



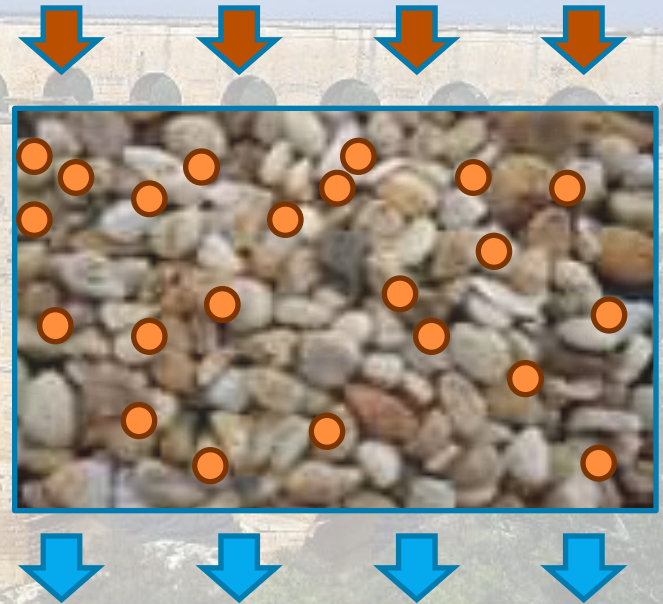
## Hybrid Sand Filtration

10/9/2014

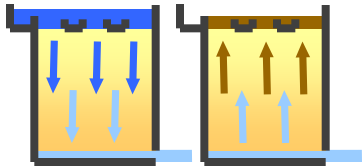
# Sand Filtration Basics

- 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

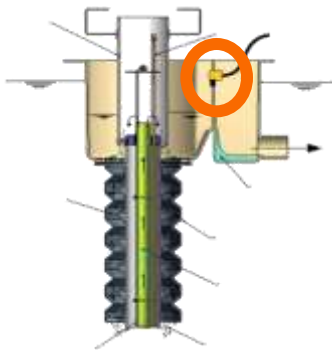
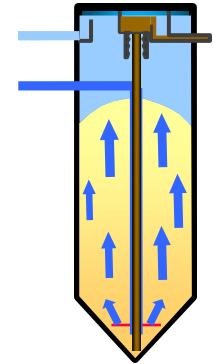


## Hybrid Filtration Basics



Traditional filters backwash based upon solids, which can be better for performance, but require redundant filters and ancillary 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.

