Improving Phosphorus Removal with Side Stream RAS Conditioning

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UPPER TRINITY
REGIONAL WATER DISTRICT

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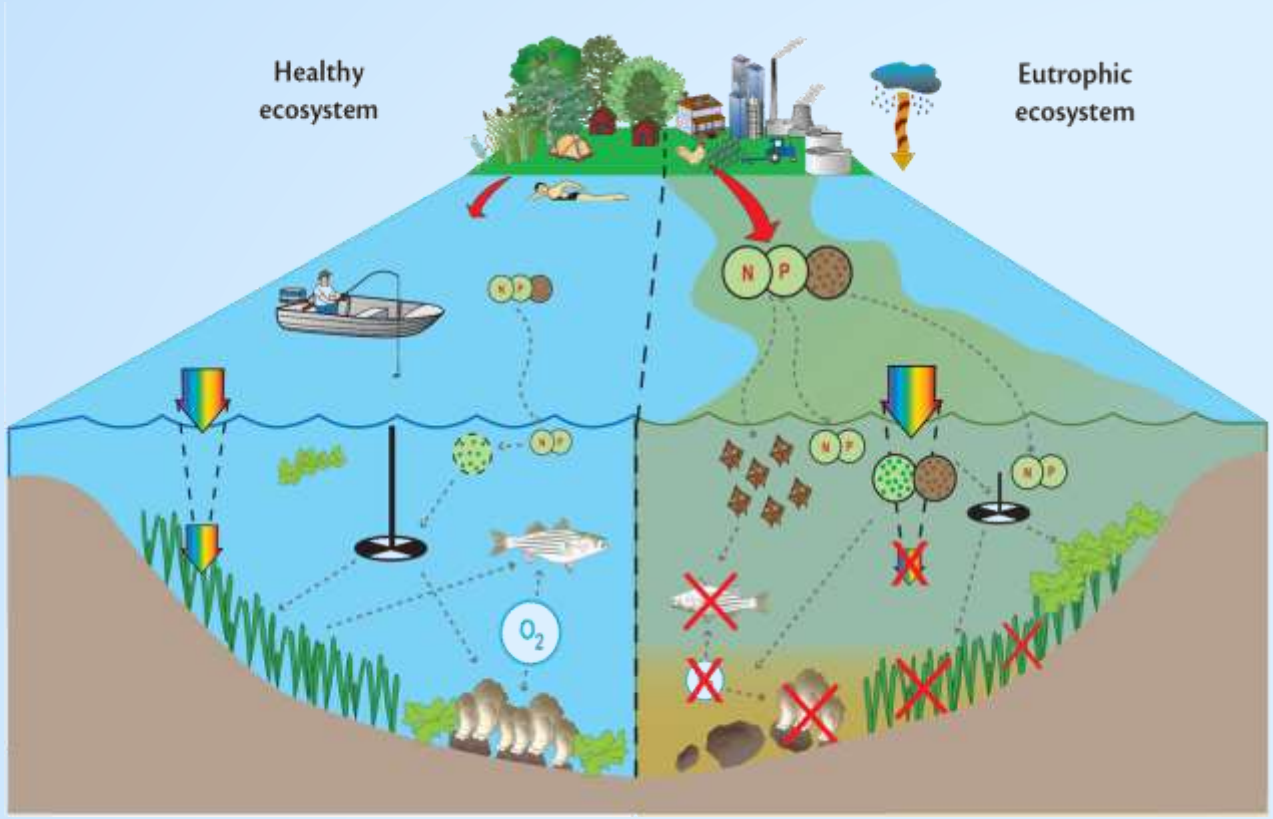
Agenda

- Phosphorus Removal Technologies
- Riverbend and Doe Branch WRPs Overview
- Sidestream Treatment in Sludge Holding Tanks
- Full-Scale RAS Conditioning Results

Many utilities in Texas are complying with phosphorus discharge limits

- TCEQ implemented numeric criteria for 75 reservoirs in 2010.
- Facilities in Texas have permitted limits of 0.5 to 1 mg/L
- Texas limits based on reasonably achievable technology



Bricker et al. 2007. NOAA Coastal Ocean Program Decision Analysis Series No. 26.

Phosphorus removal transfers P to the solids stream

- Chemical phosphorus removal (CPR)
  - Pre-precipitation
  - Simultaneous precipitation
  - Post precipitation
- Enhanced biological phosphorus removal (EBPR)
  - Mainstream
  - Sidestream
- Hybrid phosphorus removal
  - EBPR + CPR

Technological Milestones

1950

P uptake in activated sludge in excess of metabolic requirements

1960

Phostrip

1970

Barnard describes biological phosphorus removal in South Africa

Laughlin presents "Designing to Remove Phosphorus by Using Metal Salts and Polymers in Conventional Plants"

Bardenpho

Pho-redox (A/O)

