



TREATMENT OF SIDE-STREAM CENTRATE AT PIERCE COUNTY & BAY PARK WWTP USING ANAMMOX TECHNOLOGY

**PRESENTED BY: CHANDLER JOHNSON
4 FEBRUARY, 2021**

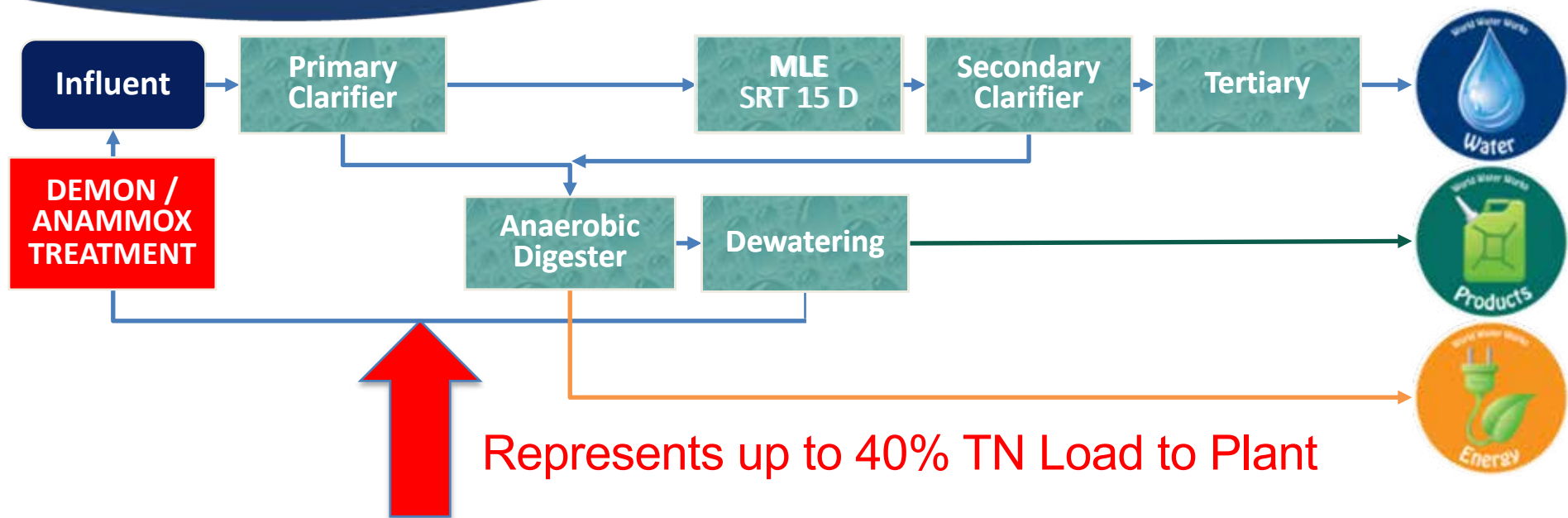
**NEWEA 2021 ANNUAL VIRTUAL CONFERENCE
SESSION 15 – RESIDUALS HANDLING**

Outline of Presentation

- Overview of Deammonification
- Summary of DEMON® Process
- Pilot Study Results from Pierce County
- Lessons Learned / Design Considerations
- Start-Up and Operational Results
- Conclusions

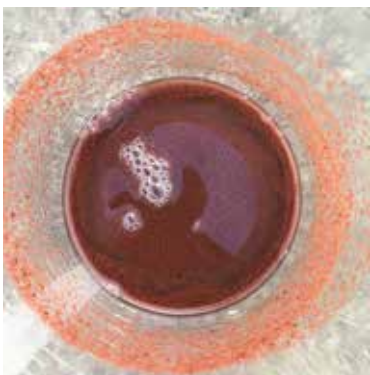


Deammonification of high strength ammonia using Anammox



Anaerobic sludge digestion is very beneficial but **has many “bad” effects:**

- Reduces C/N ratio, Shock loads to system, Alkalinity issues



Anammox allows treatment of high strength ammonia using 60% less energy and NO external carbon.

Achieve 80-90% ammonia removal and 70-80% TIN removal

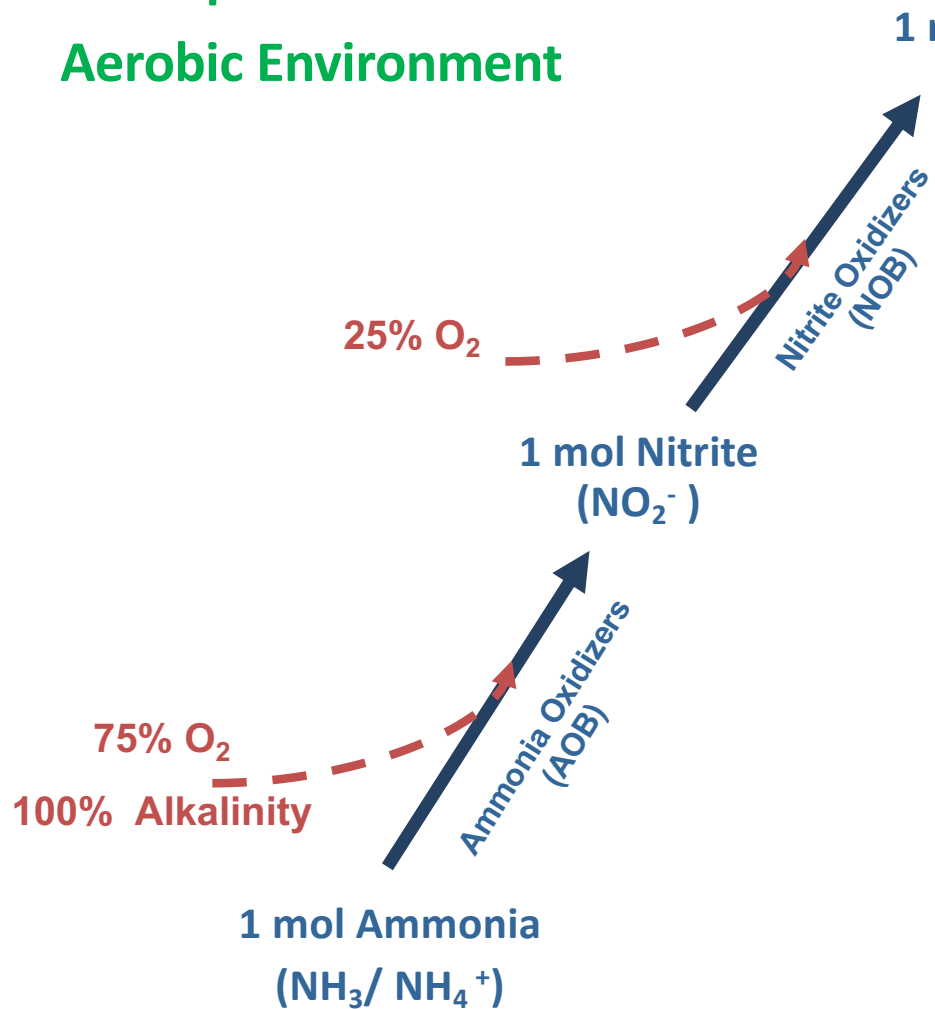
Granular Anammox achieve high treatment rates at good SVI's



