AquaPASS®
Phased Activated Sludge System

Mark P. Hughes, P.E.
Product Manager – Biological Processes

Agricultural

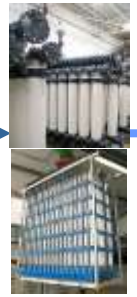
Industrial and Residential Reuse

Influent

Screening and grit for disposal

Biological Processes

Filtration



Membranes

Disinfection

Solids Handling

Direct Discharge

PRIMARY

SECONDARY

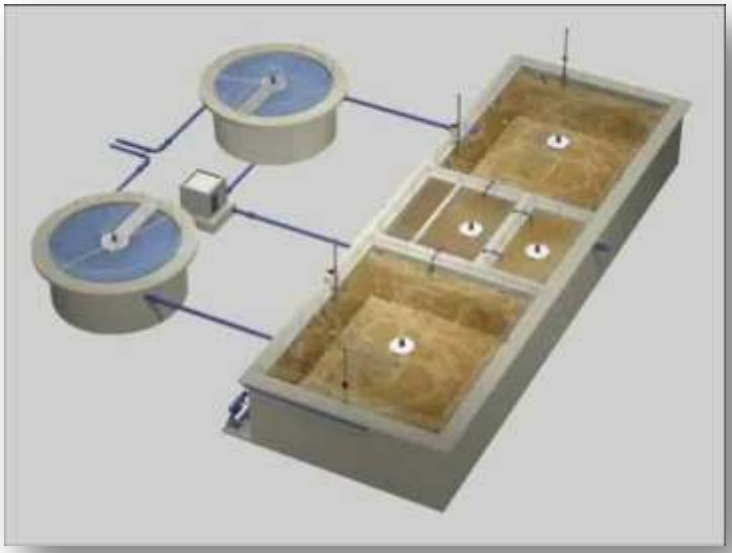
TERTIARY

Presentation Outline

- Definition of the AquaPASS® System
- Process Description of the AquaPASS® System
- Applications
- Process Comparisons/Advantages
- Summary

What is an AquaPASS® System?

- **P**hased **A**ctivated **S**ludge **S**ystem
- Continuous Flow, Activated Sludge
- Aqua MixAir® System
- Biological Nutrient Removal (BNR) Focus



Aqua MixAir® System

Aqua MixAir® System

Heart of Biological Systems

- Independent Mixing
  - AquaDDM® Mixer
  - AquaCAM-D®

- Independent Aeration
  - Diffused or surface aeration
  - Retrievable or fixed

Aqua MixAir® System

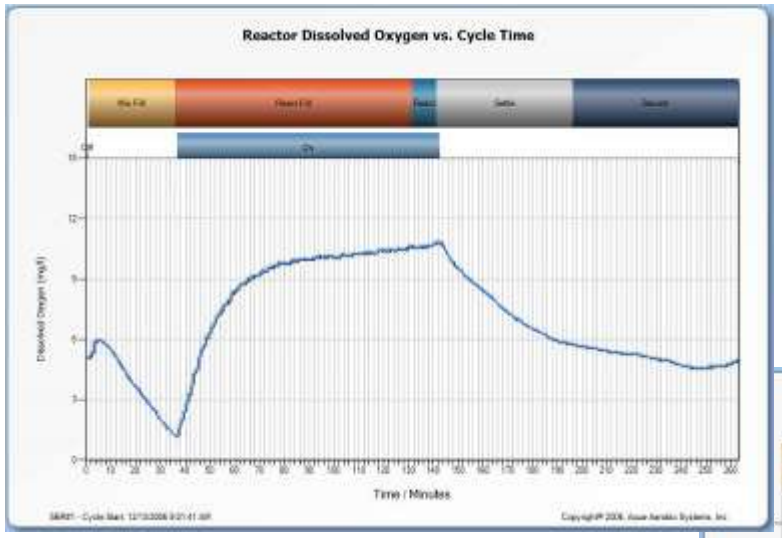
Biological Nutrient Removal

Aerobic Mixing (Nitrification)

Anoxic Mixing
(Denitrification and Power Savings)

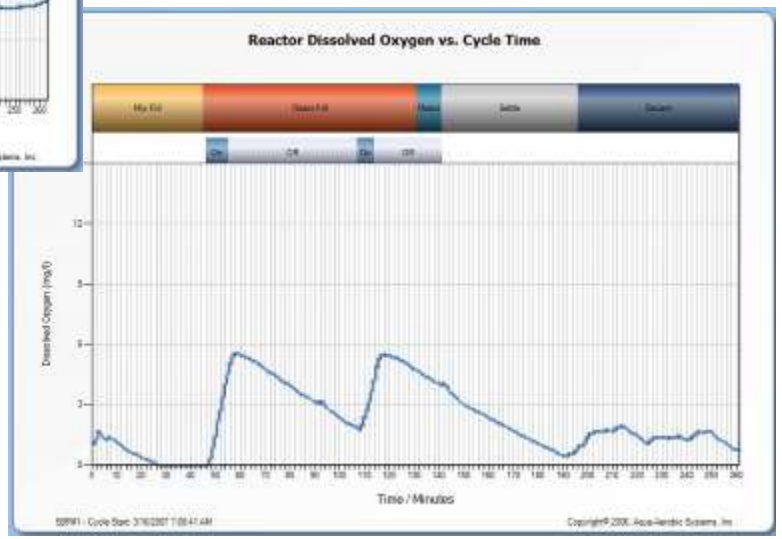
Aqua MixAir® System

Energy Control



"Significant power savings can be experienced with the Aqua MixAir® system"

