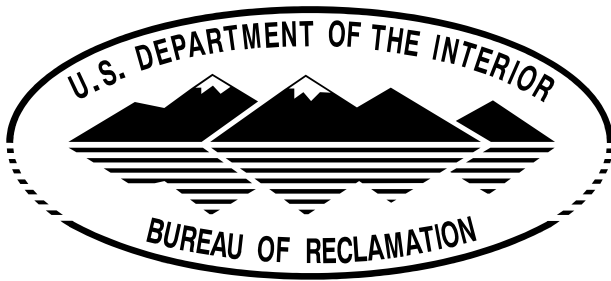


ICAIS – RESPONSE AND CONTROL

Taking No Prisoners Beating Back Invasive Species Bureau of Reclamation



Leonard Willett
Hoover Dam
Lower Colorado Region

Background



2007

- January- adult quagga mussels found in Lake Mead and assumed to be from mussel infested house boat
- Fall- Reclamation's Lower Colorado Dams Office (LCDO) completed facility review

Findings from review and updated activities of the lower Colorado River dams

Research activities and environmentally friendly control barriers

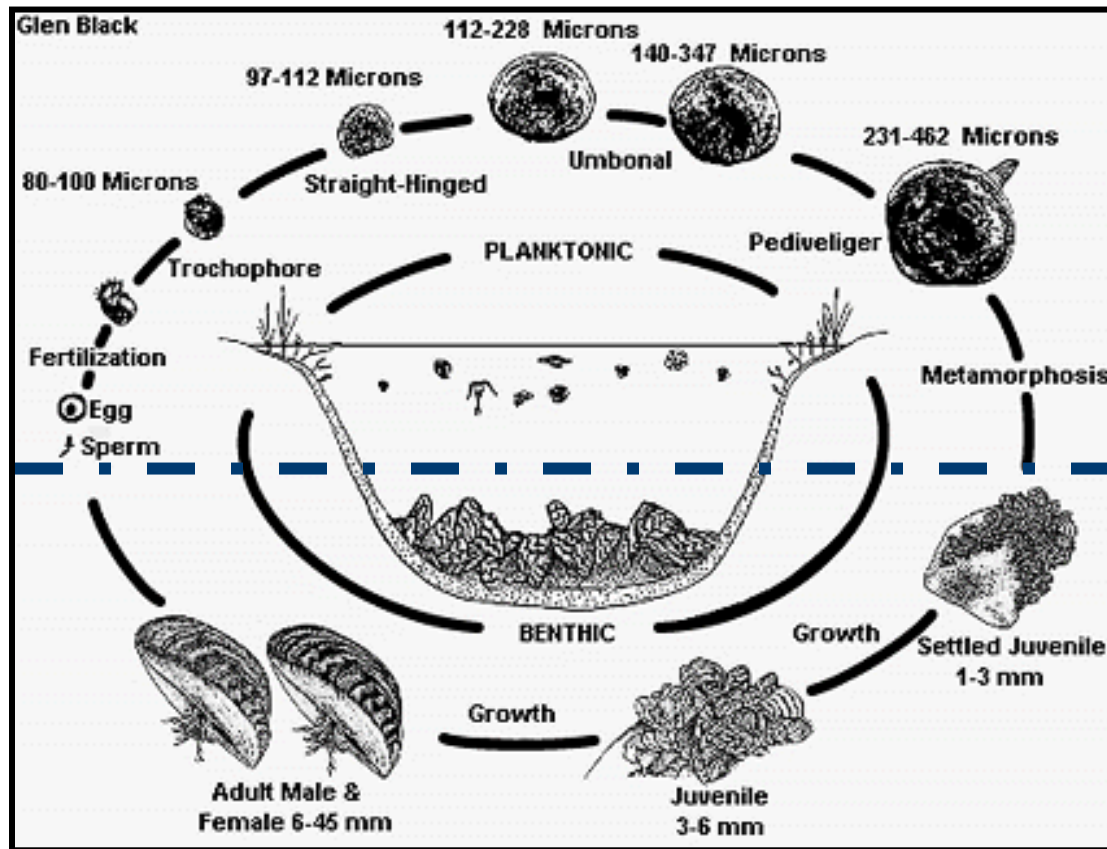
Zebra and Quagga Mussel Sightings Distribution