A2O

1980

UCT

MUCT

Johannesburg

Westbank

1990

Detergent industry phases out P

VIP

2000

Ostara

Airprex

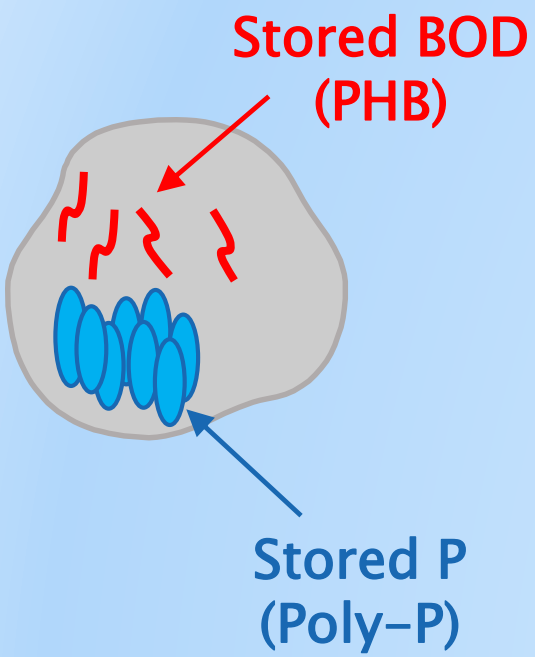
2010

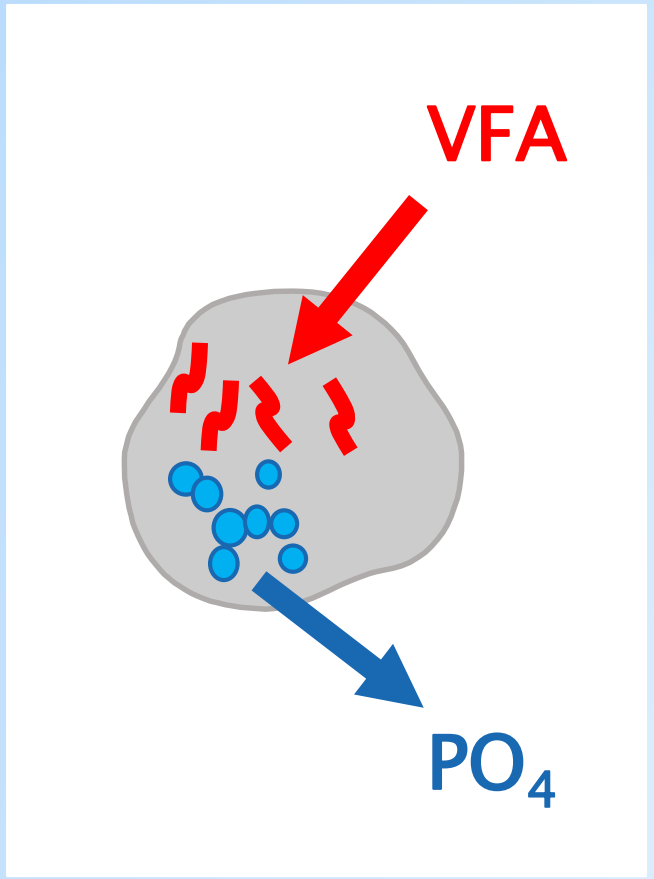
NuResys

Aerobic Granular Sludge

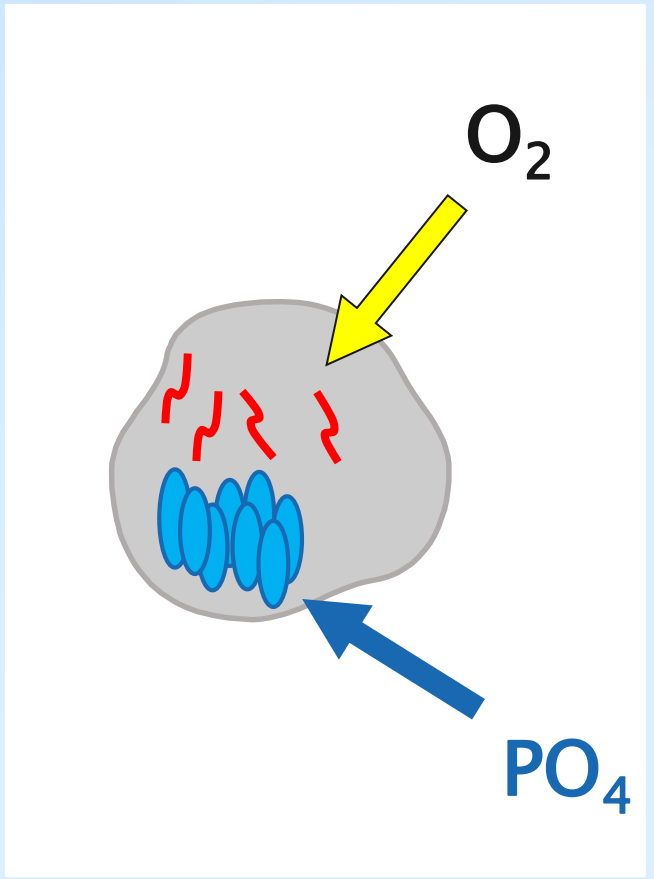
S2EBPR

Biological P removal relies on phosphorus accumulating organisms (PAO)



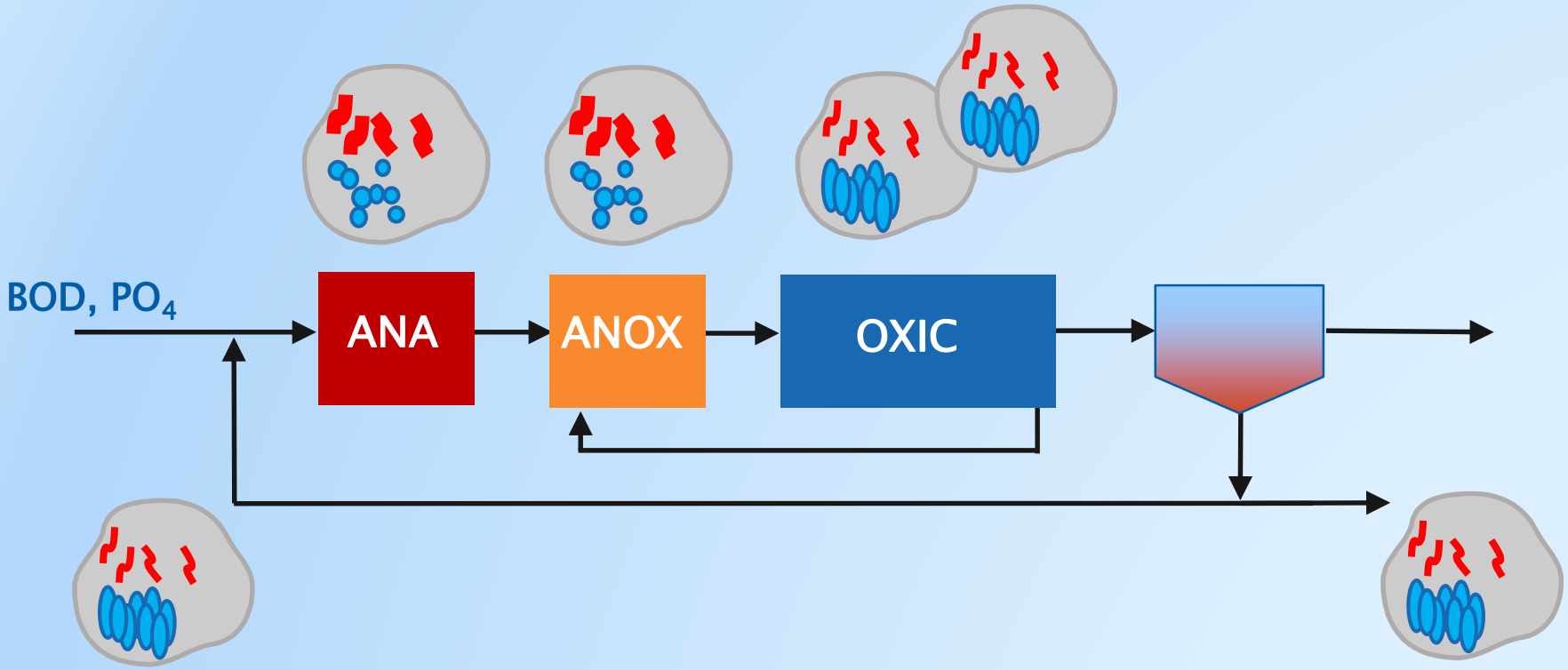


Anaerobic

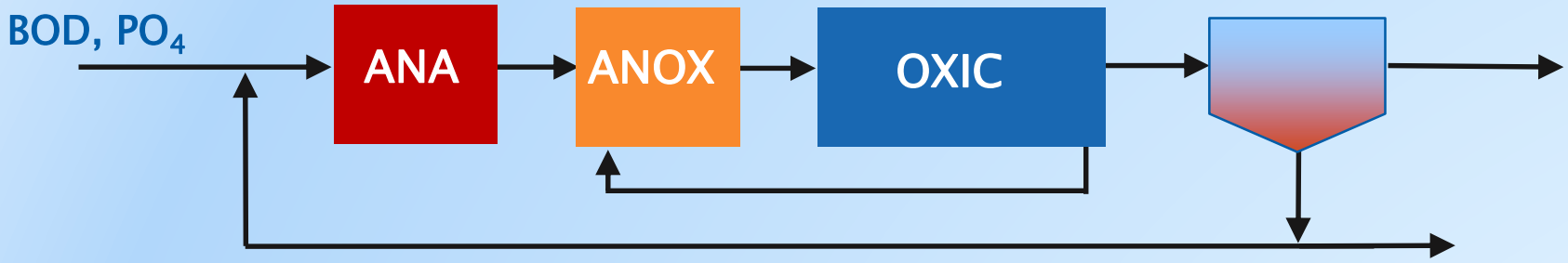


Aerobic

Anaerobic-aerobic sequence promotes PAOs



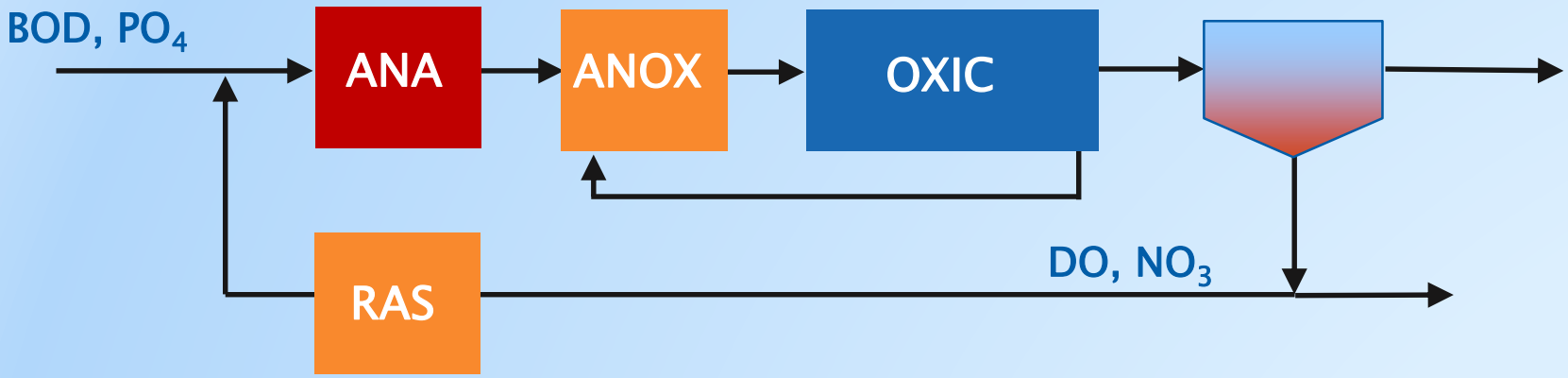
P removal efficiency depends on basic requirements



