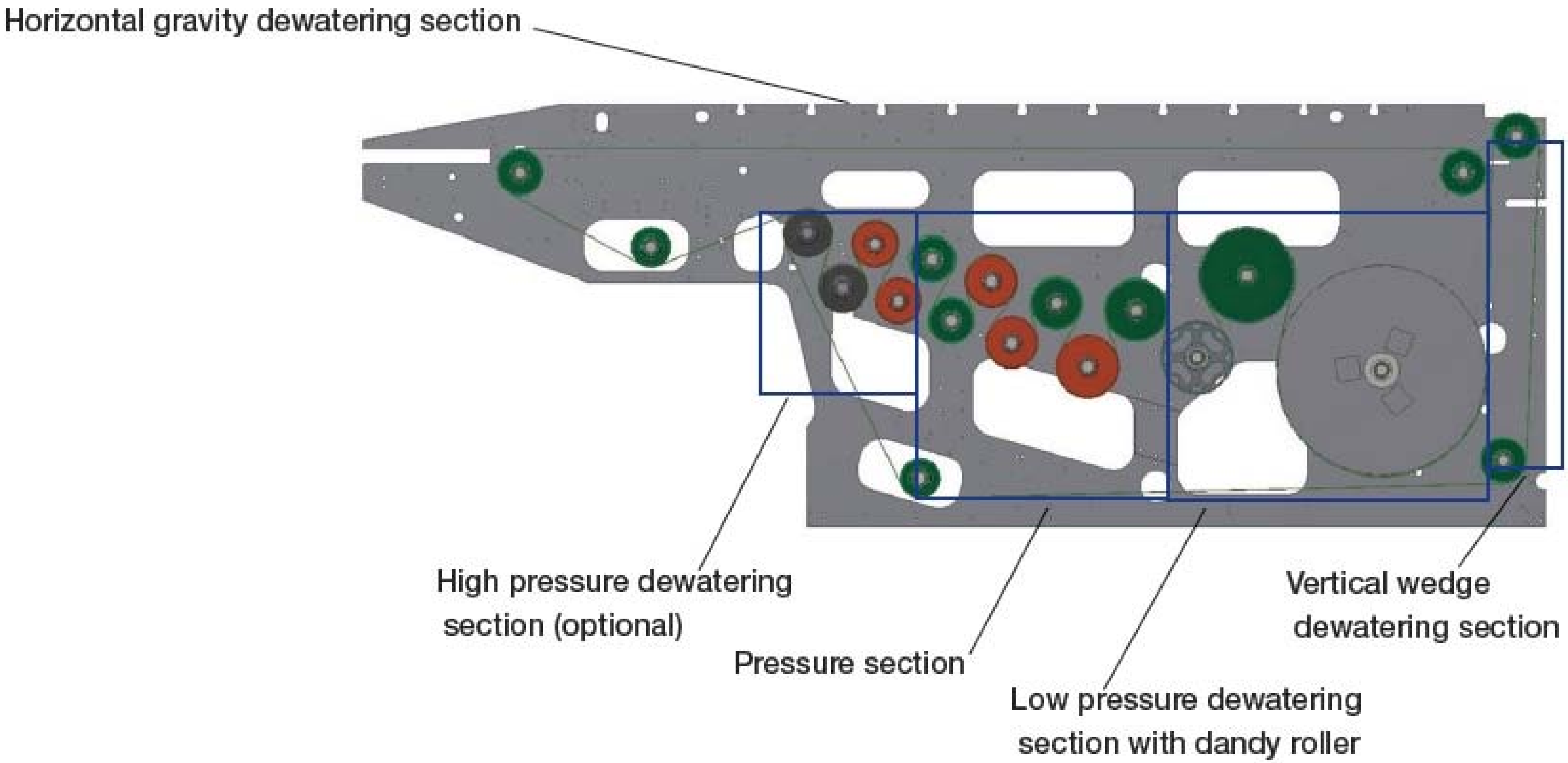
Decanter centrifuges (Figure 4.23) employ centrifugal force to dewater biosolids. The centrifugal force is generated within the centrifuge by rotating the centrifuge bowl at high speed. The sludge is pumped into the centrifuge where the high centrifugal forces separate the solids from the liquid. The separated water (centrate) is collected and discharged at one end of the centrifuge. The dewatered residuals are deposited on the inclined beach area of the bowl through the movement of an auger called the scroll that rotates inside the bowl at a differential speed inducing the solids to move along the rotating bowl to the discharge port. The scroll and corresponding drive system are at the heart of the centrifuge.

Obtaining and sustaining consistent dewatered biosolids requires a scroll drive that can respond rapidly to changes in the feed sludge characteristics by making smooth, subtle changes to the scroll speed. Instrumentation and controls allow these functions to be automated and monitored by a manufacturer-designed monitoring and control system inclusive of VFDs, probes, and a controller. Operation can be optimized with adjustment of the bowl speed, scroll speed, pond depth, feed rate, and polymer dose. Centrifuges also tend to operate best when run continuously without frequent start-ups and shut-downs. Start-up of a centrifuge may take up to an hour to stabilize and begin producing a dry cake. In addition, centrifuges are often subject to increased noise and vibration in comparison to BFPs and screw presses.



SCHEMATIC OF A 3-BELT KLAMPRESS® (ALFA LAVAL)

FIGURE 4.21

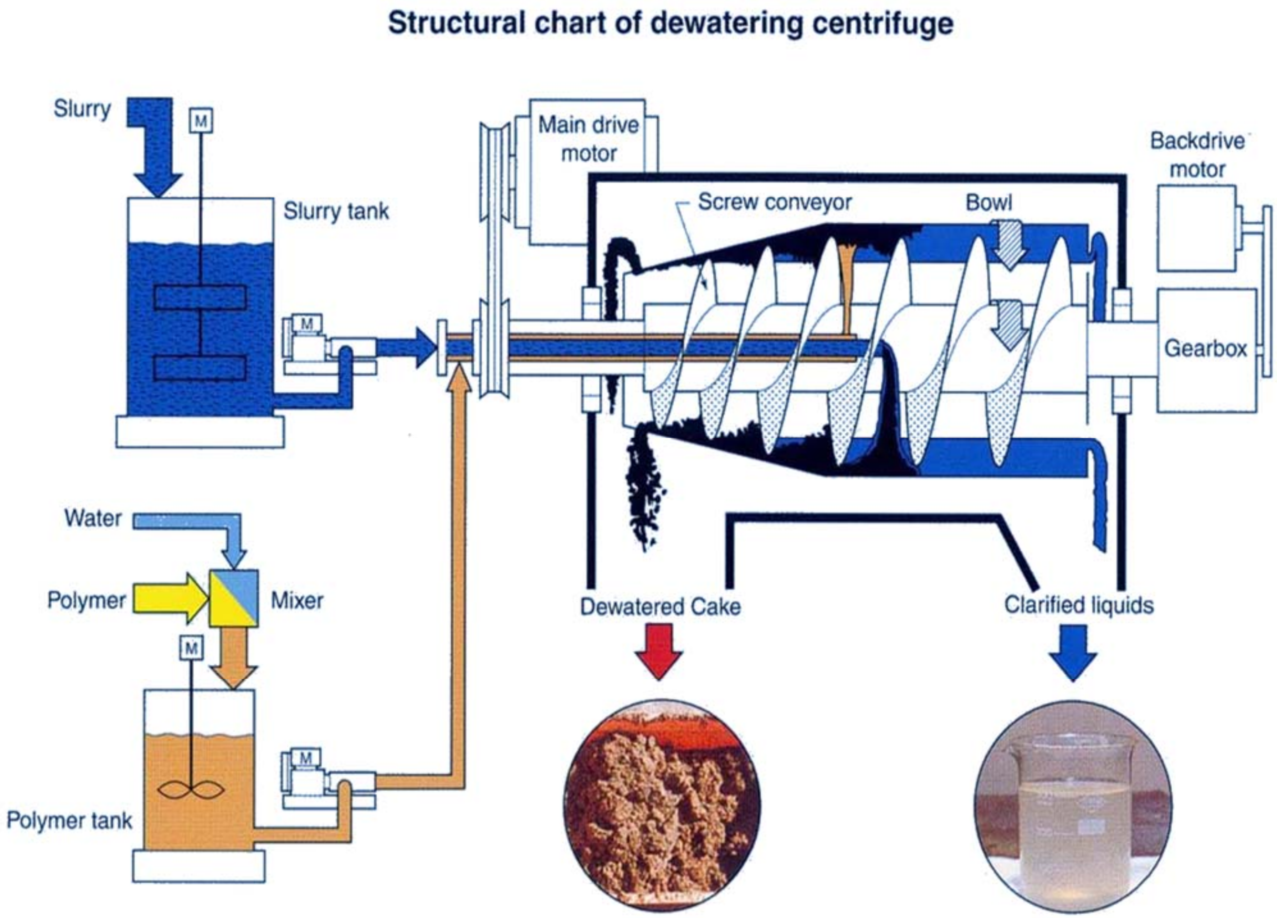


SCHEMATIC OF A 2-BELT WRINKLEPRESS® (ALFA LAVAL)

FIGURE 4.22

MANATEE COUNTY
WRF TREATMENT ALTERNATIVES ANALYSIS

carollo



SCHEMATIC OF A CENTRIFUGE (ALFA LAVAL)

FIGURE 4.23

MANATEE COUNTY
WRF TREATMENT ALTERNATIVES ANALYSIS

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Some lessons learned from existing installations include:

- Washing down the centrifuge at shut down typically returns significant solids to the liquid treatment process.
- Ensure control system is modifiable by internal staff so factory technicians are not required every time a change is needed. Also, require a narrative on how the program works when purchasing a centrifuge.
- Make sure an operator is present during startup with the technician to learn the tips and tricks to operating the unit.

