

# Energy Efficiency and Process Operation

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Donohue & Associates

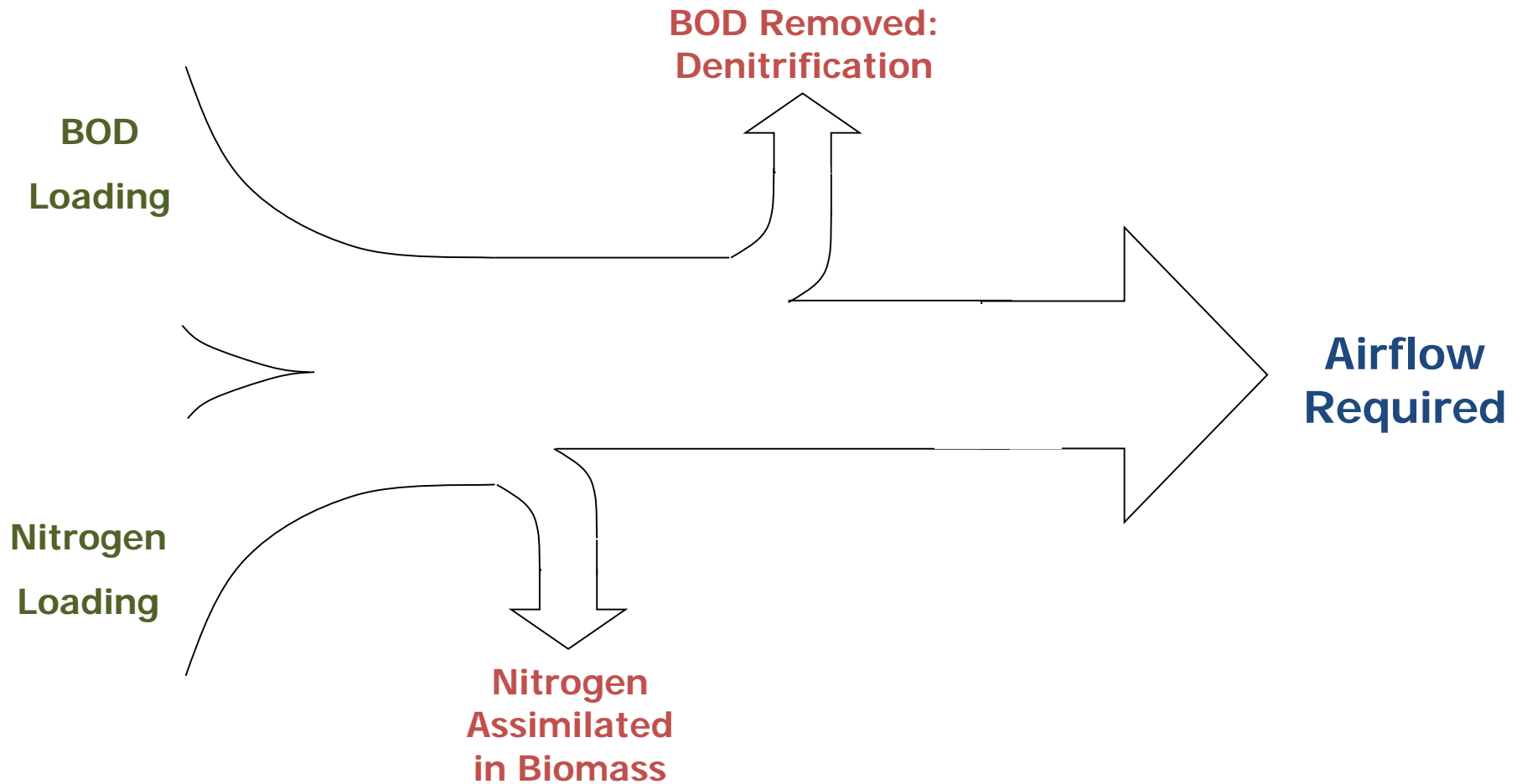


WWOA Annual Meeting  
Stevens Point, WI  
October 2013

# Agenda

- **Energy independence**
  - Popular motto in industry
  - Decrease dependency on external energy sources
- **How do you get to independence?**
  - Where is energy consumed?
  - Stepwise process
- **Energy reduction**
  - Focus on aeration (at least for this presentation...)

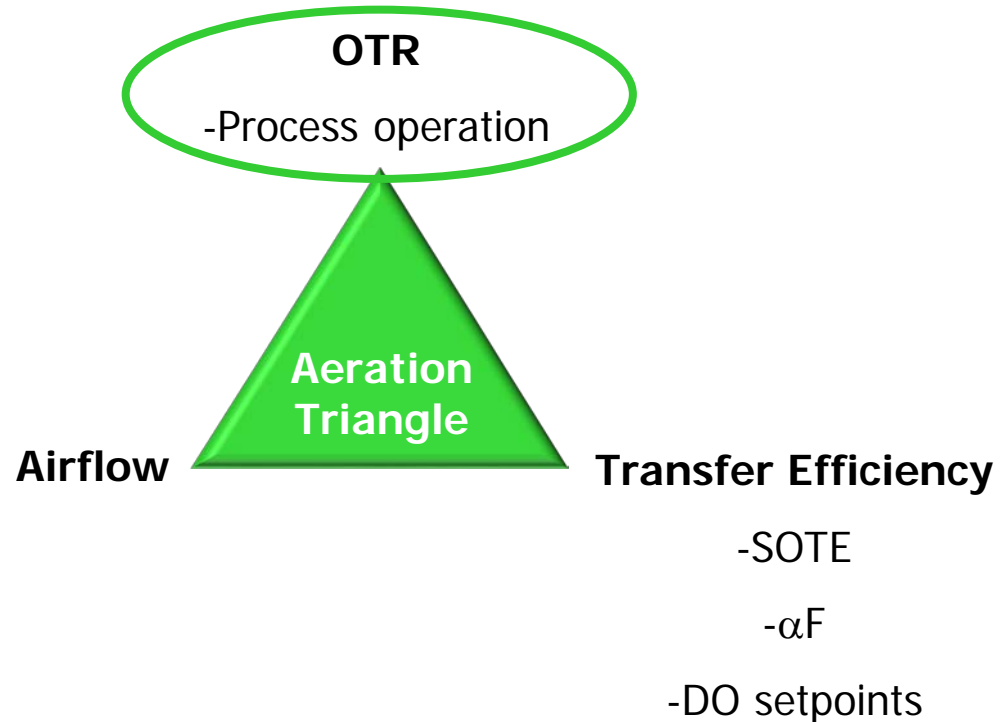
# Airflow Requirements



# Airflow Requirements

## ■ Variables of main concern

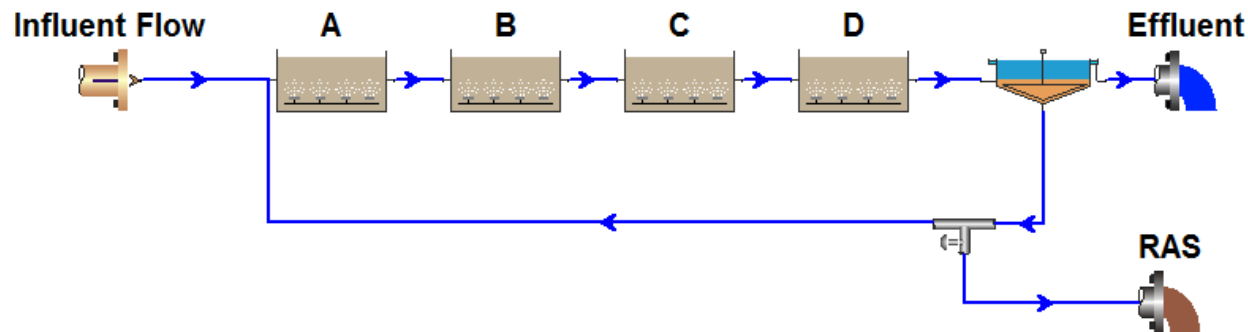
- Diffuser type
  - SOTE
  - $\alpha F$
- Diffuser age
  - $\alpha F$
- Process operation
  - DO setpoint
  - Process configuration
- Mixing requirements
  - 0.06-0.10 scfm/ft<sup>2</sup>



