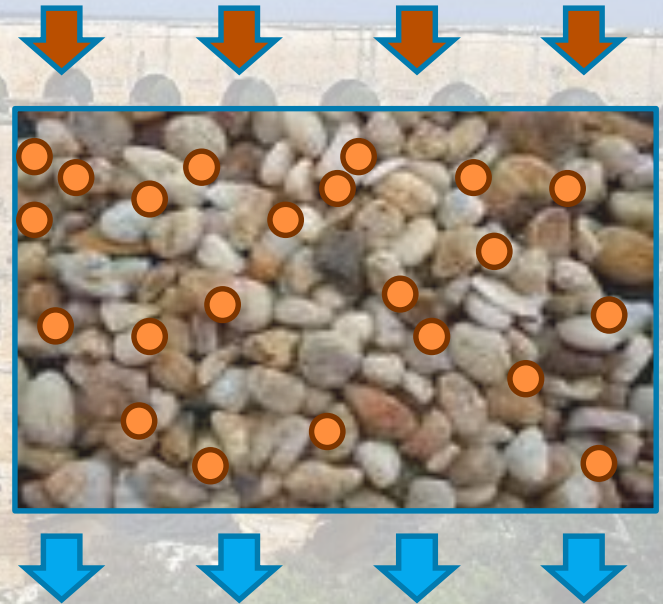# Hybrid Sand Filtration

February 18, 2015
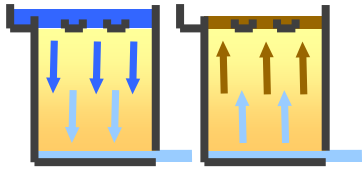
Sand Filtration Basics

- **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**
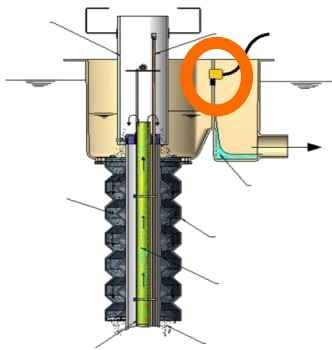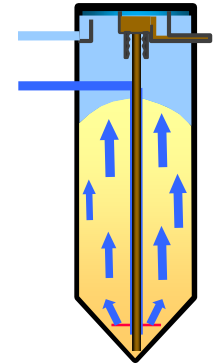
Granular Media Filtration

Hybrid Filtration Basics

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

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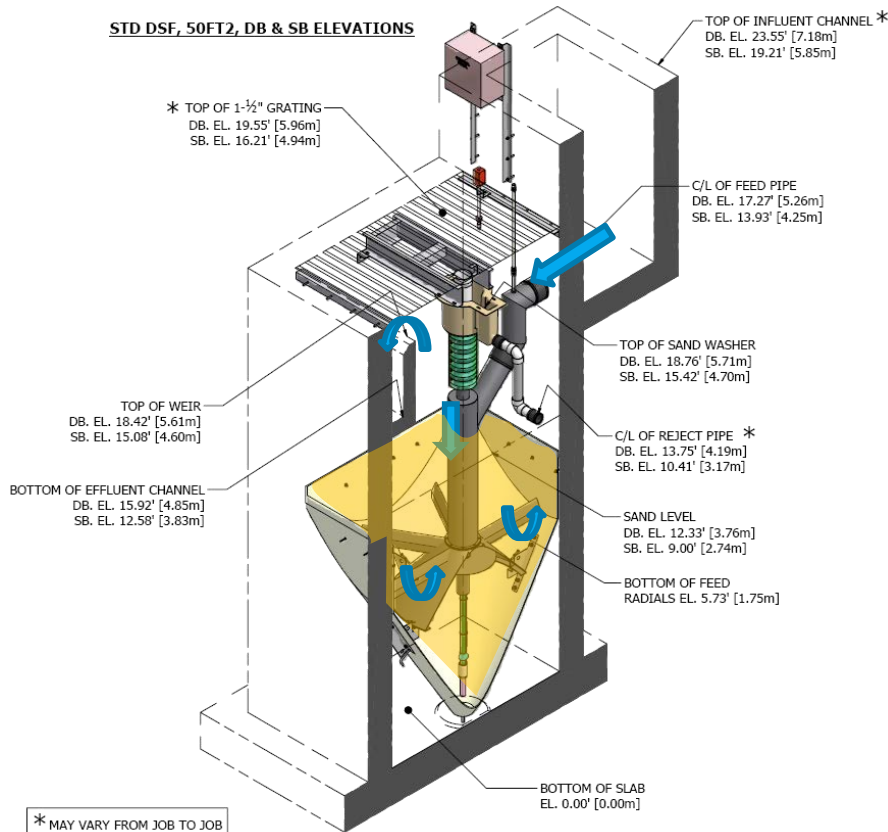

EcoWash is Hybrid of these two. EcoWash uses a continuous filter, but operates it based on solids like a traditional filter, giving the best of both worlds.

