The Sequenced Aeration Process
Montague, Massachusetts

Grant Weaver, PE & wastewater operator
The Water Planet Company

Webinar
April 15, 2014

The Water Planet Company

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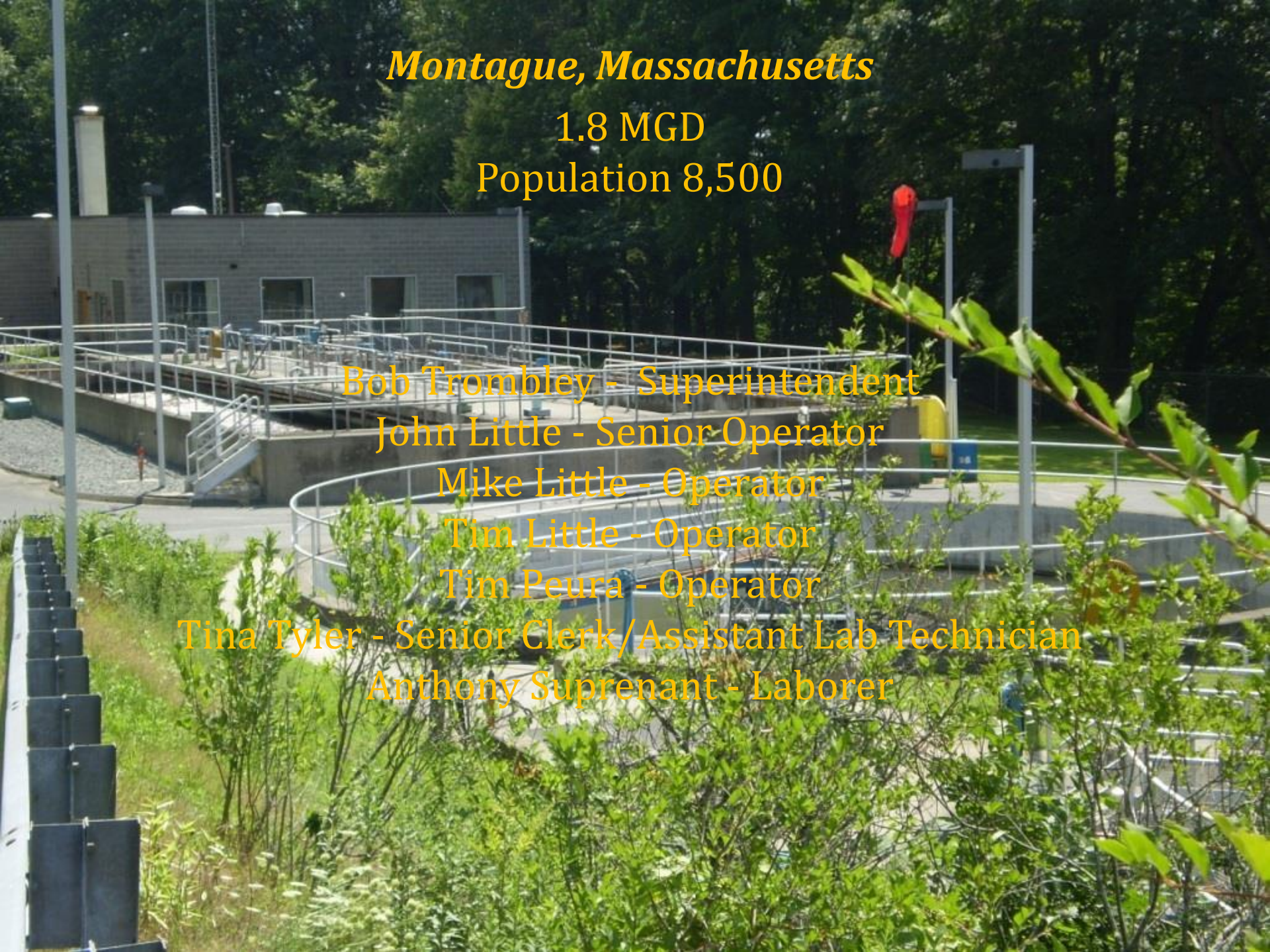

Montague, Massachusetts
1.8 MGD
Population 8,500
Bob Trombley - Superintendent
John Little - Senior Operator
Mike Little - Operator
Tim Little - Operator
Tim Peura - Operator
Tina Tyler - Senior Clerk/Assistant Lab Technician
Anthony Suprenant - Laborer

Sequenced Aeration Process
Montague

Process Description:

- Mainstream - Aeration is Cycled for Nitrogen & Phosphorus Removal
- WAS - Sludge is consumed using OSA Process

Cost Savings:

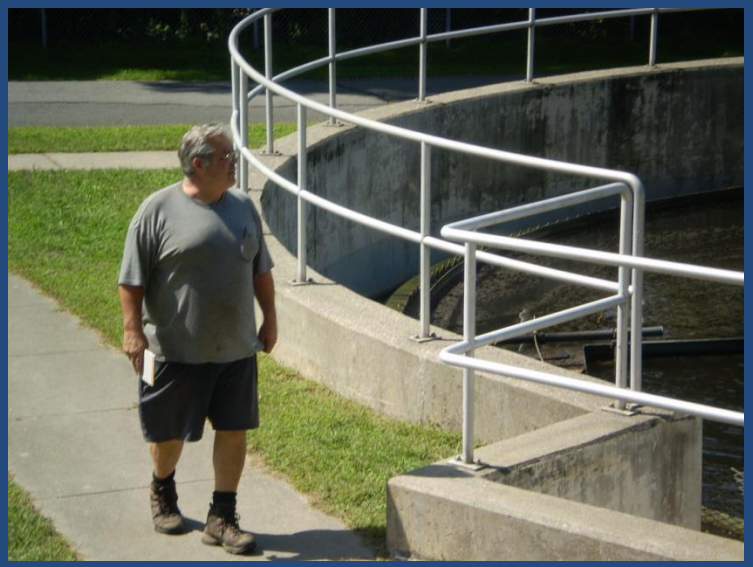
- $650,000/yr (increased revenues & reduced expenses)
- $75,000 capital vs. $4.5+ million

Nitrogen & Phosphorus Removal:

- tN - 5.0 mg/L
- tP - 0.75 mg/L

Challenges

- TSS & BOD - 30+ mg/L at times



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Montague, Massachusetts (population 8,500)