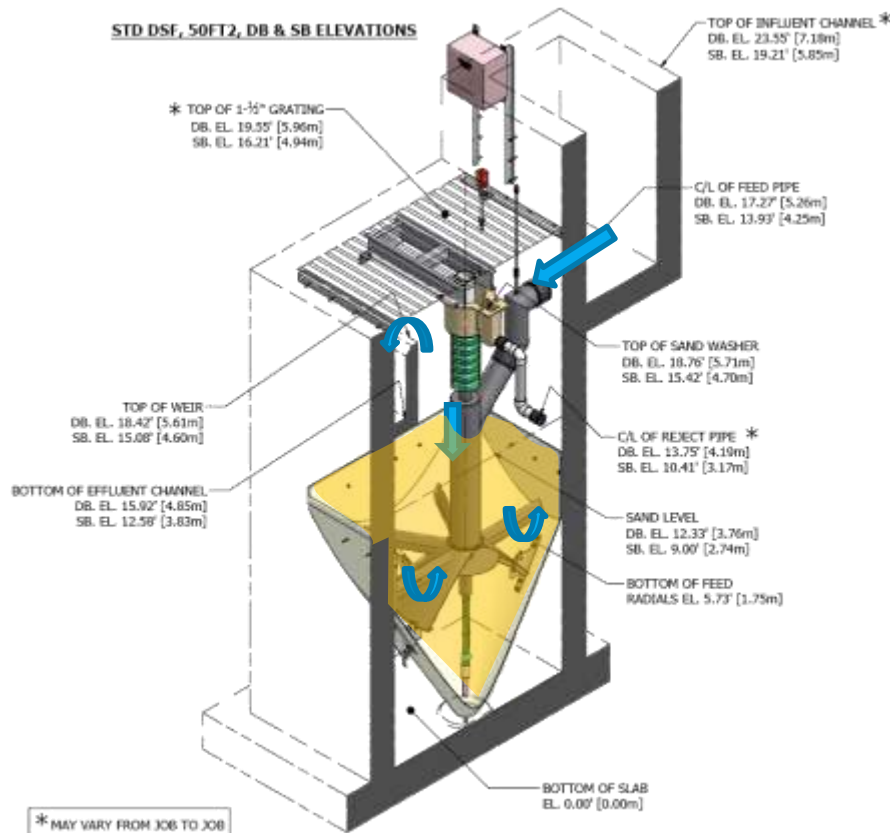


DynaSand® **EcoWash™** *A Hybrid Filter*

# Continuous Filtration

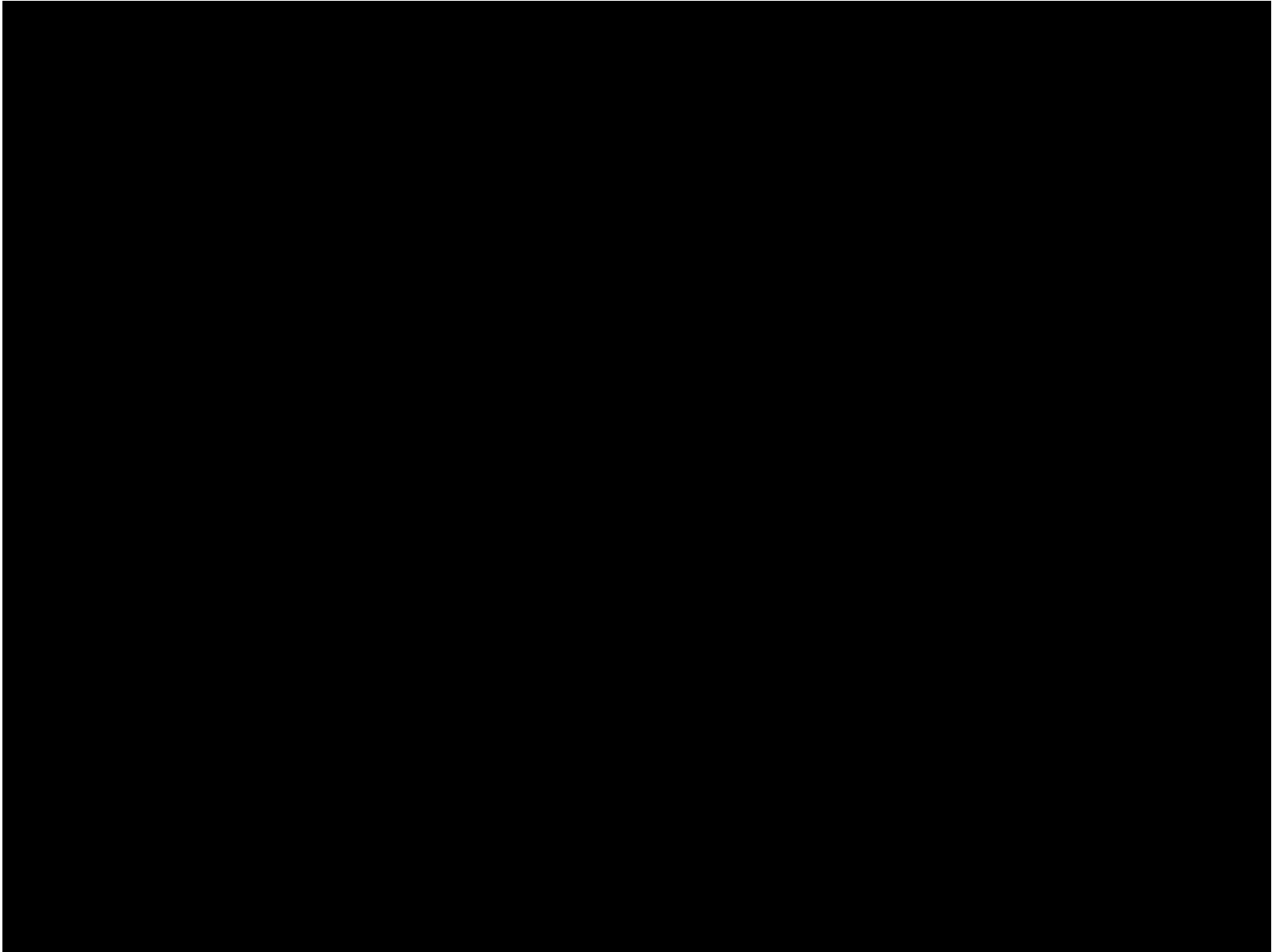
*First upflow continuous backwash in America - 1978*

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



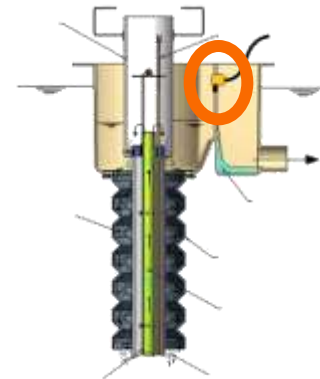
- Up Flow – Dirty water is introduced at the bottom of the sand bed
- Deep Bed – Process is defined as depth filtration as opposed to surface filtration
- Granular Media – Sand (0.9mm or 1.4mm depending on application)
- Filter – Big stuff stays in, small stuff goes out
- Continuous Backwash – Sand is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

# Process Animation



# 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

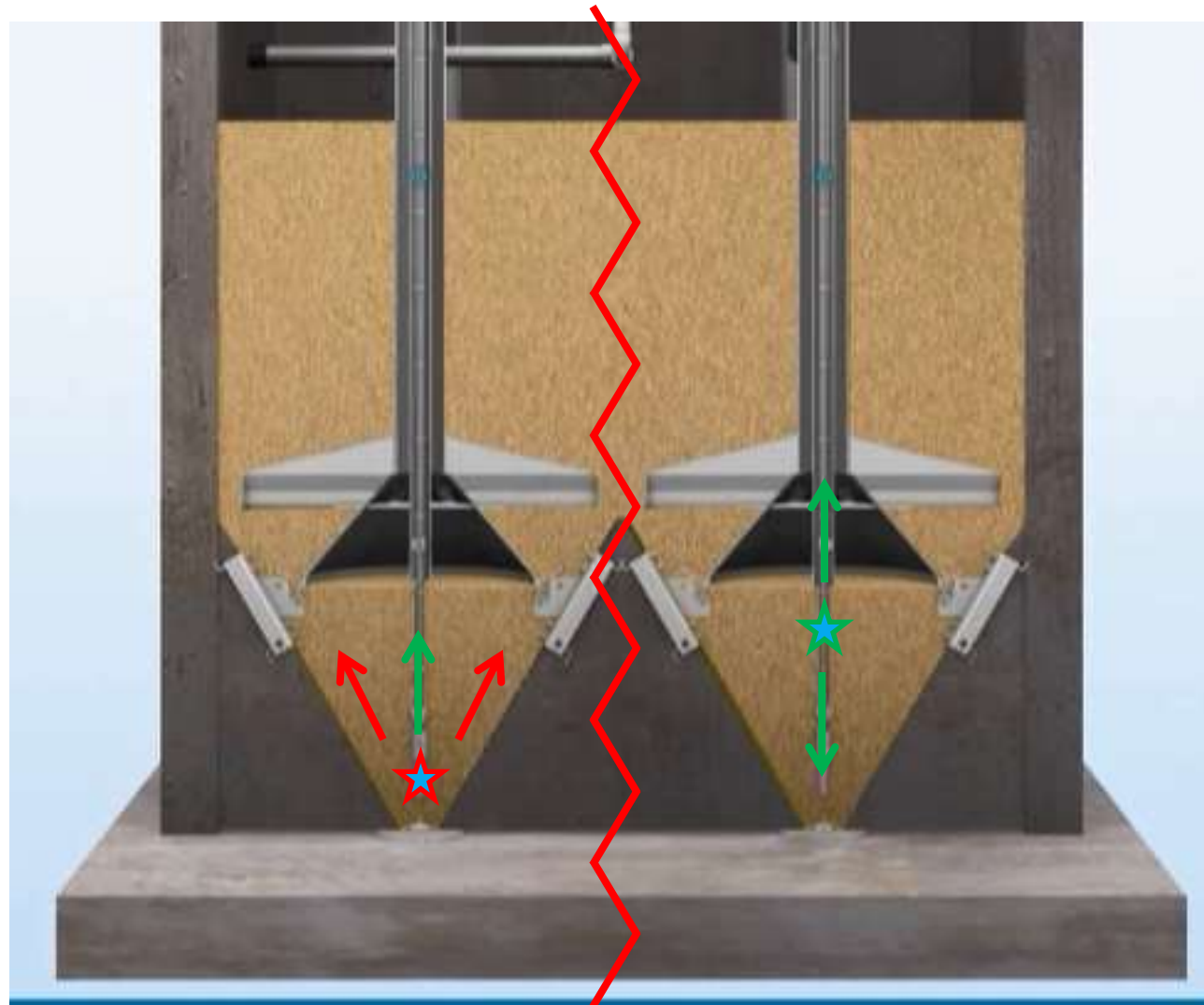
- The Single Largest Obstacle to Overcome – Monitoring of Proper Operation
  - Continuous filters lift sand indirectly
  - Stopping and starting of sand must be monitored
- Monitoring Requirements:
  - Real time and continuous
  - Cost effective
  - Ensure sand washing has initiated
  - Ensure proper 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)