Dreissena polymorpha and *D. rostriformis bugensis*



- Zebra mussel occurrences
- Quagga mussel occurrences
- Both species occurrences
- Zebra/Quagga mussels eradicated
- Zebra/Quagga mussels failed

Control Strategies



Proactive
Preventive

Reactive

“Clean” after establishing
Can be labor intensive
Redesign/retrofit

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Invasive Species = Problems

Biological/Environmental

- Food chain
- Habitat
- Water quality
- Water resource industry
- Toxic accumulations

Chemical Degradation

Flow Restriction

- Roughening (friction loss)
- Blockage

Quagga mussel, Lake Havasu –
Jan. 2007



April 2013 Hoover Dam Pressure Relief Valve
Shaft Corrosion

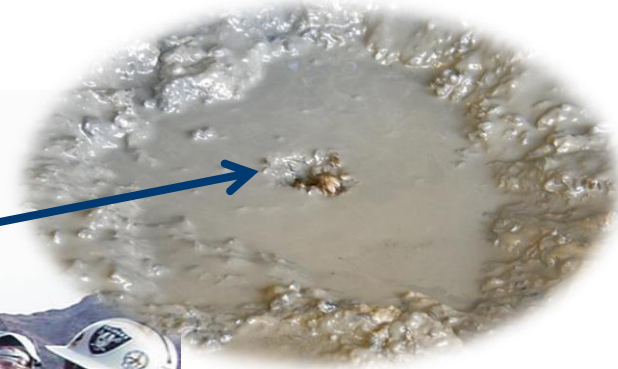


January 2013 Parker Dam Trash Rack Blockage



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October 2007 Davis Dam Fixed Wheel Gate Blockage



