Mike Loveless
Raleigh Water

Smith Creek Resource Recovery Facility

Influent Screening, Pumping, and Grit Removal Improvements

July 25, 2023

Agenda

- Project Background
- Upgrade Mechanical Screens
- Influent Pump Station Improvements
- New Grit Removal System
- Summary
- Questions

Project Background

Smith Creek Resource Recovery Facility (RRF)

New Grit Removal

Inf. Flow Measurement

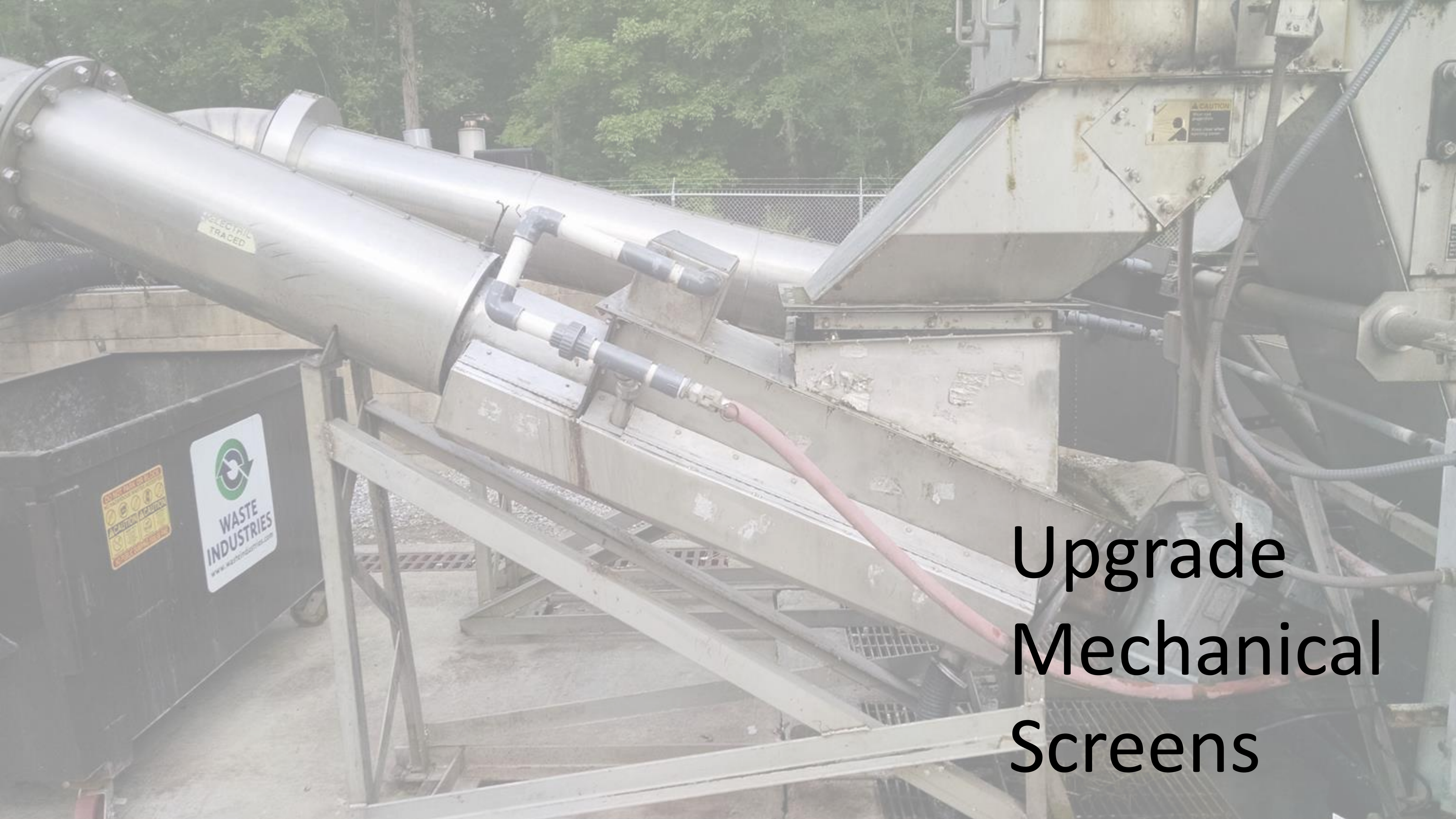
Influent Pump Station

Old Grit Removal

- Originally owned and operated by the Town of Wake Forest
- Discharge to Neuse River
- Capacity – 3 MGD
- Biological Nutrient Removal

Project Scope

- Upgrade Mechanical Screens
- Influent Pump Station Improvements
- New Grit Removal System