# Process and Mixing Airflow

## ■ Thought experiment

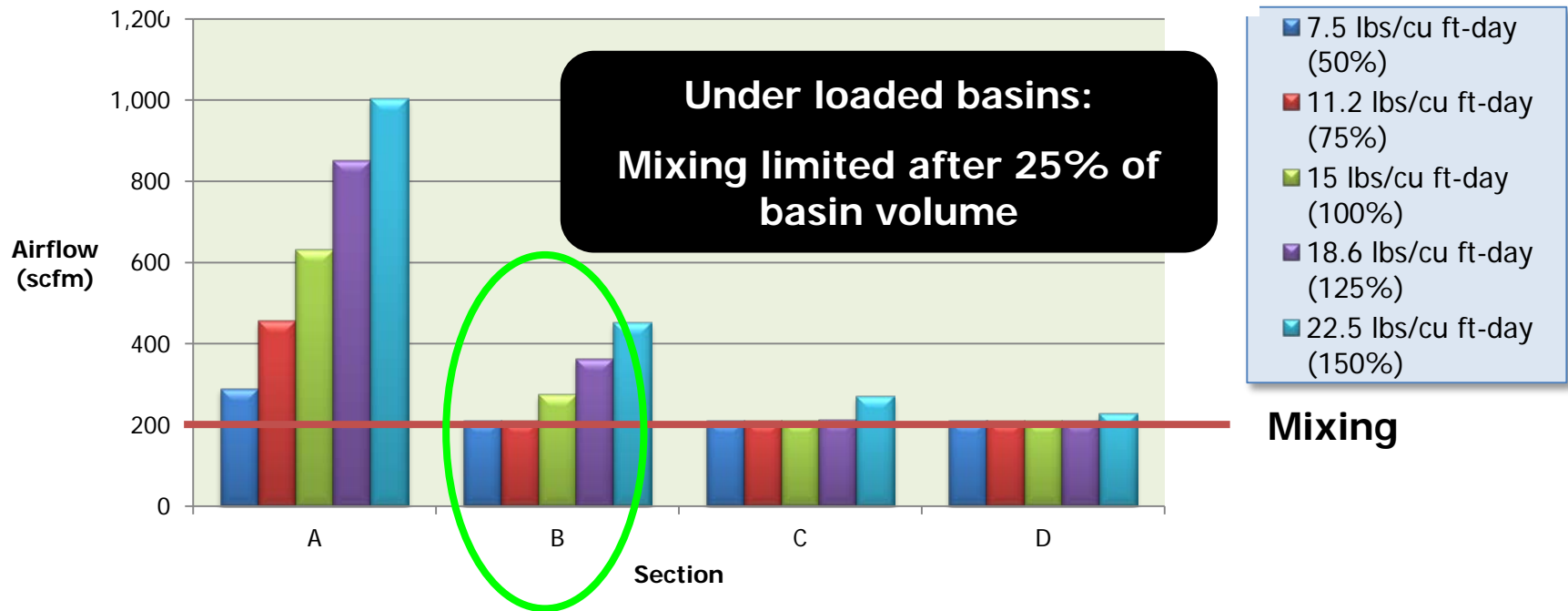
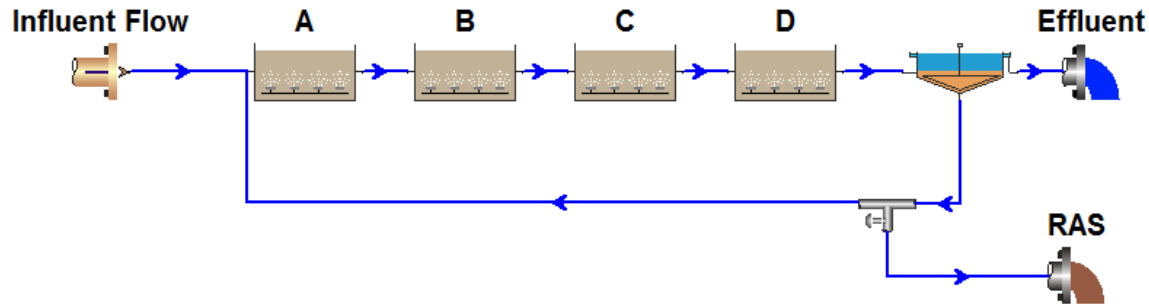
- 1 million gallon, four pass basin
- 12 day SRT
- 2 mg/L DO in all sections
- Influent: 200 mg/L BOD, 30 mg/L TKN
- How does loading rate impact airflow?



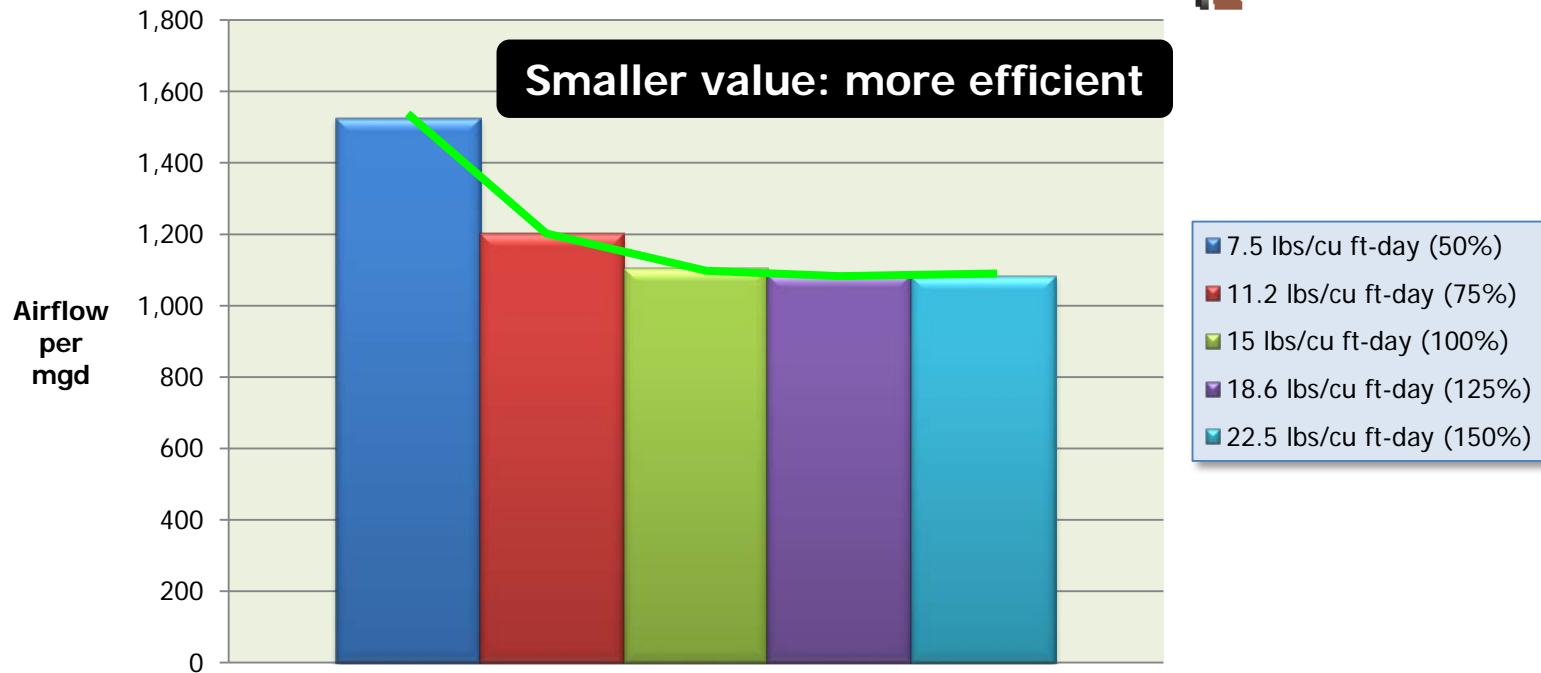
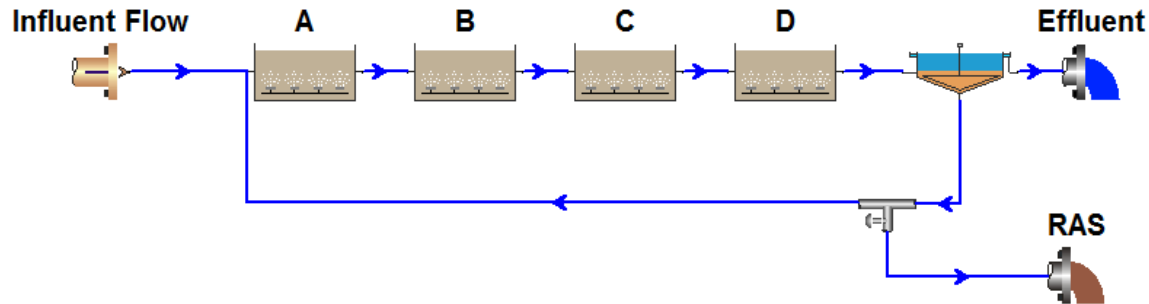
# Process and Mixing Air

- **10 States design loading**
  - BOD: 15 lbs/1000 cu ft-day
- **Mixing conditions**
  - Minimum airflow: 0.12 scfm/square ft tank area
- **Operation**
  - Typically less than design loading
  - 50%? 75%?

