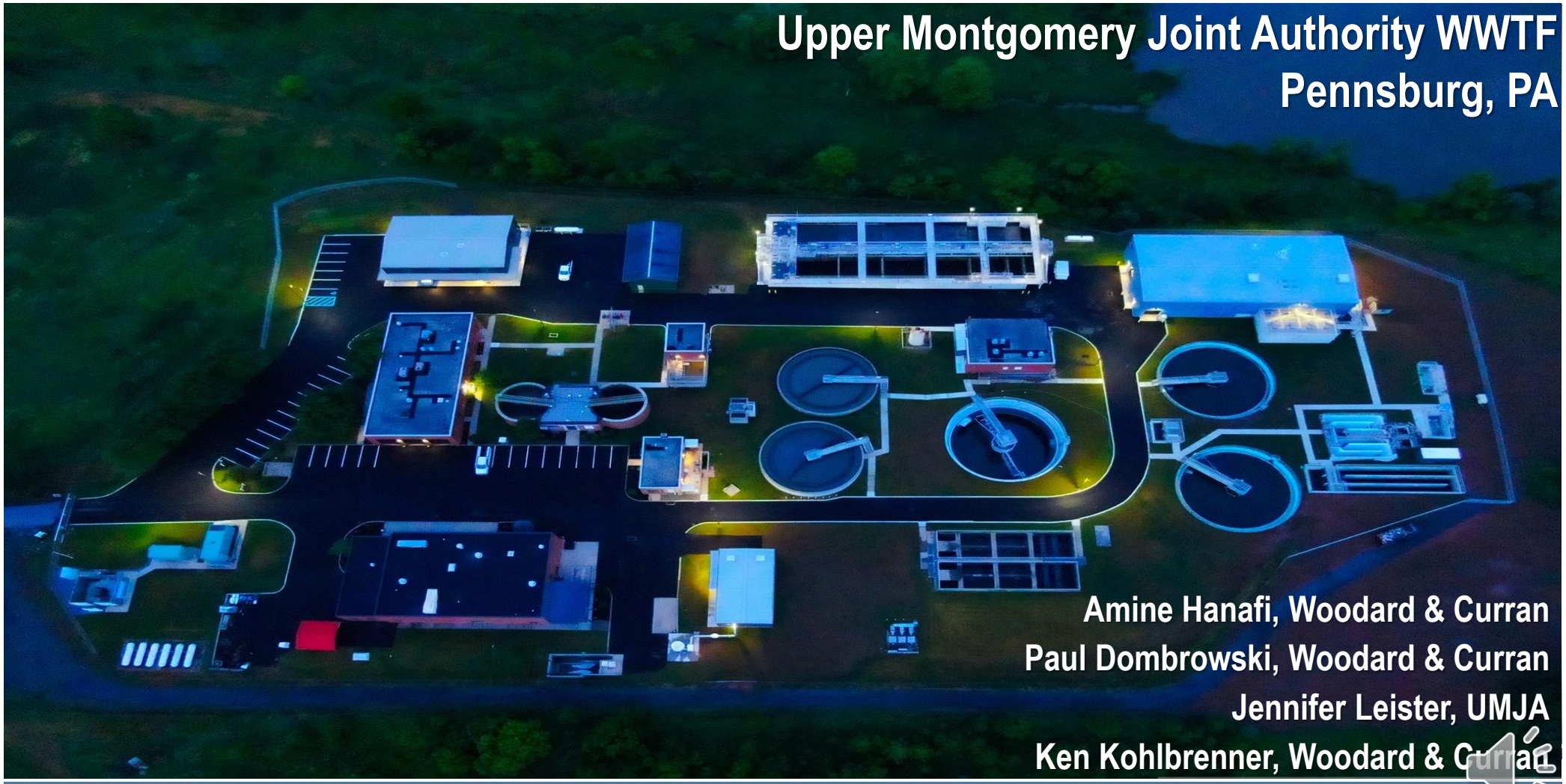
Utilizing a Combination of Proven and Innovative Technologies to Achieve Stringent Nutrient Limits



Upper Montgomery Joint Authority WWTF
Pennsburg, PA

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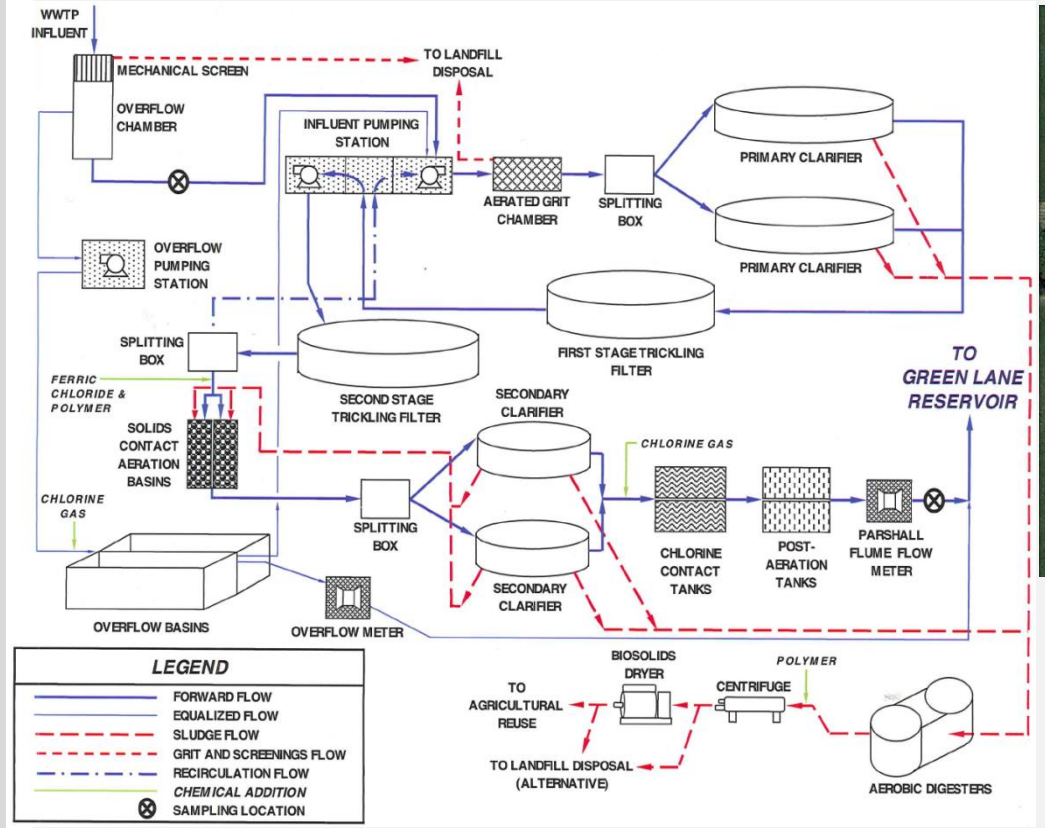
Presentation Outline