- Anaerobic conditions: Minimal DO and NO_3-N
- Readily available carbon: VFAs
- Carbon to phosphorus ratio: BOD/P

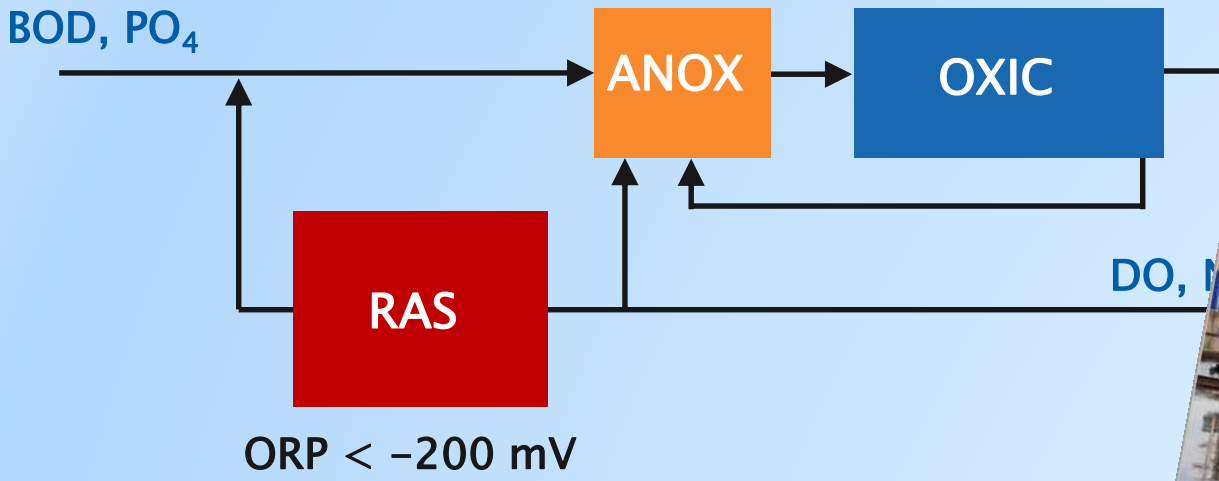
Efficiency	BOD/P
Low	15 – 20
Medium	20 – 25
High	> 25

Unaerated RAS zones improve phosphorus removal



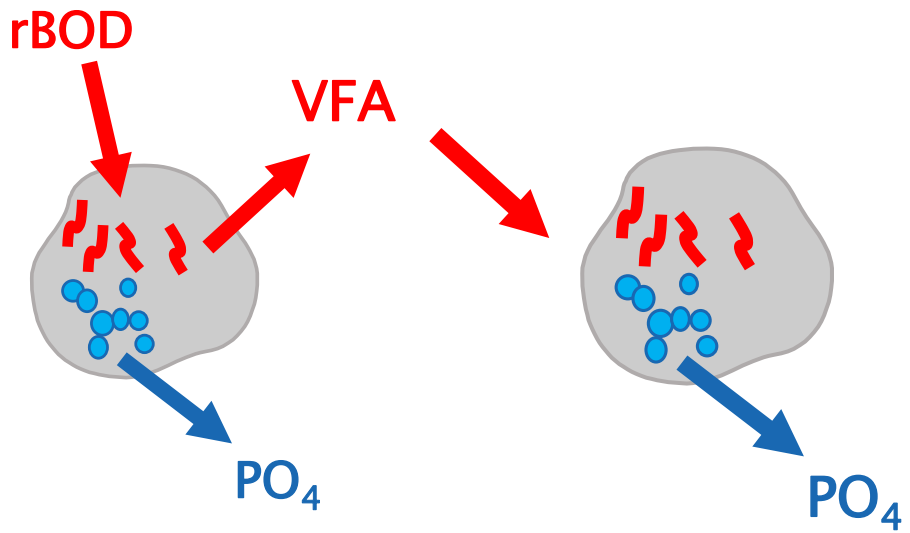
Johannesburg Process

Unaerated RAS zones improve phosphorus removal

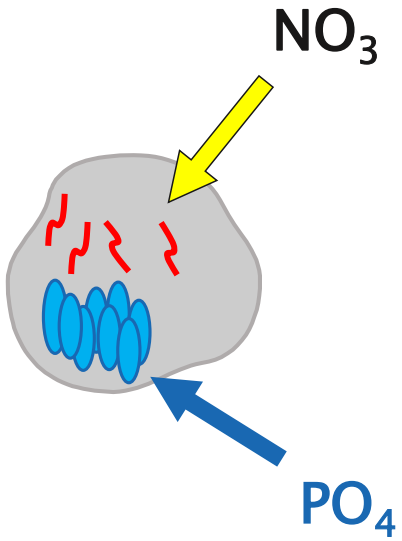


Sidestream EBPR (S2EBP

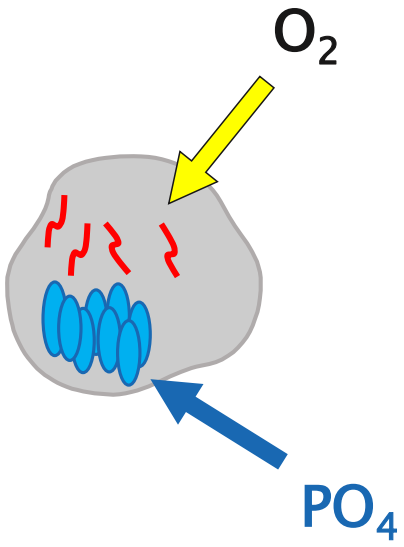
Deep anaerobic zones promotes different PAOs