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>

STD DSF, 50FT2, DB & SB ELEVATIONS

TOP OF INFLUENT CHANNEL ✱
DB. EL. 23.55' [7.18m]
SB. EL. 19.21' [5.85m]

✱ TOP OF 1-½" GRATING
DB. EL. 19.55' [5.96m]
SB. EL. 16.21' [4.94m]

C/L OF FEED PIPE
DB. EL. 17.27' [5.26m]
SB. EL. 13.93' [4.25m]

TOP OF SAND WASHER
DB. EL. 18.76' [5.71m]
SB. EL. 15.42' [4.70m]

TOP OF WEIR
DB. EL. 18.42' [5.61m]
SB. EL. 15.08' [4.60m]

C/L OF REJECT PIPE ✱
DB. EL. 13.75' [4.19m]
SB. EL. 10.41' [3.17m]

BOTTOM OF EFFLUENT CHANNEL
DB. EL. 15.92' [4.85m]
SB. EL. 12.58' [3.83m]

SAND LEVEL
DB. EL. 12.33' [3.76m]
SB. EL. 9.00' [2.74m]

BOTTOM OF FEED
RADIALS EL. 5.73' [1.75m]

BOTTOM OF SLAB
EL. 0.00' [0.00m]

✱ MAY VARY FROM JOB TO JOB

- 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
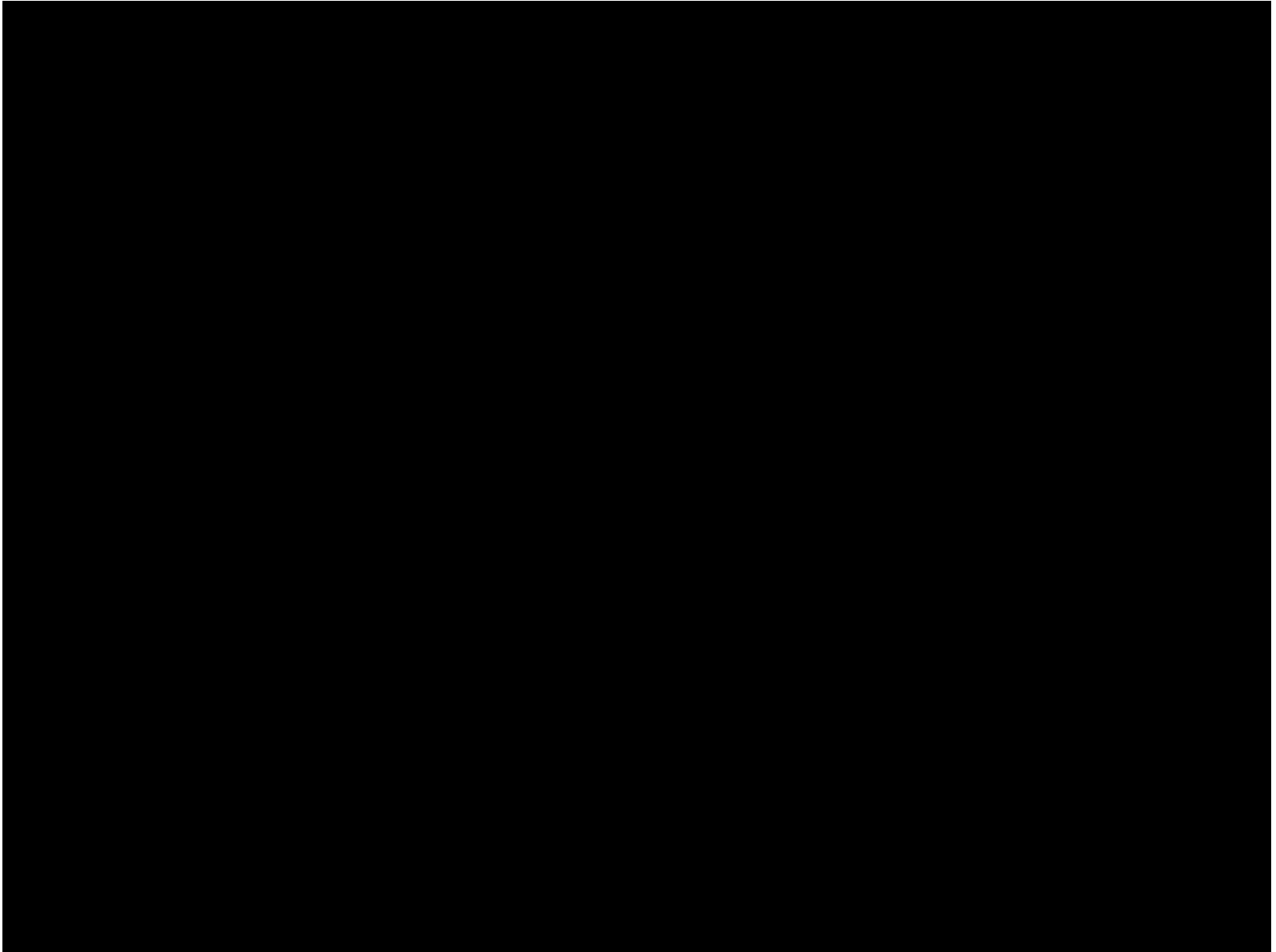
Hybrid Filtration Operation

- EcoWash utilizes a continuous filter but backwashes intermittently when needed as <u>dictated by solids buildup in the filter</u>.

- 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
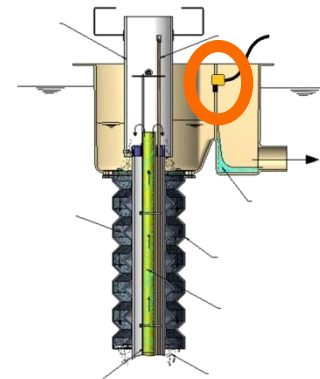
Hybrid Filtration Development