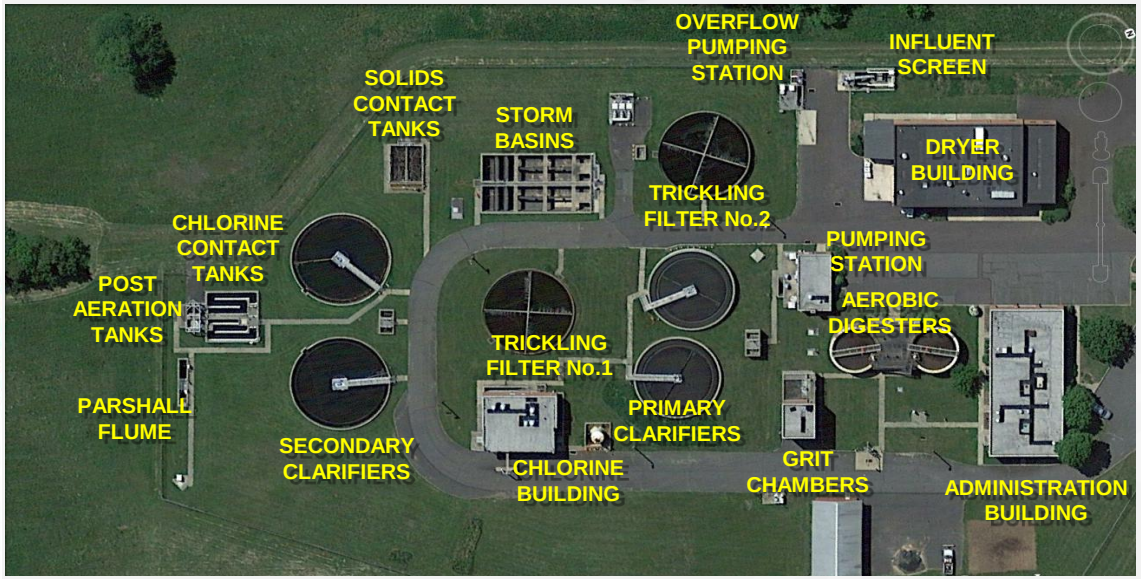
1. Background
2. Project Drivers and Goals
3. Existing Conditions
4. WWTP Major Upgrades
5. Nutrients Removal Preliminary Results
6. Design and Construction Challenges
7. Lesson Learned

Upper Montgomery Joint Authority (UMJA)

- UMJA located in Pennsburg – Montgomery County
- 50 miles north of Philly, 100 miles west of NY
- Population over 8,550
- Provides sewer collection and treatment for three boroughs: Red Hill, East Greenville and Pennsburg
- 2.5 MGD trickling filter WWTP discharging to Green Lake Reservoir
- Collection system comprised of 33 miles sewer pipes and 5 pump stations

UMJA Wastewater Treatment Facility





- 2.5 MGD trickling filter / solids contact plant with 11.4 MGD peak flow
- Wet weather overflow PS and bypass
- Chemical phosphorus removal

Project Drivers

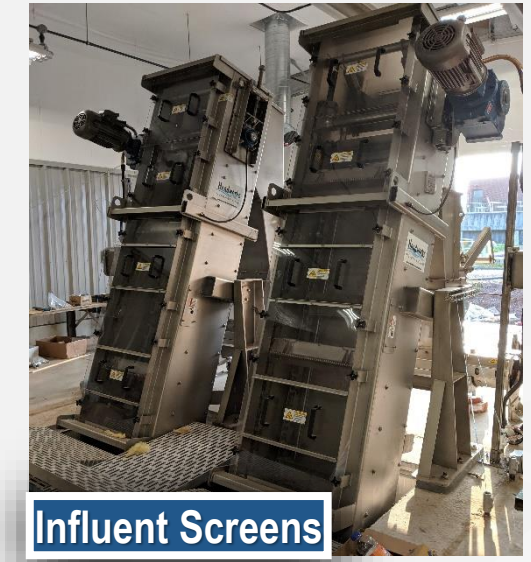
- Multiple NPDES permit limit violations (mostly related to TP, TSS, cBOD, and ammonia)
- Operational challenges during wet weather periods
- Future stringent limits for nutrient removal
- Inability to consistently meet TP limit w/out substantial chemical addition
- Aging and deteriorating infrastructure

Trickling Filter

Old Chem System

What is the Upgrade Plan?

- Influent Screens: Repurpose the overflow channel into a new screen building to house the 2 bar screens, washer compactors, and odor control system
- Influent Pumping (EPS-1): Install 5 new forward flow pumps to handle peak hour flows
- Replace existing grit removal system with a grit separation system and a grit washer.
- BNR process: Replace existing trickling filter/ solids contact treatment system with biological reactors to improve nutrient removal (Target Limits: TN of 6 mg/L and TP of 0.2 mg/L)


Influent Screens

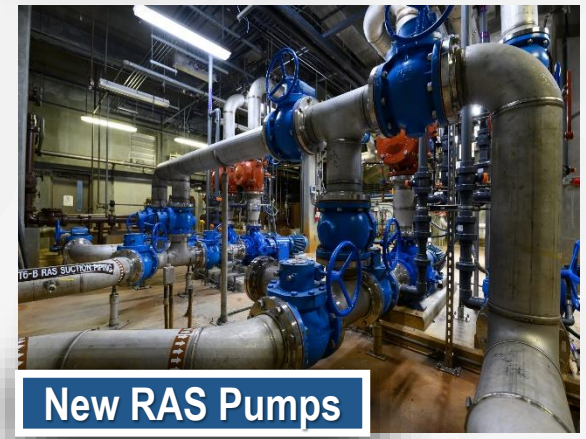

Bioreactors

What is the Upgrade Plan?

