Ammonia-based Aeration Control (ABAC)

Project with Rivanna Sewer and Water Authority's (RWSA)
Charlottesville, Virginia

Dave Quast, Operations Specialist
Rob Haacke, Wastewater Manager

MPCA Minnesota Nutrient Reduction Strategy

Figure 1. Major drainage basins in Minnesota.

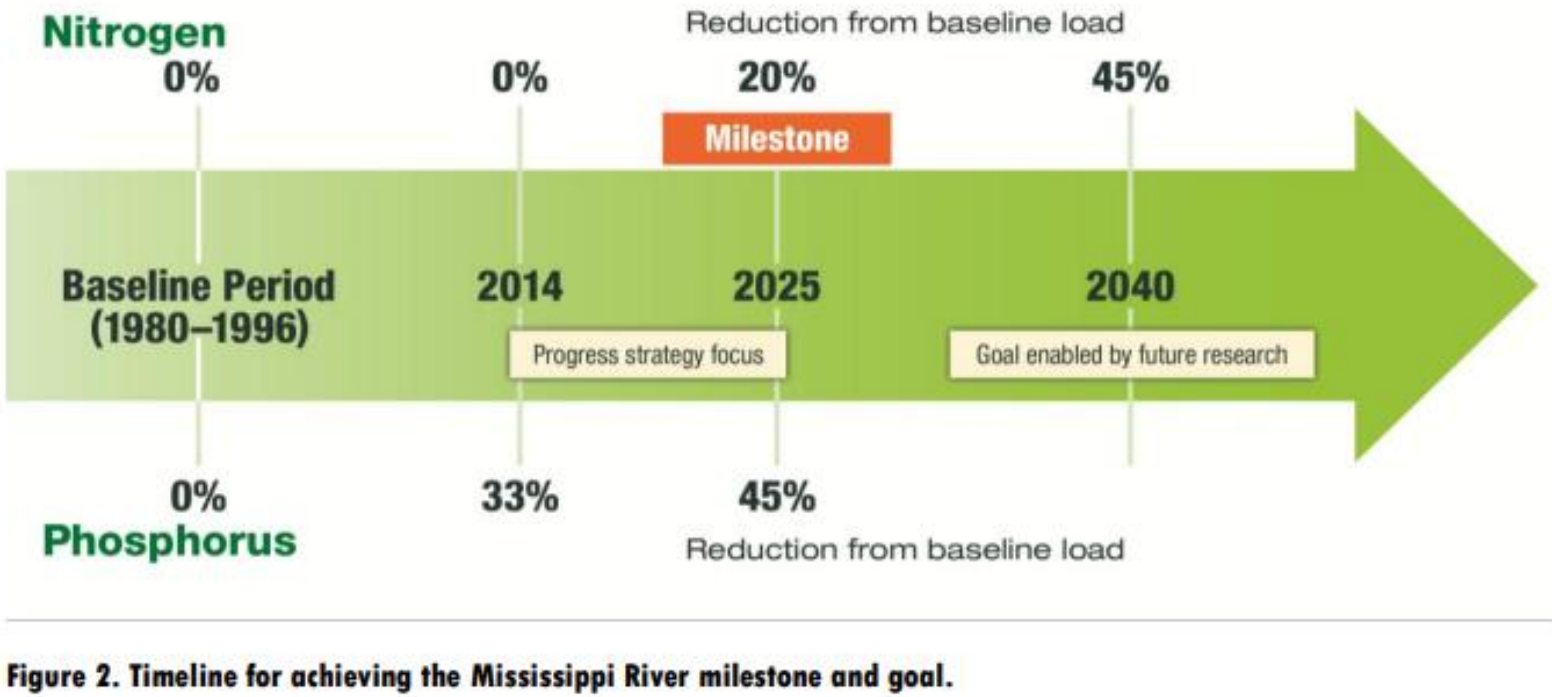


Figure 2. Timeline for achieving the Mississippi River milestone and goal.

Rivanna Sewer and Water Authority (RWSA)

ABAC at Moores Creek Facility **Moores Creek Water Resource Recovery Facility**

SEH

RIVANNA WATER & SEWER AUTHORITY

WaterJAM 2024 | September 11, 2024

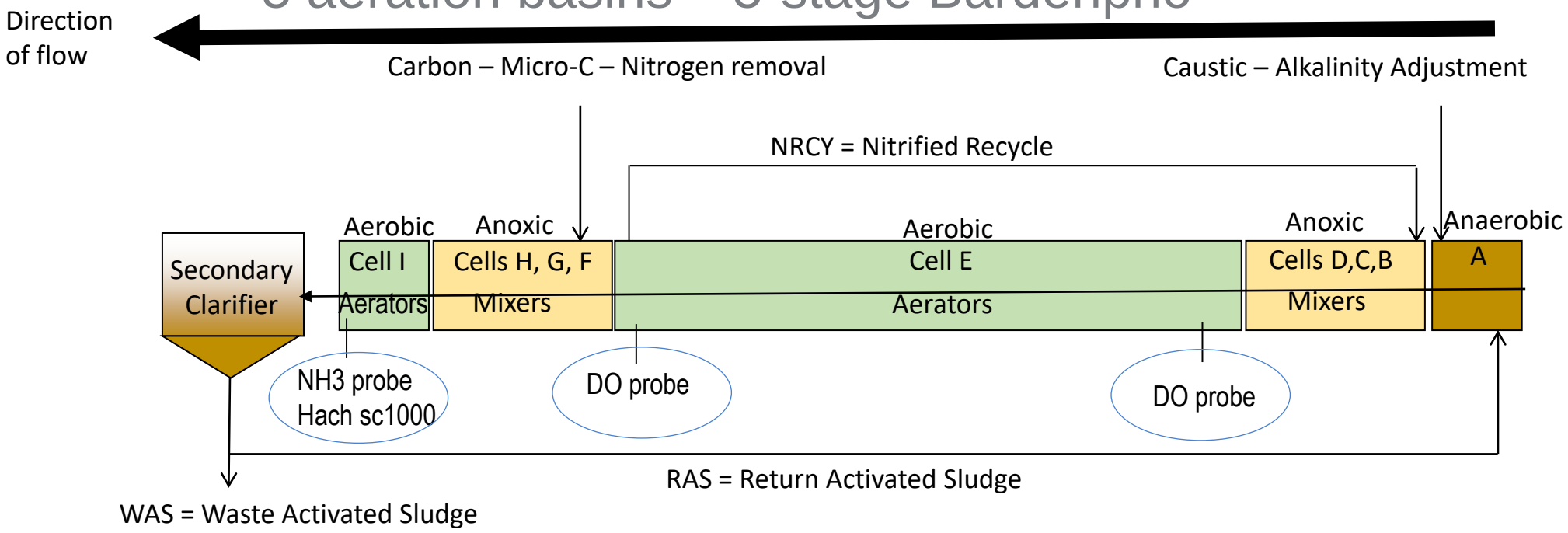
Building a Better World for All of Us®

Permit limits and Sampling

- Ammonia-N (May-Nov) monthly avg 2.2 mg/L weekly avg 2.7 mg/L
- Ammonia-N (Dec-Apr) monthly avg 6.4 mg/L weekly avg 8.1 mg/L
- Total Nitrogen 5.0 mg/L for the calendar year
- Total Phosphorus 0.3 mg/L for the calendar year
- Ammonia-N sampling and testing 5 days per week
- TN and TP sampling and testing 2 days per week
- Primary influent NH4 avg 37.32 mg/L
- Final effluent NH4 avg 0.149 mg/L

Moores Creek Aeration

5 aeration basins – 5-stage Bardenpho



Permit Limits	Monthly ave	Weekly Ave
CBOD	9 mg/l	14 mg/l
TSS	22 mg/l	33 mg/l

Permit Limits	Calendar Year
Total N	5.0 mg/l
Total P	0.3 mg/l

Permit Limits	Monthly ave	Weekly Ave
NH3-N (May – Nov.)	2.2	2.7
NH3-N (Dec. – April)	6.4	8.1

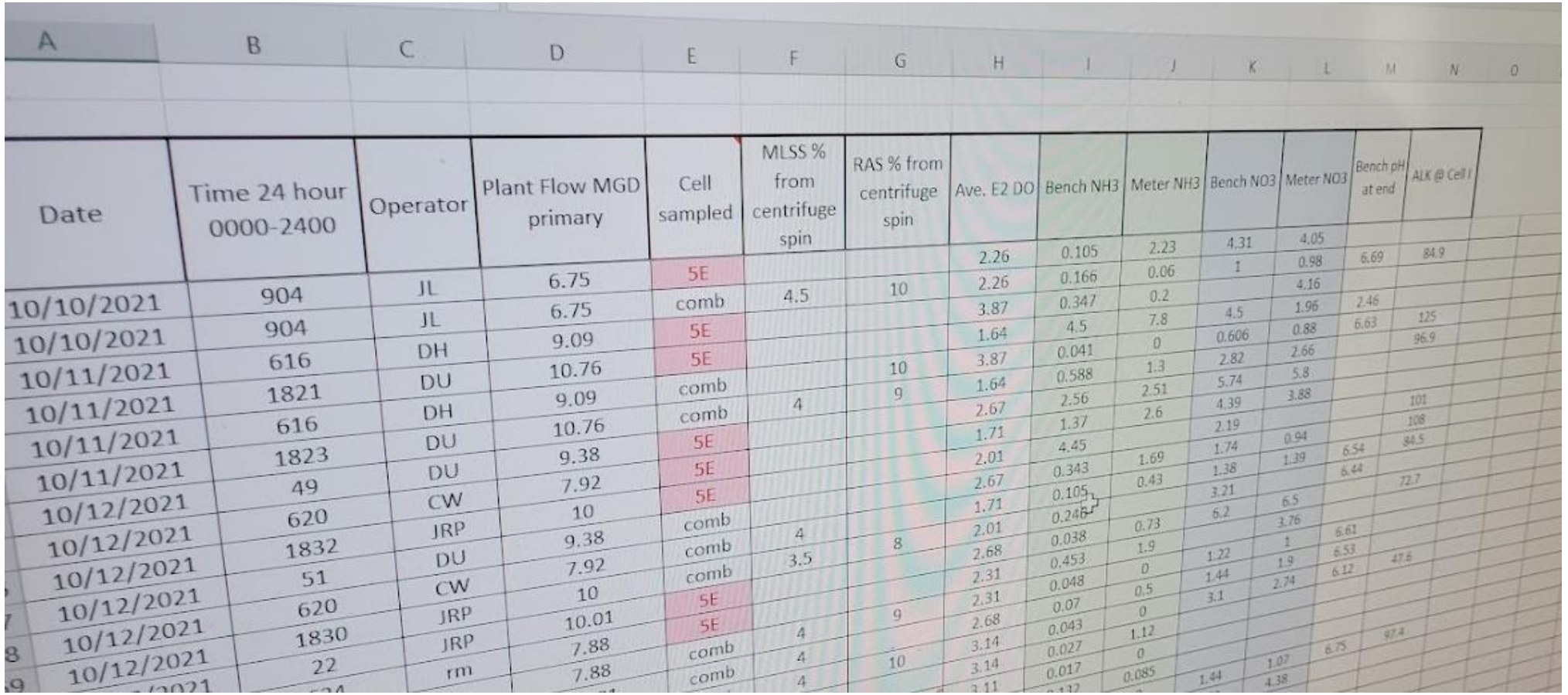
Steps to implement ABAC

1. Verify accuracy of continuous monitors
2. Run model
3. Program PLC and tune controllers
4. Verify field instrumentation
5. Revise SCADA screens
6. Train users
7. Monitor
8. Summarize results

Ammonia Testing in Field: Verification of Hach monitors

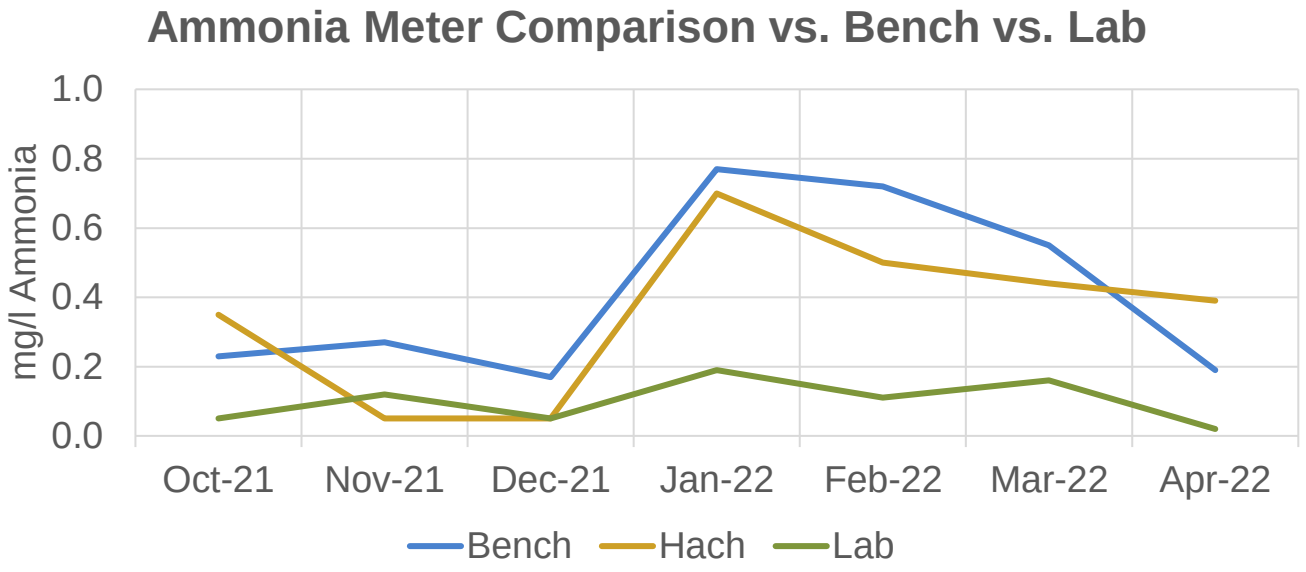
- Bench testing with Hach 3900 and test vials in appropriate range
- Spot checks with NH4 test strips