Fundamentals of Nitrification – Denitrification

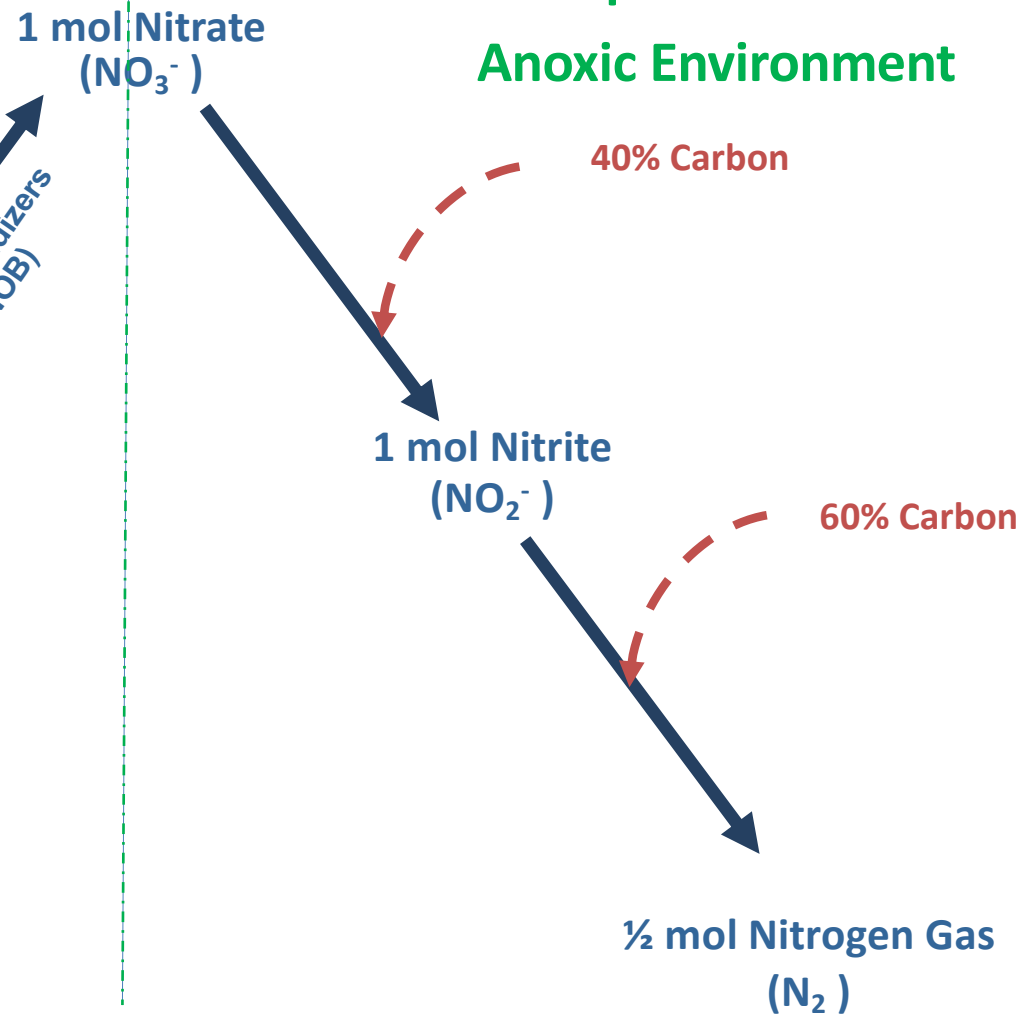
Autotrophic Nitrification

Aerobic Environment



Heterotrophic Denitrification

Anoxic Environment



Oxygen demand 4.57 g / g $\text{NH}_4^+\text{-N}$ oxidized
Carbon demand 4.77 g COD / g $\text{NO}_3^-\text{-N}$ reduced



Fundamentals of Deammonification

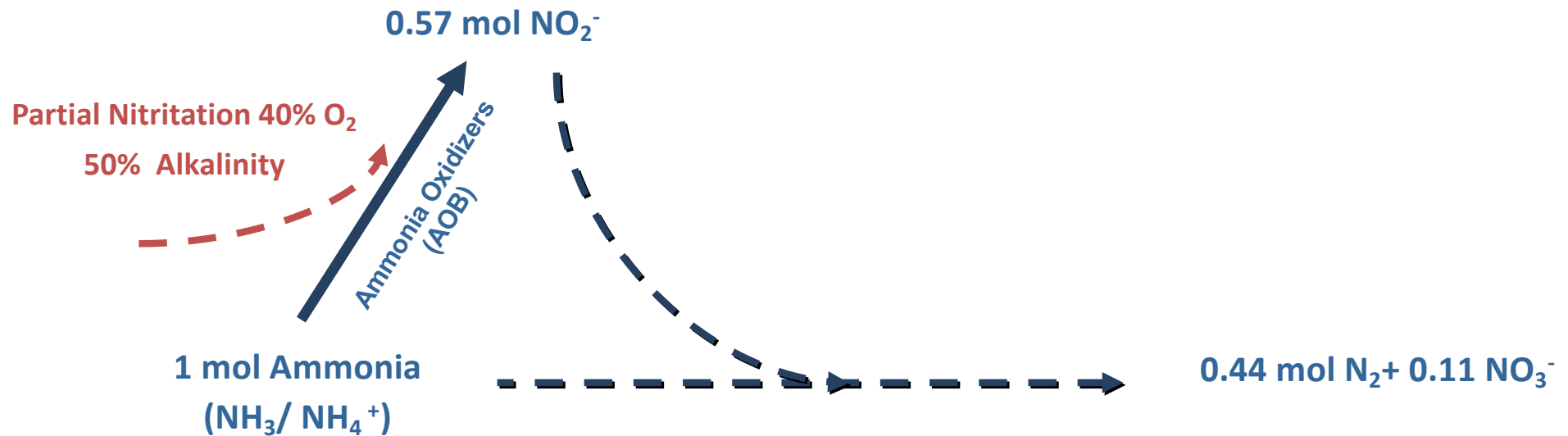
Aerobic Ammonium Oxidation

AerAOB

Anaerobic Ammonium Oxidation

Anammox or AnAOB

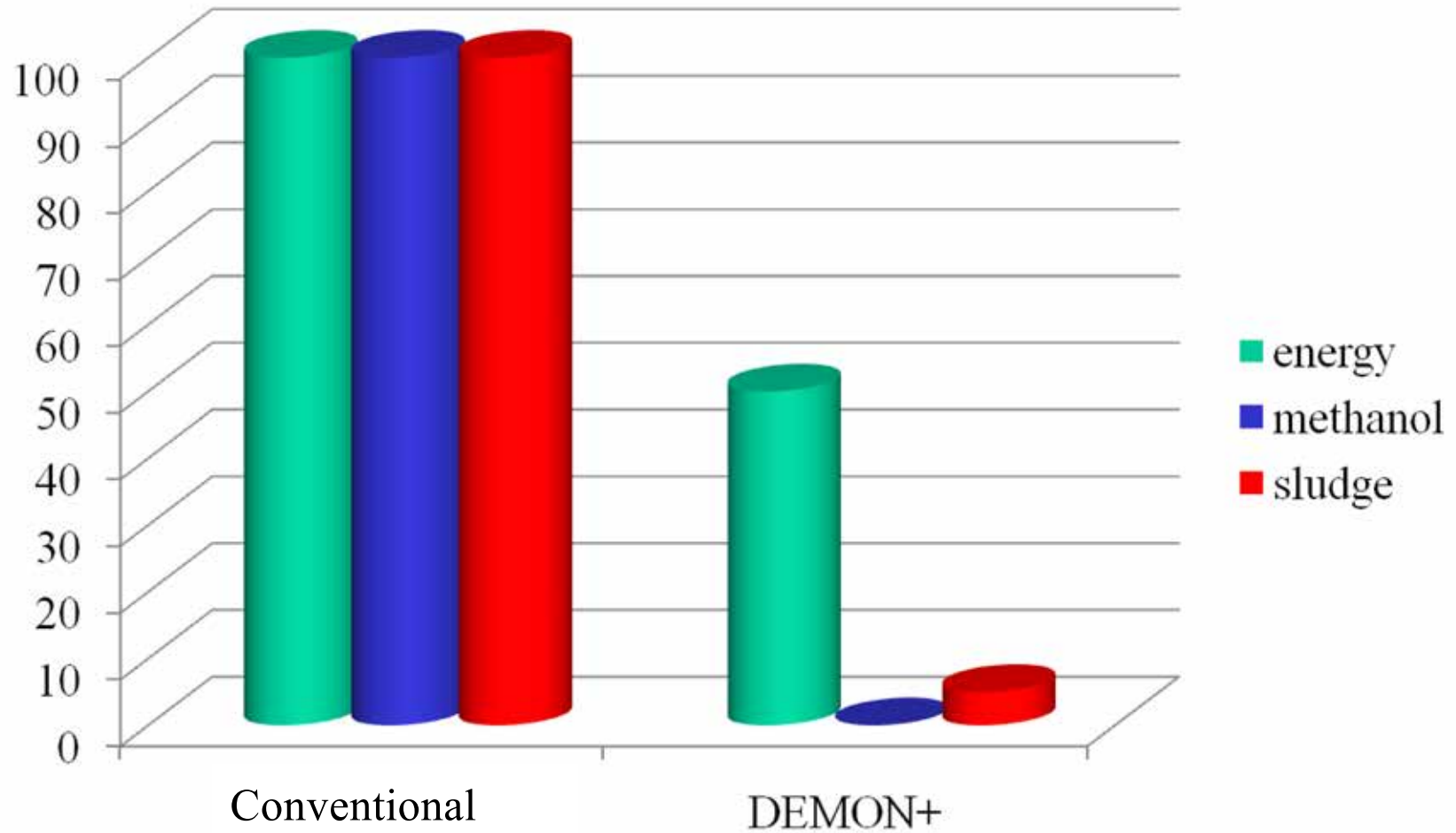
- > 60% reduction in Oxygen / Energy
- Eliminate demand for supplemental carbon
- 50% of the alkalinity demand



