2014 One Water Ohio Technical Conference and Expo

Overcoming Challenges during Design, Construction, and Startup of a Cost Effective Nutrient Upgrade

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August 28th 2014; 11:05-11:35 AM; Columbus, OH





#obgPresents

One Water

O'BRIEN & GERE

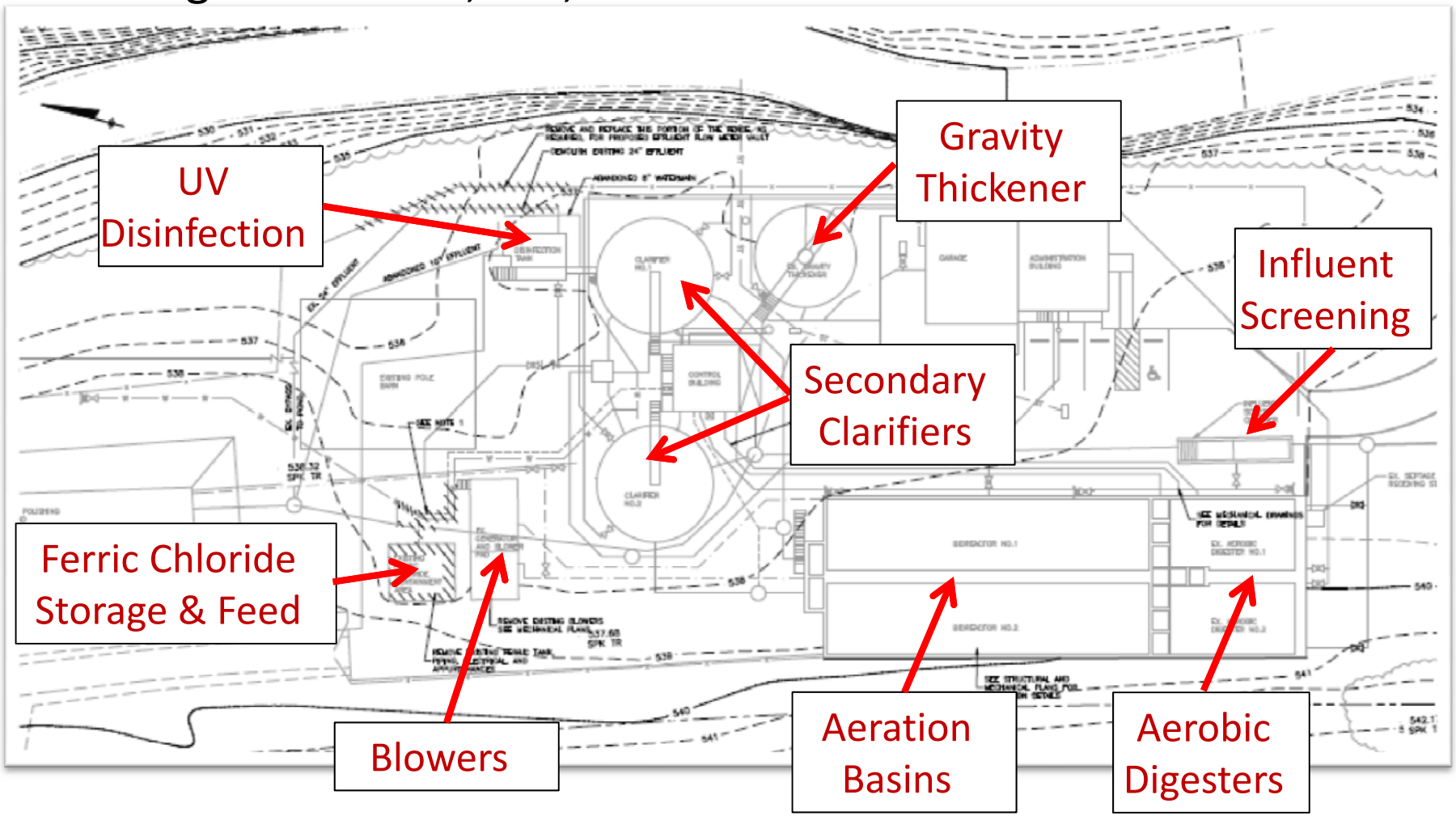
GRSA WWTP
GLEN ROCK, PA

Agenda

- Purpose for Upgrade Project
- Process Selection
- Startup Challenges
- Project Outcome

Glen Rock WWTP – 2009, prior to Upgrade

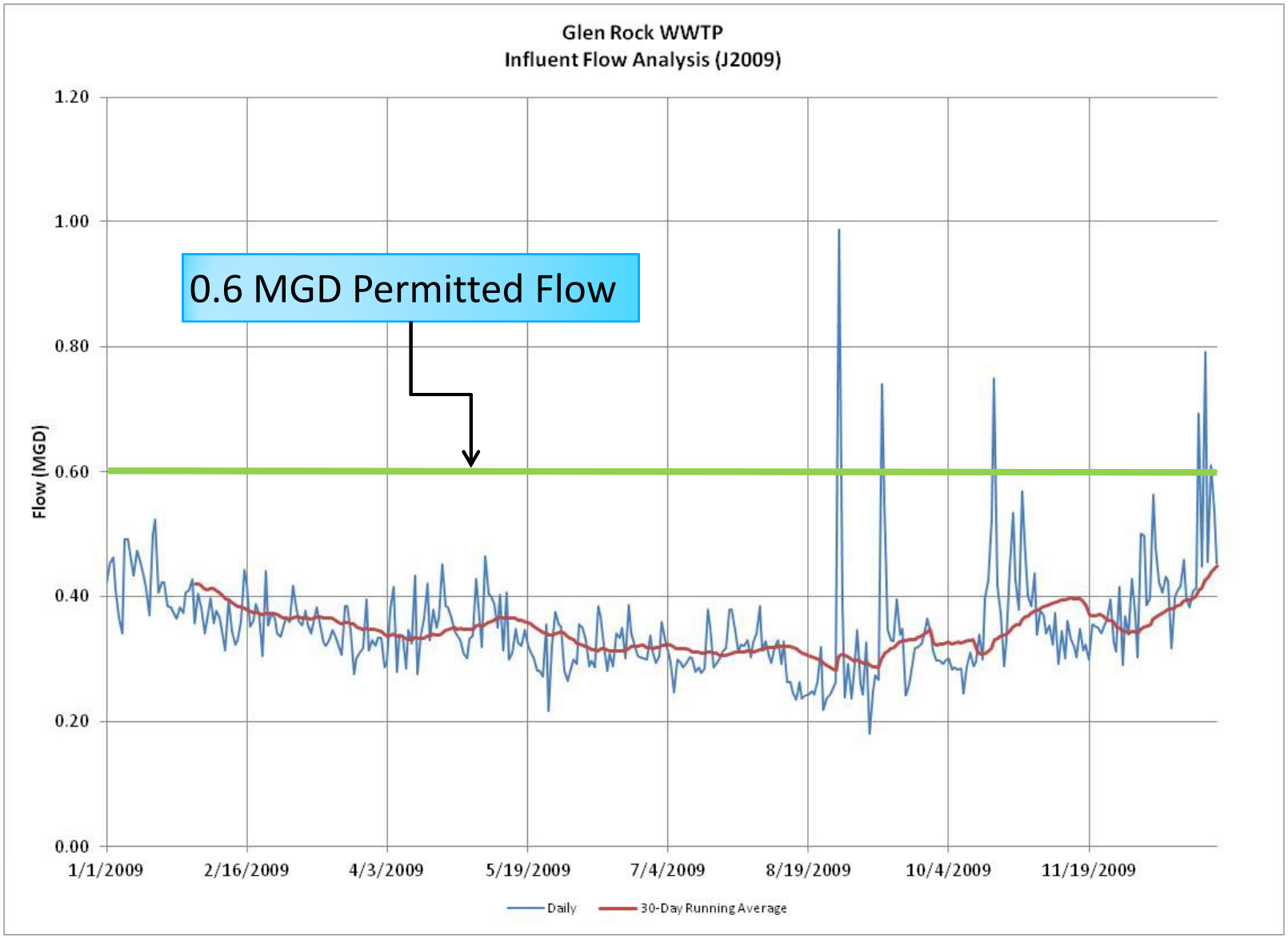
- 0.6 MGD Annual Average Permitted Flow
- Designed for BOD, TSS, and Ammonia Removal