1.8 MGD design / 1.0 MGD average day

1962 upgrade
Primary Treatment

1982 upgrade
Secondary Treatment

2009 upgrade
Combined Sewer Overflow

2012 upgrade
Sludge Press

2012-2014 projects
Sequenced Aeration
Sludge Composting

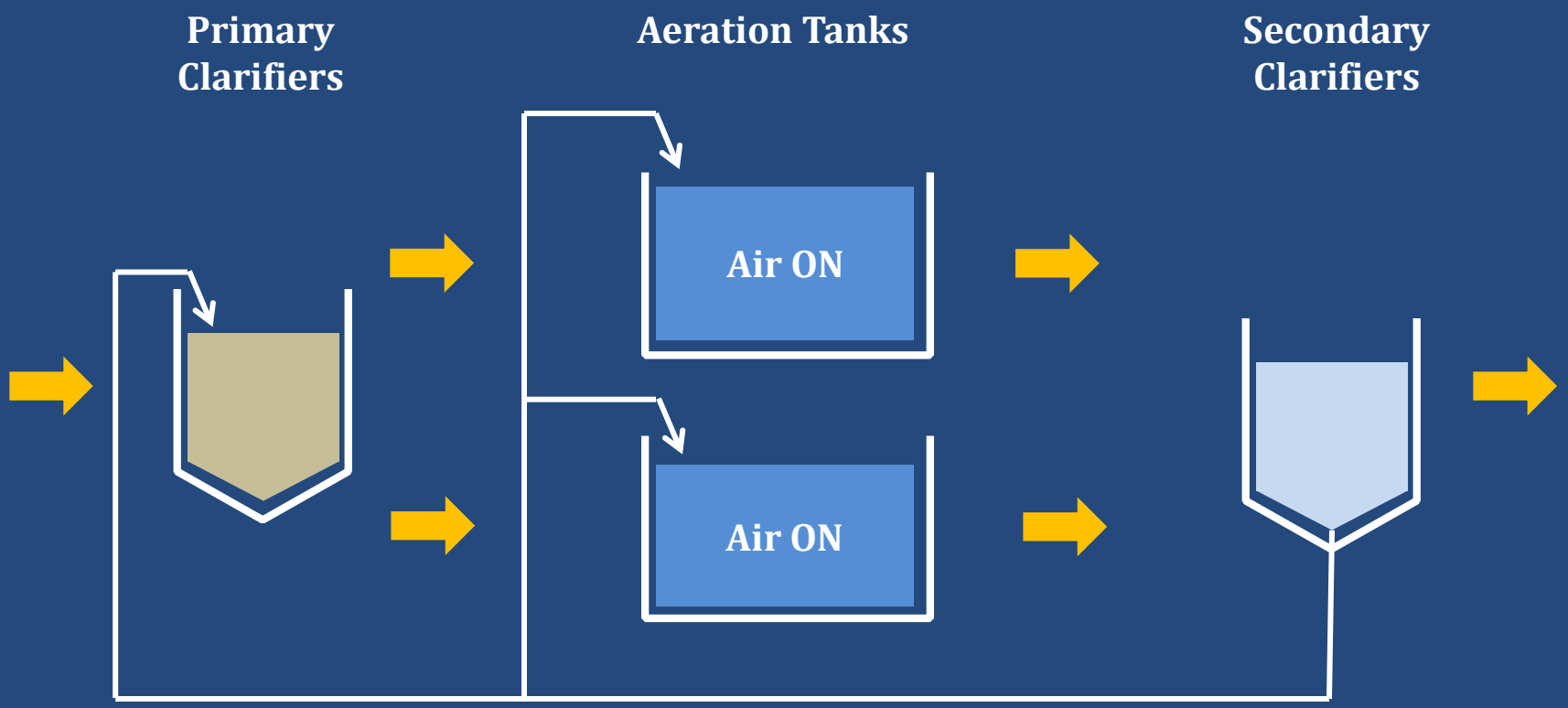
Current Mode of Operation: Sequenced Aeration

Sequenced Aeration

Using ORP as the process controller, every 1-1½ hours, valves open and close to switch conditions in the aeration tanks, much like a Sequencing Batch Reactor

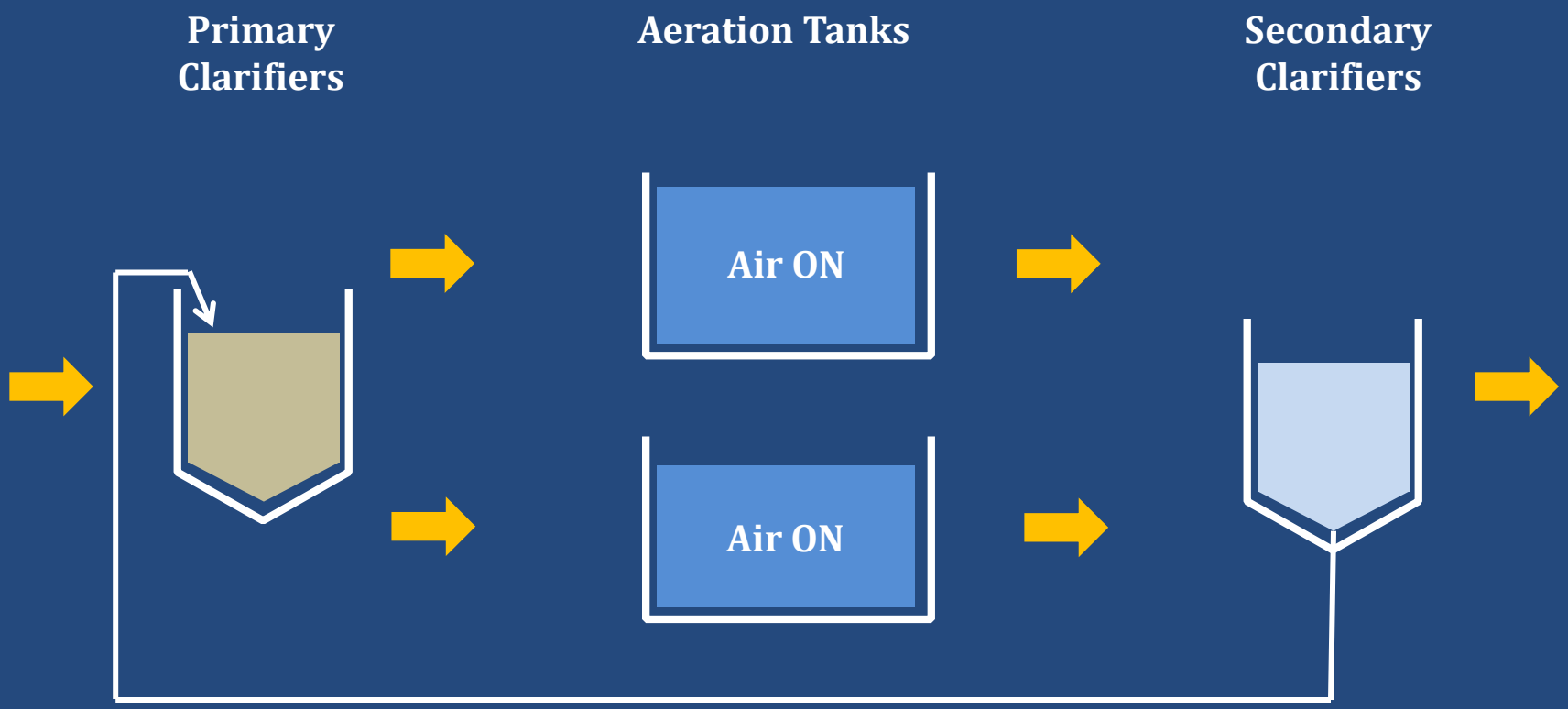
Air ON cycle
- Aeration valve opens
- Influent valve closes