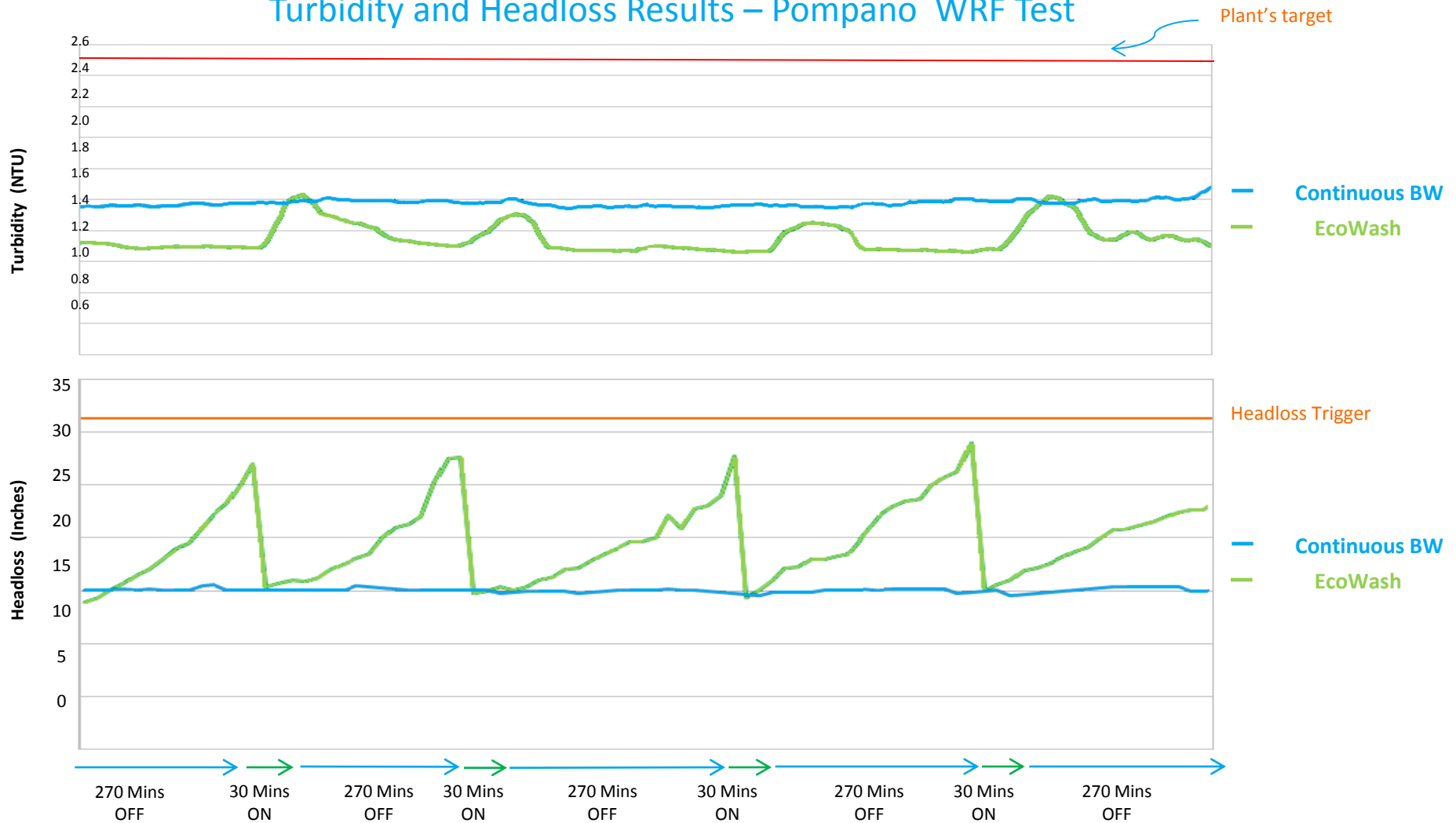
### Turbidity Spikes

- 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



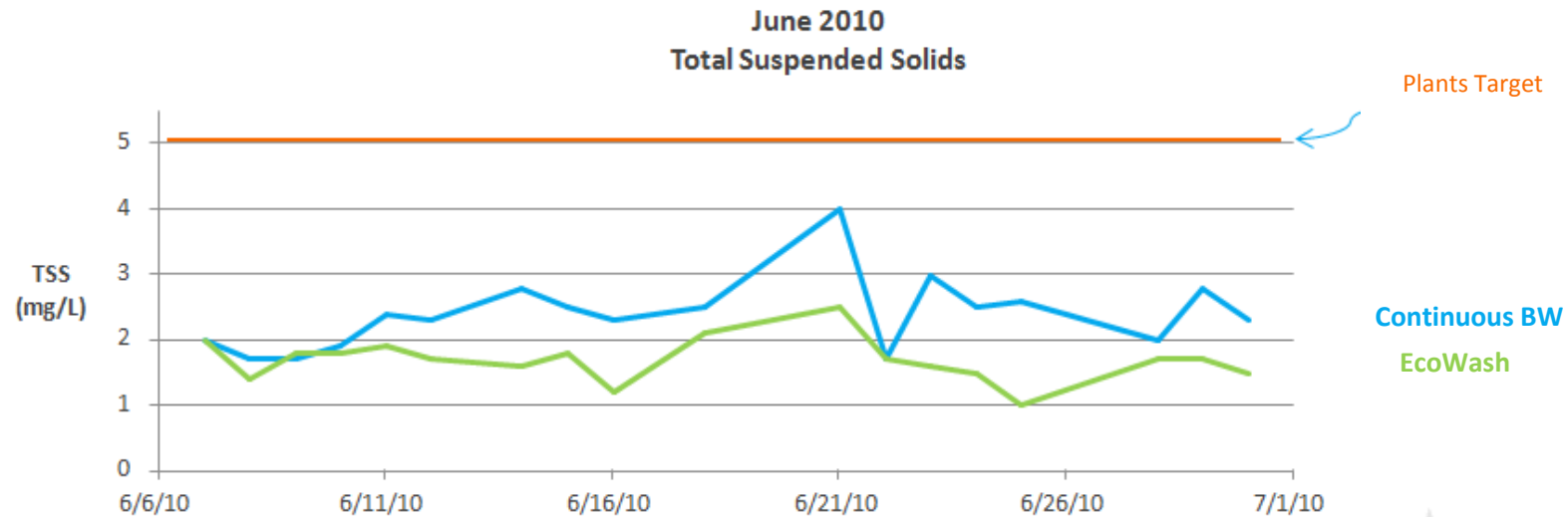
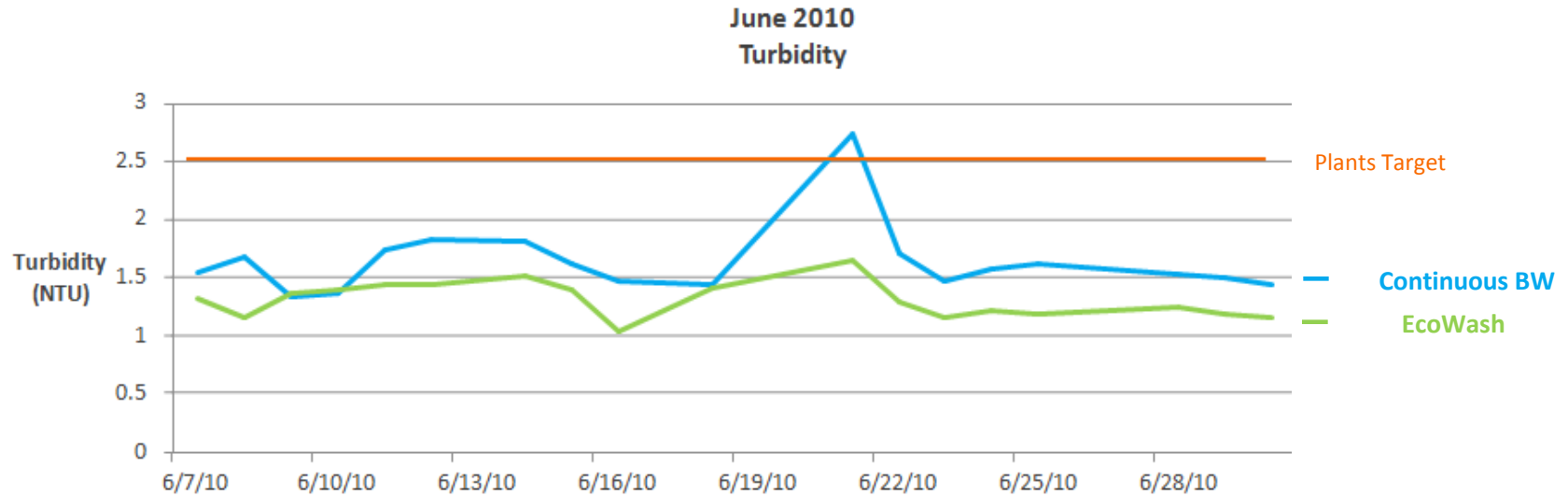
# Hybrid Filtration Results

## Turbidity and Headloss Results – Pompano WRF Test



# Hybrid Filtration Results

## Turbidity and TSS Results – Pompano WRF Test

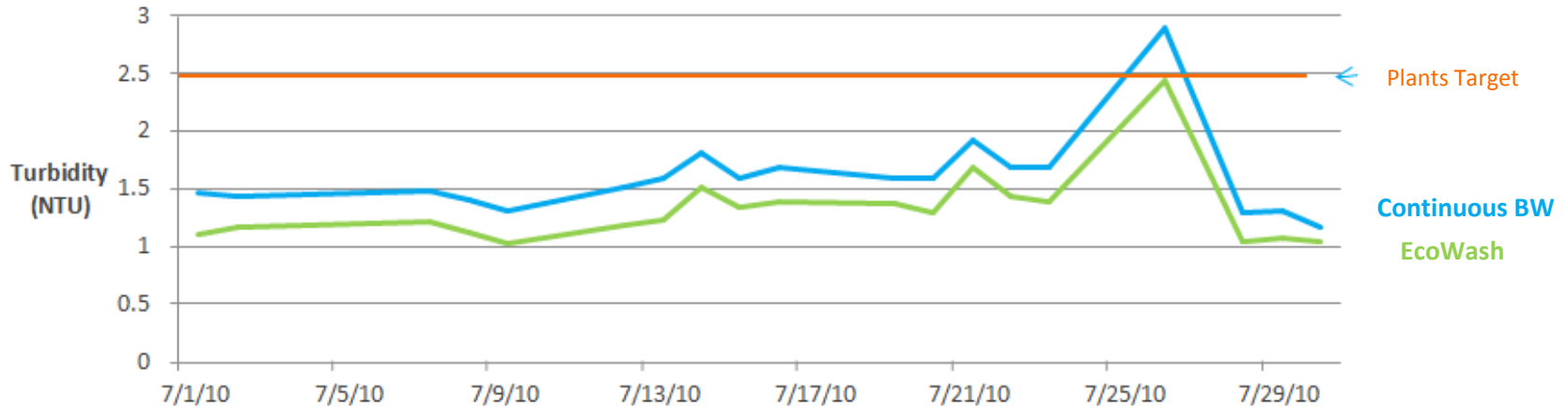


# Hybrid Filtration Results

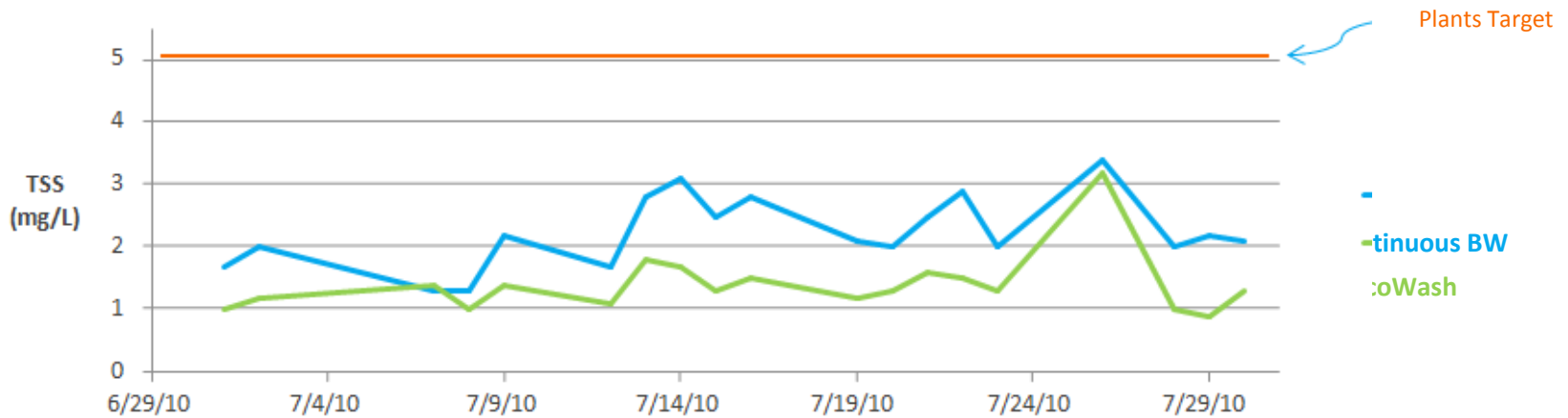
## Turbidity and TSS Results – Pompano WRF Test