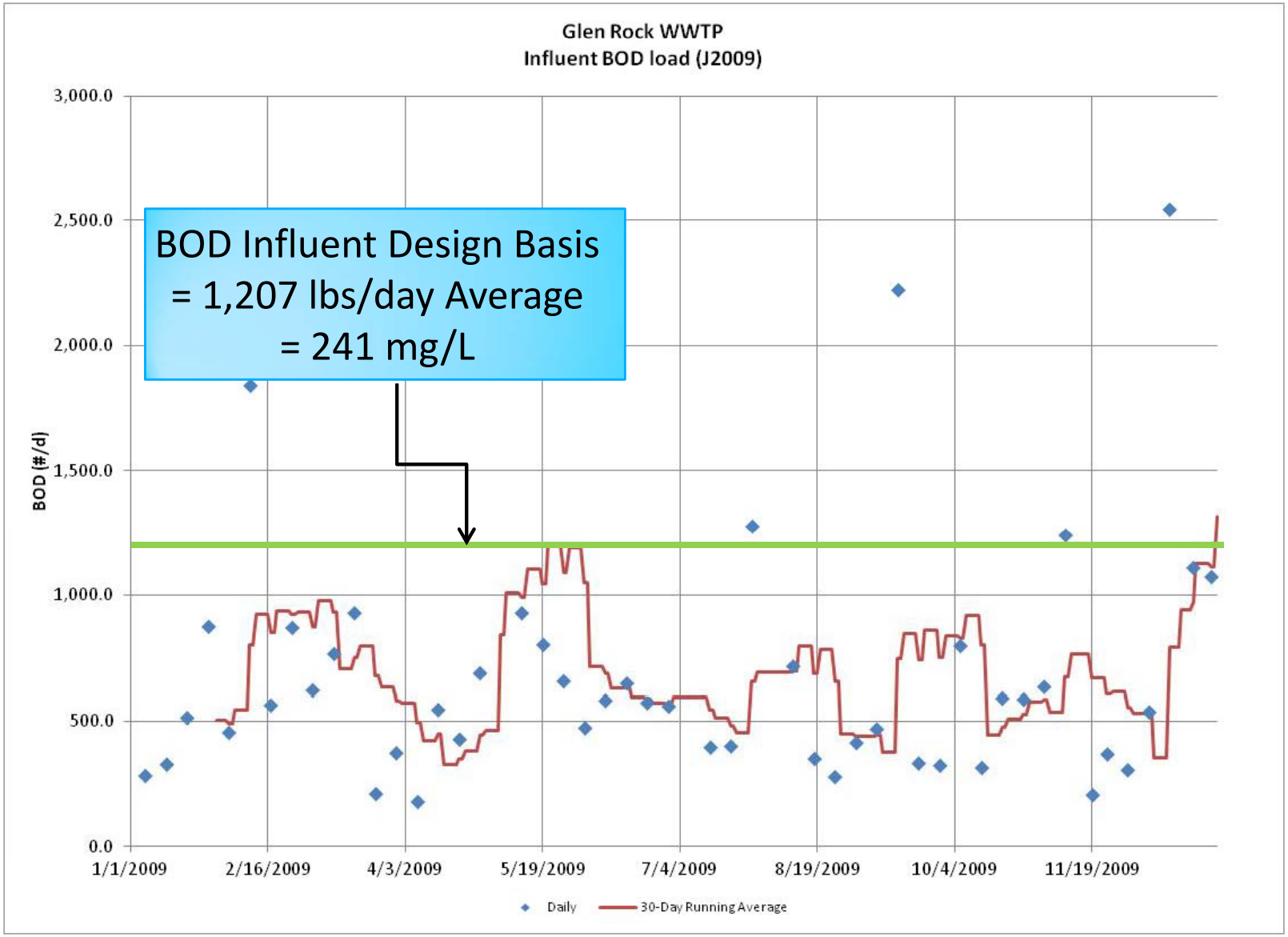
Key Issues for Upgrade

- Loadings & Performance
- Permit Compliance
  - Flexibility to meet stringent limits *(Bay TMDL – Summer 2010)*
  - *Annual Effluent Nutrient Mass Limits Equivalent to:*
    - *6.0 mg/L TN*
    - *0.8 mg/L TP*
- Plant operations impact
- ***Project cost reductions?***

