Hybrid Sand Filtration

August 28, 2014

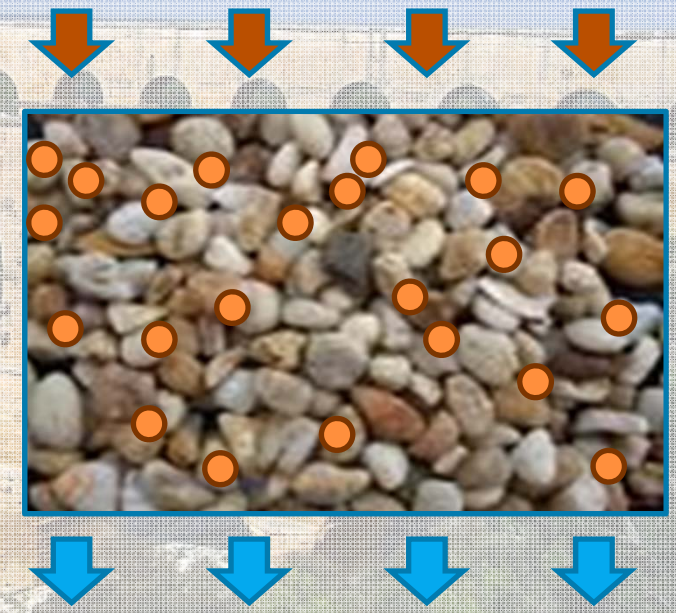
Agenda

- Hybrid Filtration Introduction
- Continuous Sand Filtration Background
- Hybrid Filtration Details
- Hybrid Filtration Results and Data
- Next Step: Phosphorus Removal
- Wisconsin Pilot Description and Status

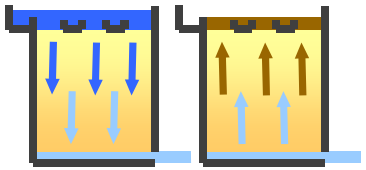
Sand Filtration Basics

- As old as water treatment itself dating back to 2,000 – 4,000 BC
- Big stuff stays in, small stuff passes through
- Porous media – Depth Filtration
- Solids Build Up in Sand Bed then Need to be Removed/Cleaned

Granular Media Filtration

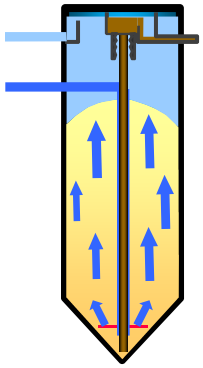


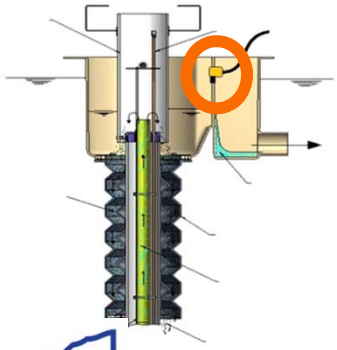
Hybrid Filtration Basics



Traditional filters backwash based upon solids, which can be better for perfomrance, but require redunant filters and ancilliary equipment.

Continuous filters backwash based on hydraulics, which may sacrifice some performance, but doesn't require additional redundancy or ancillary equipment.





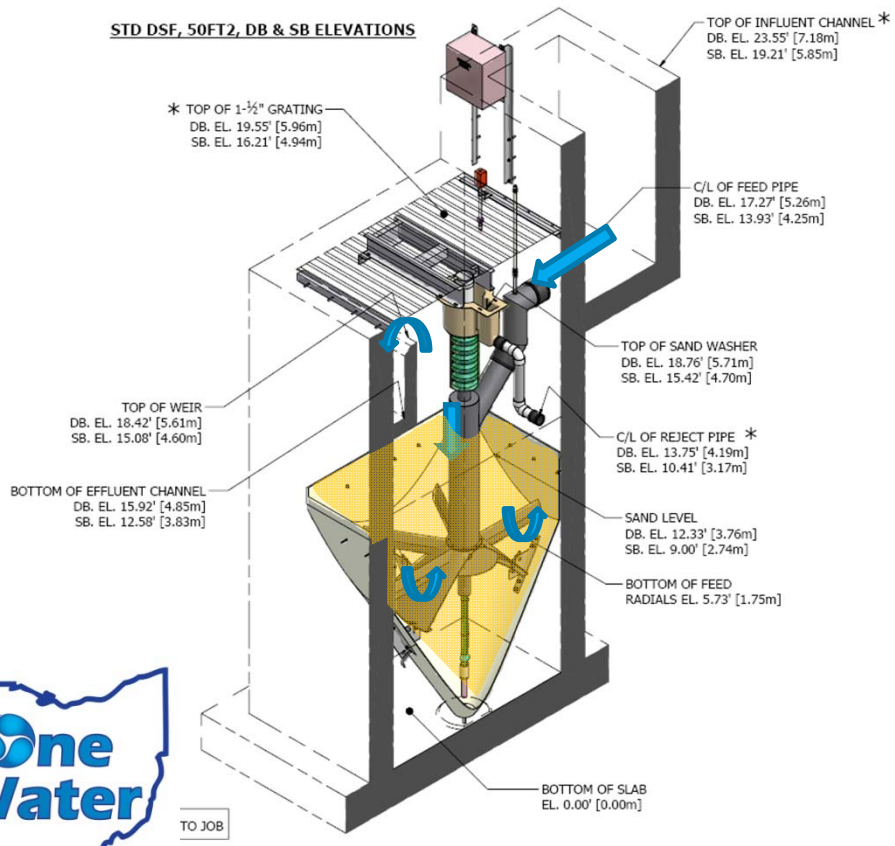
EcoWash is Hybrid of these two. EcoWash uses a continuous filter, but operates it based on solids like a traditional filter, giving the best of both worlds.