"A 1 MGD plant could save $10,000 in the first year with the Aqua MixAir® system and proportional D.O. control"



Supplemental Carbon Addition

Aiding Denitrification

- Review of 40 AquaSBR® installations with effluent TN requirement of 10 mg/l or less.
  - 12% additional carbon
- Literature review of 20 flow-through BNR plants designed for 10mg/l or less.
  - 65% add additional carbon

Supplemental Carbon Addition

Plant Name	Design Effluent TN (mg/l)	Carbon Addition	% of Design Load BOD	Design C:N Ratio	Current C:N Ratio (no Carbon)	Current C:N Ratio (w/ Carbon)	Carbon Added (lbs/day)
Big Coppitt, FL	3	No	19.9%	4.03	1.63	1.63	N/A
Boonsboro,MD	3	No	42.5%	4.76	4.01	4.01	N/A
Key Largo, FL	3	Yes	31.5%	5.00	4.69	4.90	86.7
Mashantucket, CT	3	No	17.9%	3.60	6.12	6.12	N/A
Millville, FL	3	No	60.2%	3.89	8.31	8.31	N/A
Huntington, NY	4	Yes	66.8%	4.50	4.03	4.20	104.1
Lee, MA	6	No	42.3%	5.80	6.48	6.48	N/A
Dale Service Section 1, VA	8	Yes	47.1%	4.41	4.00	4.71	891.7
Dale Service Section 8, VA	8	Yes	47.1%	4.41	4.00	5.03	1,288.0

C:N Ratio from 1.63-8.31 with and without carbon addition

Supplemental Carbon Addition

Flow-Through Systems

Plant Name	Design Effluent TN (mg/l)	Carbon Addition	Current C:N Ratio (no Carbon)	Current C:N Ratio (w/ Carbon)	Carbon Added (lbs/day)	Process
Alexandria Renew WRF, VA	3	Yes	5.5	7.8	12028.2	5 Stage Bardenpho
Central Johnston, NC	3.7	Yes	Unknown	10	Unknown	Activated Sludge with denite filter
Clark County, NV	5.8	No	5.5	5.50	N/A	A/O
Clearwater, FL	3	No	6.7	6.7	Unknown	Bardenpho
Crowders Creek WWTP	6	Yes	Unknown	Unknown	1200.0	A^2O
Easton WWTF, MD	4	Yes	Unknown	Unknown	62.8	Oxidation Ditches configured as 5 Stage Bardenpho
Elkton WWTF, MD	3.8	No	Unknown	Unknown	120.1	Oxidation Ditch with Post-Anoxic and Re-aeration tanks.
Henrico County, VA	5	Yes	Unknown	7.90	Unknown	5 Stage Bardenpho
JD Phillips, CO	10	Yes	Unknown	Unknown	5343.5	A^2O - 3 stage
Kalispell, MT	4	No	5.7	5.70	N/A	Modified UCT
Kelowna, BC	4.38	No	5.3	5.3	Unknown	Westbank
Lee County, FL	3	Yes	Unknown	4	Unknown	Activated Sludge with denite filter
Long Creek WWTP	6	Yes	Unknown	Unknown	1660.0	A^2O
Lott WWTP, WA	10	Yes	Unknown	4.75	3616.4	4 stage bardenpho
MWRD RWHTF, CO	10	Yes	Unknown	Unknown	10000.0	MLE
Neuse River WWTP, NC	2.7	Yes	Unknown	Unknown	8917.1	4 Stage Bardenpho with denite filters
Noman M. Cole PCP, VA	5.25	No	5.40	5.40	N/A	Step Feed Activated Sludge and denite filter
North Cary, NC	3.94	No	4.3	4.3	Unknown	Oxidation Ditch
TP Smith WRF, FL	3	Yes	Unknown	Unknown	8818.0	4 Stage Bardenpho
Western Branch WWTP, MD	3	Yes	Unknown	13.90	Unknown	4 anoxic, 8 aerobic reactors