- Addition of a third secondary clarifier and distribution box
- New RAS and WAS pumping system
- New filter building to house tertiary filters, aeration blowers, floc tanks w/ mixers, air compressors and chem feed systems
- Addition of new chlorine contact tank and post aeration tanks
- New Parshall Flume structure
- New plant water system
- New Multi floor operations building
- Upgrade existing SCADA system

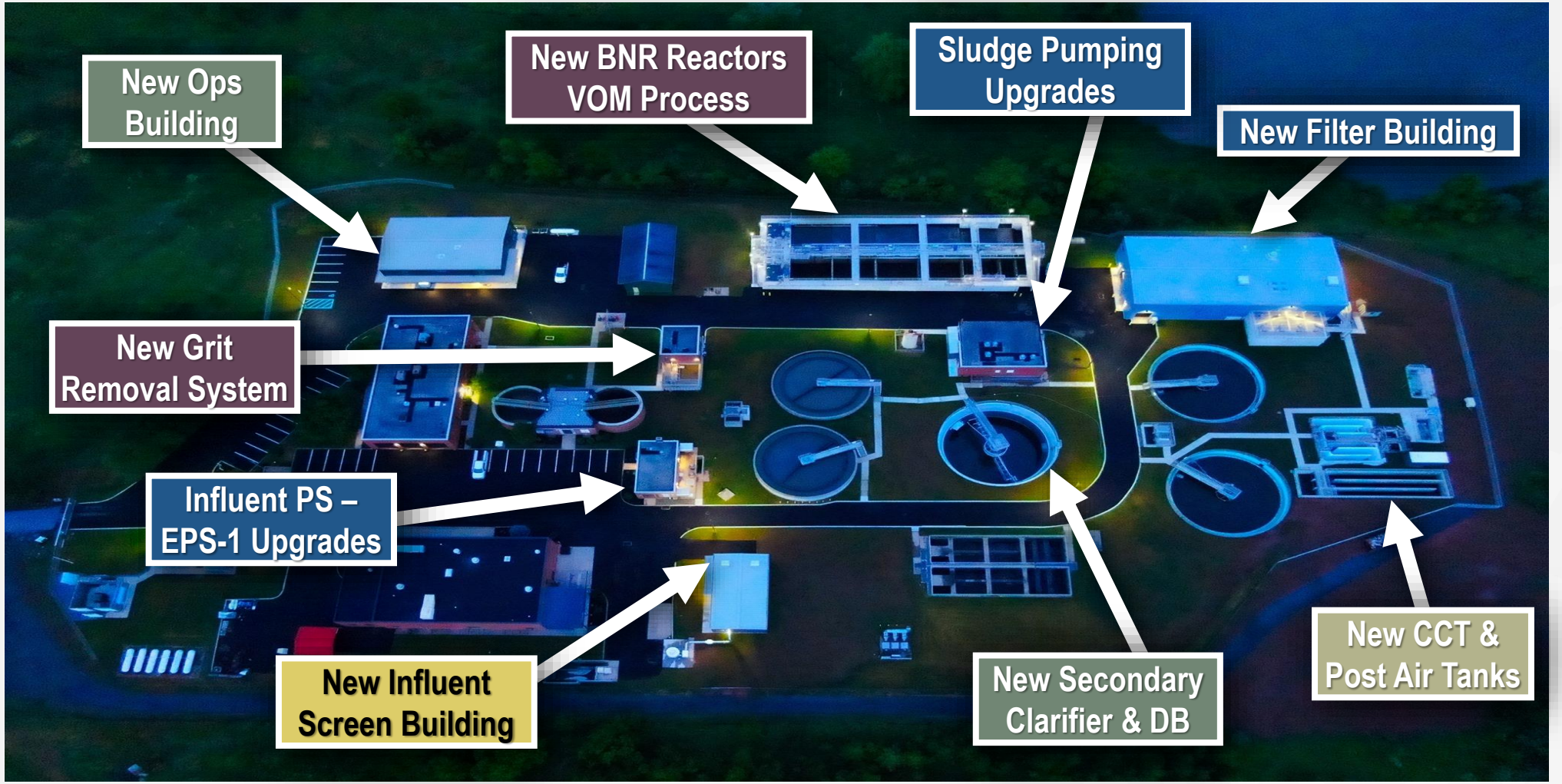
Fuzzy Filters

Plant Water System



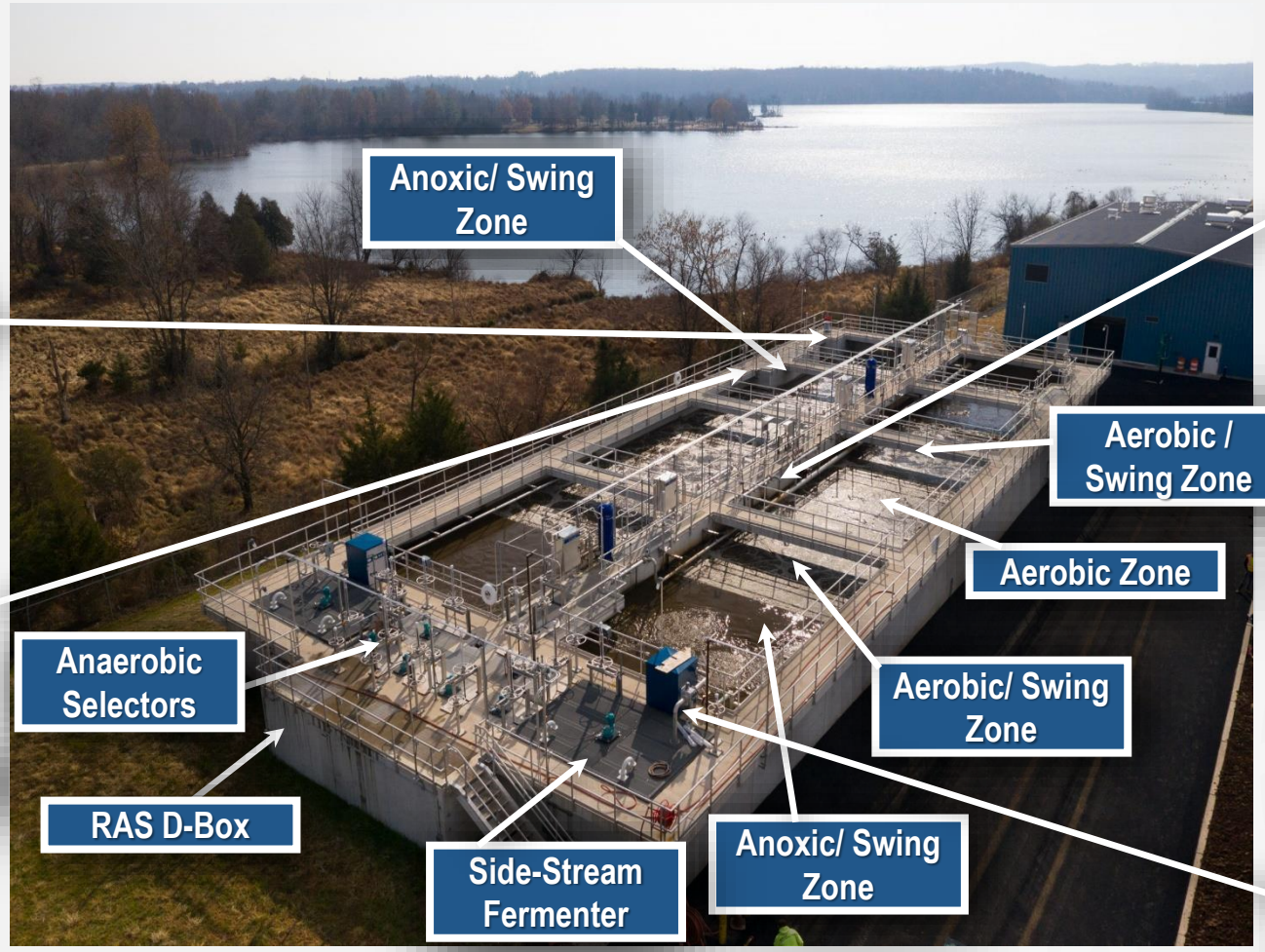
New RAS Pumps

WWTP Major Upgrades



Bioreactors Upgrades: Incorporate Proven and Innovative Technologies

Post Aeration Zone



Wet Weather Slide Gates

IMLR Box

Odor Control Blower & Mixer for S2EBPR Reactor

Bioreactors Upgrades: Implement Proven and Innovative Technologies

Precast Post-Tensioned Tank

IMLR Submersible Flowmeter

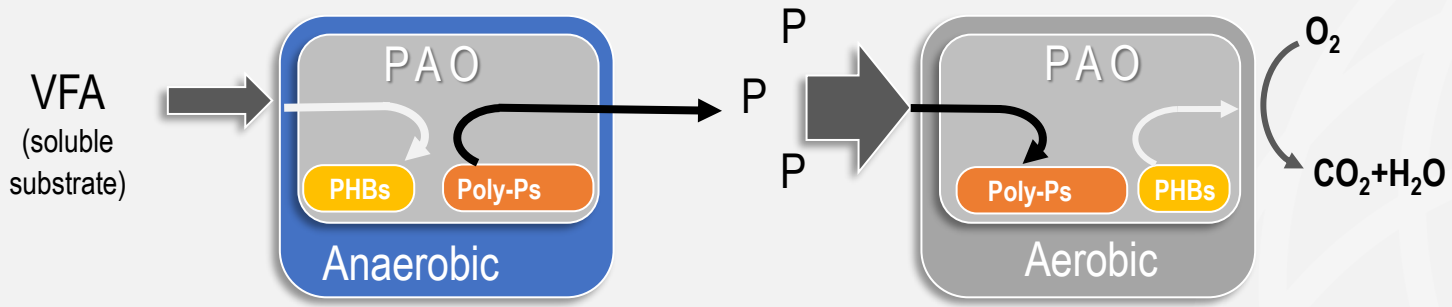
Fine Bubble Diffusers & Compressed Air Nozzles

Compressed Gas Mixing (CGM) System

NEWEA
WORKING FOR WATER QUALITY