Anaerobic



Anoxic



Aerobic

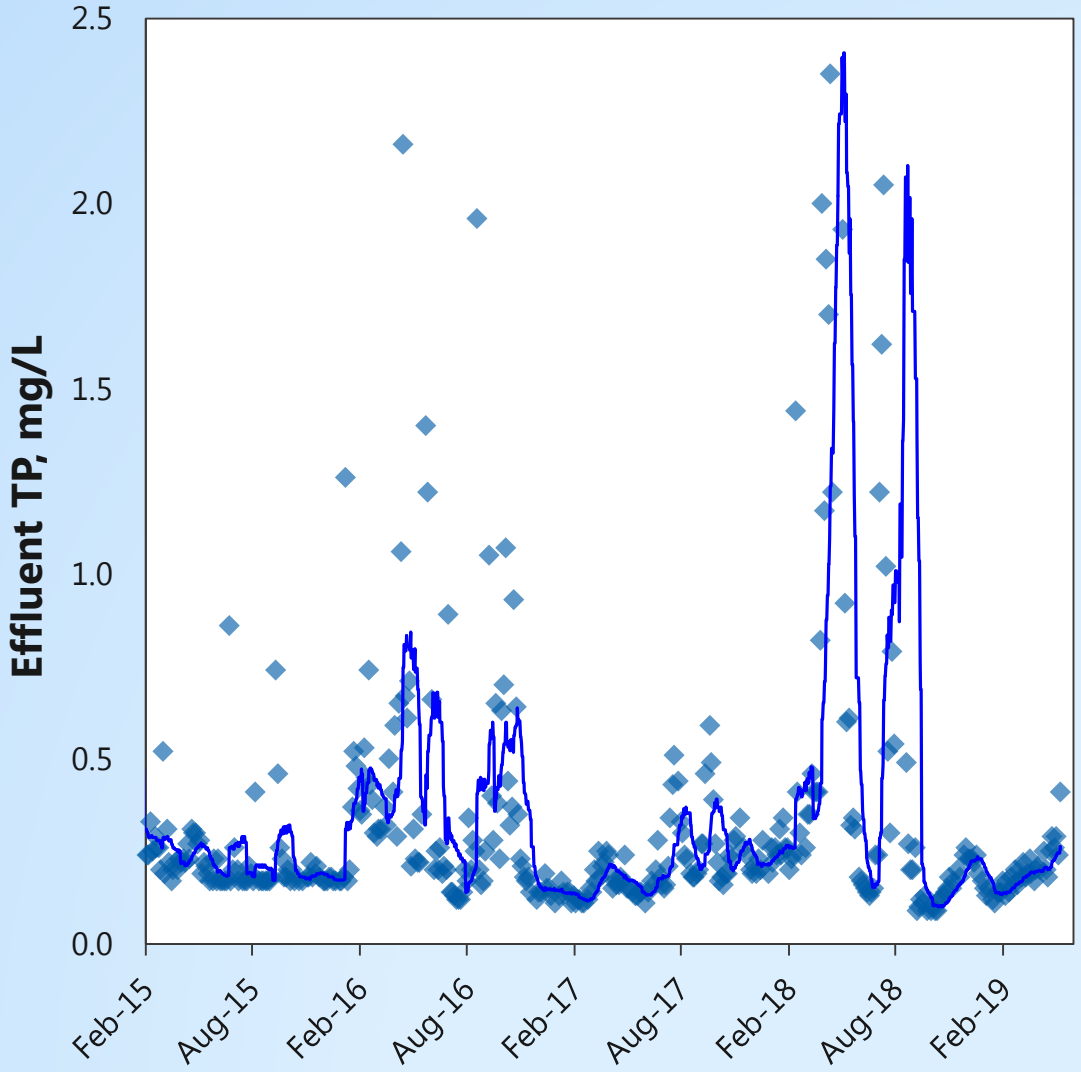
Manhattan WWTP implemented RAS fermentation using a Johannesburg Process

Manhattan WWTP

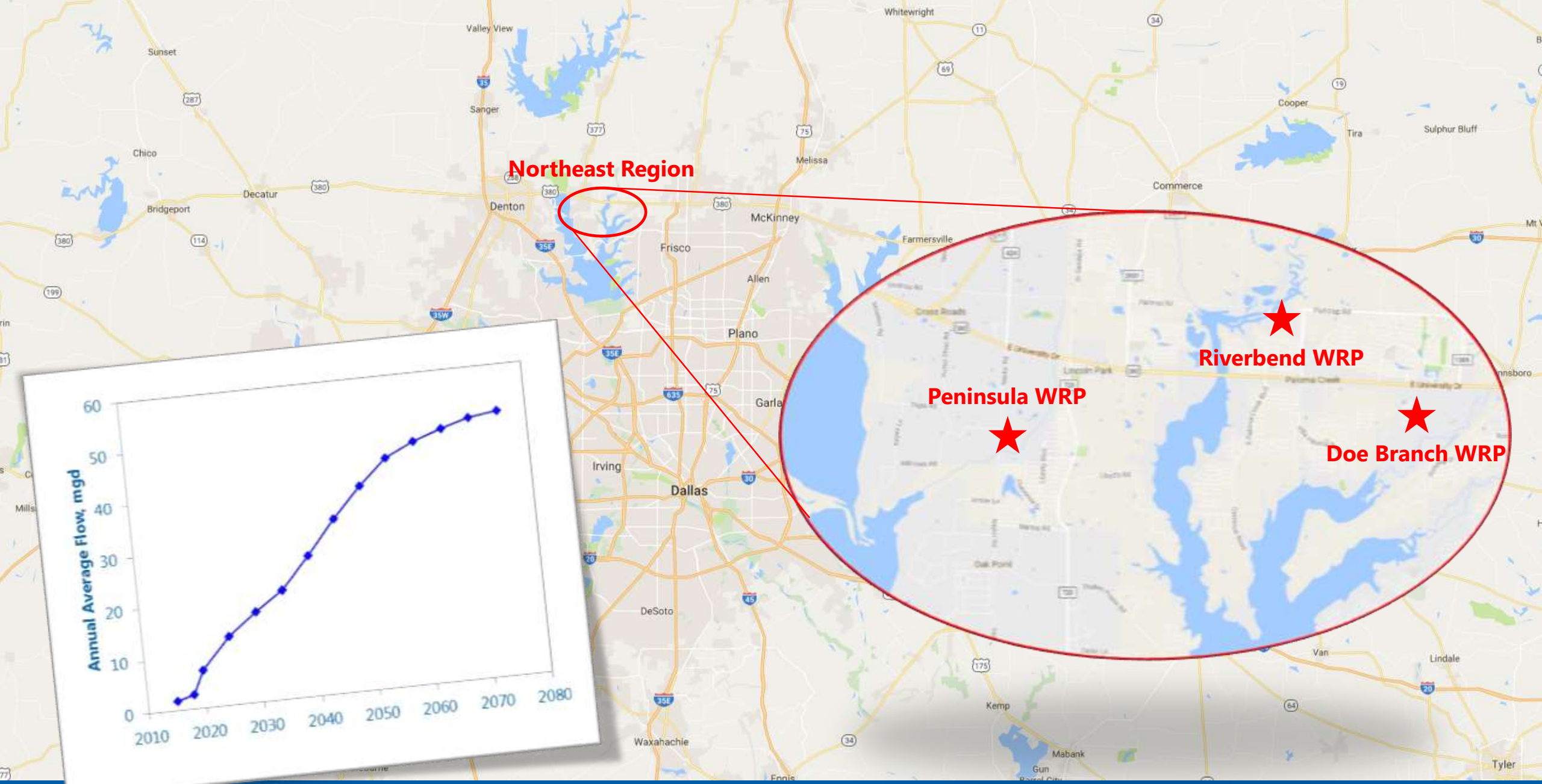
- Aeration Basins
  - Anaerobic Vol = 0.4 MG
  - Anoxic Vol = 1.6
  - Oxic Vol = 5.2 MG
- RAS Denitrification
  - Volume = 0.2 MG
  - 100 percent RAS
  - HRT = 2 to 4 hours

Sidestream EBPR provides multiple benefits

- Lower impact from DO and NO_3-N levels in RAS
- Lower P levels achieved without chemical precipitation
- Less impact from variability and quality of wastewater
- More carbon available for denitrification



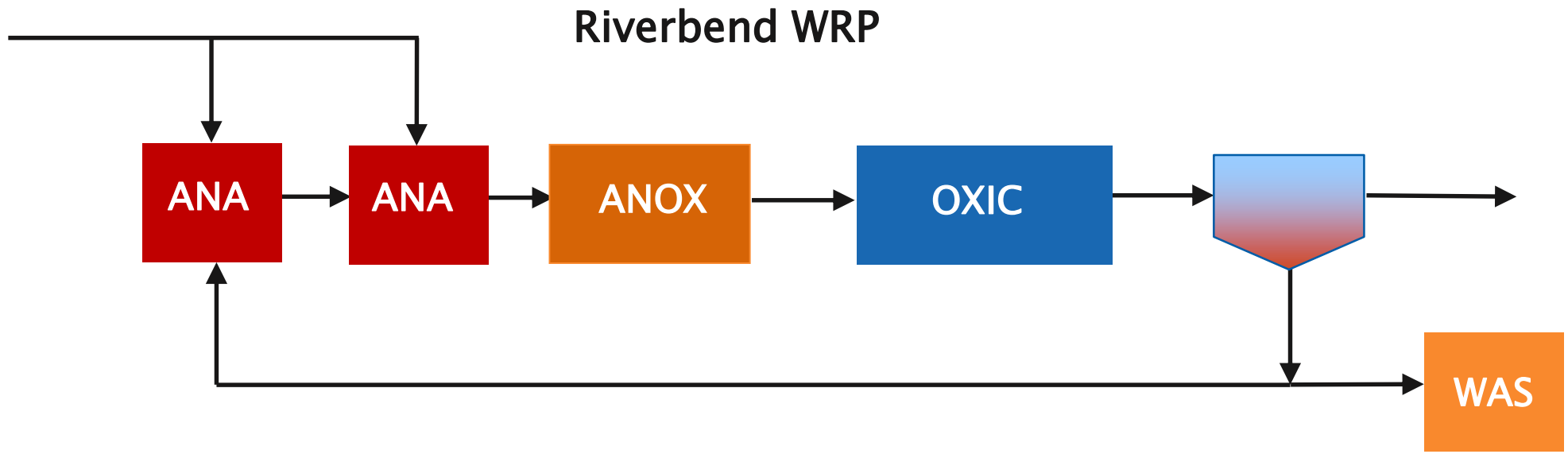
Riverbend and Doe Branch WRPs Experience