- Recordkeeping in lab

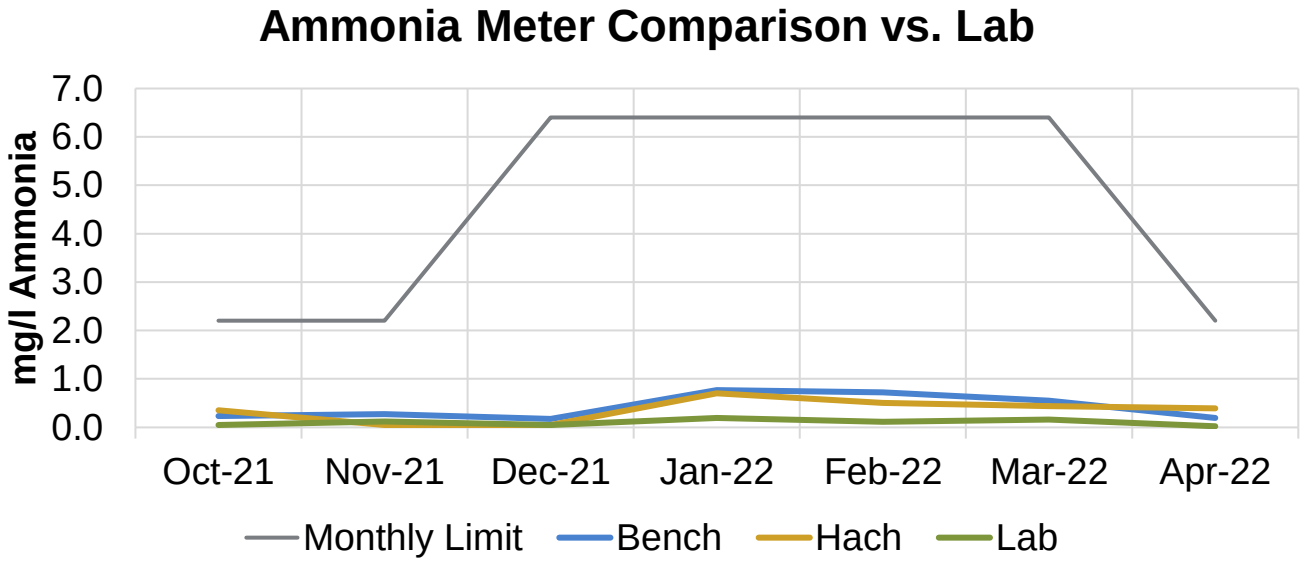


Date	Time 24 hour 0000-2400	Operator	Plant Flow MGD primary	Cell sampled	MLSS % from centrifuge spin	RAS % from centrifuge spin	Ave. E2 DO	Bench NH3	Meter NH3	Bench NO3	Meter NO3	Bench pH at end	ALK @ Cell I
10/10/2021	904	JL	6.75	5E			2.26	0.105	2.23	4.31	4.05		
10/10/2021	904	JL	6.75	comb	4.5	10	2.26	0.166	0.06	1	0.98	6.69	84.9
10/11/2021	616	DH	9.09	5E			3.87	0.347	0.2		4.16		
10/11/2021	1821	DU	10.76	5E			1.64	4.5	7.8	4.5	1.96	2.46	
10/11/2021	616	DH	9.09	comb		10	3.87	0.041	0	0.606	0.88	6.63	125
10/11/2021	1823	DU	10.76	comb	4	9	1.64	0.588	1.3	2.82	2.66		96.9
10/11/2021	49	DU	9.38	5E			2.67	2.56	2.51	5.74	5.8		
10/12/2021	620	CW	7.92	5E			1.71	1.37	2.6	4.39	3.88		
10/12/2021	1832	JRP	10	5E			2.01	4.45		2.19			101
10/12/2021	51	DU	9.38	comb	4		2.67	0.343	1.69	1.74	0.94	6.54	108
10/12/2021	620	CW	7.92	comb	3.5	8	1.71	0.105	0.43	1.38	1.39		84.5
10/12/2021	1830	JRP	10	comb			2.01	0.248		3.21		6.44	
10/12/2021	22	JRP	10.01	5E			2.68	0.038	0.73	6.2	6.5		72.7
10/12/2021		rm	7.88	5E			2.31	0.453	1.9		3.76		
			7.88	comb	4	9	2.31	0.048	0	1.22	1	6.61	
				comb	4		2.68	0.07	0.5	1.44	1.9	6.53	
							3.14	0.043	0	3.1	2.74	6.12	47.6
						10	3.14	0.027	1.12				
							3.11	0.017	0			6.75	97.4
								0.085	0	1.44	1.07		
											4.38		

Ammonia meters not great but good enough



Ion Selective Electrode (ISE) probes are less accurate at very low concentrations.

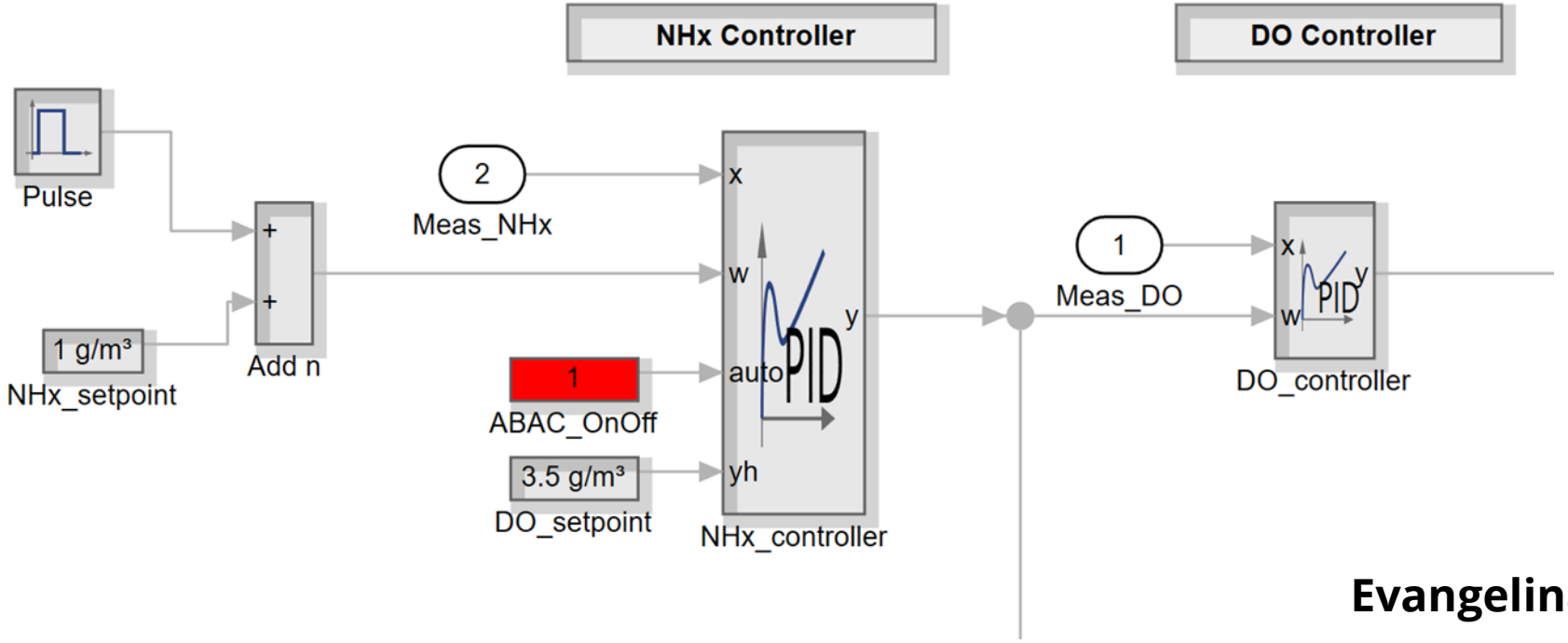


Improvement Goals - Ammonia Based Aeration Control

1. Energy Savings using instrumentation and controls
2. Better Control Strategy for Cycling Blowers
3. Better D.O. control for stability
4. Better Understanding of how the process works
5. Other savings – chemicals
6. Greenhouse Gas Reductions

Modelling

SIMBA Model



Evangelina Belia, Ph.D.

17% lower air flow with better D.O. control

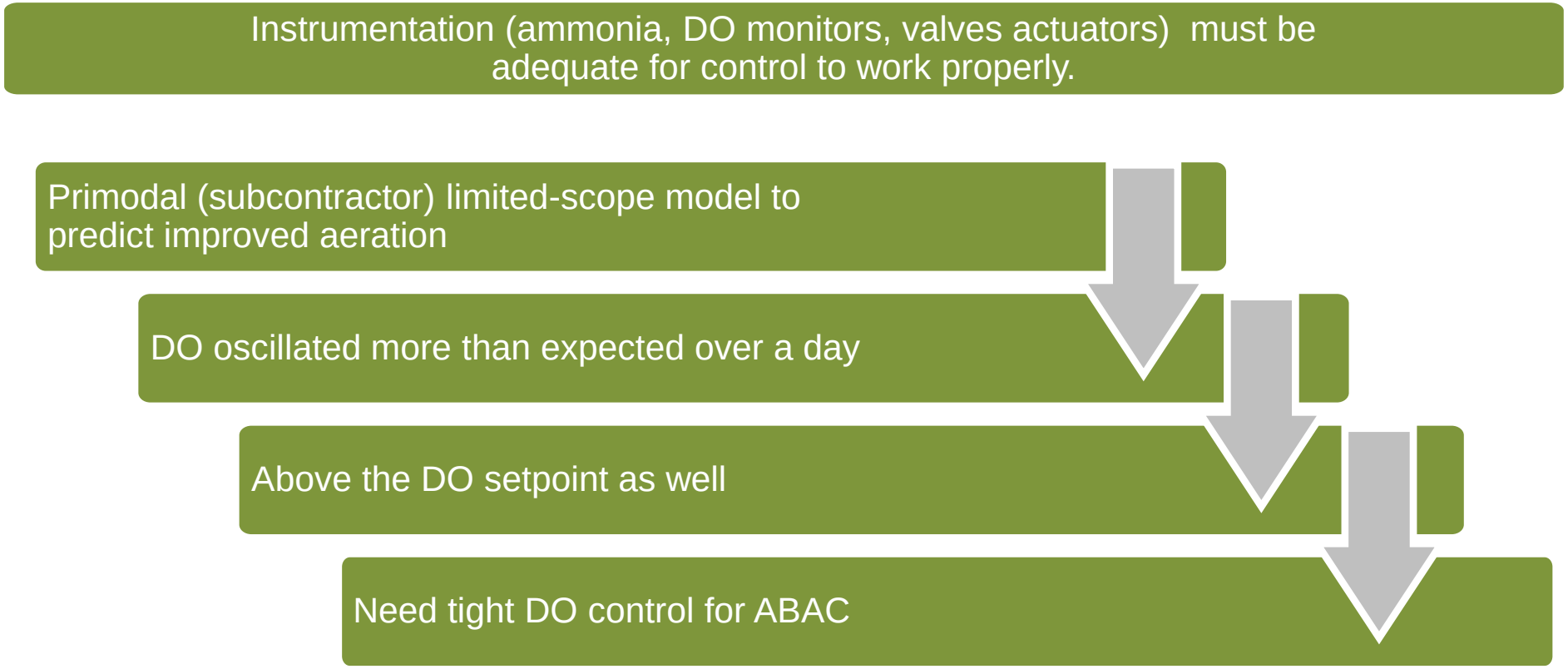
24% lower air flow adding on ABAC

Assumes running at NH3 limit of 2.2 mg/l

Actual desired NH3 = 0.2 mg/l (no backsliding)

Primodal
Earth Essential Technologies

SEH's Scope and Initial Findings



D.O. Control Better Tuning

Aeration System – Control Strategies

- First fix Dissolved Oxygen (DO) Control
  - Blower adjustments
  - Air valve adjustments

- Then, implement Ammonia-Based Aeration Control

- Simpler operation – easy to understand and teach

Superstar Programmer – SEH Senior Control Systems Engineer

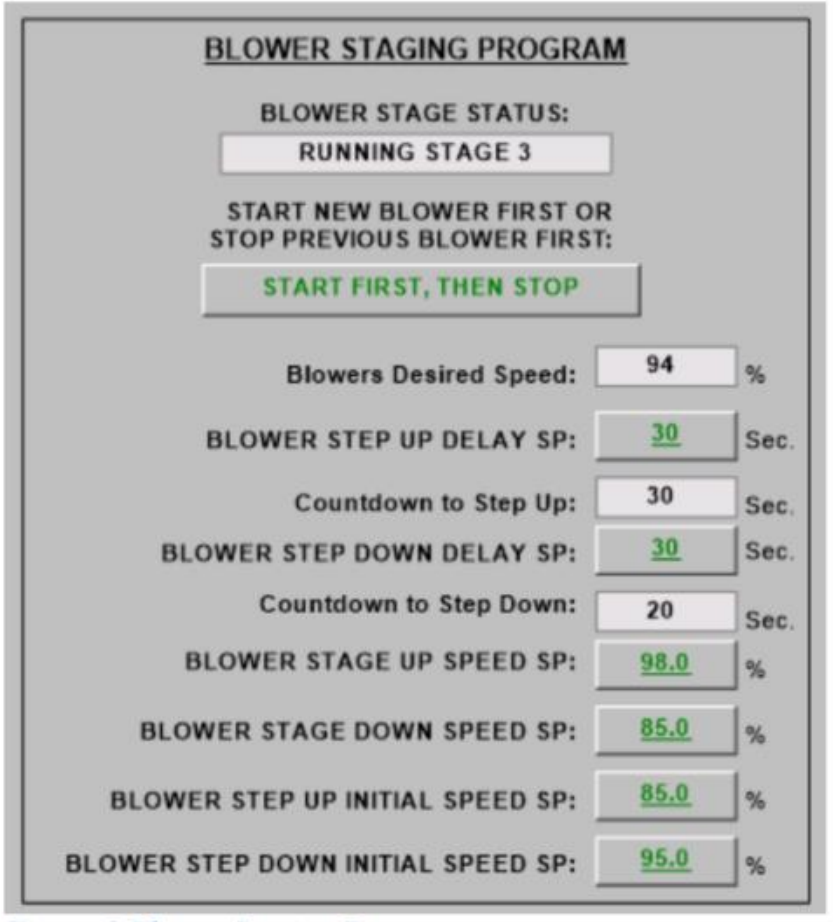
Preliminary Evaluation

Successful Stabilization of:

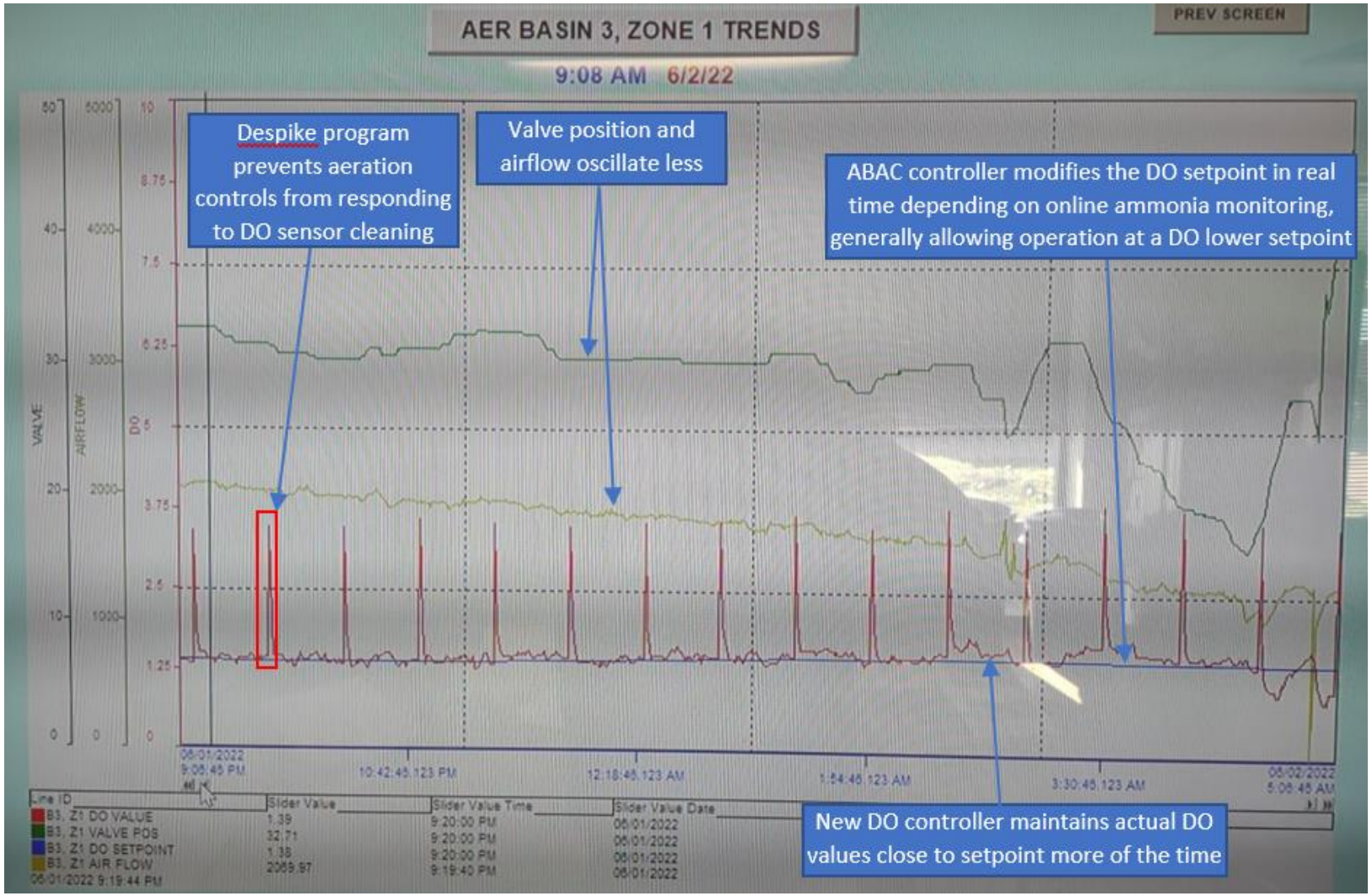
- DO concentration close to the setpoint
- Valve position
- Blower flow rate

Implementation

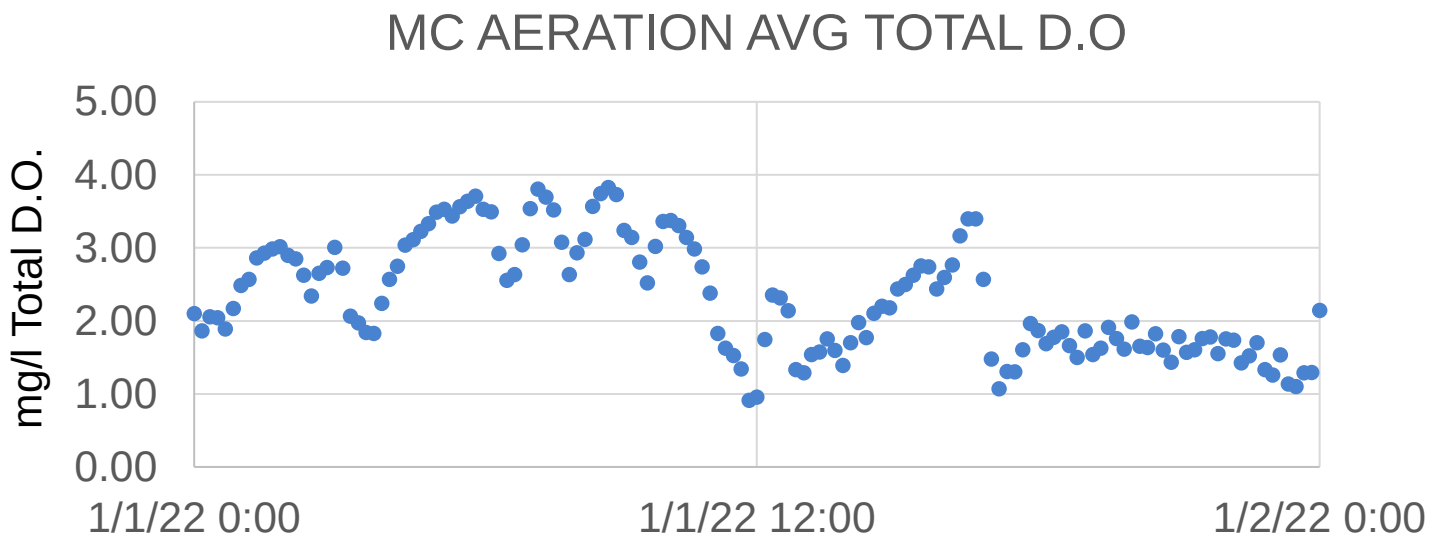
- Programmed April 2022
- Started May 2022
- Tuned by July 2022
- Flow Meter Logic Corrections
- De-spiking Program Modifications
- Most Open Valve Logic
- Blower Staging Program Improvements