Enhanced Biological Phosphorus Removal (EBPR)

- Requires absence of Oxygen
- Requires absence of Nitrate
- Requires readily degradable carbon in form of short chain volatile fatty acids (VFA)
- Removal occurs through waste sludge



Umble, 2018)

Limitations of Conventional EBPR

- Reliant on influent conditions and can be affected by biological toxicity
- Performance is more sensitive to influent flow and pollutant loading variations
- Minimal process control options
- Potential competition of GAOs with PAOs

Sidestream EBPR is the next wave…

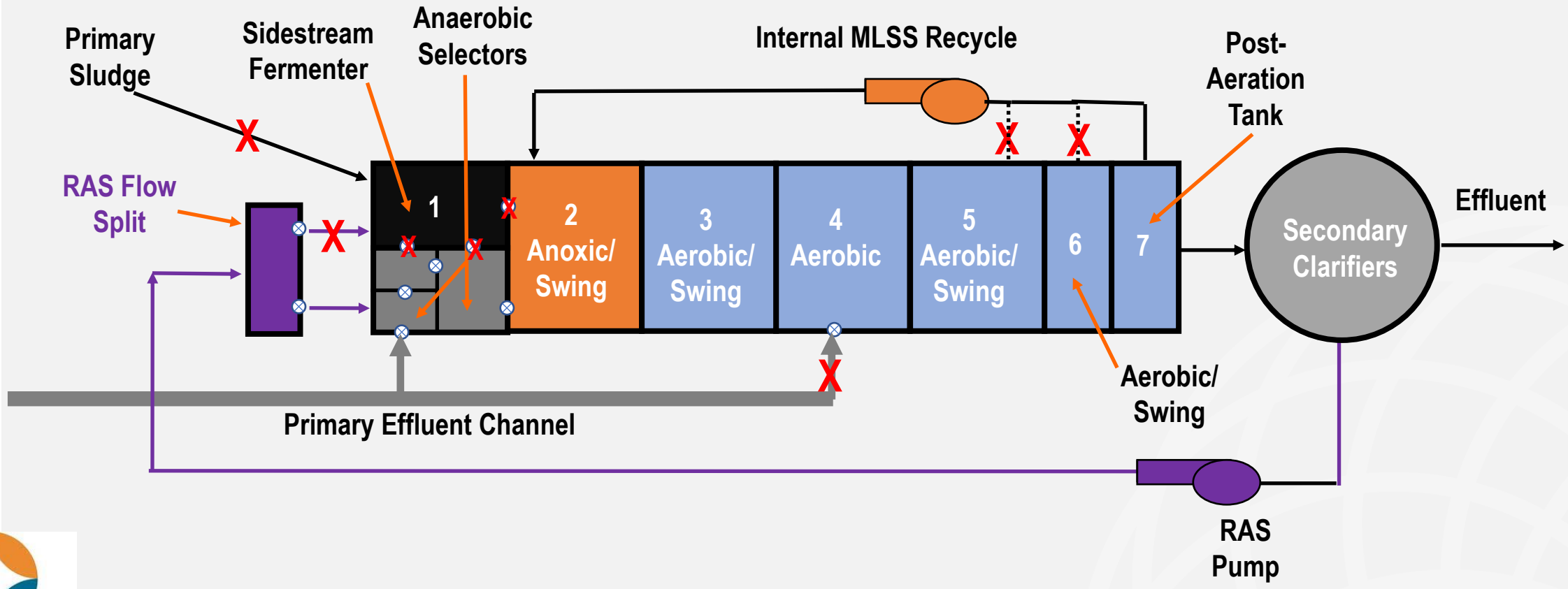
- S2EBPR is a fairly recent development in nutrient removal
  - Europe: in use for about 10 years
  - USA: in use at a few facilities in recent years
- S2EBPR conditions a portion of the RAS or MLSS to grow PAOs
- S2EBPR requires:

  Holding the solids under “deep” anaerobic conditions
  to ferment the activated sludge solids to make VFA’s,
  allowing release and then P uptake in downstream anoxic and aerobic zones.