Fire Protection & Other Cooling Water Systems Need Protection



Transformer
Cooling
Water



Fire Nozzles

Penstock Interior Surfaces Inspection



Mussel Shell Debris in Penstock
serving Multiple Laterals

Penstock Drain – Heavy Settling

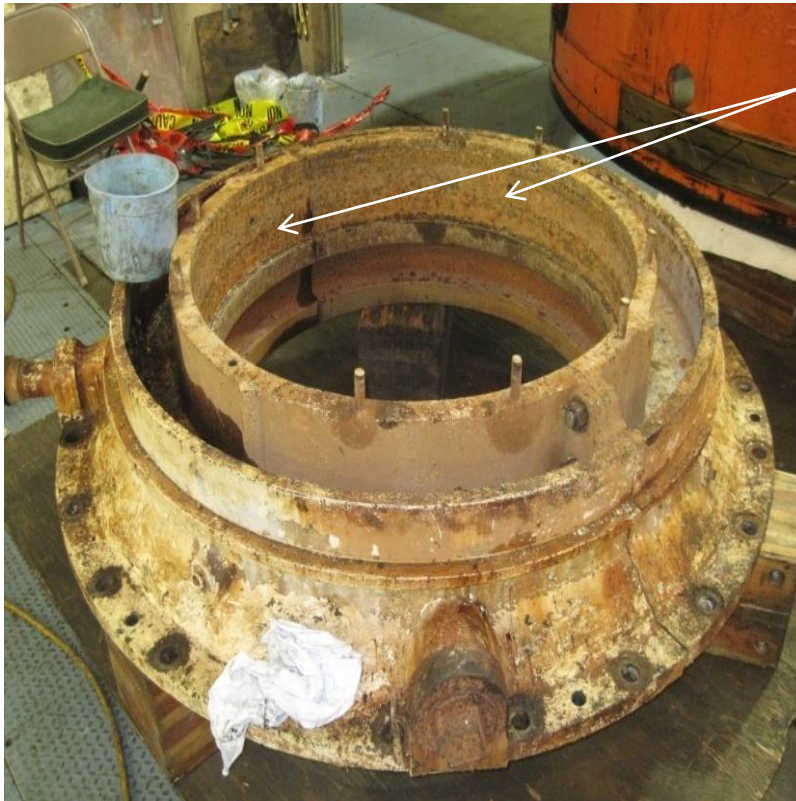


10/22/2008

October 2010 Penstock Belly Drain



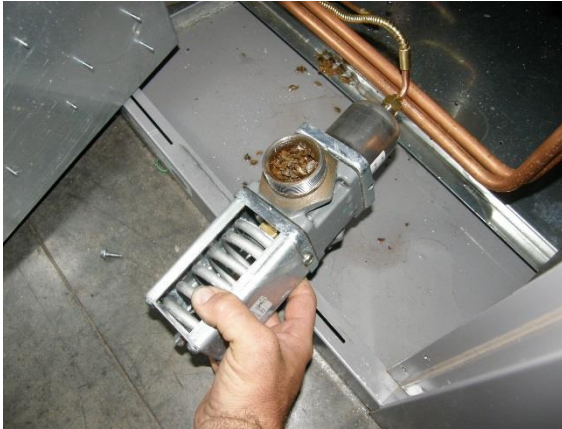
Hoover Dam Generator Packing Area Problematic Mussel Fouling



Small water opening to supply
packing stuffing box



Parker Dam Biofouling – Heat Exchangers and HVAC Systems 2014



Clogged HVAC Control Valve



Cooling Water Heat Exchanger

Heat Exchangers 2016 – Corp of Engineer Hydro Power Plant



Asian Clams



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Corp of Engineers Facility – 2 years After Adult Mussel Finding

