Hazen

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LIQUID SOLUTIONS GROUP, LLC

Toho Water Authority

Lake Marion WRF Improvements – Workshop

Introduction

LMWRF Upgrades Workshop Agenda

Project Background
- Project Goals
- Review of Existing Process

Advanced Secondary vs. AWT
- Design Criteria
- Model Development
- Existing MLE Capability
- Advanced Secondary Process Modifications
- AWT Process Modifications
- Cost Comparison
- Process Recommendations
- Basin Upgrades

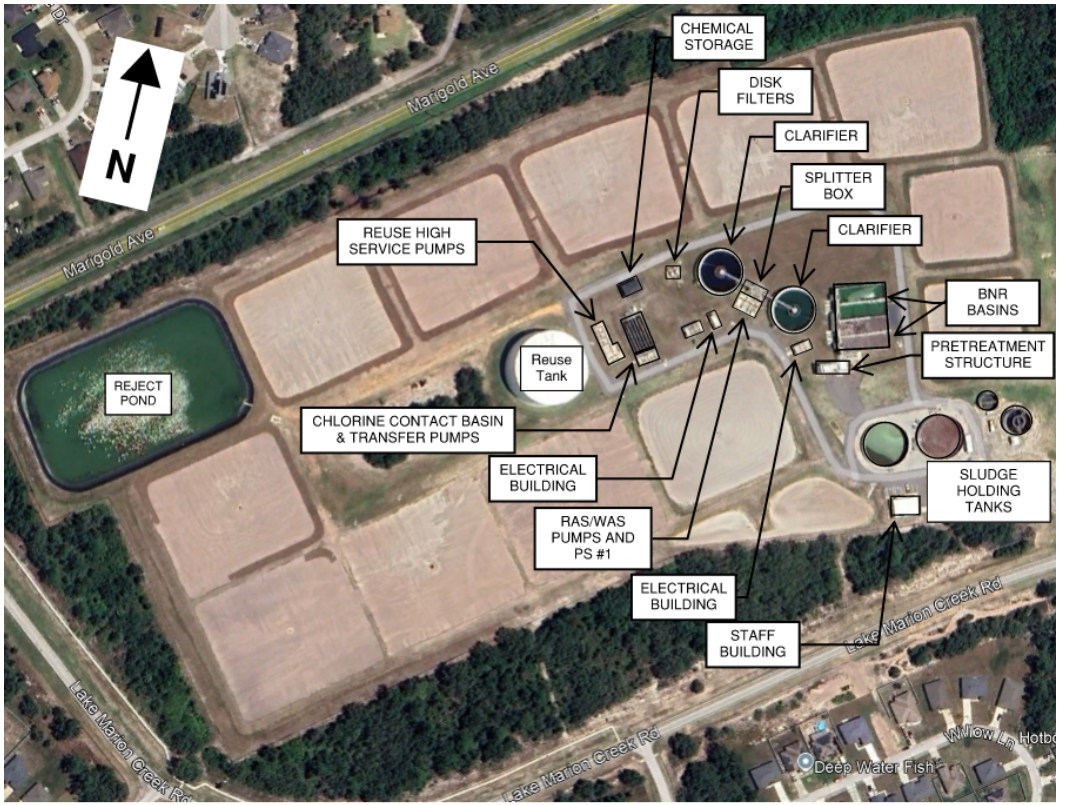
Plant-wide Improvements Recommended
- Headworks Improvements
- IR Pump Replacement
- RAS Pump Replacement
- Filters
- Wet Weather / PAR Storage
- Reject Pond Liner Repair
- Electrical / Engine Generator
- I&C / PLCs
- Stormwater Pond Repair

Conclusions

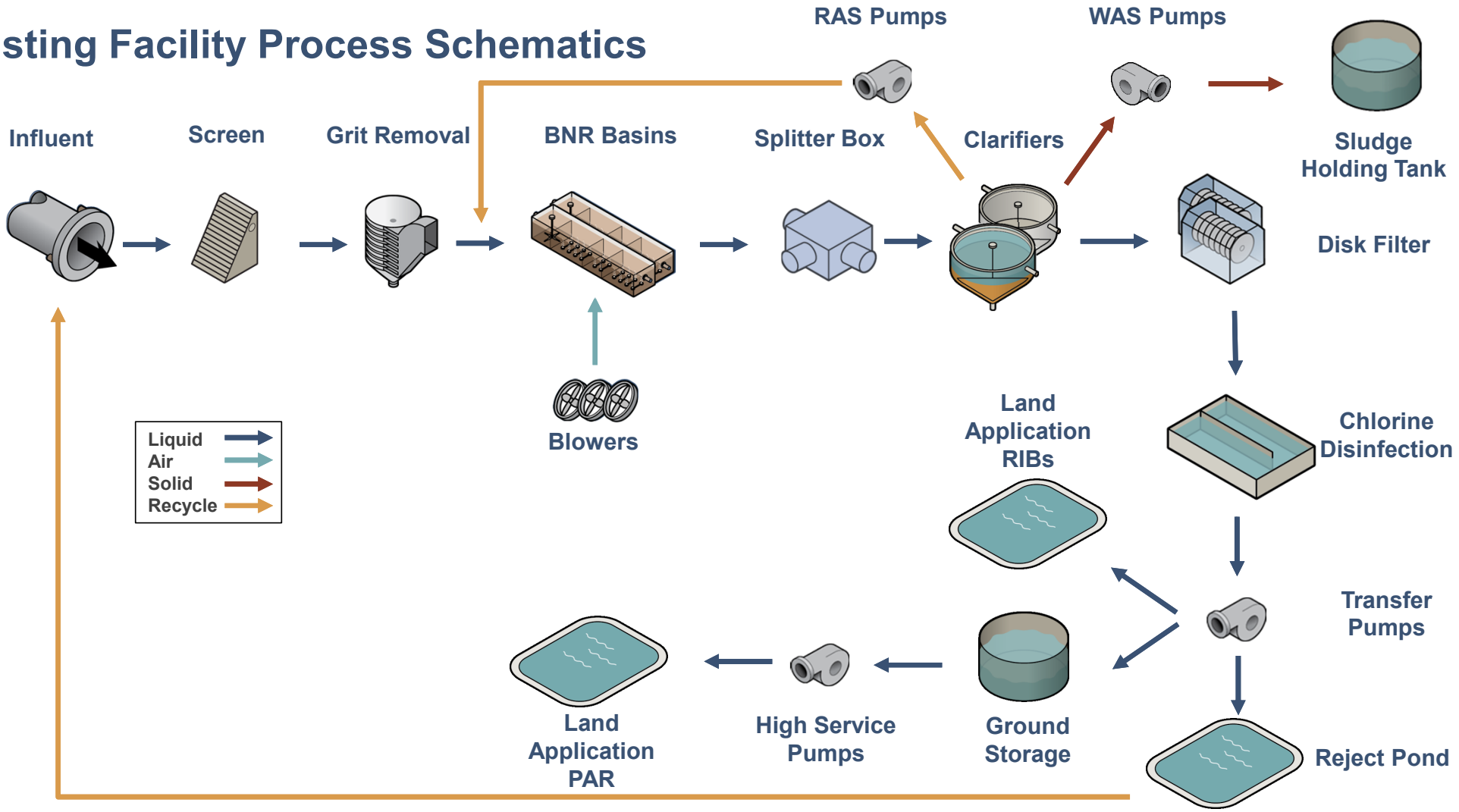
Project Background

Project Goals

- Advanced Secondary vs. AWT
  - *Current permit is set to reduce reject capacity via the RIBs unless AWT quality effluent is provided*
- Provide Strategic Improvements



Existing Facility Process Schematics



Advanced Secondary vs. AWT

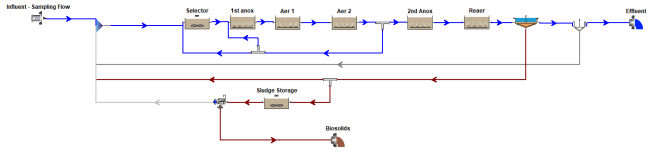
Evaluation Approach

Process Analysis

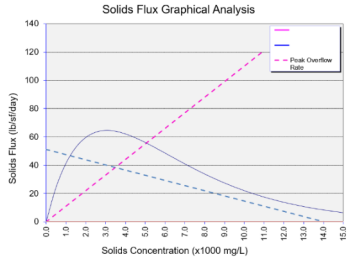
Design Loads

Boundary Conditions

Biowin



State Point Analysis



Process Tools (State Point Analysis and BioWin)

Effluent and Operating Conditions at Advanced Secondary and AWT Permit Limits

Identify infrastructure requirements

Design Criteria

Design Flows and Loads

AA Concentrations

Parameter	Value
BOD_5 (mg/L)	340
$cBOD_5$ (mg/L)	290
COD (mg/L)	731
TKN-N (mg/L)	58
TP-P (mg/L)	6.7
TSS (mg/L)	290

Load Peaking Factors

Condition	Peaking Factor
Annual Average	1
Max Month	1.17

Design Flows

Condition	Existing*	Peaking Factor	Permitted Capacity
Annual Average Daily Flow (mgd)	1.92*	1.00	3
Max Month Flow (mgd)	2.23*	1.17	3.51
Max Day Flow (mgd)	4.84	2.3	6.9
Peak Hour Flow (mgd)	-	3	9