The Northeast Region has three Water Reclamation Plants

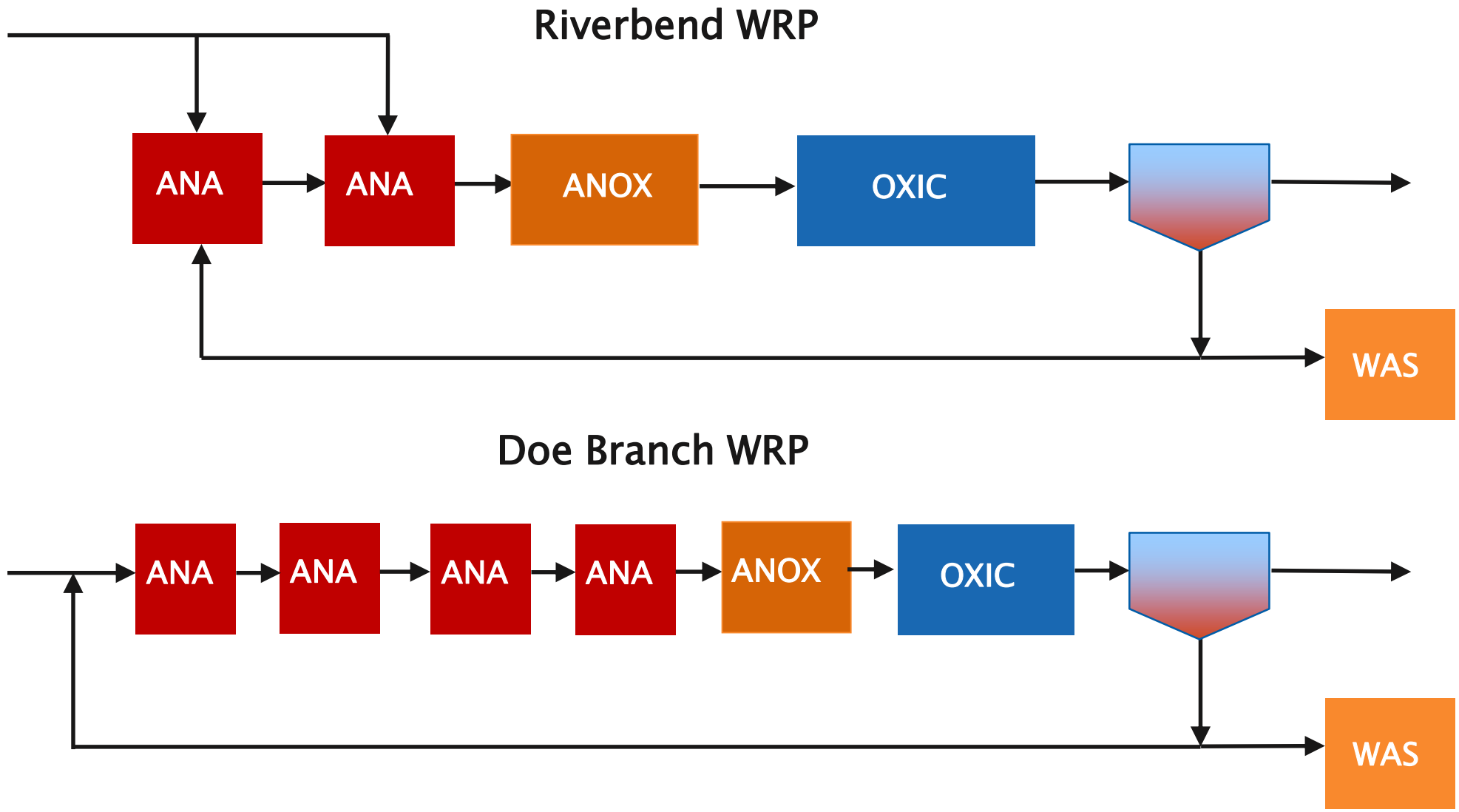
Riverbend WRP (Under Expansion to 4 mgd AADF)

Secondary Treatment Process Diagrams



Doe Branch WRP (2 mgd AADF)