Oxygen demand 1.9 g / g NH_4^+ -N oxidized



Comparison of Consumables

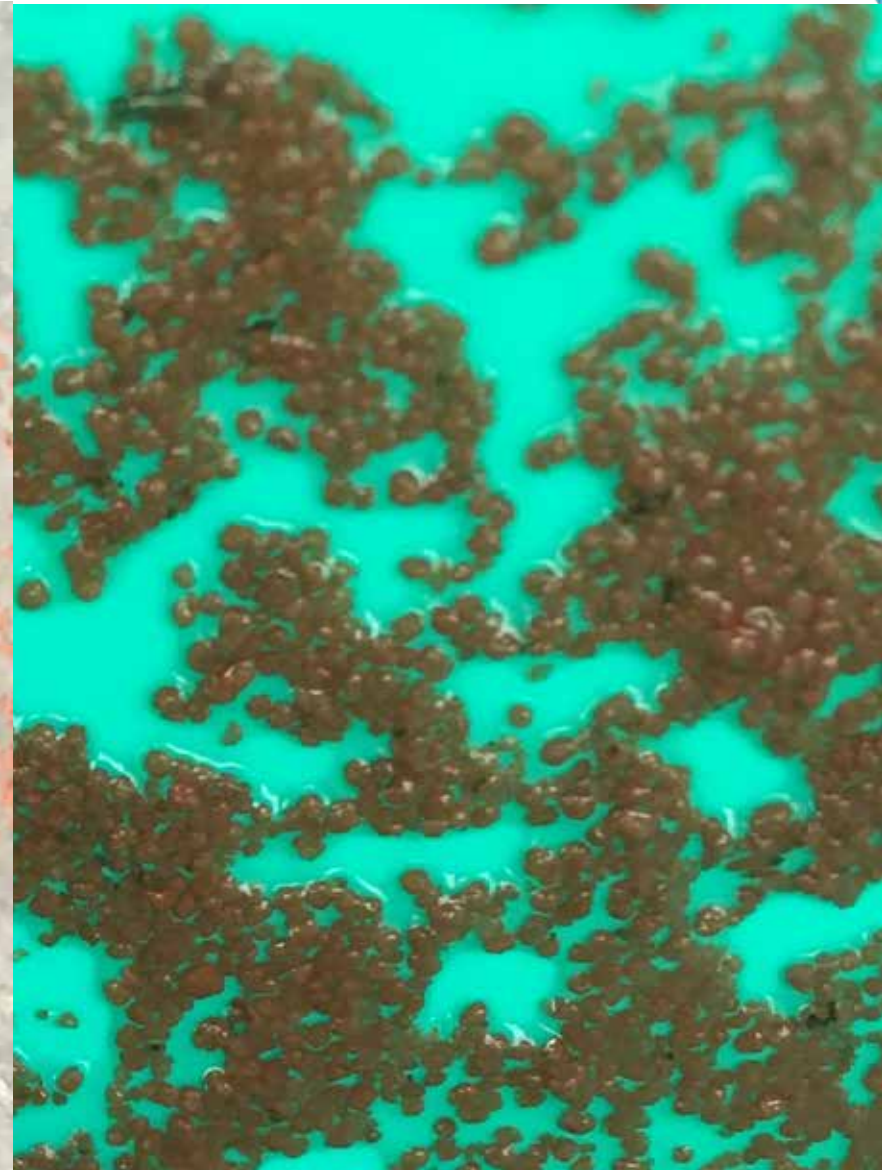


Why Anammox??

- Destruction of organic material in anaerobic digesters release lots of ammonia
- Most of ammonia load ends up in filtrate / centrate during dewatering
- High ammonia concentration (300 – 2,000 mg/L) is sent back to main activated sludge system and results in higher energy consumption in Nitrification
- New THP / Thermophilic digestion has provided some challenges to treatment of centrate / filtrate however new research is showing very good results in treatment.
- Ability to bio-augment mainstream WWTP for short-cut nitrogen removal / mainstream deammonification



The DEMON[®] / Anammox -Process



DEMON[®] Projects World Wide

< Back to report

SUM OF N (LB/D) BY COUNTRY



Country	Sum of N (lb/d)
USA	38676
Chile	31680
The Netherlands	26415
Israel	17600
Germany	13039
UK	12166
Italy	8800
Singapore	6600
Poland	6578
Finland	6358
Switzerland	5764
Denmark	5720
Hungary	5302
Austria	4730
Spain	3740
Sweden	3146
Turkey	2860
Belarus	1650
Canada	920
Slovenia	682
Ukraine	616

92

203K

Sum of N (lb/d)



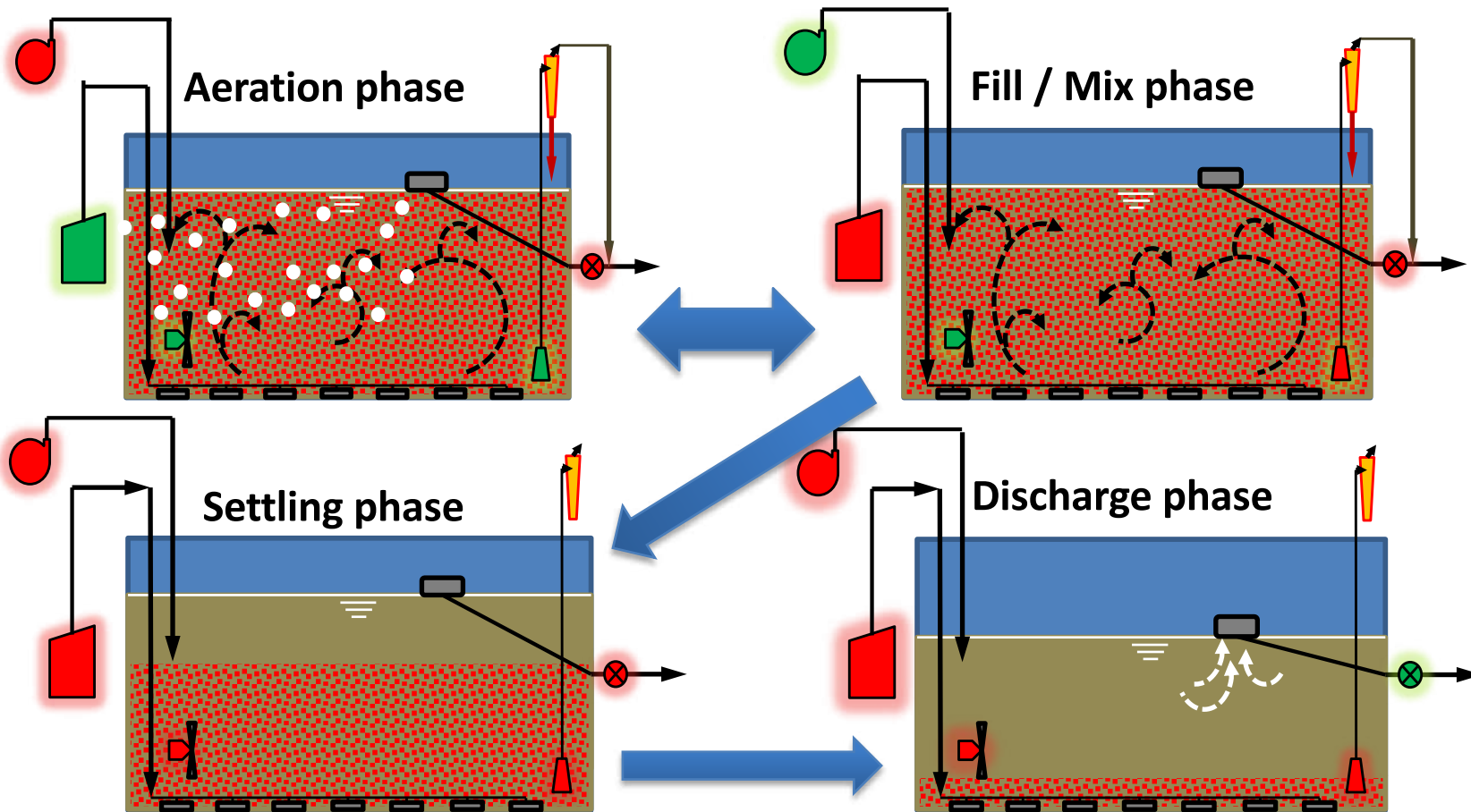
DEMON[®] Projects for North America



❖ York River, VA	Operational - 2012	554 lb/day
❖ Biogas plant, FL	Operational - 2013	1,500 lb/day
❖ Alexandria, VA	Operational - 2015	2,826 lb/day
❖ City of Greeley, CO	Operational - 2015	781 lb/day
❖ City of Guelph, Ontario	Operational - 2015	921 lb/day
❖ Pierce County, WA	Operational - 2017	4,147 lb/day
❖ DC Water, DC	Operational - 2017	27,338 lb/day
❖ Bay Park, NY	In Construction	3,770 lb/day