*Averages from annual data. Jan 2021- June end 2024

Design Loads

Condition	Annual Average	Max Month
Flow (mgd)	3	3.51
BOD_5 (lb/d)	8,500	9,900
$cBOD_5$ (lb/d)	7,300	8,500
COD (lb/d)	18,300	21,400
TKN-N (lb/d)	1,500	1,700
TP-P (lb/d)	190	200
TSS (lb/d)	7,300	8,500

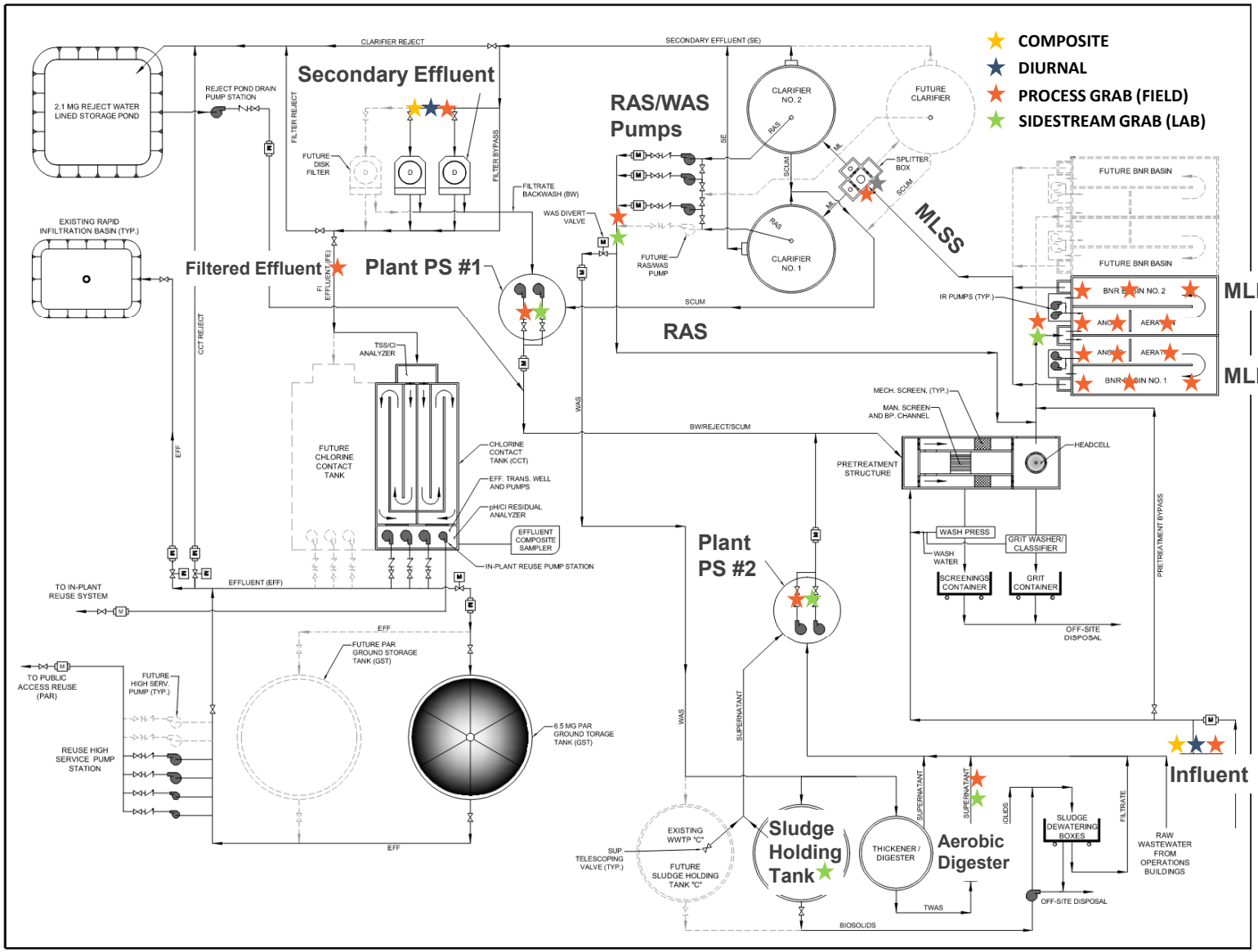
*Averages from annual data. Jan 2021- June end 2024

Class 1 Reliability

Component	Requirements
Screening	Backup bar screen required (may be manually cleaned).
Grit Removal	Backup not required.
Pumps	Backup sufficient to handle peak flow w/ one (1) pump out of service.
Aeration Basin	Minimum of two (2) basins of equal volume.
Blowers	With largest unit out of service, remaining units able to maintain design oxygen transfer.
Air Diffusers	In each basin - largest section can be isolated without measurably impairing oxygen transfer capability.
Final Clarifier	With largest unit out of service, remaining capacity is at least 75 percent of design flow.
Filters	With largest unit out of service, remaining capacity is at least 75 percent of design flow.
Chlorine Contact Chamber	With largest unit out of service, remaining capacity for at least 50 percent design flow.
Sludge Pumps	Sufficient capacity of remaining pumps to handle peak flow with one pump out of service; backup pump may be uninstalled.
Anaerobic Sludge Digestion	At least two digestion tanks shall be provided. Each tank shall have sufficient
Sludge Dewatering Equipment	Alternate methods of disposal or treatment provided.
Power Sources	Two separate and independent sources of electric power provided (e.g. utility and a generator). Capacity of backup power sufficient to operate all vital components during peak flow conditions.

Process Model Development

Sampling Event- Sample Locations



Biowin Validation Results (April 2022)

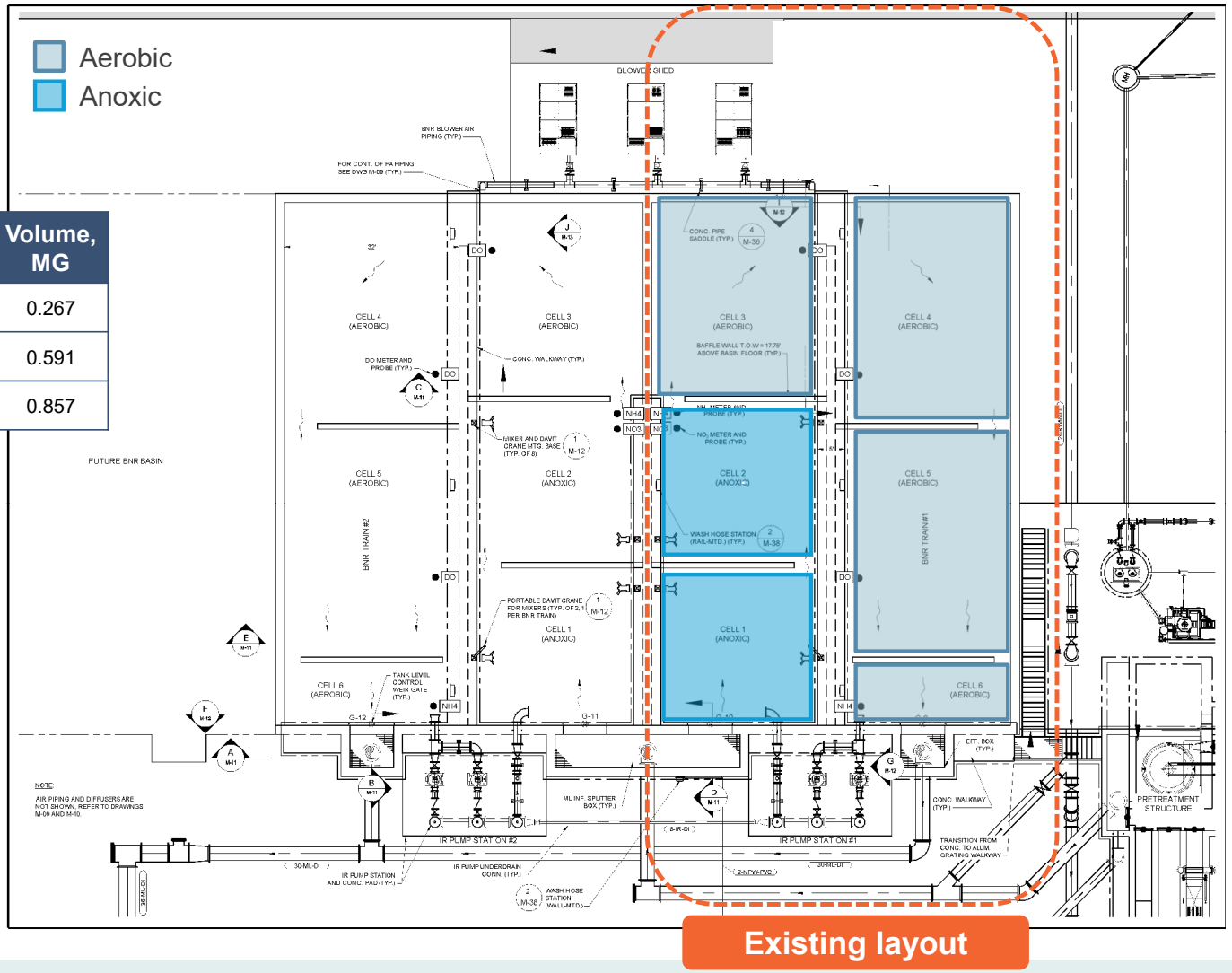
Parameter		April 2022	Modeled	% Difference
Raw Influent				
Raw Influent Flow	mgd	1.90	1.90	0%
Raw Influent BOD_5	mg/L	354	372	5%
Raw Influent TSS	mg/L	321	320	0%
Raw Influent TKN-N	mg/L	42	42	0%
Raw Influent TP-P	mg/L	7.30	7.30	0%
Raw Influent BOD_5	lb/d	5,603	5,901	5%
Raw Influent TSS	lb/d	5,087	5,070	1%
Raw Influent TKN-N	lb/d	666	666	0%
Raw Influent TP-P	lb/d	116	116	0%
Secondary				
Avg MLSS Plant	mg/L	5,498	5,466	1%
Total RAS Flow	mgd	0.81	0.81	0%
AVG RAS TSS	mg/L	17,915	18,194	2%
Total WAS Flow	mgd	0.03	0.03	0%
AVG WAS TSS	mg/L	17,912	18,194	2%
Total WAS Load	lb/d	4,482	4,555	2%