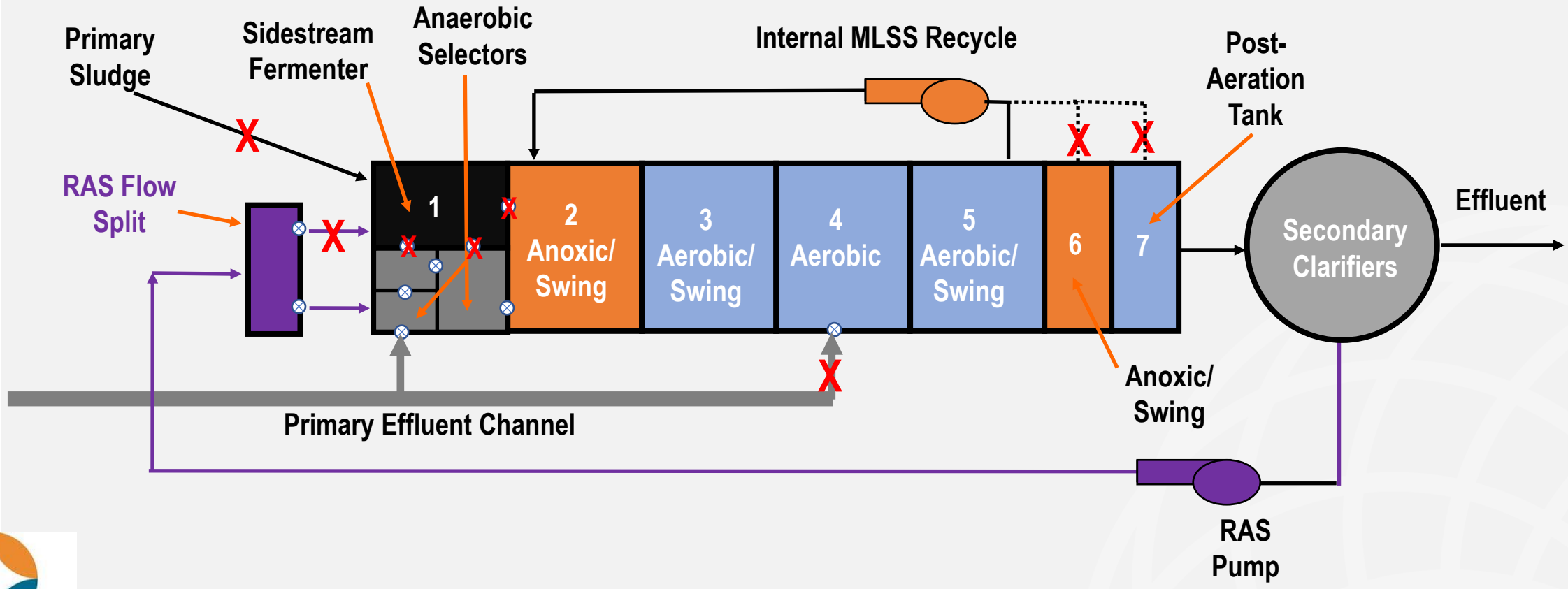
Why Use S2EBPR?

- More reliable than conventional EBPR
- Less sensitive to influent carbon quantity and quality
- Less impacted by DO and NO_3-N recycles
- Promotes PAOs growth and selects against GAO's
- Uses similar or less tank volume as standard EBPR
- Less sensitive to wet weather events and toxic discharges
- Can be readily incorporated into existing tanks

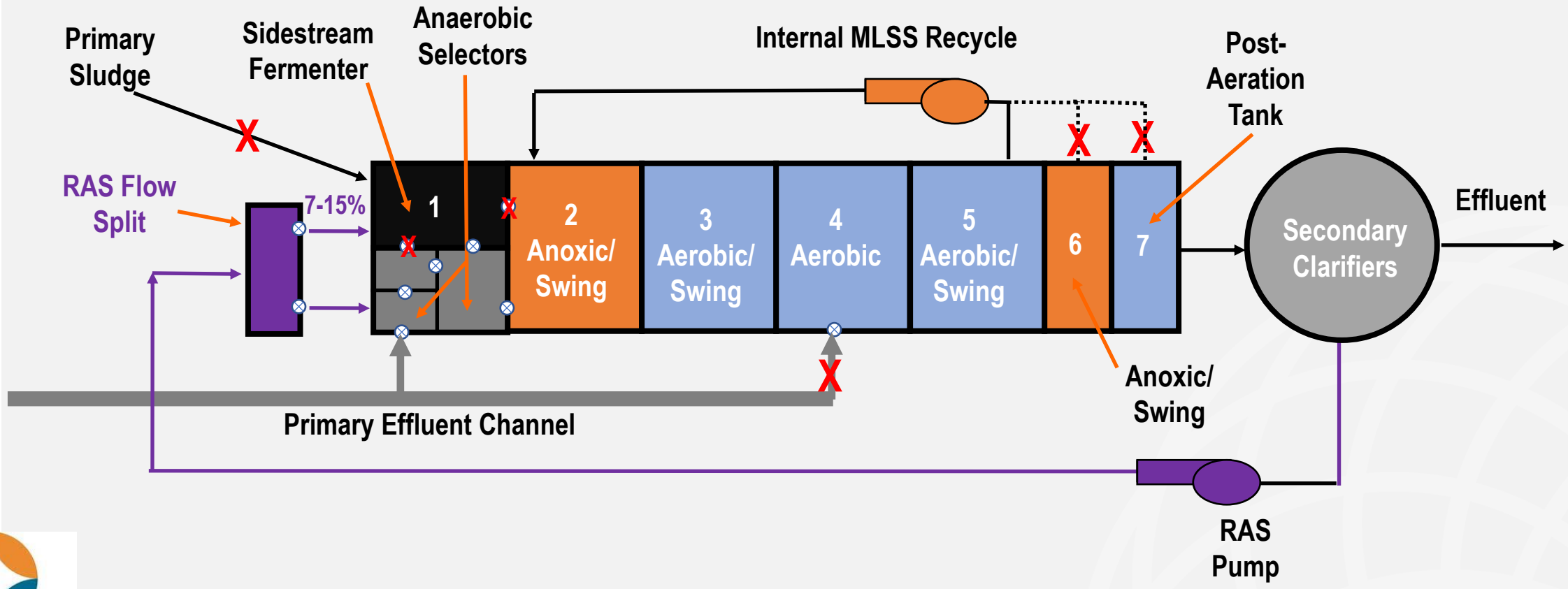
A2O Process with Conventional EBPR – Winter Mode BNR