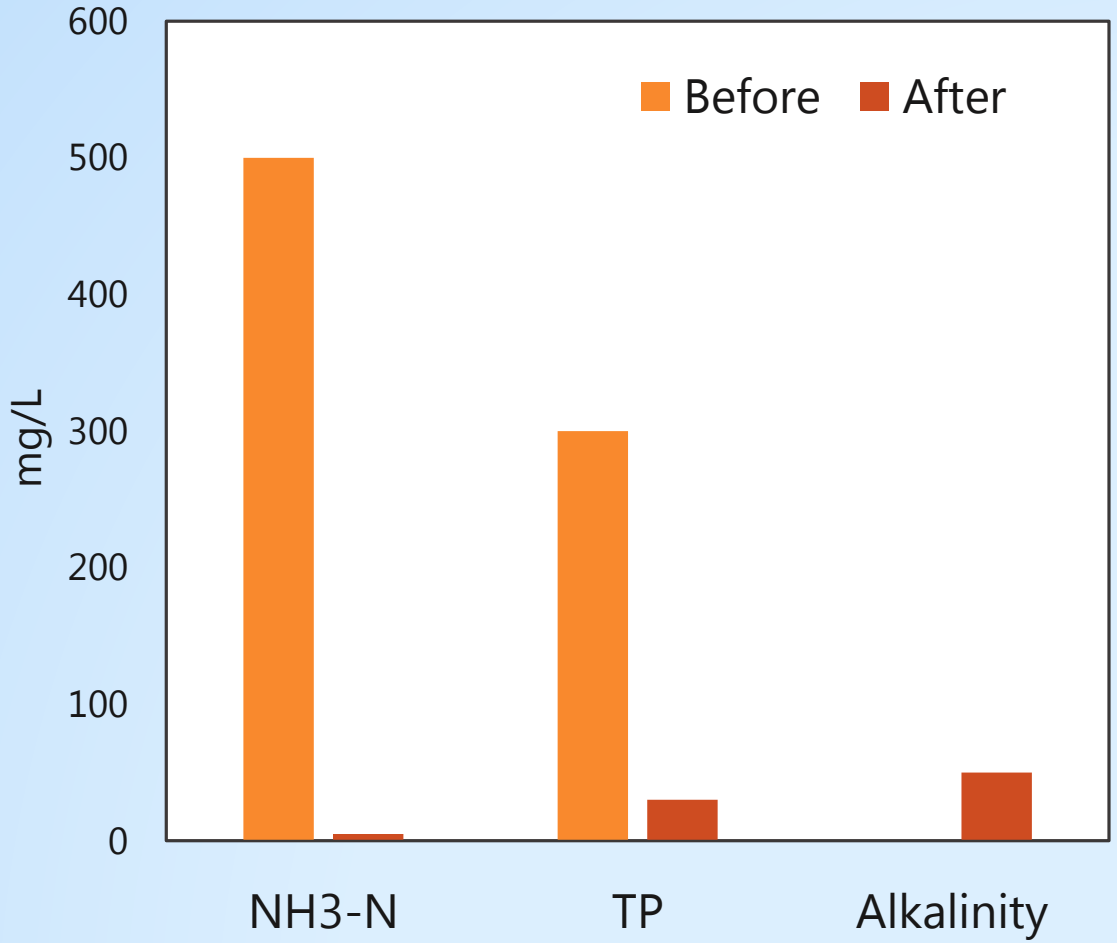
Secondary Treatment Process Diagrams



Aerated sludge holding tanks provide storage and treatment

Sidestream treatment in sludge holding tanks improved treatment performance

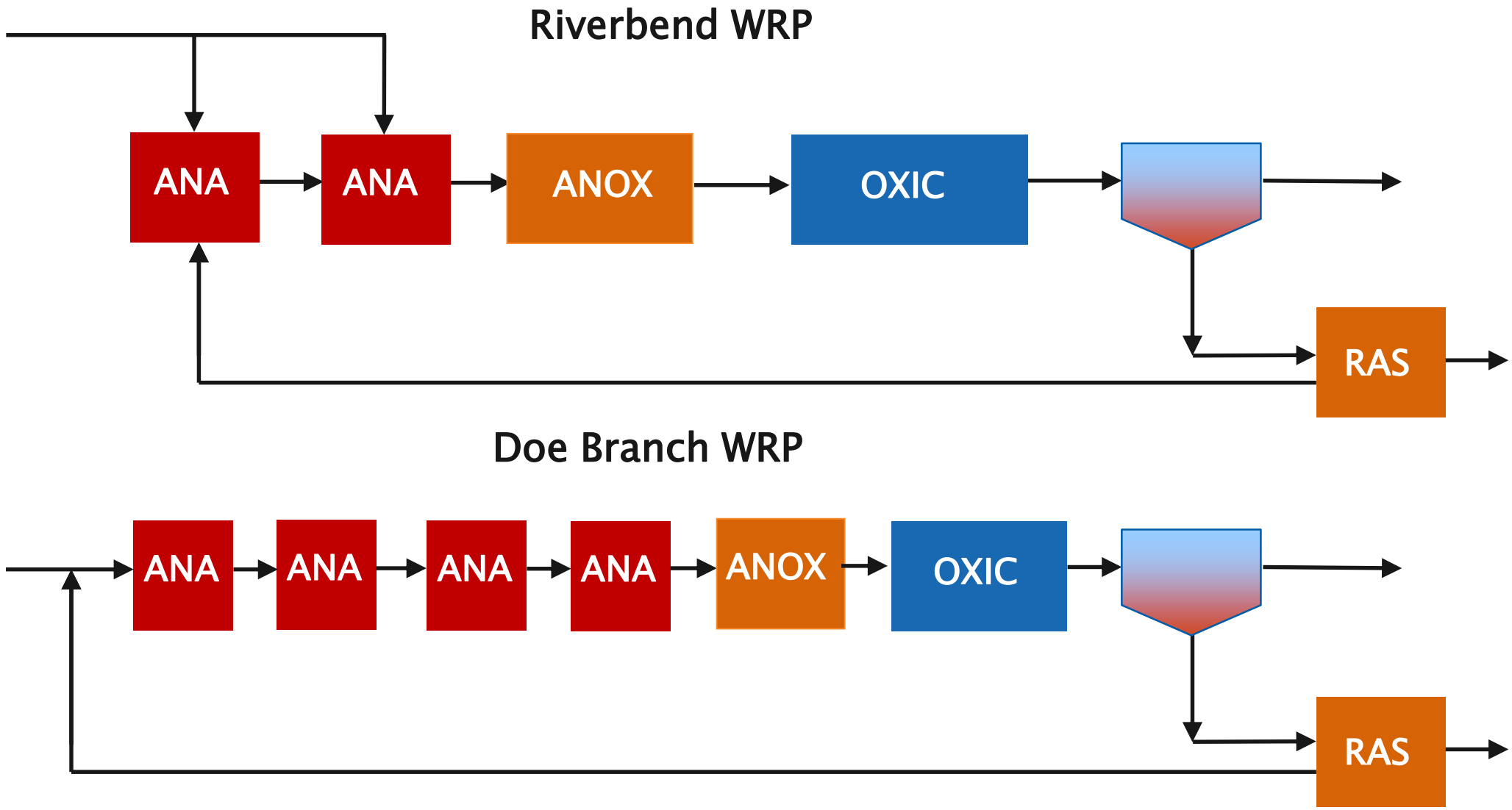
- Applied lessons learned from SBR operation to sludge holding tank
  - Intermittent aeration
  - Fill/react/decant cycles
  - DO/ORP monitoring
- Provided high quality centrate
- Improved plant effluent quality
- Operator intensive procedure



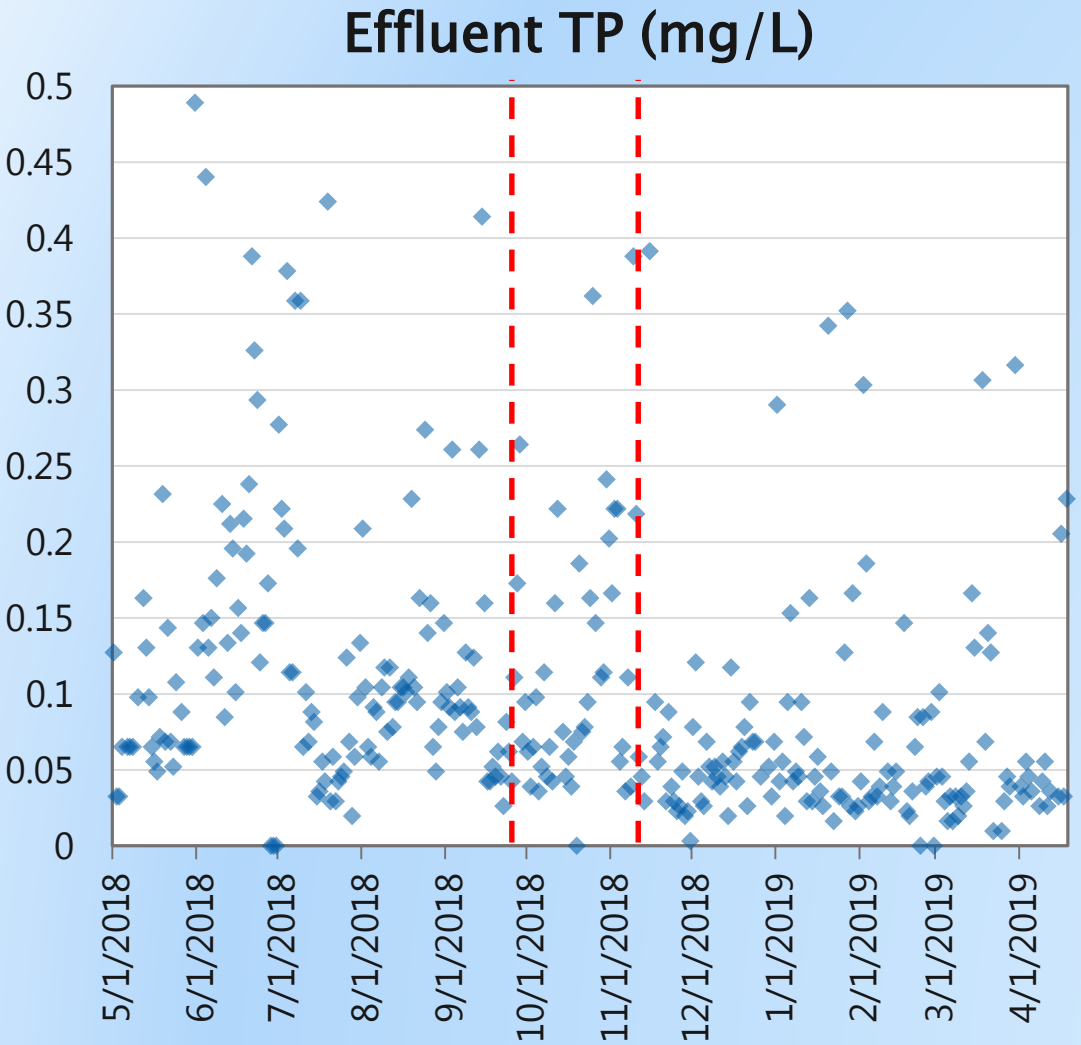
The sludge holding tanks were converted to RAS conditioning at both WRPs