Parameter		April 2022	Modeled	% Difference
Secondary Effluent				
Plant Effluent NH_3-N	mg/L	Not Measured	<0.5	-
Plant Effluent NO_3-N	mg/L	4.97	3.63	-
Plant Effluent TN-N	mg/L	7.60	5.3	
Plant Effluent TP-P	mg/L	0.6	<0.3	-
Plant Effluent TSS	mg/L	0.71	0.87	-
Plant Effluent BOD_5	mg/L	1.3	1.1	-

Existing MLE Capability

Existing Tank Configuration

Zone	Percentage of Volume	Volume, MG
Anoxic	31%	0.267
Aerobic	69%	0.591
Total	100%	0.857



Existing Configuration, MLE

2 mg/L DO and Maximum IR Capacity of Existing Pumps

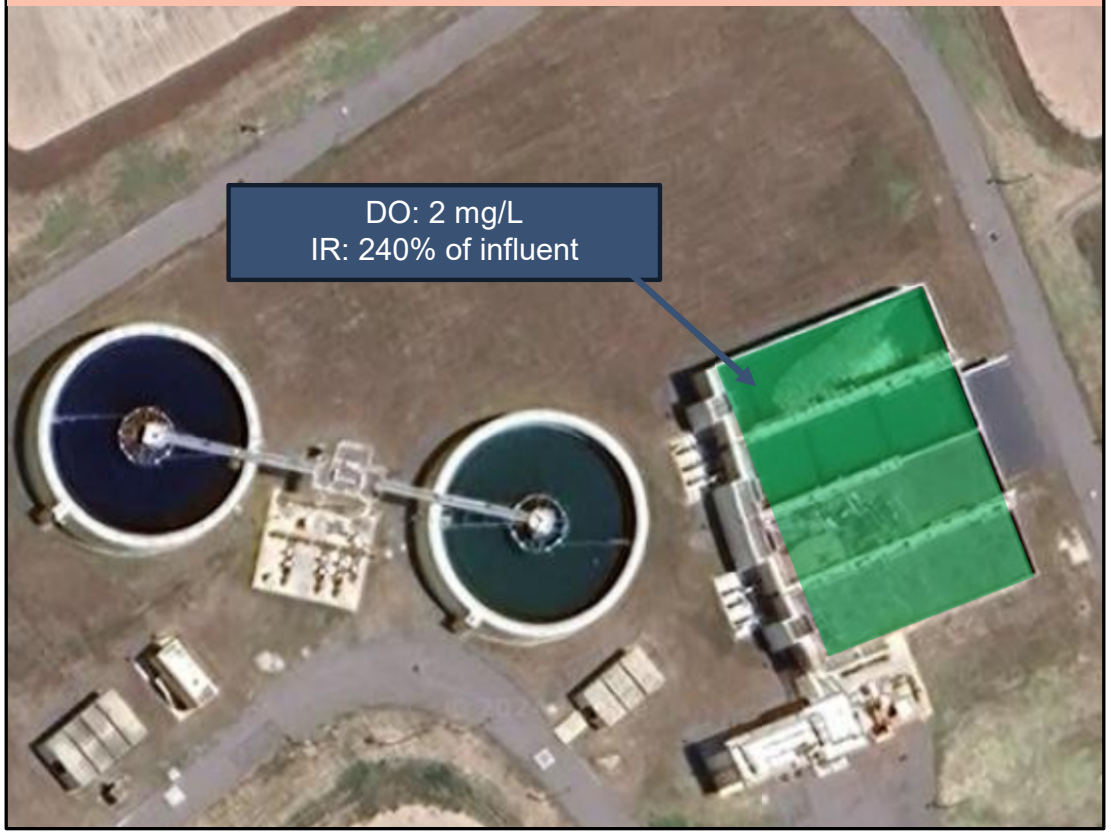
Effluent

Parameter	Units	AA
Temperature	C	25
Flow	mgd	3
TSS	mg/L	< 5
BOD_5	mg/L	< 5
NH_3-N	mg/L	< 0.3
NO_3-N	mg/L	> 8
TN-N	mg/L	> 10
TP-P	mg/L	< 0.8

Secondary

Parameter	Units	25C
MLSS	mg/L	4,300
Aerobic SRT	days	> 6
Carbon	gpd	0
Alum	gpd	0

TN Exceeds Advanced Secondary Effluent Limit at Design Flow



Existing MLE with Operational Modifications

Operational Modifications to Improve Effluent Quality

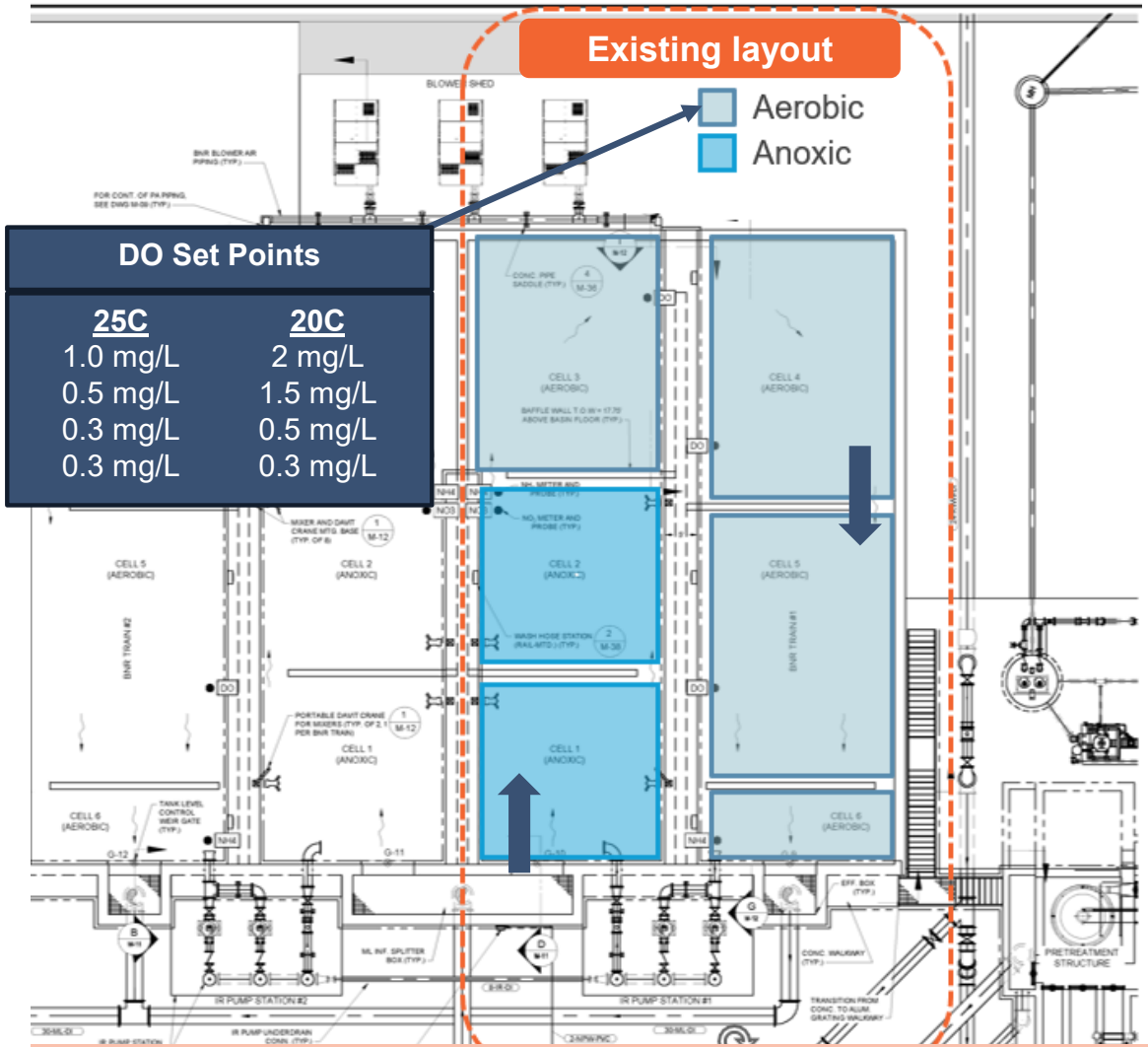
- DO control

Effluent

Parameter	Units	AA	
		25C	20C
Flow	mgd	3	
TN-N	mg/L	6.4	8.6
TP-P	mg/L	< 0.8	

Secondary

Parameter	Units	AA	
		25C	20C
MLSS	mg/L	4,500	
Aerobic SRT	days	> 6	
Carbon	gpd	0	
Alum	gpd	0	