C:N Ratio > 4 required to meet effluent TN limits

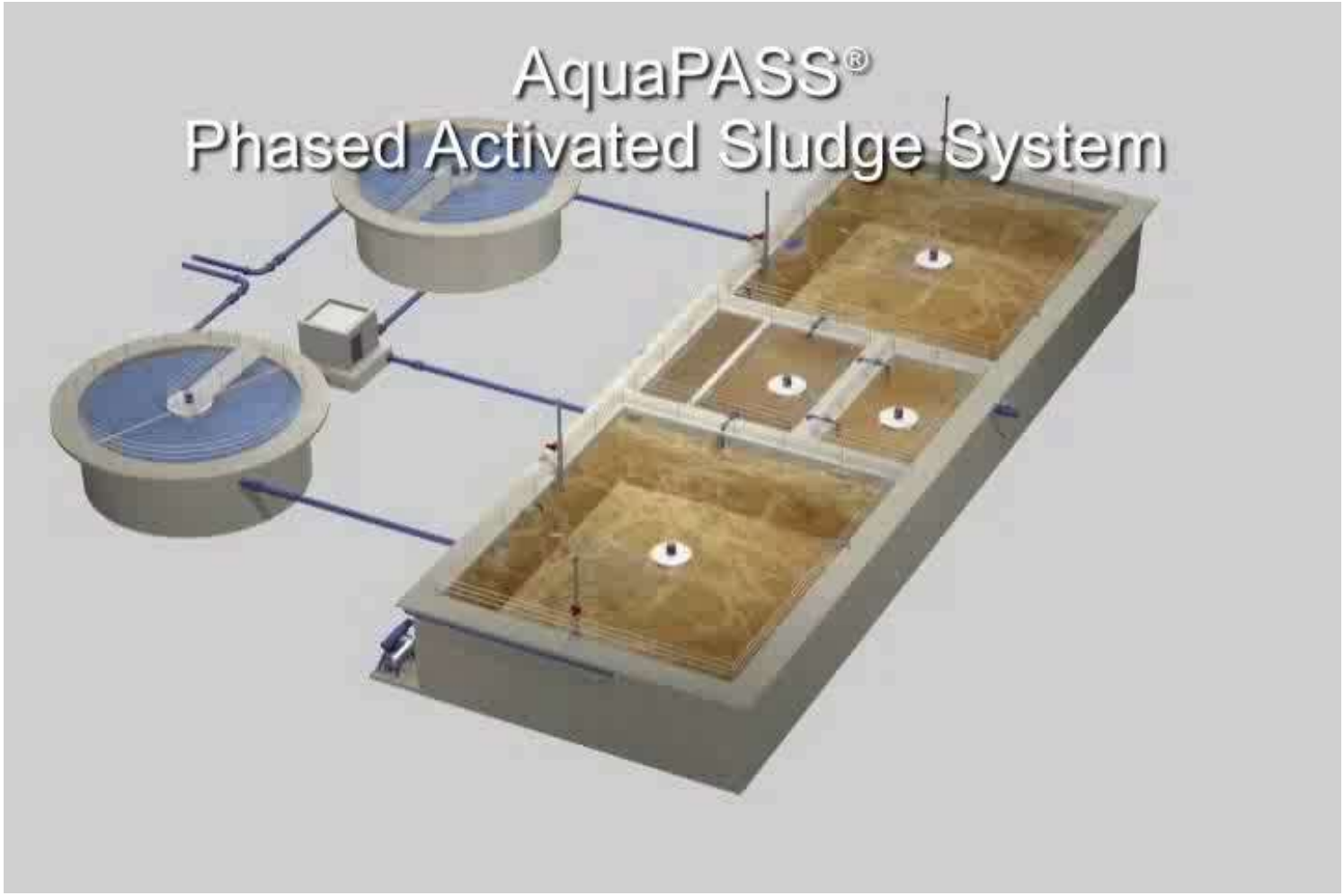
Aqua MixAir® System

Summary

- The Heart of Aqua-Aerobic Systems' Biological Process and Adaptive Design
- Advantages of Efficient Mixing
  - Process Control
  - Energy Savings
  - Carbon Savings
  - Improved Treatment (BNR) at Minimal Additional Cost