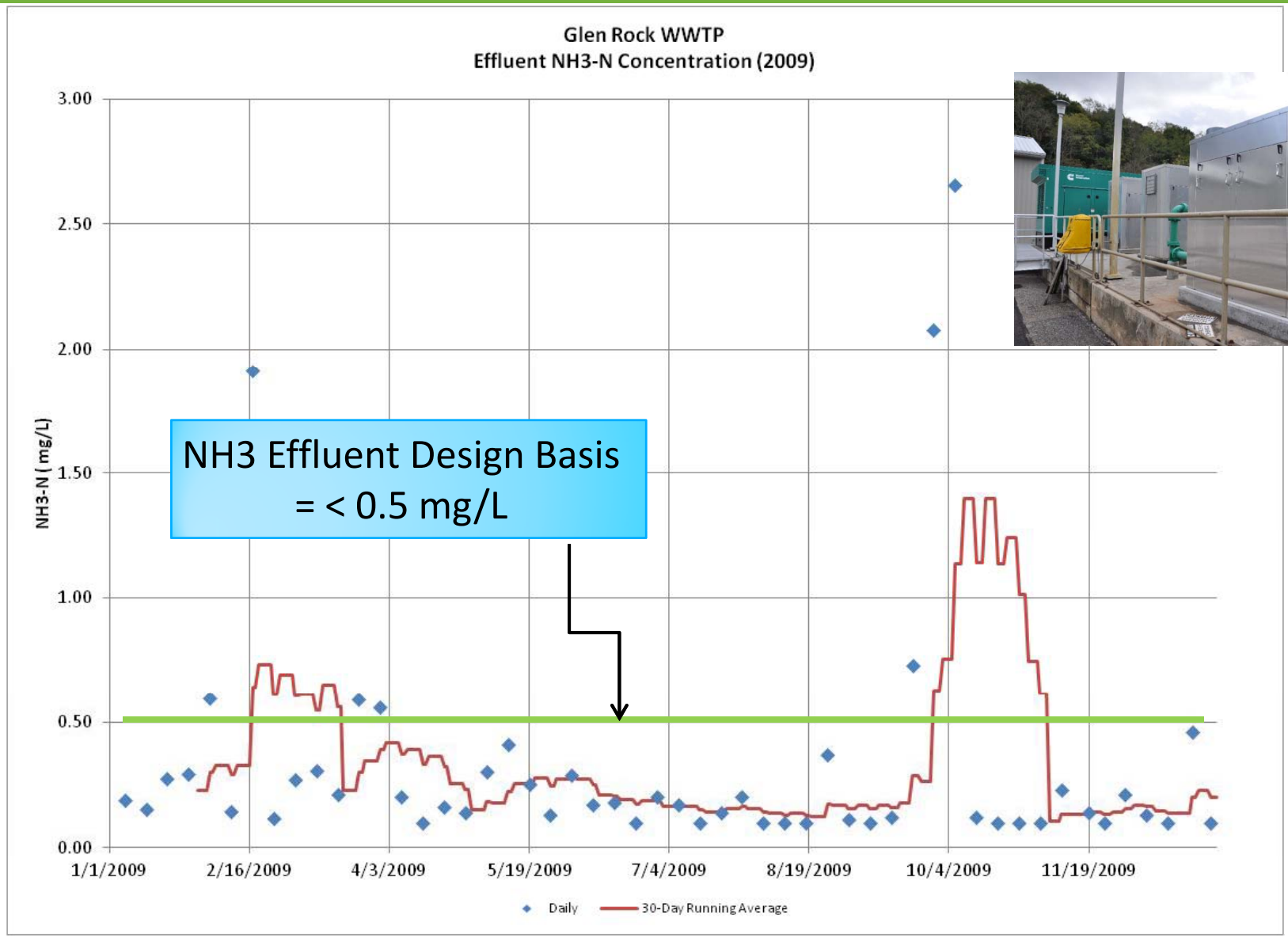
Existing Influent Flow



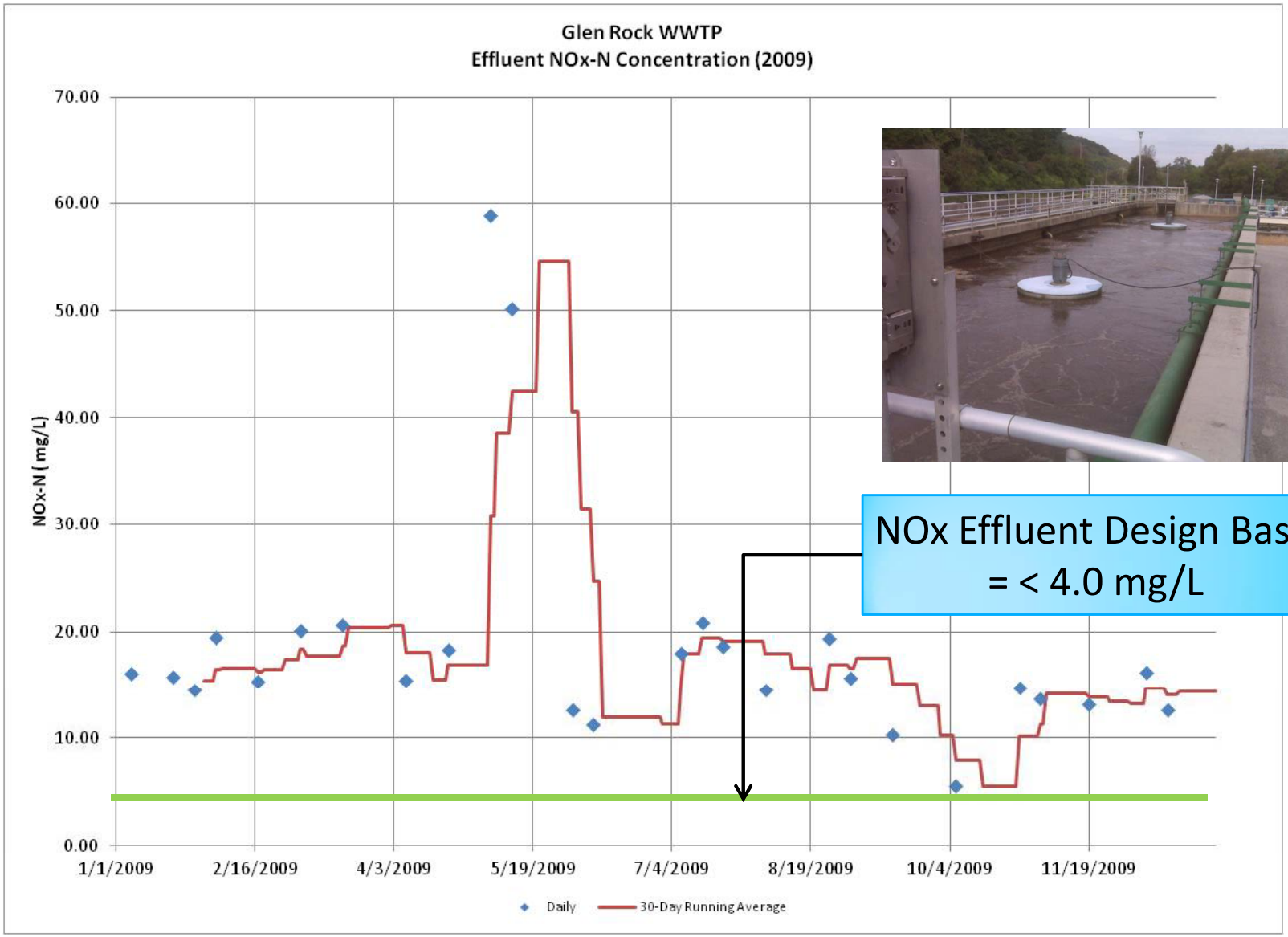
Existing Influent BOD Load



Existing Performance – Effluent NH3-N - 2009

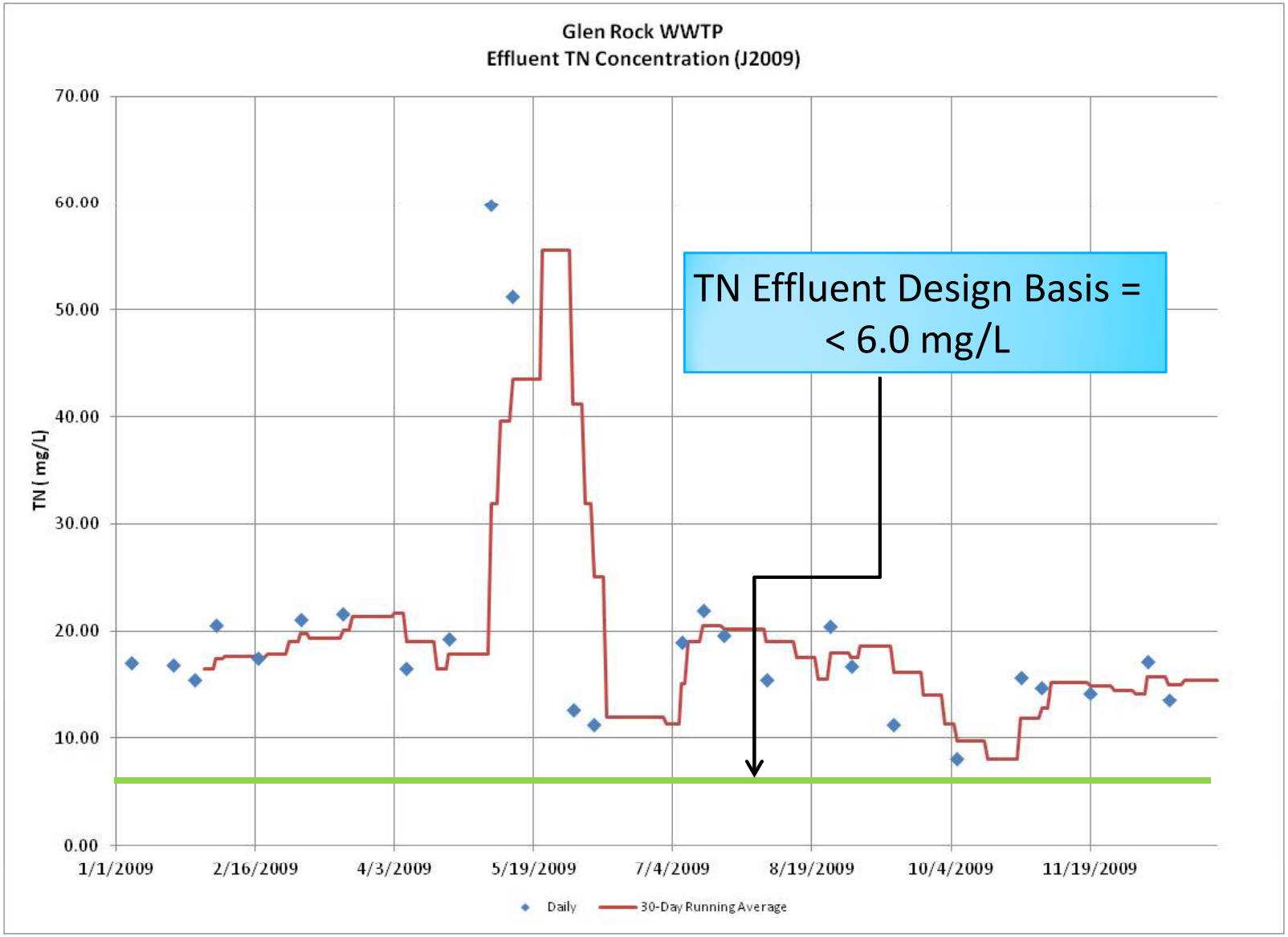


Existing Performance – Effluent NOx-N - 2009

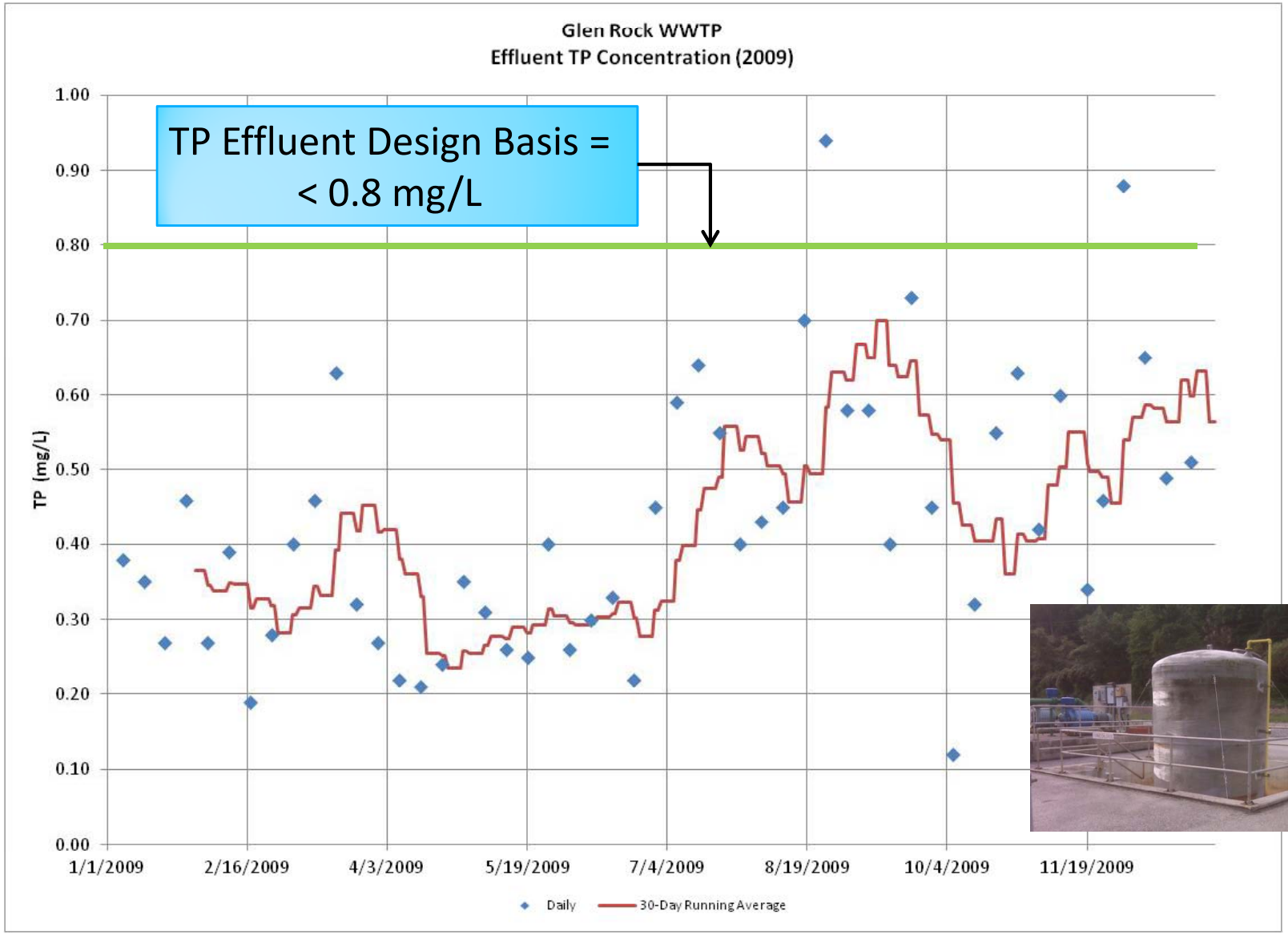


NOx Effluent Design Basis
= < 4.0 mg/L

Existing Performance – Effluent TN - 2009

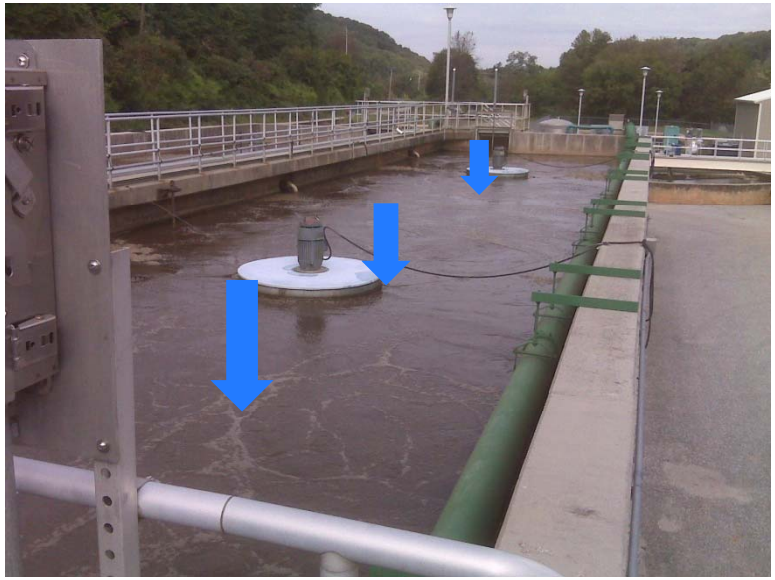


Existing Performance – Effluent TP - 2009

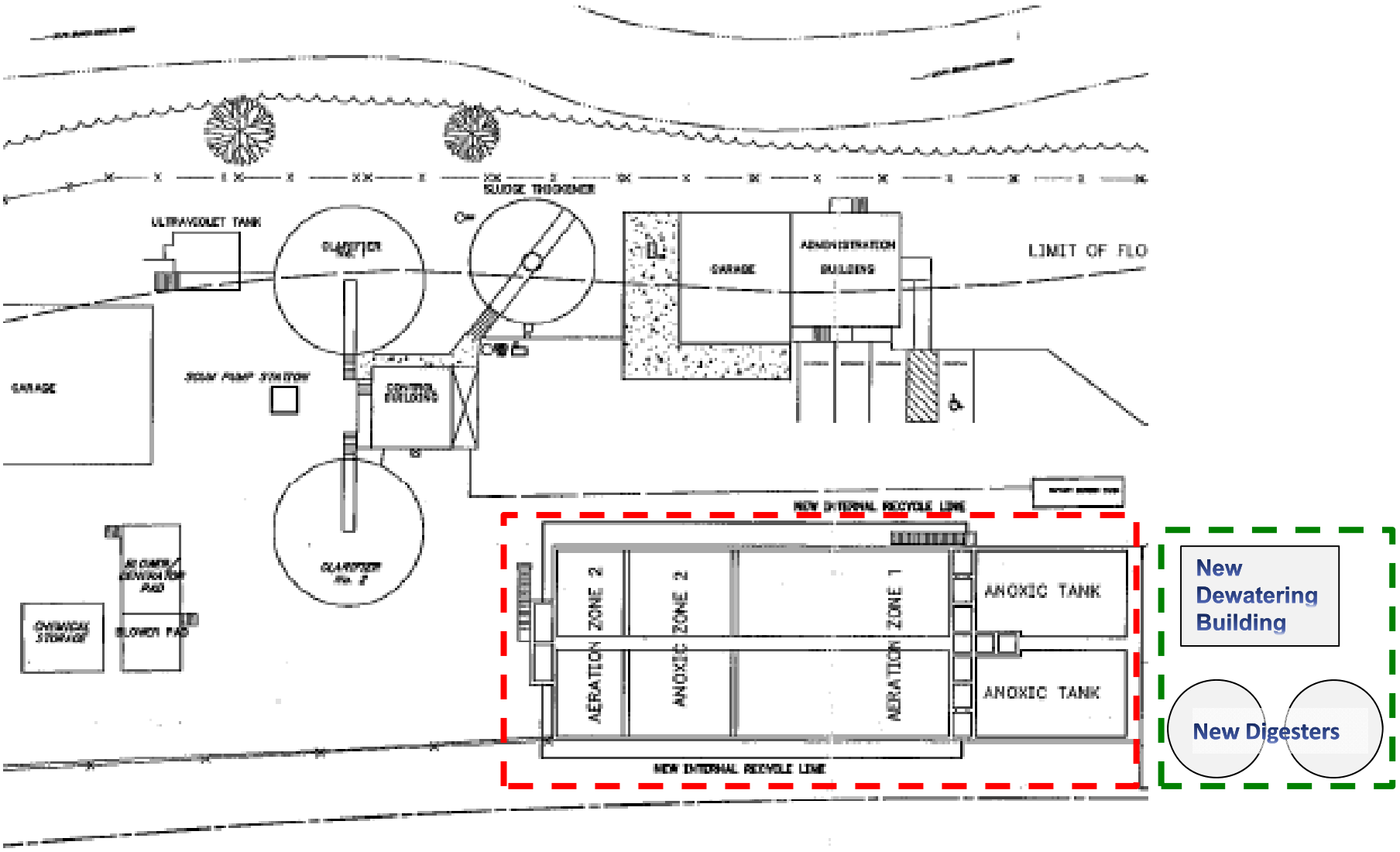