Air OFF cycle
- Aeration valve closes
- Influent valve opens

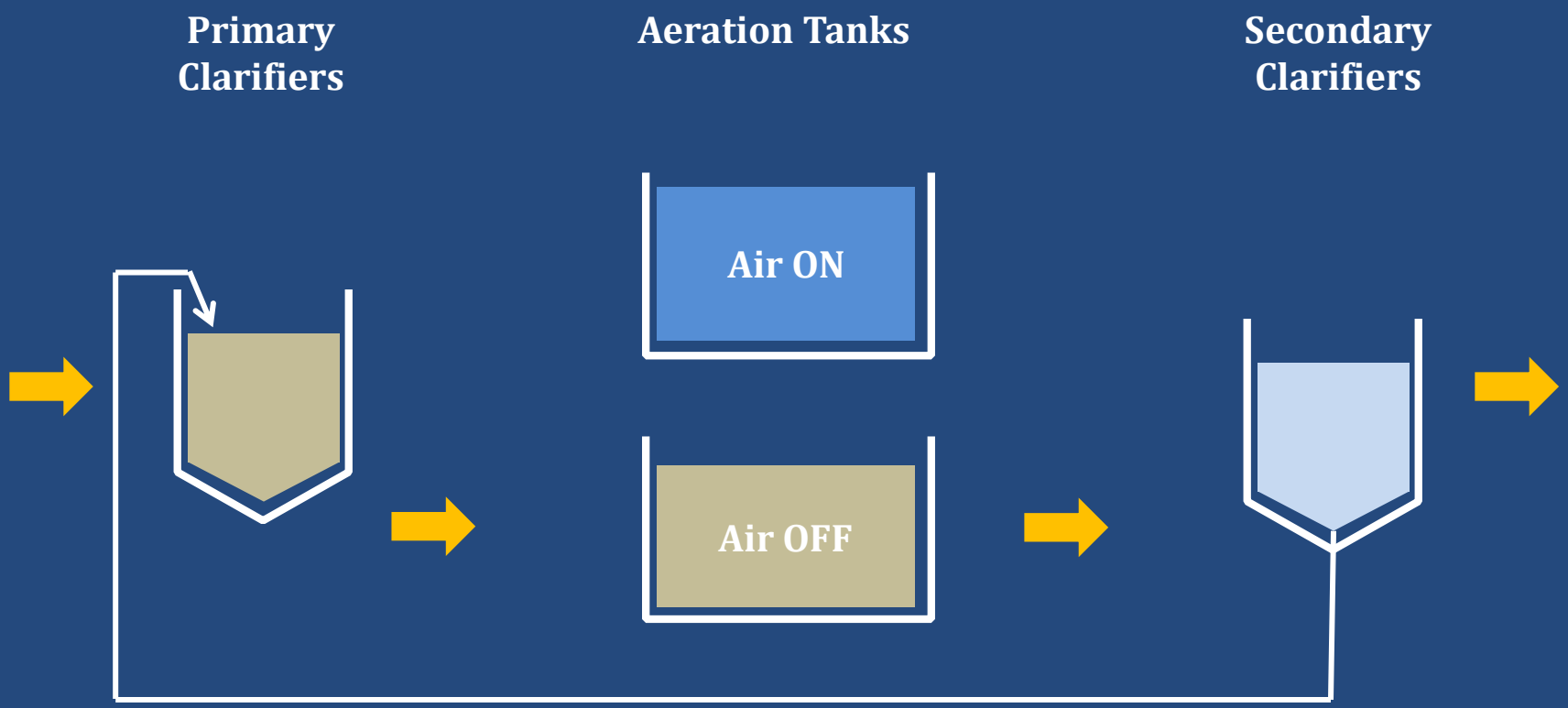


Sequenced Aeration

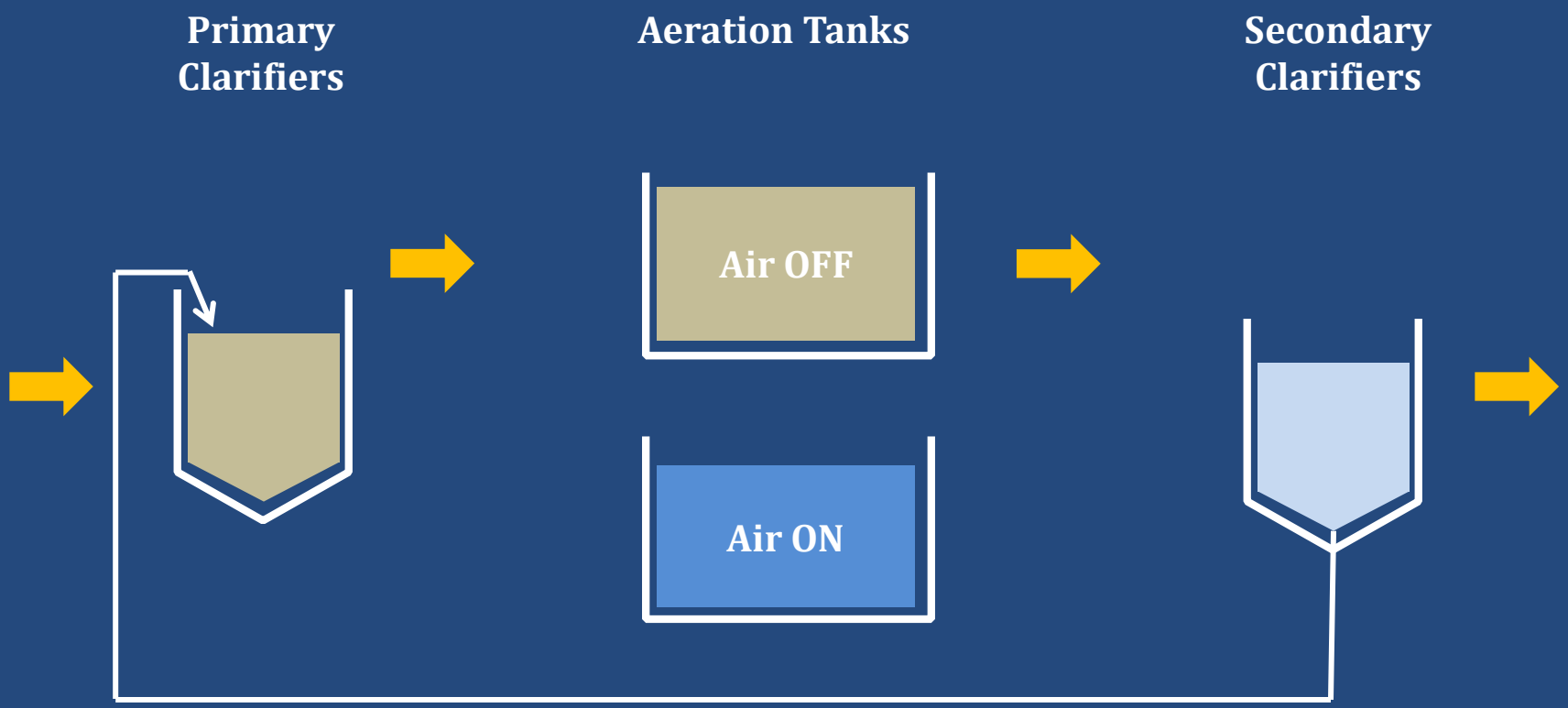
Conventional Activated Sludge



Sequenced Aeration



Sequenced Aeration



Sequenced Aeration

Sequenced Aeration Equipment

Motor operated slide gate valves in aeration tank inlet channels.

Motor operated aeration piping butterfly valves.

In-line ORP and LDO probes.