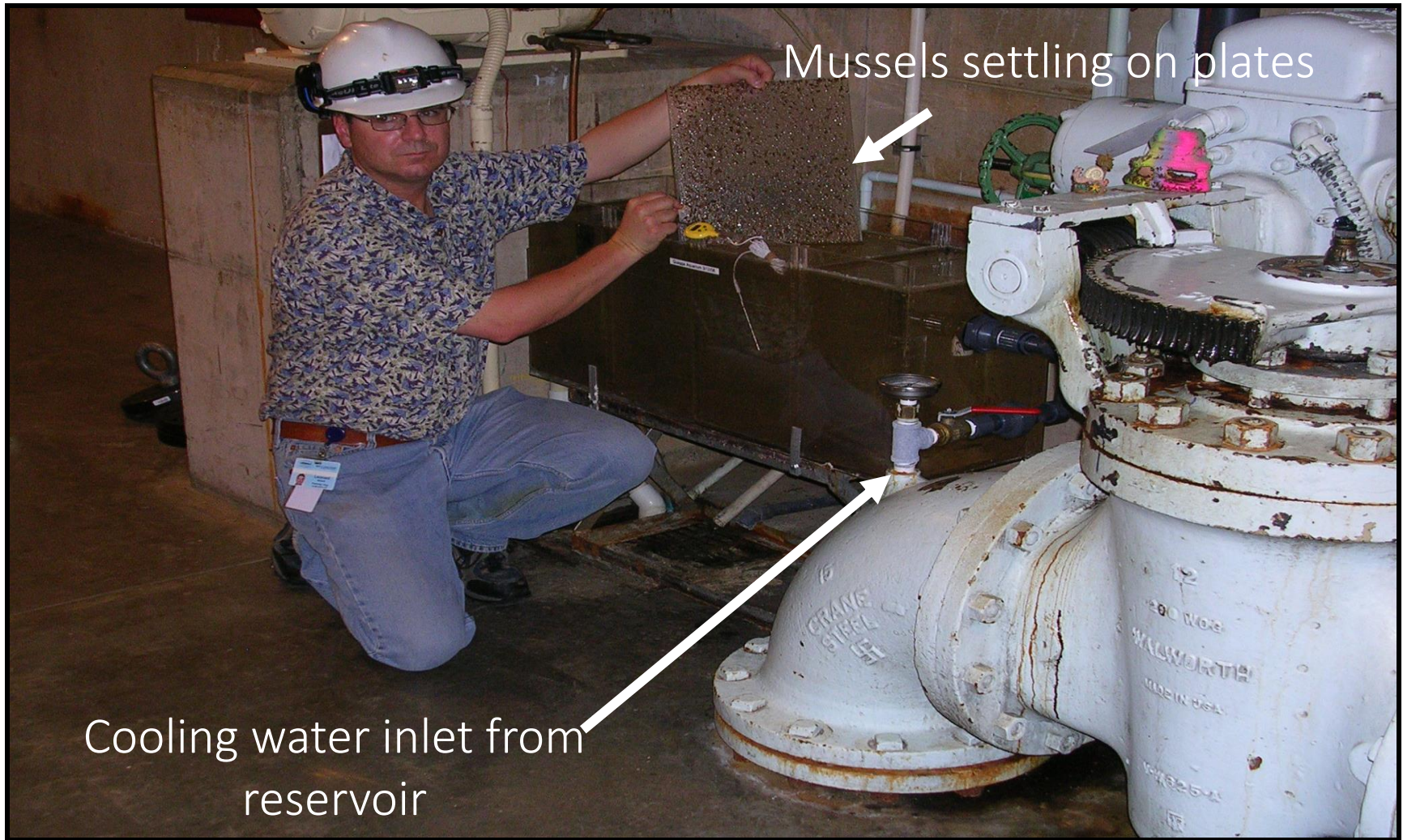


Reclamation Lower Colorado Region Research Activities



- Installed bio-boxes
- Tested micro-filtration systems - (40-80 micron)
- Fish Screens Resistance to Mussels
- Evaluating water jetting system for exterior cleaning
- Evaluating anti-foul coatings and materials to resist mussels (Dr. Allen Skaja, TSC Denver)
- Evaluation of Zequanox treatment (completed)
- Copper Ion Generator
- Copper Evaluation as Molluskcide (completed)
- Evaluating ultra-violet light treatment (on-going)

Installed Bio-Box Sampler for Monitoring



Self Cleaning Ballast Safe Filter



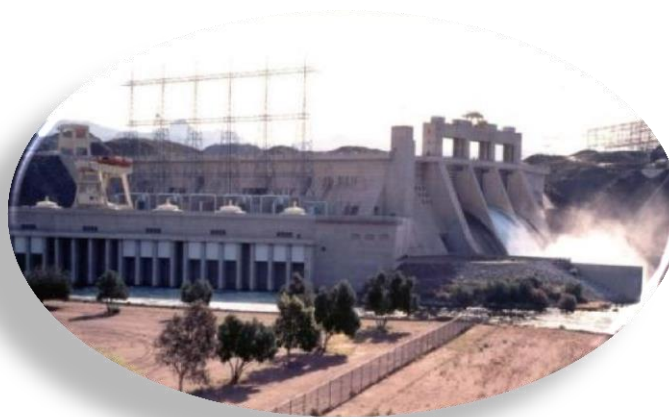
Pre-strainer (filter)

Parker Dam Trash Rake Coating Research Summer 2013



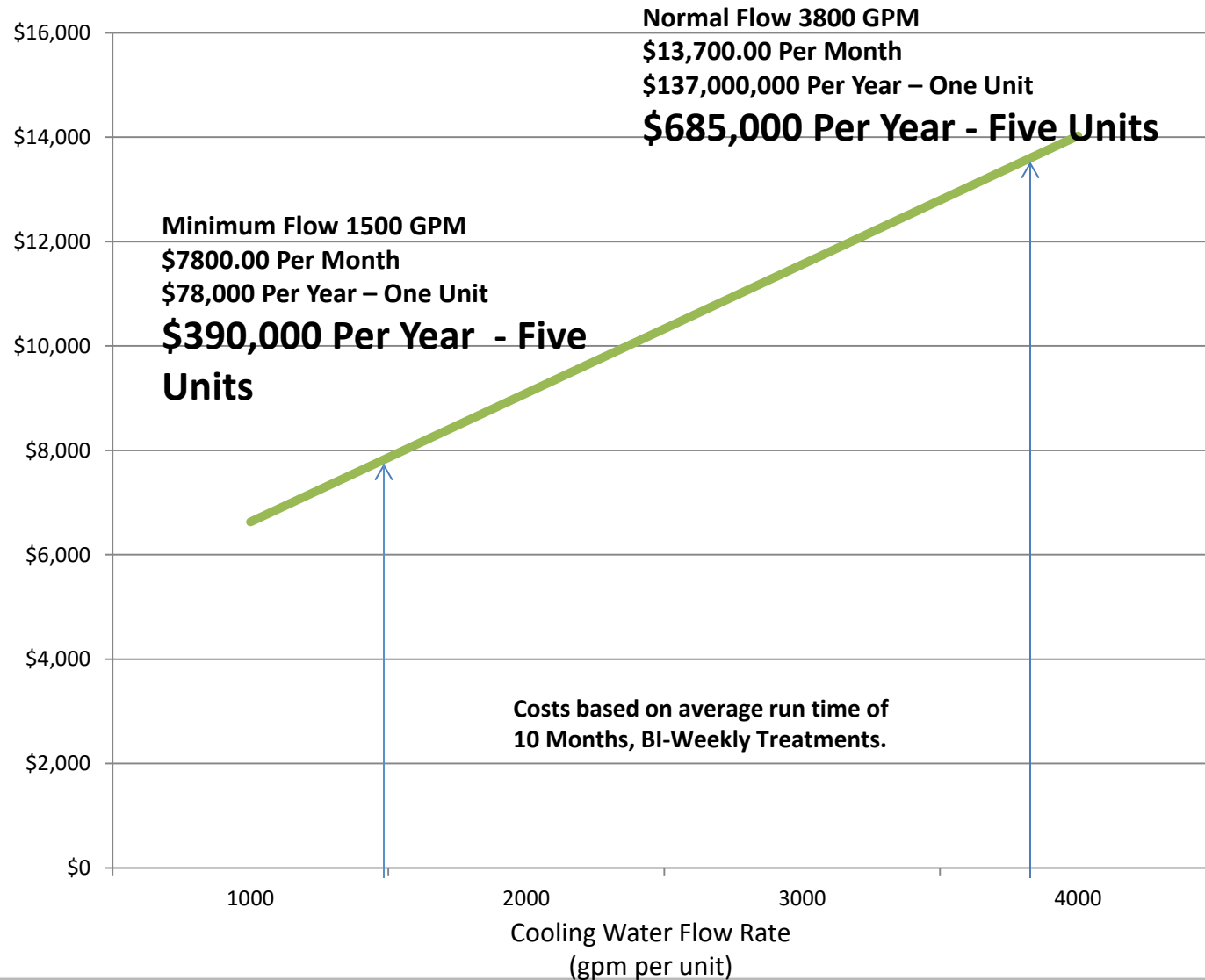
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Controlling Mussels at Davis Dam