Glen Rock WWTP – Existing Conditions

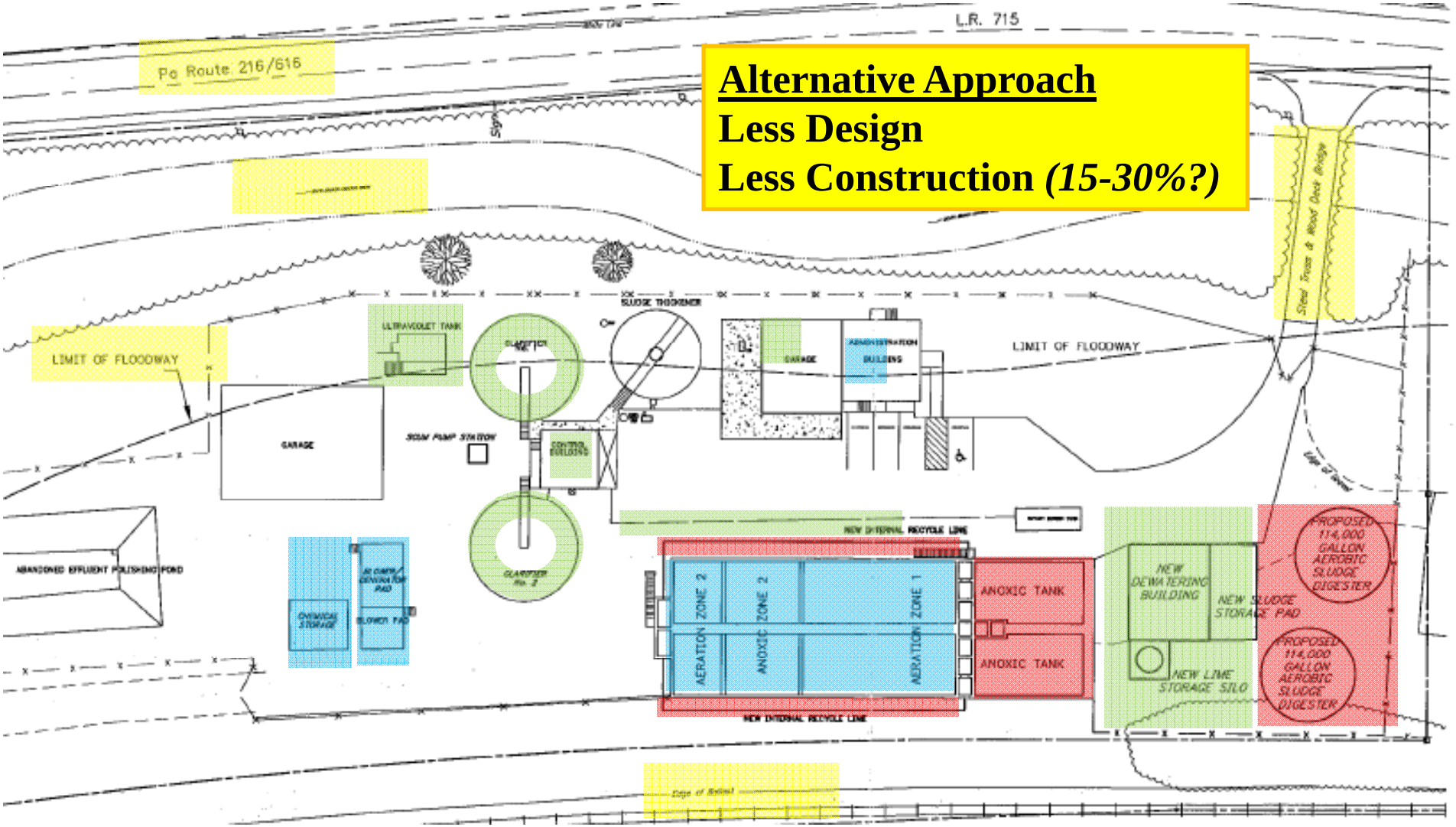
- Excellent effluent quality
  - BOD, TSS, NH3
  - Not designed for denitrification
- Existing Bioreactor Tank Capacity Adequate for aBNR at current permitted design flow / load
  - Existing 24 hours Hydraulic Retention Time @ 0.6-MGD
- Projected growth not significant
- Existing Digester Capacity Adequate
  - Replacement not necessary
- Promising Ammonia Profiling results
  - Ammonia depleted half way through existing reactors