DynaSand® EcoWash™ *A Hybrid Filter*

Continuous Filtration

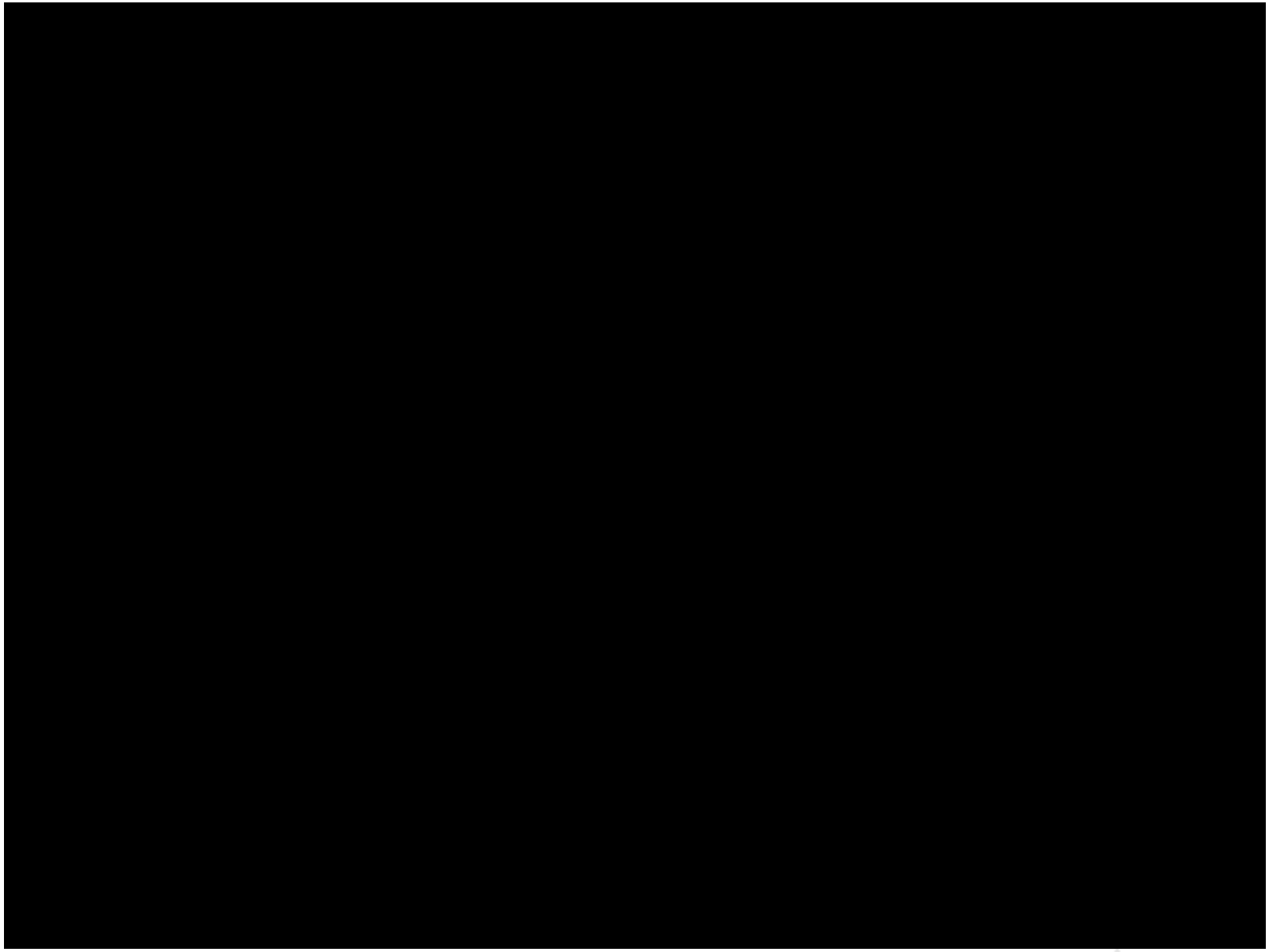
First upflow continuous backwash in America - 1978

A “Continuous” filter is an <u>upflow</u>, <u>deep bed</u>, <u>granular media</u> <u>filter</u> with <u>continuous backwash</u>

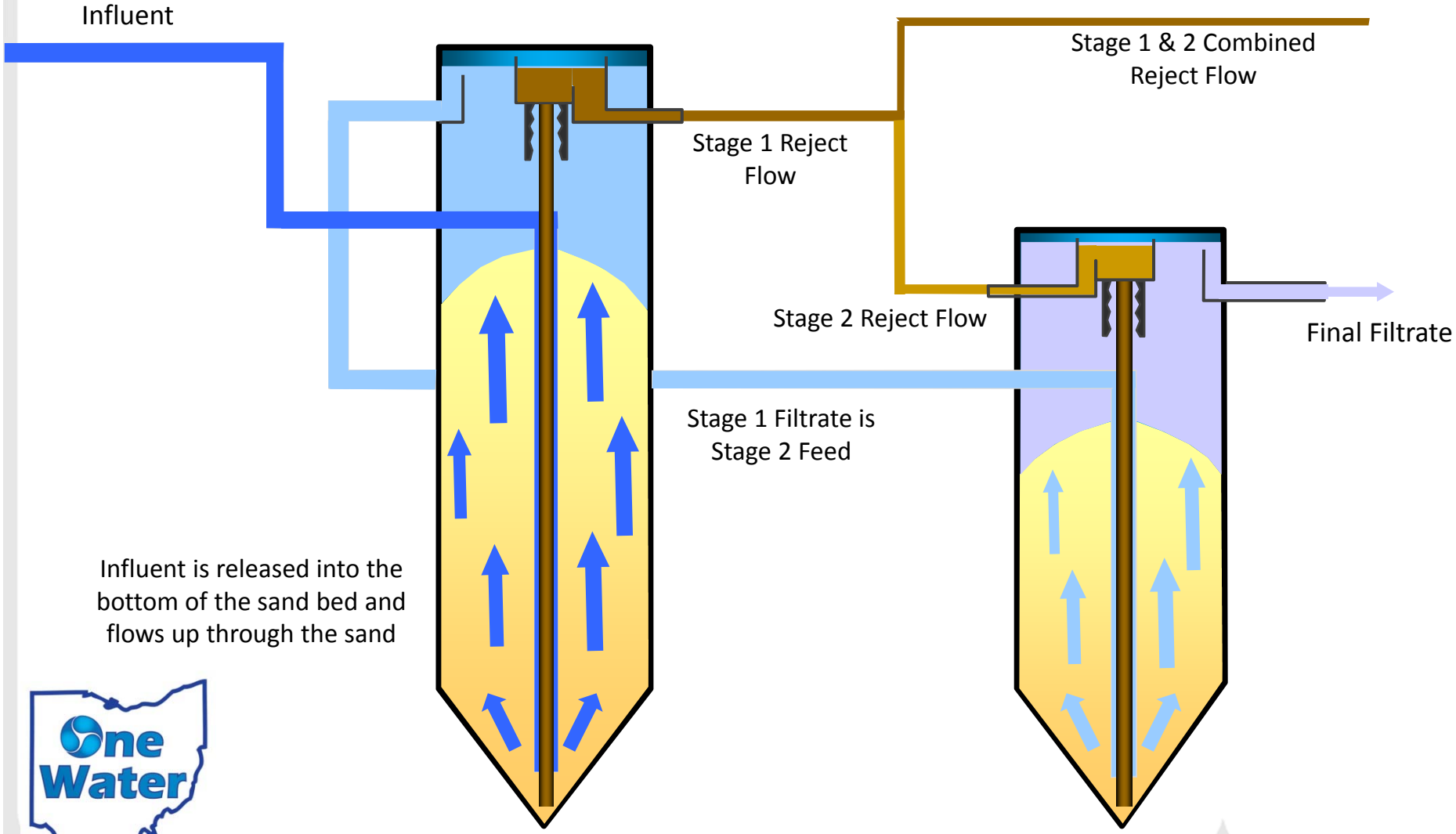


- Up Flow – Dirty water is introduced at the bottom of the sand bed
- Deep Bed – Process is defined as depth filtration as opposed to surface filtration
- Granular Media – Sand (0.9mm or 1.4mm depending on application)
- Filter – Big stuff stays in, small stuff goes out
- Continuous Backwash – Sand is cleaned during regular operation, i.e. no downtime