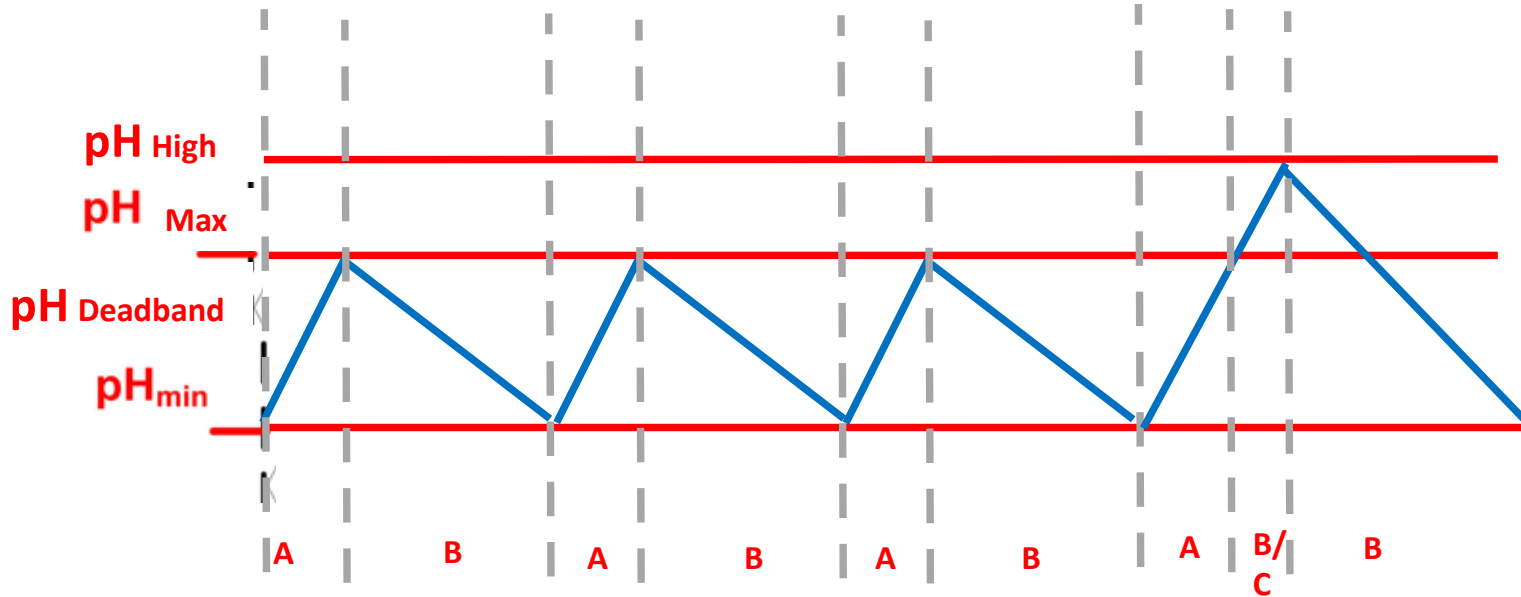
DEMON[®] SBR - Anammox Treatment



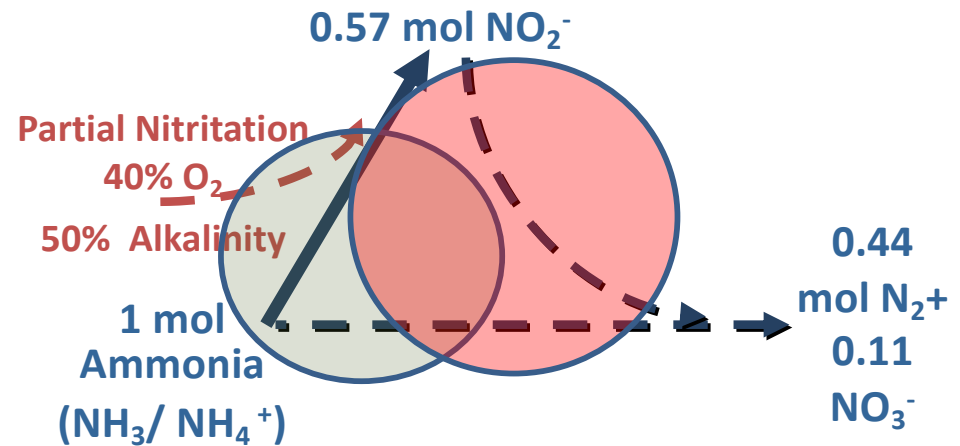
1 process cycle of the DEMON involves multiple time-controlled phases:

- Aeration phase (Nitrification) Fill & Mix Phase ($\text{NH}_3\text{-N}$ Addition)
- Mix phase (Deammonification) Settling / Discharge phase

DEMON Control Philosophy



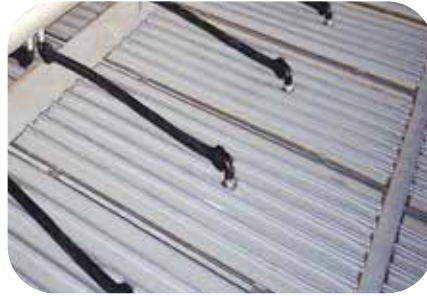
- Blower ON in Section B after hitting designated pH_{max} setpoint
- Blower OFF in Section A after hitting pH_{min} setpoint
- Feed Pump – On all the time unless the pH hits the pH High value.



Major Components for Demon Systems



Seed Sludge



Aeration System



Instruments &
Controls



Tank



Blowers



Decanter / Settling
Zone



Mixer



Separation System
for Anammox

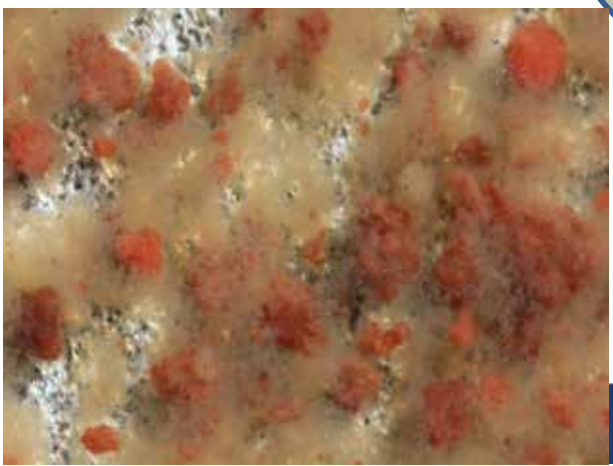
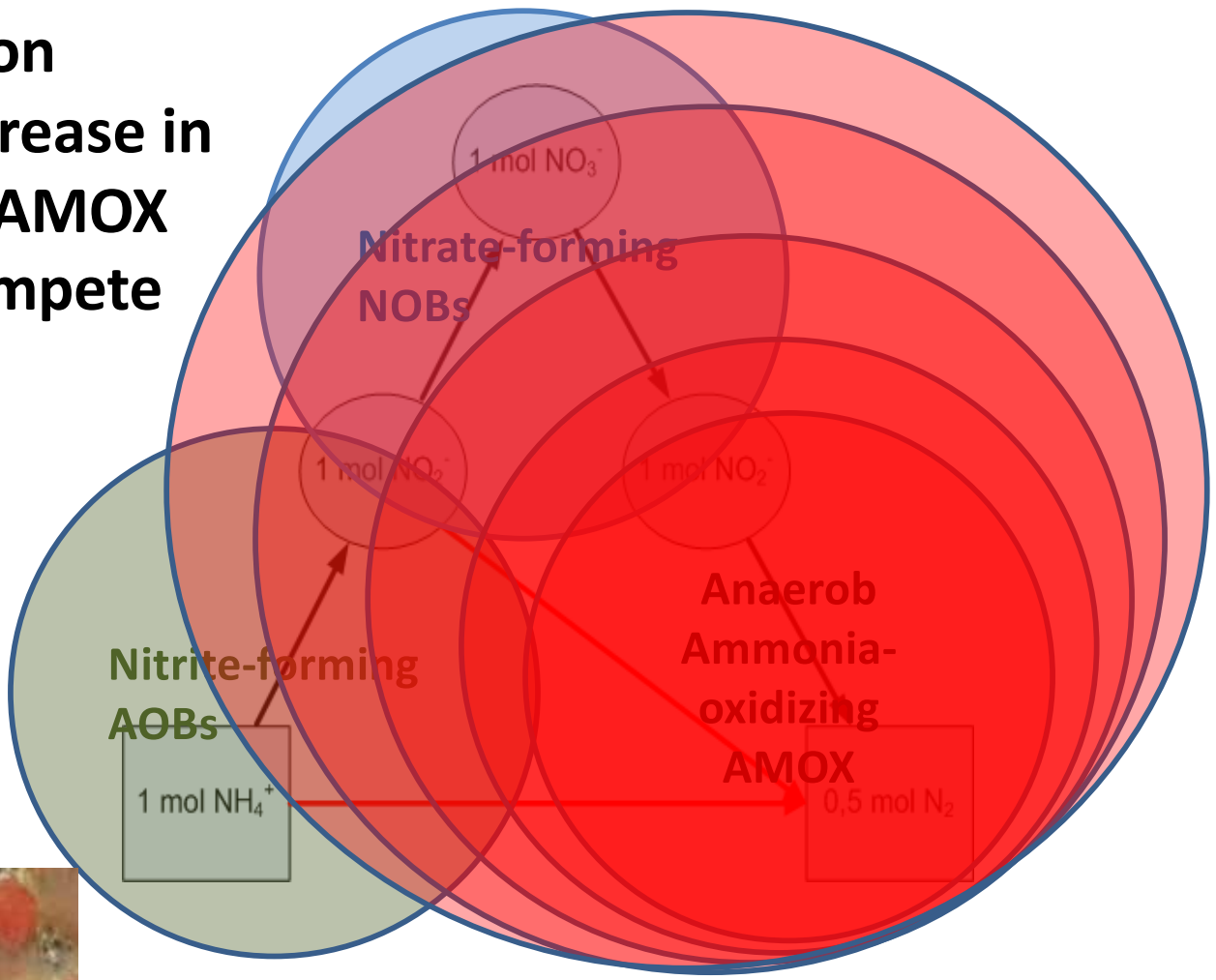
Challenges with Solids Carryover

- Dewatering operation
 - Continuous vs 8 – 12 – 16 hours per day.
- “Fines” in filtrate / centrate from normal operation not problematic
- Occasional upsets at dewatering can result in excess solids in the filtrate drain pans
- Lamella Plate Settler installed for better reliability, or
- Re-use Existing tankage for settling out TSS



Process stability achieved in a single sludge system

Biomass Separation System allows increase in Concentration of AMOX Bacteria to outcompete NOB's in system.