Initial Upgrade Proposal



Alternative Upgrade Plan – Cost Savings

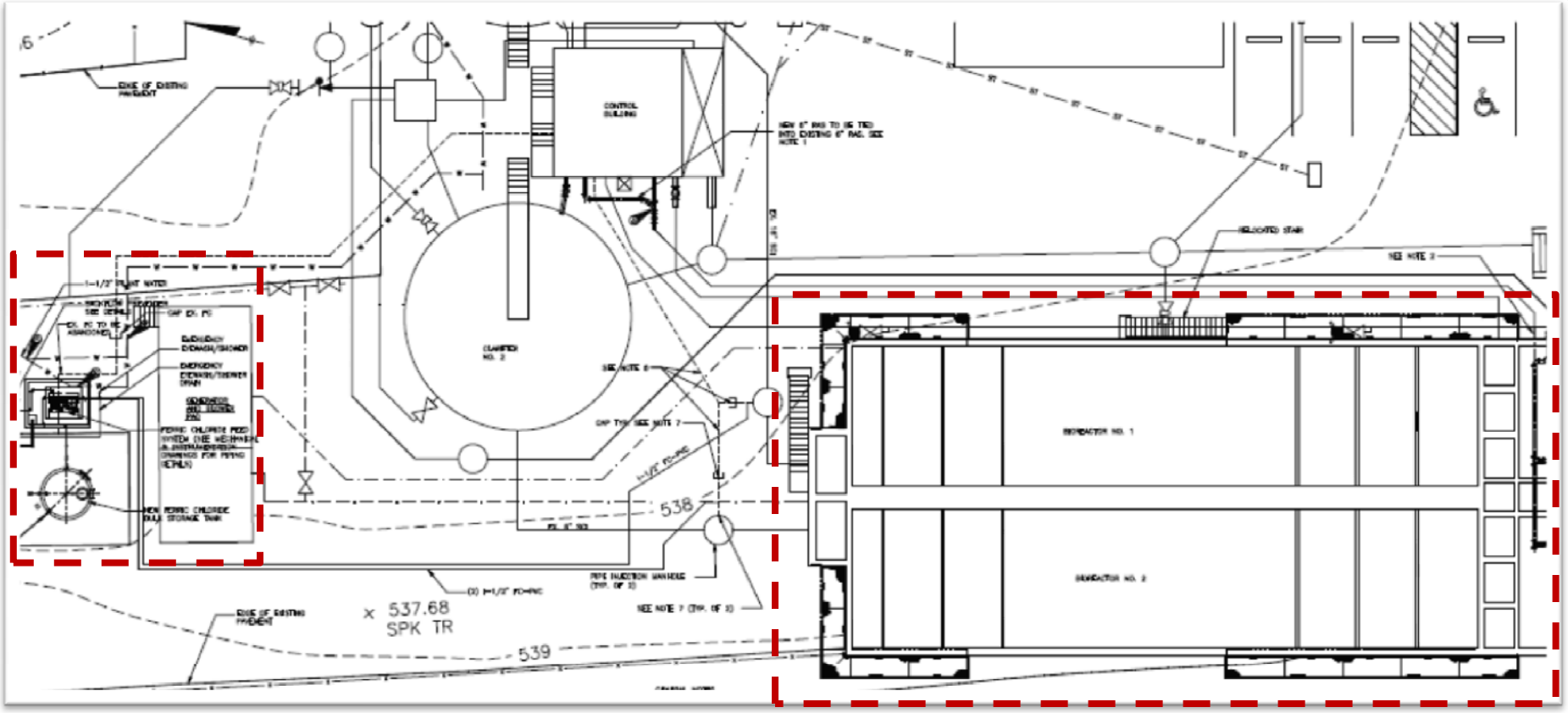


Alternative Approach
Less Design
Less Construction *(15-30%?)*

BNR ***Confirm Project*** ***Cost Reduction Opportunities***

Advanced BNR Plant Improvements – May 2011 - 2012

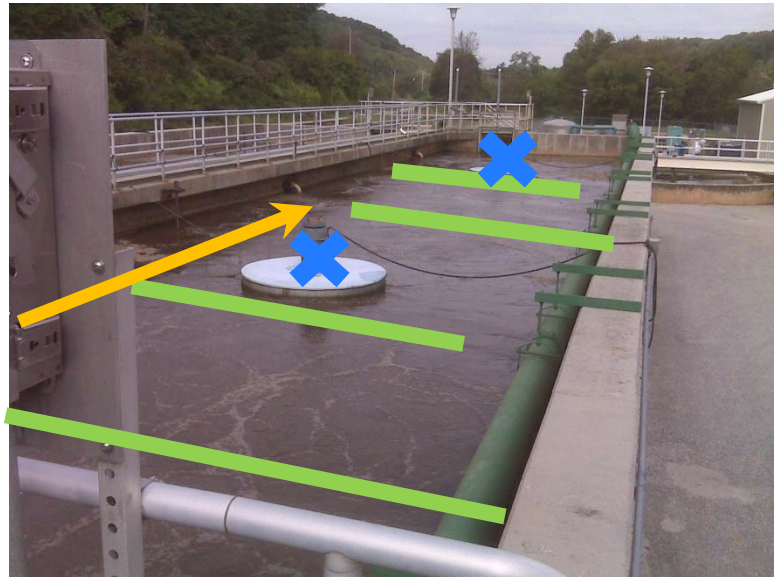
- Upgrade Bioreactors for Advanced BNR Plug Flow Process
- Right-Size Blowers
- Modernize and Automate Coagulant Feed Systems



Reconfigure Existing Bioreactors

- Remove surface aerators
  - Add Diffused Aeration
  - Add "Right Sized" Blowers
- Compartmentalize Plug Flow Reactors
  - Anaerobic
  - Pre-Anoxic
  - Oxic
  - Post-Anoxic
  - Re-aeration
- Swing Zones for Seasonal Flexibility
- Future Carbon Feed Option

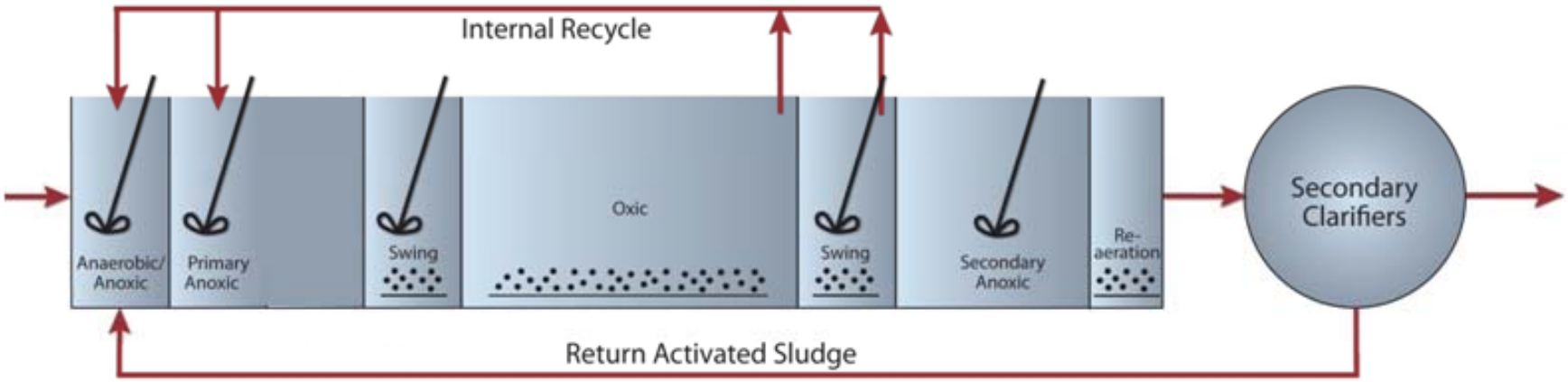
- Benefits
  - Re-Use Existing Tanks
  - More Efficient Mixing
  - Smaller HP Aeration



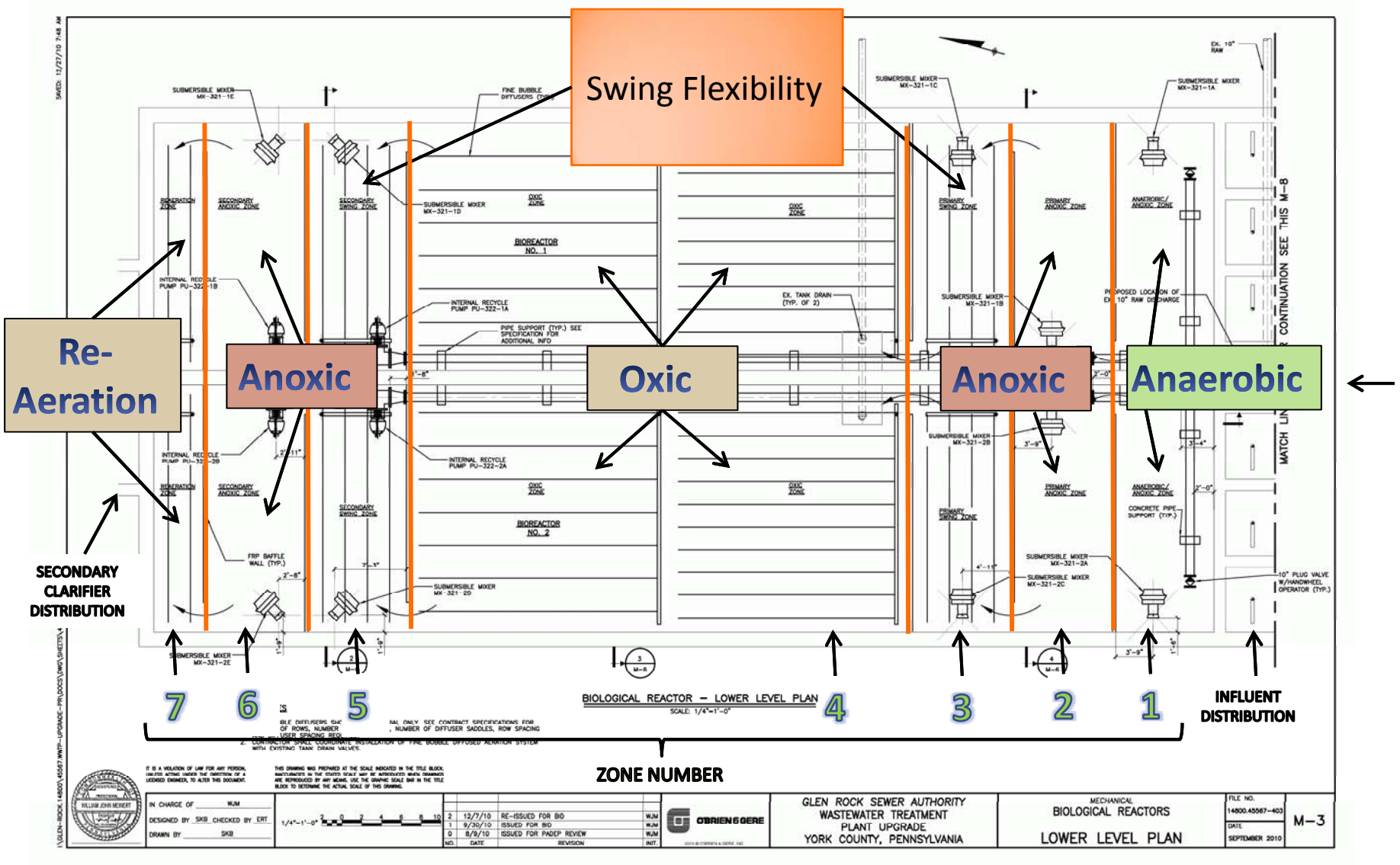
Plant Upgrade - Basis of Design

Parameter	Start-Up [1] 1 Basin O/S	Average w/2 Basins	Cold Weather Max Month
Flow [MGD]	0.29	0.59	0.74
Food to Mass (F:M) Ratio	0.07	0.07	0.14
BOD5 : TKN Ratio	7.3	7.3	9.4
Biological Sludge Yield [# TSS/# BOD]	0.67	0.67	0.7
MLSS [mg/L]	4,000	4,000	4,000
Total SRT [days]	22.3	22.3	11.5
Oxic SRT [days]	10.9	10.9	5.7
Nitrate Internal Recycle [% inf flow]	300%	300%	300%
RAS [mg/L]	8,000	8,000	8,000
RAS [% of inf flow)	60%	60%	40%
Ferric Chloride Use [gpd]	14	27	
Assume 2% P in WAS			
Assume 4% N in WAS			