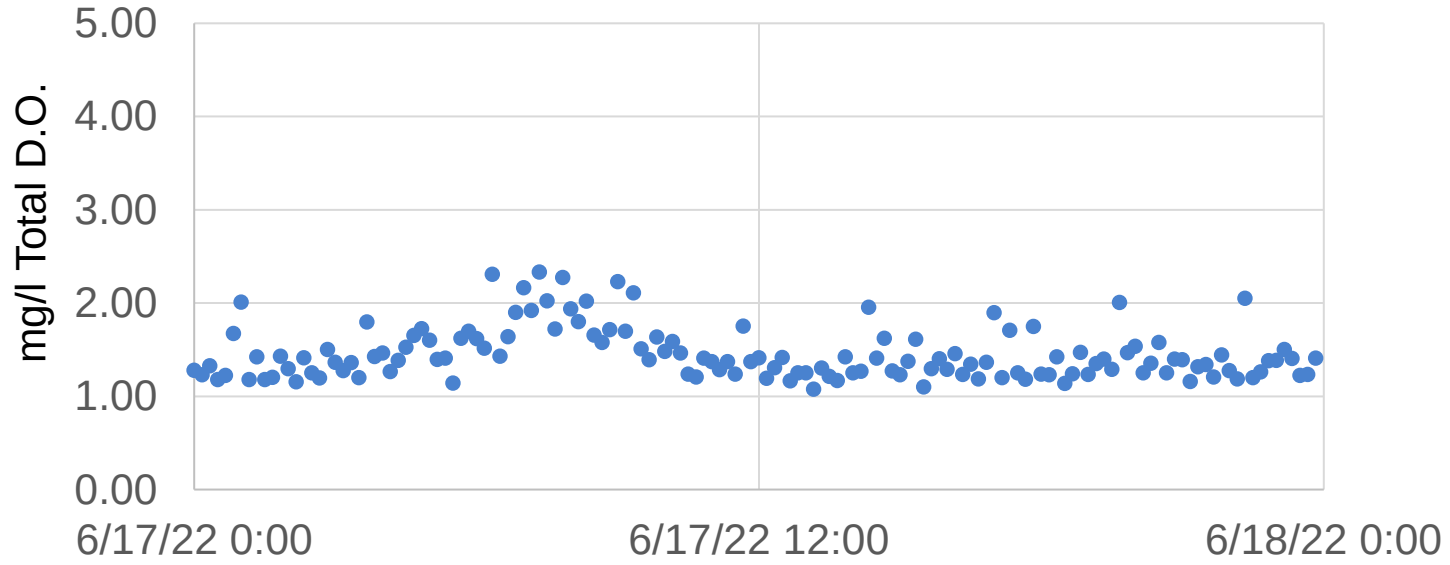
After Tuning – Despike program,



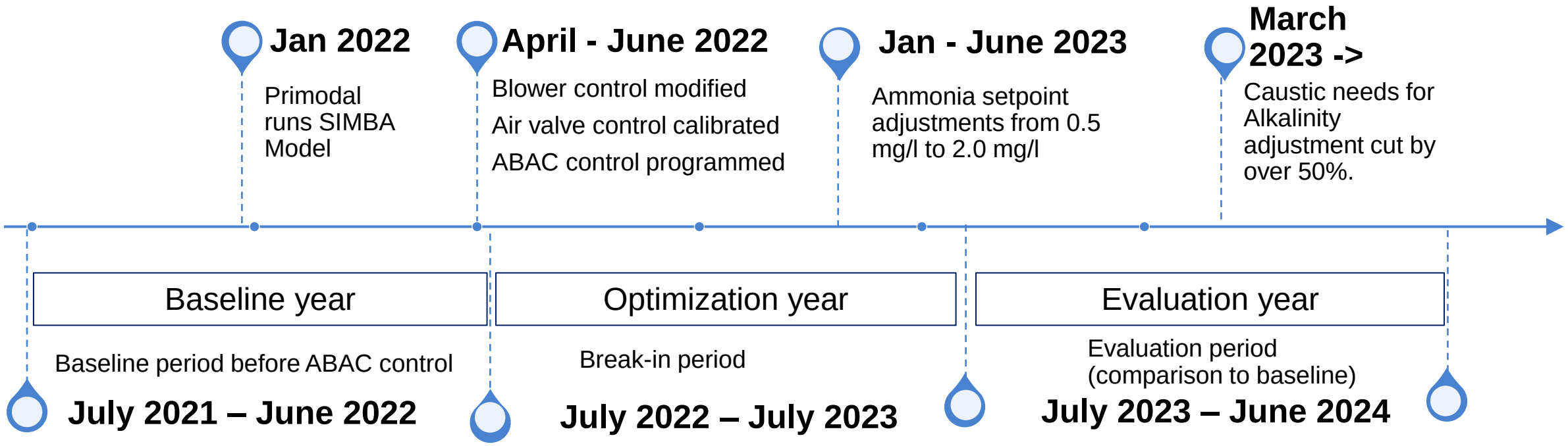
Before Tuning



After Tuning



Timeline – ABAC implementation

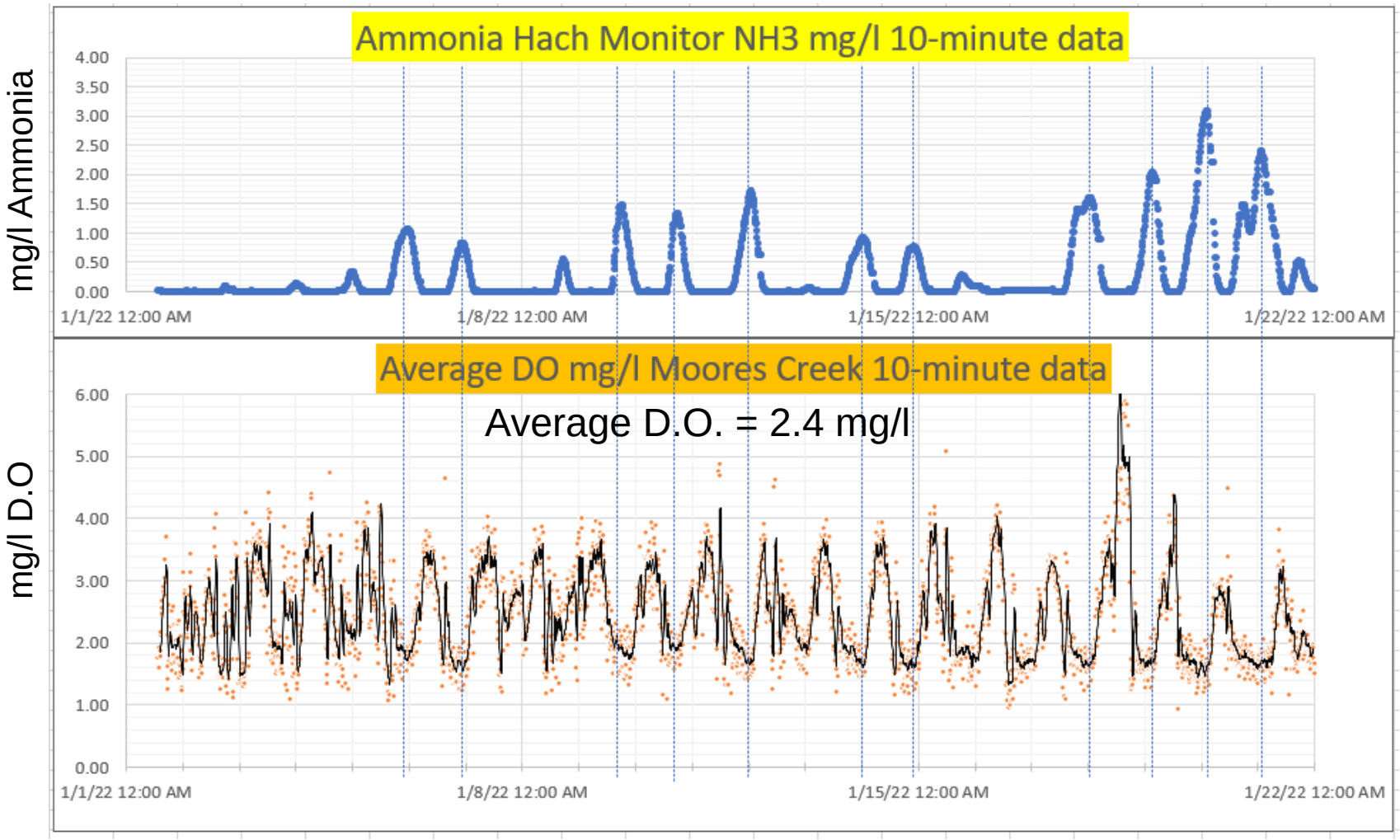


January 2022 – Baseline – typical D.O.control

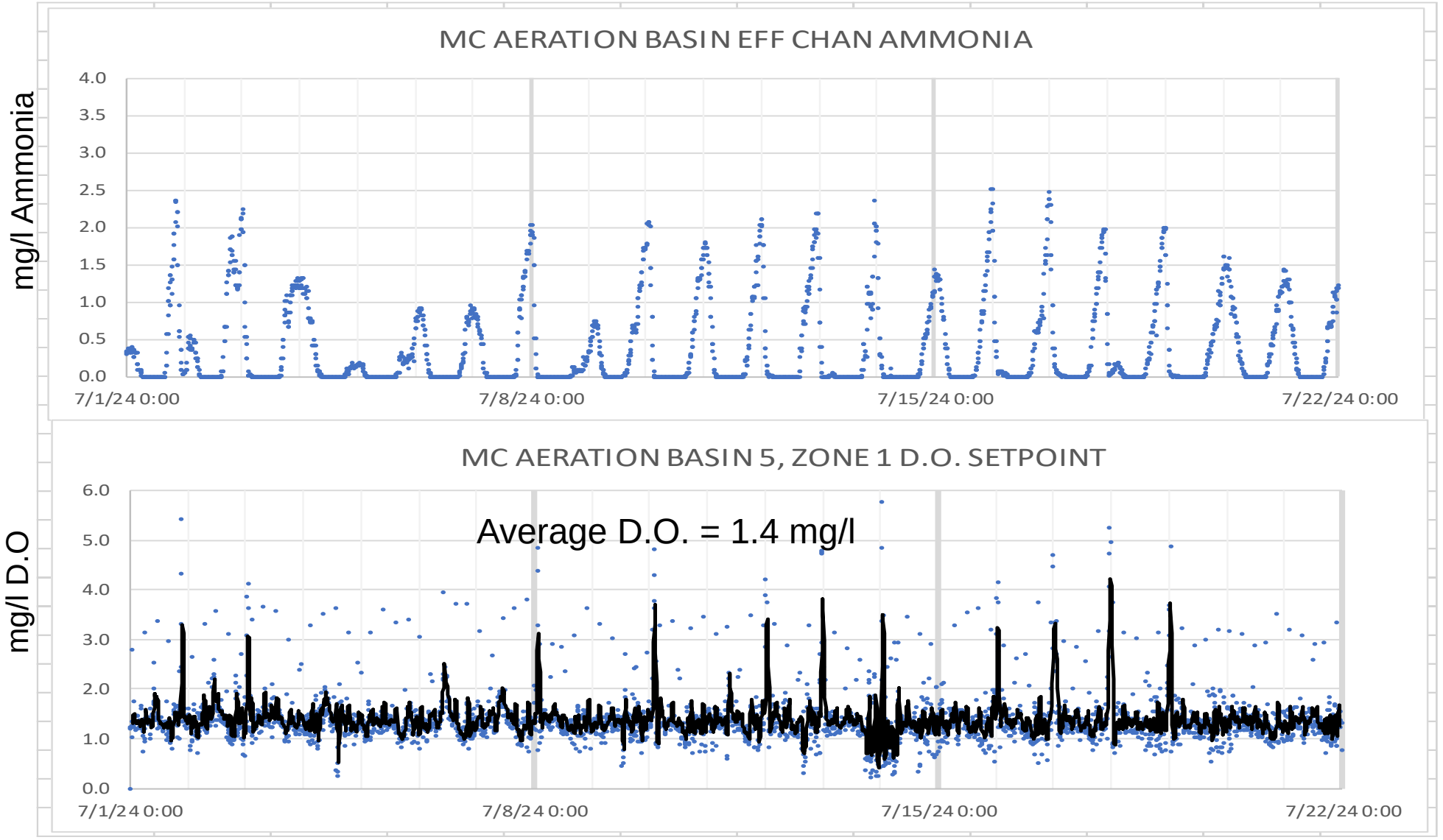
On-line Monitors

Before ABAC implementation

Higher ammonia concentrations correspond to lower D.O. levels



July 2024 – ABAC Control

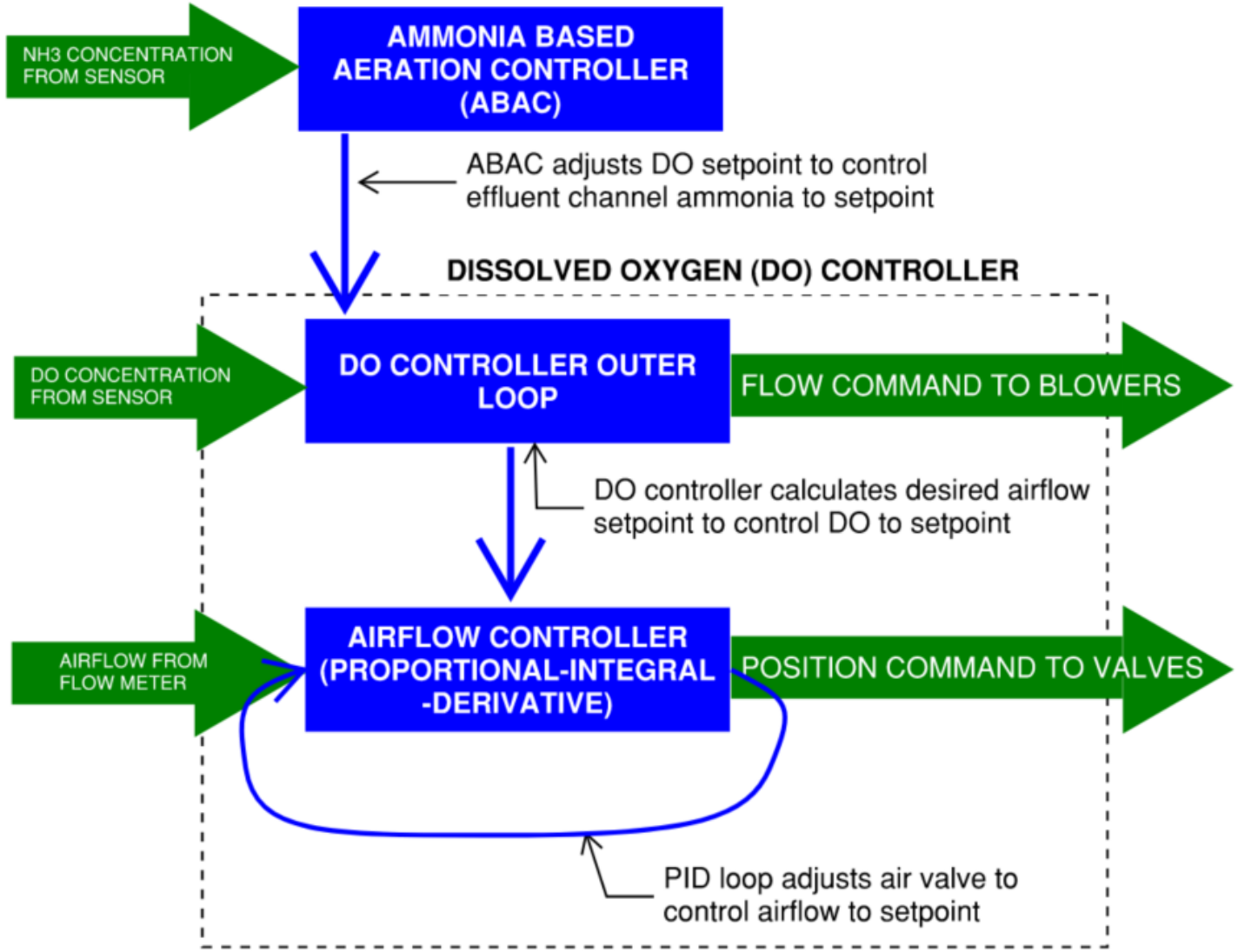


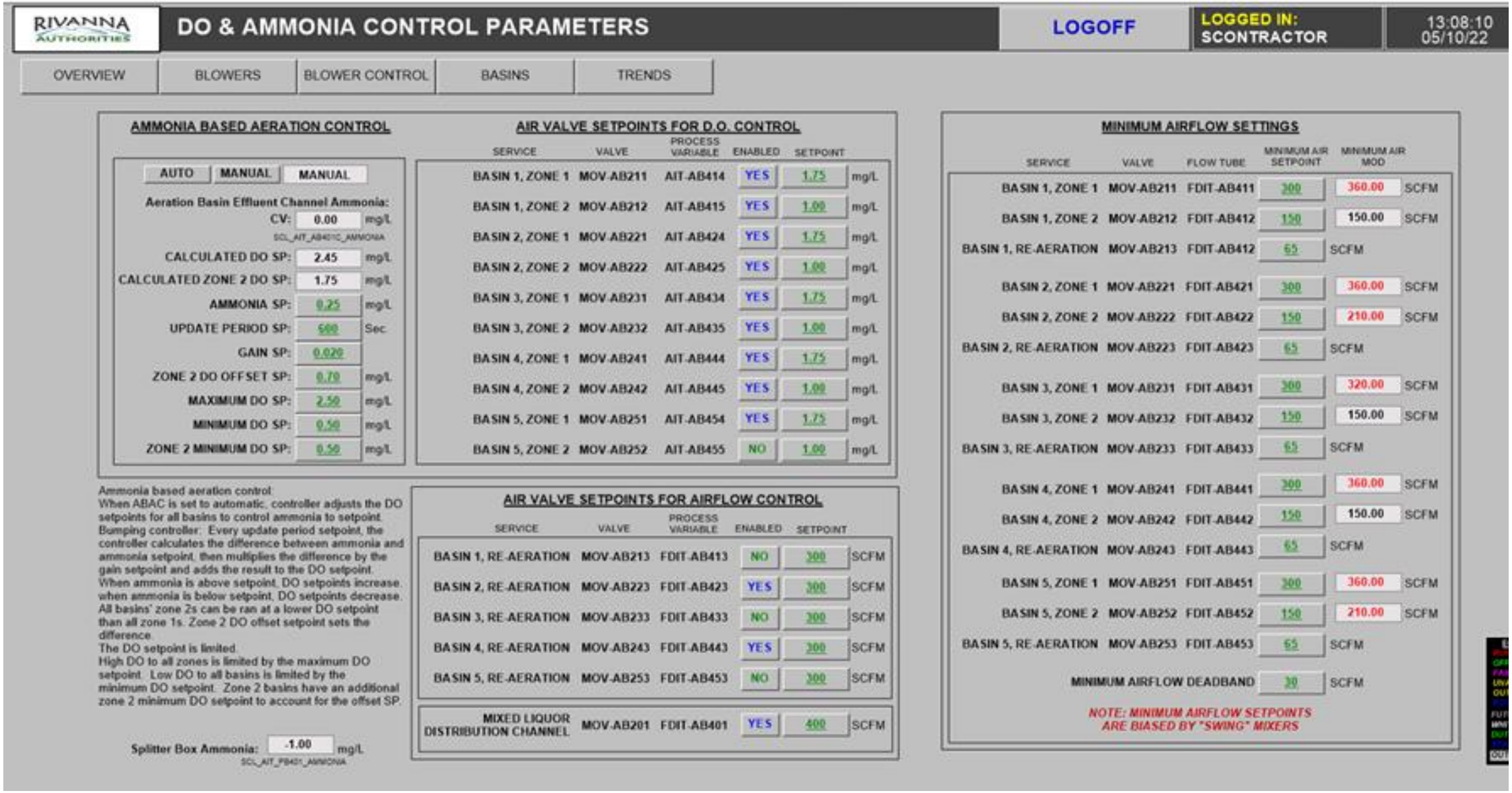
ABAC Implementation

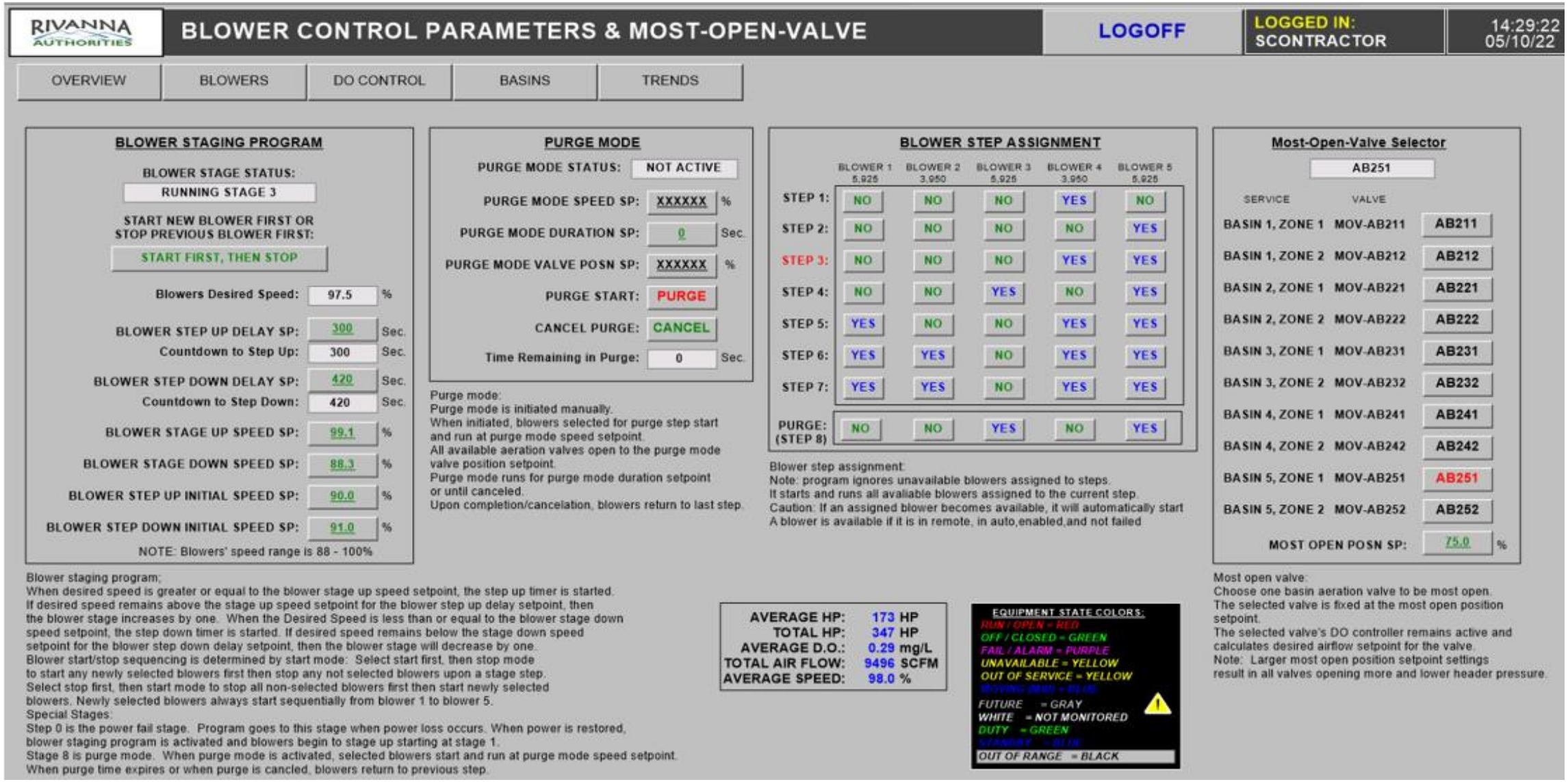
- Programming
- Tuning
- Verifying
- Training – (SCADA screens)