July 2010

Turbidity



July 2010  
Total Suspended Solids



# 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

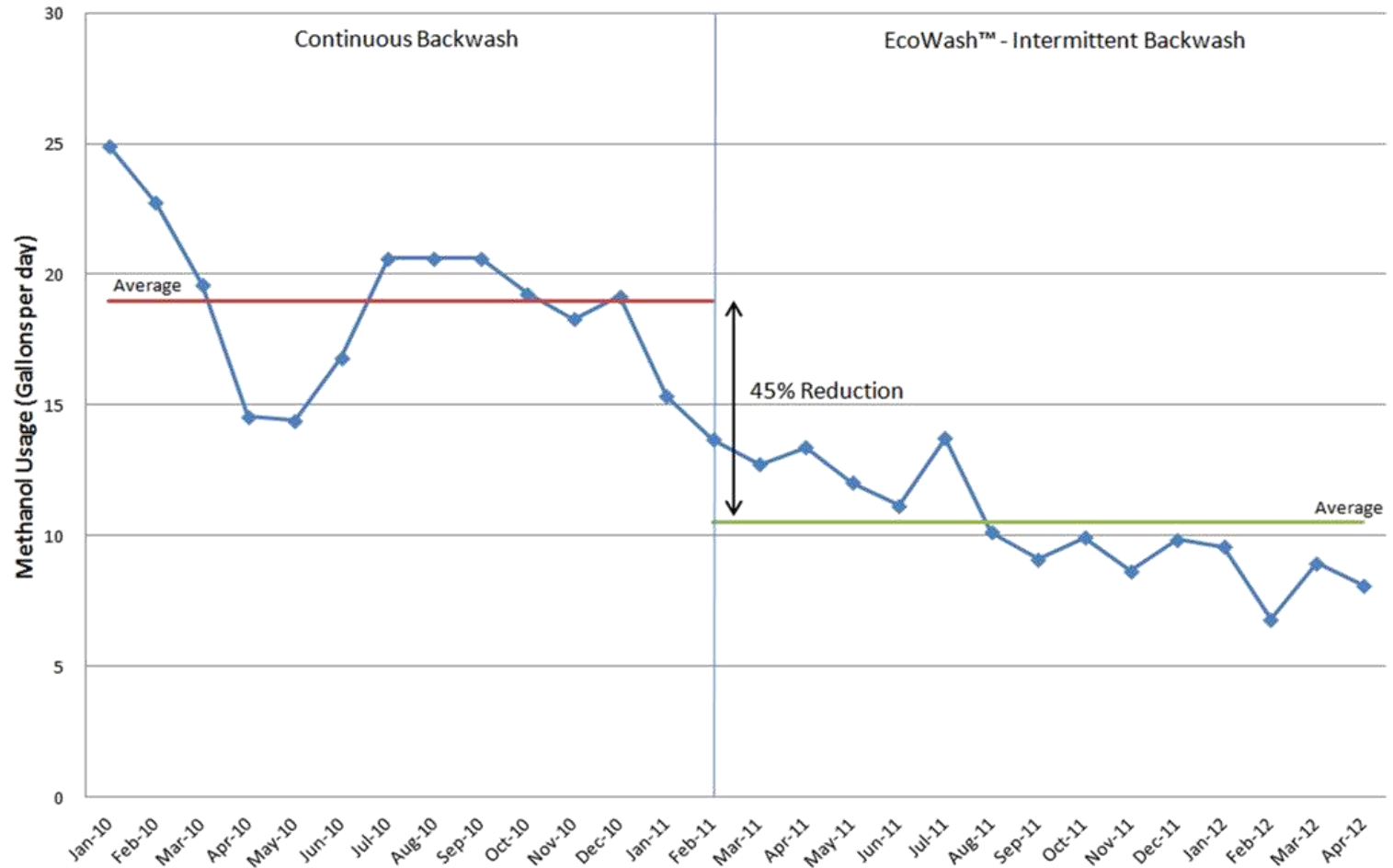


\*CBF: Continuous Backwash Filter

# Hybrid Filtration Results

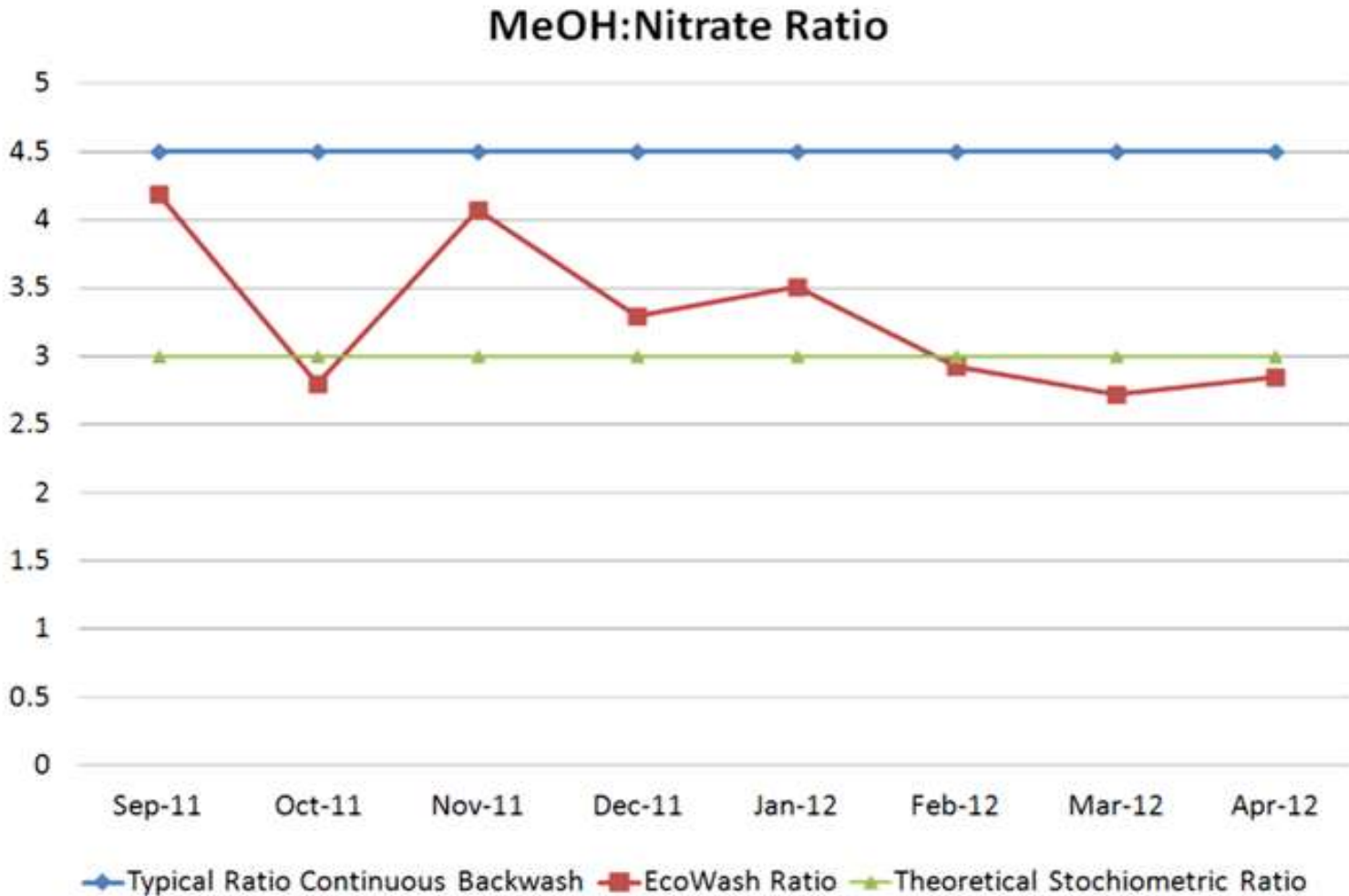
## Laurel, DE – ENR Application

Laurel, DE WWTP - DynaSand® ENR Filtration System  
Methanol Consumption



# Hybrid Filtration Results

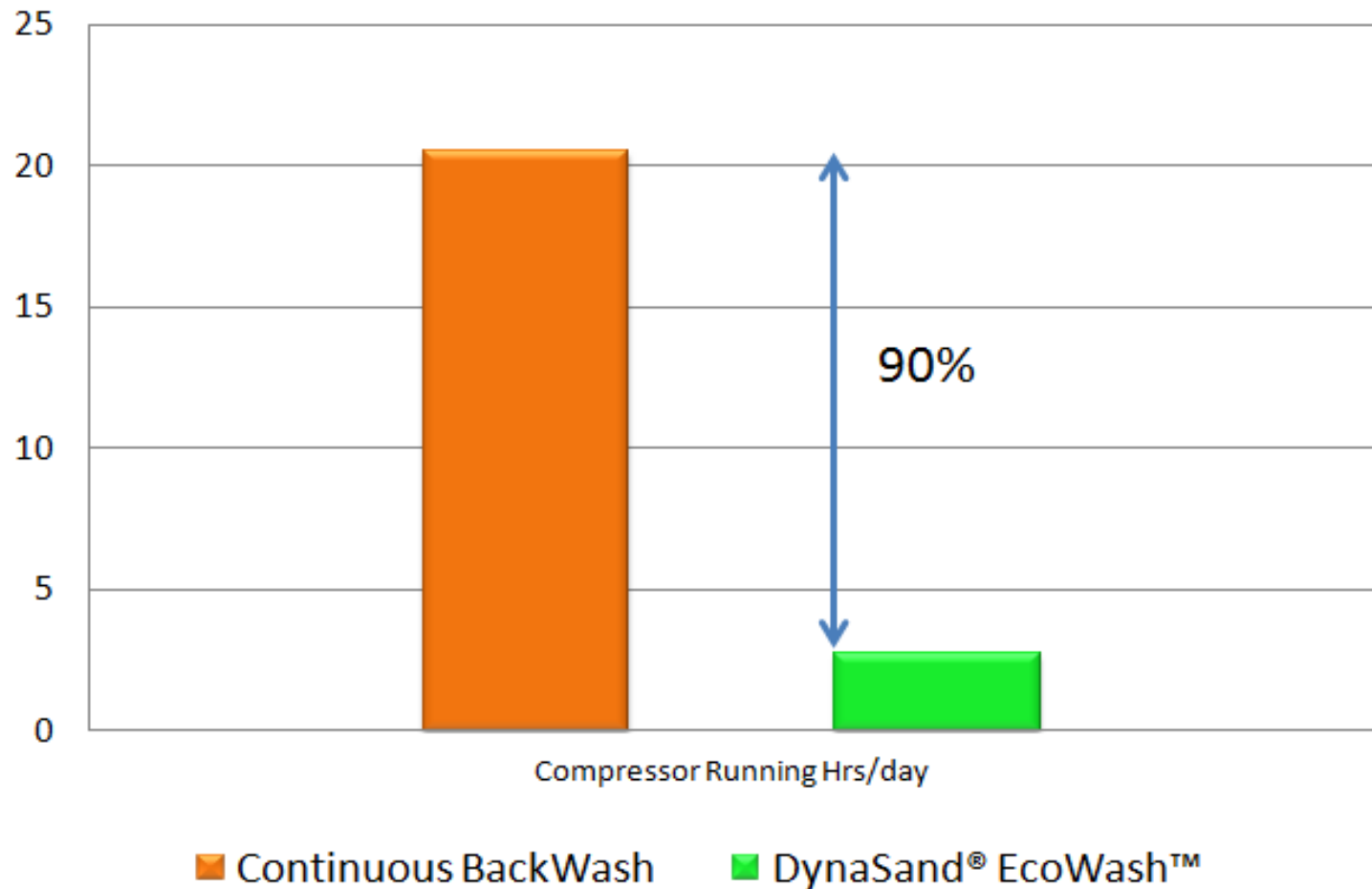