Process Animation

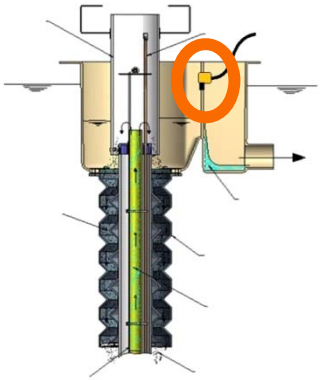


D2™ Configuration



Hybrid Filtration Operation

- EcoWash utilizes a continuous filter but backwashes intermittently when needed as dictated by solids buildup in the filter.
- Backwashing Triggers – At all times, there are two set points. Whichever is reached first triggers a backwash
  - Headloss – When solids build up and head loss increases, a backwash is triggered
  - Time – A timer will limit the amount of time between backwashes regardless of solids
- Control Strategies
  - If the headloss trigger is set more aggressively than the timer, backwashes will be predominantly started based on solids in the filter.
  - If the timer set point is set more aggressively than the headloss set point, backwashes will be predominantly started based on time.
- Sequence of Operation During Backwash
  - Reject Valve is Opened
  - Upper Air Burst
  - Lower Air Burst
  - Normal Air flow



Hybrid Filtration Development

Obstacles to Development

Monitoring

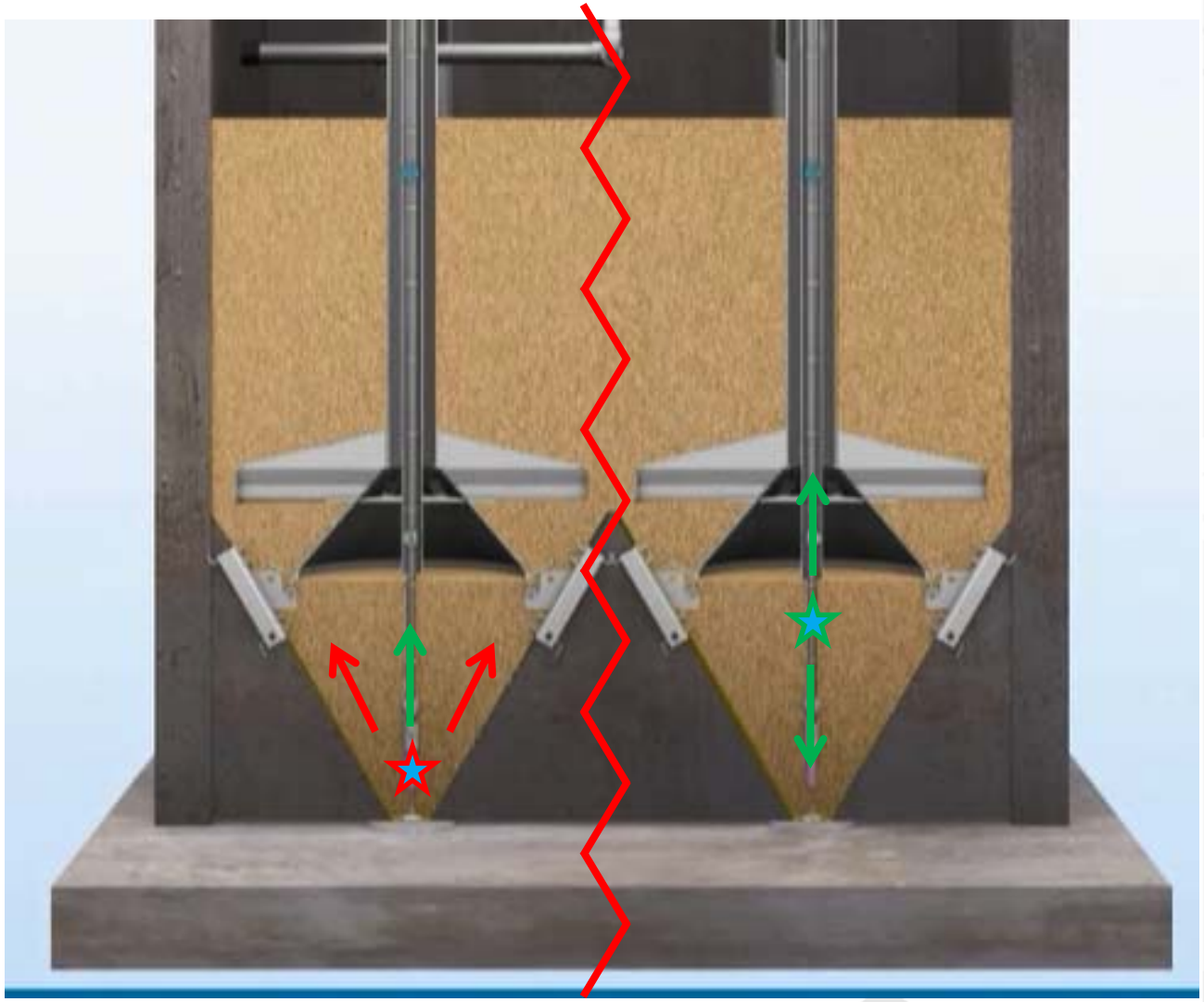
- The Single Largest Obstacle to Overcome – Monitoring of Proper Operation
  - Continuous filters lift sand indirectly
  - Stopping and starting of sand must be monitored
- Monitoring Requirements:
  - Real time and continuous
  - Cost effective
  - Ensure sand washing has initiated
  - Ensure proper sand washing throughout cycle
  - Ensure reject valve closure during off cycles
- EcoWash Monitors the hydraulics within the filter via level sensors to ensure proper operation in real time and at all times
  - Ultrasonic level sensors are cheap and effective
  - Any changes to the filter operation effects filter hydraulic as specific points
  - Utilizing level sensors to monitor proper operation is process and cost effective – The secret of EcoWash

Hybrid Filtration Development

Obstacles to Development (continued)