Upgrade Mechanical Screens

Upgrade Mechanical Screens

- Two existing screen channels – 15’ -7” deep
- Isolation gates on each channel
- Unable to completely close gates
- Manual operators on gates

Upgrade Mechanical Screens

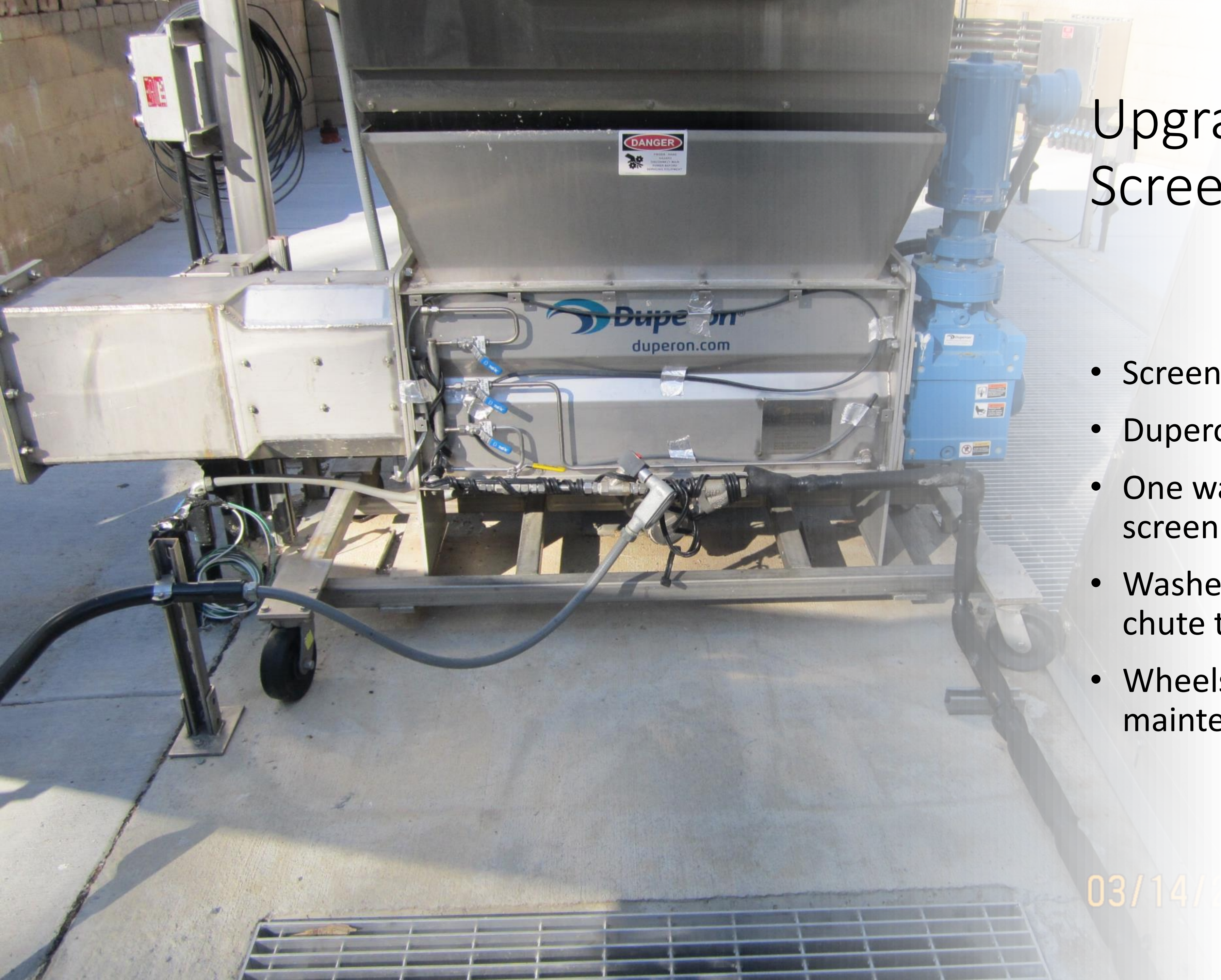
- Original Screens
- Rotating Element Screens
- ¼" Openings
- Screen Width 2-feet
- Channel Width 4-feet (concrete inserts on side of channel)
- Unsatisfactory Performance
- Nearing end of useful life
- Not sized for future expansion

Upgrade Mechanical Screens

- Proposed Improvements
- Install new gates with motor actuators
- Install second influent pipe (plugged) for future expansion
- Replace screens and washer compactors with newer technology

Upgrade Mechanical Screens

- Selected Screens
- Duperon Flexrake (Catenary Multi-Rake)
- ¼” openings between bars
- Screen Width 4-feet
- Capacity – 10 MGD each
- All stainless-steel construction