ABAC Strategy

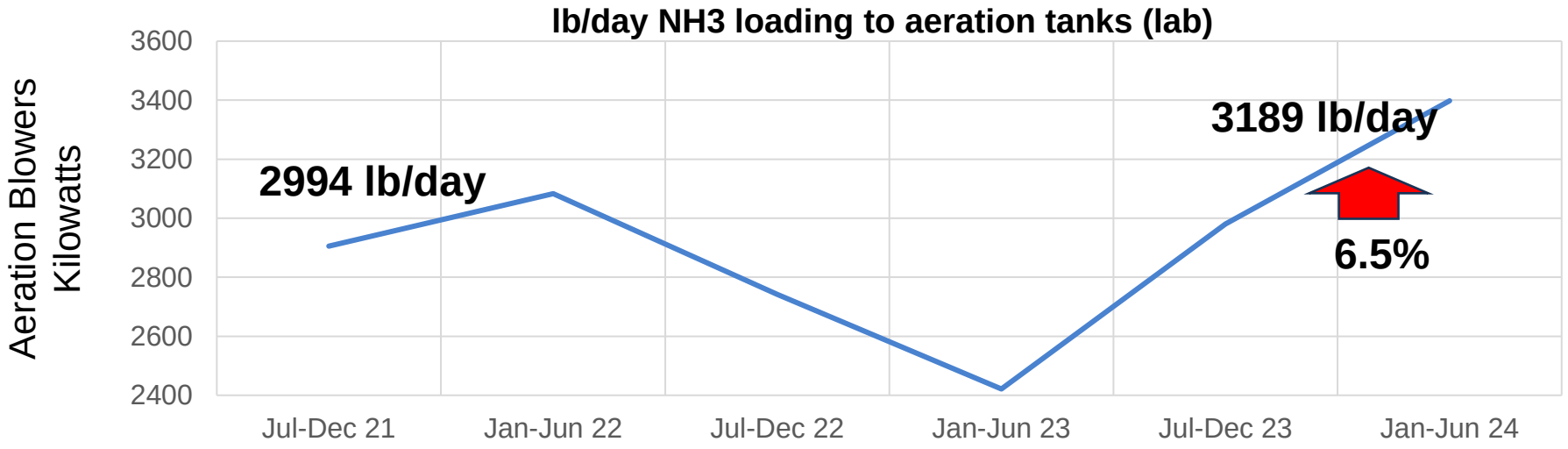
- Use ammonia concentration feedback to control the DO levels in aeration basin
- Operator sets ammonia setpoint and program updates the DO setpoints to control ammonia based on feedback from an ammonia monitor in the basin effluent channel
- Include explanation of how the system works on the operator screen

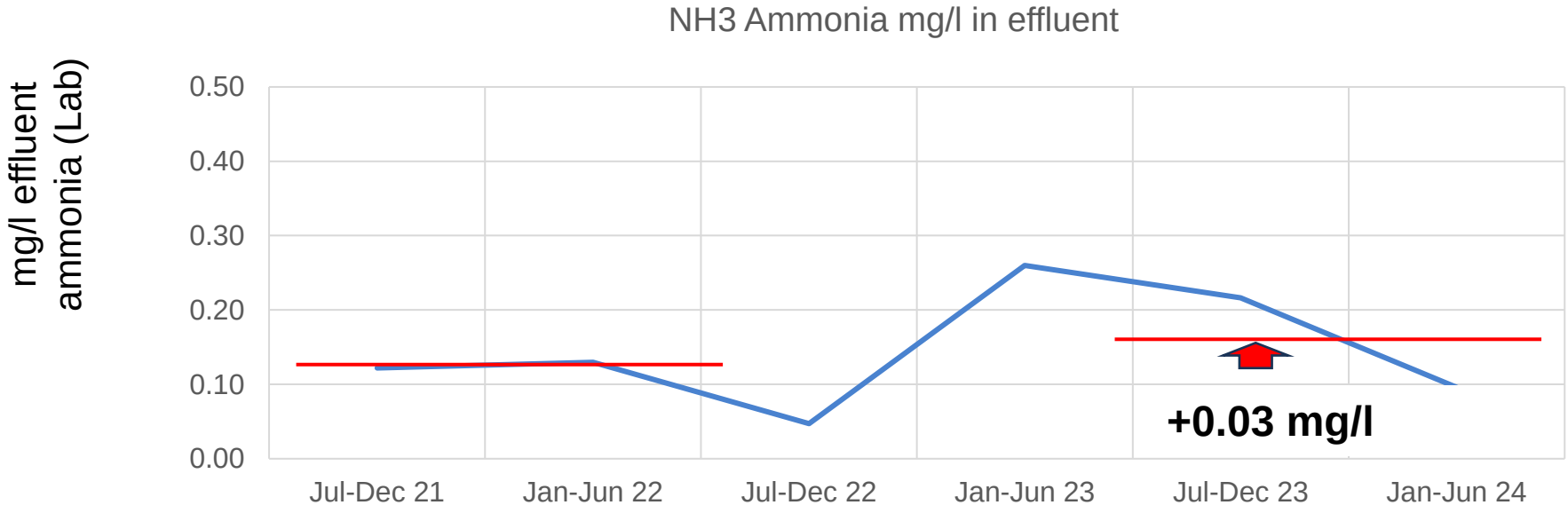

NH3 CONCENTRATION FROM SENSOR
AMMONIA BASED AERATION CONTROLLER (ABAC)
ABAC adjusts DO setpoint to control effluent channel ammonia to setpoint
DISSOLVED OXYGEN (DO) CONTROLLER
DO CONCENTRATION FROM SENSOR
DO CONTROLLER OUTER LOOP
FLOW COMMAND TO BLOWERS
DO controller calculates desired airflow setpoint to control DO to setpoint
AIRFLOW FROM FLOW METER
AIRFLOW CONTROLLER (PROPORTIONAL-INTEGRAL -DERIVATIVE)
POSITION COMMAND TO VALVES
PID loop adjusts air valve to control airflow to setpoint


RIVANNA AUTHORITIES
DO & AMMONIA CONTROL PARAMETERS
LOGOFF
LOGGED IN: SCONTRACTOR
13:08:10 05/10/22
OVERVIEW
BLOWERS
BLOWER CONTROL
BASINS
TRENDS
AMMONIA BASED AERATION CONTROL
AUTO
MANUAL
MANUAL
Aeration Basin Effluent Channel Ammonia:
CV: 0.00 mg/L
SCL_AIT_AB401C_AMMONIA
CALCULATED DO SP: 2.45 mg/L
CALCULATED ZONE 2 DO SP: 1.75 mg/L
AMMONIA SP: 0.25 mg/L
UPDATE PERIOD SP: 600 Sec
GAIN SP: 0.020
ZONE 2 DO OFFSET SP: 0.70 mg/L
MAXIMUM DO SP: 2.50 mg/L
MINIMUM DO SP: 0.50 mg/L
ZONE 2 MINIMUM DO SP: 0.50 mg/L
Ammonia based aeration control:
When ABAC is set to automatic, controller adjusts the DO setpoints for all basins to control ammonia to setpoint.
Bumping controller: Every update period setpoint, the controller calculates the difference between ammonia and ammonia setpoint, then multiplies the difference by the gain setpoint and adds the result to the DO setpoint.
When ammonia is above setpoint, DO setpoints increase.
when ammonia is below setpoint, DO setpoints decrease.
All basins' zone 2s can be ran at a lower DO setpoint than all zone 1s. Zone 2 DO offset setpoint sets the difference.
The DO setpoint is limited.
High DO to all zones is limited by the maximum DO setpoint. Low DO to all basins is limited by the minimum DO setpoint. Zone 2 basins have an additional zone 2 minimum DO setpoint to account for the offset SP.
Splitter Box Ammonia: -1.00 mg/L
SCL_AIT_FB401_AMMONIA
AIR VALVE SETPOINTS FOR D.O. CONTROL
SERVICE VALVE PROCESS VARIABLE ENABLED SETPOINT
BASIN 1, ZONE 1 MOV-AB211 AIT-AB414 YES 1.75 mg/L
BASIN 1, ZONE 2 MOV-AB212 AIT-AB415 YES 1.00 mg/L
BASIN 2, ZONE 1 MOV-AB221 AIT-AB424 YES 1.75 mg/L
BASIN 2, ZONE 2 MOV-AB222 AIT-AB425 YES 1.00 mg/L
BASIN 3, ZONE 1 MOV-AB231 AIT-AB434 YES 1.75 mg/L
BASIN 3, ZONE 2 MOV-AB232 AIT-AB435 YES 1.00 mg/L
BASIN 4, ZONE 1 MOV-AB241 AIT-AB444 YES 1.75 mg/L
BASIN 4, ZONE 2 MOV-AB242 AIT-AB445 YES 1.00 mg/L
BASIN 5, ZONE 1 MOV-AB251 AIT-AB454 YES 1.75 mg/L
BASIN 5, ZONE 2 MOV-AB252 AIT-AB455 NO 1.00 mg/L
AIR VALVE SETPOINTS FOR AIRFLOW CONTROL
SERVICE VALVE PROCESS VARIABLE ENABLED SETPOINT
BASIN 1, RE-AERATION MOV-AB213 FDIT-AB413 NO 300 SCFM
BASIN 2, RE-AERATION MOV-AB223 FDIT-AB423 YES 300 SCFM
BASIN 3, RE-AERATION MOV-AB233 FDIT-AB433 NO 300 SCFM
BASIN 4, RE-AERATION MOV-AB243 FDIT-AB443 YES 300 SCFM
BASIN 5, RE-AERATION MOV-AB253 FDIT-AB453 NO 300 SCFM
MIXED LIQUOR DISTRIBUTION CHANNEL MOV-AB201 FDIT-AB401 YES 400 SCFM
MINIMUM AIRFLOW SETTINGS
SERVICE VALVE FLOW TUBE MINIMUM AIR SETPOINT MINIMUM AIR MOD
BASIN 1, ZONE 1 MOV-AB211 FDIT-AB411 300 360.00 SCFM
BASIN 1, ZONE 2 MOV-AB212 FDIT-AB412 150 150.00 SCFM
BASIN 1, RE-AERATION MOV-AB213 FDIT-AB412 65 SCFM
BASIN 2, ZONE 1 MOV-AB221 FDIT-AB421 300 360.00 SCFM
BASIN 2, ZONE 2 MOV-AB222 FDIT-AB422 150 210.00 SCFM
BASIN 2, RE-AERATION MOV-AB223 FDIT-AB423 65 SCFM
BASIN 3, ZONE 1 MOV-AB231 FDIT-AB431 300 320.00 SCFM
BASIN 3, ZONE 2 MOV-AB232 FDIT-AB432 150 150.00 SCFM
BASIN 3, RE-AERATION MOV-AB233 FDIT-AB433 65 SCFM
BASIN 4, ZONE 1 MOV-AB241 FDIT-AB441 300 360.00 SCFM
BASIN 4, ZONE 2 MOV-AB242 FDIT-AB442 150 150.00 SCFM
BASIN 4, RE-AERATION MOV-AB243 FDIT-AB443 65 SCFM
BASIN 5, ZONE 1 MOV-AB251 FDIT-AB451 300 360.00 SCFM
BASIN 5, ZONE 2 MOV-AB252 FDIT-AB452 150 210.00 SCFM
BASIN 5, RE-AERATION MOV-AB253 FDIT-AB453 65 SCFM
MINIMUM AIRFLOW DEADBAND 30 SCFM
NOTE: MINIMUM AIRFLOW SETPOINTS ARE BIASED BY "SWING" MIXERS