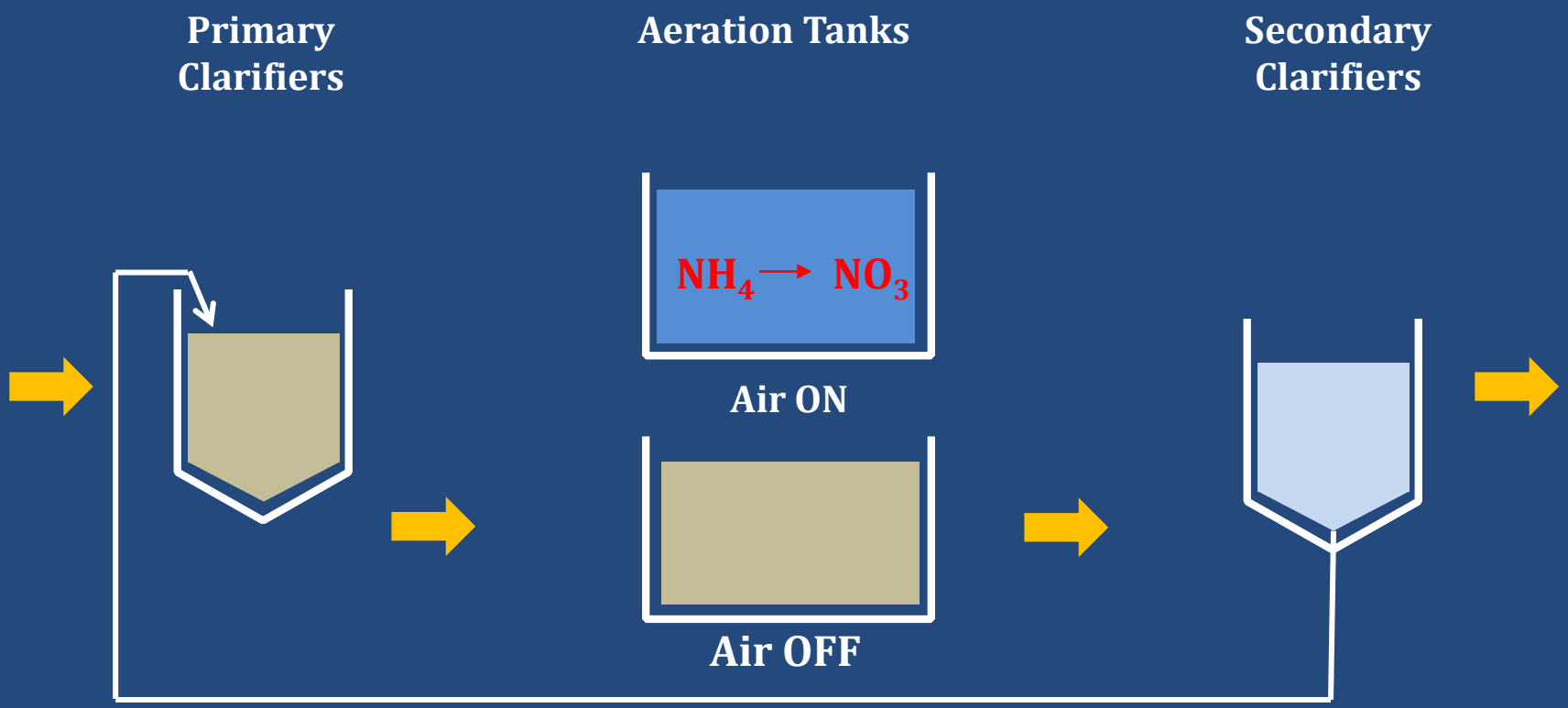
SCADA programming.

Sequenced Aeration Nitrogen Removal

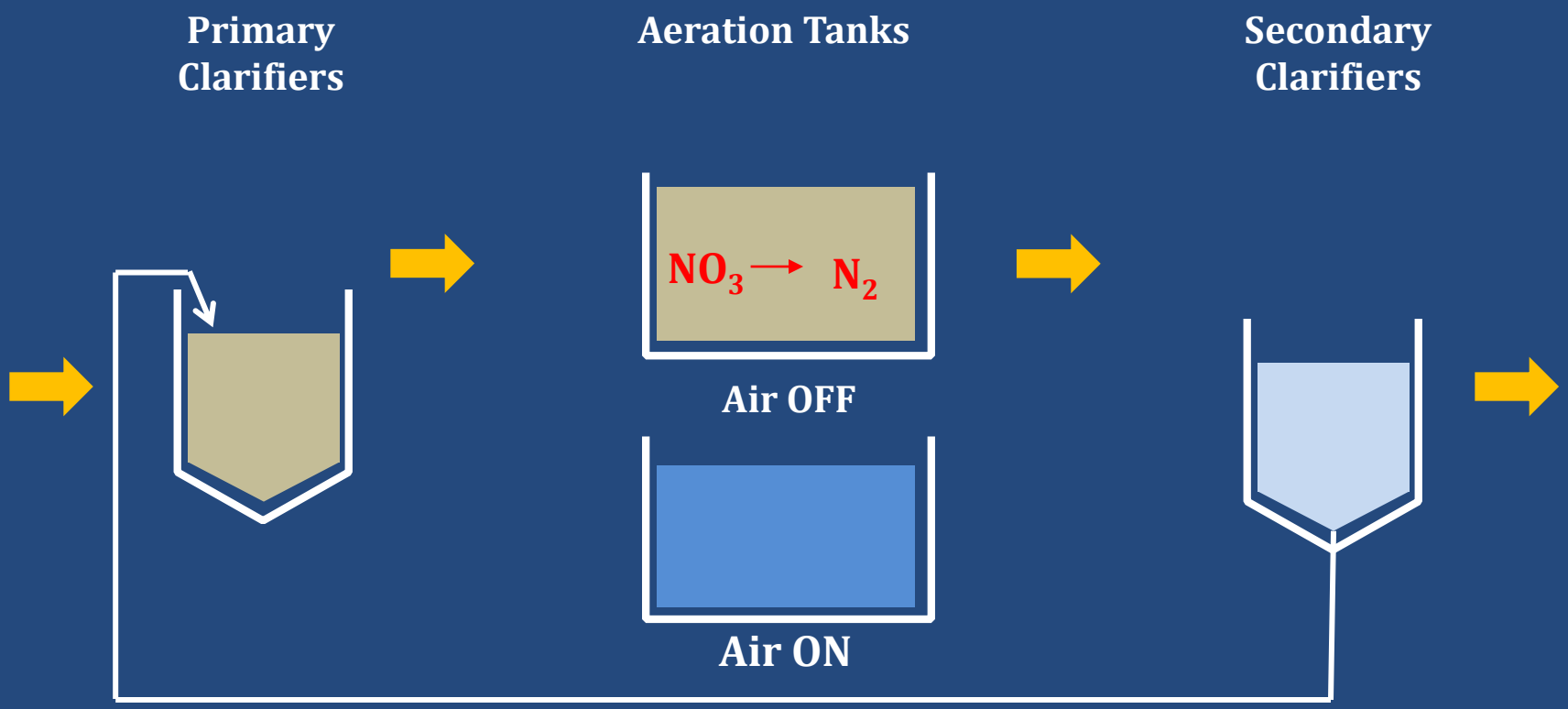
Raise bacterial population (MLSS) for …
- Ammonia-Nitrogen removal