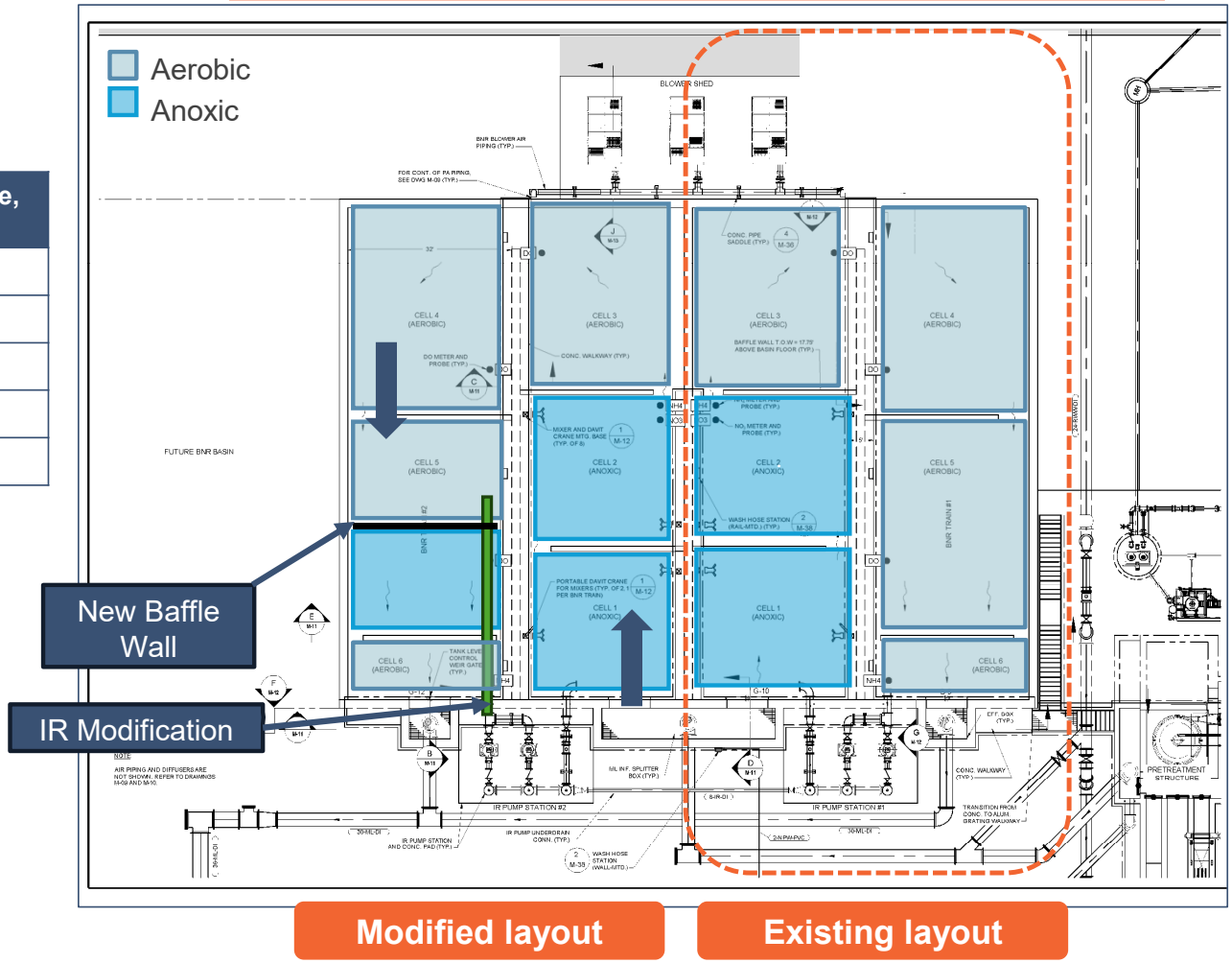
TN Exceeds Advanced Secondary Limit at Design Flow

What Modifications are Needed for Advanced Secondary?

Advanced Secondary Layout

Zone	Percentage of Volume	Volume, MG
1st Anoxic	31%	0.267
Aerobic	52%	0.442
2nd Anoxic	11%	0.096
Reaeration	6%	0.052
Total	100%	0.857

Convert MLE to 4-Stage Bardenpho (AOAO)



Advanced Secondary Requirements and Recommendations

- Effluent Limits
  - *< 6 mg/L Total Nitrogen*
  - *< 3 mg/L Total Phosphorous*
- Minimum Aerobic SRT 4 Days
- Chemical Facilities: Supplemental Carbon and Metal Salt (for Trim as Needed)

Advanced Secondary- All Units Online

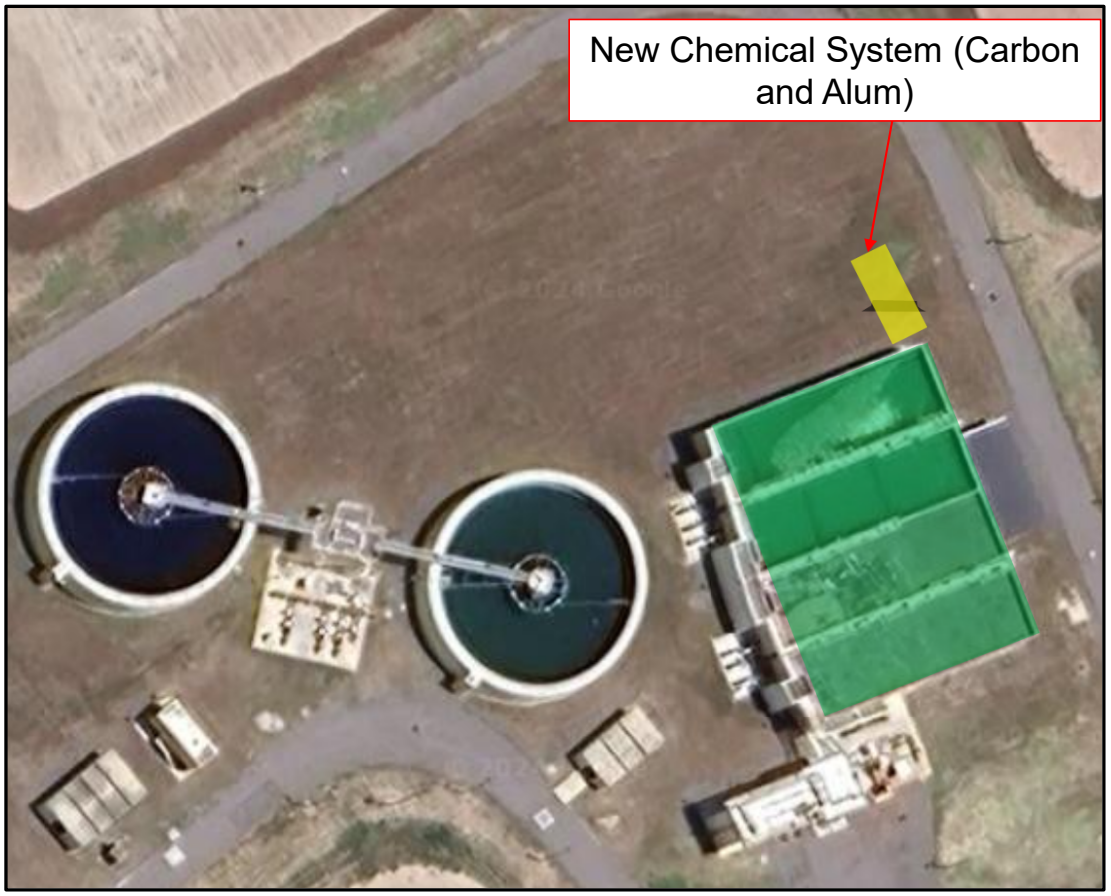
Min temperature (20C)

Effluent

Parameter	Units	MM
Temperature	C	20
Flow	mgd	3.51
TSS	mg/L	< 5
BOD_5	mg/L	< 5
NH_3-N	mg/L	< 0.4
NO_3-N	mg/L	< 4
TN-N	mg/L	< 5.6
TP-P	mg/L	< 0.8