Upgrade Mechanical Screens

- Screenings Washer/Compactors
- Duperon
- One washer/compactor per screen
- Washer/compactor discharge chute to roll-off container
- Wheels and flex connections for maintenance

Upgrade Mechanical Screens

- Startup and Operation

Influent Pump Station Improvements

Influent Pump Station Improvements

- Original Influent Pump Station
- Screening upstream of IPS
- Wetwell/Drywell
- Self-Priming Pumps in Drywell
- Pump to Parshall flume
- Grit Removal downstream of flume

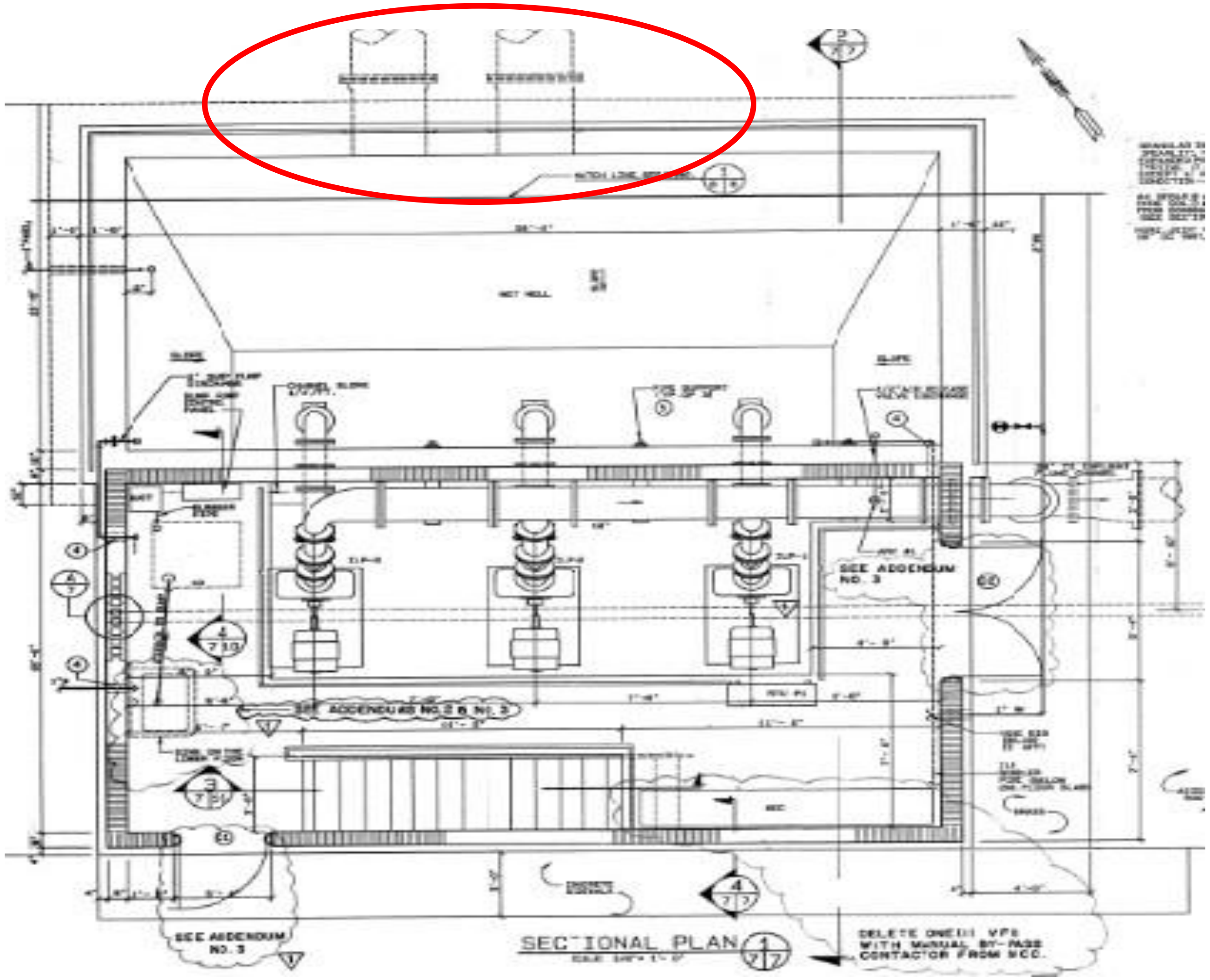
Influent Pump Station Improvements

- Drivers for conversion
- Increased pump head due to higher elevation of new grit removal
- Wetwell problems, including surface vortex and pump cavitation (from air entrainment)
- Frequent maintenance needs of Self-Priming pumps
- Poor operation with VFD’s, resulting in “slugging” of treatment process
- Raleigh preference to move away from Self-Priming Pumps