AquaPASS®
System Operation

AquaPASS® System Description



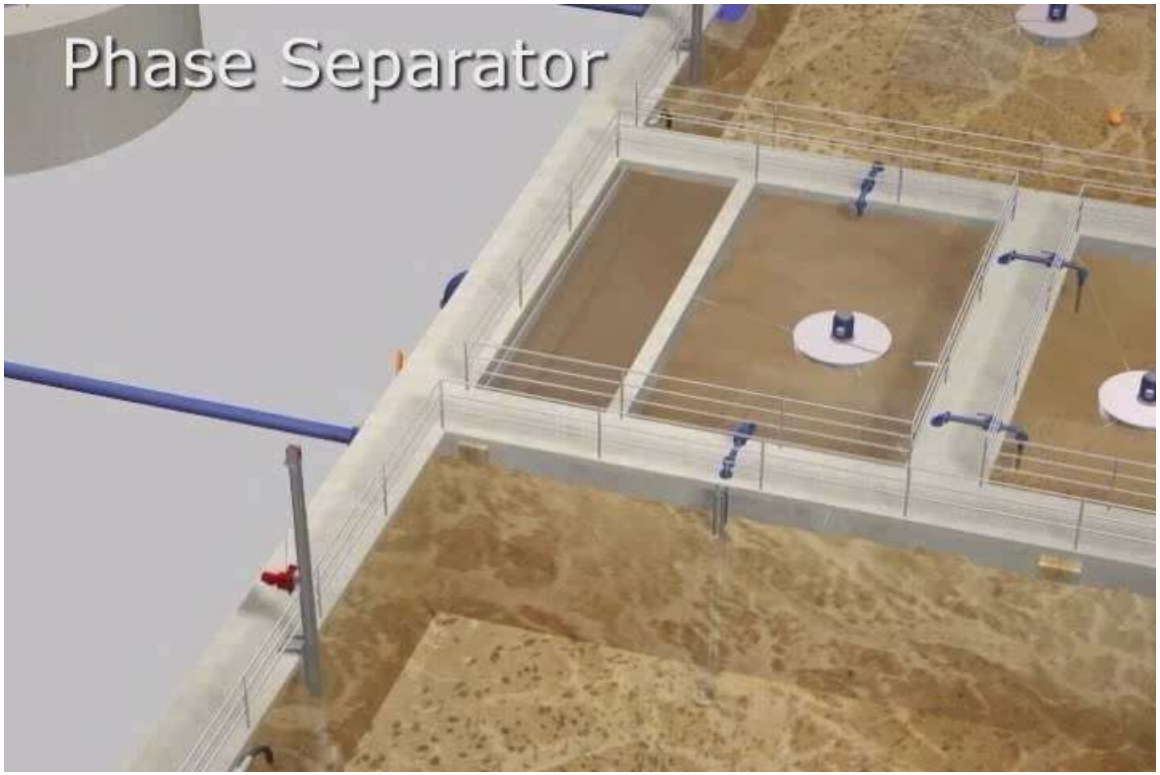
Step 1: Anaerobic Treatment

- Influent Combined With Thickened RAS
- D.O.= 0 mg/l & <3 mg/l NO_x-N
- HRT 0.5 – 1.5 Hours
- Complete Mix
- Bio-P Release
- Selector Basin

Step 2: Staged Aeration

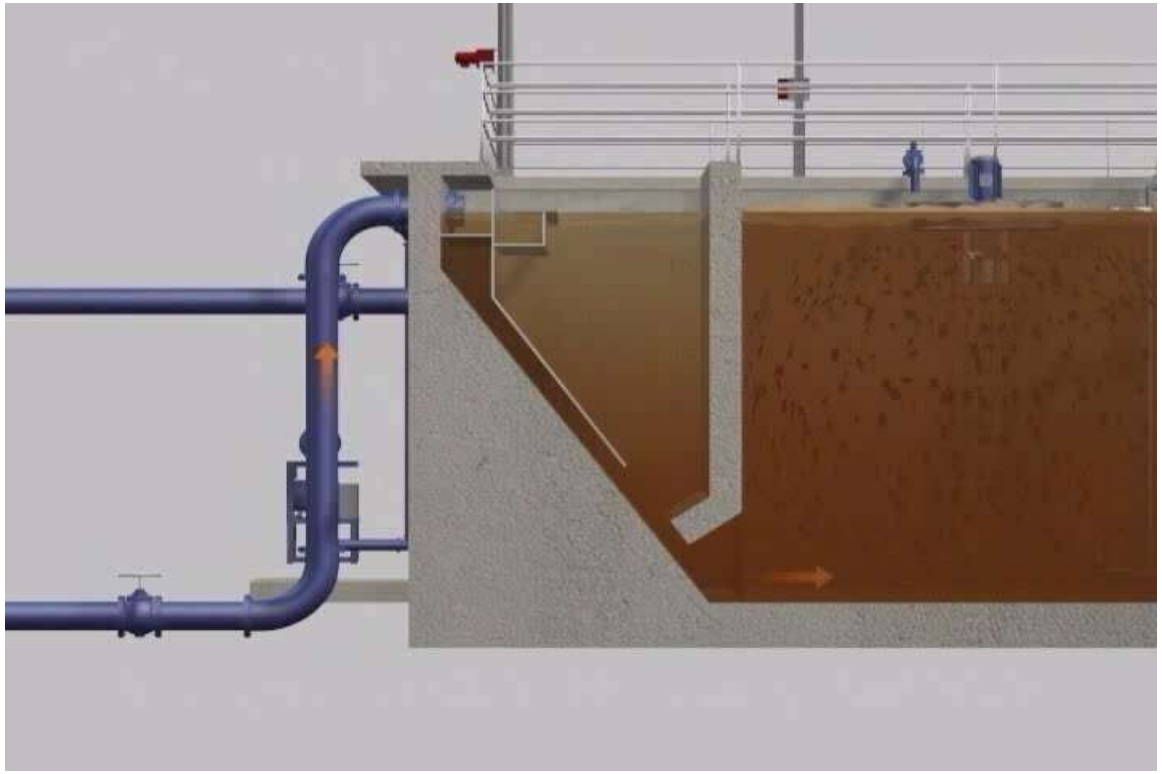
- Multi-Level Aeration Management
  - Aerobic and Anoxic Events
  - D.O Control

Step 3: Phase Separator



- RAS from Final Clarifier
- Typical HRT 0.5 Hours
- RAS Concentrated 20% – 50%
- Supernatant Transferred to Staged Reactors
- Thickened Sludge to Pre-Anoxic Reactor