Secondary

Parameter	Units	MM
MLSS	mg/L	4,400
Aerobic SRT	days	> 4
Carbon	gpd	0
Alum	gpd	0



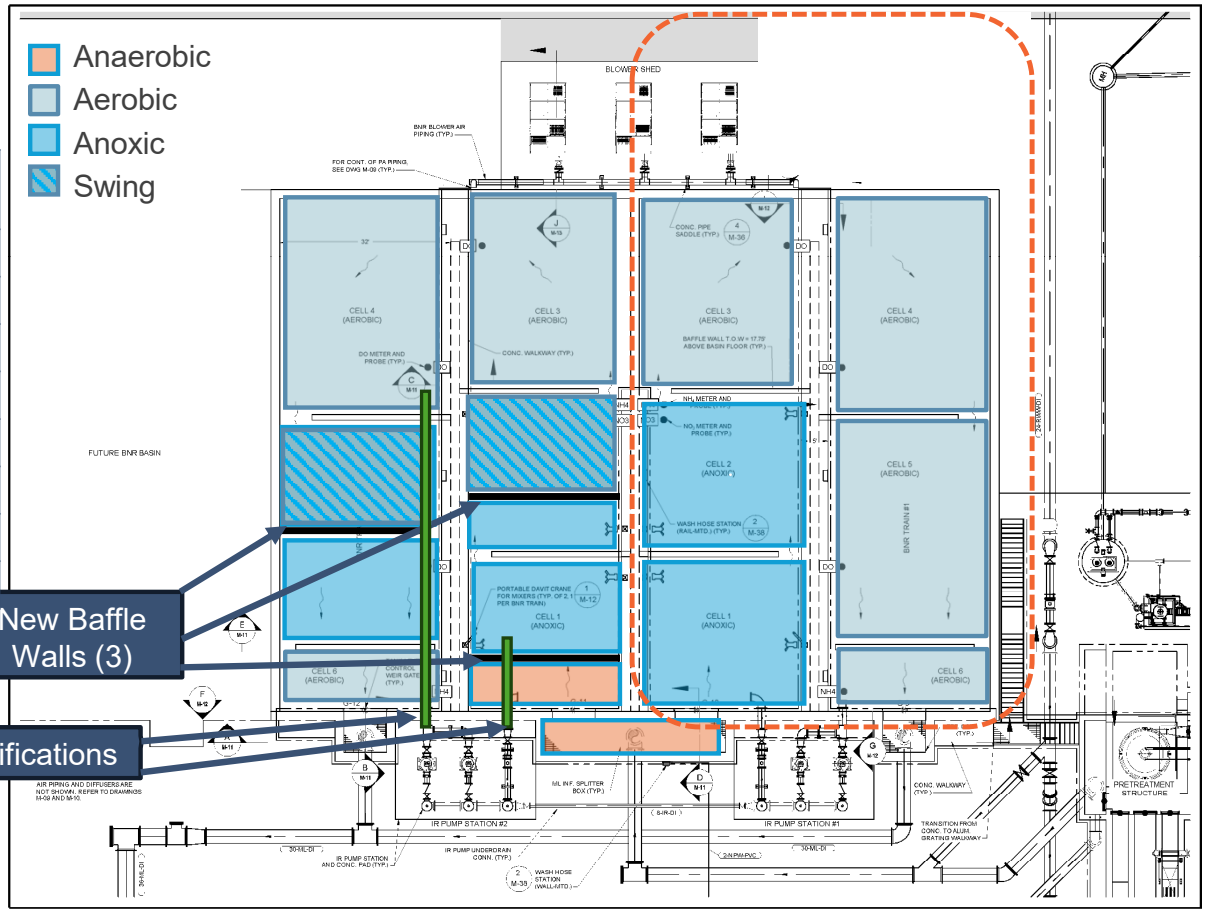
Meets Advanced Secondary Effluent Limits Year-Round

What Modifications are Needed for AWT?

AWT Layout

Zone	Percentage of Volume	Volume, MG
Anaerobic	9%	0.081
1st Anoxic	14%	0.126
1st Anoxic/Swing	10%	0.091
Aerobic	39%	0.346
2nd Anoxic/Swing	11%	0.096
2nd Anoxic	11%	0.096
Reaeration	6%	0.053
Total	100%	0.889

Convert MLE to 5-stage Bardenpho



AWT Requirements and Recommendations

- Effluent Limits
  - *< 3 mg/L Total Nitrogen*
  - *< 1 mg/L Total Phosphorous*
  - < 5 mg/L BOD_5
  - < 5 mg/L Total Suspended Solids
- Minimum Aerobic SRT: 4-5 Days
  - *4 Days at 25C*
  - *5 Days at 20C*
- Chemical Facilities: Supplemental Carbon and Metal Salt (for Trim as Needed)

AWT- All Units Online

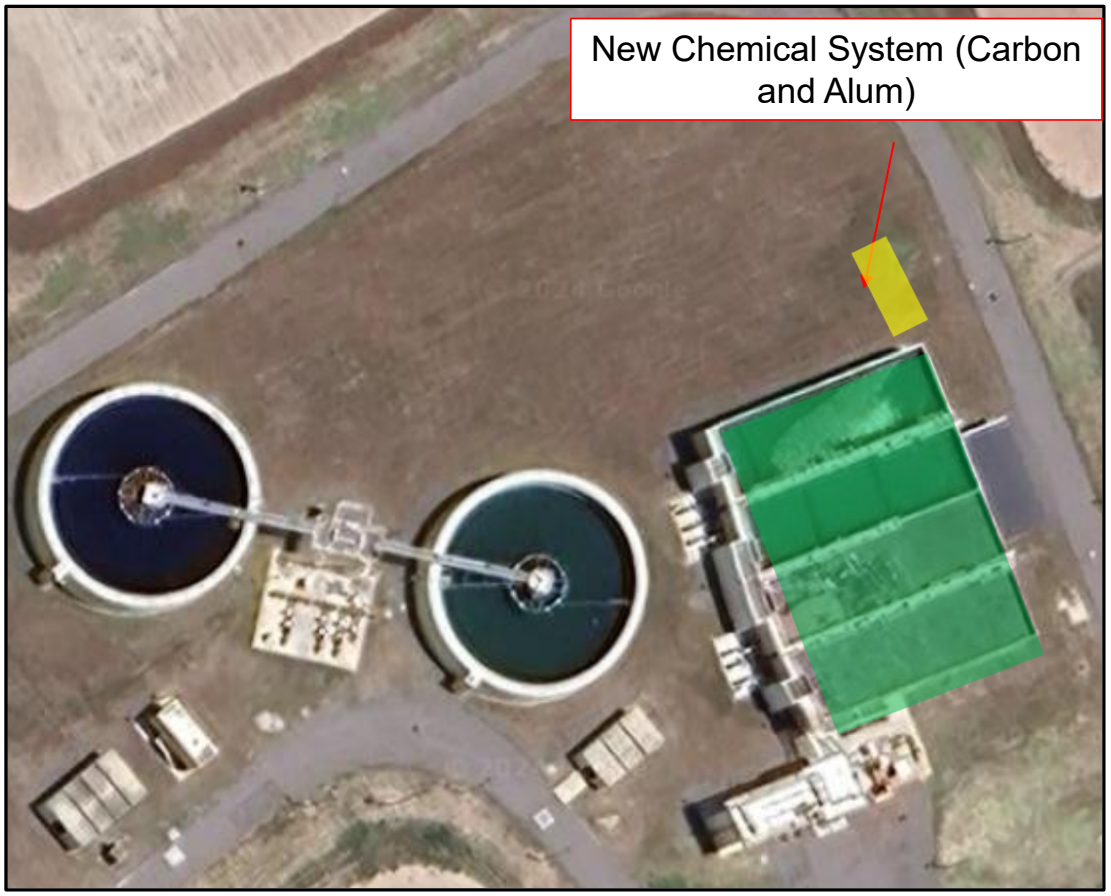
Min temperature (20C)

Effluent

Parameter	Units	MM
Temperature	C	20
Flow	mgd	3.51
TSS	mg/L	< 5
BOD_5	mg/L	< 5
NH_3-N	mg/L	< 0.6
NO_3-N	mg/L	< 1
TN-N	mg/L	< 3
TP-P	mg/L	< 0.8