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 <u>real time</u> and <u>at all times</u>
  - 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
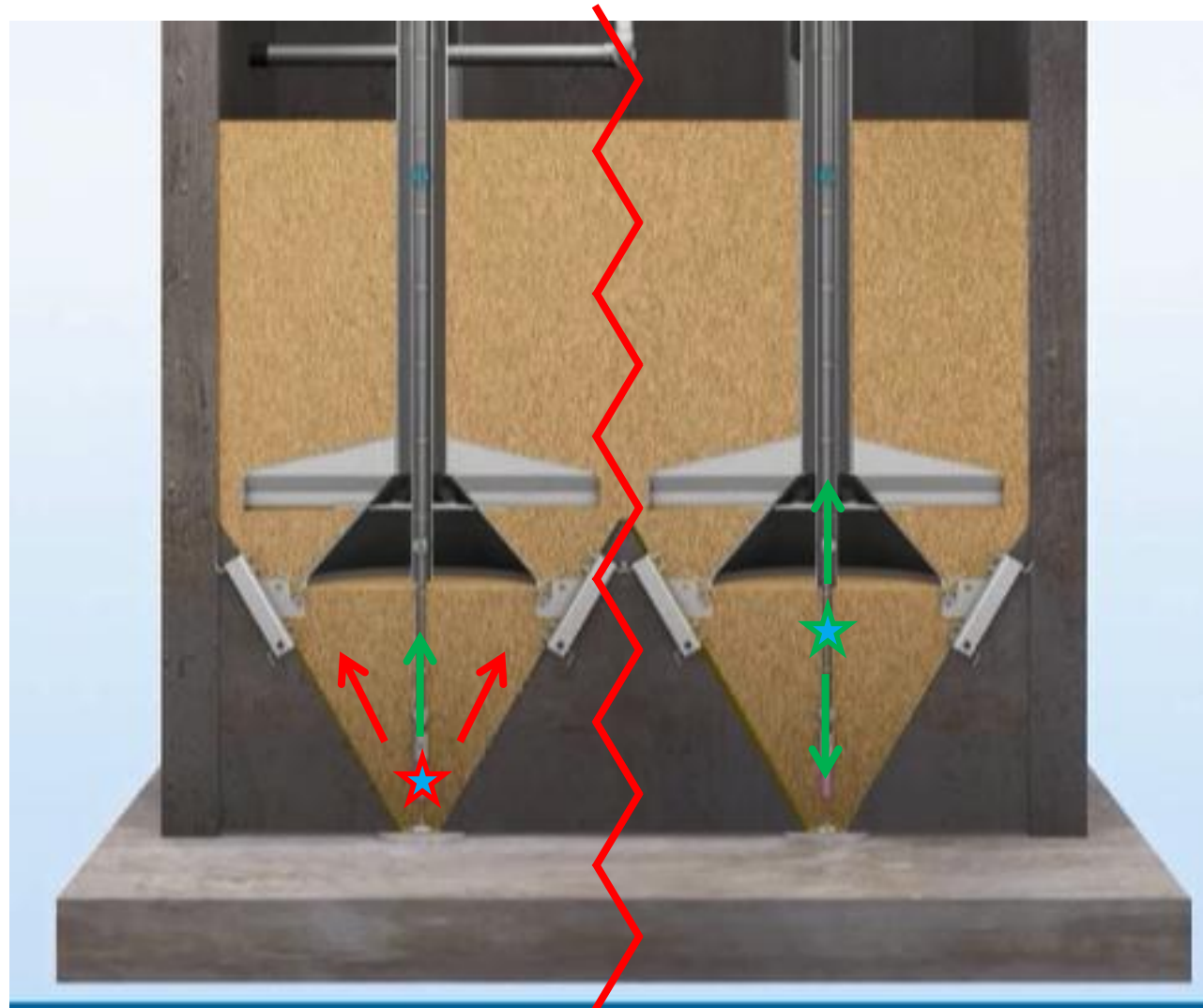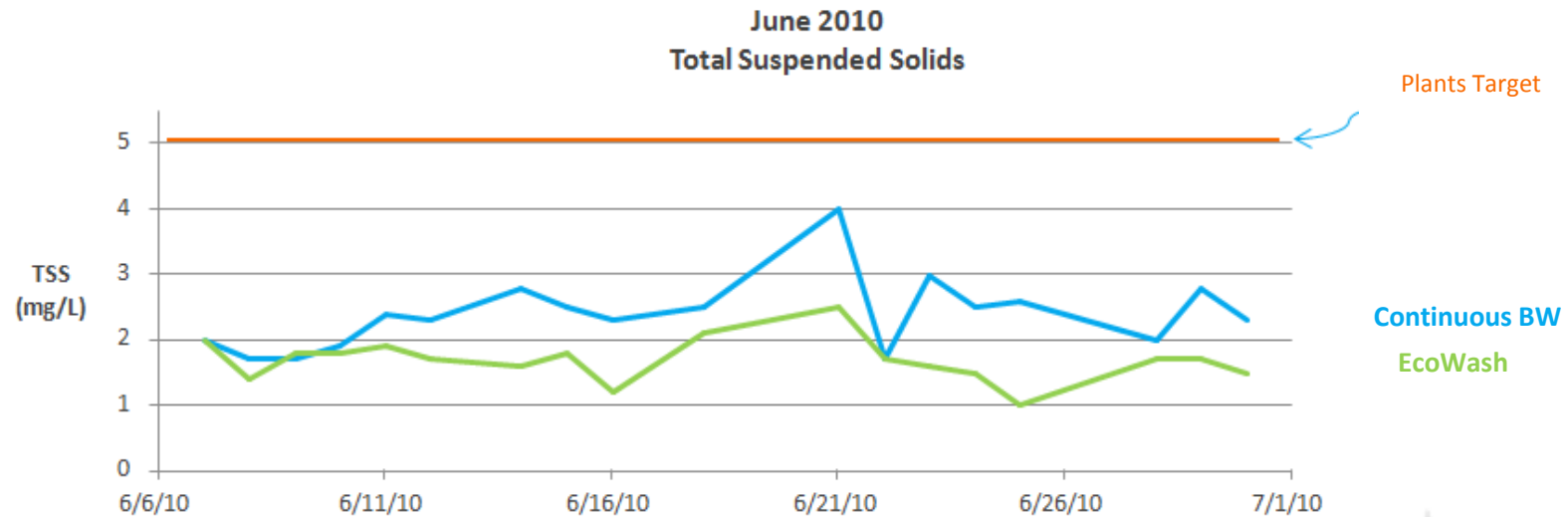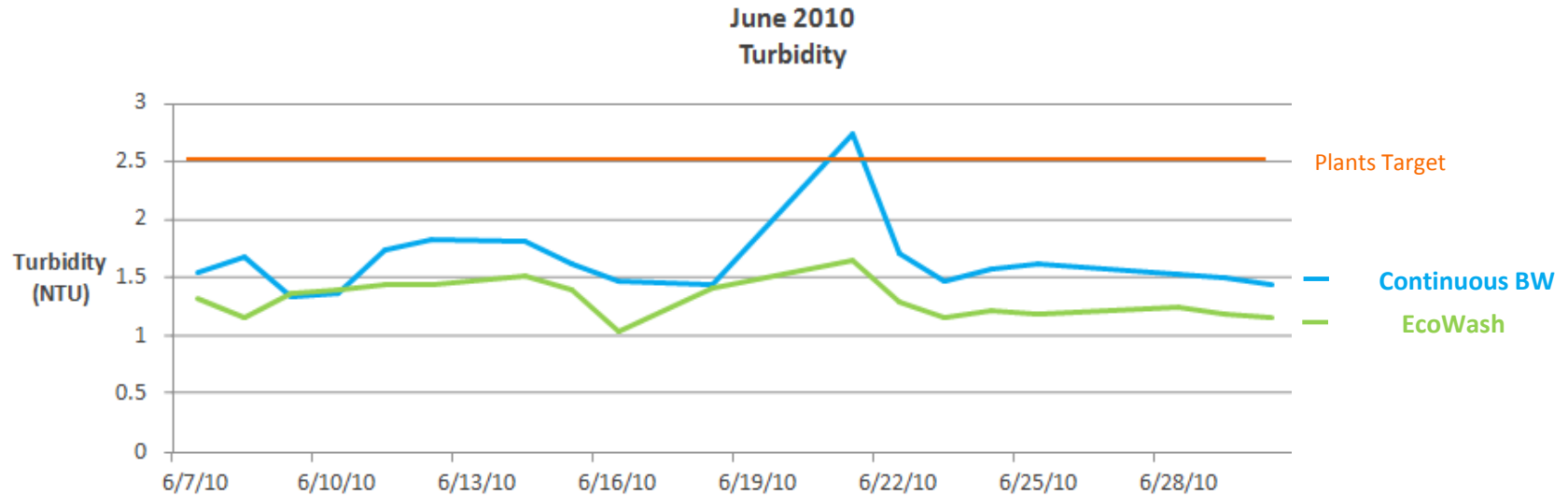
Hybrid Filtration Results