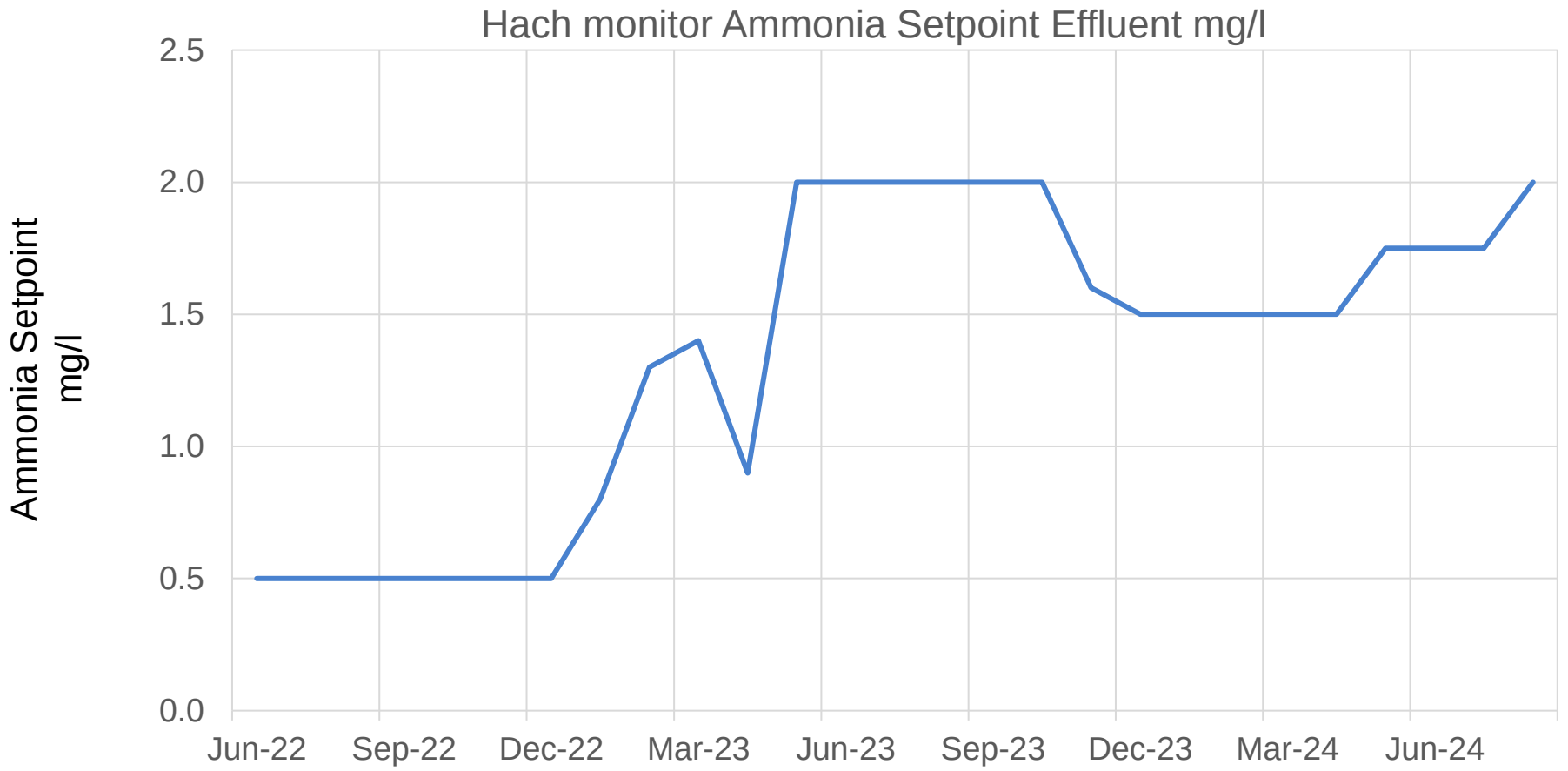

RIVANNA AUTHORITIES
BLOWER CONTROL PARAMETERS & MOST-OPEN-VALVE
LOGOFF
LOGGED IN: SCONTRACTOR
14:29:22 05/10/22
OVERVIEW
BLOWERS
DO CONTROL
BASINS
TRENDS
BLOWER STAGING PROGRAM
BLOWER STAGE STATUS:
RUNNING STAGE 3
START NEW BLOWER FIRST OR STOP PREVIOUS BLOWER FIRST:
START FIRST, THEN STOP
Blowers Desired Speed: 97.5 %
BLOWER STEP UP DELAY SP: 300 Sec.
Countdown to Step Up: 300 Sec.
BLOWER STEP DOWN DELAY SP: 420 Sec.
Countdown to Step Down: 420 Sec.
BLOWER STAGE UP SPEED SP: 99.1 %
BLOWER STAGE DOWN SPEED SP: 88.3 %
BLOWER STEP UP INITIAL SPEED SP: 90.0 %
BLOWER STEP DOWN INITIAL SPEED SP: 91.0 %
NOTE: Blowers' speed range is 88 - 100%
PURGE MODE
PURGE MODE STATUS: NOT ACTIVE
PURGE MODE SPEED SP: XXXXXX %
PURGE MODE DURATION SP: 0 Sec.
PURGE MODE VALVE POSN SP: XXXXXX %
PURGE START: PURGE
CANCEL PURGE: CANCEL
Time Remaining in Purge: 0 Sec.
Purge mode:
Purge mode is initiated manually.
When initiated, blowers selected for purge step start and run at purge mode speed setpoint.
All available aeration valves open to the purge mode valve position setpoint.
Purge mode runs for purge mode duration setpoint or until canceled.
Upon completion/cancelation, blowers return to last step.
BLOWER STEP ASSIGNMENT
BLOWER 1 5,925
BLOWER 2 3,950
BLOWER 3 5,925
BLOWER 4 3,950
BLOWER 5 5,925
STEP 1: NO NO NO YES NO
STEP 2: NO NO NO NO YES
STEP 3: NO NO NO YES YES
STEP 4: NO NO YES NO YES
STEP 5: YES NO NO YES YES
STEP 6: YES YES NO YES YES
STEP 7: YES YES NO YES YES
PURGE: (STEP 8) NO NO YES NO YES
Blower step assignment:
Note: program ignores unavailable blowers assigned to steps.
It starts and runs all available blowers assigned to the current step.
Caution: If an assigned blower becomes available, it will automatically start
A blower is available if it is in remote, in auto,enabled,and not failed
Most-Open-Valve Selector
AB251
SERVICE VALVE
BASIN 1, ZONE 1 MOV-AB211 AB211
BASIN 1, ZONE 2 MOV-AB212 AB212
BASIN 2, ZONE 1 MOV-AB221 AB221
BASIN 2, ZONE 2 MOV-AB222 AB222
BASIN 3, ZONE 1 MOV-AB231 AB231
BASIN 3, ZONE 2 MOV-AB232 AB232
BASIN 4, ZONE 1 MOV-AB241 AB241
BASIN 4, ZONE 2 MOV-AB242 AB242
BASIN 5, ZONE 1 MOV-AB251 AB251
BASIN 5, ZONE 2 MOV-AB252 AB252
MOST OPEN POSN SP: 75.0 %
Blower staging program;
When desired speed is greater or equal to the blower stage up speed setpoint, the step up timer is started.
If desired speed remains above the stage up speed setpoint for the blower step up delay setpoint, then the blower stage increases by one. When the Desired Speed is less than or equal to the blower stage down speed setpoint, the step down timer is started. If desired speed remains below the stage down speed setpoint for the blower step down delay setpoint, then the blower stage will decrease by one.
Blower start/stop sequencing is determined by start mode: Select start first, then stop mode to start any newly selected blowers first then stop any not selected blowers upon a stage step.
Select stop first, then start mode to stop all non-selected blowers first then start newly selected blowers. Newly selected blowers always start sequentially from blower 1 to blower 5.
Special Stages:
Step 0 is the power fail stage. Program goes to this stage when power loss occurs. When power is restored, blower staging program is activated and blowers begin to stage up starting at stage 1.
Stage 8 is purge mode. When purge mode is activated, selected blowers start and run at purge mode speed setpoint. When purge time expires or when purge is cancled, blowers return to previous step.
AVERAGE HP: 173 HP
TOTAL HP: 347 HP
AVERAGE D.O.: 0.29 mg/L
TOTAL AIR FLOW: 9496 SCFM
AVERAGE SPEED: 98.0 %
EQUIPMENT STATE COLORS:
RUN / OPEN = RED
OFF / CLOSED = GREEN
FAIL / ALARM = PURPLE
UNAVAILABLE = YELLOW
OUT OF SERVICE = YELLOW
FUTURE = GRAY
WHITE = NOT MONITORED
DUTY = GREEN
OUT OF RANGE = BLACK
Most open valve:
Choose one basin aeration valve to be most open.
The selected valve is fixed at the most open position setpoint.
The selected valve's DO controller remains active and calculates desired airflow setpoint for the valve.
Note: Larger most open position setpoint settings result in all valves opening more and lower header pressure.

Monitoring

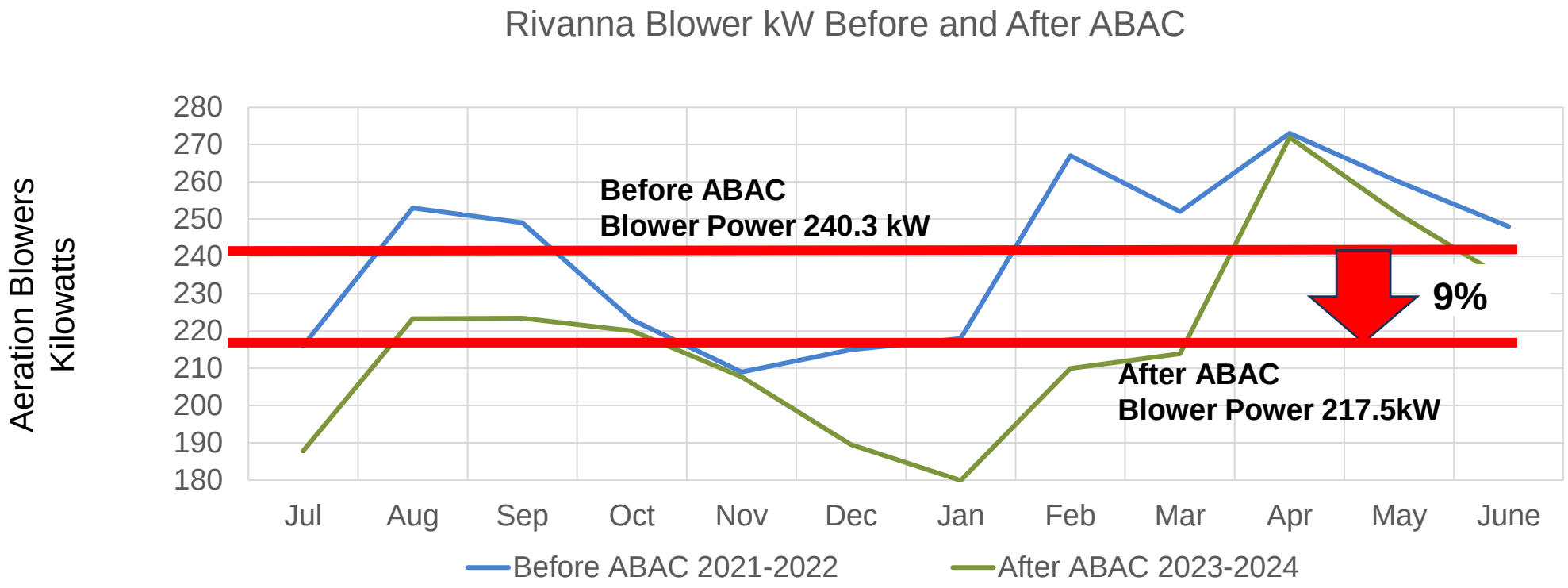

lb/day NH3 loading to aeration tanks (lab)
Aeration Blowers Kilowatts
3600
3400
3200
3000
2800
2600
2400
2994 lb/day
3189 lb/day
6.5%
Jul-Dec 21
Jan-Jun 22
Jul-Dec 22
Jan-Jun 23
Jul-Dec 23
Jan-Jun 24

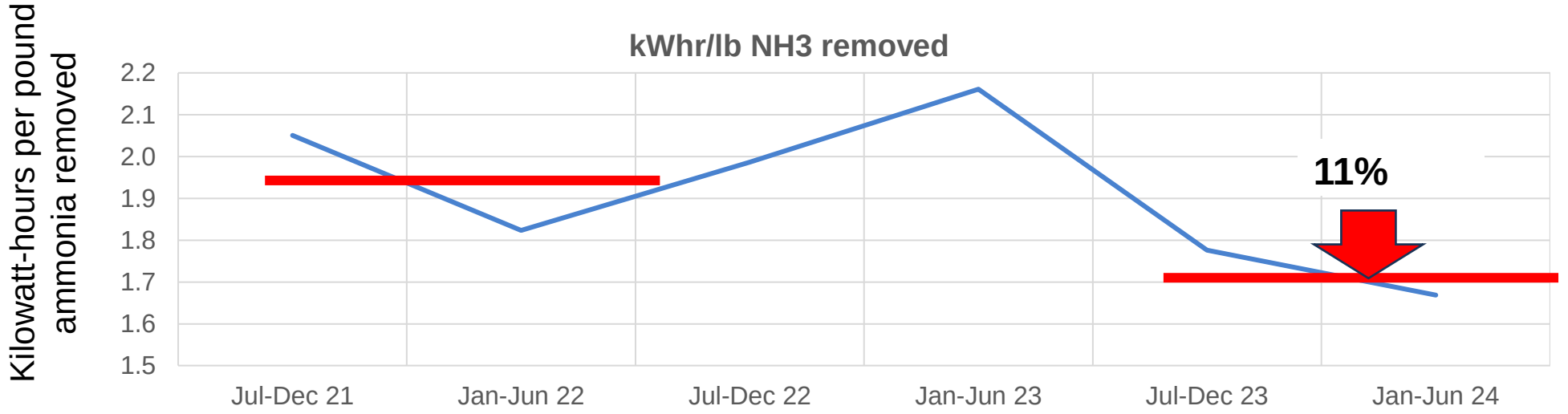

NH3 Ammonia mg/l in effluent
mg/l effluent ammonia (Lab)
0.50
0.40
0.30
0.20
0.10
0.00
+0.03 mg/l
Jul-Dec 21
Jan-Jun 22
Jul-Dec 22
Jan-Jun 23
Jul-Dec 23
Jan-Jun 24

Ammonia Setpoint Changes



Electric Use (per lb ammonia removed) reduced by 11%


Rivanna Blower kW Before and After ABAC
Aeration Blowers
Kilowatts
280
270
260
250
240
230
220
210
200
190
180
Before ABAC
Blower Power 240.3 kW
9%
After ABAC
Blower Power 217.5kW
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
June
Before ABAC 2021-2022
After ABAC 2023-2024

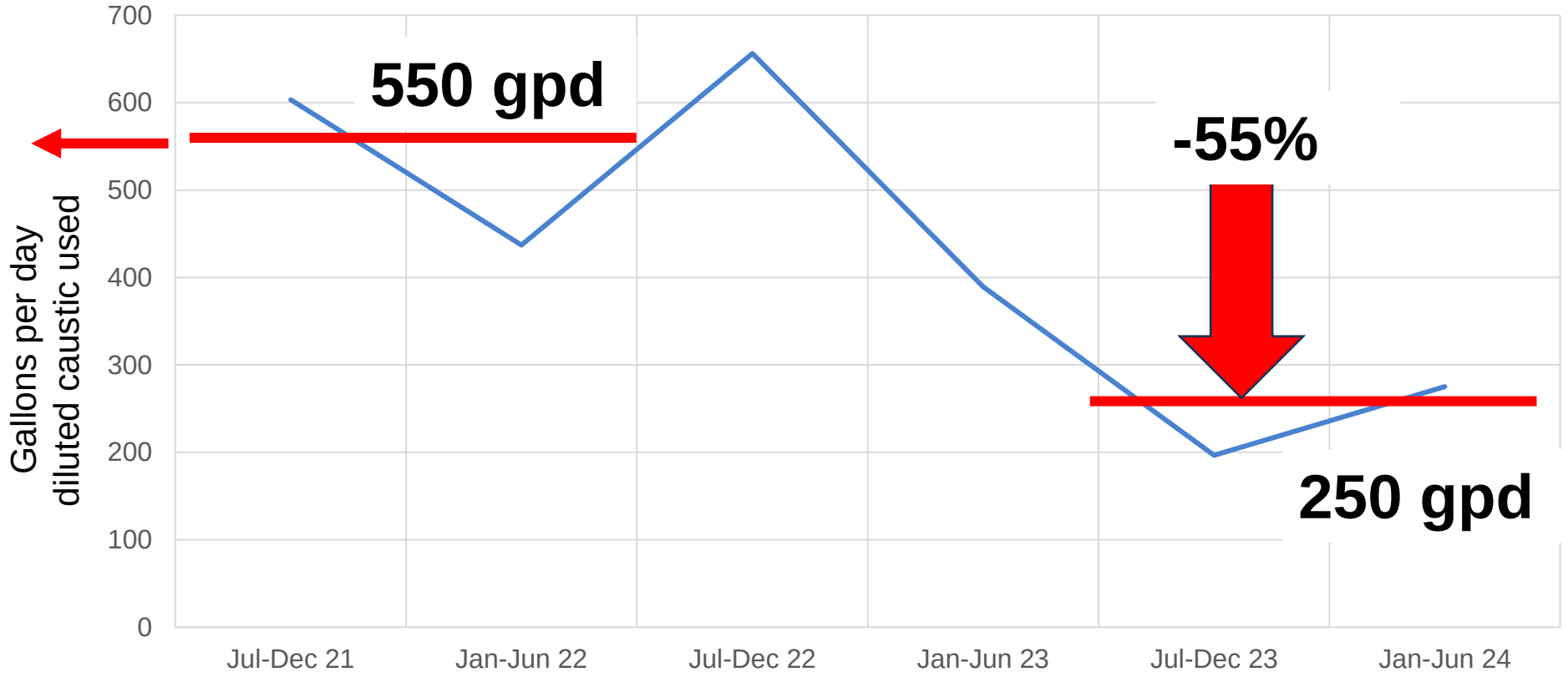

kWhr/lb NH3 removed
Kilowatt-hours per pound
ammonia removed
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
11%
Jul-Dec 21
Jan-Jun 22
Jul-Dec 22
Jan-Jun 23
Jul-Dec 23
Jan-Jun 24