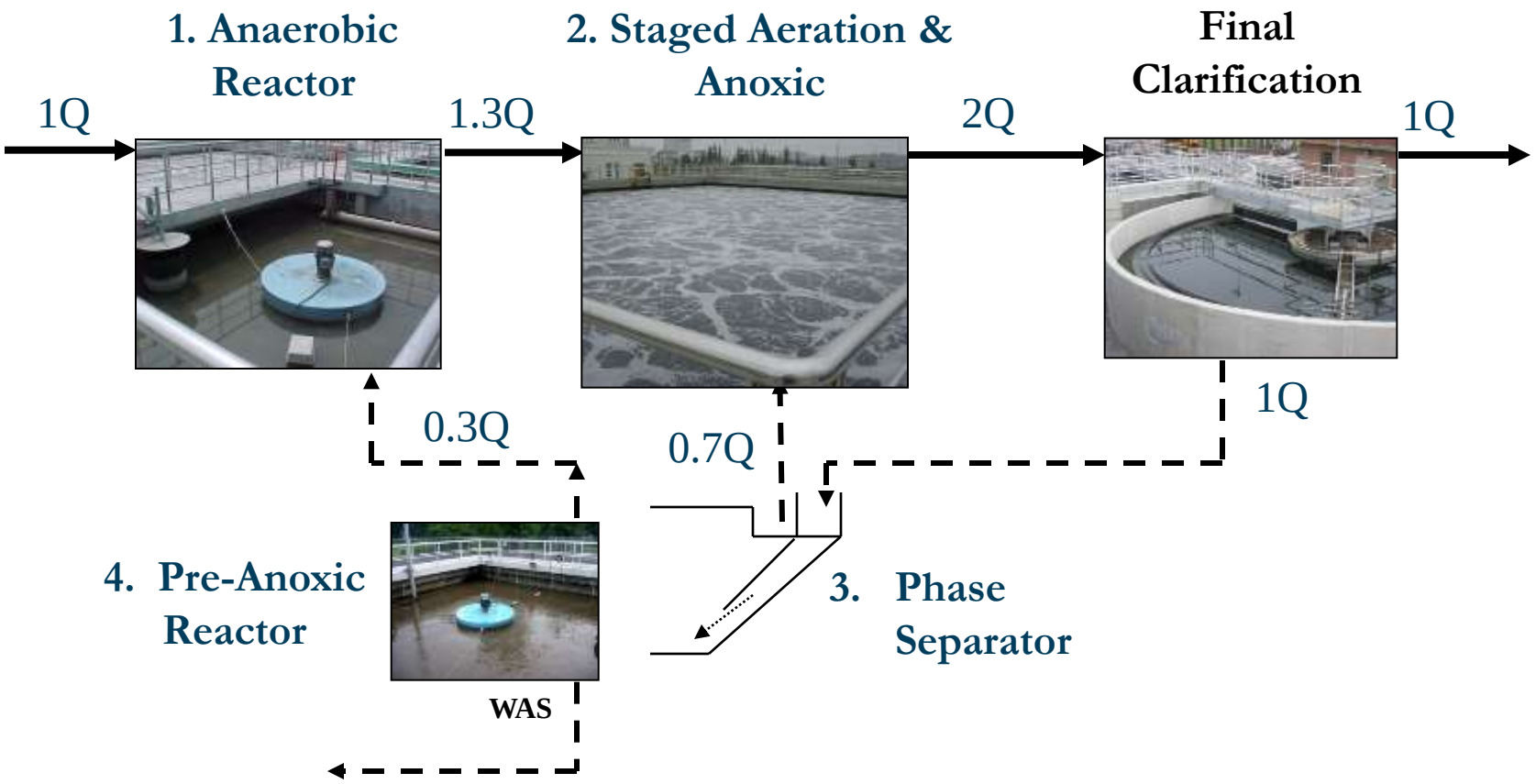
Step 4: Pre-anoxic Reactor



- Thickened RAS from Phase Separator
- Typical HRT 0.5 – 1.5 Hours
- NO_3-N Reduced Prior to Anaerobic Reactor
- Internal Recycle Rates 15% – 30% of Influent Flow