Turbidity and Headloss Results – Pompano WRF Test
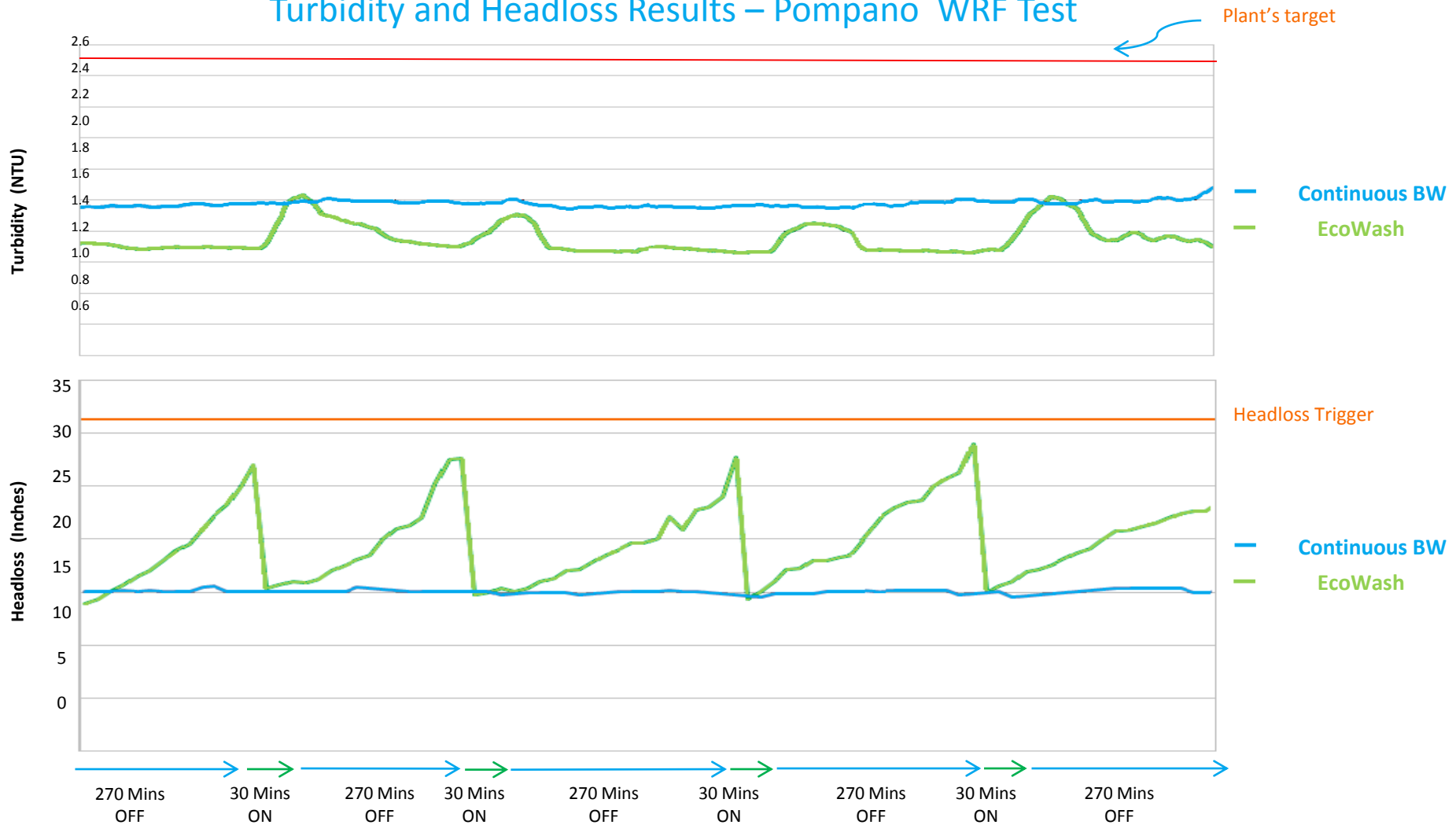
Hybrid Filtration Results