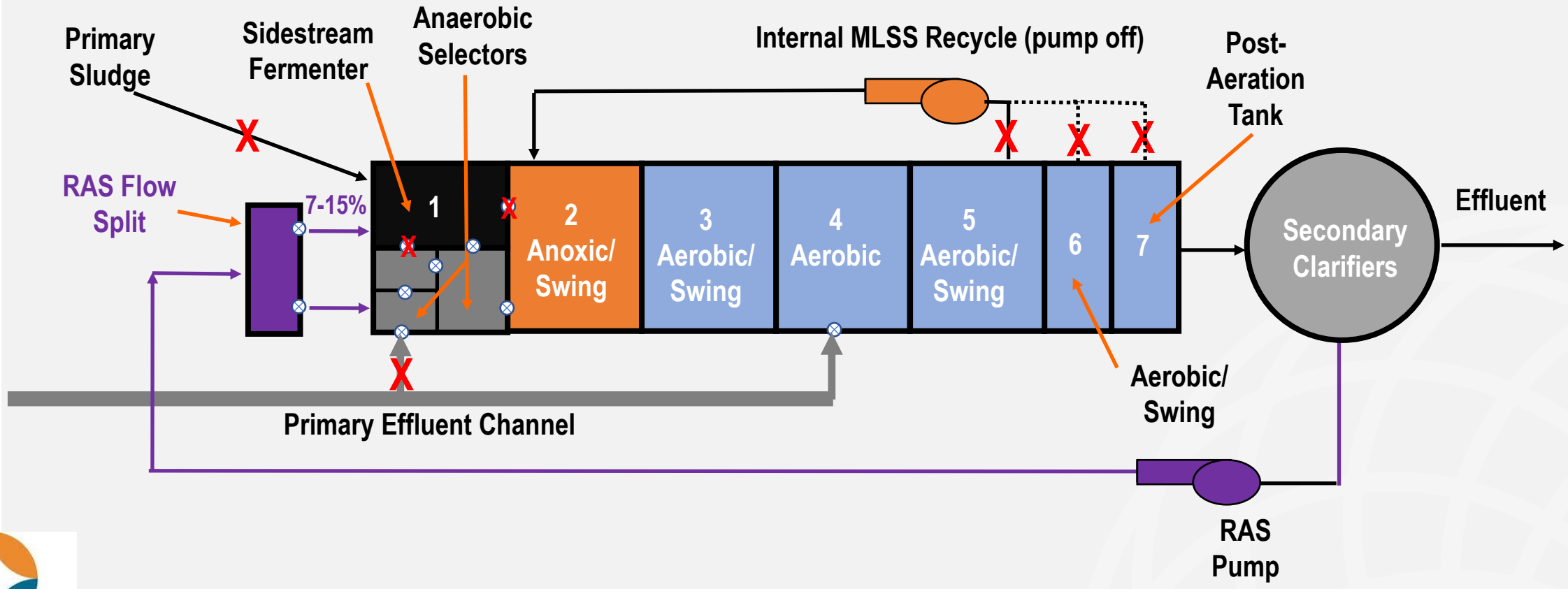
5-Stage Bardenpho Process with Conventional EBPR – Summer Mode BNR



5-Stage Bardenpho Process with S2EBPR – Summer Mode BNR



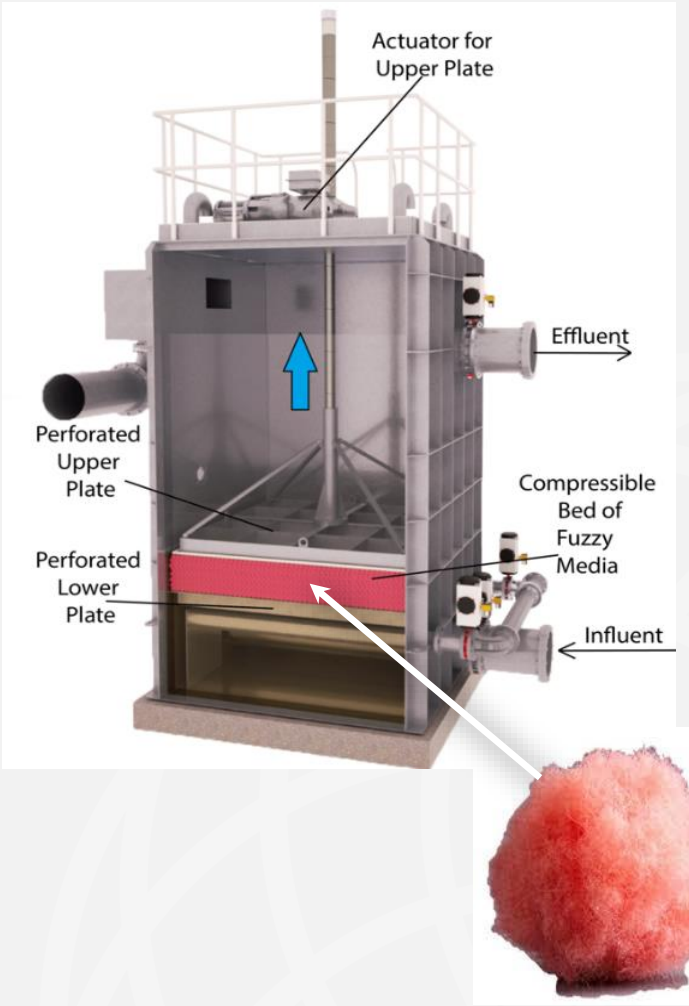
Modified Contact Stabilization Process – Wet Weather Mode with S2EBPR



Fermentation Zones | Anaerobic Zones | Aerobic Zones | Anoxic Zones | X = closed gate