## Laurel, DE – ENR Application



# Hybrid Filtration Results

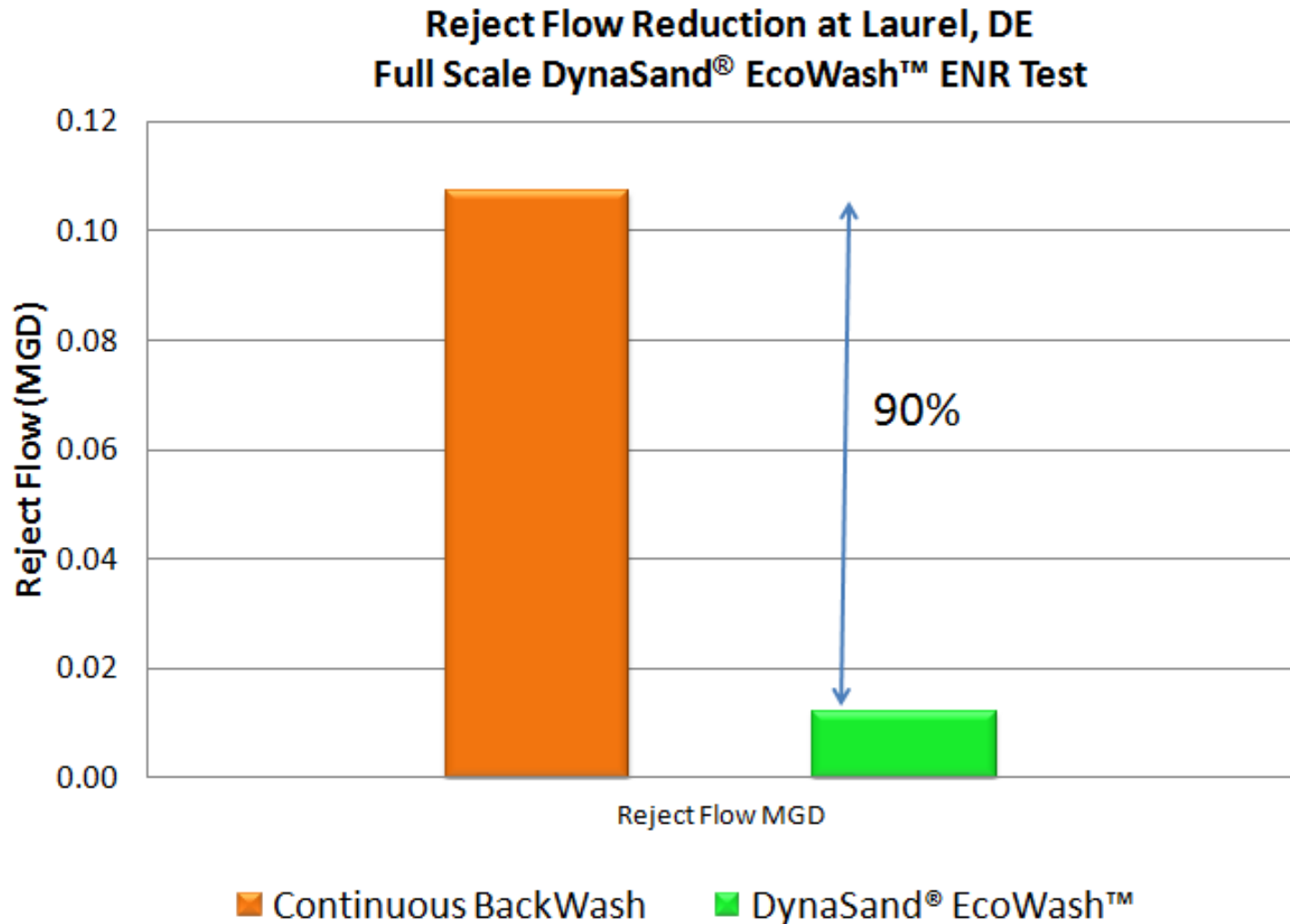
## Laurel, DE – ENR Application

**Compressor Running Hours at Laurel, DE  
Full Scale DynaSand® EcoWash™ ENR Test**



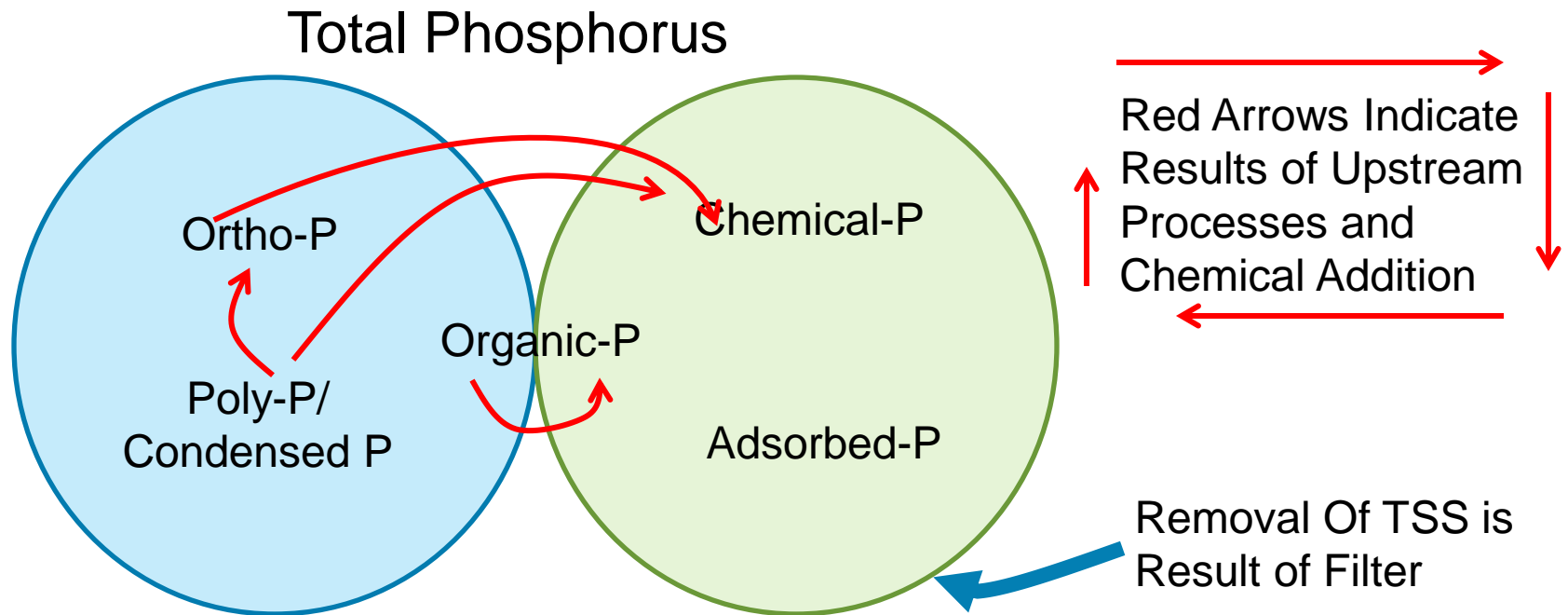
# Hybrid Filtration Results

## Laurel, DE – ENR Application



# Phosphorus Removal Fundamentals

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