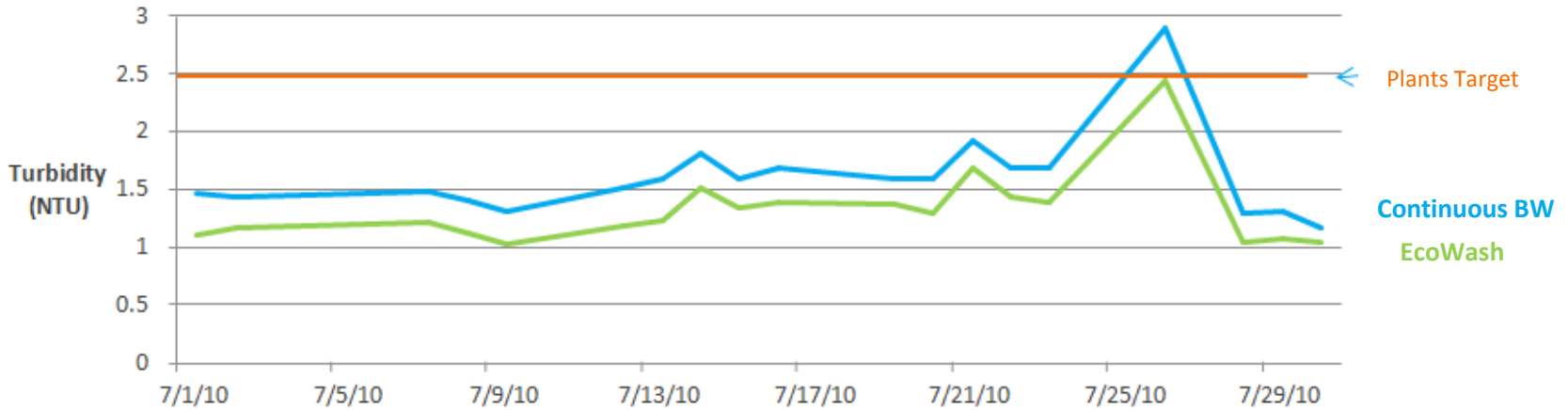## Turbidity and TSS Results – Pompano WRF Test