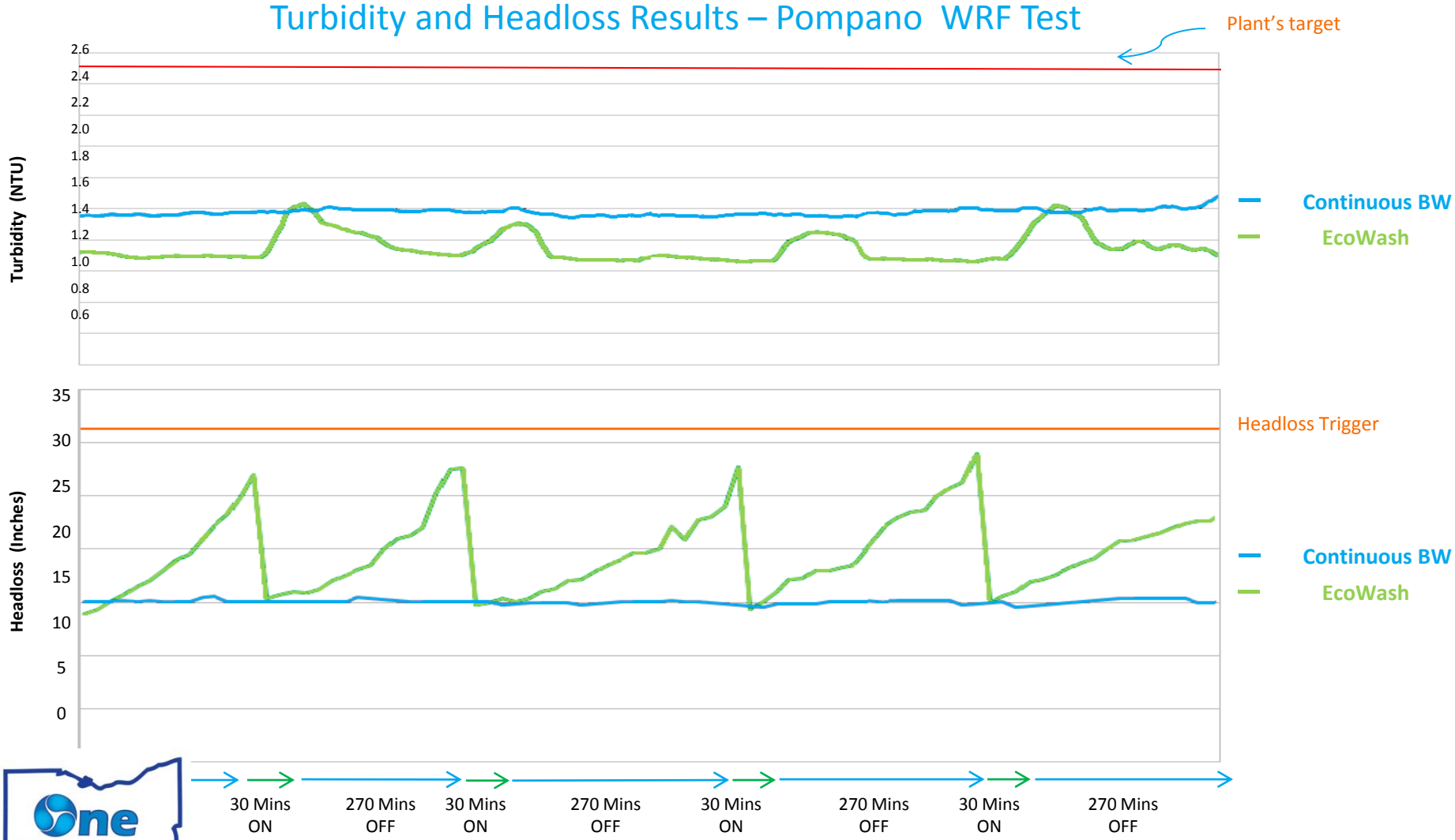
Turbidity Spikes

- When sand cleaning is initiated, the air introduction into the airlift can cause release of solids from the bed
- EcoWash utilizes a dual air burst to act as a “soft start”
- By initiating the first air introduction higher in the airlift, the energy is dissipated within the airlift without effecting the sand bed