# Hybrid Filtration Pilot

## Pilot Goals and Schedule

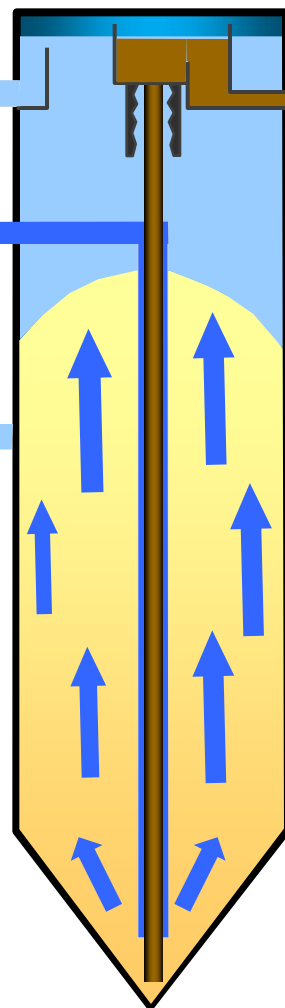
- Definition of pilot success
  - Relative effectiveness of hybrid filtration
  - More effective removal of filterable P
  - Not absolute TP removal
- Pilot Schedule
  - Run Dual Stage Filter w/o EcoWash
  - Run Dual Stage Filter w/ EcoWash
  - Run Dual Stage Filter w/o Ecowah
  - Take data samples at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