- Bullhead City, AZ; Colorado River
- Five turbine, 240 MW hydropower facility
- Each subsystem has a separate cooling water system
- 4000 gpm per cooling water subsystem

Treatment – Monthly/Yearly Product Pricing for Davis Dam (January 2013)



Copper Ion Generator Unit



Molluscicide Approved for open waters

Molluscicide Applications

- Anecdotal Reports of Quagga and Zebra Mussel Kill When EarthTec Was Used for Algae and Organic Pretreatment
- Funded Successful Academic Research at UNLV
- EPA Label Approved for EarthTec QZ Formulation as Molluscicide (August, 2013)



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Conventional UV System (Research) Hoover Dam Cooling Water Mussel Control



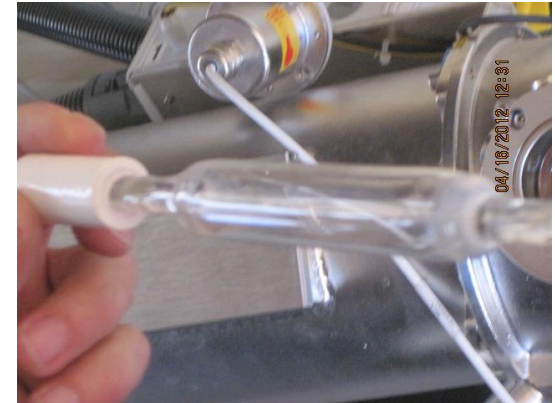
August 2010, started
evaluation of 2 lamp
conventional UV system