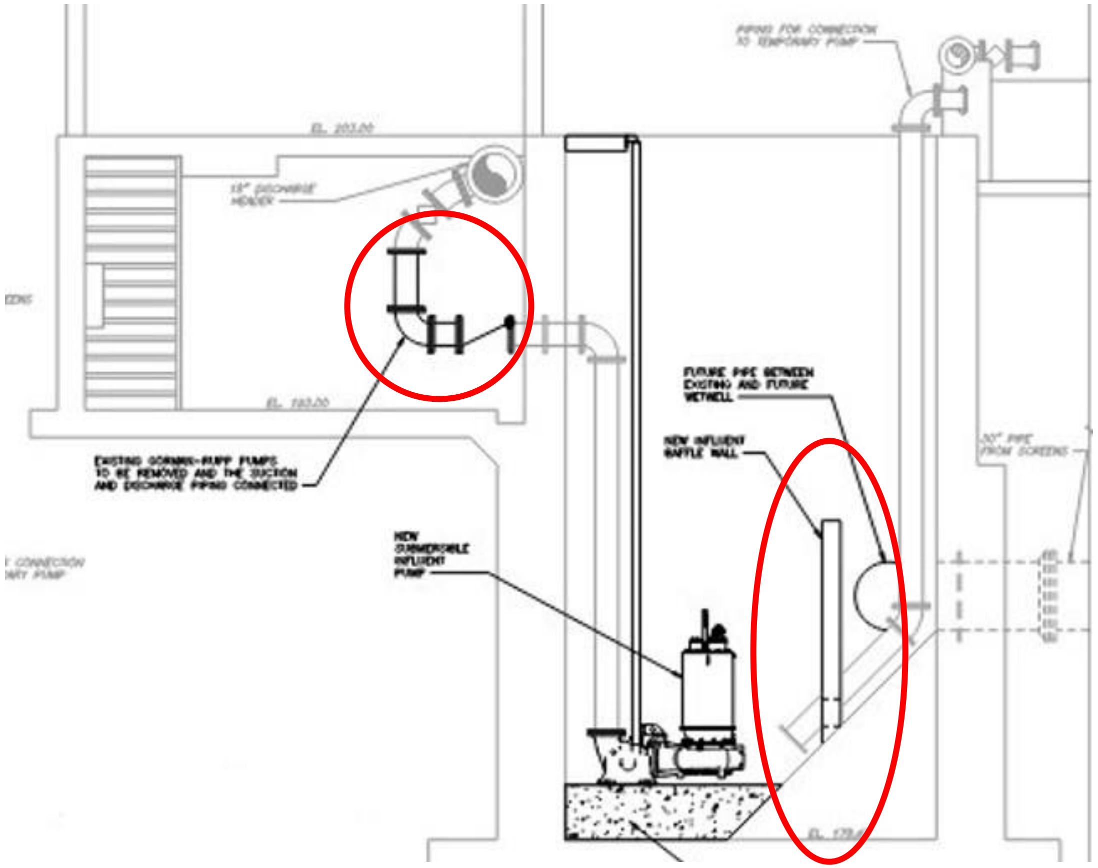
Influent Pump Station Improvements

Existing Wetwell

- Offset influent pipes
- No baffles in wetwell
- Limited wetwell storage
- Constant speed pumps