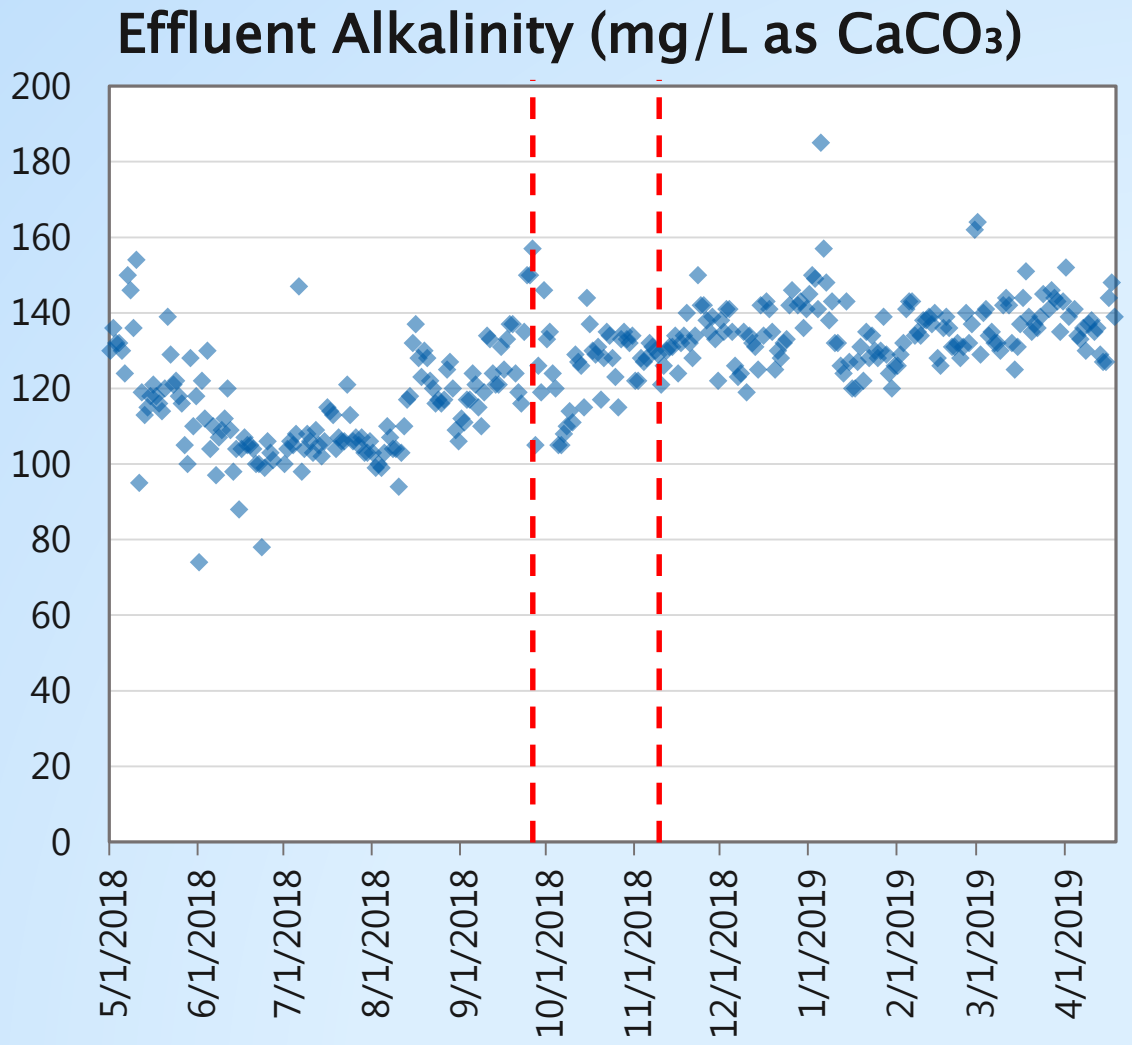
- Riverbend WRP
  - Construction sequencing
- Doe Branch WRP
  - Operator intensive process
  - RAS pumping turndown limitations
  - Poor settling in clarifiers

WAS pumps were used for RAS pumping



RAS conditioning provided process improvements





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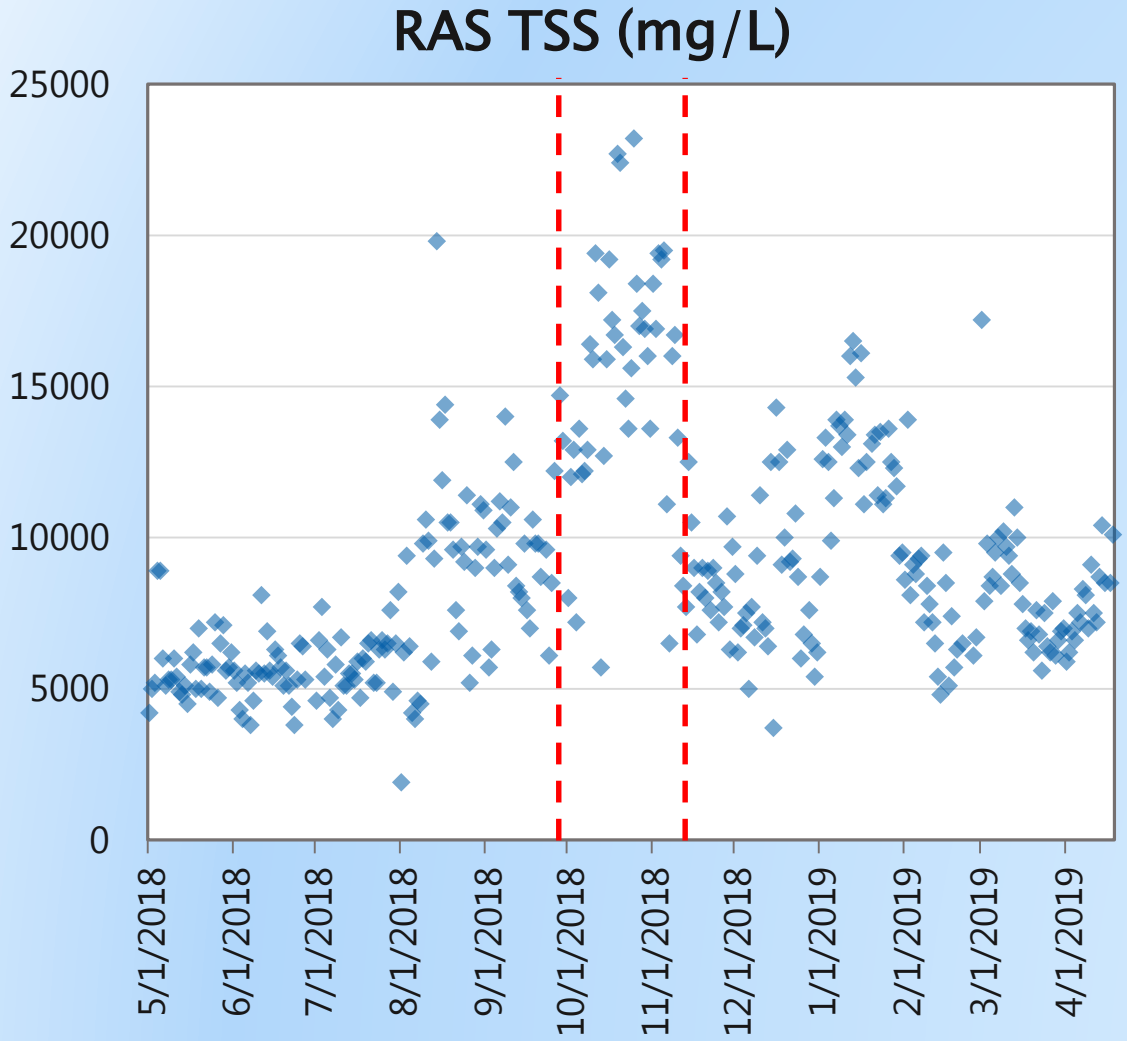