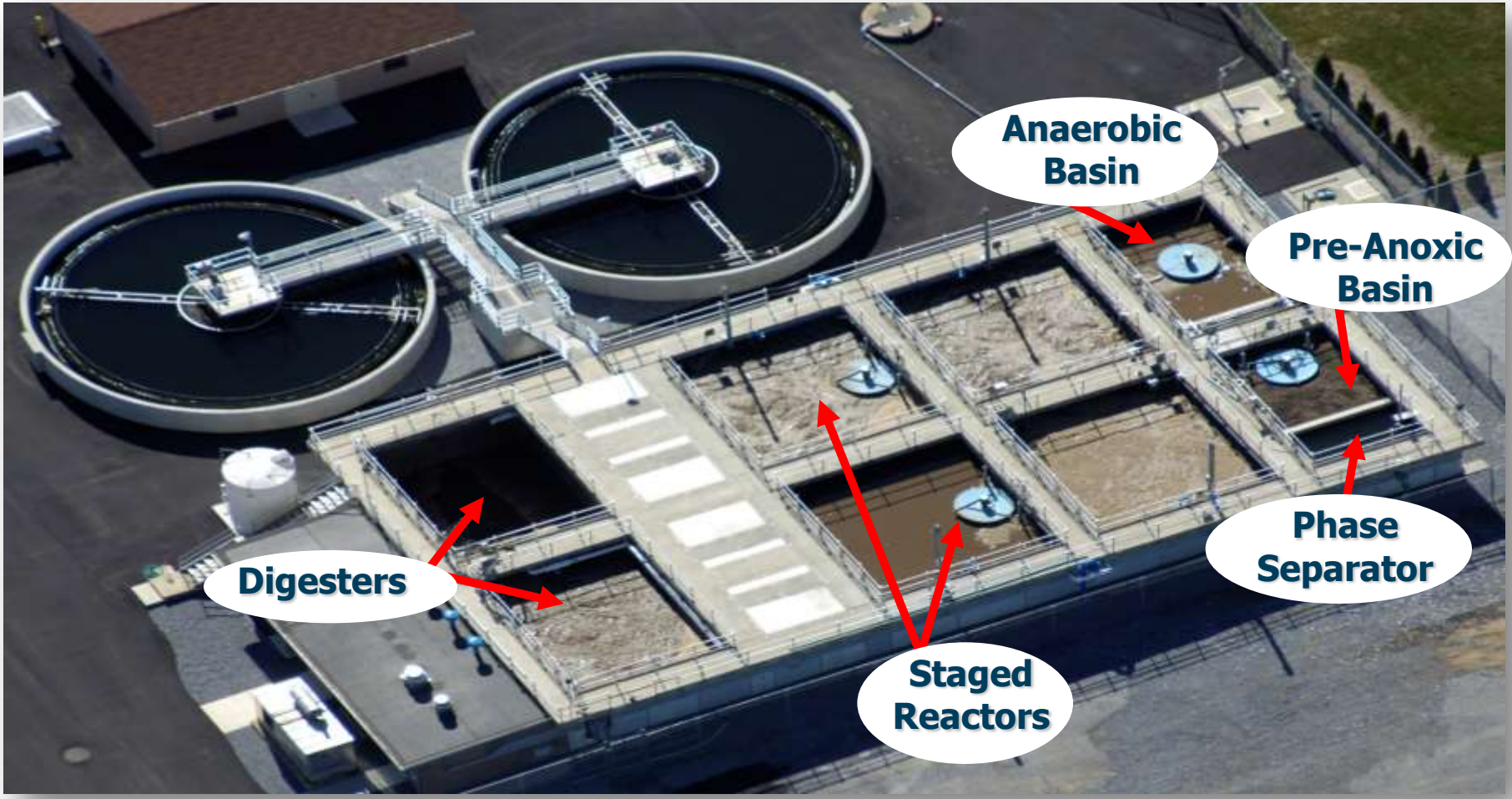
AquaPASS® System

Process Flow



AquaPASS® System

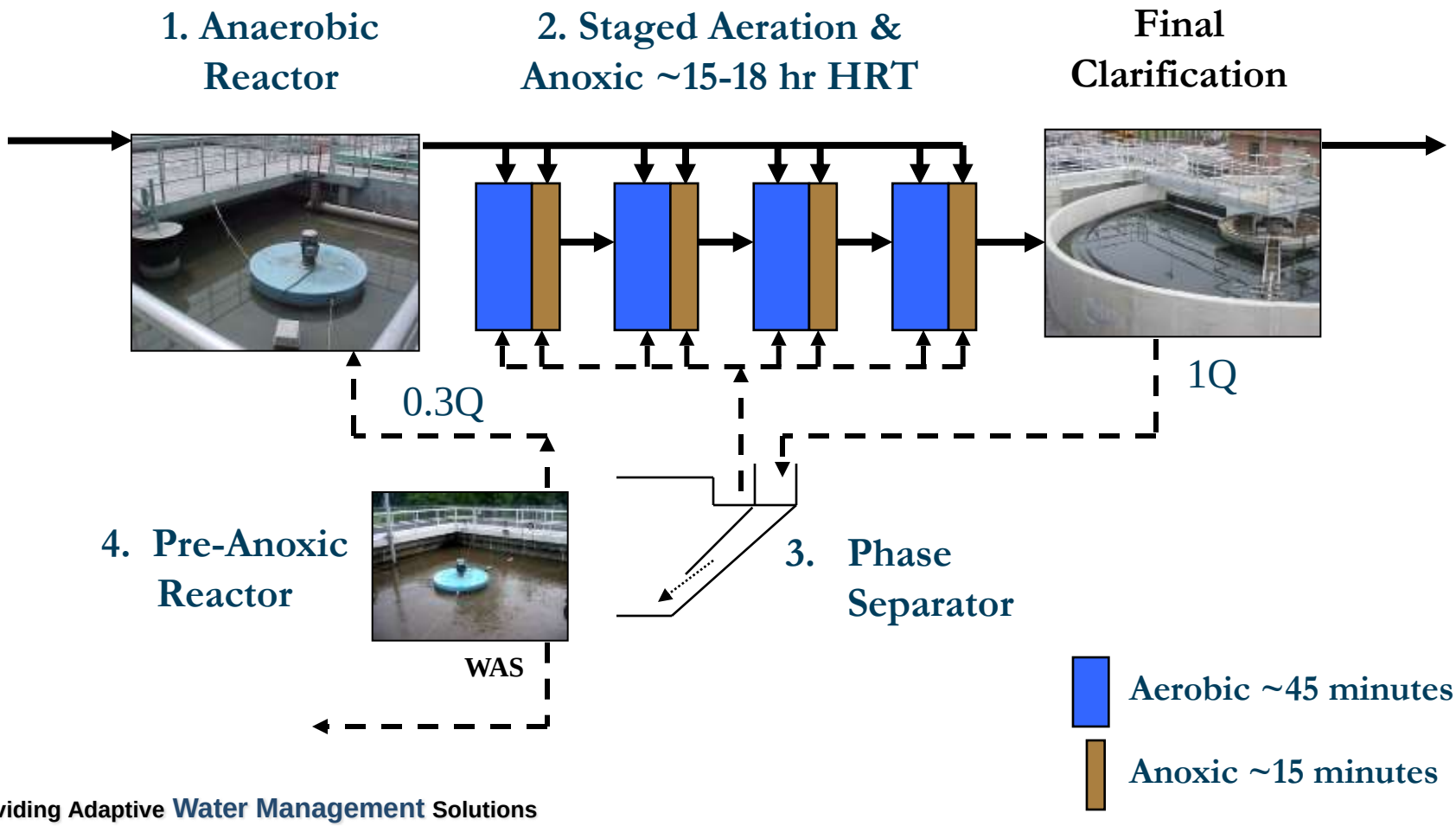
Layout Example



AquaPASS®
Design Considerations

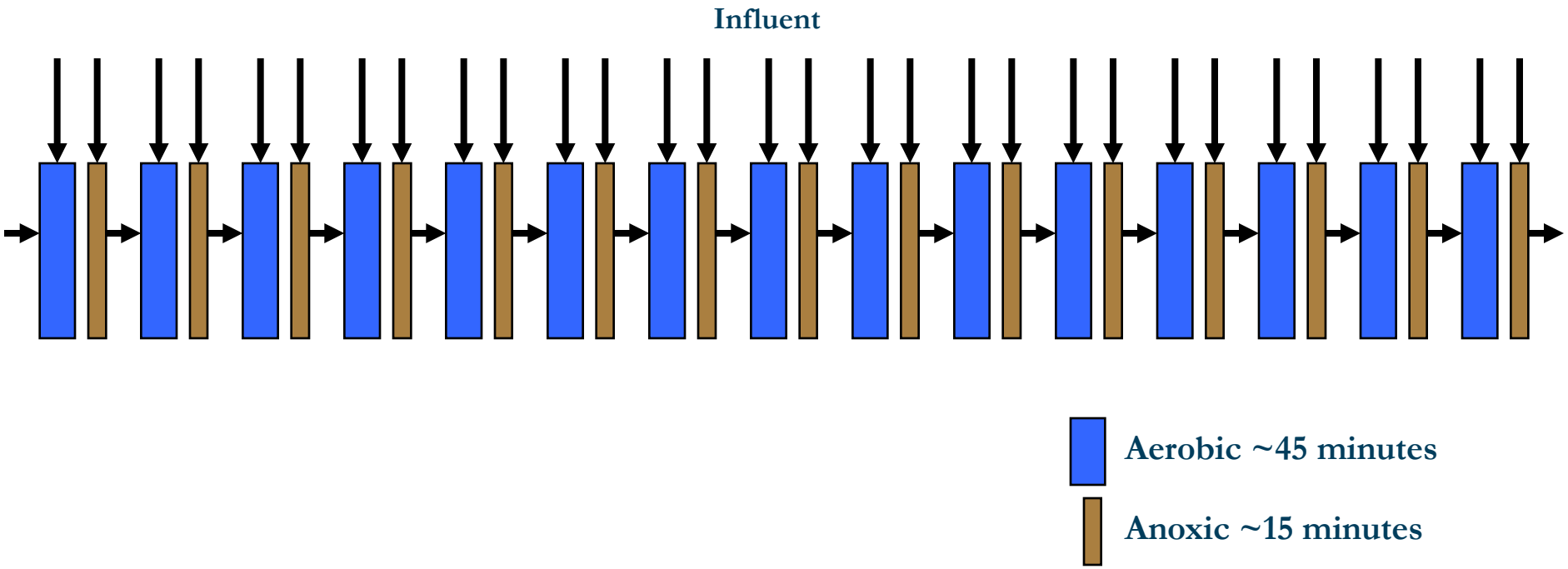
AquaPASS® System

SAR - Aerobic/Anoxic



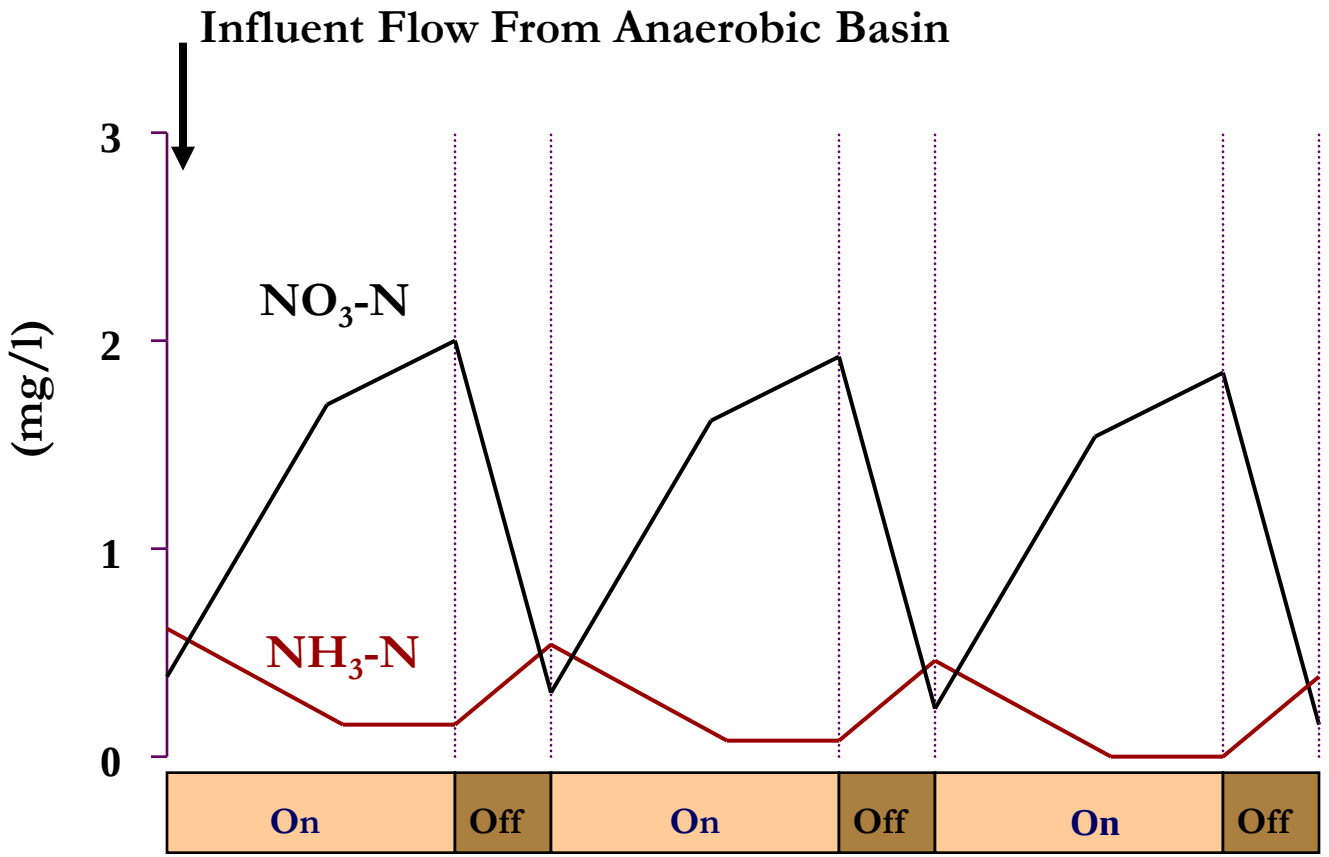
AquaPASS® System

SAR - Aerobic/Anoxic ~15-18 hours HRT



Nutrient Control

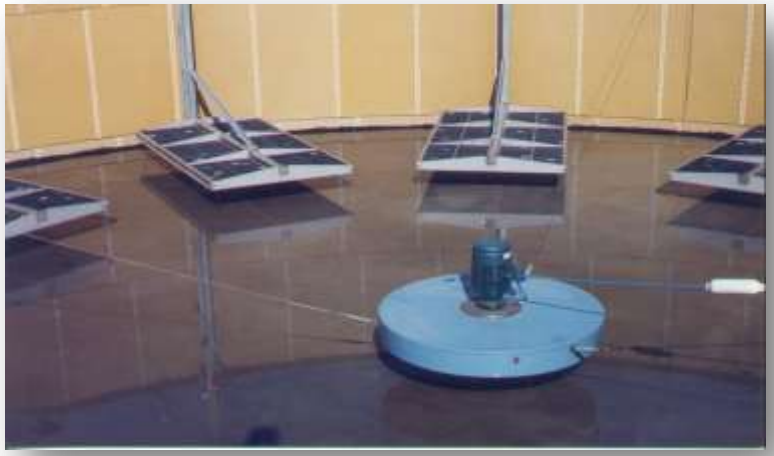
Staged Aeration/Anoxic Reactor - Nitrogen Control On/Off Management



AquaPASS®