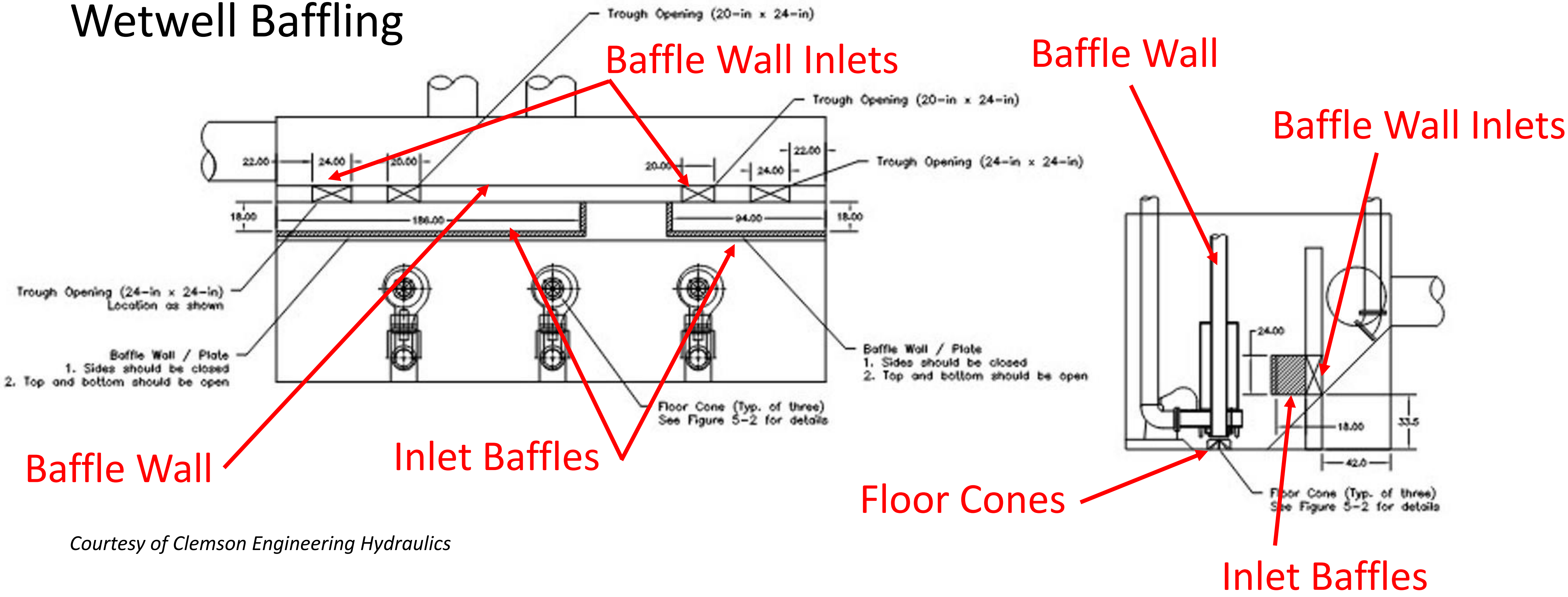
Influent Pump Station Improvements



- Convert to Submersible Wetwell configuration
- Add baffling to wetwell
- Convert drywell to pipe gallery
- Raise operating levels
- Addition of VFD’s
- Modified operating sequence
- Future expansion to include parallel wetwell and force main