Pierce County Chambers Creek WWTP

DEMON[®] Pilot Study



System Design:

- 5 ft dia x 13 ft SWD

- 1,900 gal capacity

- Fully operational on PLC program

- Remote access

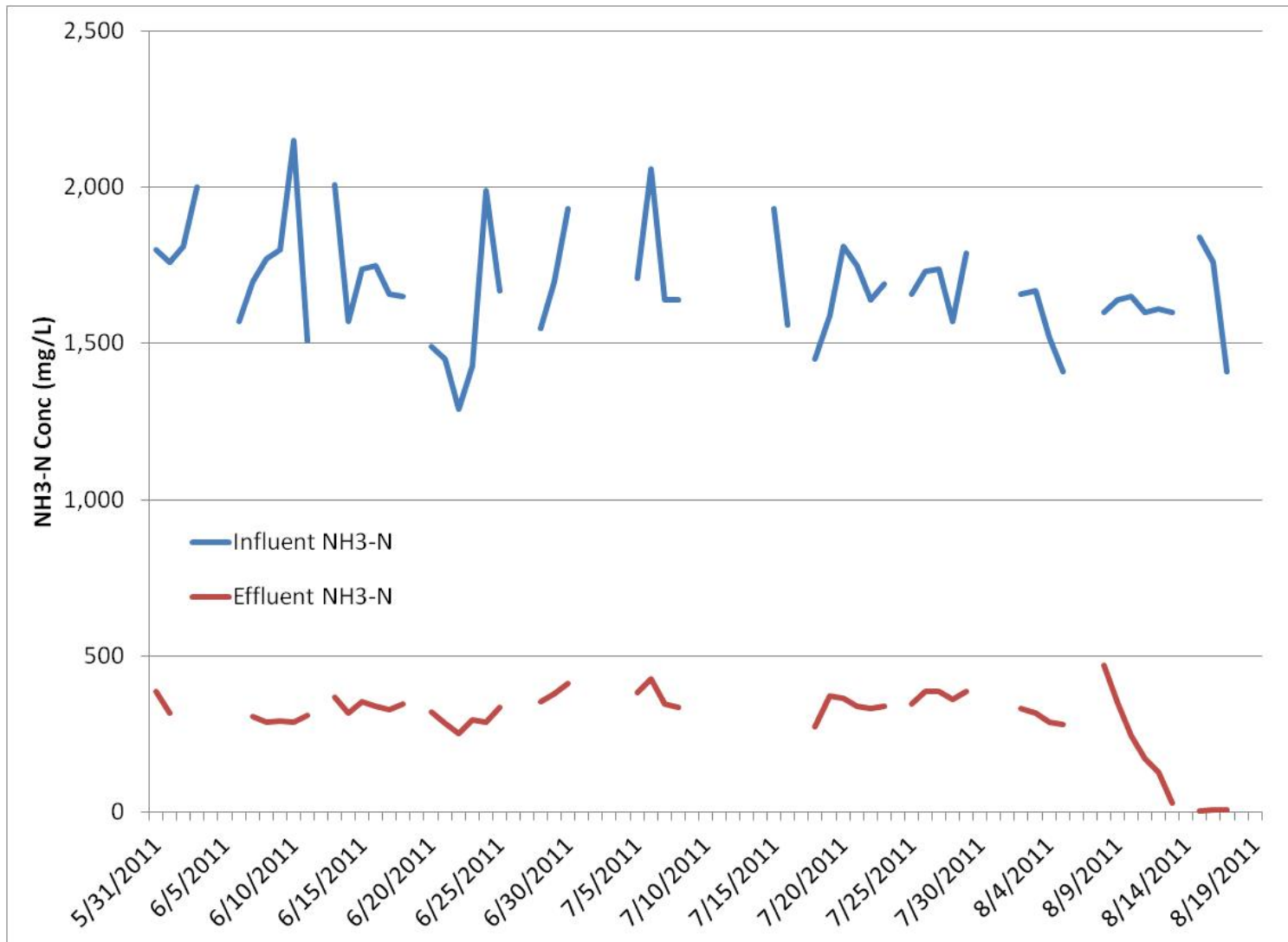
- Back up blowers, feed pump and cyclone pump