Nitrification – Ammonia (NH_4) removal –
eliminate influent and RAS flow into tank when air is ON …
- Less BOD to compete with nitrification
- More HRT to allow for effective nitrification

Denitrification – Nitrate (NO_3) removal –
Primary Effluent and RAS flow into tank when air is OFF …
- Provides BOD needed for denitrification
- Reduces anoxic zone HRT
- Partial settling keeps mixed liquor in aeration tanks



Sequenced Aeration Nitrogen Removal



Sequenced Aeration

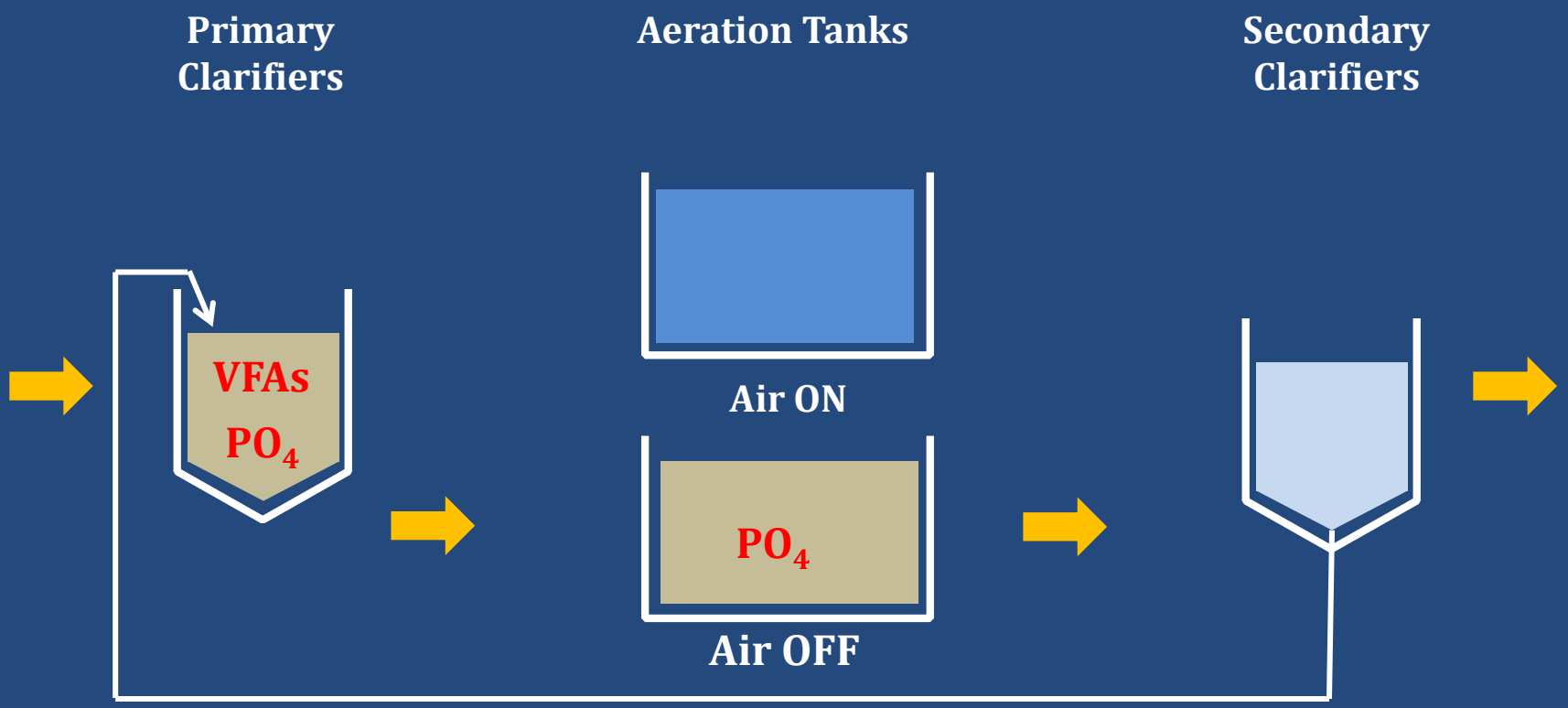
Sequenced Aeration Phosphorus Removal

VFA formation in Primary Clarifiers and Gravity Thickener

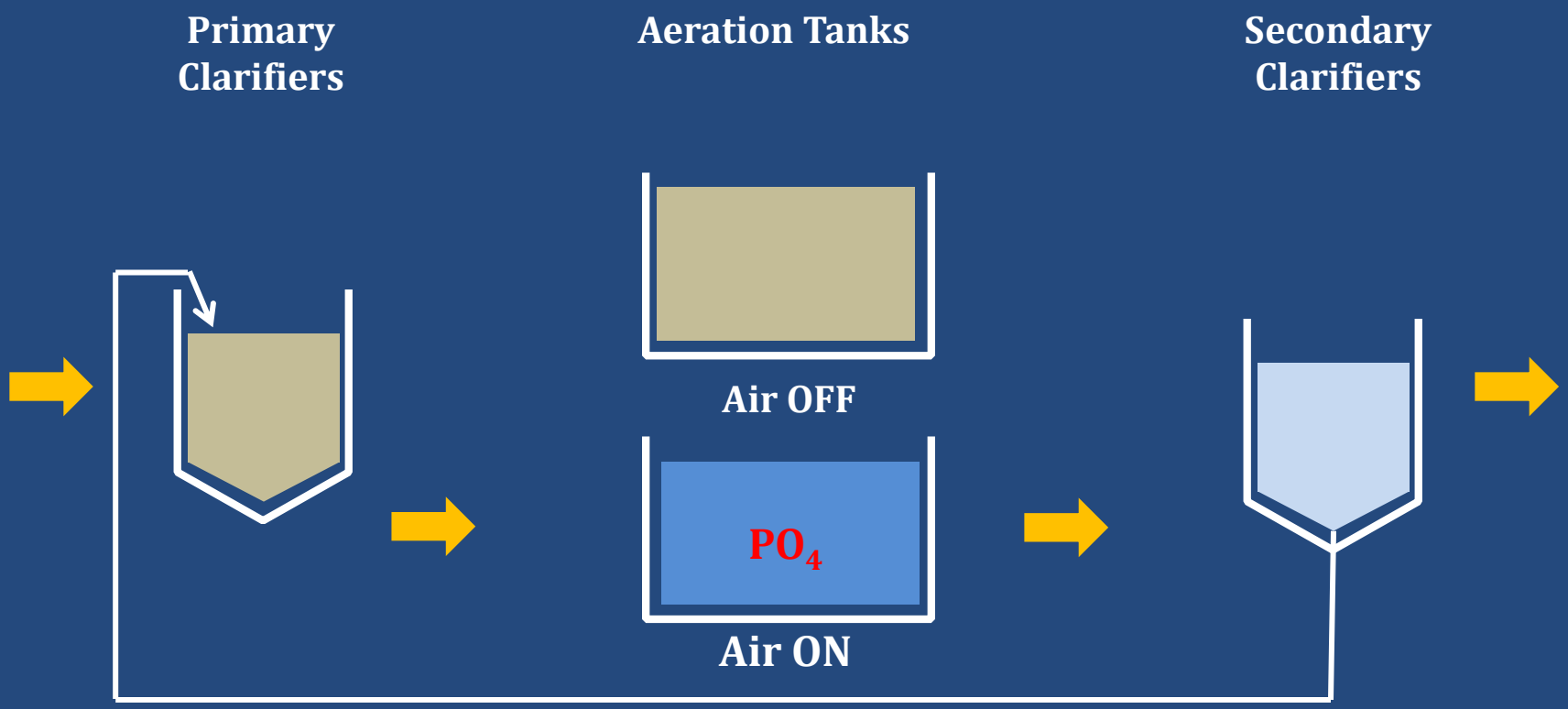
VFA uptake by bio-P bugs (PAOs) in Primary Clarifiers and Gravity Thickener – surplus BOD available

ortho-P uptake in Aeration Tanks during air ON cycle

No apparent release of ortho-P into wastestream; perhaps phosphorus escapes as a gas?