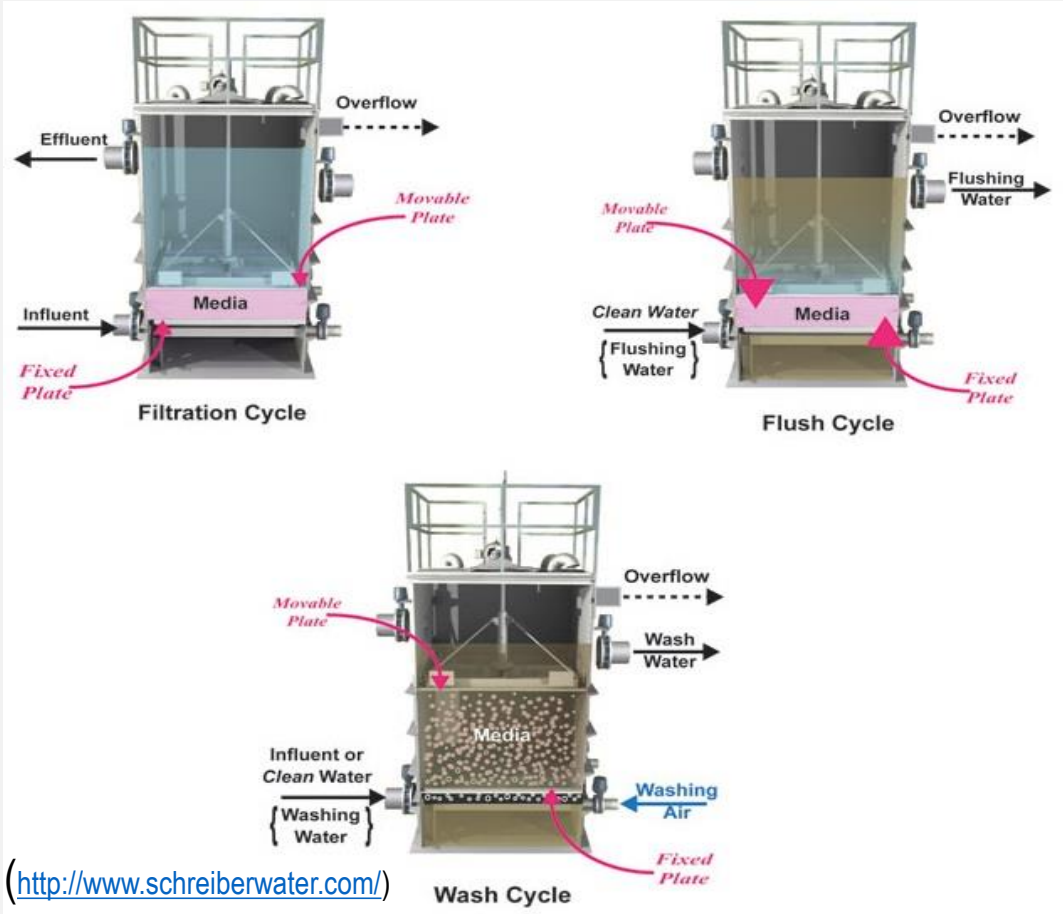
Compressible Media Technology – Fuzzy Filter

- Compressible media filter is depth filter developed in Japan and first introduced in US about 15 years ago
- Uses synthetic fiber porous material instead of conventional granular material
- Filter medium retained btw two perforated plates
- Uses upper moveable plate to change media compression during filtration and wash cycles
- Size of filter bed is increased mechanically to backwash filter
- Porosity of filter bed can be modified by compressing filter medium