June 2010
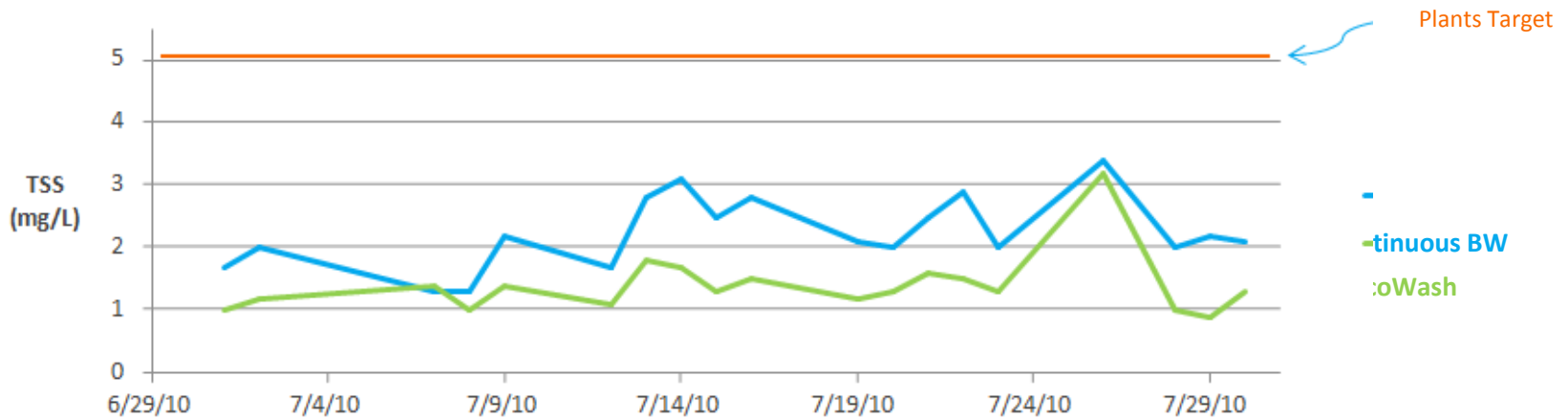Turbidity

June 2010
Total Suspended Solids

Hybrid Filtration Results

Turbidity and TSS Results – Pompano WRF Test

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
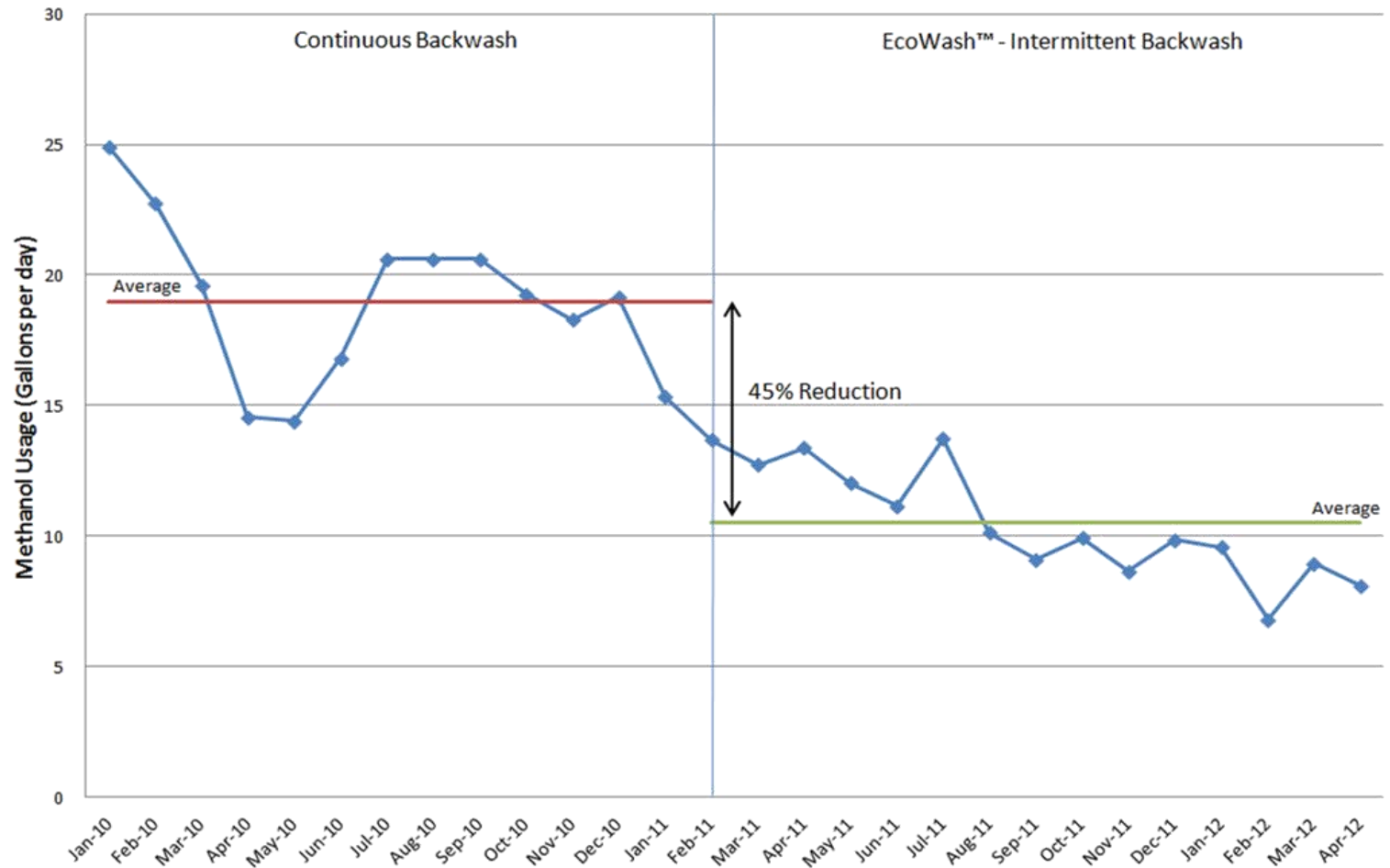- EcoWash™ operating Feb 2011