4.3.3 Screw Presses

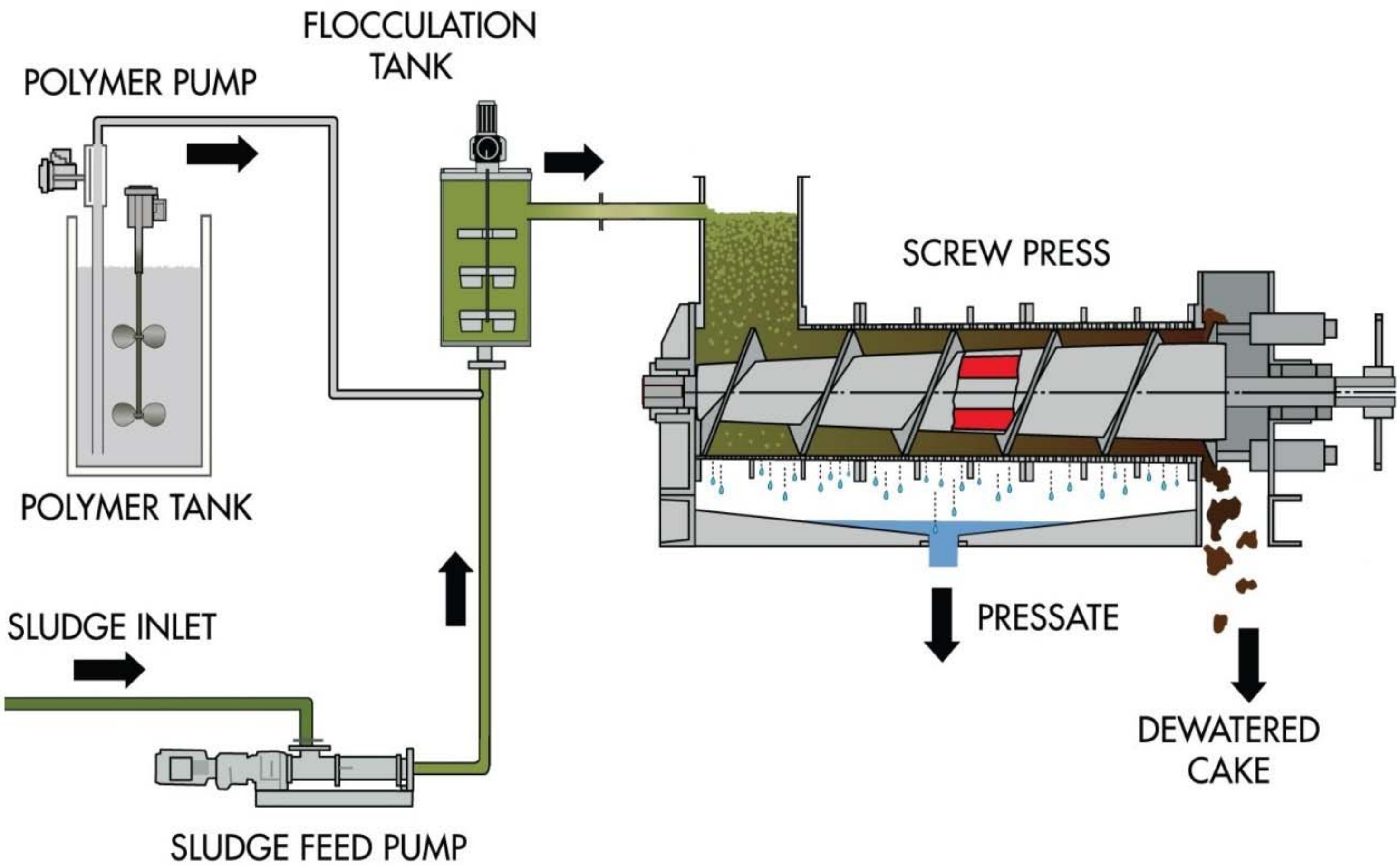
Screw presses for biosolids dewatering were first sold around 1990 and are a relatively new technology in the municipal wastewater market compared to BFPs and centrifuges; although, they have been used in other industries for a much longer time. Sludge is loaded into the screw press (Figure 4.24) where the solids move through a reduced diameter screened horizontal bowl constructed of wire mesh or a perforated plate. A slow moving, shafted screw compacts the solids and increases the pressure along the length of the screw press, separating the solids from the liquid. The separated water (pressate) flows through the screen and is collected and discharged at the bottom of the screw press while the dewatered cake is discharged from the end of the screw press. Screw presses are mechanically simple, but require consistent feed quality. There are two designs for screw presses including horizontal and inclined.

Some lessons learned from existing installations include:

- Sludge feed to the screw presses must be well mixed to maintain consistency.
- Keep the unit clean (of hair, rags, and struvite) for proper operation.
- A reliable and consistent polymer system is important.

4.4 Dewatering Technology Cost Comparison

A planning level life-cycle cost analysis was conducted to determine the 20 year life-cycle costs for use of BFPs, screw presses, and centrifuges at the three WRFs. The purpose of this cost analysis was to provide planning level information for the County to be able to make a determination for upgrading the dewatering technology.



SCHEMATIC OF A SCREW PRESS (FKC CO.)

FIGURE 4.24

MANATEE COUNTY
WRF TREATMENT ALTERNATIVES ANALYSIS

carollo

The costs analysis for each dewatering technology was broken down into five categories. These were:

1. Capital
2. Maintenance
3. Power
4. Hauling
5. Polymer

Initial assumptions were made for the wasting duration and initial solids concentration. Capital costs were developed from the average value of recent dewatering equipment evaluations within Florida. The costs only include the centrifuges, BFPs or screw presses equipment.

Maintenance costs can be very complicated to calculate as they vary by manufacturer, diligence of the wastewater utility to perform routine maintenance, and physical local conditions such as the abrasiveness and corrosiveness of the feed sludge, ambient temperature, humidity, etc. Therefore, it is common practice for equipment manufacturers to assume 5 percent of the original capital cost per year will be spent on maintenance. This is the method used in this analysis as well.

Typical power usage values were extracted from the same sources used to estimate the capital costs. The initial 2015 cost of electricity was assumed to be $0.07/kWh with 3 percent annual inflation.

Both hauling cost and polymer usage costs were calculated based on 2014 data showing dry tons of sludge produced per year. A typical set of solids capture efficiencies and cake solids contents were assume for each of the three evaluated technologies as seen in Table 4.7.

Table 4.7 Assumed Performance Parameters for Dewatering Equipment Types Water Reclamation Facilities - Master Plan Development Manatee County

	Solids Capture, (%)	Cake Solids Content, (% TS)	Polymer Dose, (lb/ton)
BFP	90	16.0	15.0
Centrifuge	95	20.5	22.5
Screw Press	90	18.5	19.5

The hauling costs were provided by the County, which was set at $10.90 per wet ton in 2015 with a 3 percent annual inflation factor.

4.4.1 SWWRF

The SWWRF was assumed to waste 15 hours a day, seven days a week. The SWWRF does not pre-thicken their sludge; therefore, the flow sent to be dewatered is assumed to be a 1.5 percent TS.

Polymer costs were provided by the County at the rate of $1.81 per pound (lb). These polymer costs were set at 2015 values with 3 percent annual inflation.

The results of the cost analysis are summarized in Table 4.8, and indicate that the BFP is the least expensive overall option. This is because its power, polymer, capital, and maintenance costs are less and the low hauling price paid by the County is not enough to make its wetter cake output a financial disadvantage in the overall 20-year cost of ownership.

Table 4.8 Results of Dewatering Technology Cost Analysis for SWWRF
Water Reclamation Facilities - Master Plan Development
Manatee County

	BFP	Centrifuge	Screw Press
Capital	$1,200,000	$2,000,000	$1,600,000
Maintenance	$892,648	$1,487,747	$1,190,198
Hauling	$13,373,483	$11,017,720	$11,566,255
Power	$1,259,428	$2,537,757	$1,462,826
Polymer	$5,921,958	$8,882,937	$7,698,545
20 Year Total	$22,647,517	$25,926,161	$23,517,825

This analysis assumes the BFPs will be replaced as new in today's dollars. In addition, the upgrades required to change the dewatering building at the SWWRF to a new technology (centrifuge or screw press) were not considered in this analysis. Both of these factors would make the BFP the more desirable technology more so than what is shown in Table 4.8.