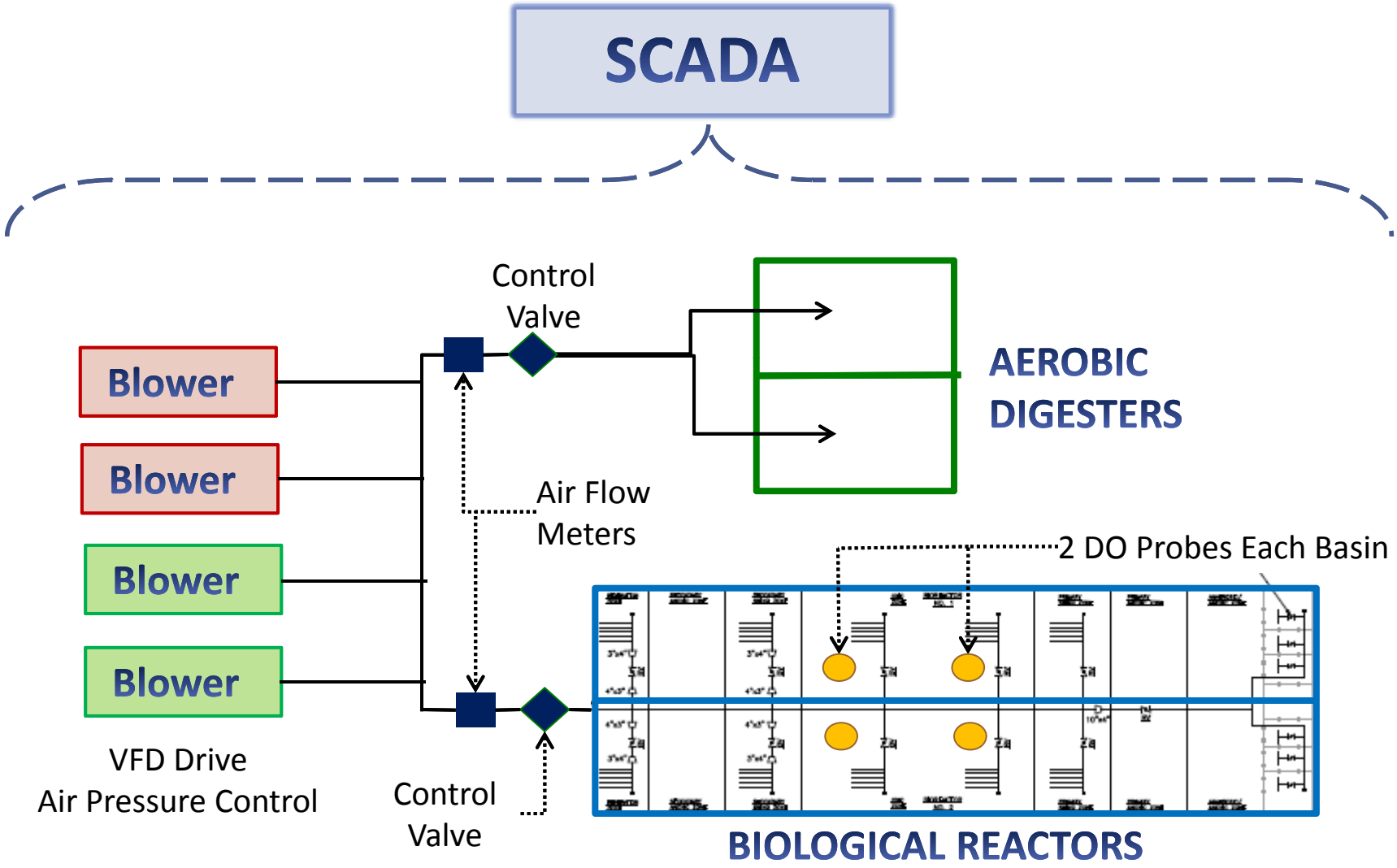
Bioreactor Upgrade – Process Flow



Bioreactor Upgrade – Zone Configuration



GRSA – Aeration System Control Overview



GRSA - Aeration System Monitoring and Control Features

- Air monitoring
  - Flow, Pressure, DO
- Air Control
  - Set flow rate to digesters
  - Pick blower pressure setpoint
    - Blower Speed Adjusts
  - Pick DO probe / setpoint
    - Control Valve Adjusts

Startup Challenges – Aeration Control

Issues	Resolution
Air Control Valve Failure 	Valve Vendor Calibration of Valve Contractor Wiring Fix CSI Calibration with SCADA
Wide Swings in Air Valve % Open	CSI Programming Modifications - trial and error under real-time conditions - added minimum valve %open setpoint - added lag between valve adjustments
High DO Solids Falling Out of Suspension  	Under-Loaded Reactors - Mixing Limited Diffused Aeration - Limit # of reactors online to what is necessary for treatment - Develop SOP for Wet Weather Flows

In-situ Instrumentation

- DO Probes –
  - Monitor Oxic DO Profile
- TSS Probes
  - Monitor MLSS

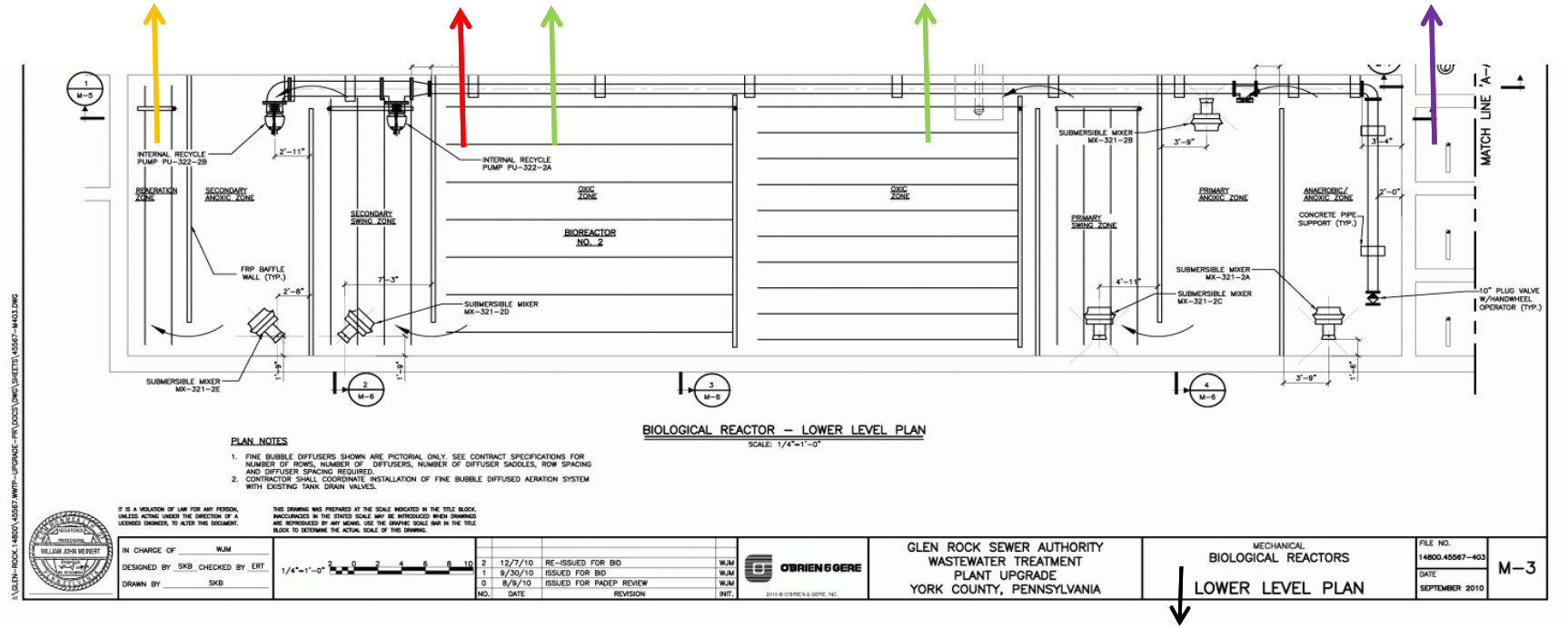
DO

AMMONIA

TSS

NITRATE

- Ammonium Probe –
  - Monitor Influent Load
- Nitrate Probe – End of Oxic
  - Monitor Ammonia conversion