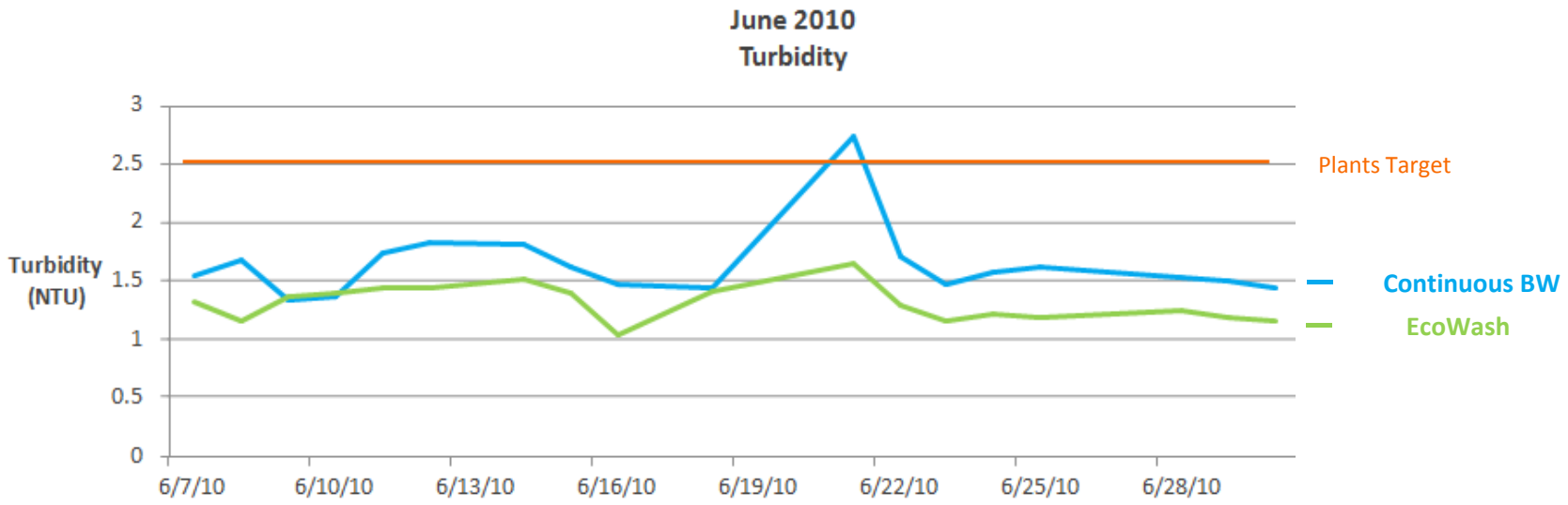
Hybrid Filtration Results

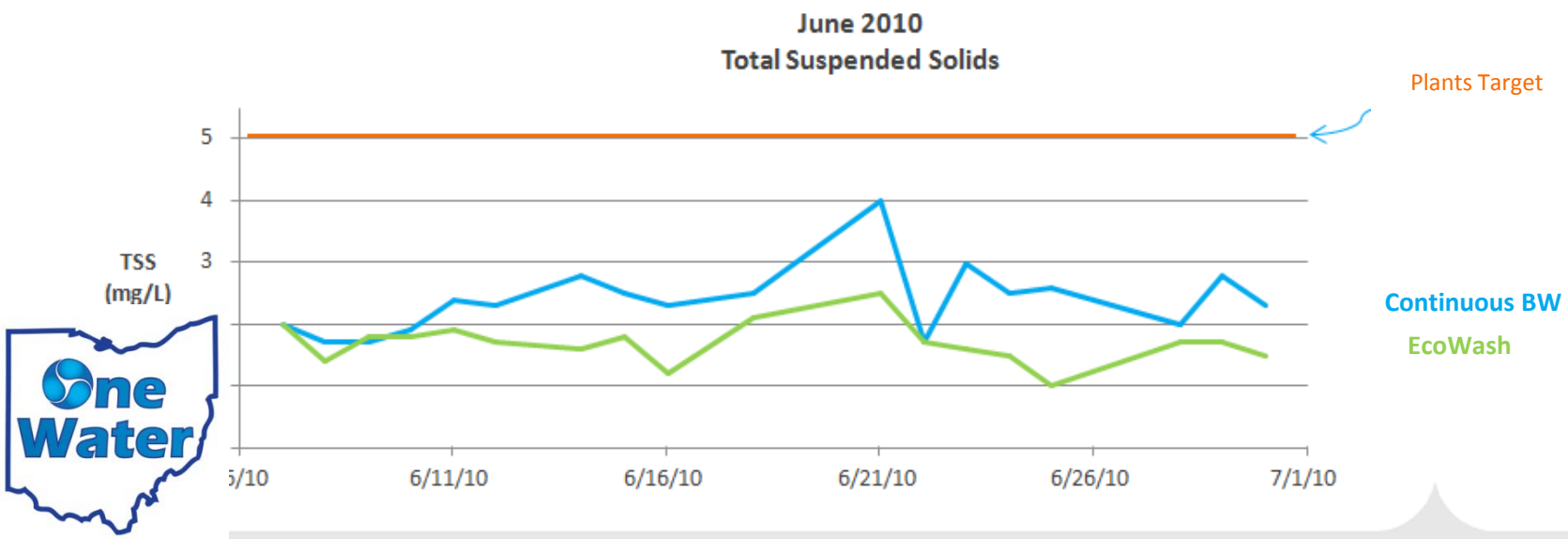
Turbidity and Headloss Results – Pompano WRF Test



Hybrid Filtration Results

Turbidity and TSS Results – Pompano WRF Test





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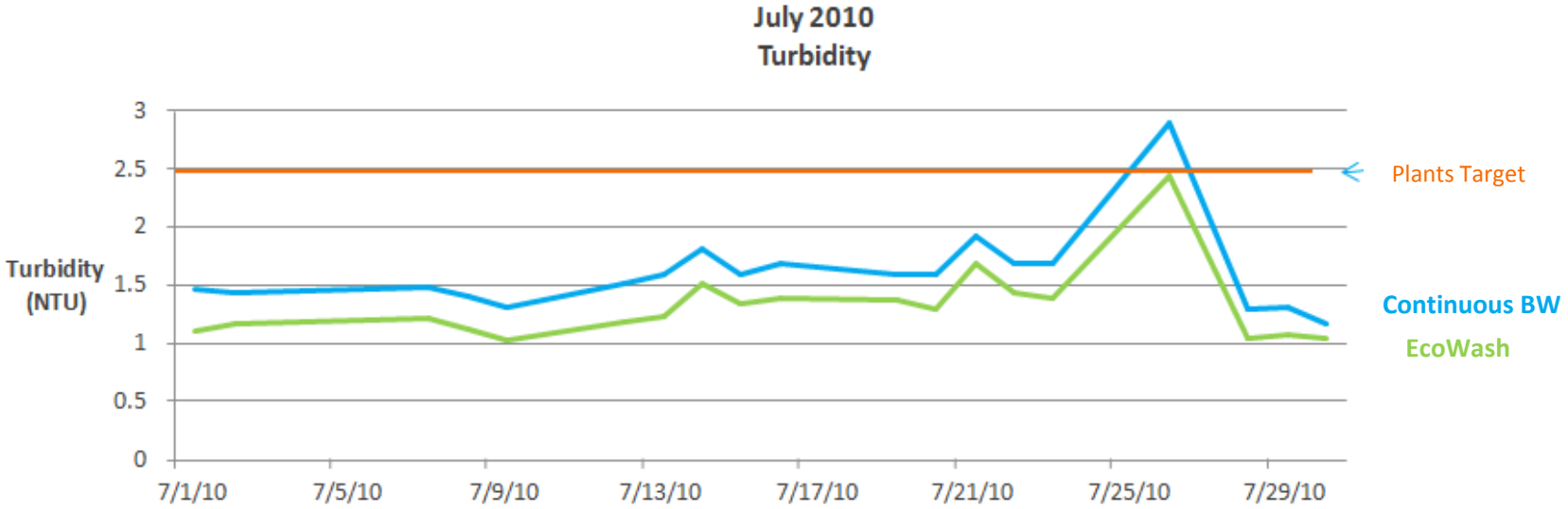
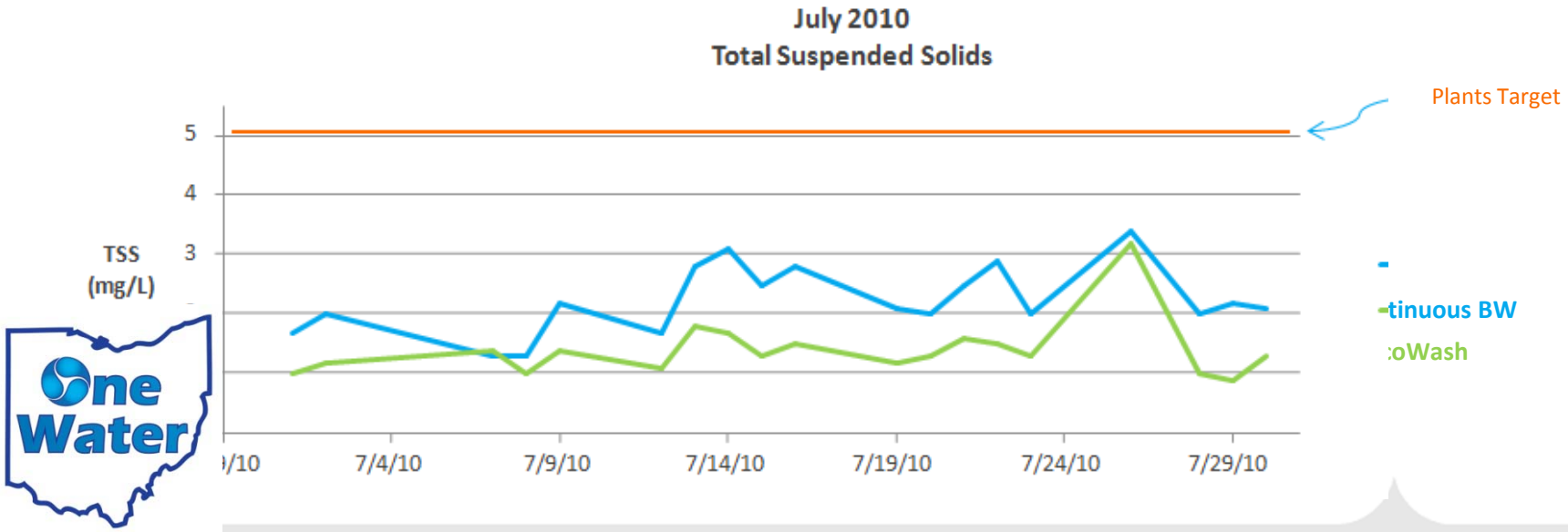