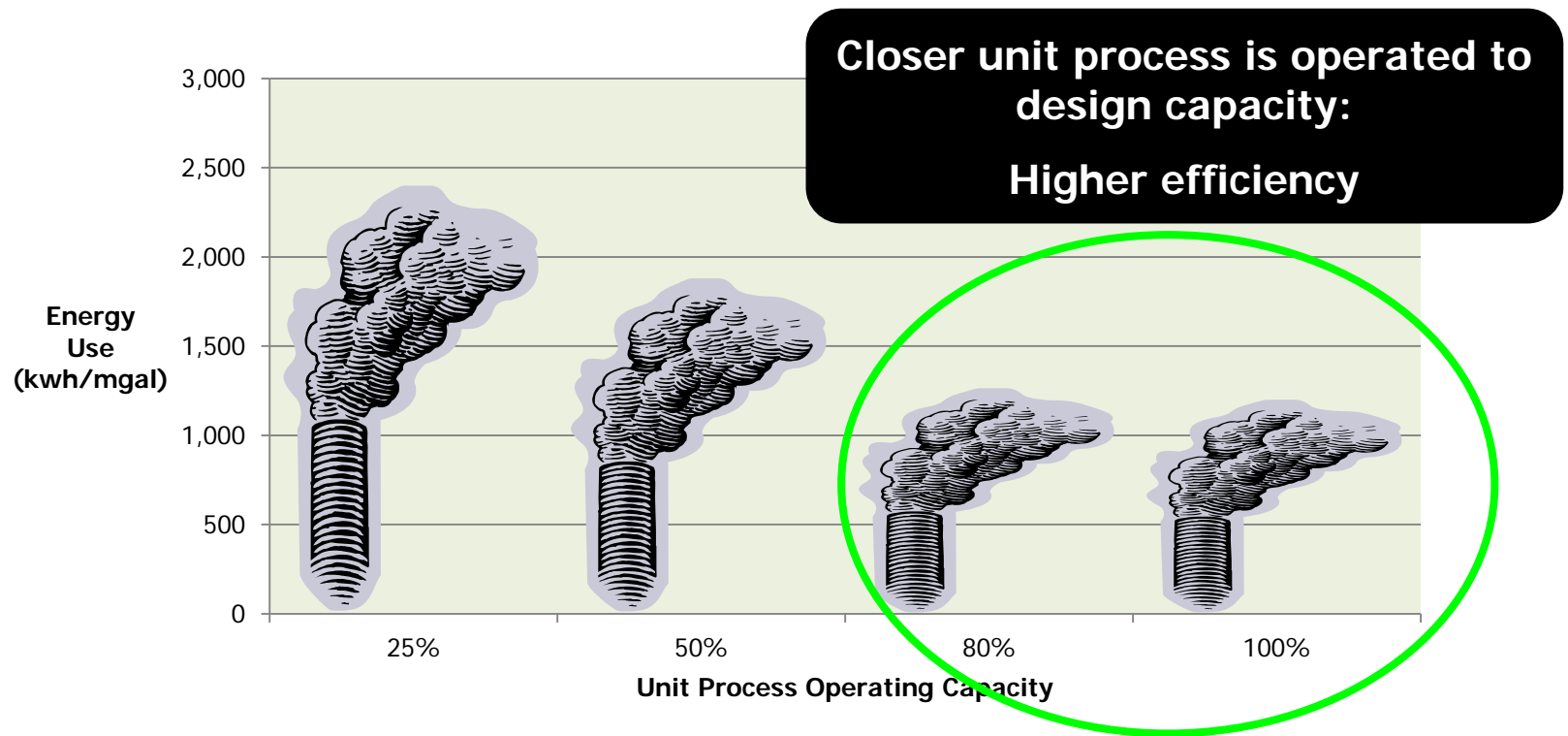
# Process and Mixing Airflow



# Process and Mixing Airflow



# Operational Flexibility

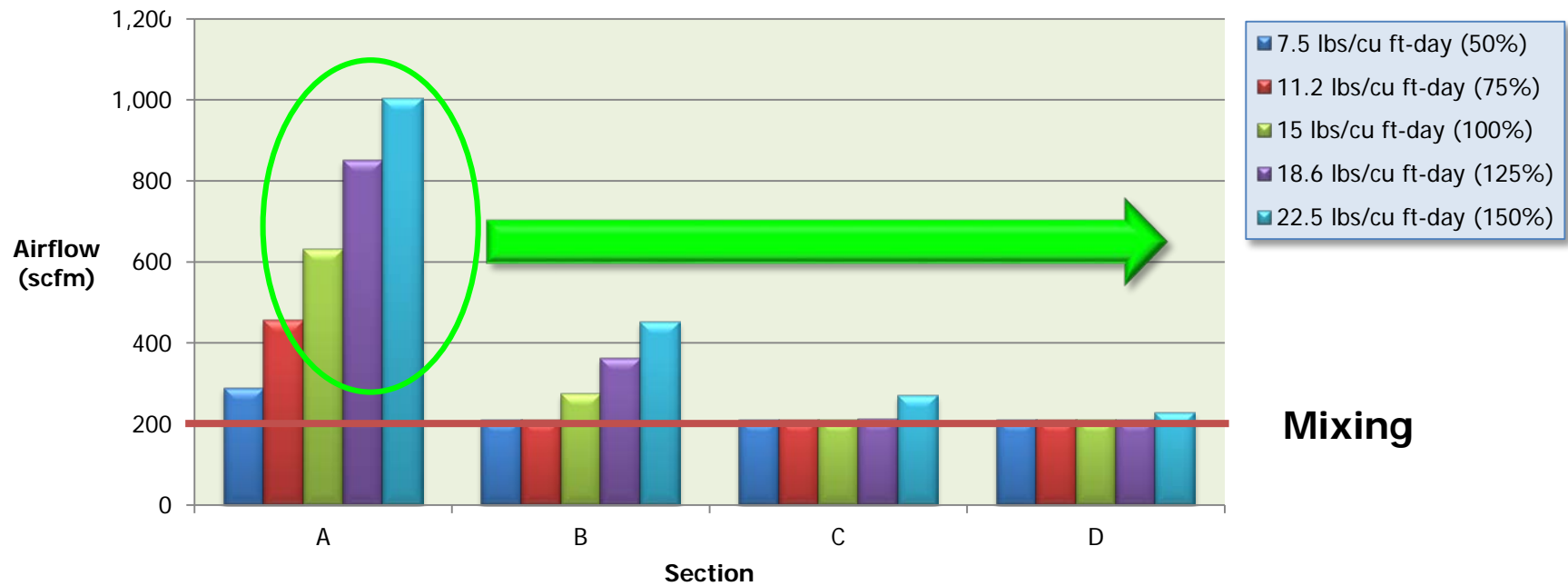
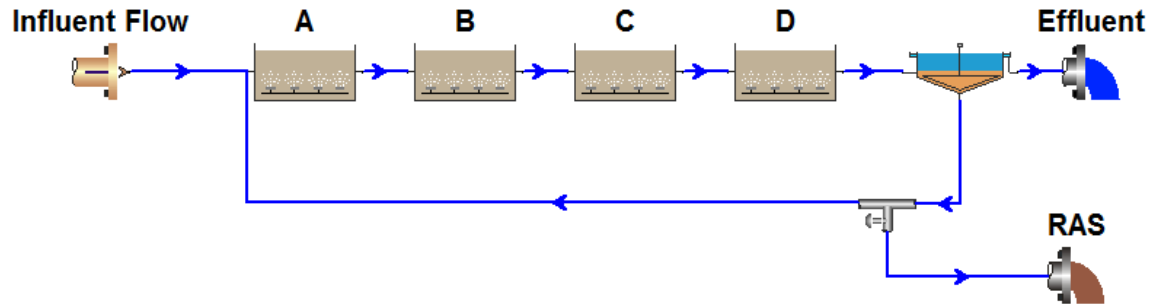


Source: WERF Energy Fact Sheet, 2011

# Process and Mixing Airflow

- **What does this mean??**
- **Efficient aeration:**
  - process air > mixing air
  - In as much of aeration basin as possible
- **Thought 1: Multi-pass basins to match load**
- **Thought 2: “Spread” load through basin**

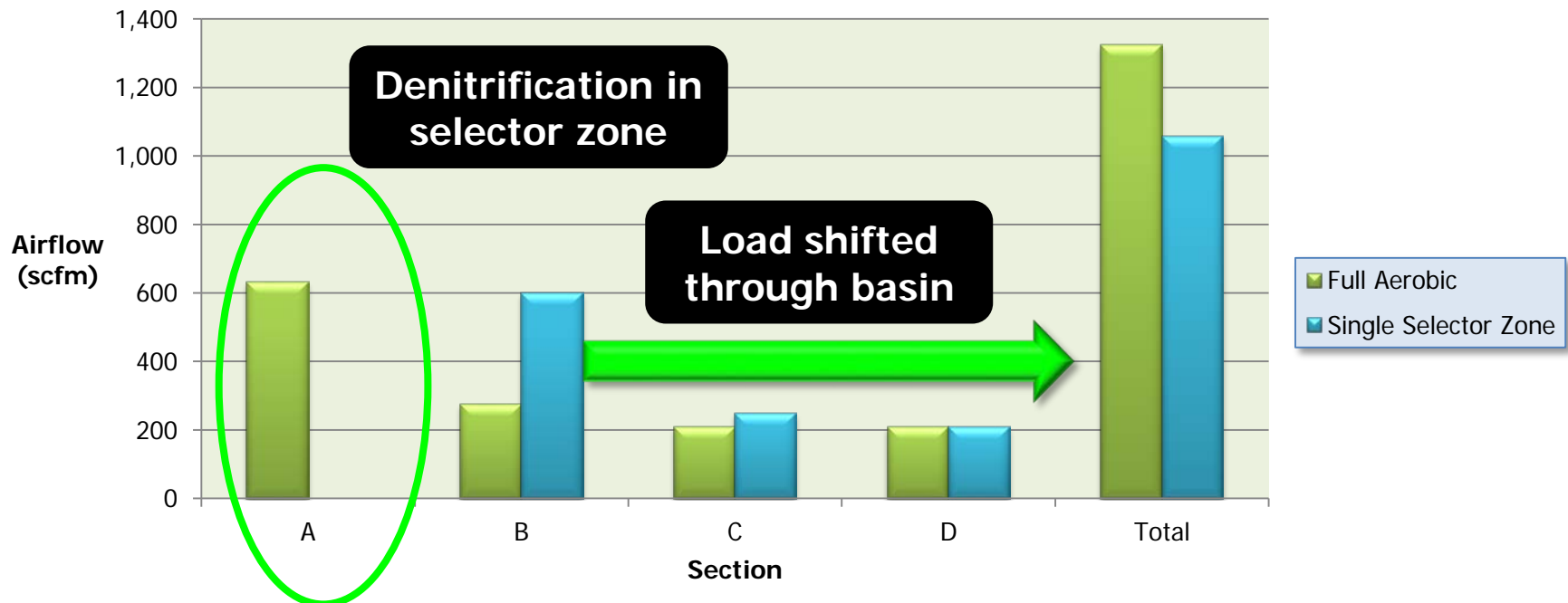
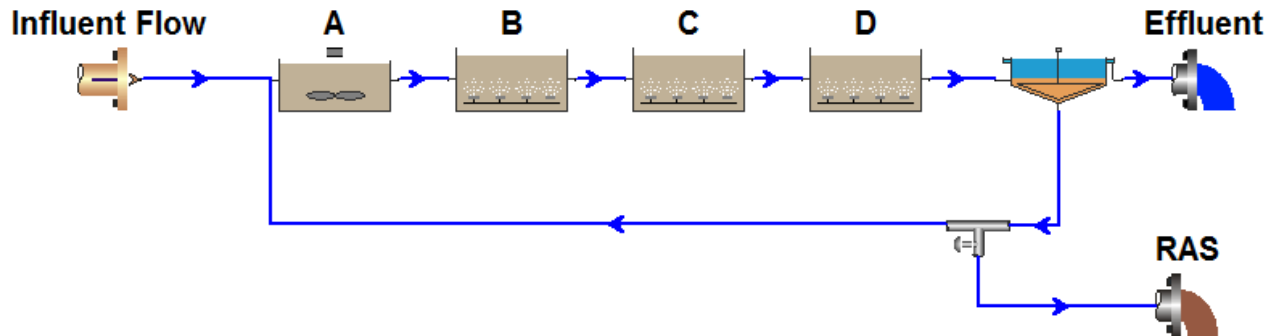
# Spreading the Load