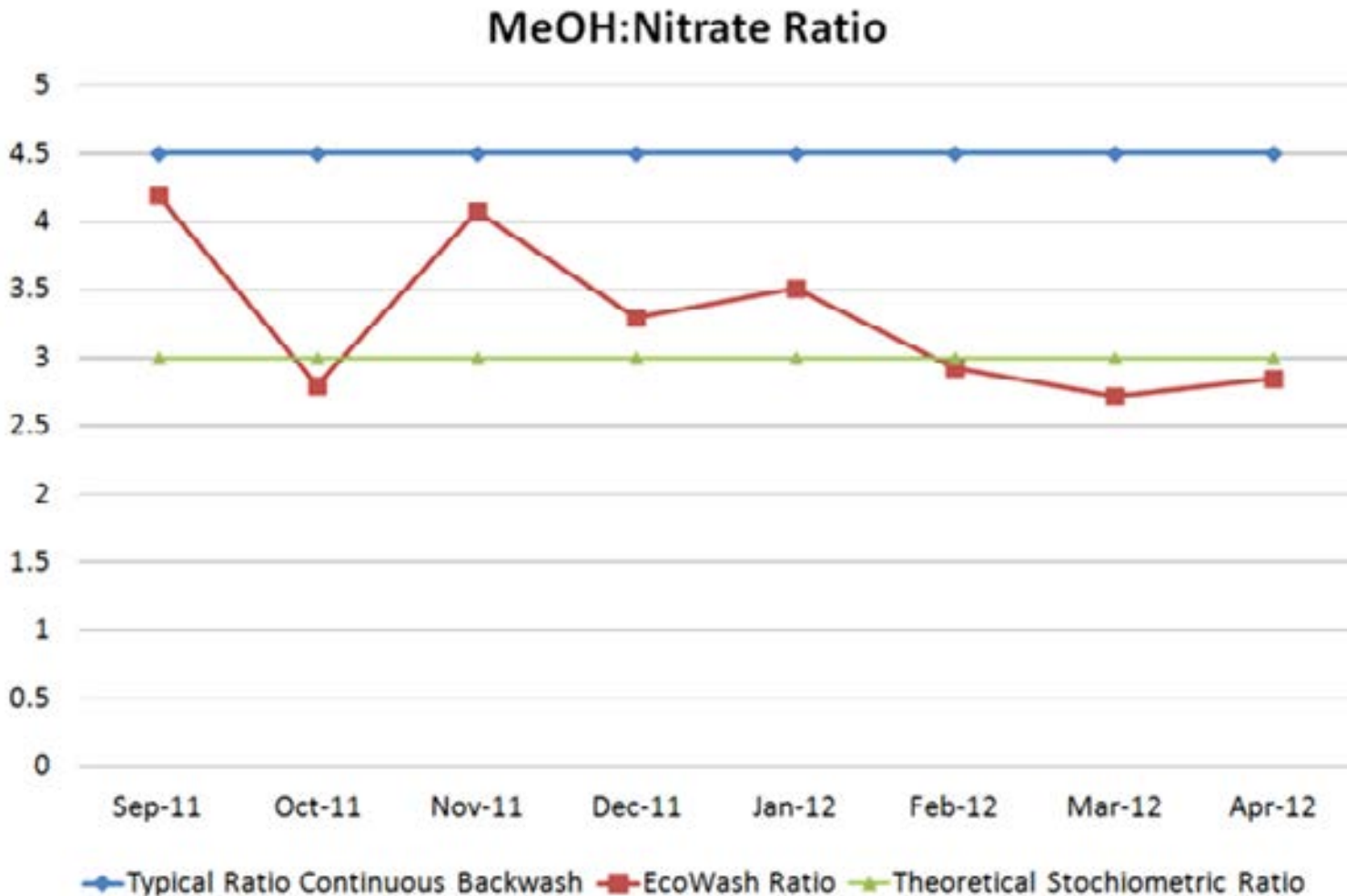*CBF: Continuous Backwash Filter

Hybrid Filtration Results

Laurel, DE – ENR Application

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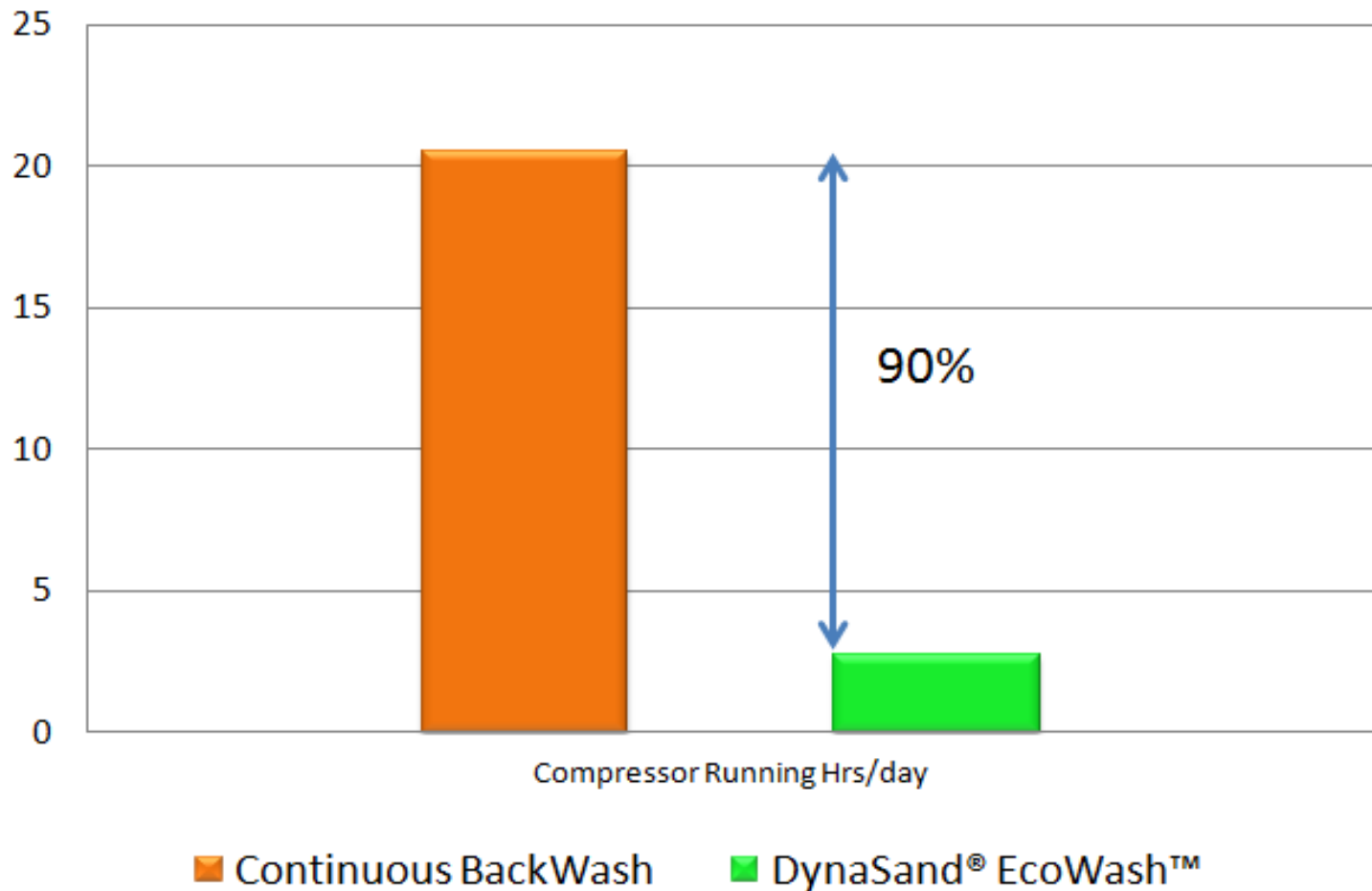
Hybrid Filtration Results