Influent Pump Station Improvements

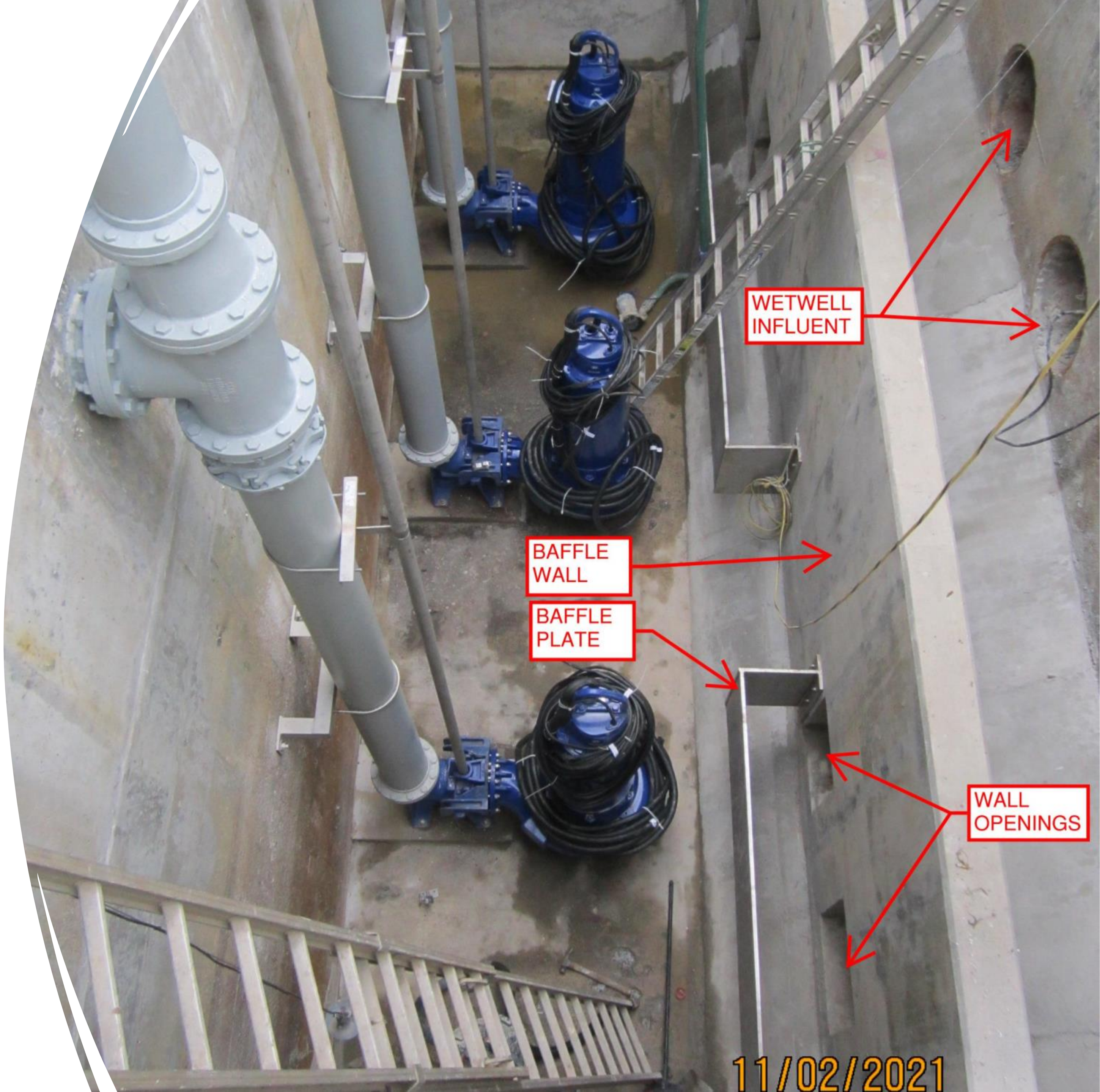
Wetwell Baffling



Courtesy of Clemson Engineering Hydraulics

Influent Pump Station Improvements

- A physical hydraulic model was used to simulate wetwell issue
- Modeling was performed by Clemson Engineering Hydraulics in Anderson, SC
- Model testing recommended wetwell baffles and floor cones to eliminate pre-swirl, uneven flow distribution, air entrainment, and floor vortex activity



Influent Pump Station Improvements

- Baffle wall with inlets and inlet baffles to direct flow downward