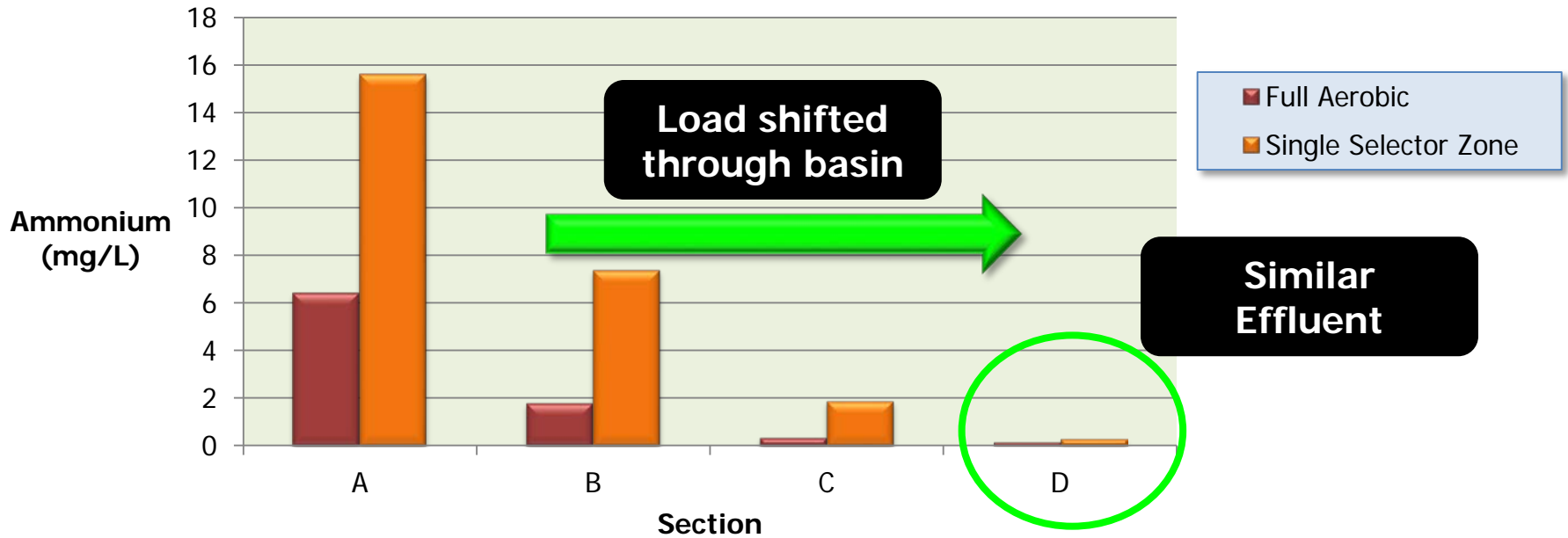
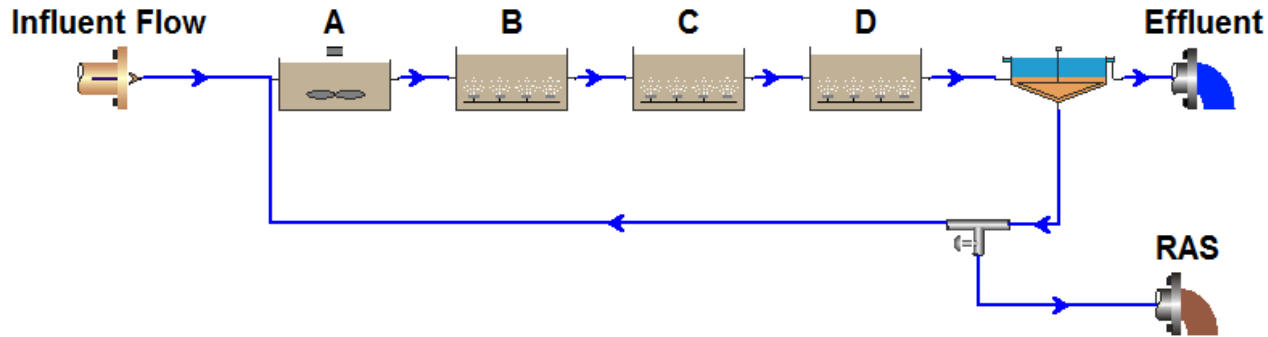
# Spreading the Load

- **Operational flexibility**
  - Operate closer to design loading conditions
  - Turn on/off aeration basins
- **Selector zones**
  - Still achieve BOD removal
  - “Push” ammonium down aeration basin
- **DO setpoints**
  - Decreased DO setpoints
  - Ammonium based DO control

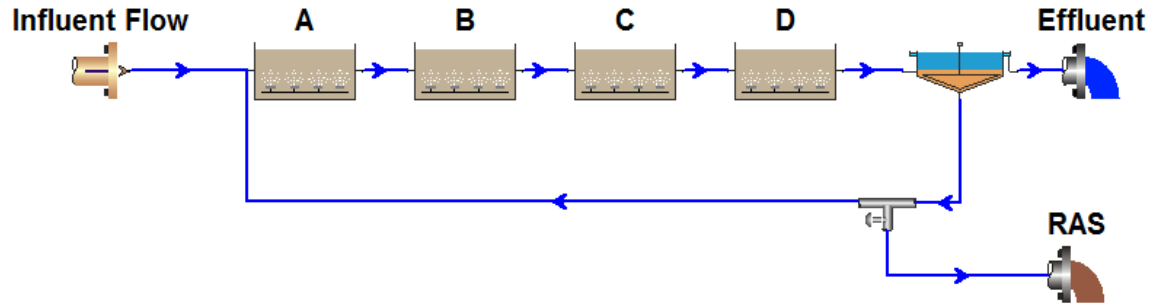
# Selector Zone Impact



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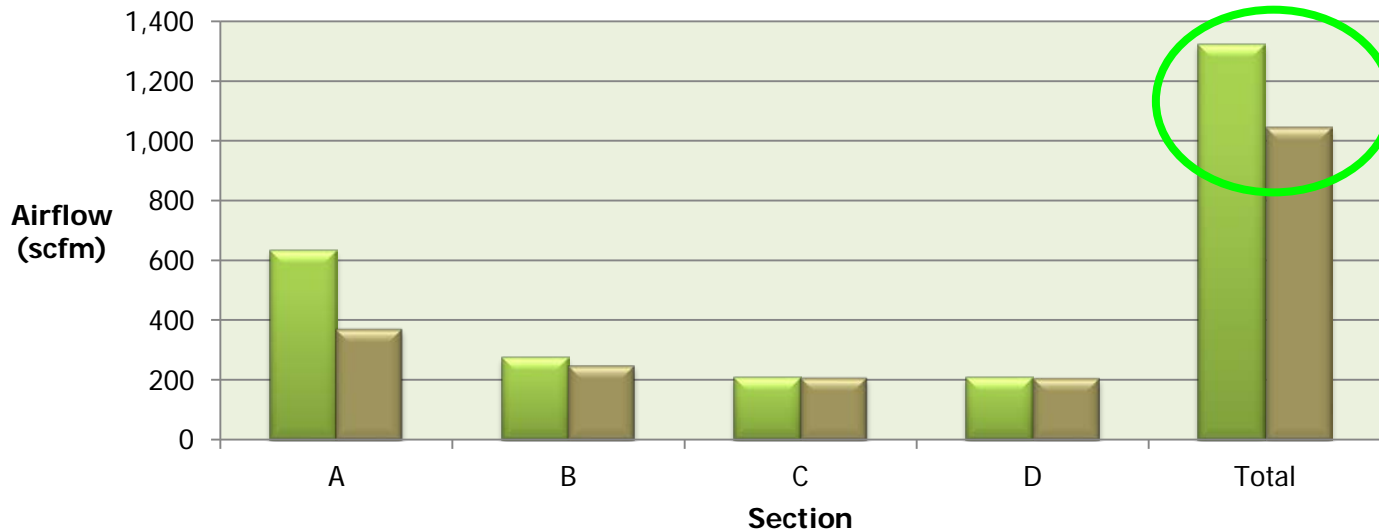
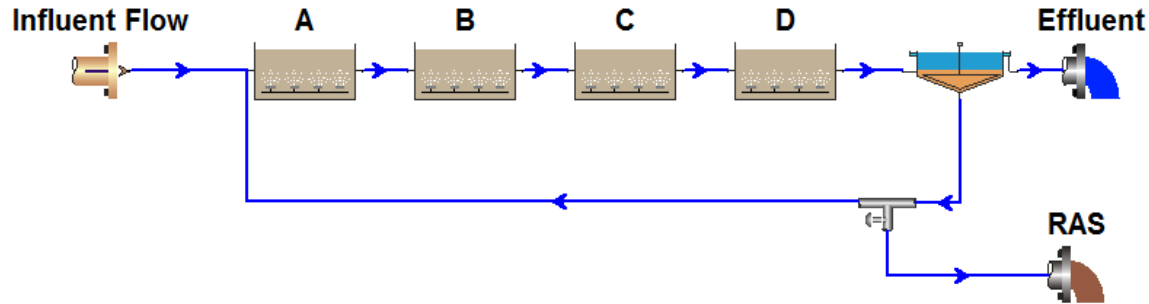