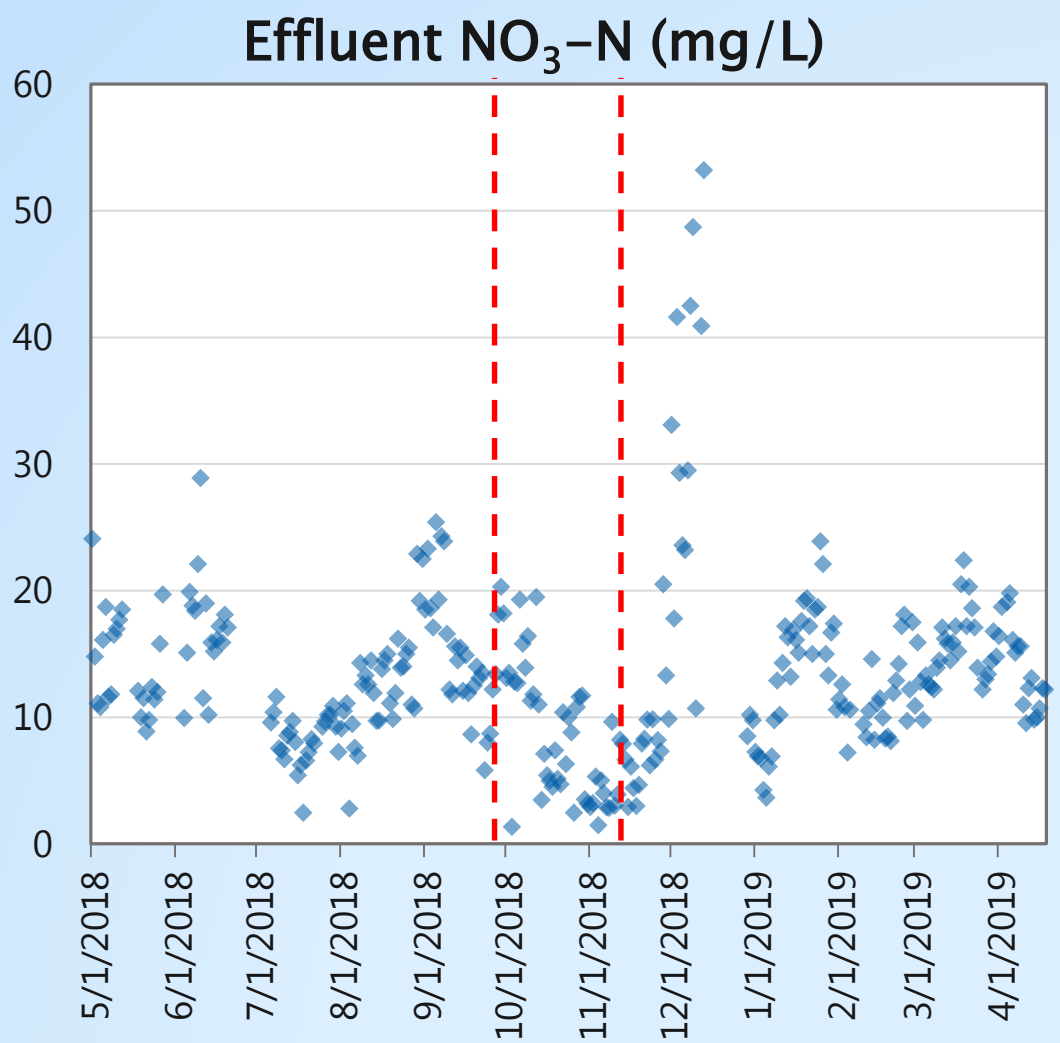

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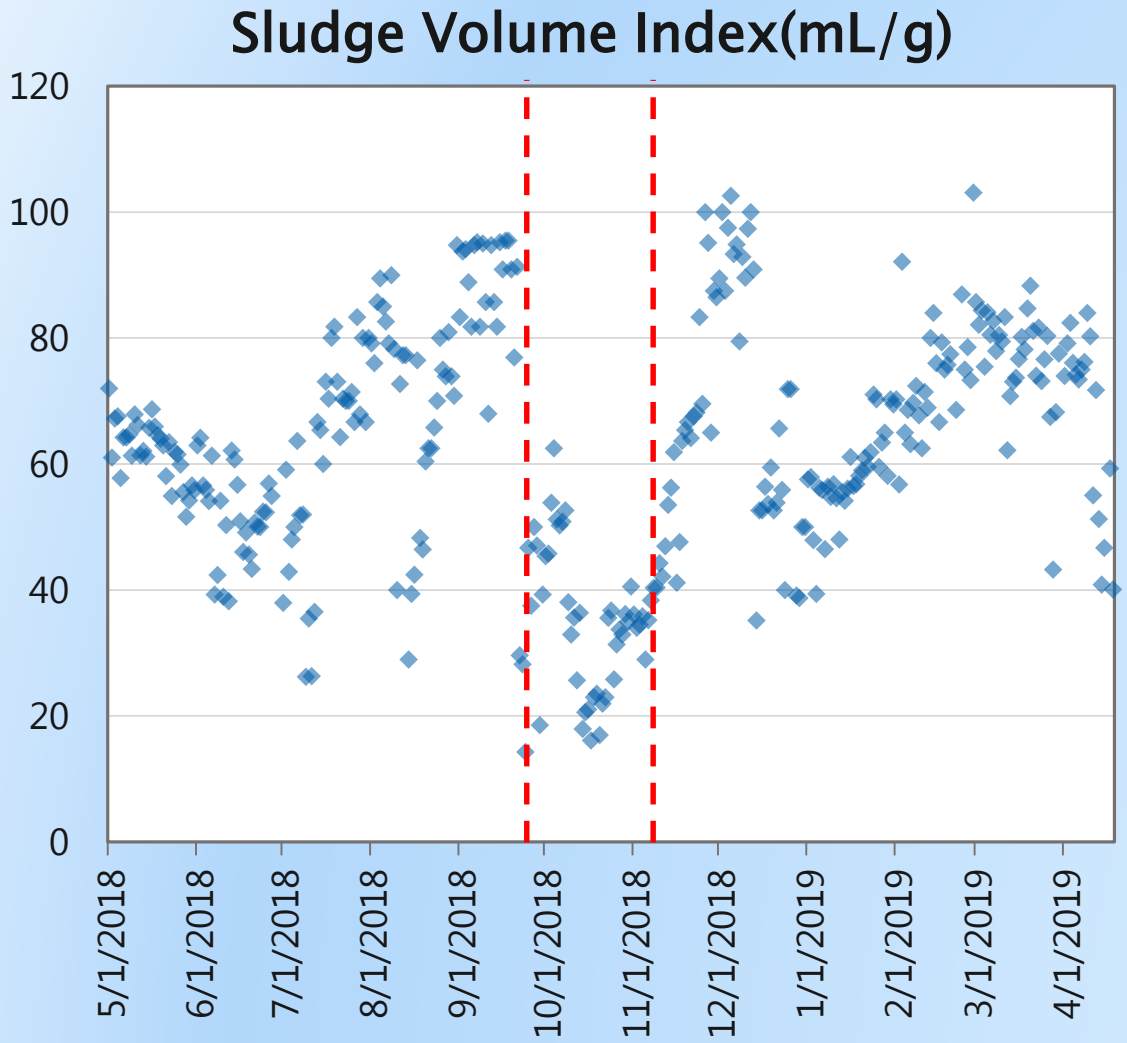

RAS conditioning provides multiple benefits at the Riverbend and Doe Branch WRPs

- Reduced chemical usage
- Lower effluent TP
- Lower RAS DO and NO_3-N
- Improved MLSS settleability
- High quality centrate
- Less operator intensive
- Odor control

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