- Floor cones installed under each pump

Influent Pump Station Improvements

Drywell piping reconfigured to connect pump discharge to station discharge header

Influent Pump Station Improvements

VFD’s in climate-controlled enclosures installed outdoors since no available space in building

Influent Pump Station Improvements

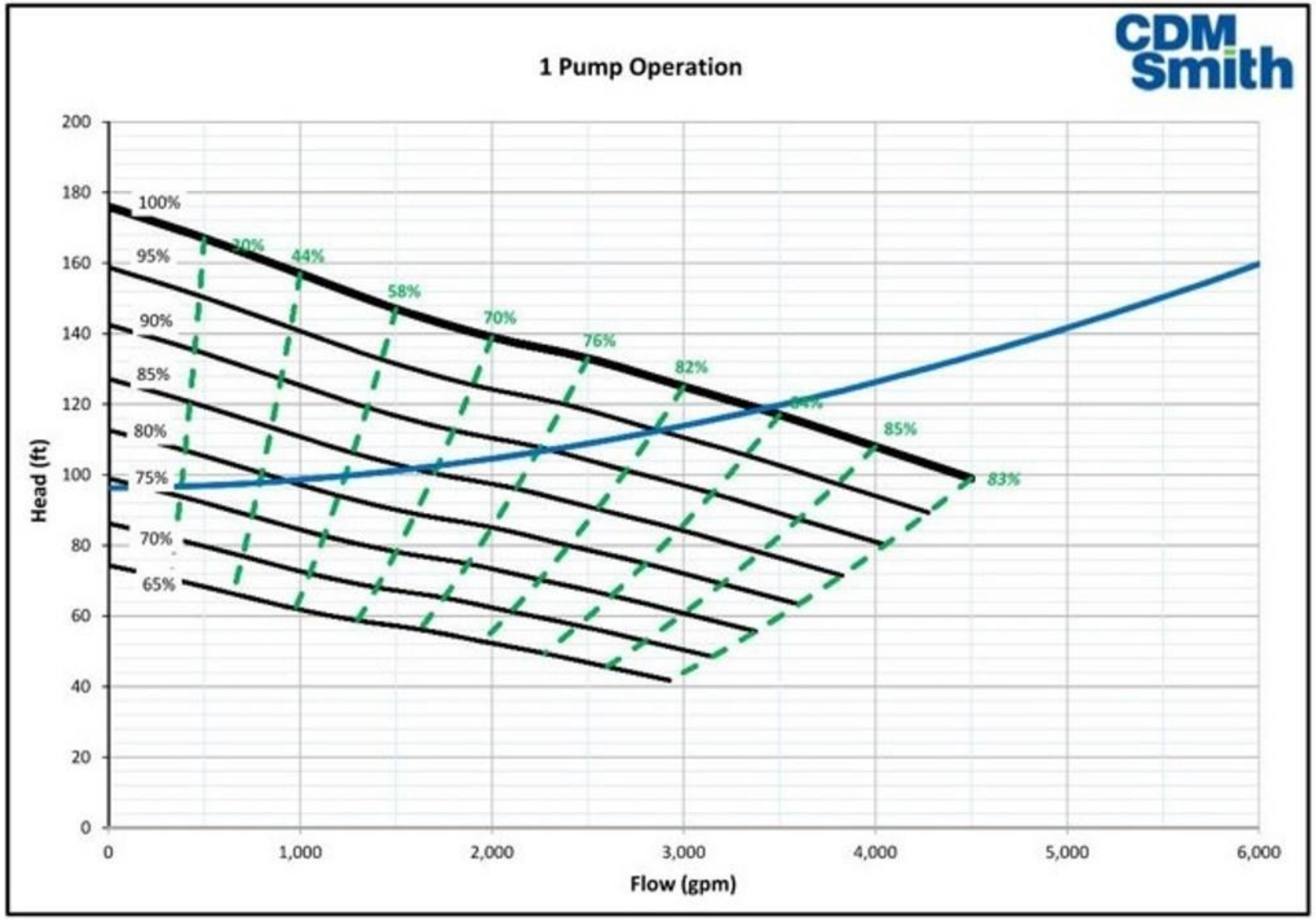
- Grating with access panels for new submersible pumps
- Combination air valves installed in pump discharge piping to release air and break siphons upstream of check valves
- Combination valves installed outdoors to prevent gas release in drywell