4.4.2 SEWRF

The SEWRF was assumed to dewater sludge eight hours a day, seven days a week. The influent solids concentration pumped to dewatering was assumed to be 4 percent TS, because SEWRF thickens its sludge via Gravity Belt Thickeners (GBTs).

Polymer costs were provided by the County at the rate of $1.59 per lb. These polymer costs were set at 2015 values with 3 percent annual inflation. Hauling costs are not included for SEWRF because cake is typically pumped to the drying facility onsite.

The results of the cost analysis are summarized in Table 4.9, and indicate that the BFP is the least expensive overall option. This analysis assumes the BFPs will be replaced as new in today's dollars. In addition, the upgrades required to change the dewatering building at the SEWRF to a new technology (centrifuge or screw press) were not considered in this analysis. Both of these factors would make the BFP the more desirable technology more so than what is shown in Table 4.9.

Table 4.9 Results of Dewatering Technology Cost Analysis for SEWRF Water Reclamation Facilities - Master Plan Development Manatee County

	BFP	Centrifuge	Screw Press
Capital	$850,000	$1,320,000	$1,400,000
Maintenance	$632,293	$981,913	$1,041,423
Power	$208,046	$676,735	$209,215
Polymer	$1,918,971	$2,878,457	$2,494,662
20 Year Total	$3,609,310	$5,857,105	$5,145,301

4.4.3 NRWRF

NRWRF was assumed to dewater sludge eight hours a day, seven days a week, NRWRF was assumed to send a flow at 1.5 percent TS to dewatering.

Polymer costs were provided by the County at the rate of $1.42 per lb. These polymer costs were set at 2015 values with 3 percent annual inflation.

The results of the cost analysis are summarized in Table 4.10, and indicate that the BFP is the least expensive overall option. This is because its power, polymer, capital, and maintenance costs are less and the low hauling price paid by the County is not enough to make its wetter cake output a financial disadvantage in the overall 20 year cost of ownership.

This analysis assumes the BFPs will be replaced as new in today's dollars. In addition, the upgrades required to change the dewatering building at the NRWRF to a new technology (centrifuge or screw press) were not considered in this analysis. Both of these factors would make the BFP the more desirable technology more so than what is shown in Table 4.10.

Table 4.10 Results of Dewatering Technology Cost Analysis for NRWRF Water Reclamation Facilities - Master Plan Development Manatee County

	BFP	Centrifuge	Screw Press
Capital	$850,000	$1,320,000	$1,400,000
Maintenance	$632,293	$981,913	$1,041,423
Hauling	$5,290,043	$4,358,192	$4,575,172
Power	$208,046	$676,735	$209,215
Polymer	$1,837,764	$2,756,646	$2,389,093
20 Year Total	$8,818,146	$10,093,487	$9,614,904

5.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this TM was to evaluate various relevant technologies which may be applied throughout the wastewater treatment process at all three of the WRFs presently operated by the County. Carollo has reviewed a number of different types of equipment to that end in the areas of preliminary, secondary, and tertiary treatment as well as solids handling. The equipment discussed in this TM has been implemented at full scale at other Florida utilities. Selection is a matter of operational preference and cost analysis. Individual discussions for each facility based on proposed projects are discuss further in the following sections.

5.1 SWWRF

5.1.1 Preliminary Treatment

5.1.1.1 Headworks

A new headworks will be constructed at the SWWRF in FY 2018. Design activities will start in 2017, and the County will have the opportunity to evaluate several of the screens and grit removal technologies that prove beneficial to the SWWRF.

The County currently uses two different screening technologies: continuous link Parkson Aquaguard at SWWRF and NRWRF and catenary Duperon at SEWRF. Screen performance can vary widely from different utilities based on wastewater composition as well as maintenance likes and dislikes. It is recommended for the County to look at their existing technology for screens to see if these will fit with the SWWRF system. If the existing screening technology is not desired for this facility, the County can review popular screening such as the perforated plate or center flow screen technology. The County can evaluate performance of these different screens at existing utilities in Florida as part of the preliminary design phase for the new headworks.

Similar to the screens, grit removal technology is typically utility specific. The County currently has two types of grit removal (mechanical and hydraulic induced vortex). It is recommended that the County evaluate these two technologies and select what they tend to prefer. Grit removal facilities tend to be less flexible for a given installation since the technology usually dictates the headworks design. The County should consider this as part of the grit removal technology evaluation.

5.1.1.2 Odor Control

The SWWRF is located adjacent to a public golf course, less than 1/3 of a mile from an apartment complex, and less than 1/2 mile from a residential neighborhood. Therefore, the County has a need to provide reliable and effective odor control for the headworks and flow equalization processes. The current chemical and biological odor control technologies are typically effective, so no innovative or alternate technologies are necessary. However, the type of odor control system should be considered based on the current odor causing components and evaluated with the different alternatives. The prevailing option should be considered and possibly pilot tested to optimize the system. Selection for odor control is site dependent but the use of biofilter technology, as indicated previously, is typically effective and inexpensive compared to chemical scrubbers.

Also, the strategy of mixing RAS in the flow equalization to reduce odor levels should be considered. Other techniques to assist with odor reduction include: reduce influent splashing or turbulence, minimize headspace with low profile covers and adequately sizing of the odor control fans to maintain a negative pressure.

5.1.1.3 Flow Equalization

The SWWRF flow equalization (FEQ) system consists of a single, large circular tank with a floating cover and return pump station. The County had considered a future CIP project to install a fixed cover, provide a new odor control system, and replace the equalization mixing. Based on the tank size (about 240 feet in diameter), a fixed, dome cover would create a significant volume of air (i.e. headspace) to remove from the tank and treat. A typical chemical or biofilter odor control system would be large and require additional area the facility may not have. One option considered was to demolish the existing single tank and construct two smaller diameter tanks near the future headworks (west or northwest of Secondary Clarifiers 3 and 4). This would have offered several advantages:

- Two tanks would provide a more reliable FEQ system, since one tank can be off-line for service and maintenance.
- The design and configuration could be optimized for more effective operation, and match similarities of the existing equalization system at SEWRF to set a consistent strategy.
- The volume of air to remove and treat for odor control purposes could be reduced.
- A combined odor control system could be used to treat foul air from both the headworks and flow equalization tanks.
- Establishing new equalization facilities in a different location would allow the existing system to stay in-service while the new facilities are being constructed.

After further evaluation by Carollo Engineers, it was determined there is not adequate area to construct the needed equalization volume near the future headworks. The County and Carollo are evaluating construction of the two smaller diameter tanks, a new return pump station, and odor control system in the same location of the existing FEQ tank. The reject storage pond and filter bypass pump station would be used to achieve equalization of the secondary effluent flow (i.e. flow after the secondary clarifiers) during construction. This option would require demolition of the existing FEQ tank prior to construction of the new tanks, demolition of the existing DAF facilities and associated buildings, and the existing FEQ return pump station. Some of the advantages listed above can still be achieved with this alternative:

- Two tanks would provide a more reliable flow equalization system, since one tank can be off-line for service and maintenance.
- The design and configuration could be optimized for more effective operation, and match similarities of the existing equalization system at SEWRF to set a consistent strategy.
- The volume of air to remove and treat for odor control purposes could be reduced

The County is also considering the use of RAS to activate the raw wastewater within the equalization tank to help reduce odors. Another option may be to remove this air in the equalization tank as part of the process air for the biological system. This option would require special coatings and modifications of the existing blowers but could be considered as part of the odor control evaluation.

As part of the mixing upgrades, the use of the RAS as odor control will need to be considered when evaluating the mixing technologies. This item coupled with the challenge of the geometry of the tank leaves few options. The preliminary recommendation will be to evaluate the use of large bubble mixing with the BioMix™ nozzles to determine the most cost effective solution.

5.1.2 Secondary Treatment

The SWWRF is currently undergoing treatment improvements to convert the existing activated sludge process to an MLE process to assist in removing ammonia and nitrate from the wastewater. The level of treatment required to meet the current and anticipated permit limits is conducive to the typical treatment performance provided by the MLE process, so additional biological nutrient removal or innovative technologies are not warranted in the foreseeable future.

Further evaluation for treatment expansion is not recommended for the SWWRF until the current process improvements are completed and in operation. After the upgraded system is in operation for some time, historical performance data can be evaluated to quantify the potential future improvements required. Carollo developed a facility plan to upgrade the SWWRF but this was prior to the recent design improvements. This facility plan should be evaluated with the historical data developed as part of the facility improvements.

5.1.3 Tertiary Treatment

The SWWRF provides filtering of the secondary effluent to provide for high level disinfection by reducing TSS to less than 5 mg/L, using CMF and ABW filters. These two types of filters provide the required treatment so no alternate or innovative technologies are warranted for the near future.

However, from the prior evaluations described in TM 3, it was determined that the CMF treats a majority of the flow, so the facility requires more redundancy of this unit to meet Class 1 reliability requirements. Also, the surface loading rate for ABW filters is not well documented and Carollo recommends the County evaluate the filter hydraulic and treatment capabilities to determine a realistic surface loading rate. The County currently is in the process of performing upgrades to the filters at this facility.