System Components

AquaPASS® Components

Unequaled Quality



Aqua MixAir®

Phase Separator

Aqua-Aerobic Control Solutions

Phase Separator

Phase Separator

RAS from Clarifier

Return to Staged Aeration Reactor

AquaPASS®
Installation Profiles

Installation Profile

Salisbury Township WWTP, PA - Retrofit

Expansion of an existing activated sludge system to meet new BNR requirements.

Installation Profile

Salisbury Township WWTP, PA - Retrofit

Avg. Flow 0.58 MGD / Peak Flow 1.16 MGD			
Loading	**Design Influent (mg/l)**	**Design Effluent (mg/l)**	**Avg. Effluent (mg/l)***
BOD	250	15	2.5
TSS	215	30	4.6
TKN	35	---	2.6
NH3-N	---	1	0.42
Total N	---	6.9	4.5
Total P	6	0.86	0.25

***Based on data from 01/2011 - 04/2012**

Summary

Summary

- Efficient "BNR" Performance
- Time-Management of Process (Flexibility)
- Proportional Aeration Turndown via Aqua MixAir® System
- Low Headloss (constant water level)
- Flexible Design
- **Low Life-Cycle Cost** (Mixing, Pumping, Aeration)

AquaPASS® Phase Activated Sludge System

Questions?