Sequenced Aeration Phosphorus Removal



Sequenced Aeration Phosphorus Removal

Sequenced Aeration
Solids Destruction

Raise bacterial population (MLSS) to 7500+ mg/L
Cycle mixed liquor through different habitats to promote endogenous respiration

- Aerobic (+100 mV ORP)
- Anoxic (-100 mV ORP)
- Fermentation (-200 mV ORP)

Truck-in septage and sludge to “fuel” biodegradation

Break down bacterial cells into digestible BOD and convert BOD to CO_2 gas

Increase the inert content of the mixed liquor
Lower the mixed liquor volatile suspended solids (MLVSS) to 20-25%

Reduce sludge production by 75%

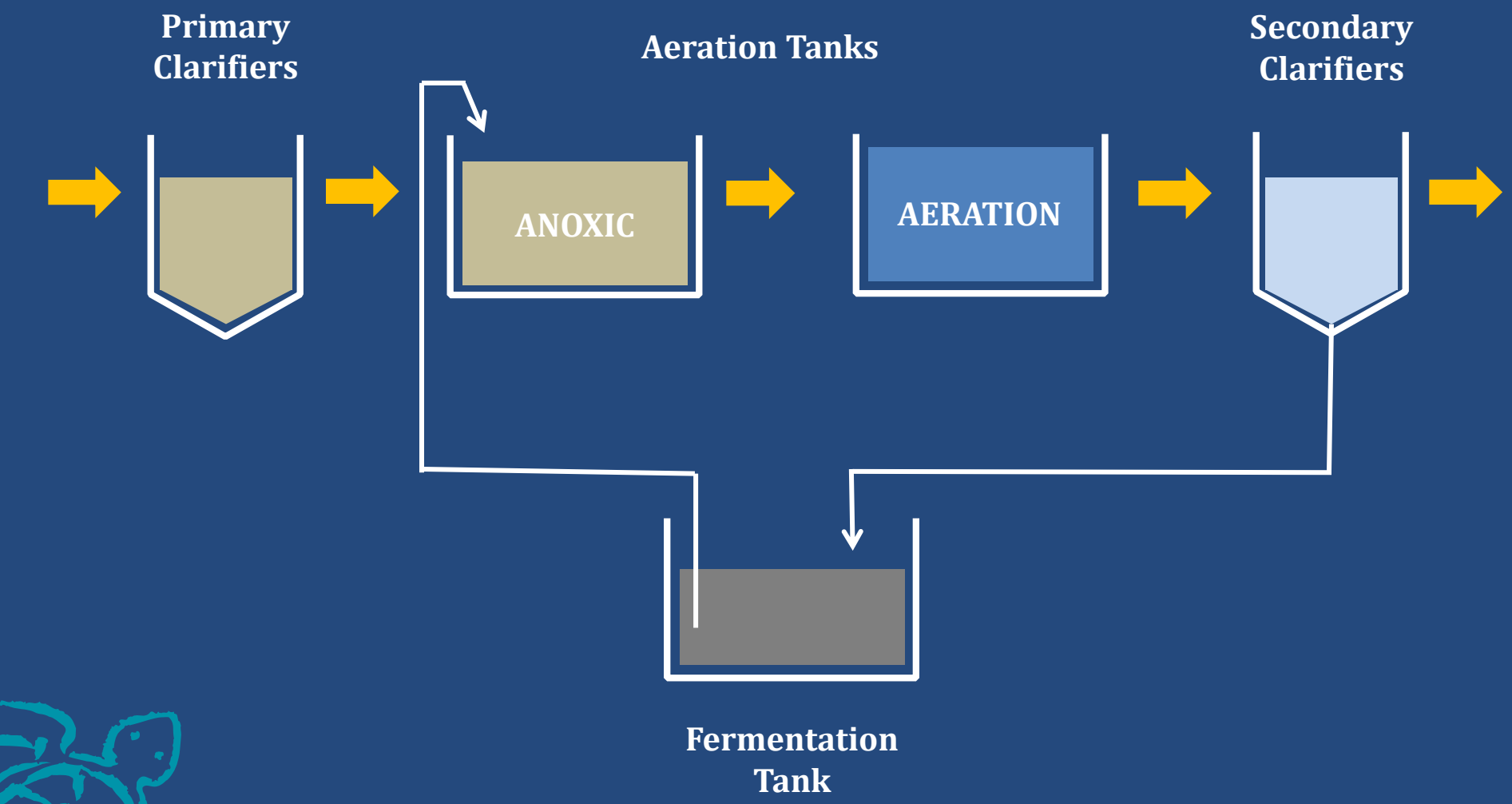
Montague Trucked-In Waste
2014 YTP

2,500 GPD Septage

13,000 GPD Thickened Sludge
All of the waste sludge from the following neighboring wastewater treatment plants; total capacity three times Montague

- Ashfield
- Old Deerfield
- South Deerfield
- Erving
- Greenfield
- Hadley
- Hatfield
- Northfield
- Orange
- Sunderland