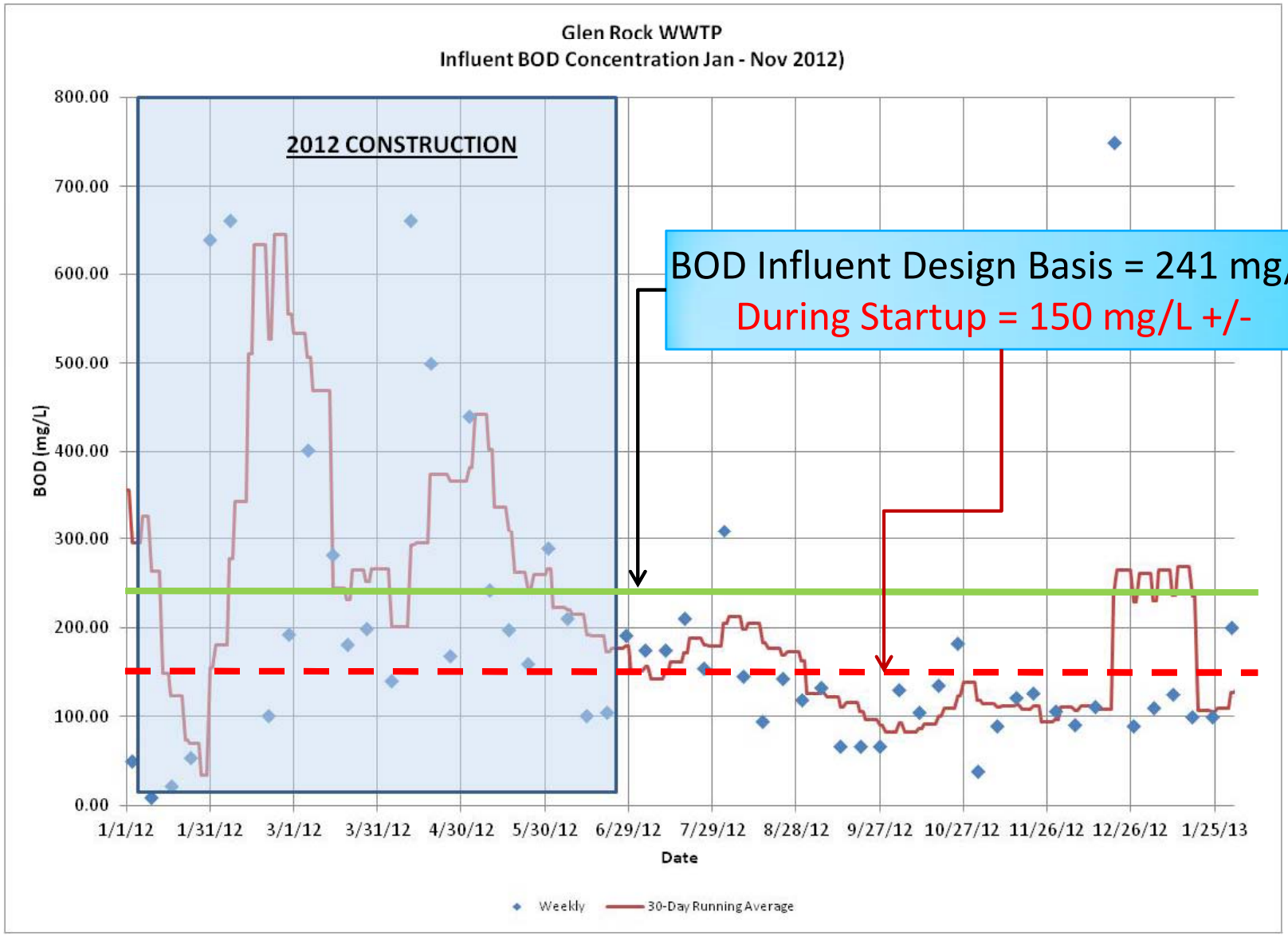
Instrumentation Challenges

- Faulty Readings
  - O&M Frequency
  - Costly Consumables
- Probe Placement (TSS, DO)
- Calibration
  - Portable Probes
    - DO
  - Grab Sampling Program
    - NH3, NOx, TSS

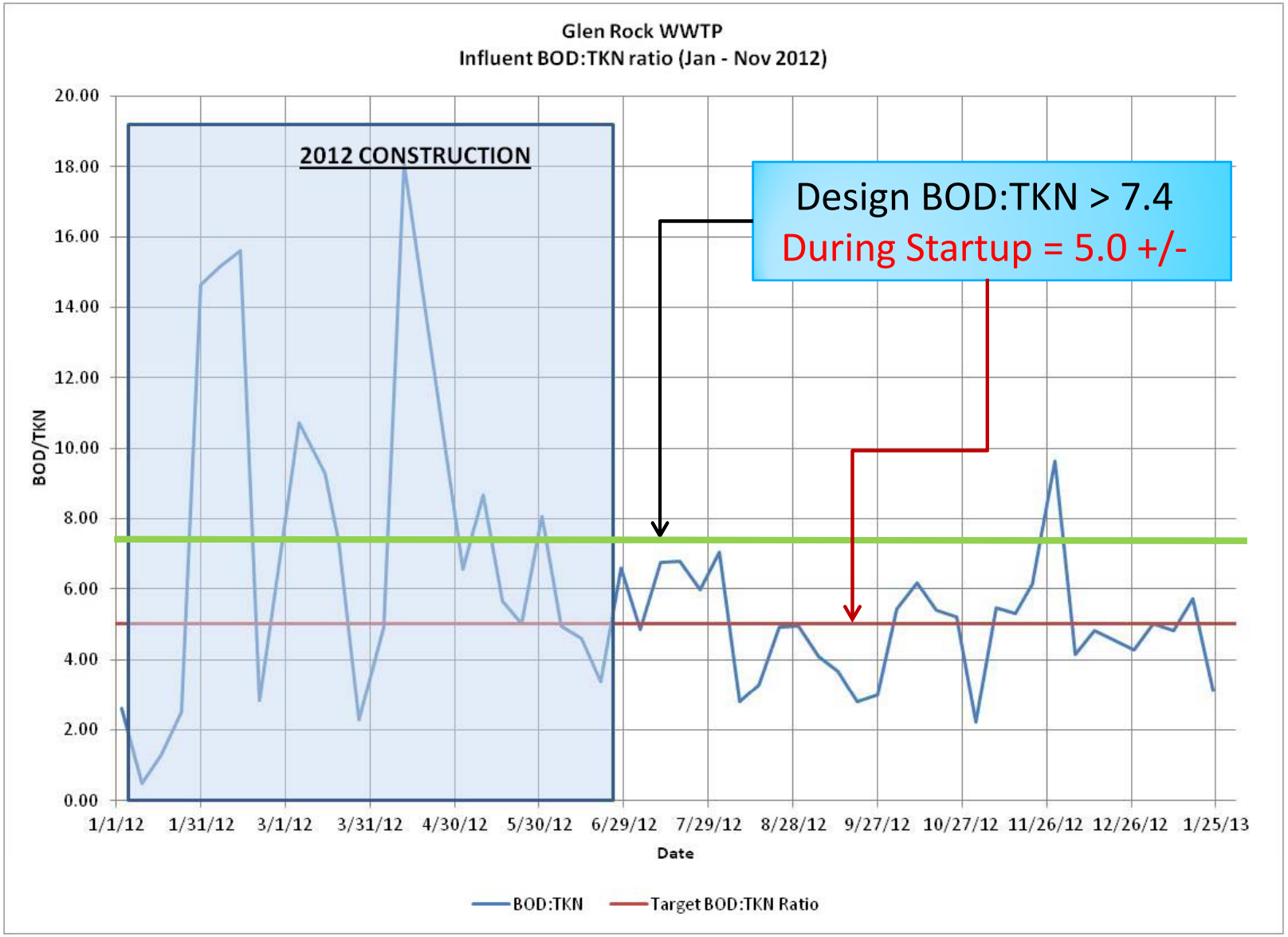
Ammonium Analyzer (Hach)

DO Probes (Endress+Hauser)

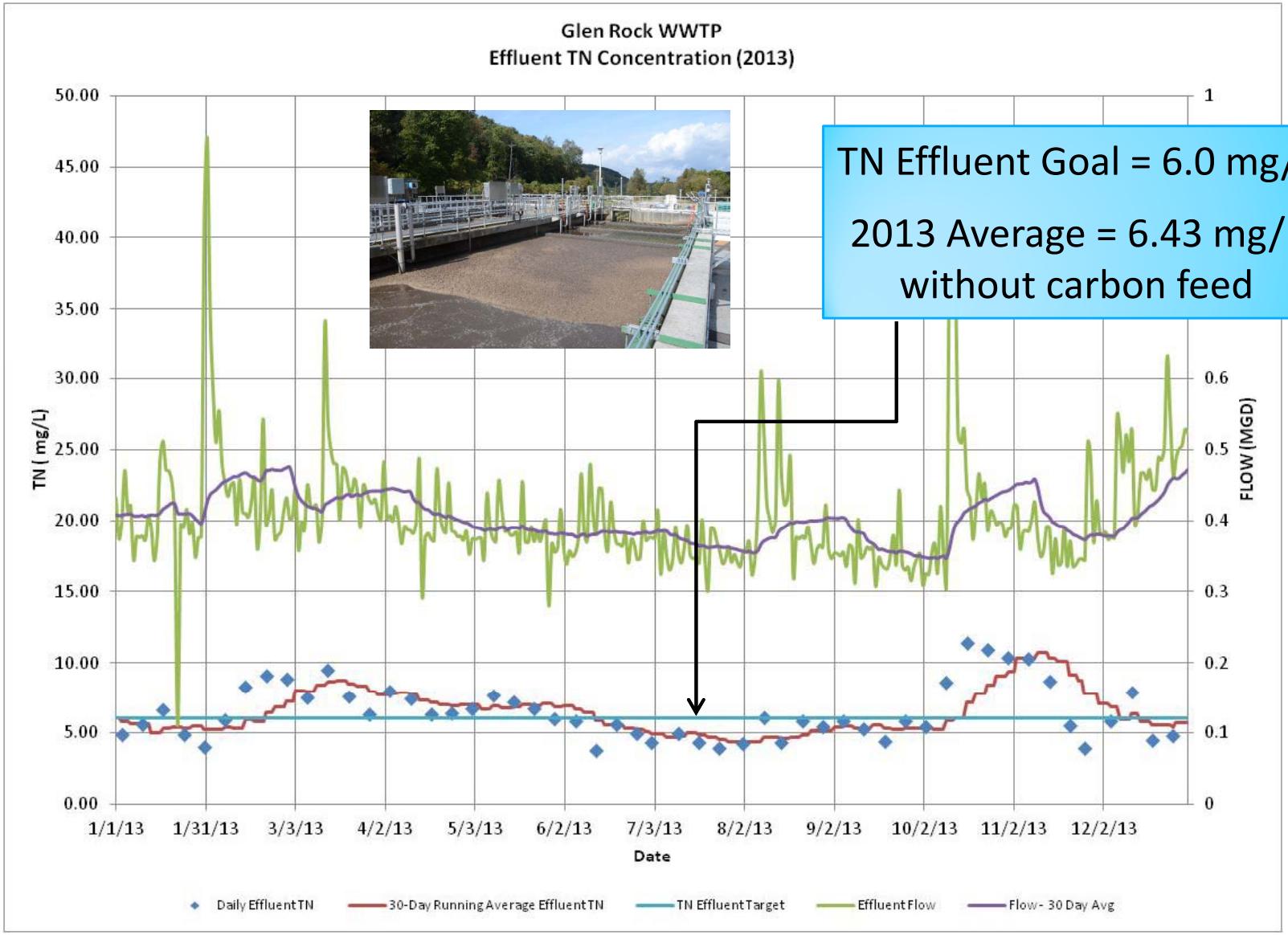
Startup Challenges - Influent Loading Variability - BOD