Wow:

Caustic Use reduced by 55%

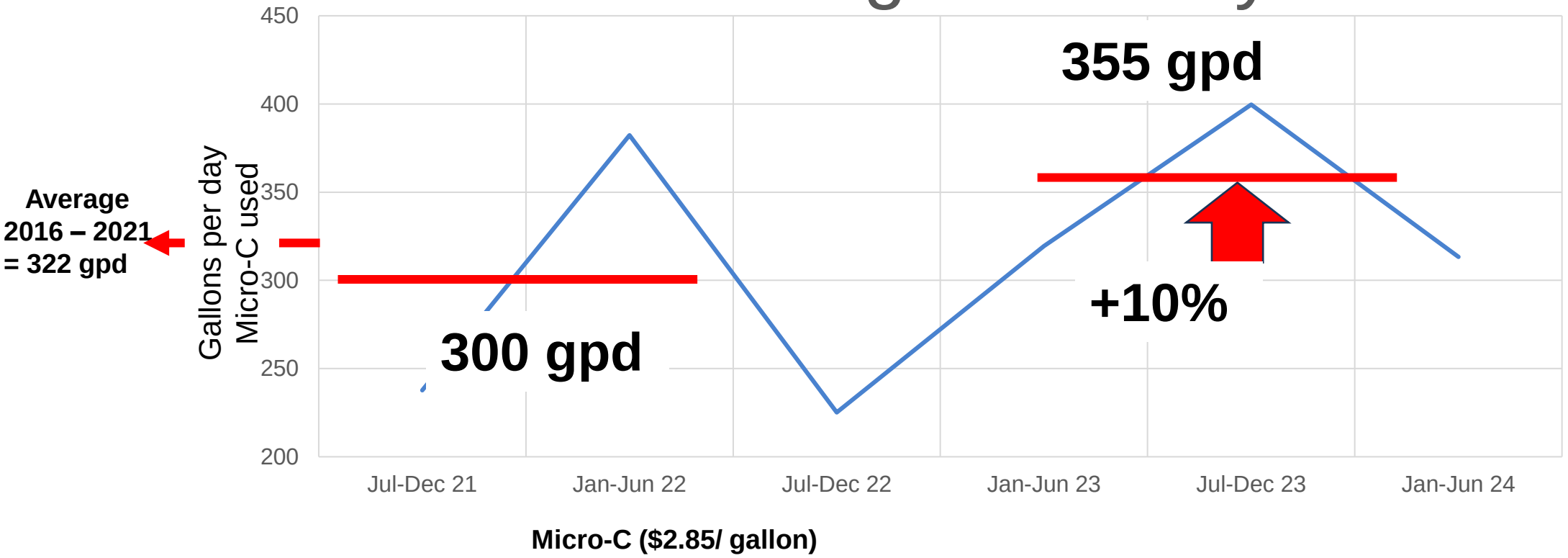
Caustic Use gallons/day

Average 2016 – 2021 = 549 gpd



Caustic gallons /day= 55% sodium hydroxide ($3.35/ gallon) diluted to about 27.5%

Supplemental Carbon
Micro-C gallons/ day



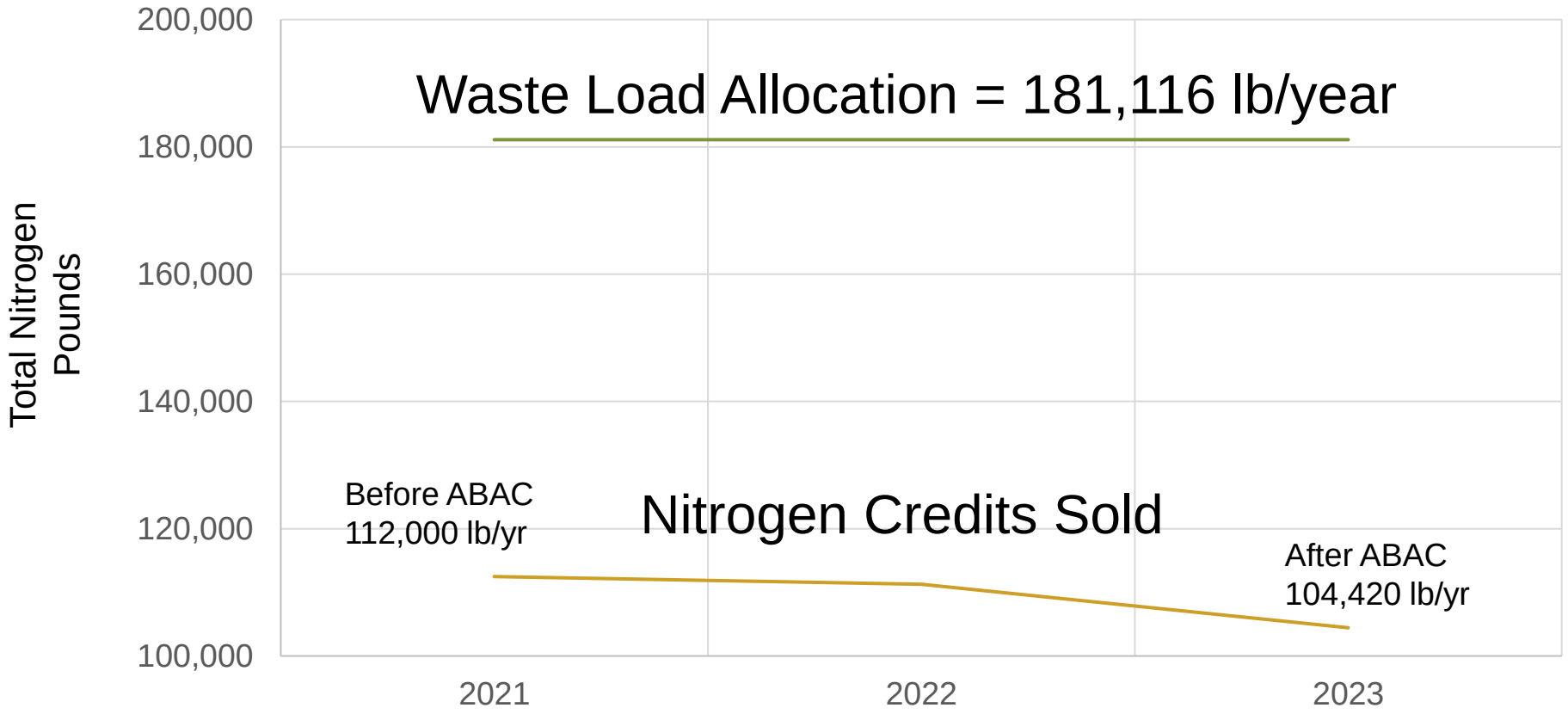
Micro-C ($2.85/ gallon)

Total Nitrogen

Nutrient Exchange Program

Nitrogen credits sold

Pounds Per Year Nitrogen



Benefits

Lower D.O. and less fluctuation in DO concentration

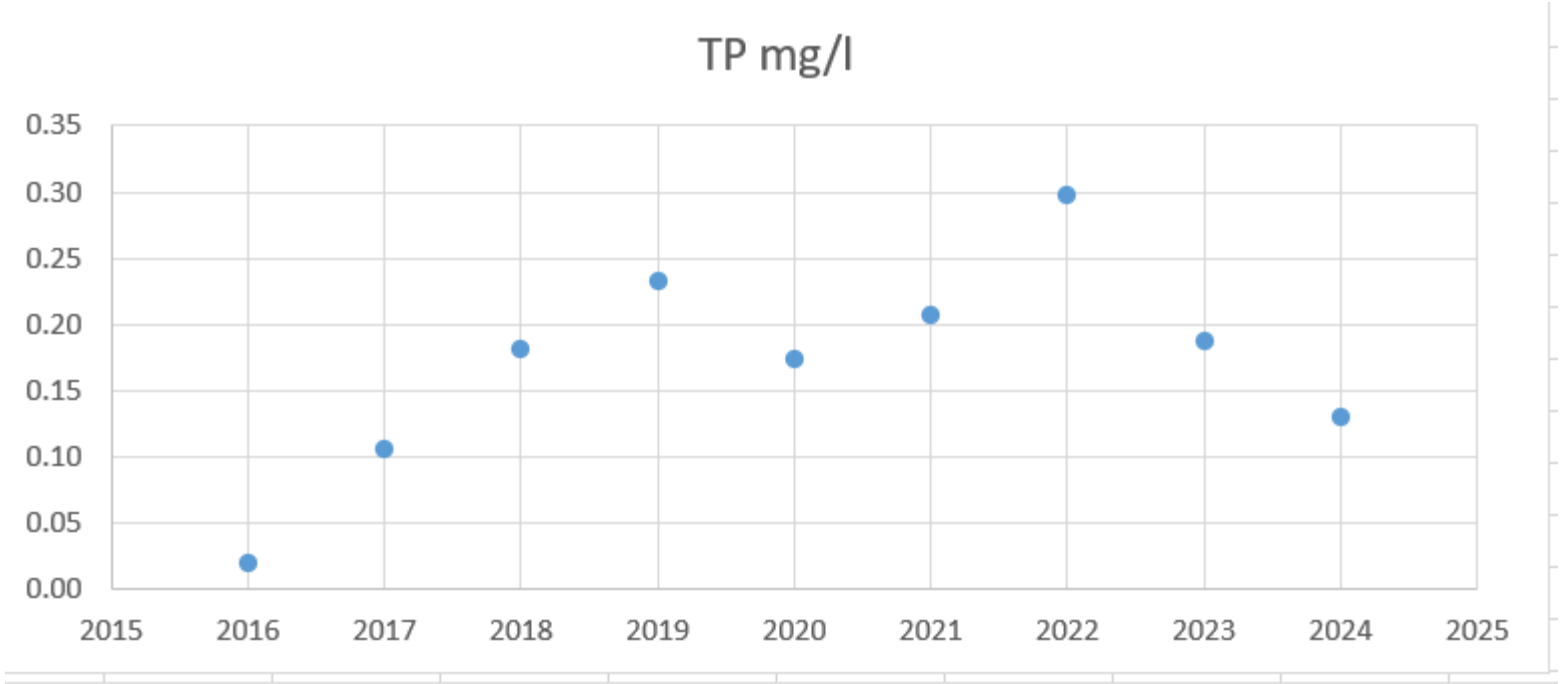
Reduced mechanical wear and tear on the equipment (less blower cycling – smoother transitions)

Simpler system – easier to understand – instructions on SDADA screen

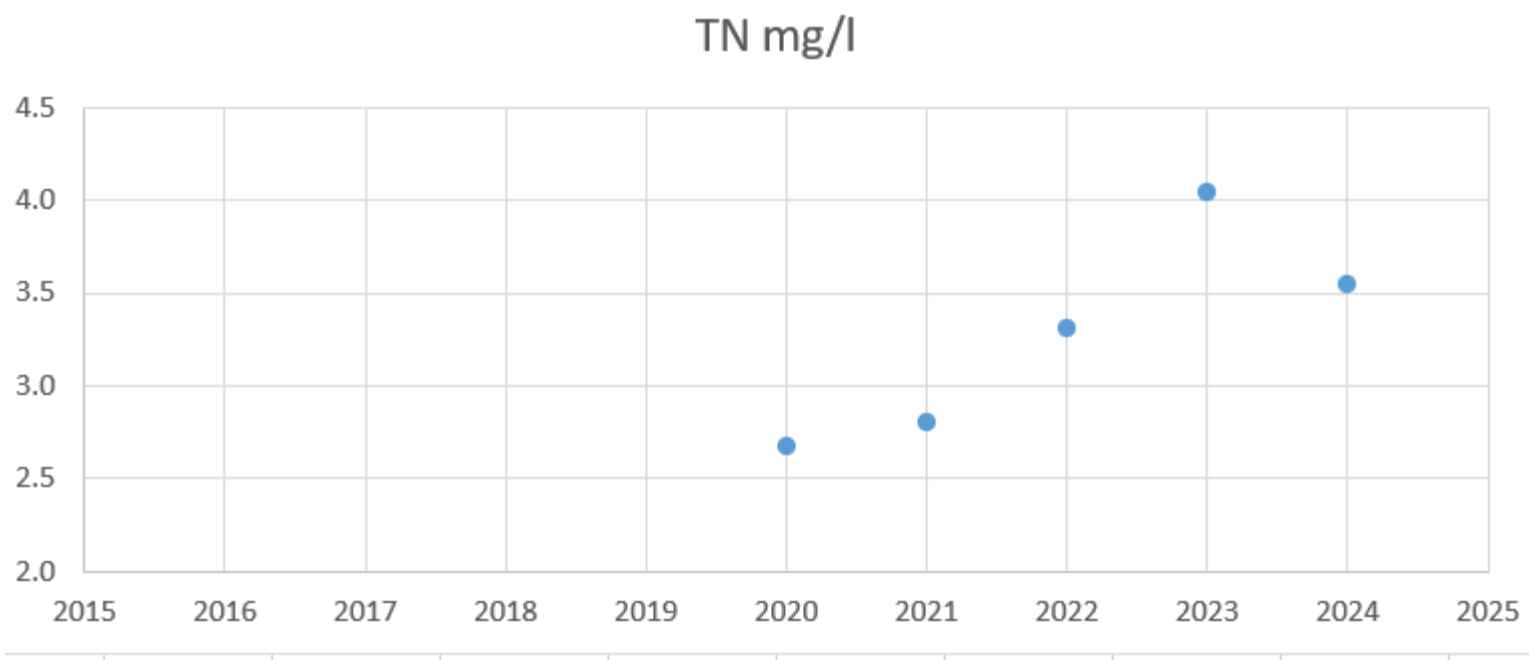
More resilient system – adjustable for upsets and outages

Recovery from Phosphorous and Nitrogen Spikes

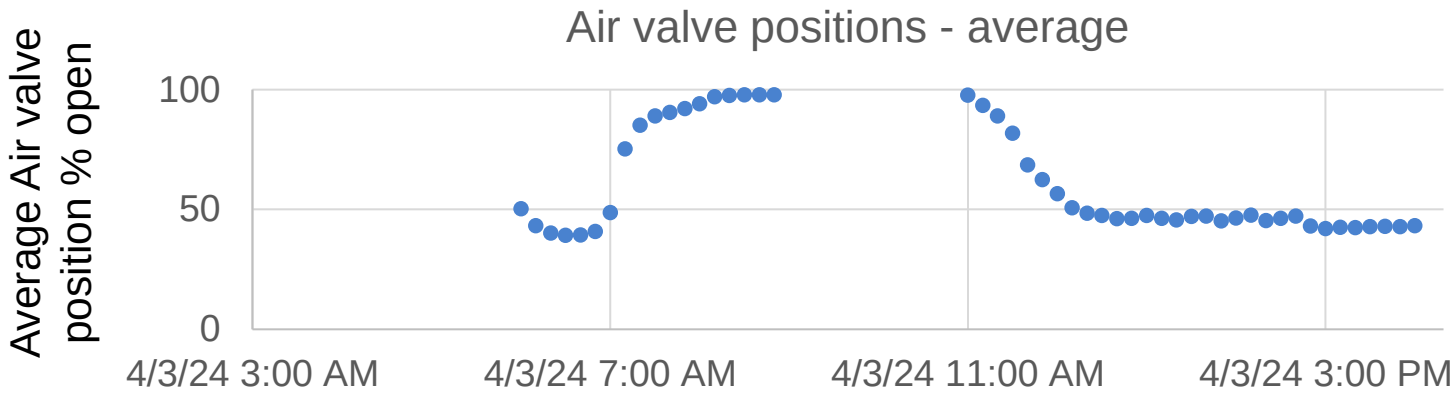
Total Phosphorous in Plant effluent mg/l