Hybrid Filtration Results

ENR – Case Study

Laurel, DE – Full Scale DynaSand® EcoWash™ ENR installation

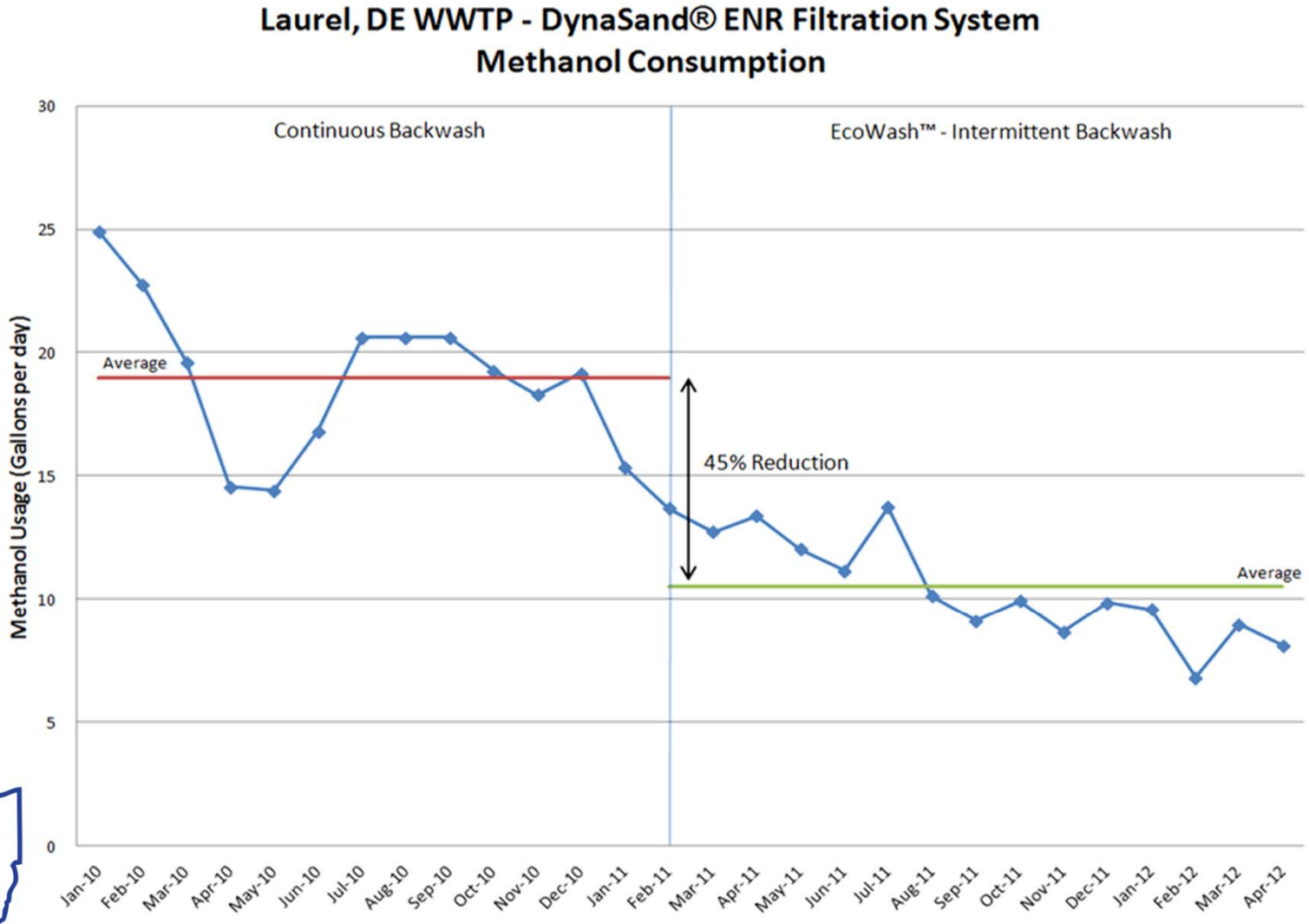
Plant data:

- Design 0.7 MGD ADF
- Current 0.35 MGD ADF
- 2 cells x 3 filters/cell
- CBF* Installed in Jul/2007
- Filters denitrifying since 2009
- Biolac W-Ox upstream
- EcoWash™ operating Feb 2011