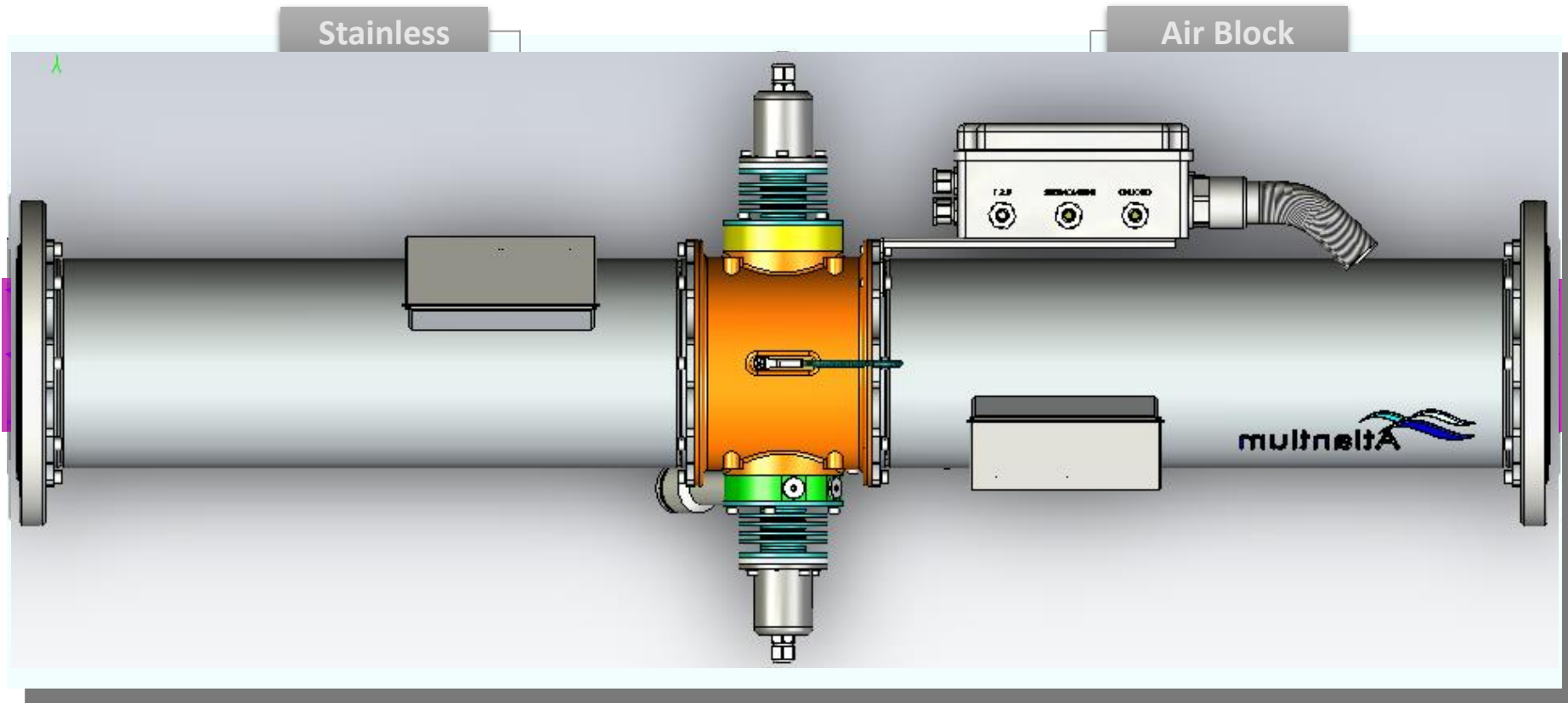
April 2011, upgraded to 4 lamp
conventional UV system to
increase dosage

HOD UV Dosage Response Evaluation for Settlement Prevention of Mussels

- UV equipment cost \$50-75K
- 1250 gpm
- UVT 85%
- Dosage 100 mj/cm²
- Power operational cost \$2500/yr or \$0.035/kwh
- UV equipment cost \$100-125K
- 4000 gpm
- UVT 85%
- Dosage 100 mj/cm²



Operation principles:



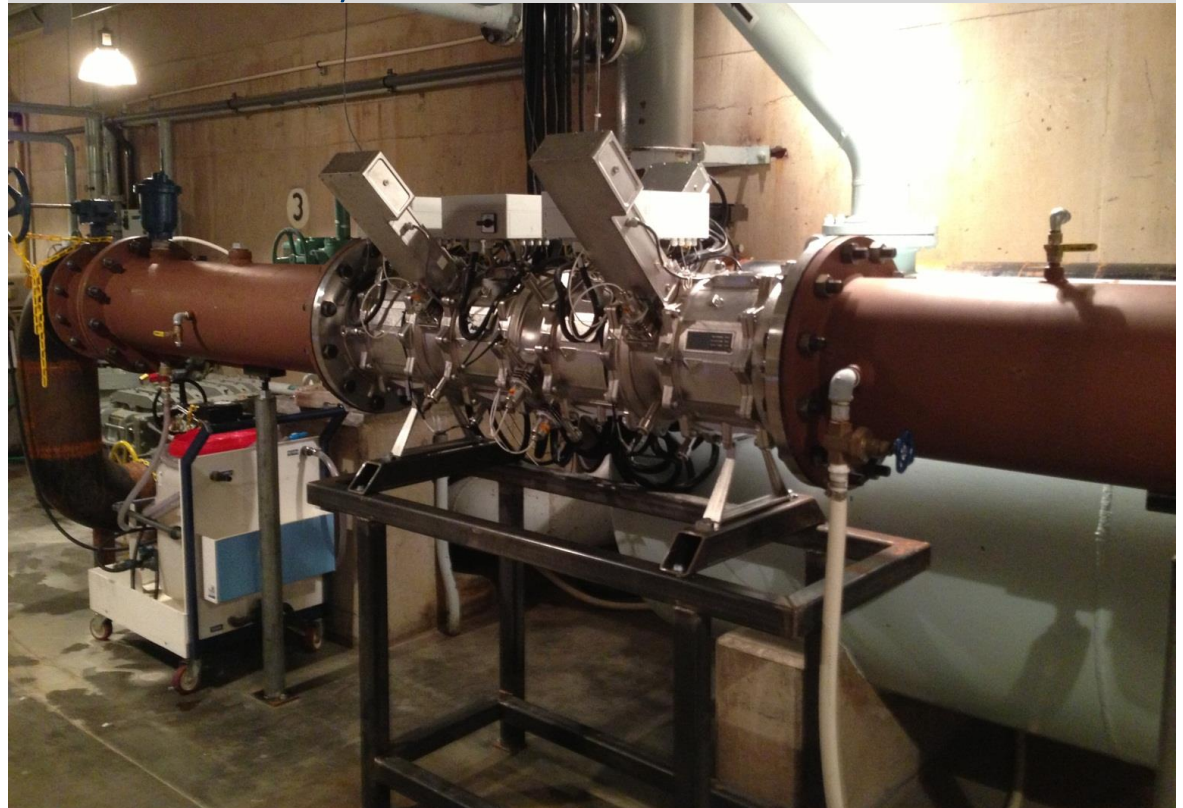
Power Plant Mussel Control System Atlantium (HOD) UV Light System

\$120K with UVT of
85 dosage of 100
mj/cm²



UV dose measured
in real-time

HOD UV Cooling Water System installed July 2013 on
a 4000 GPM system



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Power Plant Parker Dam Mussel Control System

HOD UV Cooling
Water System

- Installed Nov'15
- 1600 GPM system



Self Cleaning
Strainer

Wipers and Lamps

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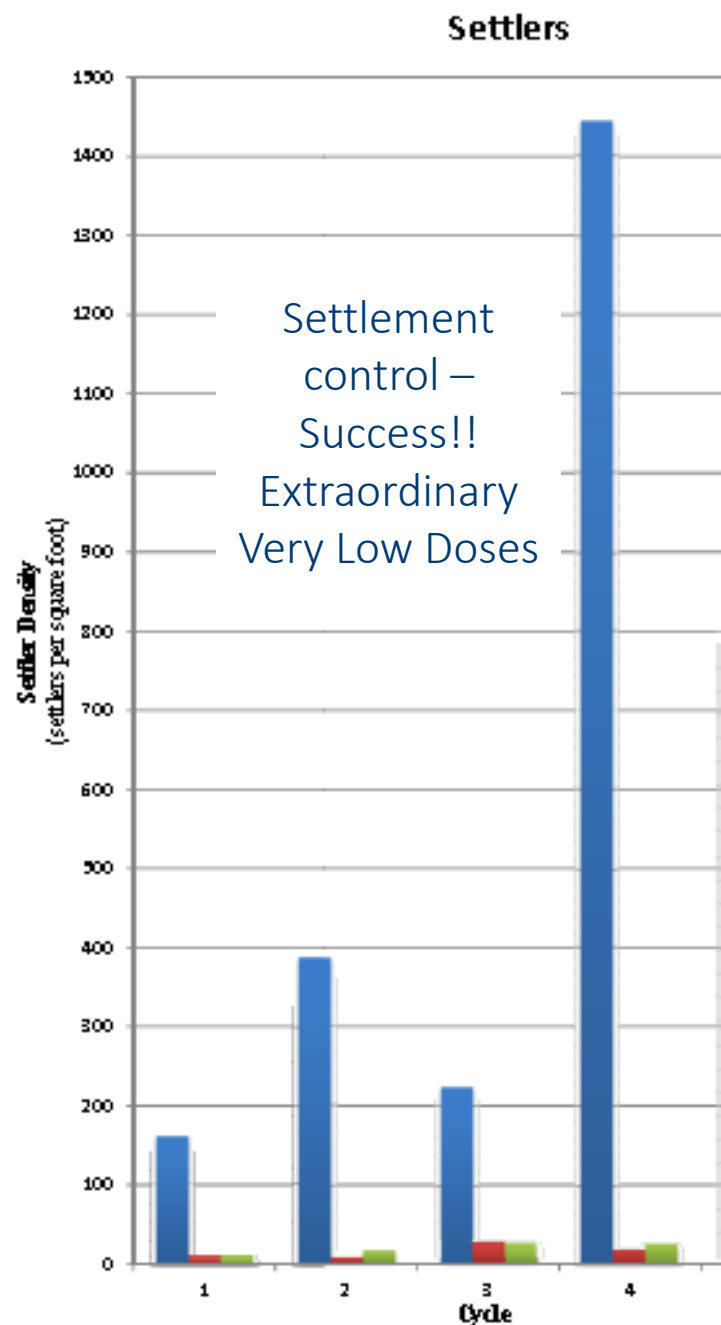
Full Scale results