- Full scale cyclone used on system

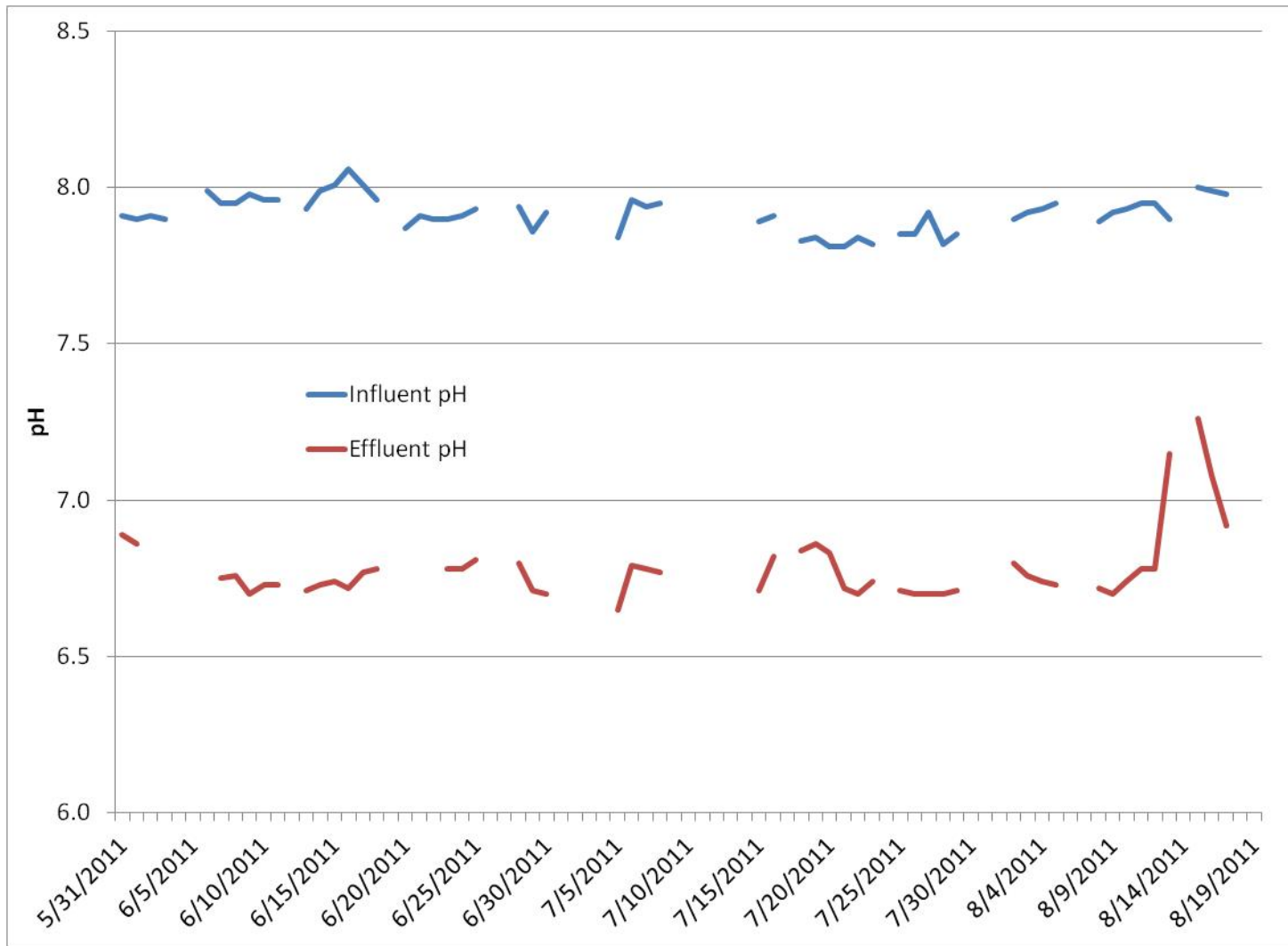


Pierce County Chambers Creek WWTP

DEMON[®] Pilot Study



Pierce County Chambers Creek WWTP DEMON[®] Pilot Study

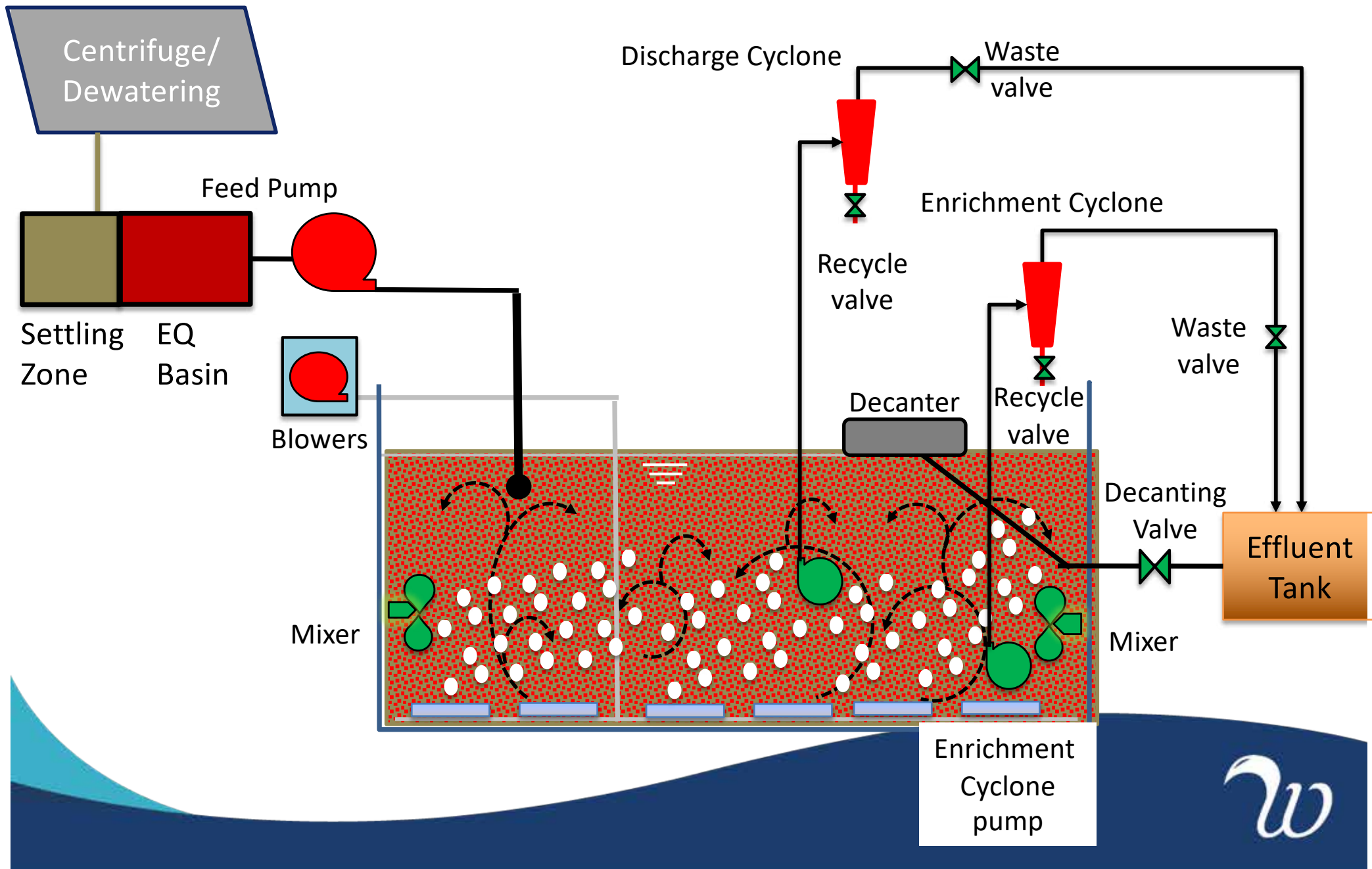


Pierce County Chambers Creek DEMON[®] Pilot Study – lessons learned

- High solids in centrate – generated lots of VFA in EQ tank
- Trouble Settling of MLSS / Anammox Granules – used cyclone for separation / decanting purposes
- Micro-nutrient deficiency – added trace metals



Pierce County DEMON[®] Process Flowchart



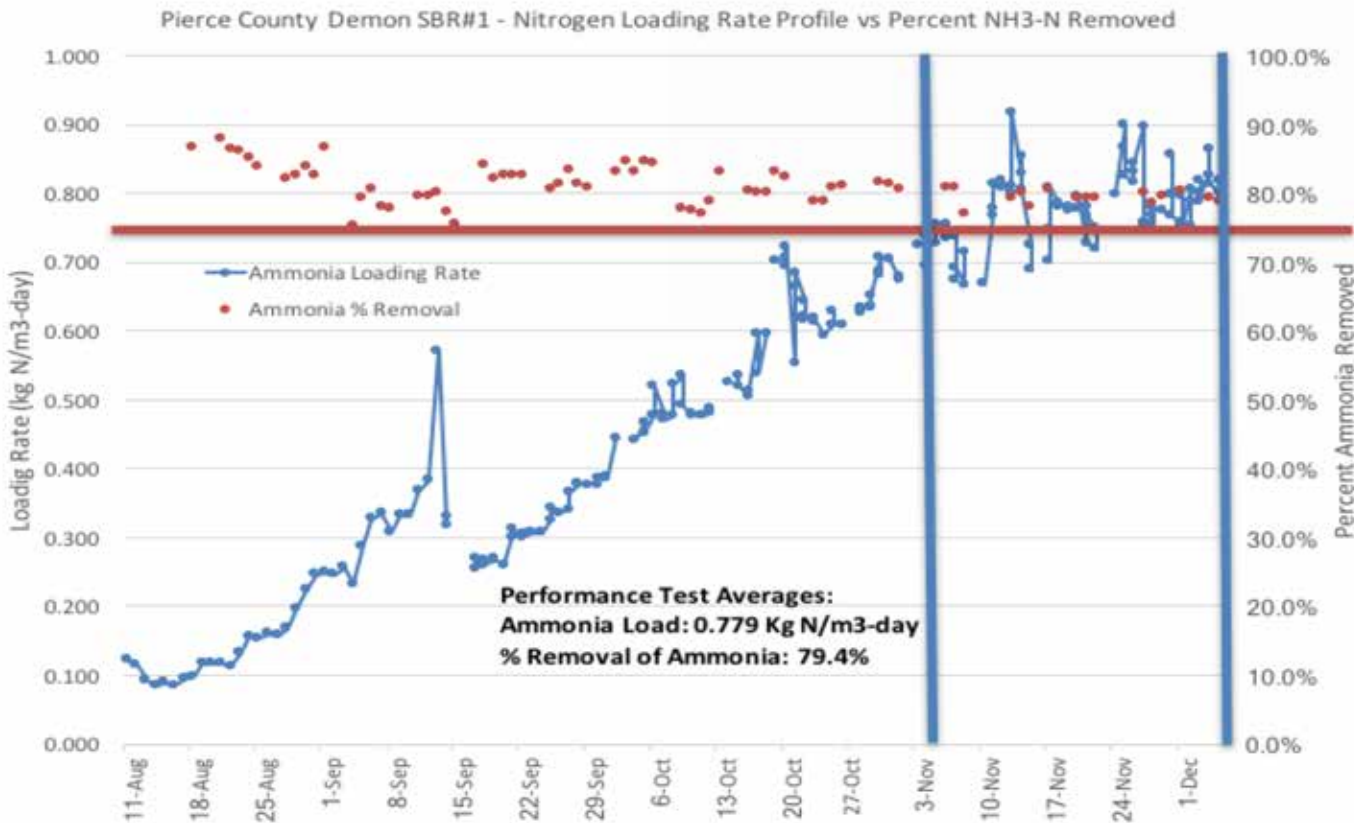
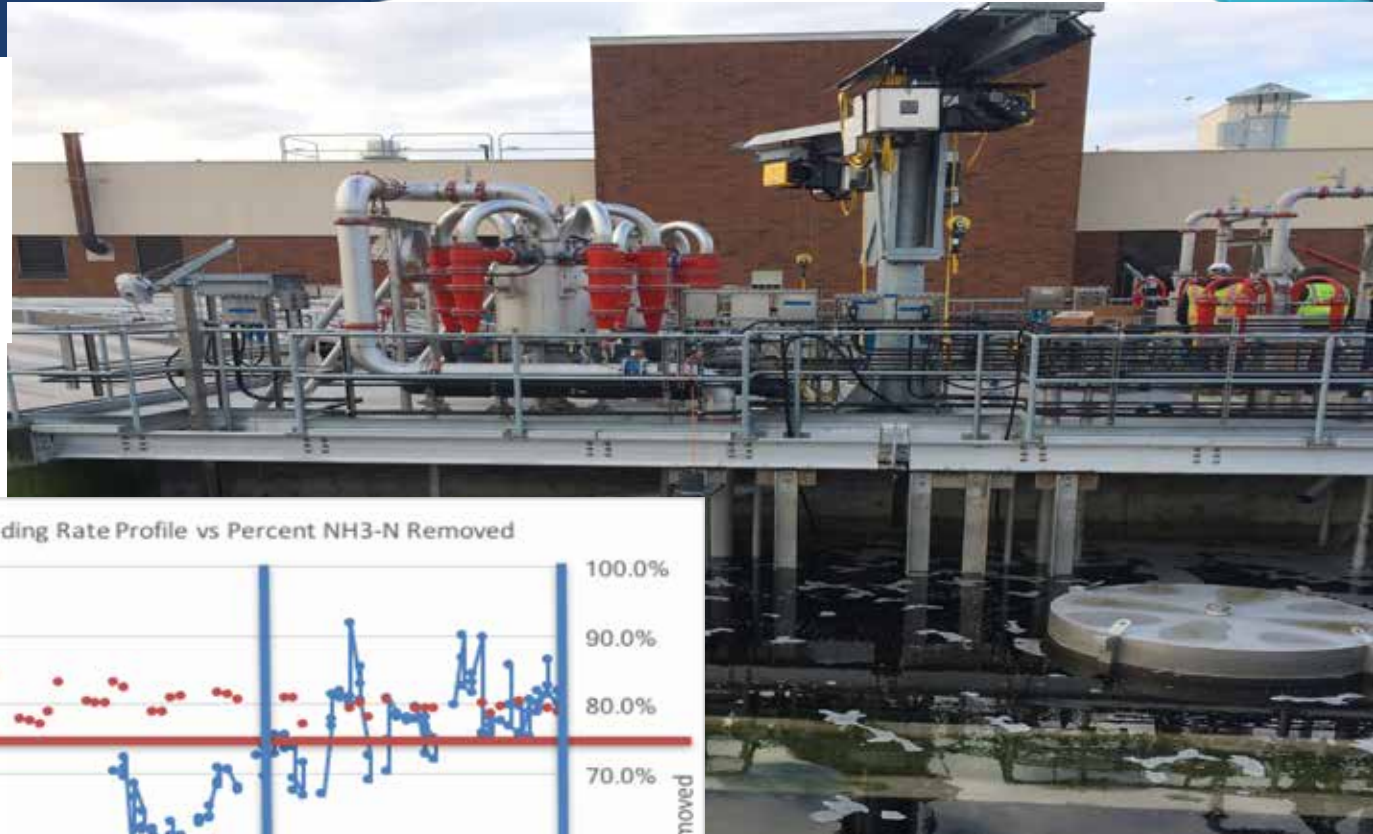
Pierce County Demon Case Study