# DO Setpoint Impact



	A	B	C	D	
Baseline	2.0	2.0	2.0	2.0	mg/L
Low DO	1.0	1.0	2.0	2.0	mg/L

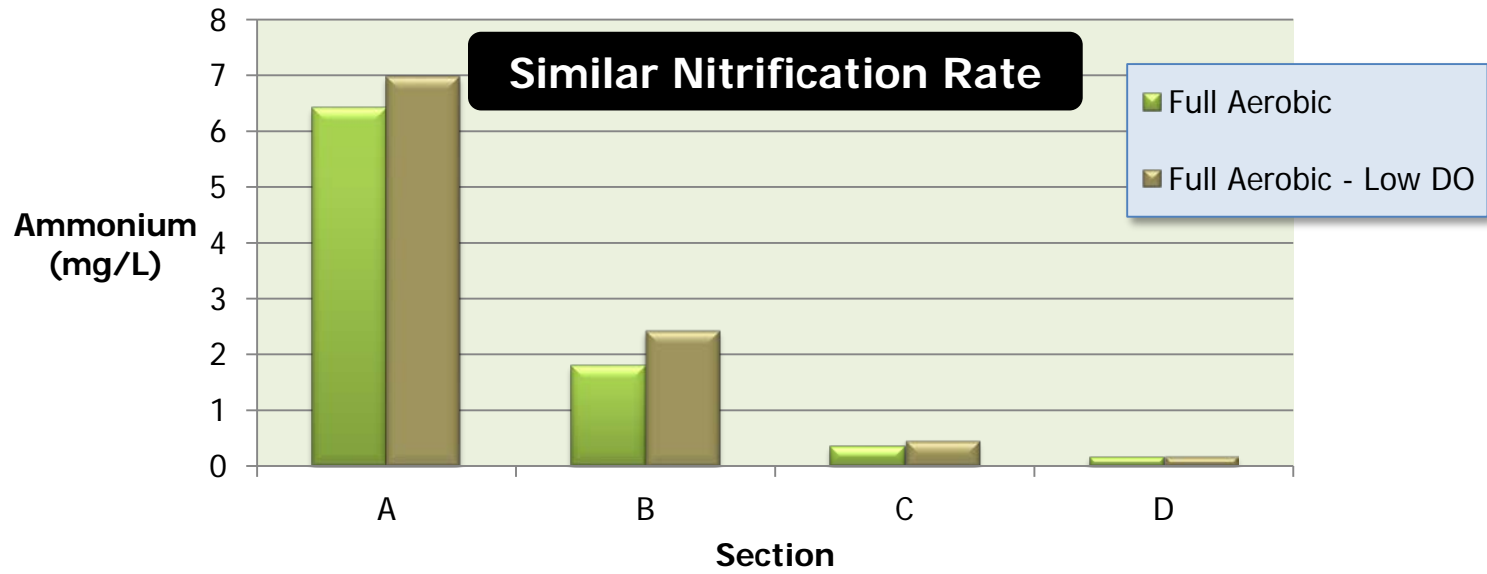
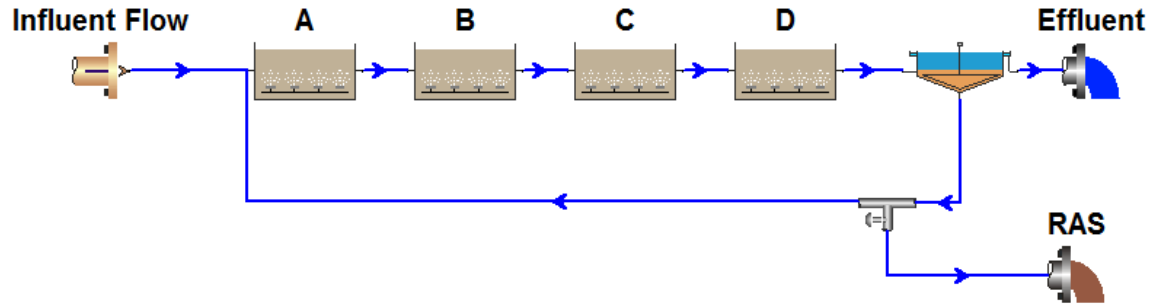
# DO Setpoint Impact