Additional CMFs are recommended for the County to provide the additional capacity at SWWRF, based on their current experience with different filter types and limited space at this facility.

5.1.4 Disinfection

The County is currently upgrading their reclaimed water system to include a recharge well at the SWWRF. As part of this upgrade, the County is evaluating the potential to use chloramines to assist the reclaimed water disinfection, and to meeting requirements for injecting reclaimed water to the well. This process is related to reduction of DBP formation in the effluent to comply with the primary and secondary water quality standards.

Based on recent meetings, the County can receive an exemption from meeting these requirements prior to injection into the well head. Therefore, the use of the chloramines will need to be evaluated once the treatment upgrades are completed and in operation. This system evaluation will need to identify:

- The proper dosing ratio between chlorine and ammonia.
- Optimization and control of the dosing for both chlorine and ammonia.
- Optimal point of injection.
- Net present value evaluation showing if there is savings with the chloramine system over keeping the existing chlorine system.

As identified, there is limited use of chloramines for disinfection of reclaimed water systems, but a few do exist within Florida. The County currently uses chloramine injection for the potable water system; therefore, the knowledge and experience can be shared between the potable water and the wastewater staff.

The County is currently considering the use of alternate mixing technologies at the injection point of the sodium hypochlorite and covering the chlorine contact chambers to help maintain residual, reduce algae growth and prevent debris from entering the chambers. Engineering evaluation of these alternatives will be incorporated into future CIP projects.

5.1.5 Biosolids

The dewatering technology evaluation conducted in this TM showed no immediate financial driver or incentive for upgrading to a new dewatering technology. The existing BFPs have remaining useful life, and the dewatering buildings are already constructed to house BFP equipment.

5.2 SEWRF

5.2.1 Preliminary Treatment

5.2.1.1 Headworks

Some components of the headworks facility at the SEWRF were upgraded as part of a recent improvement project. No anticipated process modifications are identified for this facility for the near term, however hydraulic modifications of the effluent piping to alleviate excessive head loss should be provided within the next five-year CIP cycle (FY 18 - 22) before a significant increase in facility flows occurs.

5.2.1.2 Odor Control

The SEWRF headworks facility has an odor control system, and it is functioning adequately. Also, the SEWRF is adjacent to the existing Manatee County Landfill, so odor complaints are rare. Therefore, no innovative or alternate technologies or other changes to the existing odor control are recommend at this time.

5.2.1.3 Equalization

The SEWRF equalization consists of two equally sized tanks that provide off-line equalization. Refer to the following Section (5.2.2) on Secondary Treatment as potential modifications to this system may be evaluated to assist with reducing the biological loading into the facility.

5.2.2 Secondary Treatment

The SEWRF is identified to require additional capacity installed for future treatment. The facility currently uses surface aeration to provide air to meet the biological oxygen demand. In addition to municipal wastewater, the SEWRF receives:

- Leachate flow from the County landfill next door.
- Leachate flow from the Duette landfill.
- Septage and grease from local haulers.
- Air scrubber blow-down from the biosolids dryer.

These additional loads increase the demand of the oxygen and volume at the facility. It has been noted that future work may include the construction of a Class 1 deep injection well. This well is noted to be able to remove leachate from the SEWRF influent wastewater.

For this facility, it is recommended to review the conditions of the facility and provide an evaluation to best upgrade the system. Some of the options to review are:

- Evaluate the capacity gained by removing the leachate from the influent stream to the Class 1 deep injection well.
- Evaluate the septage quantities and quality to determine the current and future demand on the facility treatment process.
- Evaluate the change in characteristics on the influent wastewater by incorporating the leachate and septage into the sludge digestion system.
- Evaluate the type of aeration modifications and liquid flows within the facility to optimize performance based the anticipated wastewater quality.

Refer to discussion in TM 2 under the SEWRF biological capacity rating (Section 4.3.2) for this recommended evaluation effort.

5.2.3 Tertiary Treatment

The SEWRF currently provides filtration of the secondary effluent to provide for high level disinfection by reducing TSS to less than 5 mg/L using ABW filters which provide the required treatment so no alternate or innovative technologies are warranted for the near future. However, from the prior evaluations described in TM 3, these filters have some hydraulic limitations, and Carollo recommends the County evaluate the filter hydraulic and treatment capabilities to determine a realistic surface loading rate. Pilot testing of the current filtration technologies used at the facility can also be performed to determine treatment limitations and identify potential improvements.

5.2.4 Disinfection

No modifications are noted for the SEWRF disinfection systems. Updates may be evaluated if the conditions are favorable to modify the system to chloramines based on the outcome of SWWRF disinfection improvements. Similar to SWWRF, the County is currently considering the use of alternate sodium hypochlorite mixing technologies and covering the chlorine contact chambers. Engineering evaluation of these alternatives will be incorporated into future CIP projects.

5.2.5 Biosolids

The dewatering technology evaluation conducted in this TM showed no immediate financial driver or incentive for upgrading to a new dewatering technology, especially given there is not a hauling requirement from SEWRF to the dryer facility. The existing BFPs have remaining useful life, and the dewatering buildings are already constructed to house BFP equipment.

5.3 NRWRF

5.3.1 Preliminary Treatment

5.3.1.1 Headworks

The NRWRF has an existing Eutek HeadCell® grit removal unit at the headworks, and a CIP project has been developed to add a second unit for reliability. The existing unit requires annual maintenance, which requires it to be offline for a significant amount of time. The second unit will allow the County to maintain continued grit removal operations during this annual maintenance. No other upgrades are proposed for the near future.

5.3.1.2 Odor Control

The NRWRF has an existing chemical scrubber. The remote location of the facility does not require odor control devices.

5.3.1.3 Flow Equalization

The NRWRF currently does not have flow equalization, but a CIP project is underway to include new equalization. The County is looking at off-line equalization and the use of RAS as odor control and potentially the BioMix™ technology for mixing.

5.3.2 Secondary Treatment

The NRWRF is currently operating under capacity and is not anticipated to require treatment upgrades for the 20-year planning period.

5.3.3 Tertiary Treatment

The NRWRF currently provides filtration of the secondary effluent to provide for high level disinfection by reducing TSS to less than 5 mg/L using ABW and CMF filters. The filters are under capacity, and no improvements are anticipated as part of this planning period.

5.3.4 Disinfection

No modifications are noted for the NRWRF disinfection systems. Updates may be evaluated if the conditions are favorable to modify the system to chloramines, based on the outcome of SWWRF disinfection improvements. Similar to SWWRF and SEWRF, the County is currently considering the use of alternate sodium hypochlorite mixing technologies and covering the chlorine contact chambers. Engineering evaluation of these alternatives will be incorporated into future CIP projects.

5.3.5 Biosolids

The dewatering technology evaluation conducted in this TM showed no immediate financial driver or incentive for upgrading to a new dewatering technology. The existing BFPs have remaining useful life, and the dewatering buildings are already constructed to house BFP equipment.

MANATEE COUNTY

WATER RECLAMATION FACILITIES – MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM NO. 5
NEAR-TERM AND LONG-TERM FACILITIES IMPROVEMENTS IMPLEMENTATION PLAN

FINAL
August 2017

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MANATEE COUNTY

WATER RECLAMATION FACILITIES - MASTER PLAN DEVELOPMENT

TECHNICAL MEMORANDUM
NO. 5

NEAR-TERM AND LONG-TERM FACILITIES IMPROVEMENTS IMPLEMENTATION PLAN

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NEAR-TERM AND LONG-TERM FACILITIES IMPROVEMENTS IMPLEMENTATION PLAN

1.0 INTRODUCTION

Manatee County owns and operates three regional water reclamation facilities (WRFs): Southwest WRF (SWWRF), Southeast WRF (SEWRF), and North Regional WRF (NRWRF). This technical memorandum (TM) is part of the development of the Facilities Master Plans for each of these WRFs, and outlines a plan for the near-term and long-term implementation of various projects. Projects identified were developed considering requirements for expansion due to increasing wastewater flows to the facilities, necessary repair and rehabilitation of existing facilities and equipment and other requirements identified by County staff for each facility.

Projects described in this TM were coordinated with the current version of the County's Capital Improvements Program (CIP) plan. The current version of the 5-year CIP is for Fiscal Years (FY) 2017 through 2021.

2.0 FY 2017 - 2021

2.1 SWWRF

The following is a listing of proposed projects for the SWWRF

- <u>SWWRF Headworks Replacement</u>- This project is for construction of a new headworks facility and yard piping improvements. The project is scheduled for FY 2017 and will include:
  - Demolition of the existing headworks and associated equipment and appurtenances
  - Headworks facility with screening, grit collection, odor control, piping, electrical, and, instrumentation and controls.
  - Yard piping improvements are required including: 1) New influent piping from the existing force main along 53rd Avenue West to the new headworks facility 2) Bypass piping for emergency shutdown of headworks, 3) Interconnections with existing wastewater force mains, and 4) Reconnection with the existing flow equalization tank.
  - Electrical upgrades to HW1 and HW2 motor control centers (MCCs).