SBR1: 256,000 gal

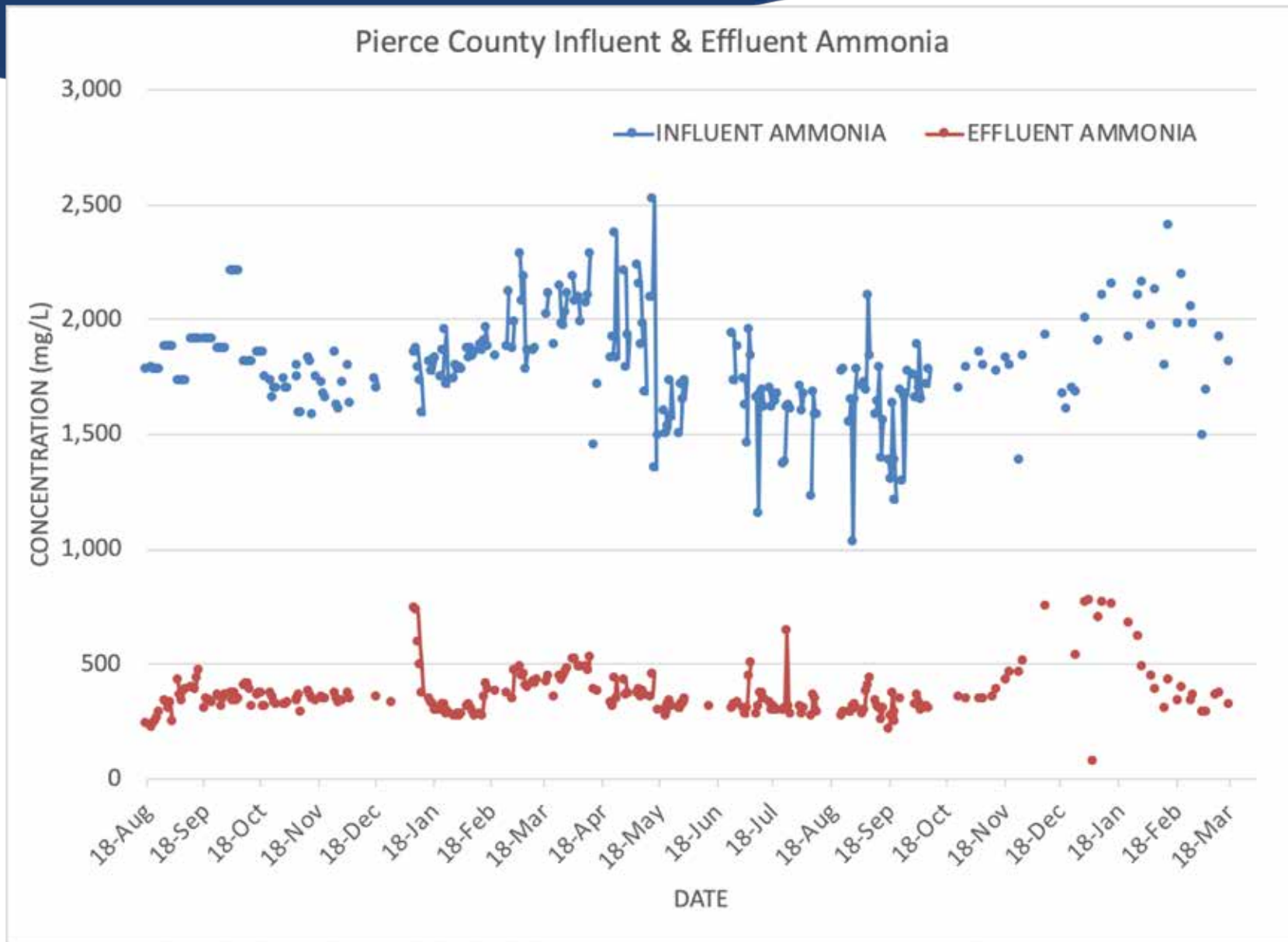
SBR2: 253,700 gal

Hi operational level – 21 ft

Low operational level – 17 ft



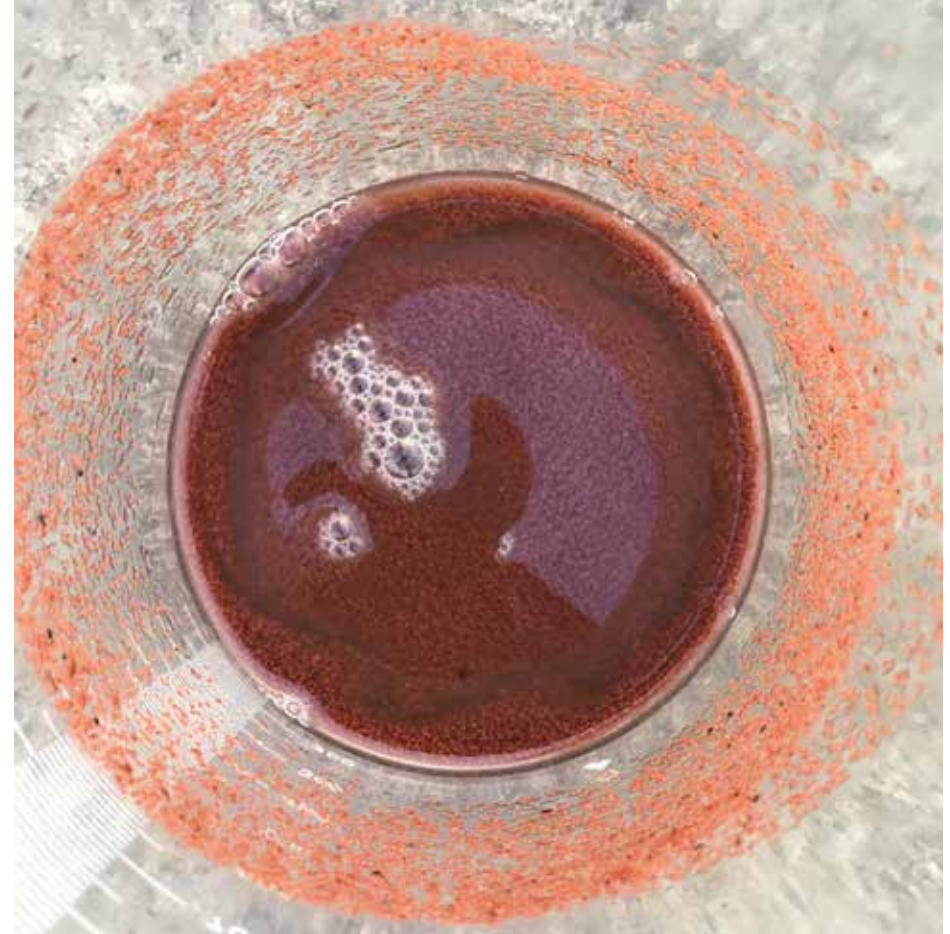
Pierce County Performance Data



PIERCE COUNTY BIOMASS PICTURES



DEMON BIOMASS AUGUST 2017

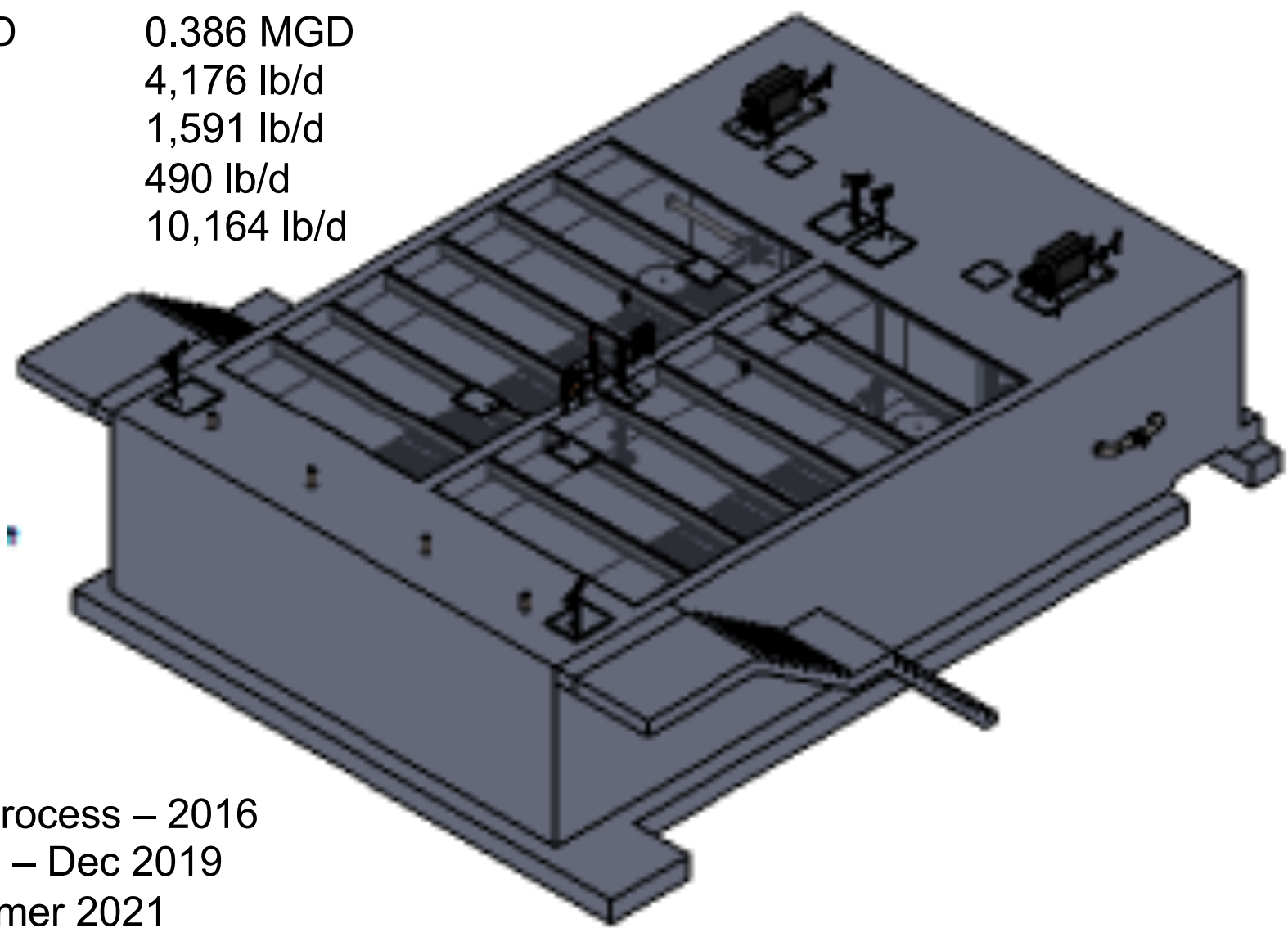


DEMON BIOMASS JANUARY 2018



Bay Park WWTP – Nassau County NY

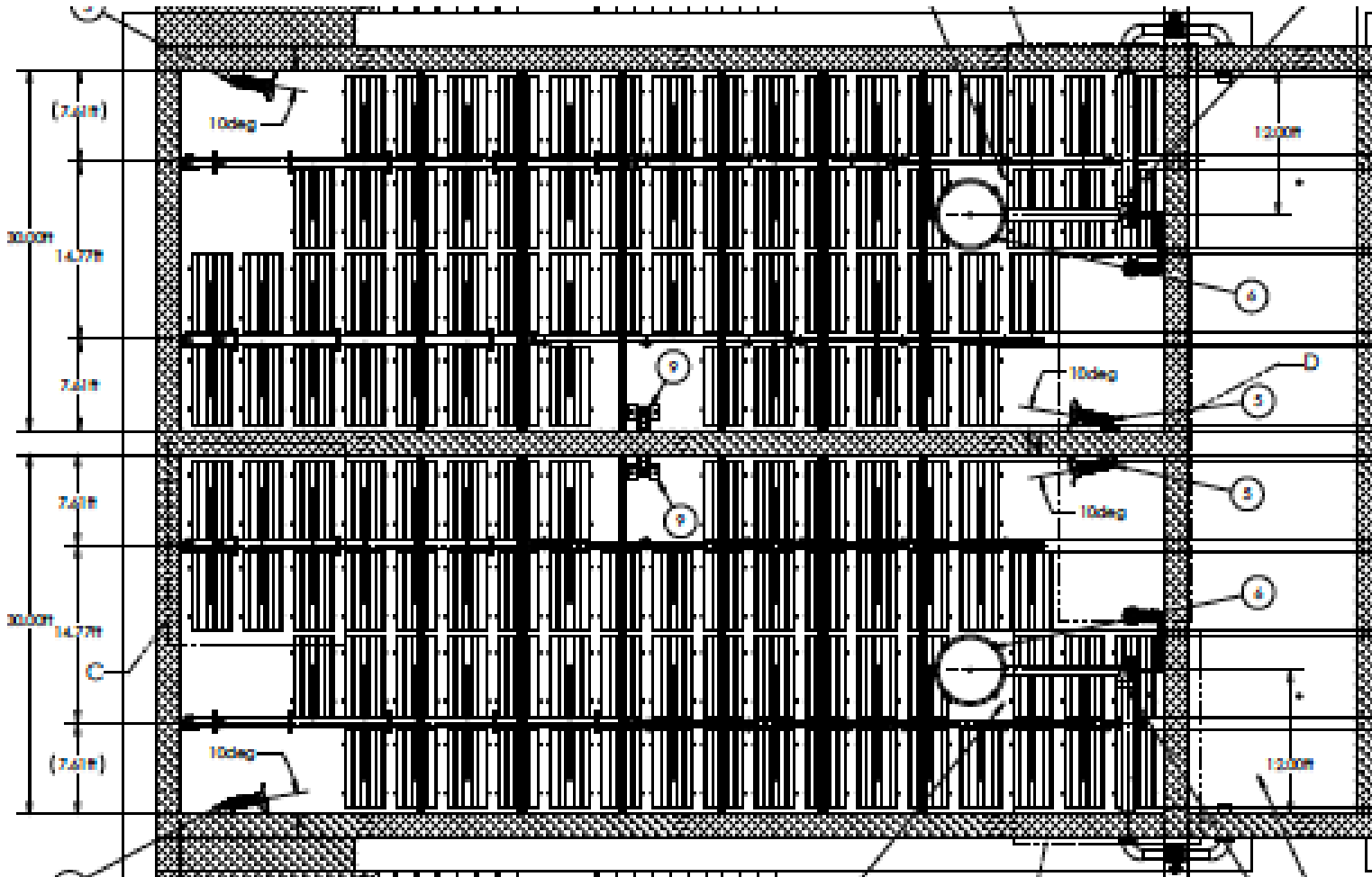
	Avg Month	Max Month
Flow	0.331 MGD	0.386 MGD
TKN	3,576 lb/d	4,176 lb/d
TSS	1,362 lb/d	1,591 lb/d
BOD ₅	420 lb/d	490 lb/d
Alk.	8,702 lb/d	10,164 lb/d



Project Timeline:
Pilot Tested – 2013
Selected DEMON Process – 2016
Construction begins – Dec 2019
Est. Start up – Summer 2021

Bay Park WWTP

Basin Dimensions: 82 ft x 30 ft x 21 ft SWD
2 Basins operating in parallel
885 SCFM per tank @ Max Month Loads
3 – 30 HP PD Blowers supplying air (2+1)



Bay Park WWTP



Bay Park WWTP



CONCLUSIONS

- Sidestream treatment using the DEMON[®] / Anammox treatment system is the most cost effective biological treatment solution.
- Seven systems now operational in North America with one system now treating filtrate from Cambi THP + Mesophilic digestion.
- Start up of the Pierce County DEMON[®] system has gone from 200 lb/day up to over 1,500 lb/day in less than 3 months.
- Bay Park WWTP will utilize DC Water Anammox Seed Sludge for start-up, estimated for summer 2021.





Thank you!!!



ANY QUESTIONS????

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