Strainer w/o HOD



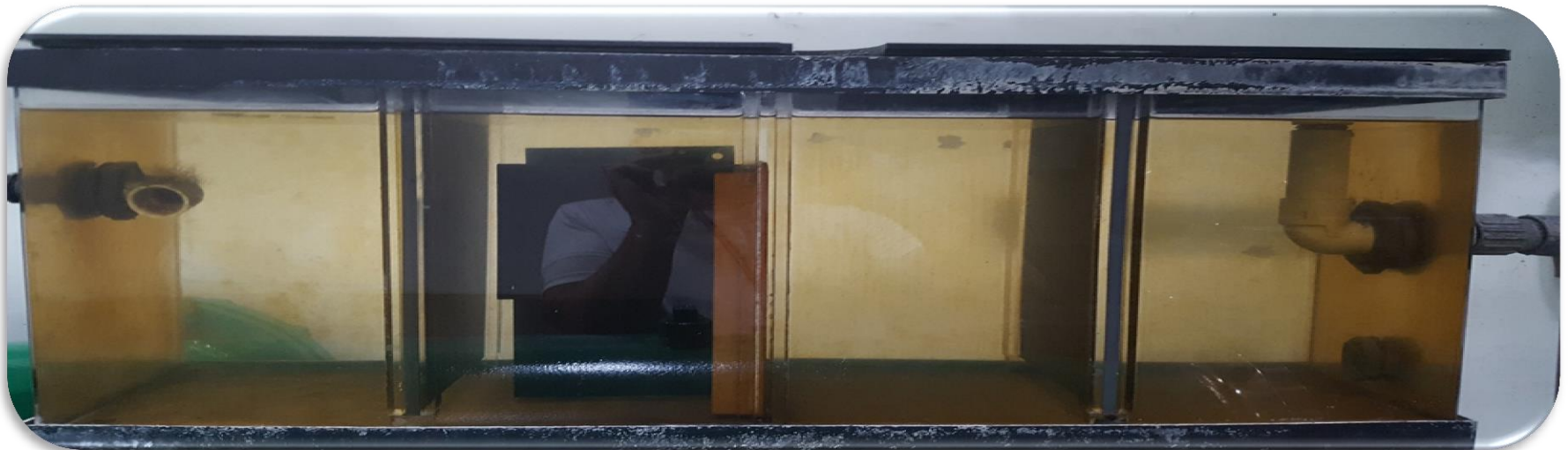
Strainer with HOD



Freshwater Colonial Hydroid Prior to HOD UV at Parker Dam



Hydroid Study Before & After HOD UV Treatment at Parker Dam



Parker Dam Cooling Water Heat Exchanger

Before Atlantium HOD UV

2014



After Atlantium HOD UV

2016



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Acknowledgements

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Suppliers

Atlantium – Dennis Bitter



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