**Reduced Airflow**

- Full Aerobic
- Full Aerobic - Low DO

# DO Setpoint Impact

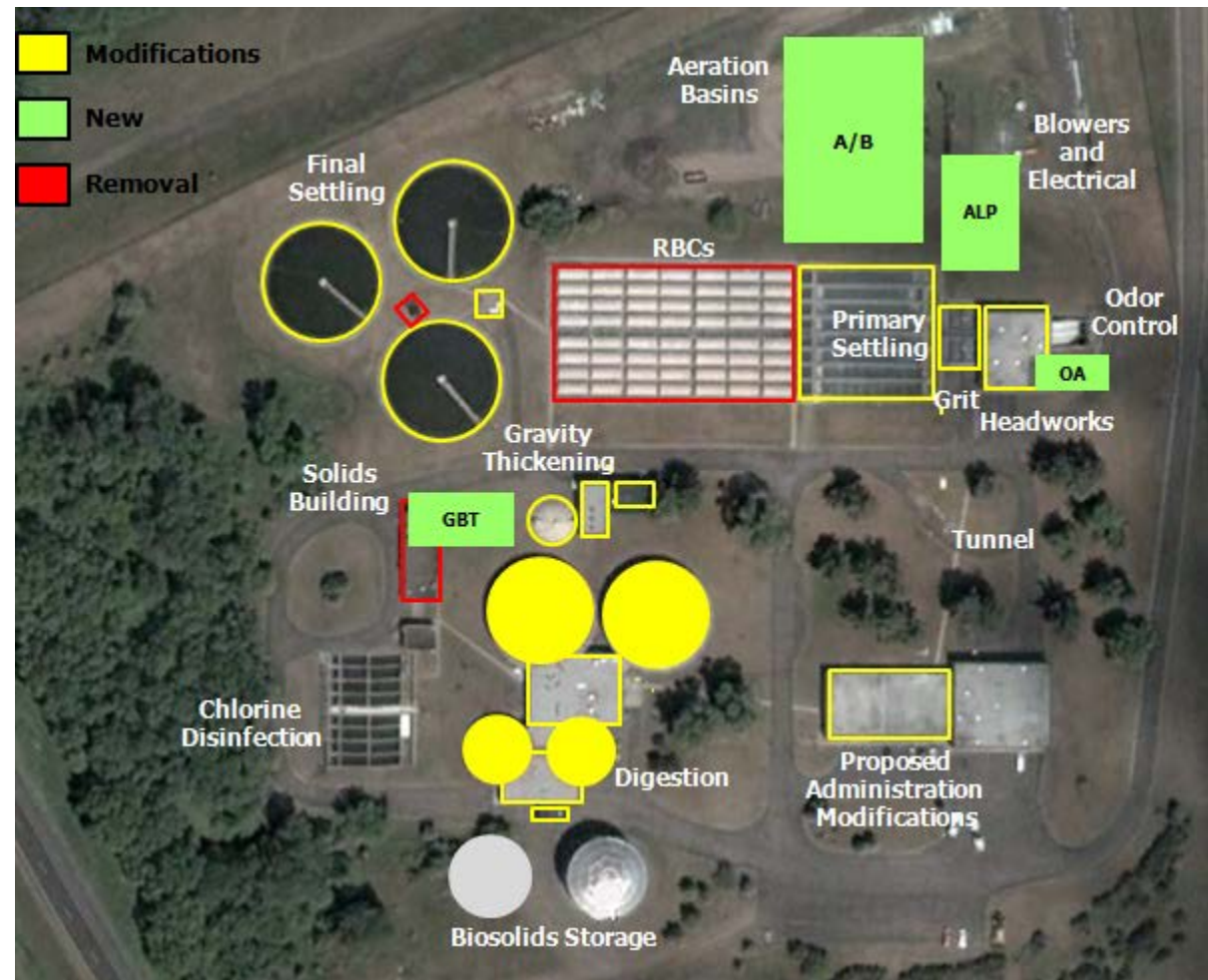


# Accomplishing Efficient Aeration

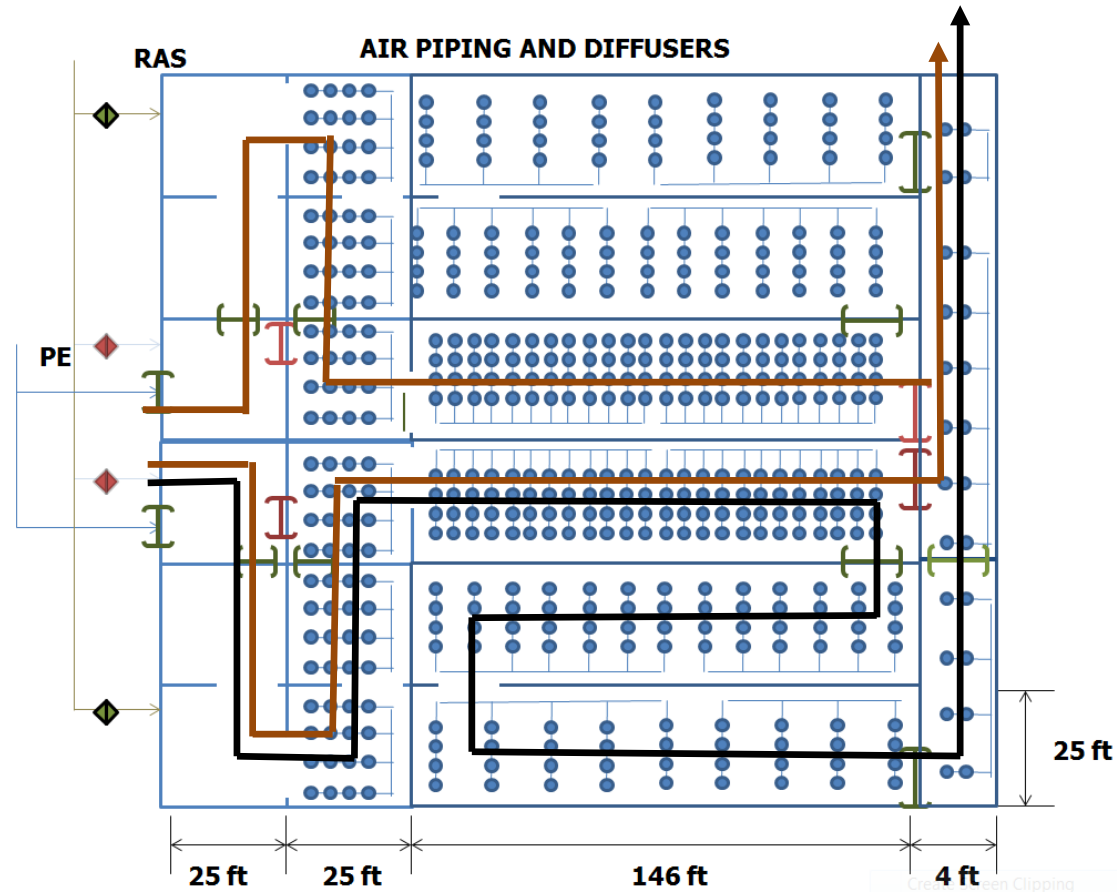
- Operational flexibility in design
- Low DO operation
- DO control and level of control

# Eau Claire, WI

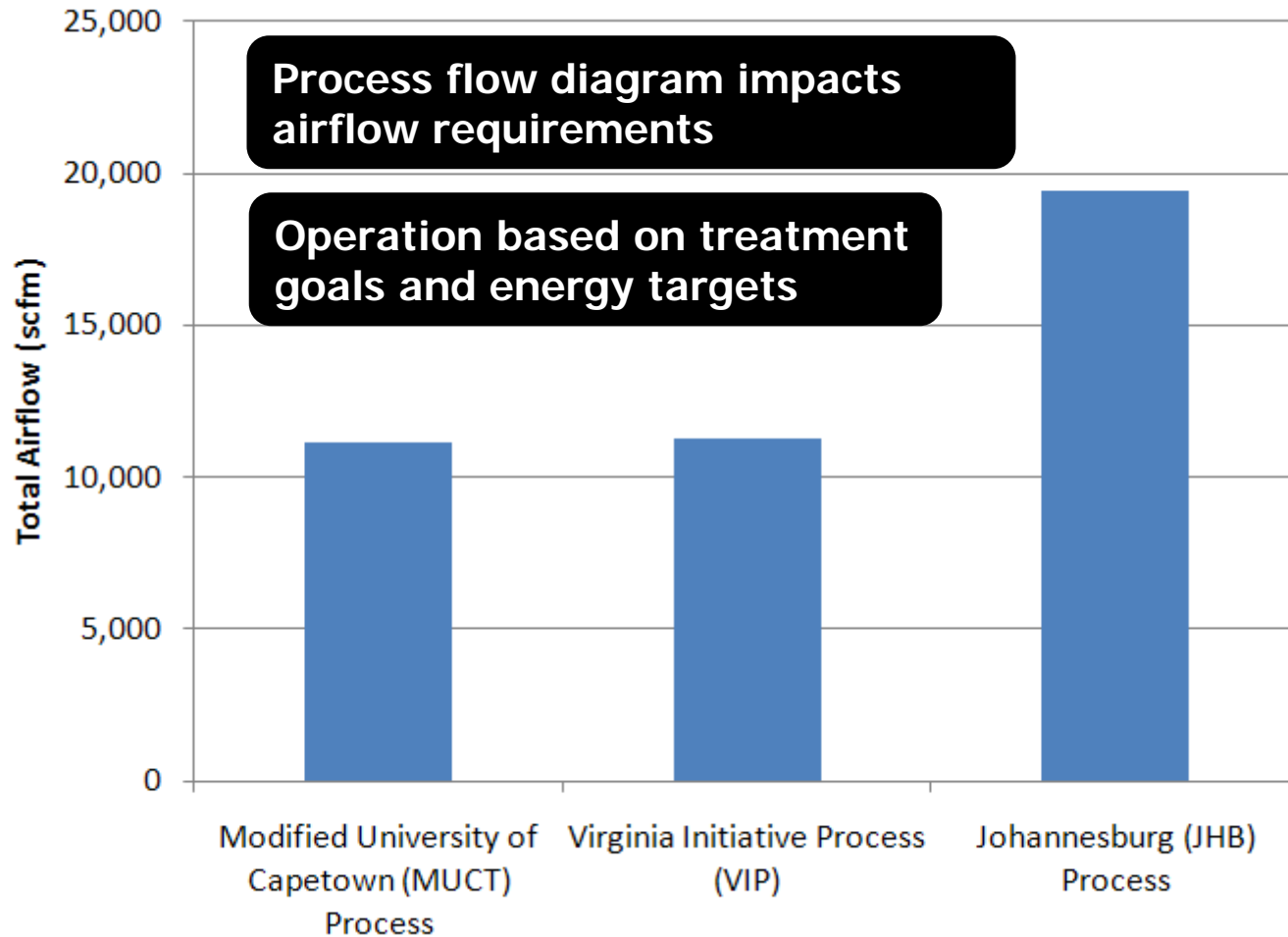
- Currently under construction
- New aeration basins and blowers



# Aeration Basin Flexibility



# Impact on Airflow

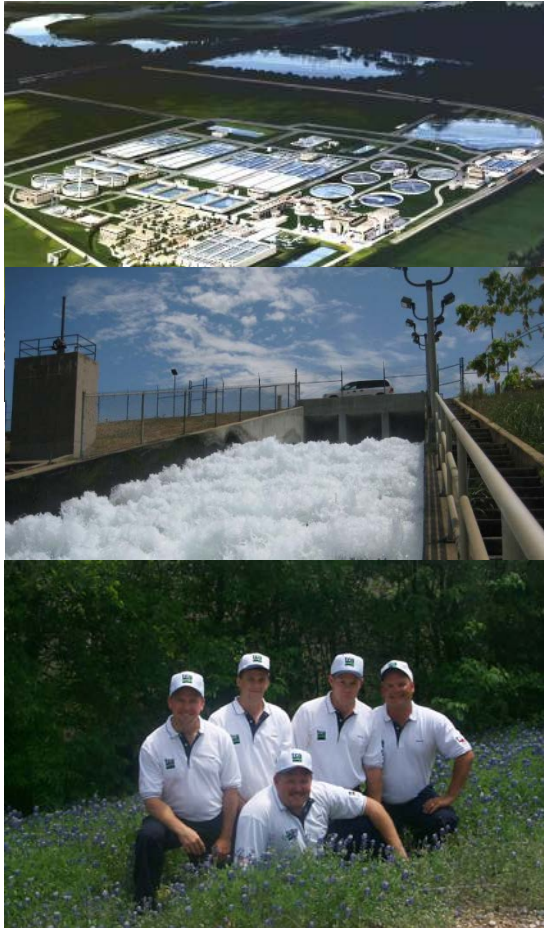


# Aeration Basins

- More to come at a future conference...