OSA (Oxic-Settle-Anaerobic) Process

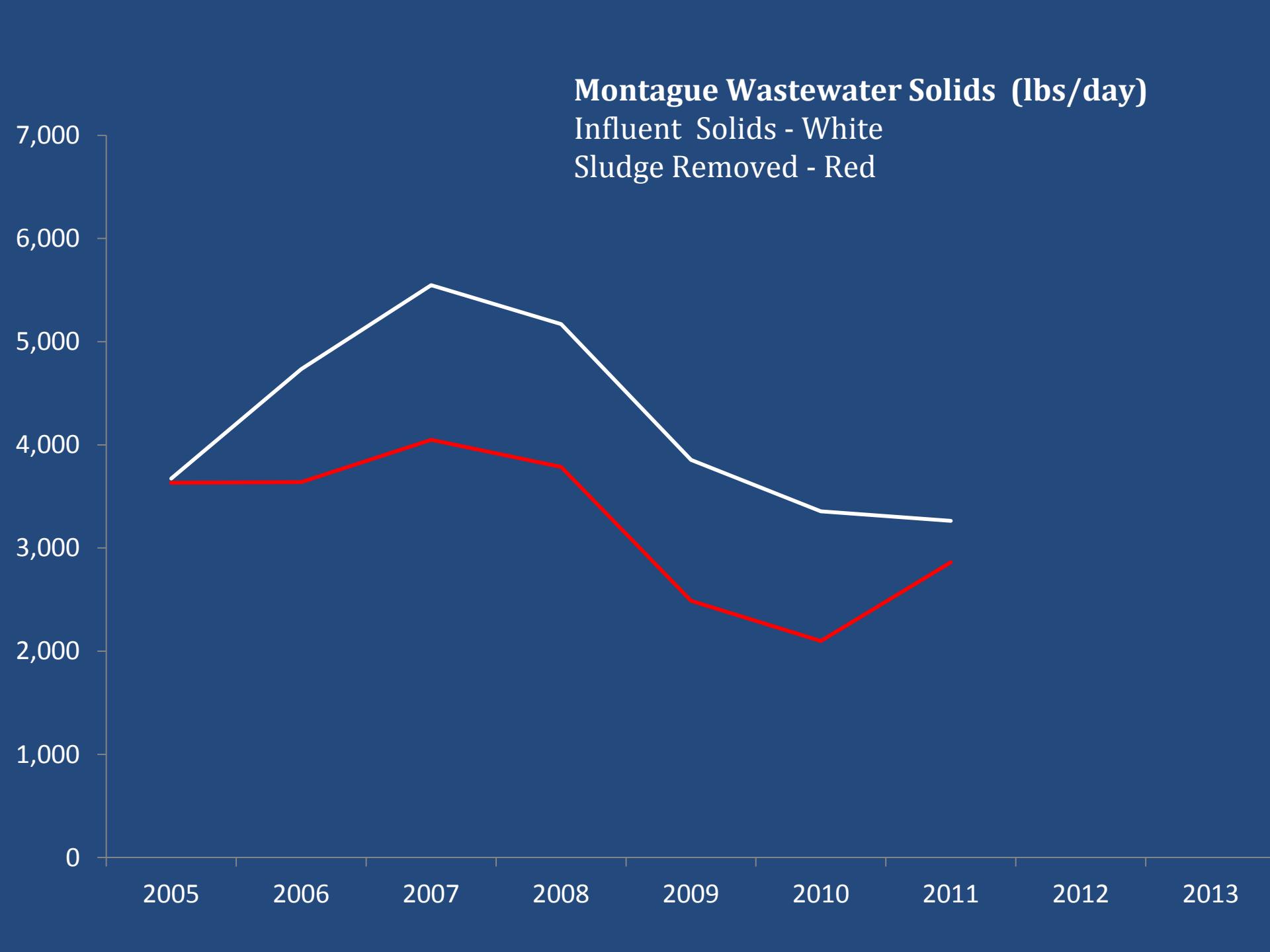


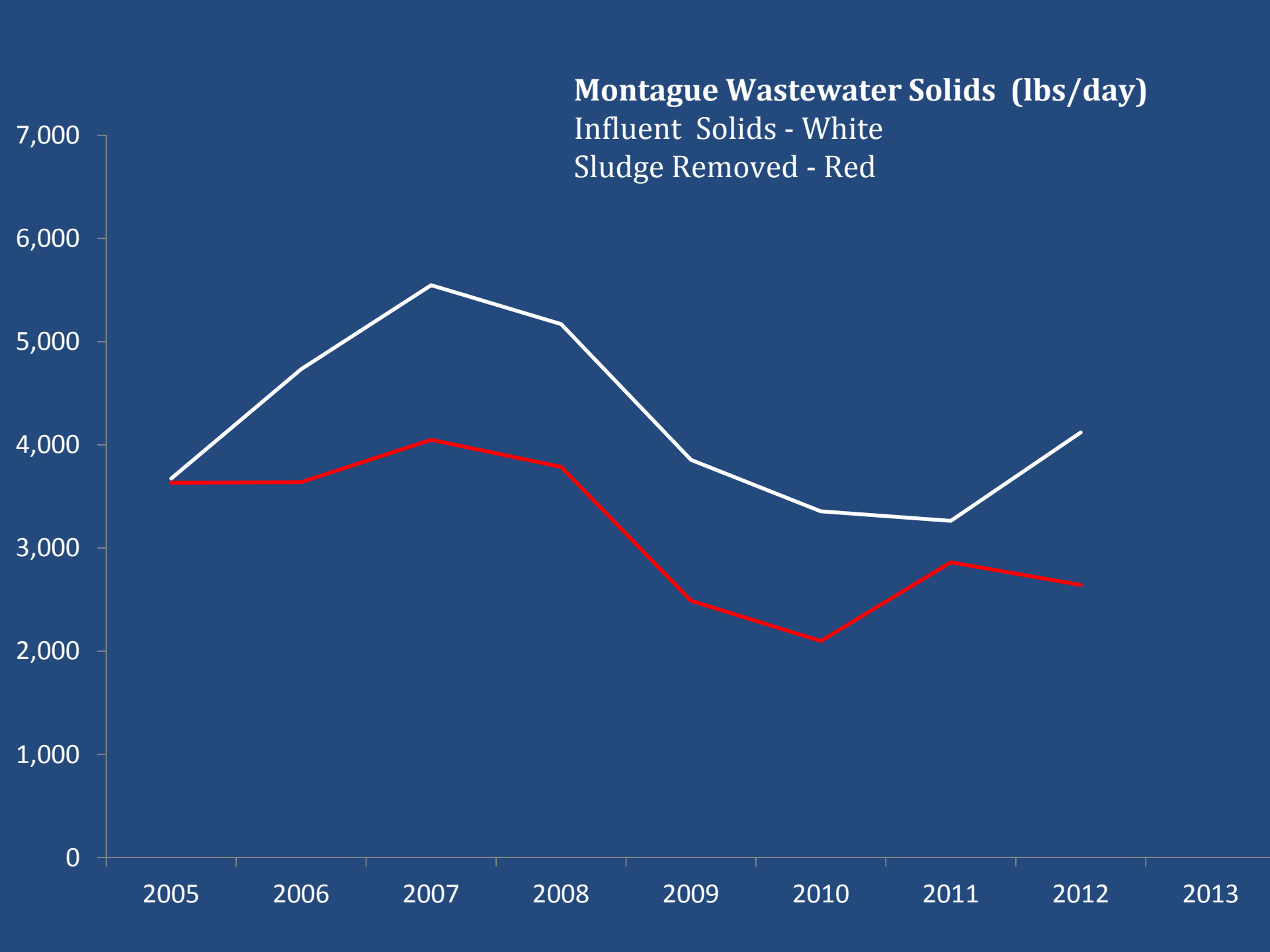
OSA: oxic-settle-anoxic system

In the oxic-settling-anoxic (OSA) system waste activated sludge is cycled between aerobic and fermentation/anaerobic reactors.

Bacteria in an anoxic tank are fed sludge in batches. Microbes are periodically starved and periodically fed the recycled sludge.

Sludge production is reduced 20-80 percent.