- <u>SWWRF Belt Filter Press System Improvements</u> - This project is for various improvements to the existing belt filter presses and related equipment for sludge dewatering, demolition of equipment associated with the shuttered anaerobic digestion system, and recommended improvements from the SWWRF Electrical Master Plan. The project combines previously established CIP projects WW01251 and WW0137. The project is scheduled for FY 2018 and will include:

– Rehabilitate one existing belt filter press (BFP) and full replacement of one existing BFP and associated polymer feed systems. This will require modification and rehabilitation of the existing sludge conveyor.
– Replace the electrical, instrumentation and control systems on all six existing BFPs to facilitate automatic remote operation.
– Install cameras to visually monitor BFPs, conveyors and truck load-out from the Administration Building control room.
– Replace the existing belt filter press feed pumps and eddy current drives. Improvements to sludge transfer pump piping, and replacement of the sludge transfer pumps as needed
– Replace associated electrical master plan components including Substations No. 7 & 8 and MCCs Nos. DW1, DW2, D1 and D2.
– Demolish existing anaerobic digestion equipment and generator, gravity thickeners and associated drain pump station, and remaining septage receiving equipment and appurtenances adjacent to the septage receiving pad
– Provide new concrete drying area and pavement
– Required SCADA programming for monitoring and control

- <u>SWWRF Chlorine Contact Chamber Rehabilitation and Deep Injection Well Booster Station</u> - This project is for various modifications and improvements to the existing chlorine contact chambers (CCC) and addition of a new booster pump station to facilitate pumping of reuse water to the on-site recharge well. The project is scheduled for FY 2018 and will include:

– Add baffles or piping to prevent water returned from the reuse storage lakes from short circuiting to the recharge well feed.
– Replace the existing CCC influent and effluent gates and remove existing, unused gates.
– Eliminate the existing bypass channel between CCCs Nos. 2 and 3.
– Install pumps or a pumping system to facilitate drainage of the CCCs for cleaning/maintenance.
– Inspect the existing structures and walkways and repair as required.
– Provide fiberglass covers for CCCs, including channels.
– Replace the existing blowers and diffusers for the CCCs with an alternate mixing system.
– Demolish the existing mixing blower building and DAF polymer building.

- Provide a recharge well injection booster station building with redundant pumps to deliver maximum flow at maximum pressure that can be permitted. This includes a new electrical room for Motor Control Centers (MCCs), PLC (if needed) and other required electrical and instrumentation/controls appurtenances. All new and existing appurtenances are to be included such as flow metering, pressure monitoring, SCADA telemetry/control, and surge valve/control.
- Eliminate old/unused distribution panels, conduits and witing in chlorine area and relocate existing electrical distribution equipment to new building

- <u>SWWRF Equalization Tank Improvements</u> - This project is for new flow equalization (FEQ) facilities, modifications to the existing filter bypass pump station to allow for temporary flow equalization to the filters during construction, demolition of existing FEQ facilities, nearby dissolved air flotation (DAF) facilities, and other miscellaneous facilities. This project is scheduled for FY 2019 and will include:
  - Demolish the existing 4.0 MG flow equalization storage tank and flow return pump station.
  - Construct two (2) 2.5 MG flow equalization storage tanks including mixing systems to keep solids in suspension.
  - New flow return pump station including a permanent hoist for removing pumps.
  - New odor control and chemical storage/feed facility.
  - SCADA programming; and appurtenances for ventilation/odor control shall be provided.
  - New transformer and MCC for existing and new FEQ power loads along with any loads remaining on Substation Nos. 5 & 6/MCC B1-B4, which shall be removed.
  - Replace existing vertical turbine pumps in the Filter Bypass Pump Station (4 total) to provide 12 mgd capacity.
  - Demolition of the RAS/Recycle pumps (including piping and pad), DAF tanks and equipment, overhead channel between anoxic and aeration basins and unused channels/tanks at head of aeration basins.

- <u>SWWRF Bleach Tank Roof</u> - This project is for a new chemical storage and feed facility to accommodate five sodium hypochlorite storage tanks and modifications to the existing containment structure for the ammonium sulfate storage tank. This project is scheduled for FY 2019 and will include:
  - Overhead canopy to limit exposure of the chemical storage tanks to sunlight and weather.
  - <u>Add overhead canopy to existing containment structure for the ammonium sulfate storage tank</u>

- Containment structure including safety eyewash/shower (with flow alarm to SCADA), hose bibs, lighting, and other necessary appurtenances.
- Relocate existing sodium hypochlorite feed pumps from the chemical feed building.
- Provide protective encasement (piping or concrete) for any new chemical feed to the CCCs.
- All necessary electrical, instrumentation and SCADA work.

- Electrical Distribution System Rehabilitation and Enhancement - This project is for needed modifications, rehabilitations, and enhancements to components of the electrical distribution system at the SWWRF. This project is scheduled for FY 2019 and will include:
  - New HVAC for electrical rooms.
  - Remove Substations Nos. 1, 2, 9 & 10.
  - Replace MCCs Nos. E1 and E2.
  - Replace Switchboards Nos. 11 and 12.
  - Replace main 5 kV switch gear and 5kV wiring.
  - Replace the 5kV breakers/controls for the existing generators.

- SWWRF Second Cloth Filter - This project is for conversion of Automatic Backwash (ABW) Filer No. 2 to a diamond clothe filter. The project is scheduled for FY 2020 and will include:
  - Convert the existing ABW Filter No. 2 to a diamond cloth filter (similar to Filter No. 1), including demolition of the existing sand filter components, installation of the equipment needed for the new cloth filter.
  - Modifications to the existing piping and channels to ensure proper distribution of water between filters and CCCs.
  - Provide a canopy over Filters Nos. 1 and 2 including hoists/trolleys for removal of filter equipment.
  - All necessary electrical, instrumentation and SCADA work.

2.2 SEWRF

The following is a listing of proposed projects for the SEWRF

- RAS and WAS System Rehabilitation - This project is for various upgrades to the RAS and WAS systems. The project is scheduled for FY 2018 and will include:
  - Replace three (3) RAS pumps, motors, and variable frequency drives (VFDs).
  - Replace four (4) WAS pumps and belt driven motors.

- Replace existing RAS and WAS piping and valves which consists of ten (10) WAS automated valves, five (5) WAS manual valves, seven (7) RAS manual valves, two (2) reclaimed water valves.
- Add piping interconnections with the plant water system to provide flushing capability for the RAS pumps with reclaim water.
- Provide a new scum removal system that can remove solid debris and rags before it reaches sludge holding tanks. This would include demolition of the existing scum ejectors, air compressors, pneumatic controls and piping and replacing with progressive cavity pumps and necessary piping.
- Remove five (5) manual slide gates at the mixed liquor splitter box and replace with slide gates equipped with motor actuators.
- All necessary electrical, instrumentation and SCADA work.

- <u>Dedicated Plant Drain Stations</u> - This project is for new plant drain stations for the biosolids dryer and septage receiving facilities, interconnection of existing stations for redundancy, and other improvements. The project is scheduled for FY 2018 and will include:
  - A new drainage pump station to receive and convey cooling water from the biosolids dryer facility and convey to either the existing headworks or flow equalization (FEQ) tank.
  - A new lift station at the septage receiving facilities station to convey water to either the headworks or the FEQ tanks.
  - Interconnect the existing South Plant drain station with the North Plant drain station with a gravity pipeline
  - Upgrade the South Plant Drain Pump Station with higher capacity pumps
  - All necessary electrical, instrumentation and SCADA work.

- <u>Storage Lakes and Pump Back Station Improvements</u> - This project is for improvements and modifications to the existing reuse water storage lakes and pump stations. The project is scheduled for FY 2018 and will include:
  - Reduce the side slope on East Lake and South Lake II berms to 3:1, where necessary.
  - Provide erosion control at existing pump stations or relocate pump stations to outside of berms.
  - Increase pump back capacity on each lake to 10 mgd.
  - Install new energy dissipating inlets on each lakes.
  - Install emergency overflows.
  - All necessary electrical, instrumentation and SCADA work.

- <u>Arc Flash Mitigation</u> - This project is for upgrades to existing power distribution system components to mitigate arc flash hazards and improve operation staff safety. The project is scheduled for FY 2019 and will include:
  - Replace nine existing disconnects (as identified in the SEWRF Short Circuit, Coordination, and Arc Flash Studies) to either a NEMA 4X or NEMA 1 rating if appropriate,
  - Replace MCCs Nos. 9 and 10.
  - Install a new breaker between the FPL transformer and the Biosolids Dryer MCC. The MCCs and breaker shall be specified for minimal arc flash hazard.