# Trinity River Authority of Texas



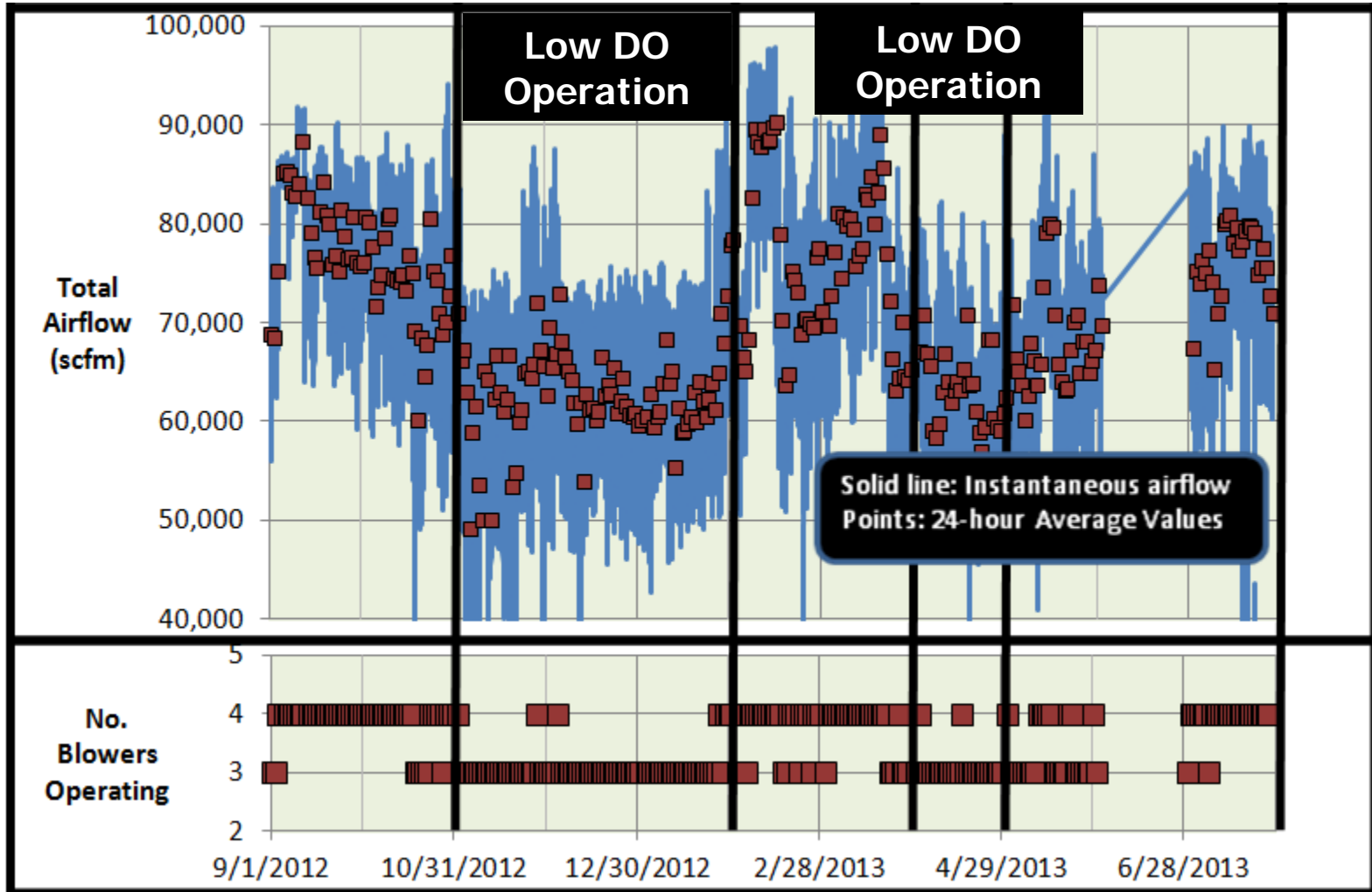
- **TRA CRWS Treatment Plant**
  - North Texas
  - 189 mgd average day flow
- **Single stage nitrification (SSN)**
- **Full scale impact of low DO and selector zones**

# Ammonia Based DO Control

- **Nine Aeration Basins in Operation**
  - AB 6: Selector zone for BNR = A/O Low DO
  - AB 12: SSN Low DO
  - AB 1-3, 4, 5, 10, 11: SSN Tapered Aeration



# Full Scale Testing



# Impact on Blowers

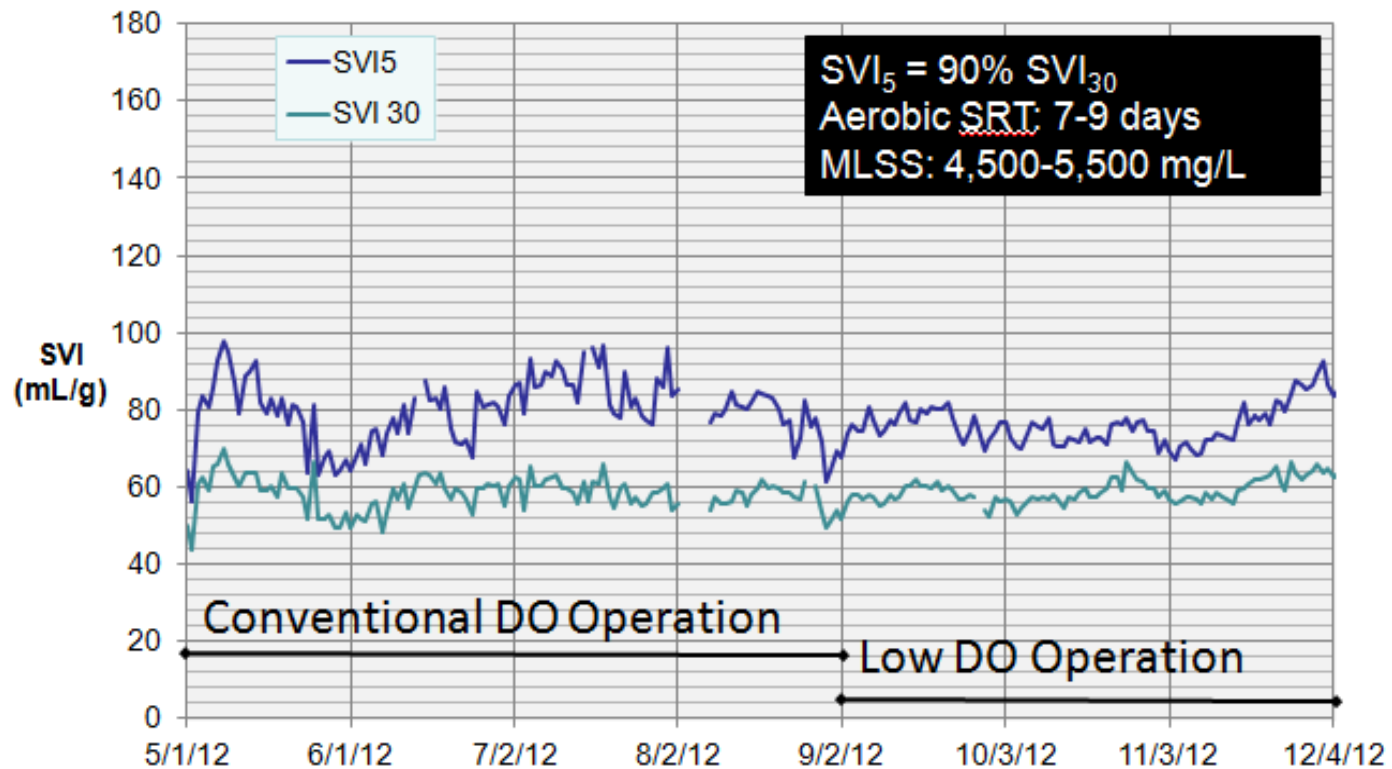
- **Historic operation:**
  - 4 blowers
  - 1,200 horsepower each
  - Guide vanes
  - Total energy: 3,800 hp
- **Current operation**
  - 3 blowers
  - 1,200 horsepower each
  - Total energy: 2,800 hp



**30% Energy Reduction**

# Impact on Settling

- Low DO operation started mid-Sept. 2012



# New Lenox, II

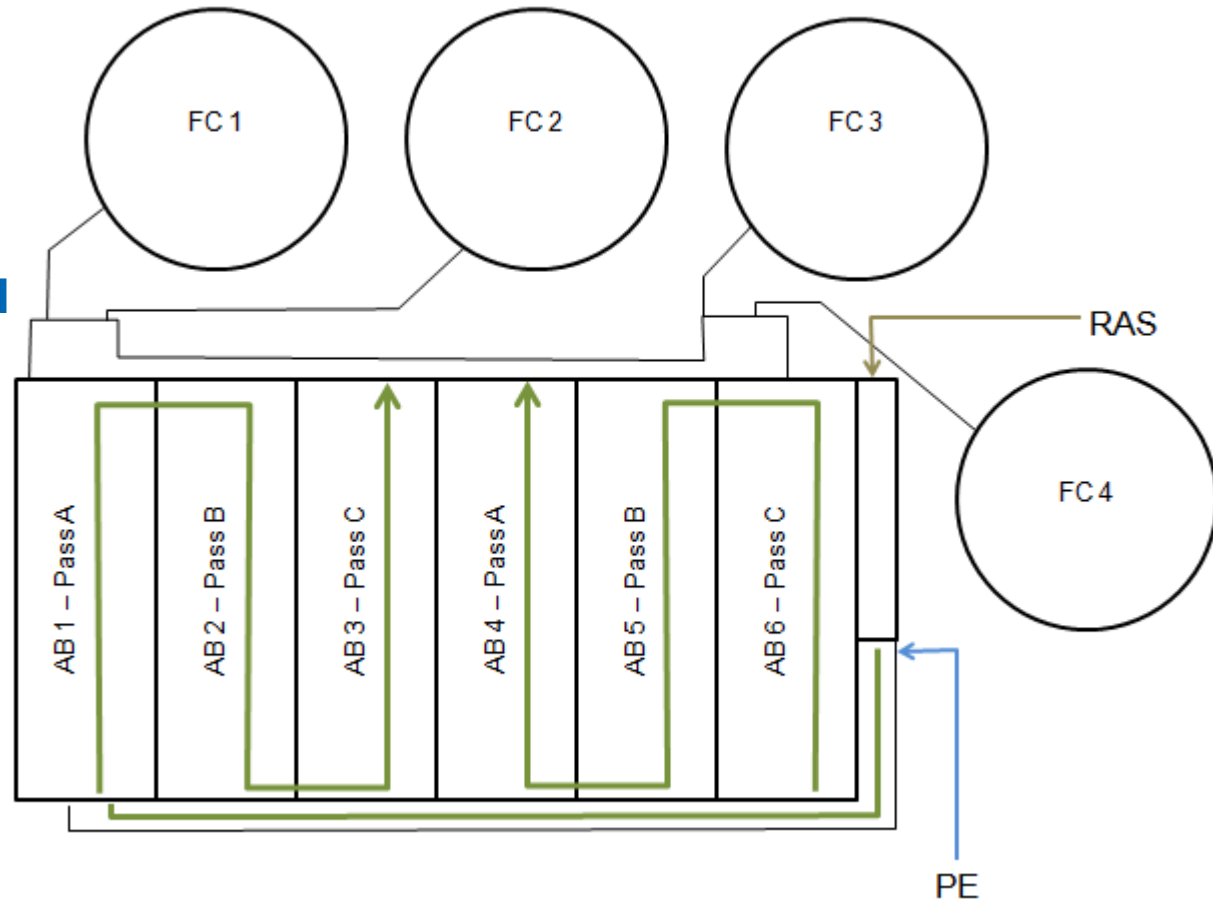


- STP No. 1: 2.5 mgd, nitrification facility
- Nutrient removal improvements currently under construction
- Aeration improvements included
  - Existing blowers: single speed, multi-stage centrifugal
  - No DO control
- How much DO control?