Montague Wastewater Solids (lbs/day)
Influent Solids - White
Sludge Removed - Red
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013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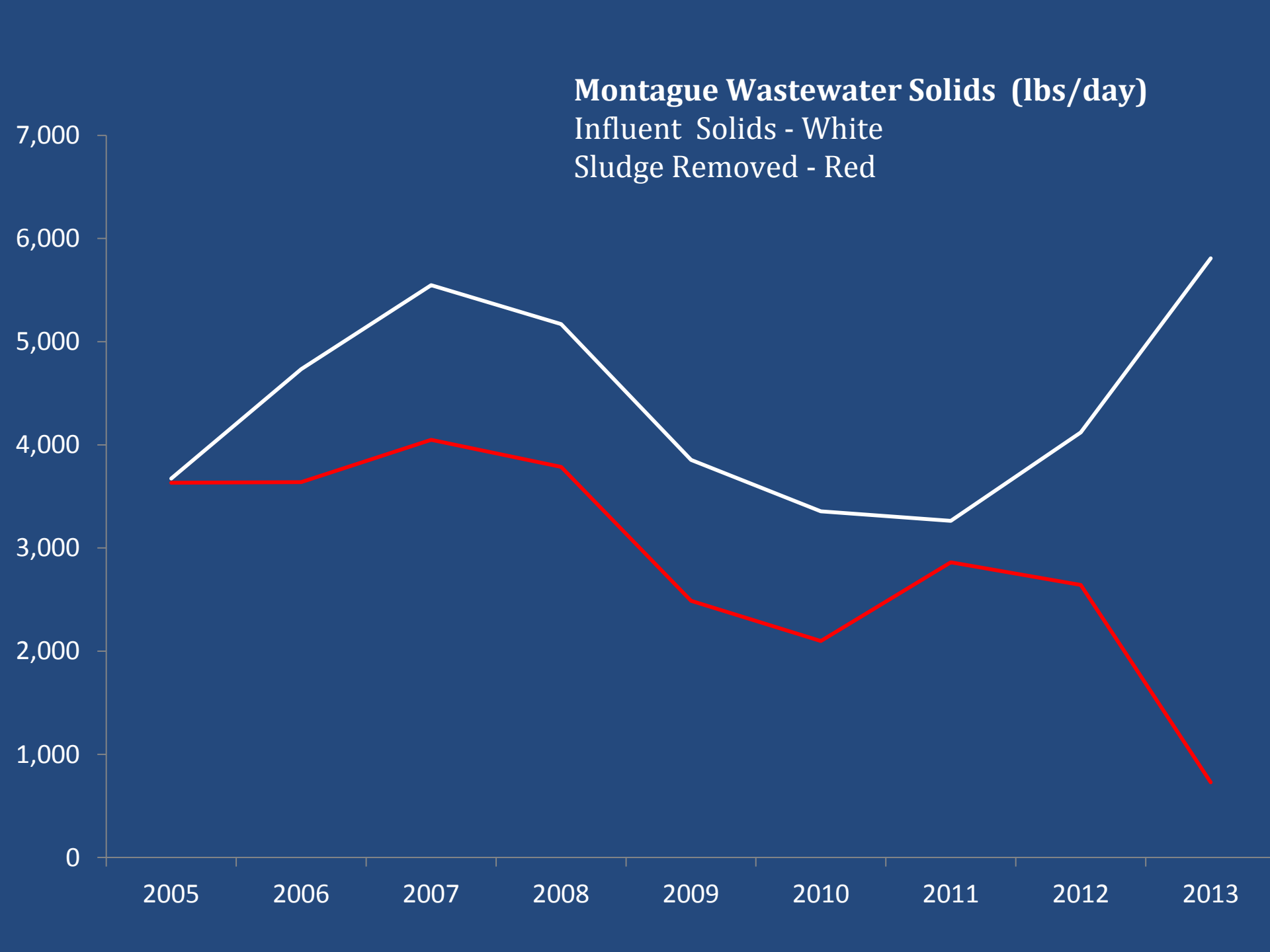
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Montague, Massachusetts
Future

Temporarily stop trucking in sludge

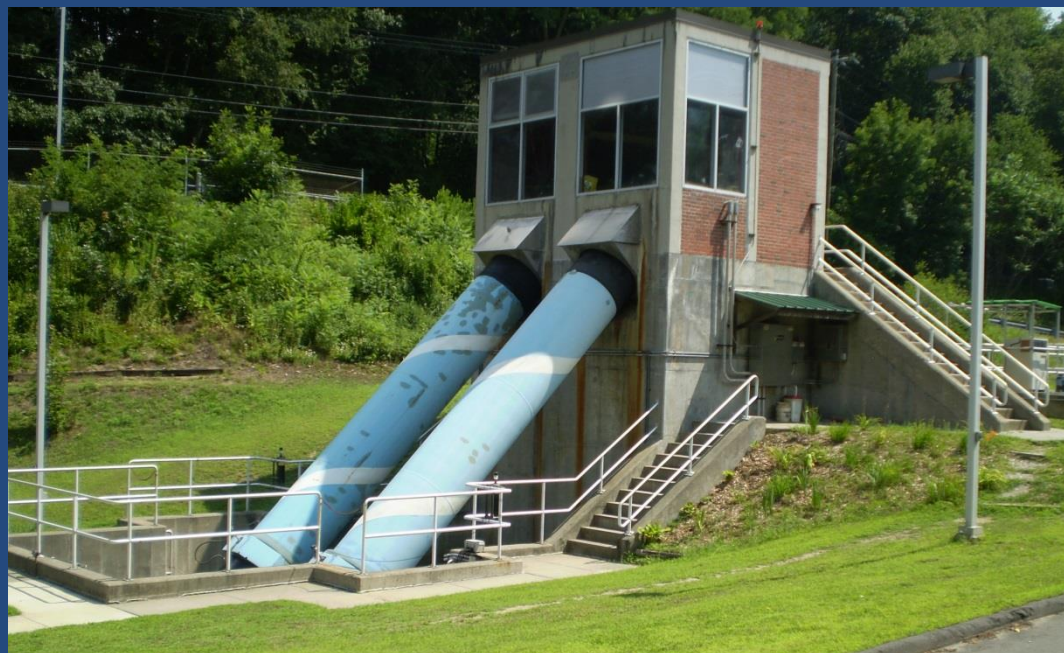
Temporarily reduce solids inventory (now 9,000 mg/L)

Clean years of accumulated debris from plant piping and tanks

Install sophisticated instrumentation (in-line analyzers & update SCADA)

Continue experimenting with …

- Sequenced Aeration Process
- On-site Composting



SUMMARY - Sequenced Aeration Process
Montague, Massachusetts

Cost-Effective Operations of 1.8 MGD wastewater treatment plant

- $400,000/yr additional revenues from trucked-in waste
- $250,000/yr sludge disposal savings
- Electrical savings: 40 HP vs 100 HP blower

Sustainable Nutrient Removal by Changing Operations

- $75,000 vs. $4.5 million upgrade
- t-N: 5 mg/L
- t-P: 0.75 mg/L

Sludge Reduction

- Mixed liquor volatile solids: 20-25%

Problems to be solved

- Effluent TSS: 22
- Effluent BOD: 18

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N Removal in Activated Sludge wwtps

P Removal in Activated Sludge wwtps

N&P Removal in Activated Sludge wwtps

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Grant Weaver
Your presenter

President
The Water Planet Company

<u>Licensing</u>

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Wastewater Operator

<u>Education</u>

Massachusetts Institute of Technology (MIT):
Post-Graduate Studies in Environmental Toxicology

Oklahoma State University (OSU):
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Kansas State Univer[illegible]:
BS Biology

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