- <u>Anoxic/Aeration Basins Enhancements</u> - This project is for various improvements to the existing anoxic/aeration basins. The project is scheduled for FY 2020 and will include:
  - Remove and replace the existing anoxic mixers and aerators in Anoxic/Aerobic Basins Nos. 1, 2 and 3. Alternate technology should be considered for both. Replace existing power cables and breakers.
  - Perform a structural inspection of Anoxic/Aerobic Basin No. 3 and recommend/design any structural repairs or modifications required.
  - Replace the existing fiberglass cover (with concrete or aluminum grating) and existing return mixed liquor gate on Anoxic/Aerobic Basin No. 3.
  - Replace the existing sluice gates on Anoxic/Aerobic Basins Nos. 1 and 2. Replace the weir gates at the influent splitter box (11 total).
  - Remove existing return mixed liquor (RML) pumps, piping from Basins Nos. 1 and 2. Remove wiring and breakers.
  - Provide new concrete trough with slide gates for RML flow for Basins Nos. 1 and 2.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

- <u>Automatic Backwash Filters Refurbishment</u> - This project is for rehabilitation of ABWs Nos. 3 and 4. The project is scheduled for FY 2020 and will include:
  - Retrofit of the existing automatic backwash with diamond cloth filters. This includes removal of the filter media, washwater troughs, porous plates, and air diffusers.
  - All necessary electrical, instrumentation and SCADA work.

- <u>Replacement of Slide and Sluice Gates</u> - This project is for various improvements at the CCCs. The project is scheduled for FY 2020 and will include;
  - Remove and replace all sluice and slide gates (including all actuators and handles) at the CCCs and the mixing/flocculation basins. The gate locations are as follows: seven (7) slide gates and three (3) sluice gates at CCC Nos. 1 and

2, five (5) slide gates and three (3) sluice gates at CCCs Nos. 3 and 4, and six (6) slide gates at the mixing/flocculation basin.

- Replace the existing blowers and aerators for mixing of CCCs.
- Add fiberglass covers to CCCs.
- Provide carrier pipe or concrete conduit system for protection of underground PVC chlorine feed lines.

- Flow Equalization Tanks and Mixed Liquor Splitter Box Rehabilitation - This project is for various rehabilitation items at the FEQ tanks and mixed liquor splitter box. The project is scheduled for FY 2021 and will include:
  - Clean and remove debris from both FEQ tanks. Inspect and repair tanks as needed.
  - Replace all five (5) submersible pumps (two-30 HP and three-10 HP) in the flow splitter box including feed wire and controls. Provide a new hoist and monorail system for removing pumps.
  - Replace existing above ground ductile iron discharge piping (16" and 12"), plug valves (one 12", ten 8", five 16" valves) and check valves (five 8" valves).
  - Clean and remove debris from submersible pump well at flow splitter box.
  - Paint exterior walls of FEQ tanks and flow splitter box.
  - Replace all odor control ducting and dampers at flow splitter box and all ducting between splitter box and odor control unit.
  - Upgrade existing lighting to LED's.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

- Headworks Hydraulic Improvements - This project is for improvements to the headworks and downstream piping (from headworks to flow splitter box) to increase the hydraulic capacity: The project is proposed for FY 2021 and will include:
  - Demolish existing yard piping and valves as necessary.
  - Redesign and replace downstream piping.
  - Modifications to headworks structure and/or equipment
  - Bypass pumping system during construction.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

2.3 NRWRF

The following is a listing of proposed projects for the NRWRF

- NRWRF Headworks Second Grit Removal - This project is to add a second grit removal system to the NRWRF headworks. This project is scheduled for FY 2018 and will include
  - A second grit removal unit (Eutek HeadCell) to match existing equipment.
  - Two (2) new grit pumps, associated valves and piping
  - New grit cyclone (Slurry Cup) and grit classifier (Grit Snail) to match existing equipment.
  - All gates, liners, and piping needed to complete the second independent grit removal system.
  - Install all electrical panels and SCADA connections needed to match existing system installed.
  - Two additional mechanical slide gates to isolate north and south flow.
  - All necessary electrical, instrumentation and SCADA work.

- Secondary Clarifiers Nos. 1 and 2 Refurbishment - This project is for various refurbishment items on Secondary Clarifiers Nos. 1 and 2. The project is scheduled for FY 2018 and will include:
  - Reseal all existing joints and grout the clarifier floors.
  - Replace the secondary clarifier mechanical equipment including the drives, rakes, and sludge suction tubes.
  - Repair and replace the clarifier launders, V-notch weirs, and scum baffles.
  - Replace inlet and slide gates and all gate control mechanisms.
  - Replace the existing ducking skimmers for scum removal with full-radius skimmer and scum beach.
  - Provide a new scum removal system that can remove solid debris and rags before it reaches sludge holding tanks. This would include demolition of the existing scum ejectors, air compressors, pneumatic controls and piping and replacing with progressive cavity pumps and necessary piping.
  - Provide new clarifier control panels and tie-in all status/alarms controls to existing SCADA include upgrade of the existing PLC if needed.

- Chlorine Contact Chamber Refurbishment - This project if for various refurbishment items on Chlorine Contact Chambers Nos 1 and 2. The project is scheduled for FY 2018 and will include:
  - Replace the expansion strips and provide a new seal coat on both CCCs.
  - Replace all the inlet slide gates and slide gate control mechanisms.
  - Install an isolation valve on the existing 36" line.
  - Replace the existing blowers and diffusers for the CCCs with an alternate mixing system.

- Add fiberglass covers to both CCCs.
- Provide carrier pipe or concrete conduit system for protection of existing underground PVC chlorine feed lines.

- Belt Filter Press No. 4 and Automation - This project is for various improvements to the existing belt filter presses and related equipment. The project is scheduled for FY 2019 and will include:
  - Install a fourth belt filter press (BFP), associated catwalk and other required appurtenances; two additional polymer and sludge feed pumps; and one additional polymer mixing tank.
  - Rehabilitate and modify the existing sludge conveyor and truck load-out system to accommodate the new BFP and an additional truck.
  - Expand/modify existing canopy, roadway, and security fence at dewatering building for additional truck access.
  - Rehabilitate the existing three BFPs. Replace power, instrumentation, and controls to facilitate automatic operation.
  - Install cameras to visually monitor BFPs, conveyors and truck load-out from the Administration Building control room.
  - All necessary electrical, instrumentation and SCADA work.

- NRWRF Reclaimed Water Storage Lake Improvements - This project is for improvements to the reclaimed water storage lakes. The project is scheduled for FY 2020 and will include:
  - Reduce the lake berm slope to 3:1 where necessary on the Golf Course Lake.
  - Remove all peninsulas in the Golf Course Lake and level berm to a slightly higher elevation than the wetlands south of the lake.
  - Rehabilitate the existing outfall structures and install emergency overflows. Include manual slide gates for improved flow control.

- NRWRF 10 MG Reclaimed Water Storage Tank & HSPS - This project is for a new 10 MG reclaimed water storage tank and high service pumps station (HSPS) to feed the Master Reuse System (MRS) and the plant water system. The project is scheduled for 2021 and will include:
  - Demolition of the existing steel storage tank and grouting and/or removal of the existing piping.
  - Installation of a new 10 million gallon (MG) reclaimed water storage tank
  - New high service pump station (HSPS) with electrical building for MCCs, VFDs and other electrical and instrumentation and controls equipment.
  - Conversion of the existing effluent pump station to a low pressure transfer station to convey effluent to the storage lakes and the new 10 MG tank.

- All necessary appurtenances, including valves, piping, electrical, instrumentation and controls, and SCADA programming modifications and additions.

3.0 10-YEAR CIP

The 10-year CIP extends through 2027, and the projects described in this section are scheduled or proposed for FYs 2022 - 2027.

3.1 SWWRF

The following is a listing of proposed projects for the SWWRF:

- SWWRF Stormwater System Rehabilitation: This project is for required rehabilitation, modifications, and improvements to the stormwater drainage, collection, and storage system to eliminate on-site flooding. The project is scheduled for FY 2022 and will include:
  - Engineering evaluation and design of improvements to the existing stormwater system.
  - Modifications and rehabilitation to stormwater inlets, outlets, piping, swales, and stormwater ponds
  - Modifications to historical grades or grade per new design to convey stormwater to existing or new stormwater features for treatment and/or conveyance off site. Rehabilitate stormwater piping, inlets, and outlets.
  - Re-establish stormwater pond volumes, litoral zones, and banks to historical or new permit conditions.
  - Inspect North Lake toe drain and recommend maintenance. The boundaries of the project are the area inside and adjacent to the SWWRF fence including the Wastewater Laboratory.
  - All permitting and modifications to the Stormwater Pollution Prevention Plan.

- SWWRF Expansion - Provide new biological process tanks to increase capacity to approximately 16.0 mgd. This project is proposed for FY 2022 and will include:
  - Anoxic Basin No. 5 with mixing and gates
  - Aeration Basin No. 5 with fine bubble diffusers and gates
  - Air distribution piping and control valves
  - Return mixed liquor pumps, piping and appurtenances
  - New yard piping and existing piping modifications
  - Site civil, paving and drainage
  - All necessary electrical, instrumentation and SCADA work.

3.2 SEWRF

The following is a listing of proposed projects for the SEWRF:

- Administration Building Rehabilitation - This project is for rehabilitation of the existing Administration building. This project is scheduled for FY 2022 and will include:
  - Replace the existing roof.
  - Replace A/C and air handling units
  - Identify and perform exterior repairs including painting and replacing exterior doors and lighting
  - Various interior repairs and replacement of floors, cabinets, plumbing, employee locker and shower areas, enclose ice machine area, and lighting upgrades.