Secondary

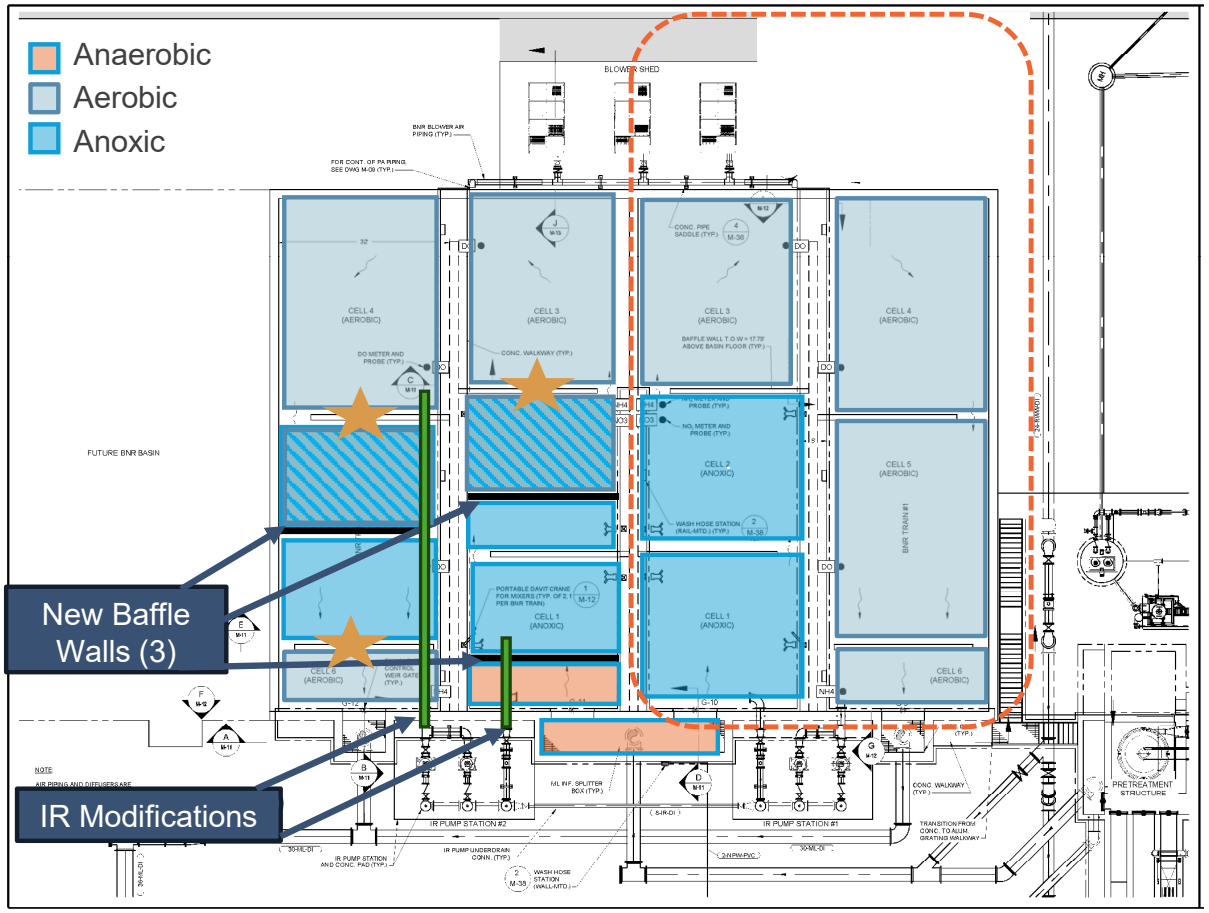
Parameter	Units	MM
MLSS	mg/L	4,500
Aerobic SRT	days	5
Carbon	gpd	0
Alum	gpd	0



Meets AWT Effluent Limits Year-Round

AWT Basin Modifications

- Anaerobic Zone
  - *New Mixers*
- 1st Anoxic/Swing
  - *New Diffusers*
- 2nd Anoxic
  - *New Mixers*
- IR Pump Modifications
- Air Piping
- Modified Baffle Walls ★
- Chemical Feed Dosing
- ABAC
- Improve IR pumps for 3Q flow.



Supplemental Carbon and Alum System - Example

Existing “Temporary” supplemental carbon at Hamlin WRF. The units at Lake Marion would be provided with an overhead canopy.

AWT vs. Advanced Secondary Costs

Conceptual Comparative Costs

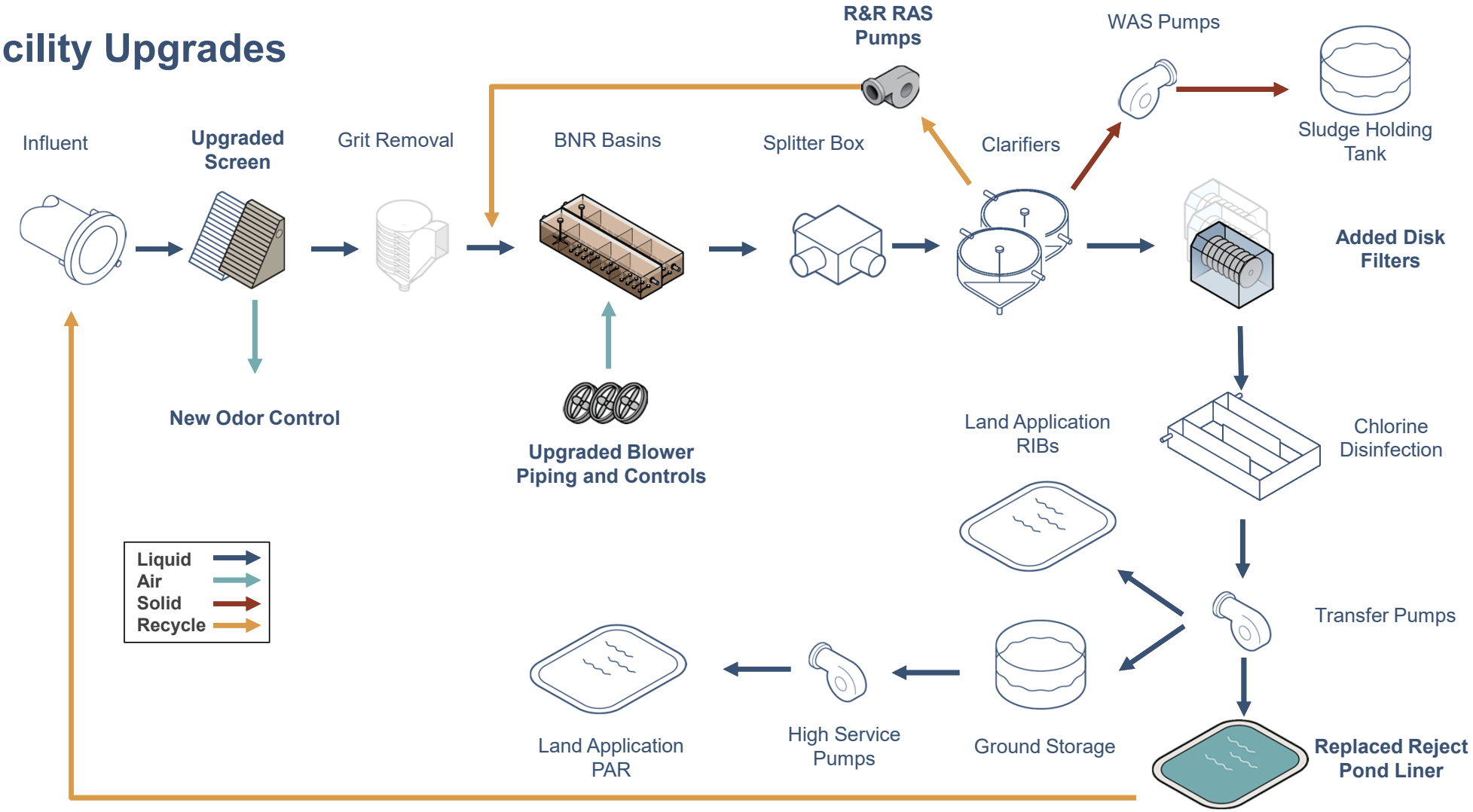
	Option 1	Option 2	Option 3
	Advanced Secondary	Advanced Secondary	AWT
	Basin Modifications	Basin Modifications	Basin Modifications
	Supplemental Carbon and Alum	Supplemental Carbon and Alum	Supplemental Carbon and Alum
	New GST (2 MG)	Expand Reject Pond	
Total	$6.7 M	$3.9 M	$4.3 M

Recommendations

- Convert Existing MLE to 5-stage Bardenpho Process to Meet AWT Effluent Limits
- Advantages of AWT
  - *Not decreasing RIBs capacity*
  - *Defer ground storage tank to future expansions*
  - *Comparative costs support AWT*