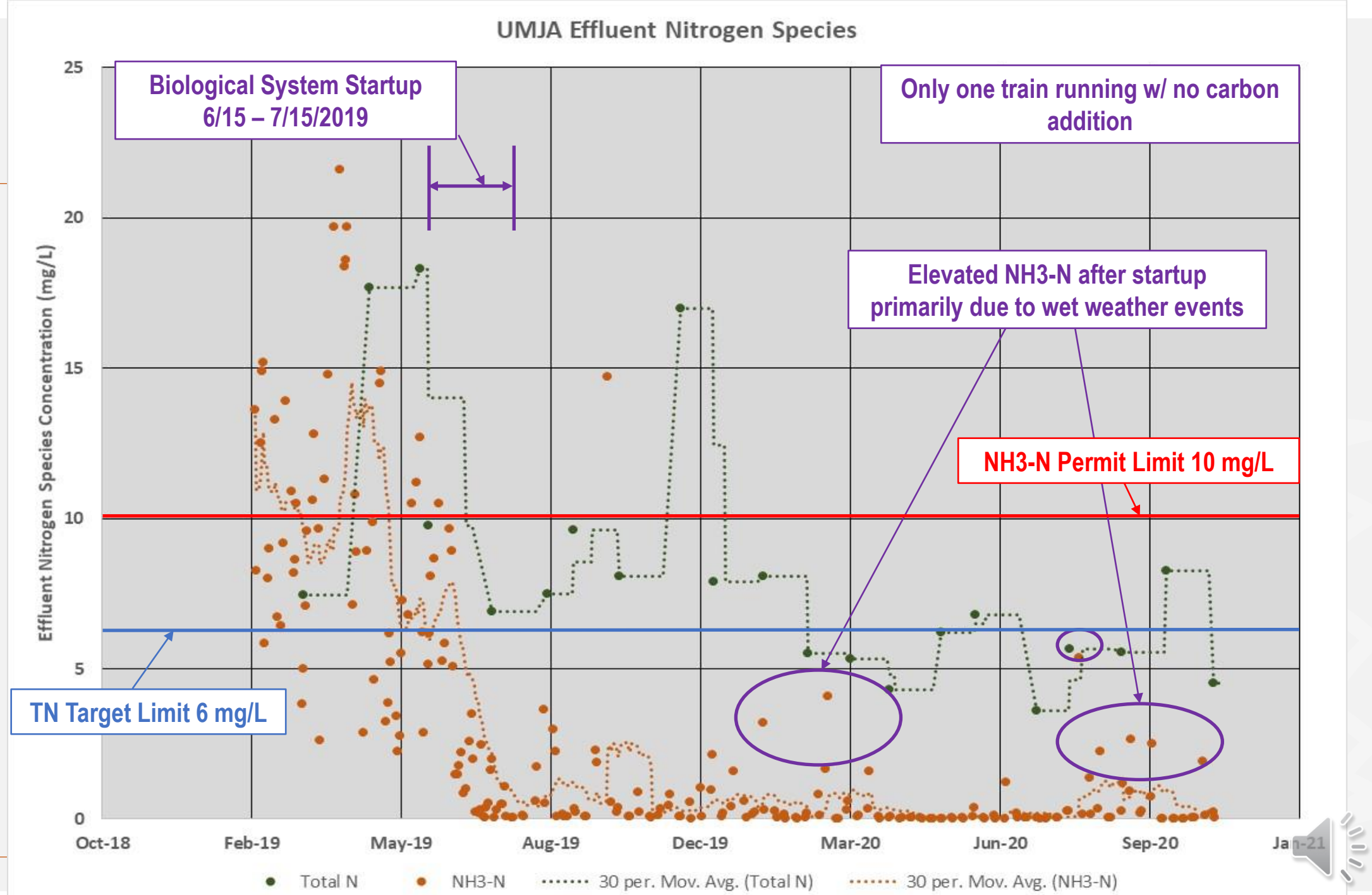


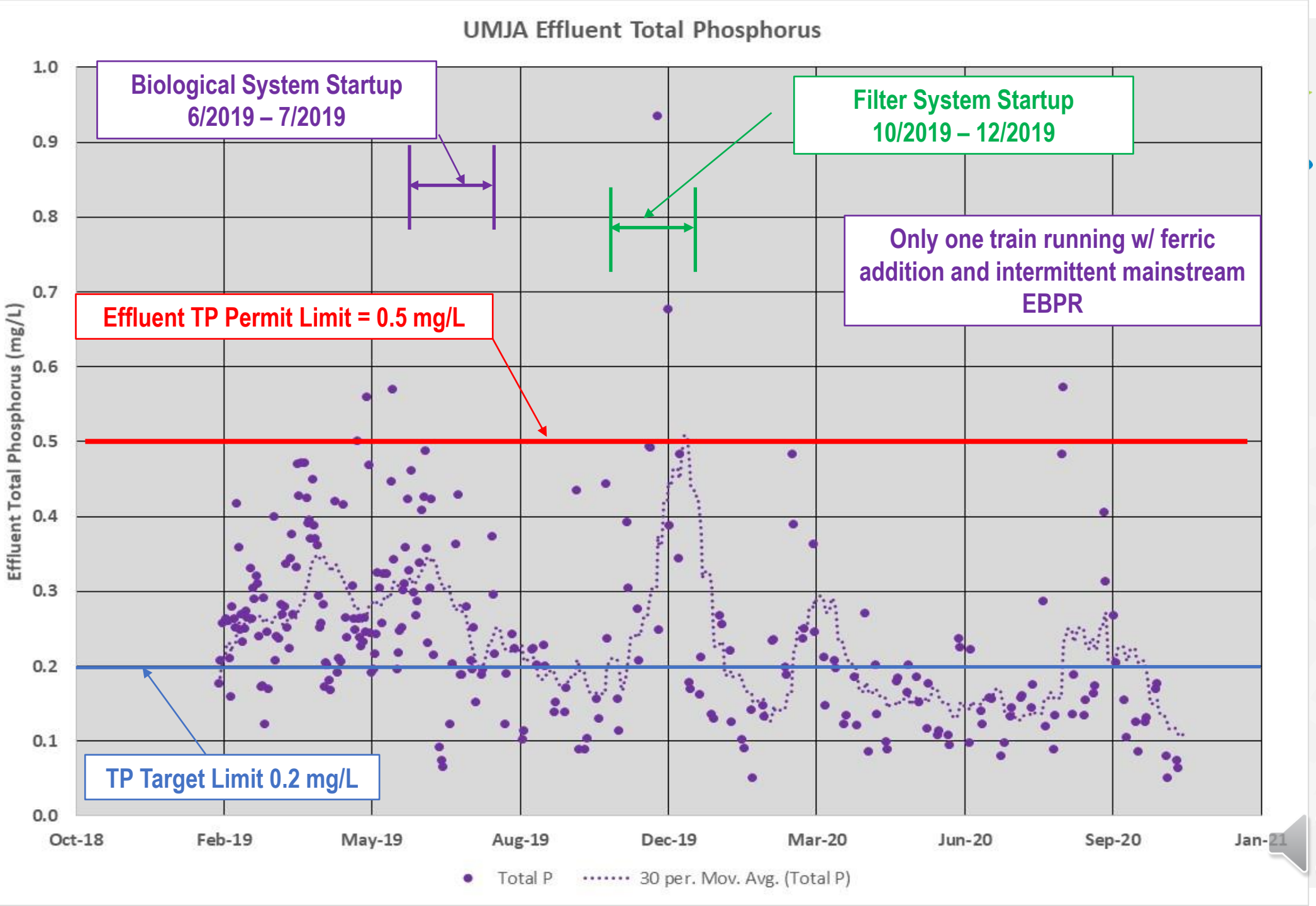
Compressible Media Technology – Fuzzy Filter

- Filtration Mode: influent introduced in the bottom, flows upward through filter medium and discharged from the top
- Backwash Cycle: Upper plate is raised and air is introduced while flow to the filter continues
- Wastewater containing solids removed from filter and returned to plant influent for subsequent processing



(http://www.schreiberwater.com/)


UMJA Effluent Nitrogen Species
Biological System Startup 6/15 – 7/15/2019
Only one train running w/ no carbon addition
Elevated NH3-N after startup primarily due to wet weather events
NH3-N Permit Limit 10 mg/L
TN Target Limit 6 mg/L
Effluent Nitrogen Species Concentration (mg/L)
25
20
15
10
5
0
Oct-18
Feb-19
May-19
Aug-19
Dec-19
Mar-20
Jun-20
Sep-20
Jan-21
Total N
NH3-N
30 per. Mov. Avg. (Total N)
30 per. Mov. Avg. (NH3-N)


UMJA Effluent Total Phosphorus
Biological System Startup
6/2019 – 7/2019
Filter System Startup
10/2019 – 12/2019
Only one train running w/ ferric addition and intermittent mainstream EBPR
Effluent TP Permit Limit = 0.5 mg/L
TP Target Limit 0.2 mg/L
Effluent Total Phosphorus (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Oct-18
Feb-19
May-19
Aug-19
Dec-19
Mar-20
Jun-20
Sep-20
Jan-21
Total P
30 per. Mov. Avg. (Total P)

Design & Construction Challenges

- Conventional EBPR process upsets due to high flow conditions
- BNR Design incorporated capabilities to hit future low nutrient limits much stringent than existing permit limits
- UMJA operators not spending additional labor and operation cost associated with reaching stringent limits until they're required to do so by permit
- Delayed startup of fully sidestream S2EBPR Reactor

Lesson Learned

- Preliminary plant data suggest that mainstream EBPR was not reliable due to extreme high flow events and the benefit to switch to sidestream EBPR to consistently meet stringent phosphorus limits
- Engage Client Leadership and entire staff
- Keep reasonable balance between available budget and critical project needs during design and construction
- Allocate enough budget for operators training and follow up services

Acknowledgements

- Extremely thankful for all the assistance received from UMJA especially the following:
- WWTP Staff
  - Jennifer Leister, Executive Superintendent
  - Gregory Young, Assistant Superintendent
  - Jason DiPietro, Chief Operator
  - Bryer Eshbach, Operator
- UMJA Board of Directors
  - William Ingram, Chairman
  - Elizabeth DeJesus, Vice Chairman
  - Ryan Pugh, Treasurer
  - Donna Paul, Secretary

Questions?

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