# D2™ Configuration

Influent

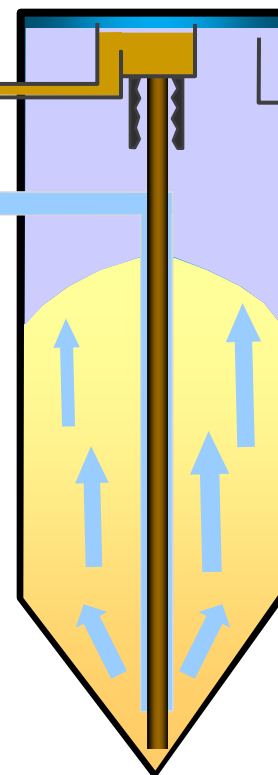
Influent is released into the bottom of the sand bed and flows up through the sand



Stage 1 Reject Flow

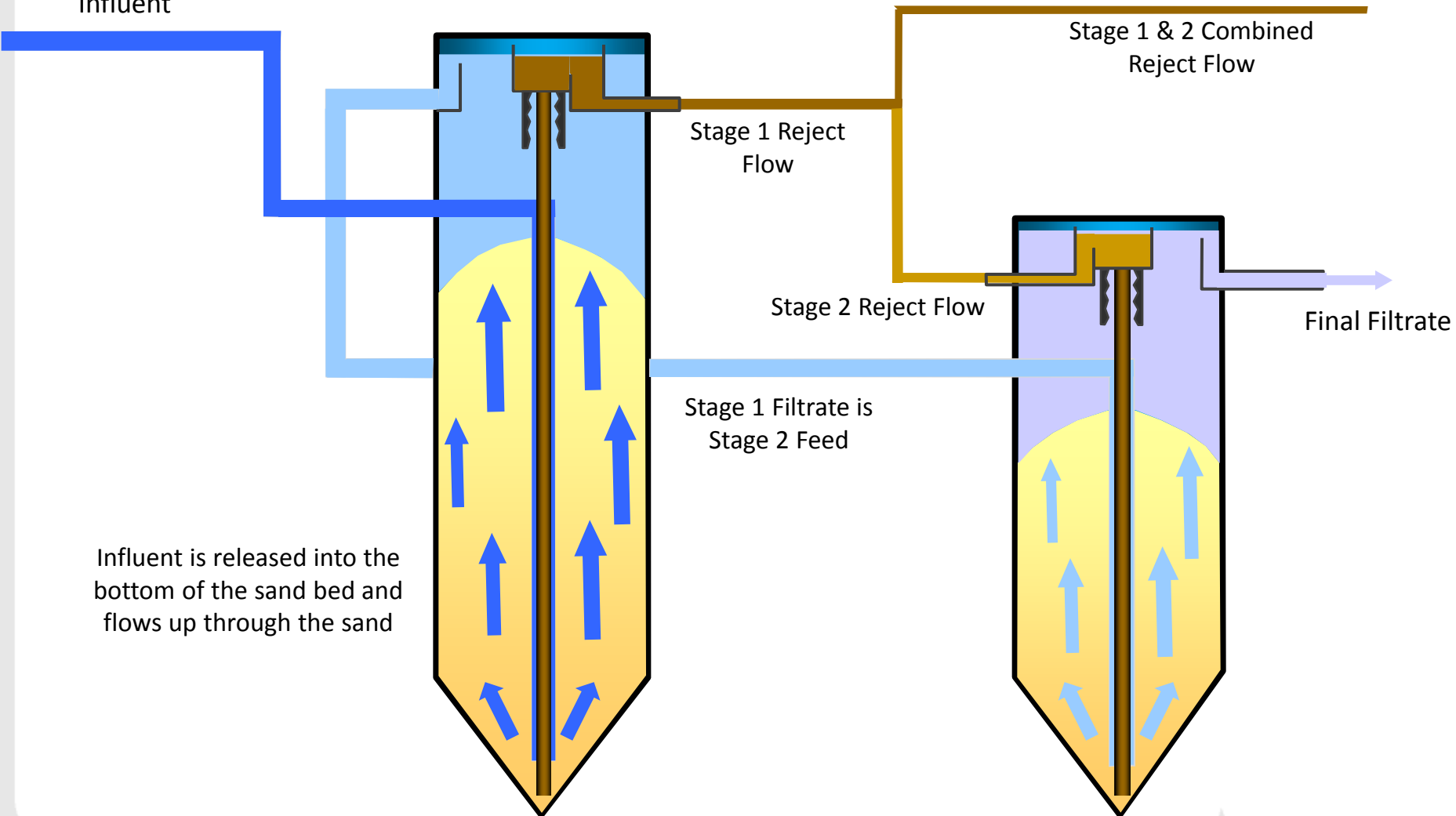
Stage 1 Filtrate is Stage 2 Feed

Stage 2 Reject Flow



Stage 1 & 2 Combined Reject Flow

Final Filtrate



# Hybrid Filtration Pilot Results



- Pilot began in late winter 2014
- Multiple weather related delays
  - Pipe bursts due to cold weather
  - Low influent phosphorus
  - High removals at Ferric doses over 25 mg/L precluded good comparative data
- Data gathering did not begin until August of 2014
- Two of weeks of usable data (with all controls to compare w/ and w/o EcoWash)
- Pilot and staff needed to be moved to other locations
- In Planning stages of utilizing new D2 EcoWash Installation in WI (Requesting Anonymity at this time) to continue testing
- Unofficial Results (OP4 Removal at 15 mg/L dose Ferric – Averages of composite data)

	<b>Influent</b>	<b>Stage 1 Effluent</b>	<b>Stage 1 % Removal</b>	<b>Stage 2 Effluent</b>	<b>Stage 2 % Removal</b>
Hybrid	0.24	0.08	66%	0.07	69%
Continuous	0.26	0.19	27%	0.18	31%



DynaSand® EcoWash™ *A Hybrid Filter*



Questions

Omar Gadalla, PE  
ogadalla@parkson.com  
954-917-1880  
Parkson Corporation  
1401 West Cypress Creek Road  
Suite 100  
Fort Lauderdale, FL 33309