Other Facility Improvements

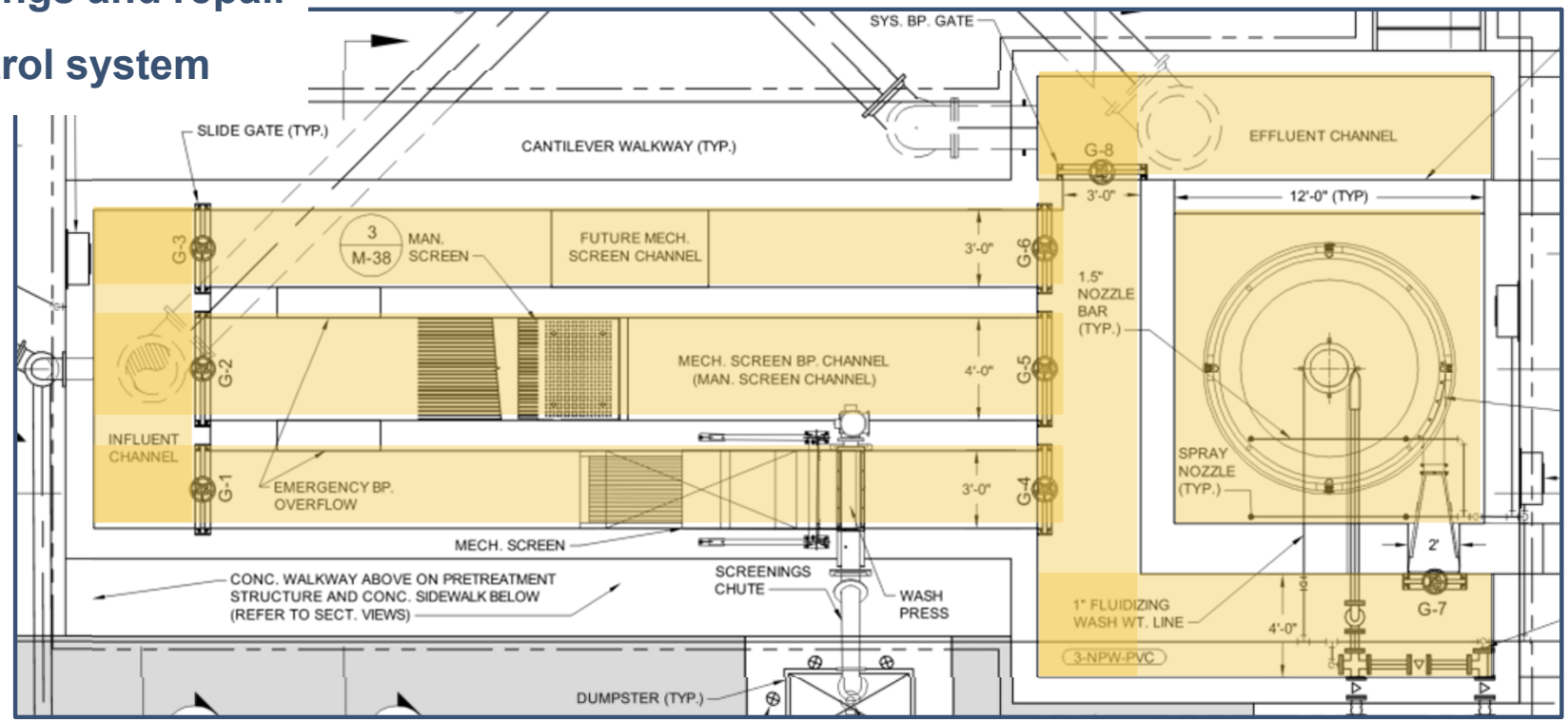
Facility Upgrades



Headworks Improvements

Headworks Improvements

- New perforated plate screen
- Concrete coatings and repair
- New odor control system



IR Pump Replacement

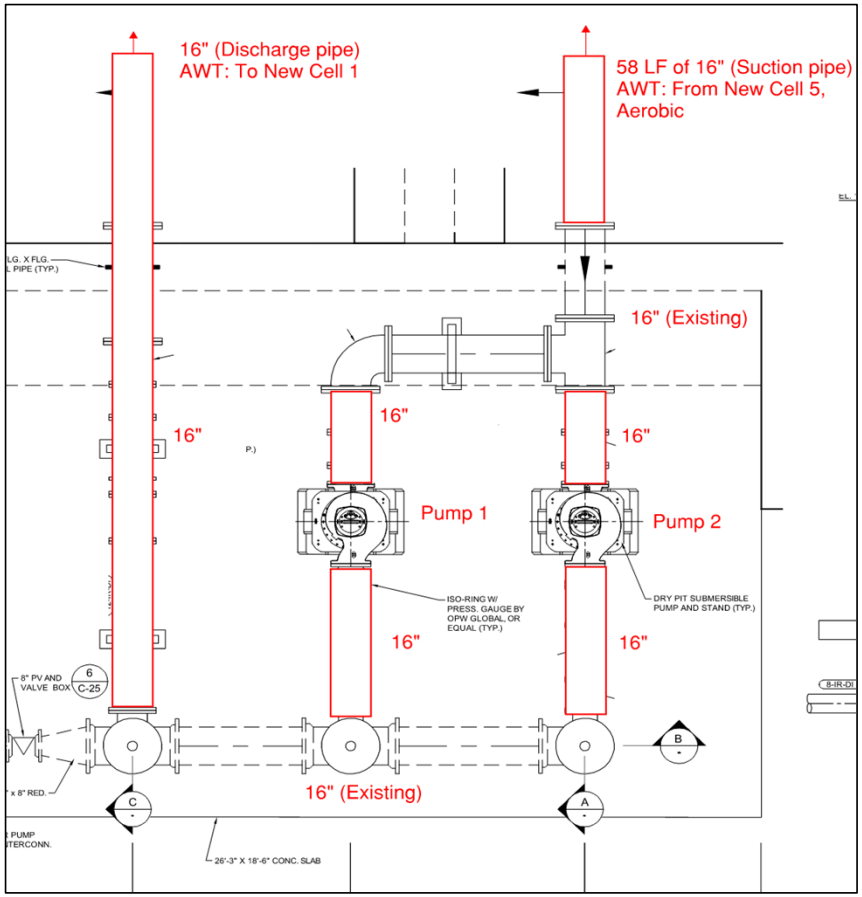
Existing IR Pump Overview

- Currently two (2) pumps per basin, 1 lead + 1 standby
  - 16” intake is from Cell 6 (Aerobic)
  - 16” discharge to Cell 1 (Anoxic)
  - 8” interconnect between basin pump assemblies
- Increased capacity is needed for the new IR pumps based on the new basin configuration for both advanced secondary and AWT scenarios.
- Existing Wilo Pumps have been ragging up and are unreliable.

Proposed IR Pump Layout

AWT Scenario

- Upgrade the two (2) existing pumps per basin (4 Total)
  - 16” intake is from new Cell 4 (Aerobic)
  - 16” discharge to new Cell 1 (Anoxic)
  - New pumps will provide 3Q flow.
  - New pumps will be Sulzer or Xylem
- Recommend upgrading pipe sizes to meet increased pipe velocities.
  - 16” piping, both on discharge and suction



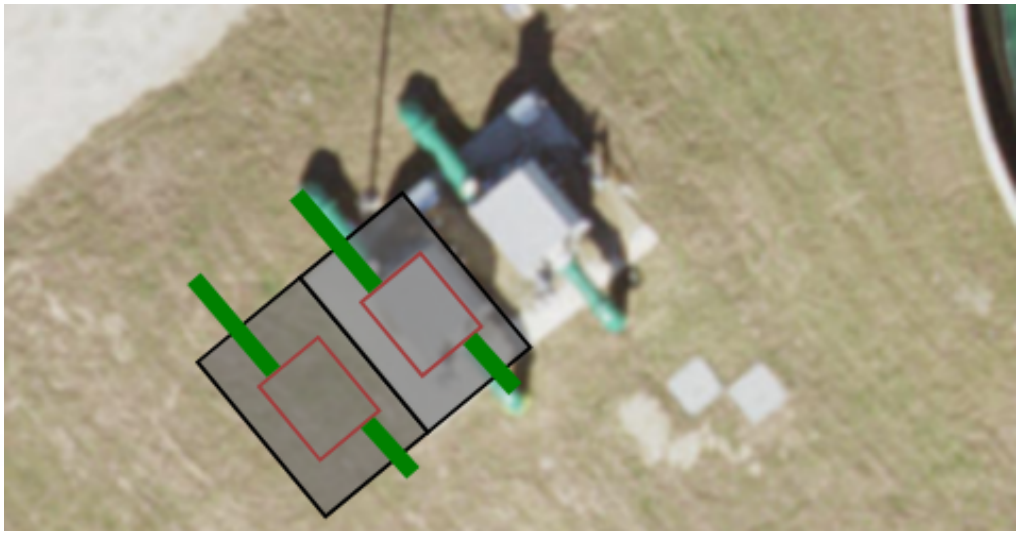
RAS Pump Replacement

Existing Pump Overview

- Currently three (3) pumps with space for one additional
  - 12” intake from Clarifier 1, and Clarifier 2
  - 20” discharge to Pretreatment Effluent Channel Structure
- Existing Wilo Pumps have been ragging up and are unreliable.

Filter Improvements

Filter Replacement

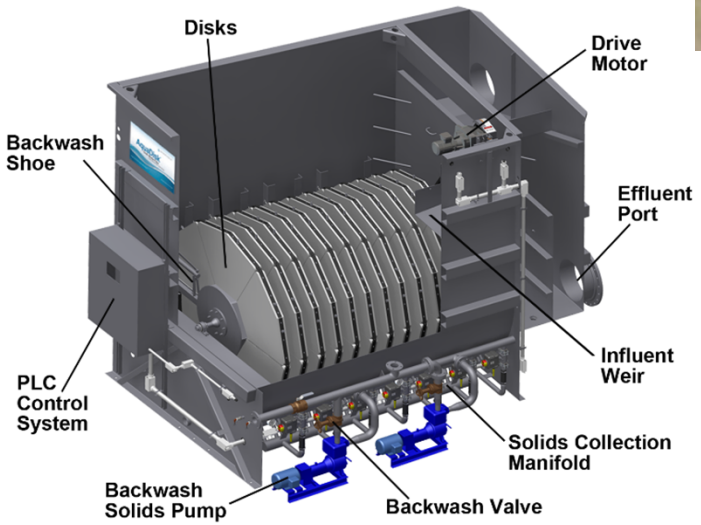


Design Considerations

- Hydraulic driving force through 3rd filter
- Future space was originally designed for Nova filter