- Belt Filter Presses Rehabilitation - This project is for rehabilitation of existing belt filter presses and related equipment for sludge dewatering. The project is scheduled for FY 2022 and will include
  - Rehabilitate BFP No. 2.
  - Install one new BFP, control panel, sludge feed pump, two new washwater booster pumps, dry polymer mixing system and two polymer storage tanks.
  - Relocate four existing booster pumps and water heater.
  - Replace sludge feed piping.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

- Secondary Clarifiers Rehabilitation - This project is for various refurbishment item on Secondary Clarifiers Nos. 1 and 2. The project is scheduled for FY 2022 and will include:
  - Re-grout clarifier floors.
  - Replace secondary clarifier mechanical equipment including the stilling well, sludge box, rakes, and sludge suction tubes.
  - Replace the V-notch weirs, and scum baffles.
  - Replace the existing skimmers with full-radius skimmers and skimmer and scum beach.
  - Re-coat clarifier parts and structure.

- Second 10 MG Reclaimed Water GST and MCMRS Chlorination System - This project is for addition of a new reclaimed water ground storage tank (GST) and chlorination system. This project is scheduled for FY 2022 and will include:
  - Addition of a 10 MG prestressed concrete reclaimed water storage tank to match the existing tank with associated piping, valves, and appurtenances.

- New sodium hypochlorite storage and feed system with: 1) An overhead canopy and side panels to limit exposure of the chemical storage tanks to sunlight and weather; 2) containment structure including safety eyewash/shower (with flow alarm to SCADA), hose bibs, lighting, and other necessary appurtenances; and 3) Sodium hypochlorite feed pumps and piping
- All necessary electrical, instrumentation and controls and SCADA integration work.

- Rehabilitate Gravity Belt Thickener No. 1 - This project is for rehabilitation of Gravity Belt Thickener No. 1, control panel and appurtenances. This project is recommended for FY 2024 and will include:
  - Rehabilitate GBT No. 1 including replacement of control panel and
  - Replace sludge transfer pump and piping.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

- Flow Equalization Tanks Diffuser System Replacement - This project is for evaluation of the existing diffusers/mixing system in the existing FEQ tanks. This project is recommended for FY 2024 and will include:
  - Evaluation, design, and replacement of the diffuser/mixing systems in the existing FEQ tanks. Alternate technology such as large bubble mixing should be considered.
  - Replacement of existing exterior piping and appurtenances.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

- SEWRF Improvements: This project is for addition of a new anoxic/aeration basin. The project is proposed for 2026 and will include:
  - One additional anoxic/aerobic basin with aerators, mixers, gates, and appurtenances.
  - One additional sludge holding tank with jet aeration mixing system
  - Yard piping and civil work
  - All necessary electrical, instrumentation and controls and SCADA integration work.

3.3 NRWRF

The following is a listing of proposed projects for the NRWRF

- NRWRF Maintenance Building Addition - This project is for construction of a new maintenance building. The project is scheduled for FY 2022 and will included:

– New metal maintenance building (approximately 58' x 38') located where the existing concrete slab is that was previously used for the Everfilt filters adjacent to the existing maintenance building.
– Building with mechanical and electrical shops two offices and restroom facilities.

4.0 20-YEAR CIP

The 20-year CIP extends through 2037 and the projects described in this section are proposed for FYs 2028 - 2037.

4.1 SWWRF

The following is a listing of proposed projects for the SWWRF

- <u>Secondary Clarifiers and WAS Improvements</u> - This project is for various improvements to existing equipment for Secondary Clarifiers Nos. 1 and 2 and WAS Pumps Nos. 3 and 4. The project is proposed for FY 2028 and will include:
  – Replace clarifier and skimming pump control panels for Secondary Clarifiers Nos. 1 and 2.
  – Replaced the VFDs for WAS Pump Nos. 3 and 4.
  – All necessary electrical, instrumentation and controls and SCADA integration work.

- <u>Effluent System Electrical/I&C Improvements</u> - This project is for improvements to various electrical and instrumentation and control components of the effluent system. The project is proposed for 2030 and will include:
  – Replace existing control panel for the chlorine feed pumps.
  – Replace existing VFDs for the effluent transfer pumps.
  – Replace motor operators on the middle pond slide gates.
  – All necessary electrical, instrumentation and controls and SCADA integration work.

4.2 SEWRF

The following is a listing of proposed projects for the SEWRF

- <u>Phase 2 Electrical System Upgrades</u> - This project is for various upgrades to power distribution equipment. The project is proposed for FY 2029 and will include:
  – Replace Main Switchgear Nos. 1 and 2 in the main electrical room.
  – Replace Generator Breakers Nos. 1, 2A, 2B and 3 in the main electrical room.
  – Replace MCCs Nos. 9 and 10.

- Replace Isolation Transformers Nos. 1, 2 and 3 in the main electrical room.
- Replace MCCs Nos. 5 and 6 in the Dewatering Building.
- Replace Isolation Transformers Nos. 1, 2 and 3.

- ABW Filters Nos. 1 and 2 Rehabilitation: The project is for complete rehabilitation of ABW filters Nos. 1 and 2. The project is proposed for FY 2034 and will include:
  - Rehabilitate ABW Filters No. 1 and 2 which may include underdrain systems, filter media, controls panels, skimmer assemblies, backwash shoe assemblies, backwash shoe tension assemblies, bridge drive assemblies, bridge idler assemblies, festoon cable systems, rails, rail caps, level sensors, limit switches, and limit switch trip peg assemblies.
  - All necessary electrical, instrumentation and controls and SCADA integration work.

4.3 NRWRF

The following is a listing of proposed projects for the NRWRF

- Electrical Upgrades - This project is for various upgrades to existing power distribution equipment and control panels. The project is proposed for FY 2029 and will include:
  - Replace MCCs Nos. 1, 2, 3 4 and Panel PC/TC in the main electrical room.
  - Replace MCCs Nos. 5 and 6 in the sludge dewatering building.

- Anoxic/Aeration Upgrades - This project is for various upgrades to the existing anoxic/aeration basins. The project is proposed for FY 2029 and will include:
  - Replace Anoxic Mixer No. 1 (South) and the motorized weir gate on Anoxic/Aerobic Basin No. 1
  - Replace Sluice Gates 3 and 4 and the motorized weir gate on Anoxic/Aerobic Basins No. 1

5.0 SUMMARY

Tables 5.1, 5.2 and 5.3 provide a summary of the total 20-year CIP, including existing and recommended master plan projects for the SWWRF, SEWRF and NRWRF, respectively.

Table 5.1 CIP Projects for SWWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

CIP Project Number	Project Name	Description of General Work	Project Start	Project Costs(1)
6083381	SWWRF Headworks	New headworks facility with screens, grit collection, odor control, yard piping, electrical, and controls. Demolition of existing headworks and associated equipment and appurtenances. Electrical upgrades to HW1 and HW2 MCCs.	FY 2017	$10,000,000
WW01251/ WW01371	SWWRF Belt Filter System Improvements	Various improvements to the existing belt filter presses and related equipment for sludge dewatering, demolition of equipment associated with the shuttered anaerobic digestion system, and recommended improvements from the SWWRF Electrical Master Plan. The project combines previously established CIP projects WW01251 and WW01371.	FY 2018	$3,450,000
WW01222	Chlorine Contact Chamber Rehabilitation and DIW Booster Station	Various modifications and improvements to the existing chlorine contact chambers (CCC) and addition of a new booster pump station to facilitate pumping of reuse water to the on-site recharge well.	FY 2018	$6,670,000
WW01254	SWWRF Equalization Tank Improvements	Install two new equalization tanks with mixing systems, odor control system, and return pumping station. Includes demolition of existing EQ tank and pump station, nearby DAF facilities, and other miscellaneous facilities.	FY 2019	$8,410,000
WW01256	Bleach Tank Roof Over	New chemical storage and feed facility to accommodate five sodium hypochlorite storage tanks. Add overhead canopy to existing containment structure for the ammonium sulfate tank.	FY 2019	$902,000

Table 5.1 CIP Projects for SWWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

WW01370	Electrical Distribution System Rehabilitation and Enhancement	Modifications, rehabilitations, and enhancements to components of the electrical distribution system.	FY 2019	$3,905,900
WW01423	SWWRF Second Cloth Filter	Conversion of Automatic Backwash (ABW) Filer No. 2 to a diamond cloth filter and installation of a canopy with bridge crane and trolley.	FY 2020	$4,710,000
TBD	Anoxic and Aeration Basins	Addition of Anoxic Basin No. 5 and Aeration Basin No. 5	FY 2022	$8,200,000
WW01627	Stormwater System Modifications	Rehabilitation, modifications, and improvements to the stormwater drainage, collection, and storage system to eliminate on-site flooding	FY 2022	$520,000
TBD	Secondary Clarifiers and WAS Improvements	Various improvements to existing equipment for Secondary Clarifiers Nos. 1 and 2 and WAS Pumps Nos. 3 and 4.	FY 2028	$200,000
TBD	Effluent System Electrical/I&C Improvements	Improvements to various electrical and instrumentation and control components for the effluent system.	FY 2030	$1,200,000

Notes:

(1) Project costs including engineering design and construction. The construction costs were based on Class 4 cost estimates according to the definitions of AACE International. Value represent the expected costs in the Project Start year Original estimates were in August 2013 dollars and escalated to the Project Start year assuming an escalation factor of 2.7%/year.