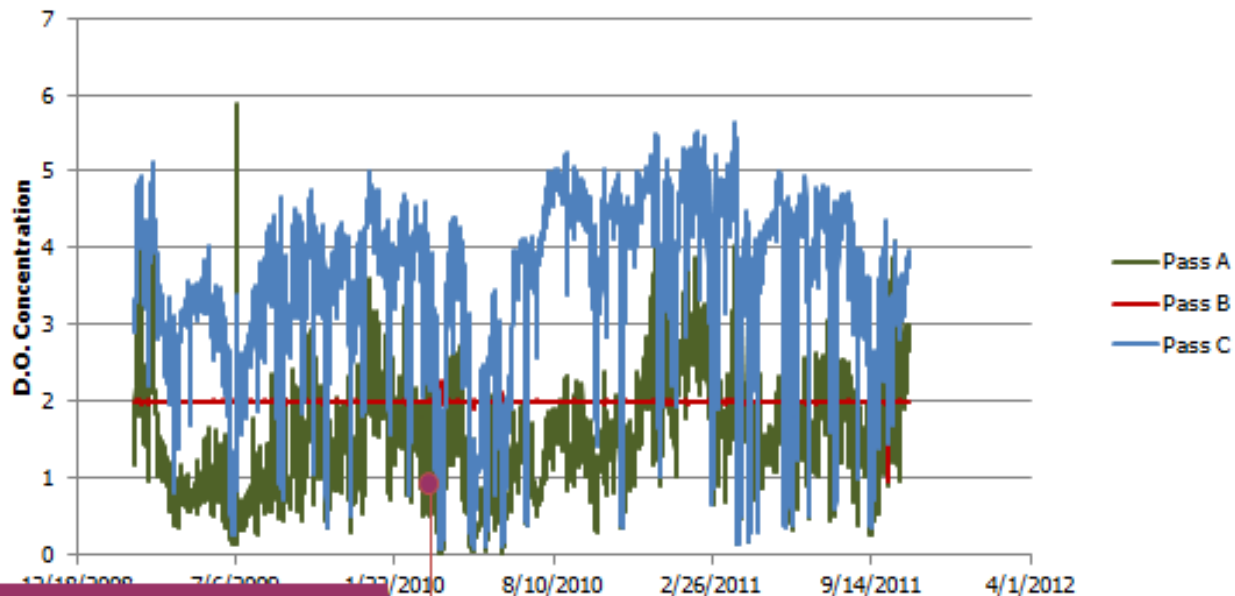
# New Lenox II

- Option 1 – No Auto Control
- Option 2 – Full Control
- Option 3 – Control B+C
- Option 4 – Control A
- Option 5 – Control B
- Option 6 – Control C



# Impact on DO Concentrations

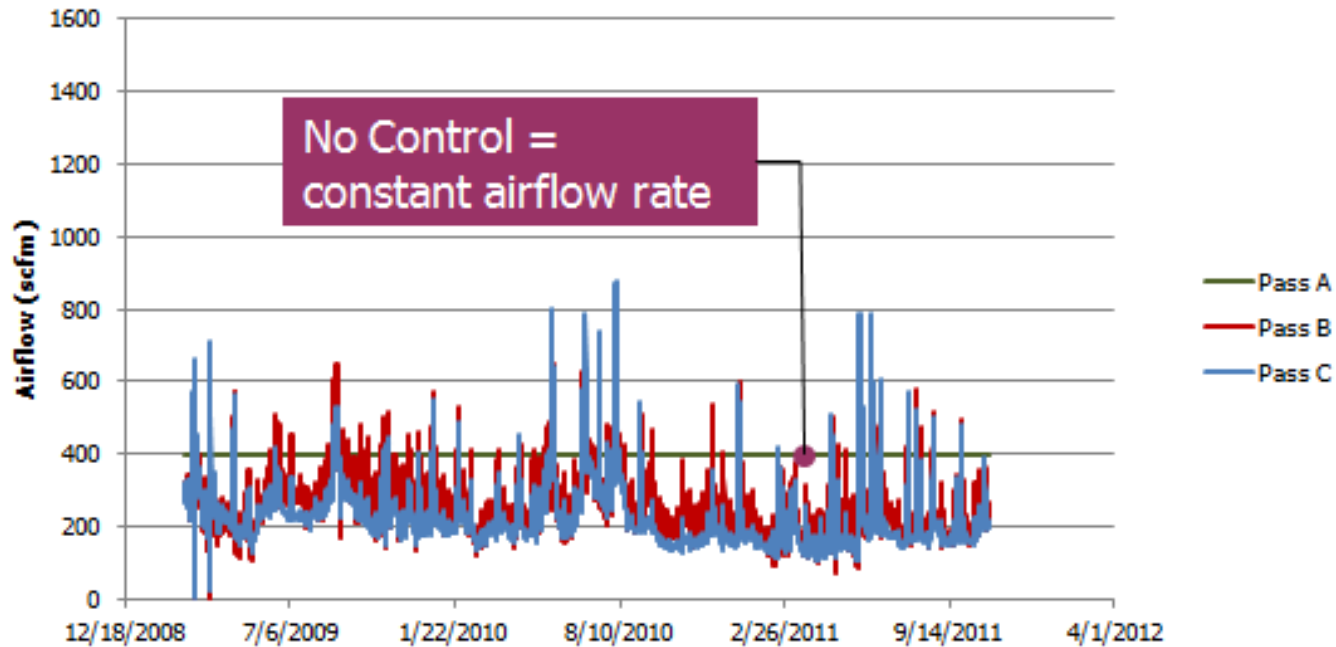
- DO Profile – Option 5 (Control B)



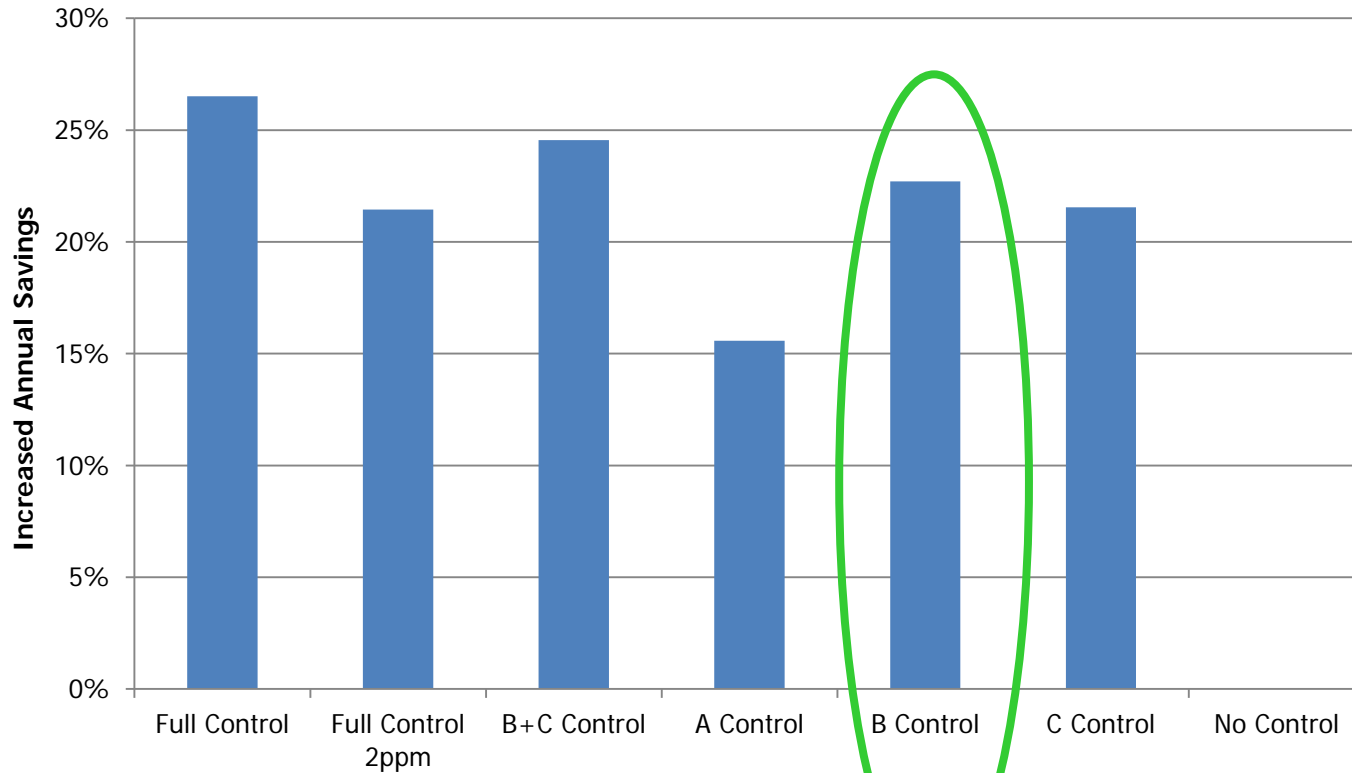
Model does not account for manual adjustments

# Impact on Airflow Rates

- Option 3 –Control B+C



# Annual Savings



**High savings, lowest capital (fewest control points)**

# Take Home Messages

- **Operate close to design capacity**
- **Selector zones:**
  - Reduced aerobic load
  - Utilize mixing air for process air
- **DO control**
  - Lower DO setpoints
  - Cost/benefit analysis on number of control points

# Questions?

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