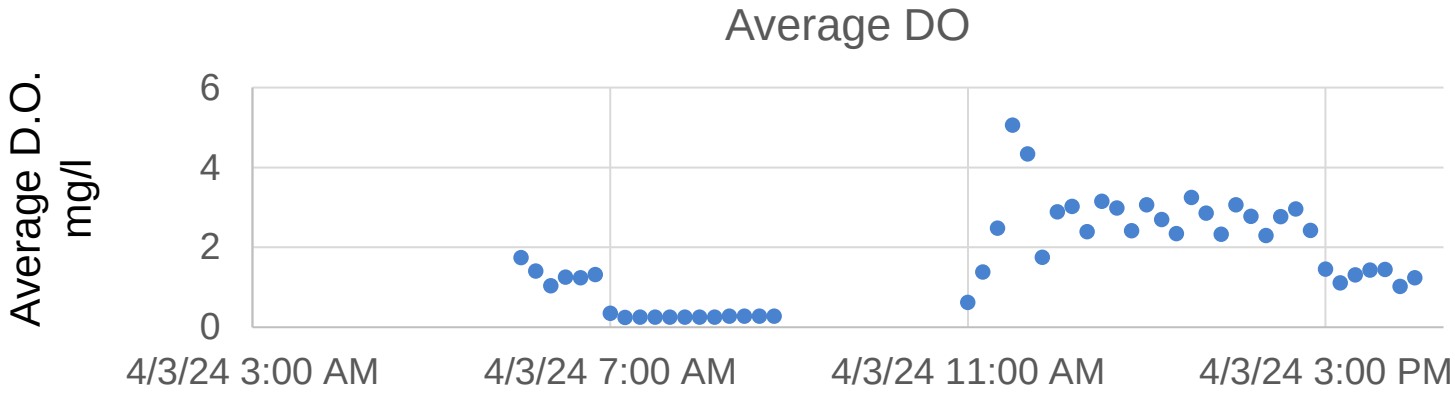


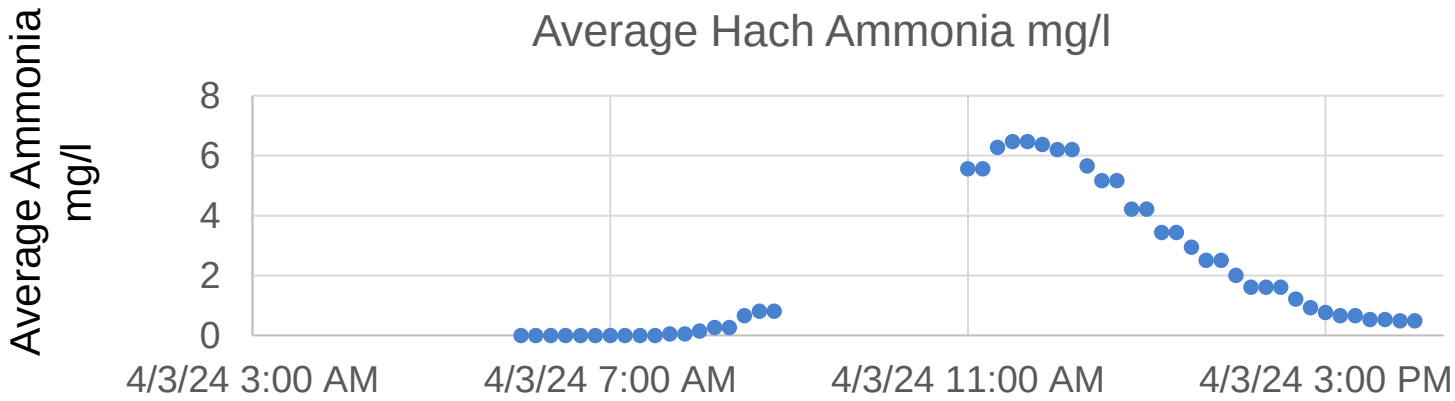
Total Nitrogen in Plant effluent mg/l



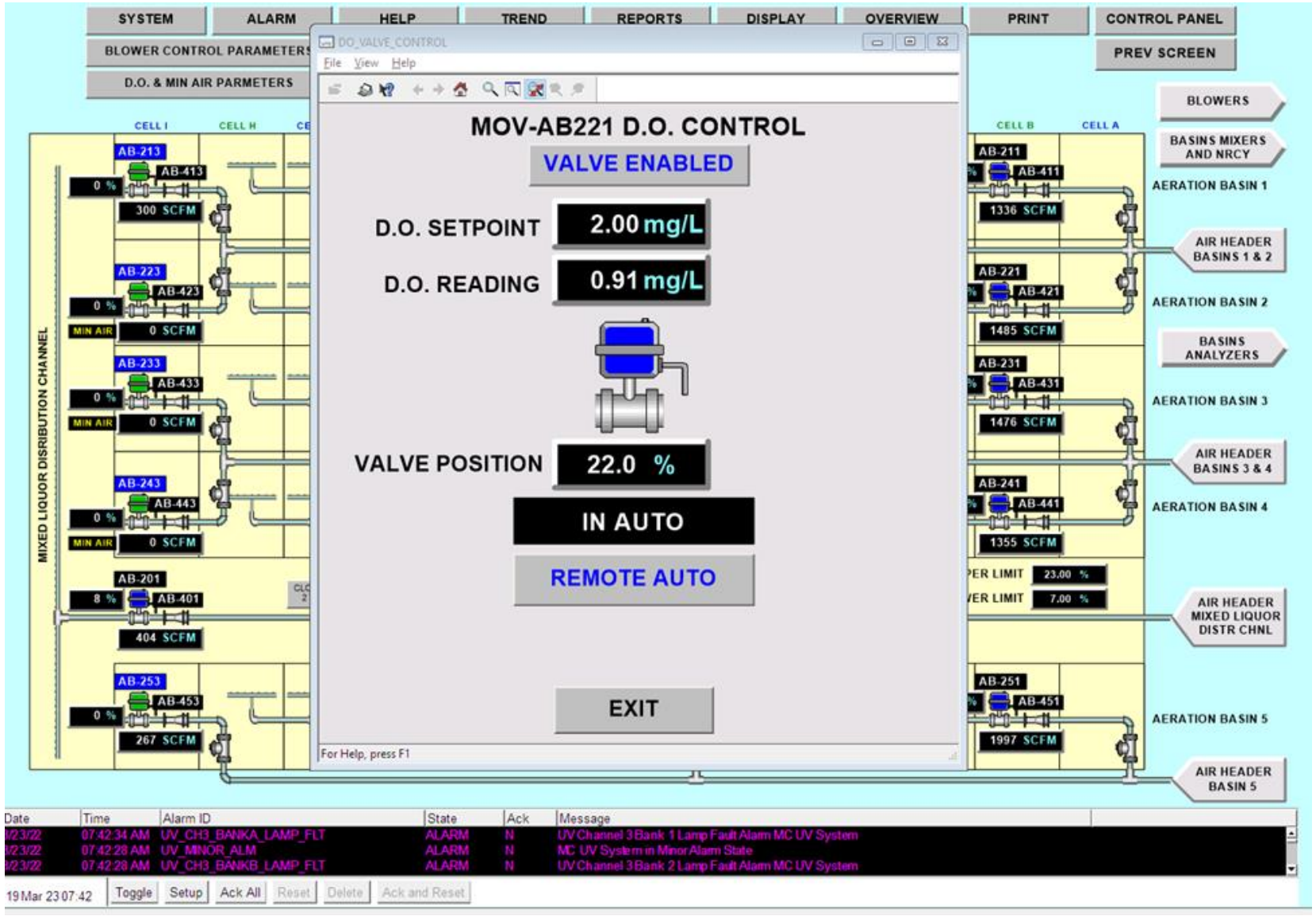
Planned Power Outage 4-3-24
0700 - 1100


Air valve positions - average
Average Air valve position % open
100
50
0
4/3/24 3:00 AM
4/3/24 7:00 AM
4/3/24 11:00 AM
4/3/24 3:00 PM


Average DO
Average D.O. mg/l
6
4
2
0
4/3/24 3:00 AM
4/3/24 7:00 AM
4/3/24 11:00 AM
4/3/24 3:00 PM


Average Hach Ammonia mg/l
Average Ammonia mg/l
8
6
4
2
0
4/3/24 3:00 AM
4/3/24 7:00 AM
4/3/24 11:00 AM
4/3/24 3:00 PM

Recovery from Loss of Signal Communications


SYSTEM
ALARM
HELP
TREND
REPORTS
DISPLAY
OVERVIEW
PRINT
CONTROL PANEL
BLOWER CONTROL PARAMETERS
D.O. & MIN AIR PARMETERS
PREV SCREEN
DO_VALVE_CONTROL
File View Help
MOV-AB221 D.O. CONTROL
VALVE ENABLED
D.O. SETPOINT
2.00 mg/L
D.O. READING
0.91 mg/L
VALVE POSITION
22.0 %
IN AUTO
REMOTE AUTO
EXIT
For Help, press F1
BLOWERS
BASINS MIXERS AND NRCY
AERATION BASIN 1
AIR HEADER BASINS 1 & 2
AERATION BASIN 2
BASINS ANALYZERS
AERATION BASIN 3
AIR HEADER BASINS 3 & 4
AERATION BASIN 4
AIR HEADER MIXED LIQUOR DISTR CHNL
AERATION BASIN 5
AIR HEADER BASIN 5
MIXED LIQUOR DISRIBUTION CHANNEL
CELL I
CELL H
CELL B
CELL A
AB-213
AB-413
300 SCFM
AB-223
AB-423
0 SCFM
AB-233
AB-433
AB-243
AB-443
AB-201
AB-401
404 SCFM
AB-253
AB-453
267 SCFM
AB-211
AB-411
1336 SCFM
AB-221
AB-421
1485 SCFM
AB-231
AB-431
1476 SCFM
AB-241
AB-441
1355 SCFM
AB-251
AB-451
1997 SCFM
Date Time Alarm ID State Ack Message
UV_CH3_BANKA_LAMP_FLT ALARM N UV Channel 3 Bank 1 Lamp Fault Alarm MC UV System
UV_MINOR_ALM ALARM N MC UV System in Minor Alarm State
UV_CH3_BANKB_LAMP_FLT ALARM N UV Channel 3 Bank 2 Lamp Fault Alarm MC UV System
19 Mar 23 07:42
Toggle
Setup
Ack All
Reset
Delete
Ack and Reset

Summary Table

Chemical Savings					
	$/gallon	usage before ABAC gpd	usage after ABAC gpd	% improvement	$ Savings/year
Caustic 25% solution	$1.68	550	250	54.5%	$183,200
Micro-C	$2.85	322	355	-10.2%	-$34,300
Electric Savings					
	$/kWhr	usage before ABAC kWh/year	usage after ABAC kWh/year		$ Savings/year
Blowers	0.0972	2,076,120	1,900,920	9.5%	$17,000
MCAWRRF (Plant)	*0.0972*	*9,040,000*	*7,916,223*	*12.4%*	*$109,231*
Nutrient Trading					
	$/CREDIT (Upper James River)	Nitrogen credits before ABAC 2021	credits after ABAC Nitrogen 2023		$ Savings/year
Total Nitrogen	$0.80	112,506	104,420	-7.1%	-$6,500
Net Annual Savings					$161,800

Comparison with Other ABAC Studies

Location Utility Year Average Flow Study	Ontario CA Ontario MUC 2018 - 2019 25 MGD Full Scale	Westfield MA Westfield Public W 2019 3.4 MGD Pilot Scale	Nansemond VA HRSD 2013 - 2015 30 MGD Full Scale	Charlottesville VA Rivanna (RWSA) 2022- 2024 10 MGD Full Scale
	% improvement	% improvement	% improvement	% improvement
Caustic		20%		55%
Supplemental Carbon			51%	-10%
Electricity (kWhr)	9%	10 – 15%	10%	11%
Total N			6.0 -> 7.6 mg/l	2.2 - > 3.5 mg/l (-7% 2023)
Net Savings $/year			$300,000/yr	$161,800/yr
Return On Investment	4 years	6.7 years		< 1 year
Reference	Impact of Ammonia-Based Aeration Control (ABAC) on Energy(mdpi.com)	1cityofwestfield.org	Nansemond HRSD ABAC 2014	

Summary

Blower energy savings

- ~9% = 175,200 KWh/year

Greenhouse Gas reductions[1,2,3]

- + 60 tons/year CO2
- + 160 tons/year CO2
- + ? tons/year N_2O

Chemical Savings

- 150 gallons per day of 55% caustic = 55,000 gallons per year

Cost Savings

- Electric $17,000 / yr
- Caustic $183,200 / yr
- Micro – C ($34,300)/yr
- N Credits (6,500)year

Overall Savings

$161,800 / year

Greenhouse Gas Reduction

220+ tons per year CO_2 equivalent

[1]https://www.epa.gov/system/files/documents/2022-04/ghg_emission_factors_hub.pdf
[2]ghg-emission-factors-hub-2024.xlsx (live.com)
[3]Chloralkali process - Wikipedia

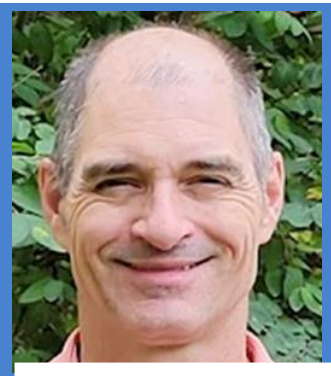
Recommendations

- Continue to operate the DO minimum setpoints at 1.00 to 1.25 mg/L. Most recently, the setpoints have been 1.25 mg/L in the first zone and 0.75 mg/L in the second zone.
- Continue to operate with the effluent ammonia setpoint at 1.5 - 2.0 mg/L.
- Add feed forward control with new ammonia probe at the inlet of aeration tanks (Fall 2024)

Rob Haacke, RWSA

Lina Belia, Primodal

Amy Prok, PM SEH



Dave Quast SEH

Ted Bottelberghe SEH

Thad Webb SEH

ABAC Project Team

Questions?

BQZJQ