Laurel, DE – ENR Application

MeOH:Nitrate Ratio

Legend: Typical Ratio Continuous Backwash · EcoWash Ratio · Theoretical Stochiometric Ratio

Hybrid Filtration Results

Laurel, DE – ENR Application

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

90%

Compressor Running Hrs/day

■ Continuous BackWash   ■ DynaSand® EcoWash™

Hybrid Filtration Results

Laurel, DE – ENR Application

Reject Flow Reduction at Laurel, DE
Full Scale DynaSand® EcoWash™ ENR Test

EcoWash™ *A Hybrid Filter*

Parkson
Treating Water Right

50 YEARS
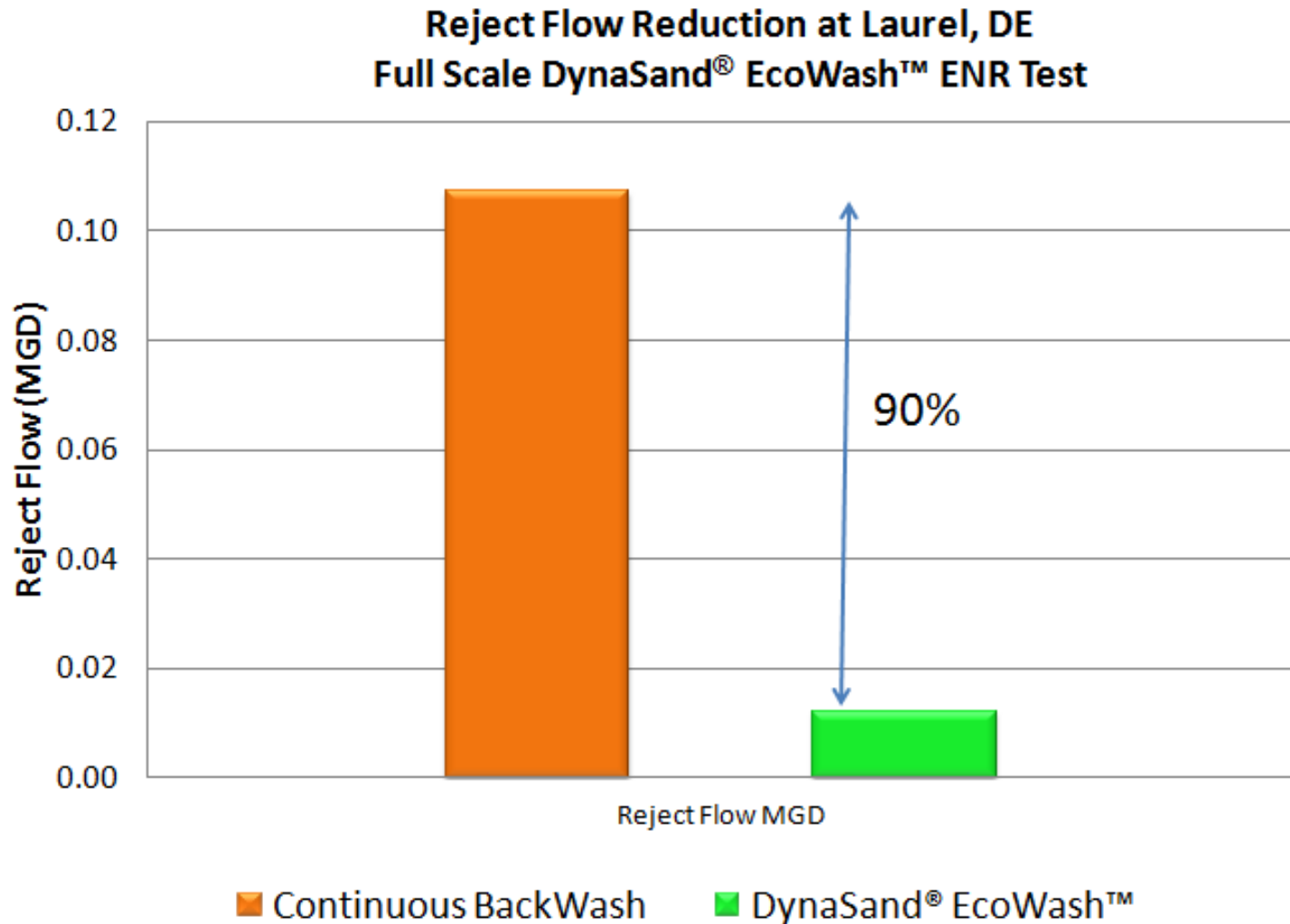
Questions

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1401 West Cypress Creek Road
Suite 100
Fort Lauderdale, FL 33309

D2™ Configuration

Influent

Stage 1 & 2 Combined Reject Flow

Stage 1 Reject Flow

Stage 2 Reject Flow

Final Filtrate

Stage 1 Filtrate is Stage 2 Feed

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