Table 5.2 CIP Projects for SEWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

CIP Project Number	Project Name[(1)]	Description of General Work	Project Start	Project Costs[(1)]
WW01249	RAS and WAS System Rehabilitation	Various upgrades to the RAS and WAS systems including replacement of existing RAS and WAS pumps, piping valves and slide gates, and installation of new scum pumping and screening system.	FY 2018	$2,832,000
WW01248	Dedicated Plant Drain Stations	New plant drain stations for the biosolids dryer and septage receiving facilities, interconnection of existing drain stations for redundancy, and other improvements.	FY 2018	$1,776,000
WW01250	Storage Lakes and Pump Back Station Improvements	Improvements and modifications to the reuse water storage lakes and pump stations including: reduce the side slopes on East Lake and South Lake II berms, erosion control at existing pump stations, increase pump back capacity at each lake to 10 mgd, installation of emergency overflows.	FY 2018	$7,780,000
WW01420	Arc Flash Mitigation	Upgrades to existing power distribution system components to mitigate arc flash hazards and improve operation staff safety.	FY 2019	$400,000
WW01417	Anoxic Basins Mixer Replacement	Various improvements to the existing anoxic basins including replacement of existing anoxic mixers and aerators in Anoxic/Aerobic Basins Nos. 1, 2 and 3, structural inspection and repairs or modifications as required, replacement of existing sluice and weir gates, removal of existing return mixed liquor pumps and replacement with concrete channel and slide gates.	FY 2020	$6,265,000
WW01418	Automatic Backwash Filters Refurbishment	Conversion of ABWs Nos. 3 and 4 to diamond cloth filters.	FY 2020	$7,560,000

Table 5.2 CIP Projects for SEWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

WW01416	Replacement of Slide and Sluice Gates	Improvements at the CCCs including replacement of existing slide and sluice gates, new chlorine mixing system, addition of FRP covers and a protection system for buried chlorine feed piping.	FY 2020	$1,723,000
	Flow Equalization Tanks and Mixed Liquor Splitter Box Rehabilitation	Various rehabilitation items at the FEQ tanks and mixed liquor splitter box including cleaning, evaluation and repair of FEQ tanks, replacement of submersible pumps, piping and valves, and odor control ducting at the mixed liquor box, painting, and upgrading of existing lighting to LEDs.	FY 2021	$1,385,000
TBD	Headworks Hydraulic Improvements	Redesign and replacement of yard piping downstream of the headworks (from headworks to flow splitter box) and modification to headworks structure and/or equipment to increase the hydraulic capacity.	FY 2021	$700,000
WW01622	Administration Building Rehabilitation	Rehabilitation of the existing Administration building including replacement of roof, AC and air handling units, exterior repairs, and interior improvements.	FY 2022	$205,000
WW01623	Belt Filter Presses Rehabilitation	Rehabilitation of existing BFP No. 2 and installation of a new BFP system including control panel, sludge feed pump, washwater booster pumps, dry polymer mixing system and polymer storage tanks. Relocate existing booster pumps and water heater and replace sludge feed piping.	FY 2022	$3,190,000
WW01624	Secondary Clarifiers Rehabilitation	Various refurbishment items on Secondary Clarifiers Nos. 1 and 2 including replacement of mechanical equipment, V-notch weirs and scum baffles, new full-radius skimmers and scum beaches. Re-grout clarifier floors.	FY 2022	$1,570,000
WW01626	Second 10 MG Reclaimed Water GST	New 10 MG reclaimed water ground storage tank and sodium hypochlorite storage and feed system.	FY 2022	$4,410,000

Table 5.2 CIP Projects for SEWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

	and MCMRS Chlorination System			
TBD	Rehabilitate Gravity Belt Thickener No. 1	Rehabilitation of Gravity Belt Thickener No. 1. Replace existing control panel, Sludge Transfer Pump No. 7 and piping, and appurtenances.	FY 2024	$1,270,000
TBD	Flow Equalization Tanks Diffuser System Replacement	Evaluation, design, and replacement of the diffuser/mixing systems in the existing FEQ tanks. Includes replacement of existing exterior piping and appurtenances.	FY 2024	$850,000
TBD	SEWRF Improvements	Addition of one Anoxic/Aeration Basin and one sludge holding tank, yard piping, electrical, and instrumentation & controls.	FY 2026	$12,600,000
TBD	Electrical System Upgrades	Replacement of power distribution equipment in the main electrical room including main switchgear, generator breakers, MCCs and isolation transformers. Also includes replacement of MCCs in the dewatering building.	FY 2029	$11,500,000
TBD	ABW Filters Nos. 1 and 2 Rehabilitation	Complete rehabilitation of ABW filters Nos. 1 and 2	FY 2034	$4,300,000

Notes:

(1) Project costs including engineering design and construction. The construction costs were based on Class 4 cost estimates according to the definitions of AACE International. Value represent the expected costs in the Project Start year Original estimates were in July 2015 dollars and escalated to the Project Start year assuming an escalation factor of 2.7%/year.

Table 5.3 CIP Projects for NRWRF
Water Reclamation Facilities – Master Plan Development
Manatee County

CIP Project Number	Project Name[1]	Description of General Work	Project Start	Project Costs[1]
WW01245	NRWRF Headworks Second Grit Removal	Add a second grit removal unit (Eutek HeadCell to the headworks to match existing equipment) including grit pumps, grit cyclone and classifier, slide gates, associated valves and piping, and control panels.	FY 2018	$1,720,000
WW01246	Secondary Clarifiers Nos. 1 and 2 Refurbishment	Various refurbishment items on Secondary Clarifiers Nos. 1 and 2 including replacement of mechanical equipment, V-notch weirs and scum baffles, scum skimmers and control panels. Re-grout clarifier floors. Provide new scum removal and screening system.	FY 2018	$1,860,000
WW01247	Chlorine Contact Chamber Refurbishment	Various refurbishment items on the CCCs including replacement of expansion strips and inlet slide gates, new seal coating, new chlorine mixing system, Install 36" isolation valve, addition of FRP covers, and a protection system for buried chlorine feed piping.	FY 2018	$1,760,000
WW01244	Belt Filter Press No. 4 and Automation	Various improvements to the existing belt filter presses and related equipment including new BFP system including control panel, sludge feed pump, washwater booster pumps, dry polymer mixing system and polymer storage tanks, Modify and expand sludge conveyor, truck loading system and existing canopy. Rehabilitate existing BFPs and install cameras for remote visual monitoring.	FY 2019	$3,155,000
WW01421	NRWRF Reclaimed Water Storage Lake Improvements	Improvements to the reclaimed water storage lakes including modifications to the lake berms slopes and elevations, removal of peninsulas to create additional lake volume, rehabilitation of outfall structures, and installation of emergency overflows.	FY 2020	$5,940,000

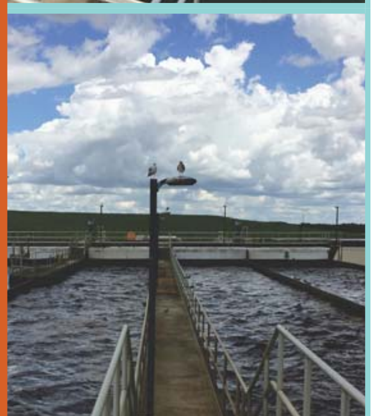
Table 5.3	CIP Projects for NRWRF Water Reclamation Facilities – Master Plan Development Manatee County			
WW01422	NRWRF 10 MG Reclaimed Water Storage Tank & HSPS	New 10 MG reclaimed water storage tank and HSPS to feed the MRS and plant reuse water system. Includes demolition of the existing storage tanks, and conversion of the existing effluent pump station to a low pressure transfer station to convey effluent to the storage lakes and the new 10 MG tank.	FY 2021	$4,410,000
WW01621	NRWRF Maintenance Building Addition -	Construction of a new maintenance building with mechanical and electrical shops, offices, and restroom facilities.	FY 2022	$250,000
TBD	NRWRF Electrical Upgrades	Upgrades to existing MCCs and control panels.	FY 2029	$3,700,000
TBD	Anoxic/Aeration Basin Upgrades	Upgrades to the existing anoxic/aeration basins including replacement of mixers, weir gates, and sluice gates.	FY 2029	$500,000

Notes:

(1) Project costs including engineering design and construction. The construction costs were based on Class 4 cost estimates according to the definitions of AACE International. Value represent the expected costs in the Project Start year Original estimates were in July 2015 dollars and escalated to the Project Start year assuming an escalation factor of 2.7%/year





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