*CBF: Continuous Backwash Filter

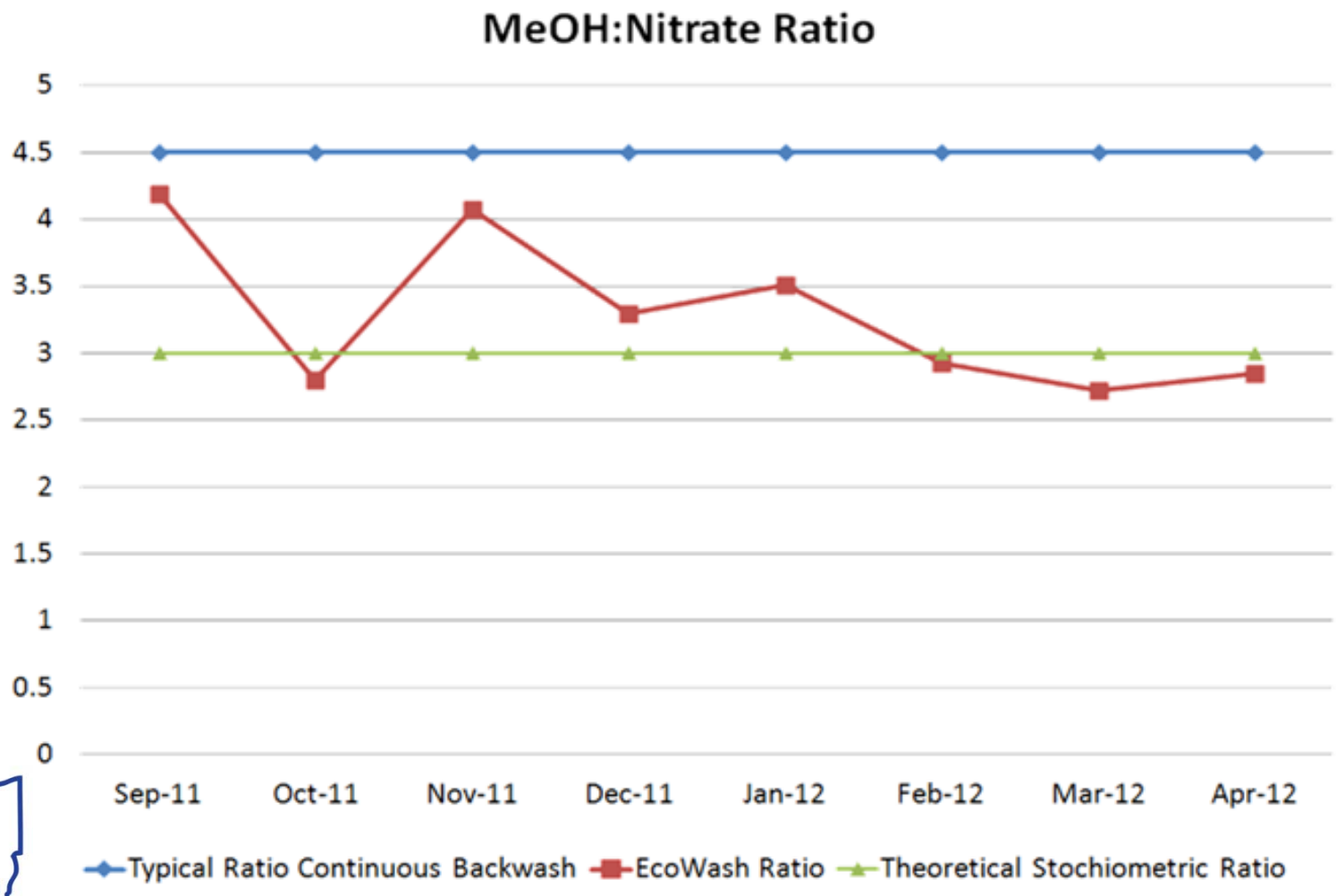
Hybrid Filtration Results

Laurel, DE – ENR Application



Hybrid Filtration Results

Laurel, DE – ENR Application



Hybrid Filtration Results

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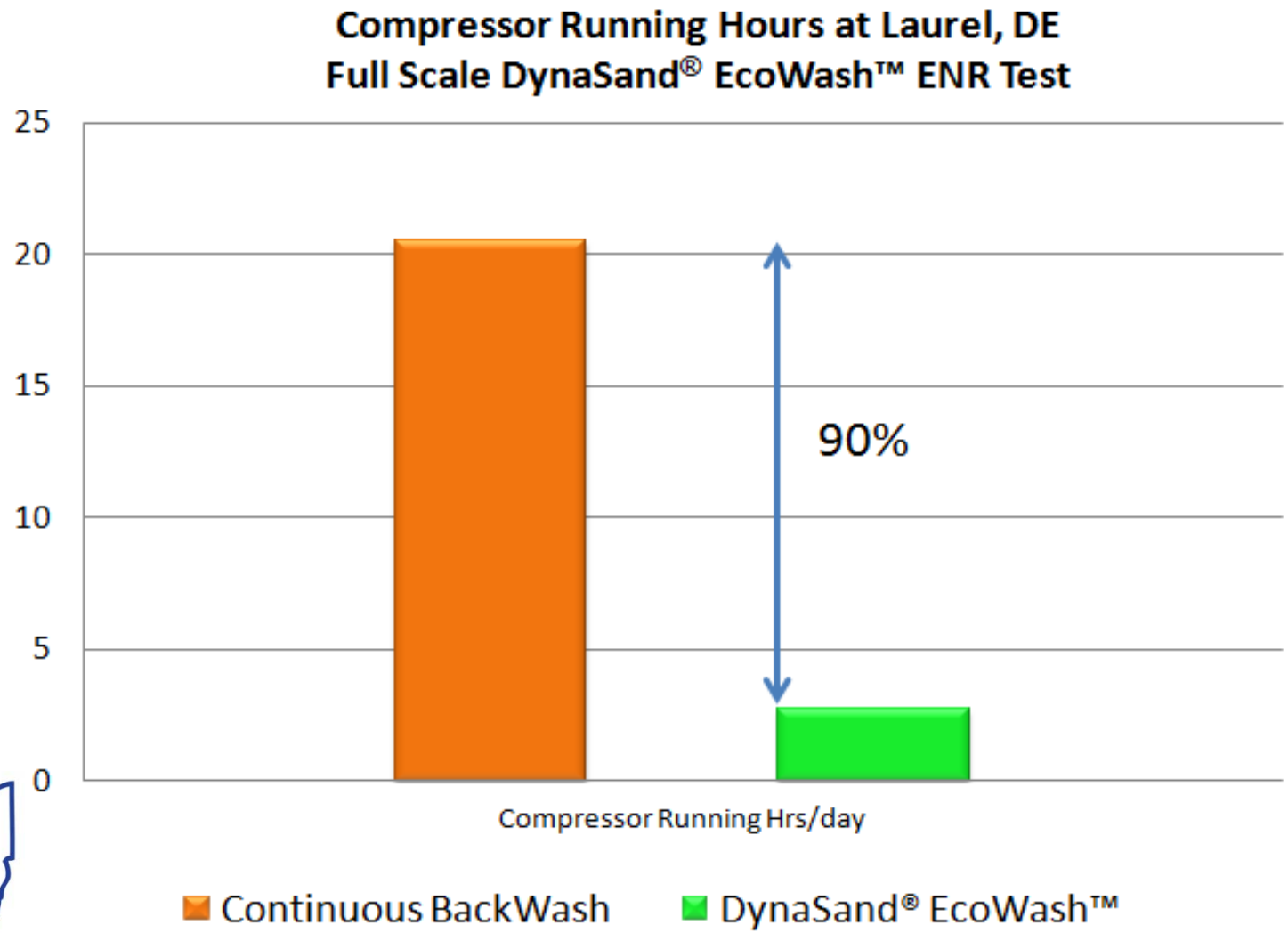