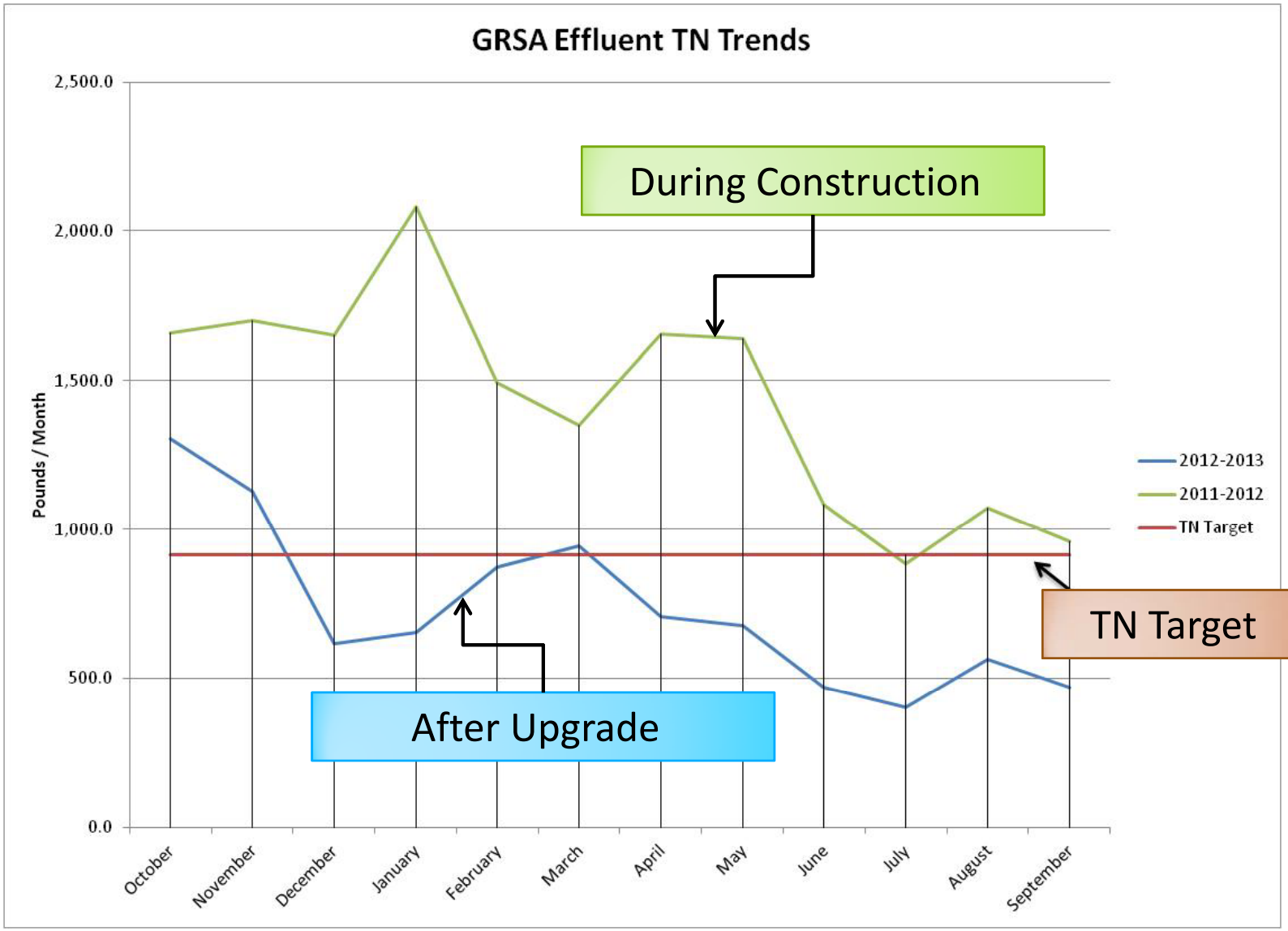
Startup Challenges - Influent Loading Variability – BOD:TKN



Effluent TN Performance - Post Construction – 2013

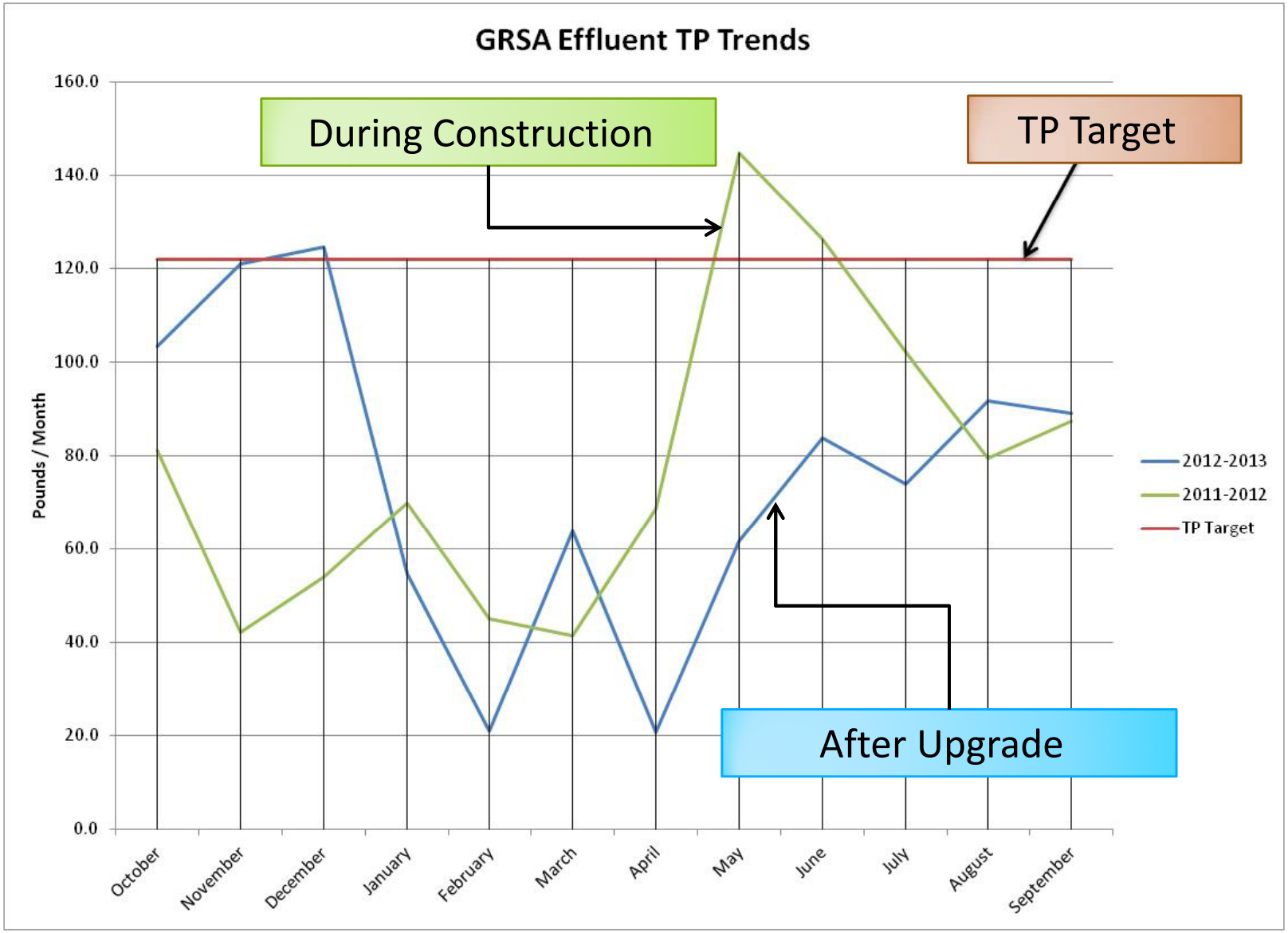


NPDES Permit Compliance – TN Pre and Post Construction



Effluent TP Performance - Post Construction – 2013

NPDES Permit Compliance – TP Pre and Post Construction

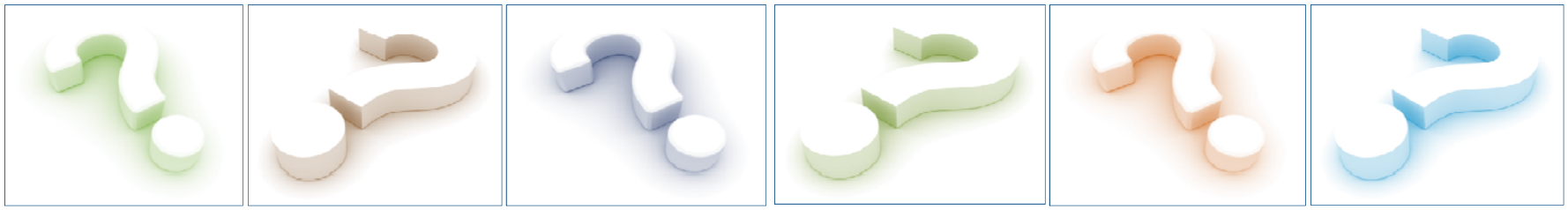


Conclusions

- Re-Configuration of existing tankage
  - Possible to optimize to meet lower nutrient limits
  - Can equate to substantial cost savings
- Initial calibration and O&M of in-situ instrumentation is critical to automated process control
- Startup of Aeration Control is an iterative process
- Match load to Process Tankage for best results
  - Energy and Chemical Cost Savings
  - Stable process

	2012-2013 Permit Cycle		
	TN	TP	
Annual Permit Limtis =	10,959 lbs	1,461	lbs
Pounds Left Over (not used) =	2,145 lbs	552	lbs
% Pounds Remaining =	20%	38%	

QUESTIONS?



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