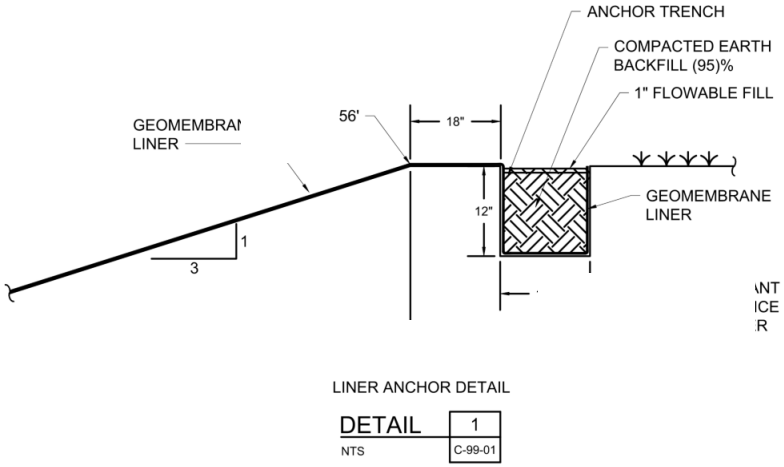
Aqua Aerobics Disk Filters

- Cloth media filters
- Maximum Loading Rate: 6.5 gpm/ft2



Pond Liner Replacement

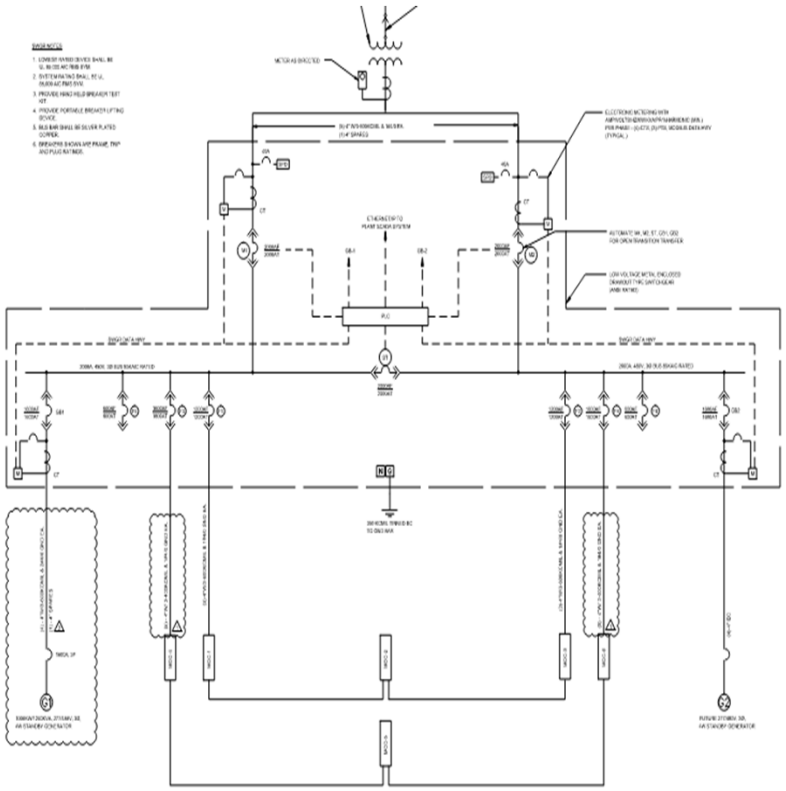
Pond Liner Replacement



Electrical Improvements

Electrical: Load Requirements

- Existing Max Demand (Utility Metered): 490 KW
- Existing Operating Load: 1600KW
  - System not running at full load capacity in 2024 but that's with operation in a low DO mode that is not the future.
- Existing Gen-1 Capacity = 1000 KW
- An additional generator is recommended.
- Provision for a portable/rollup generator should be provided – Code requirement

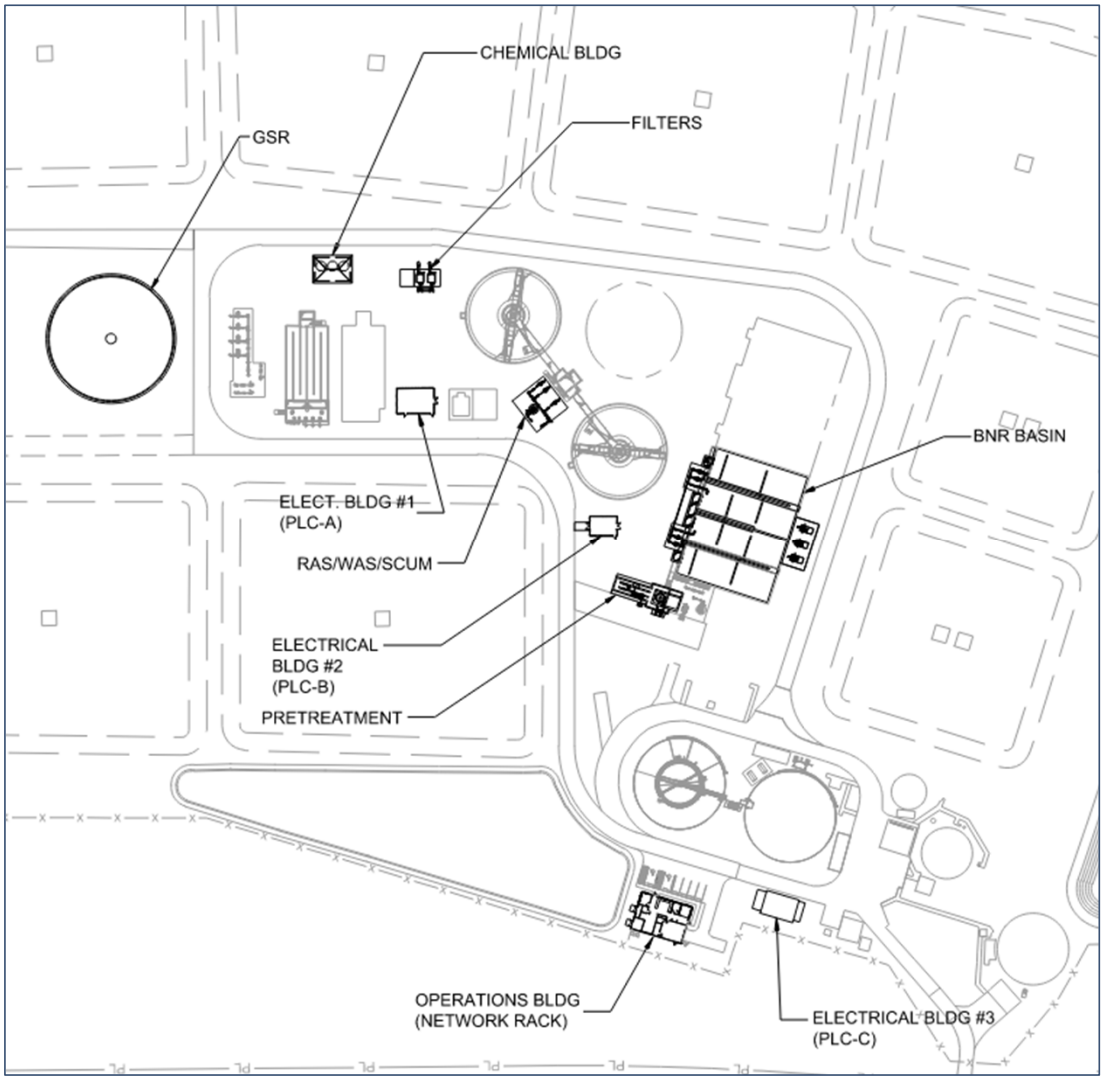


I&C Improvements

Instrumentation

Existing SCADA System

- Consists of network panel and three SCADA PLCs
- SCADA PLC-A located in Electrical Building #1
- SCADA PLC-B located in Electrical Building #2
- SCADA PLC-C located in Electrical Building #3
- The existing SCADA PLC Panels are in good condition and were installed in 2022



Instrumentation

We Will Follow the Latest 2025 TOHO Standards

Integrators

- Revere (Sunbridge Well #3)
- GCS (Old Curry Controls Employees)
- Inframark (Hazen not familiar with this Company)
- Commerce Controls (South Bermuda WWRF)

Field Instrumentation

- CAT6: Ethernet IP preferred
- Fiber Optic: Corning 12 Strand Singlemode and 24 Strand Multimode
- Manufacturers: Will follow latest standards
- Flow, Pressure, Level, Analytical (Preference to have Ethernet communication, as available)

UPS

- Eaton 9SX1500

PLC Manufacturers

- CompactLogix 5069

OIT/HMI

- EZAutomation HMI

Ethernet Switches

- Fortinet, 8-port Managed
- Stratix 2000 Unmanaged

Color Conventions

- Operator Workstation Graphic Displays
- Field Equipment and Panels

Security Cameras

Stormwater Pond Repair

Lake Marion WRF Stormwater Pond

Conclusions

Schedule – AWT Improvements

AWT Conceptual Capital Costs

	Cost ($)
Site Work	$400,000
Yard Piping	$265,000
Headwork Upgrades (Screen/Coatings/Odor Control)	$1,580,000
Process Basin Upgrades	$4,300,000
IR Pump System	$1,080,000
RAS Pumps	$240,000
Filters (2)	$1,900,000
Reject Pond	$300,000
Generator/Fuel Storage	$2,500,000
Electrical	$1,450,000
I&C	$750,000
Total Construction	**$14,765,000**
Bonds and Insurance (15%)	$2,215,000
Contractor Overhead (20%)	$2,953,000
Contingency (30%)	$4,430,000
Total	**$24,363,000**

Questions ?