Hybrid Filtration Results

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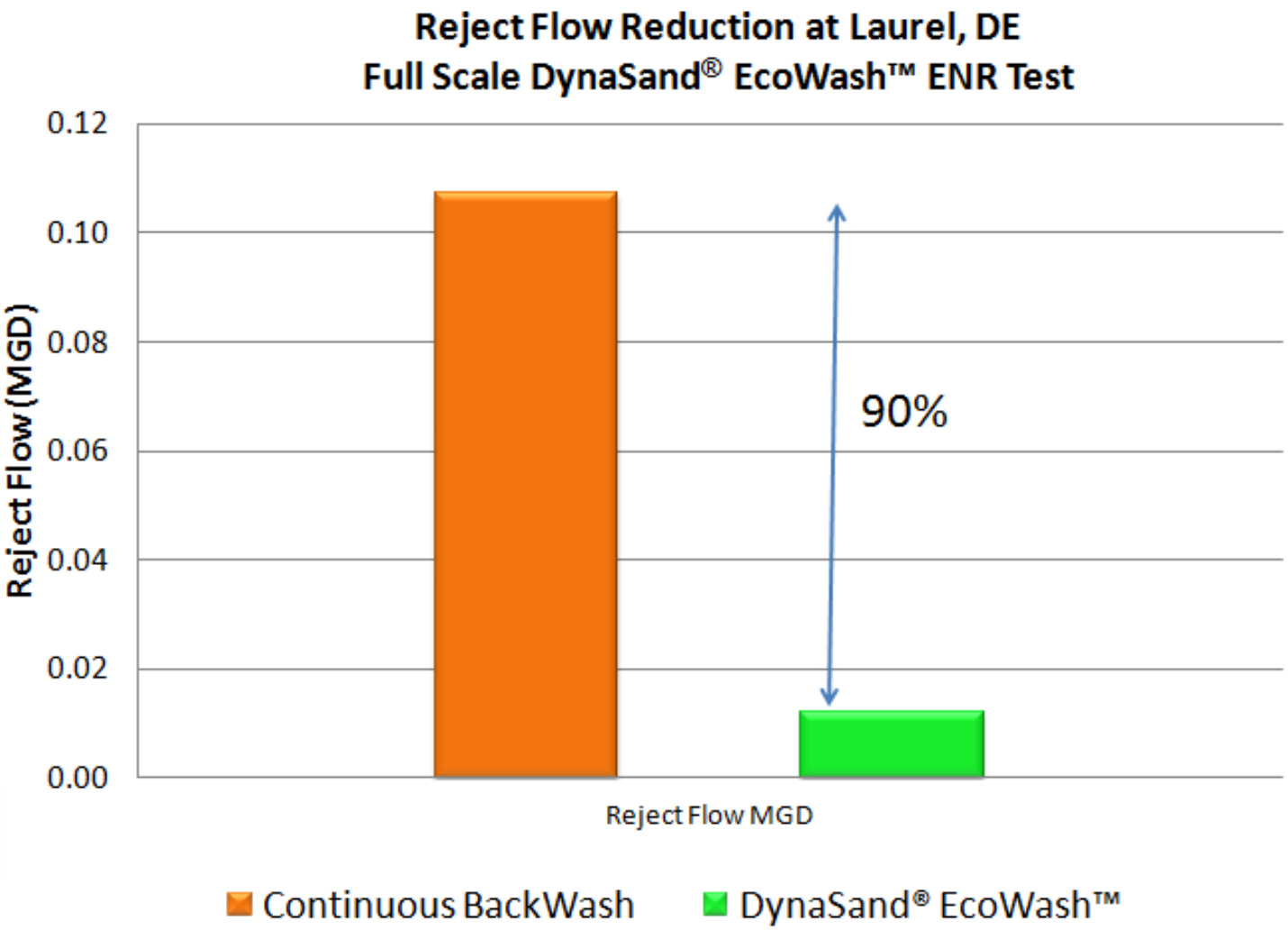
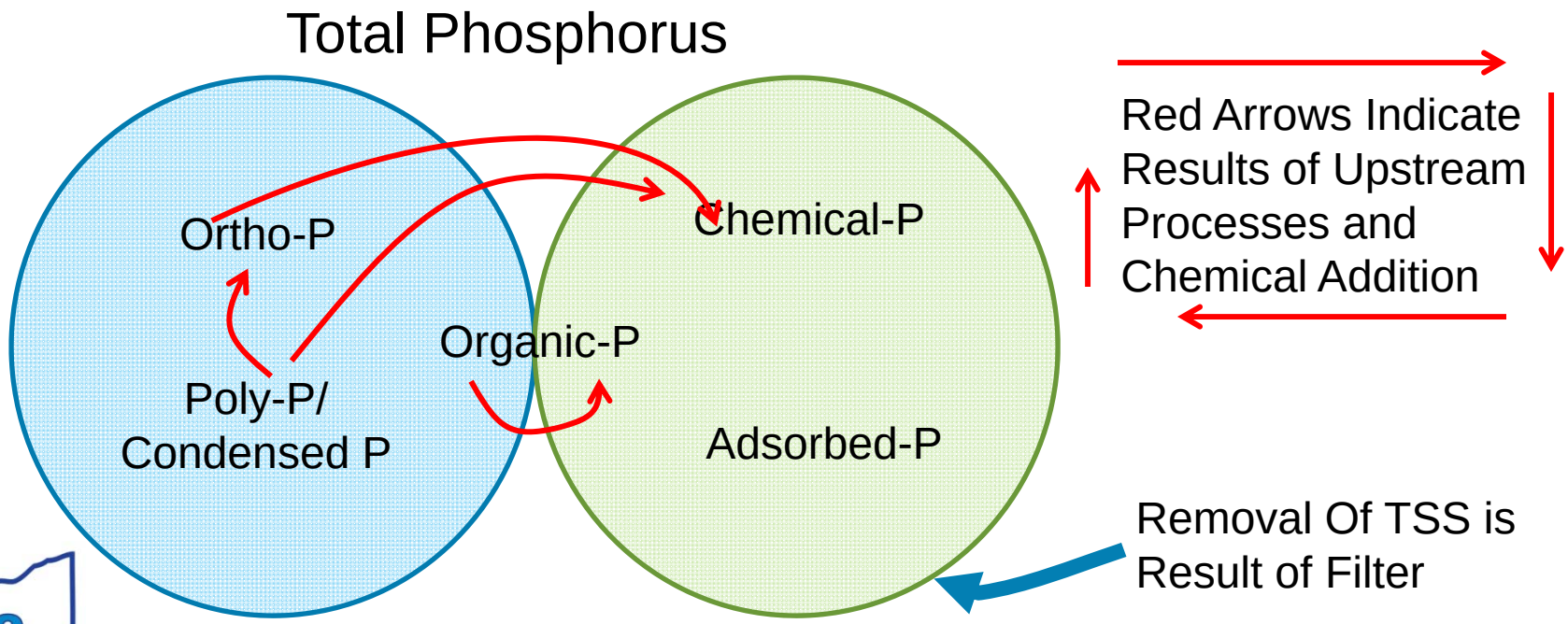


Phosphorus Removal Fundamentals

- Phosphorus Removal
  - Highly Site Specific
  - Dependent Upon Speciation of Phosphorus within waste stream
  - <u>Sand filters Remove TSS</u>
  - Chemical Addition and Reactivity of Phosphorus outside of Sand filter Itself



Hybrid Filtration Pilot

Pilot Goals and Schedule

- Definition of pilot success
  - Relative effectiveness of hybrid filtration
  - More effective removal of filterable P
  - Not absolute TP removal
- Pilot Schedule
  - Run Dual Stage Filter w/o EcoWash
  - Run Dual Stage Filter w/ EcoWash
  - Run Dual Stage Filter w/o Ecowah
  - Take data samples at effluent of each stage

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50 YEARS 2010

Questions

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One Water