Influent Pump Station Improvements

New submersible pumps being lowered into place

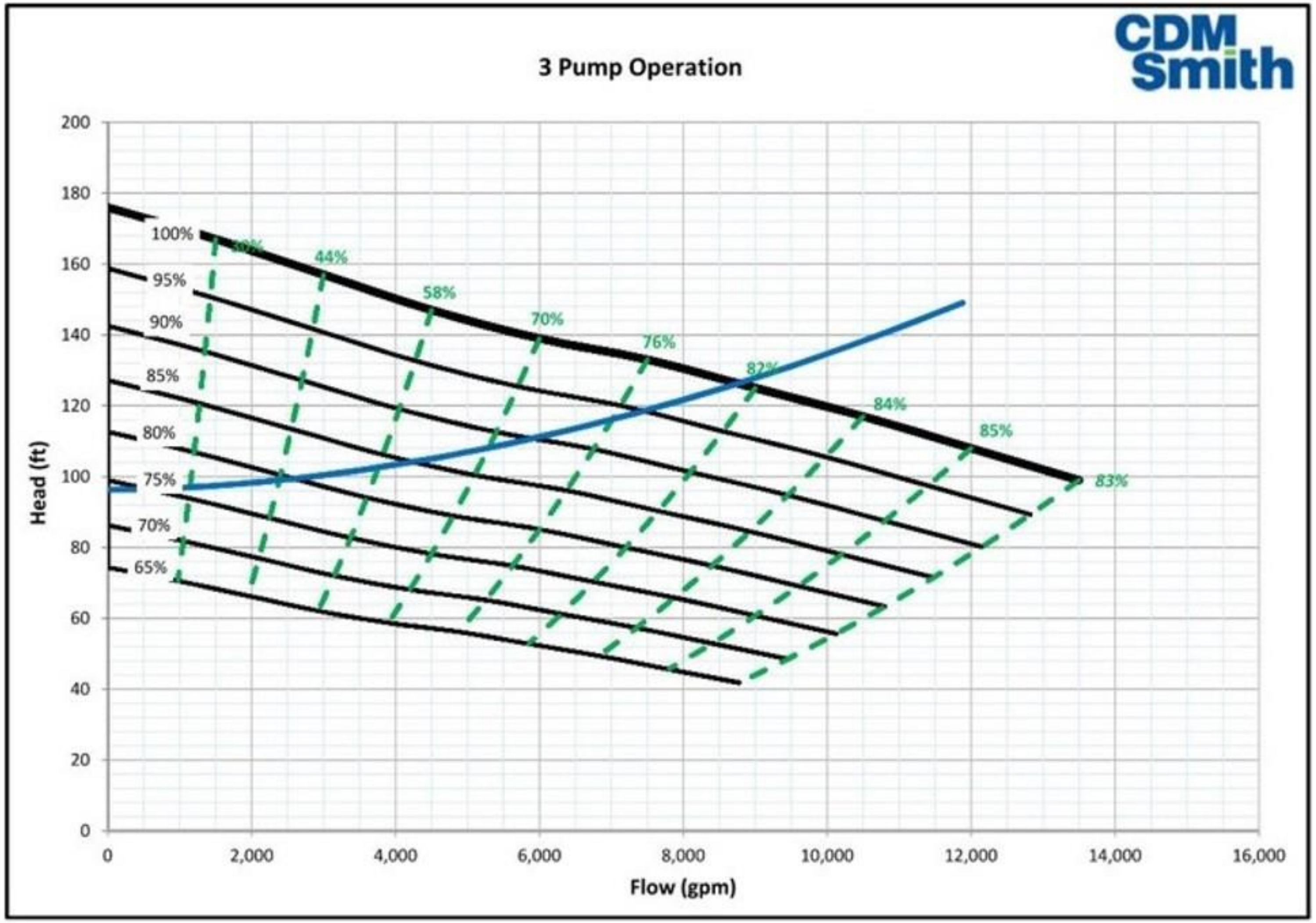
1 Pump Running

- Full Speed 3500 gpm
- Reduced Speed 1000 gpm



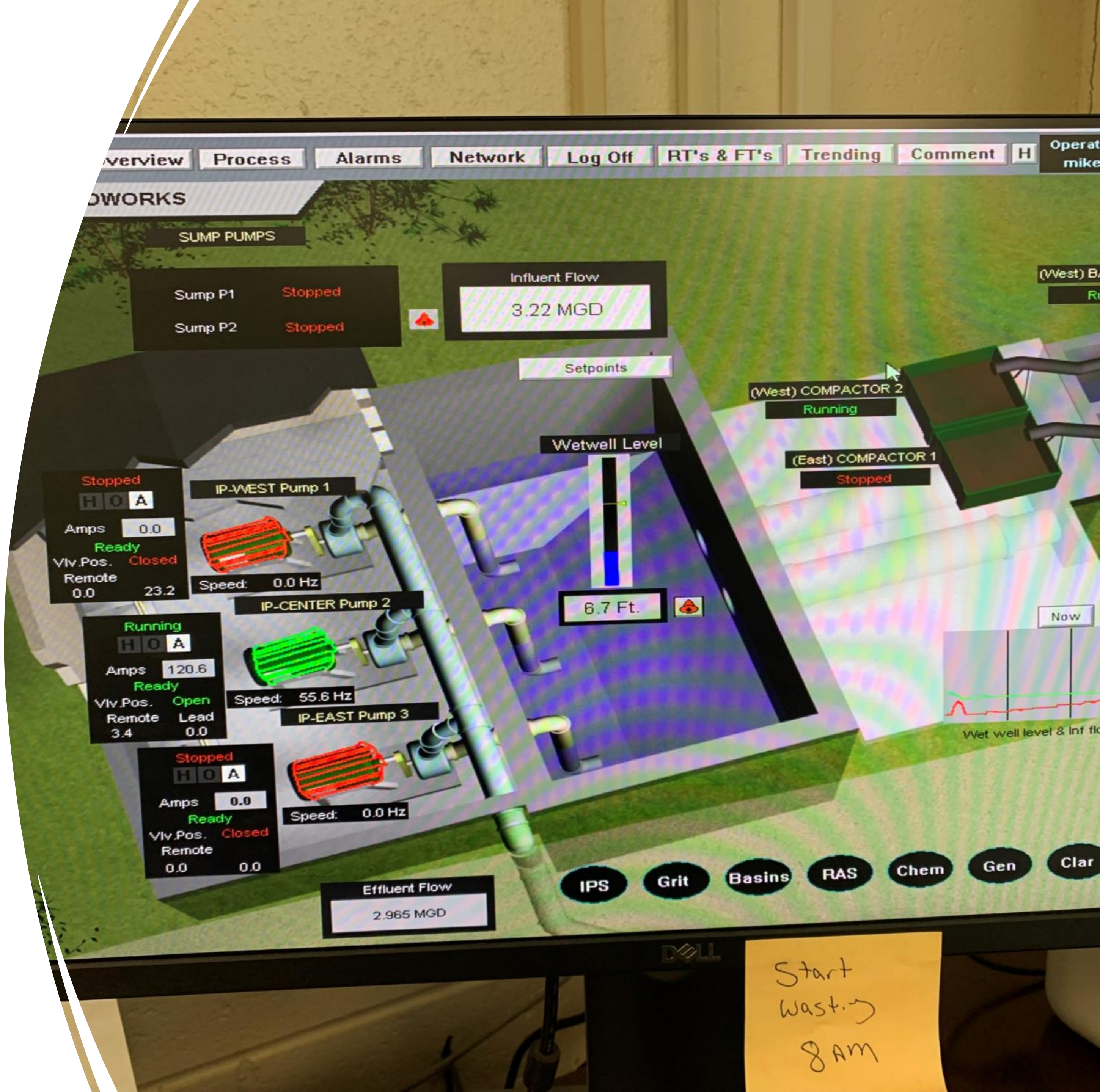
3 Pumps Running

Full Speed 9,000 gpm



IPS Control Modifications

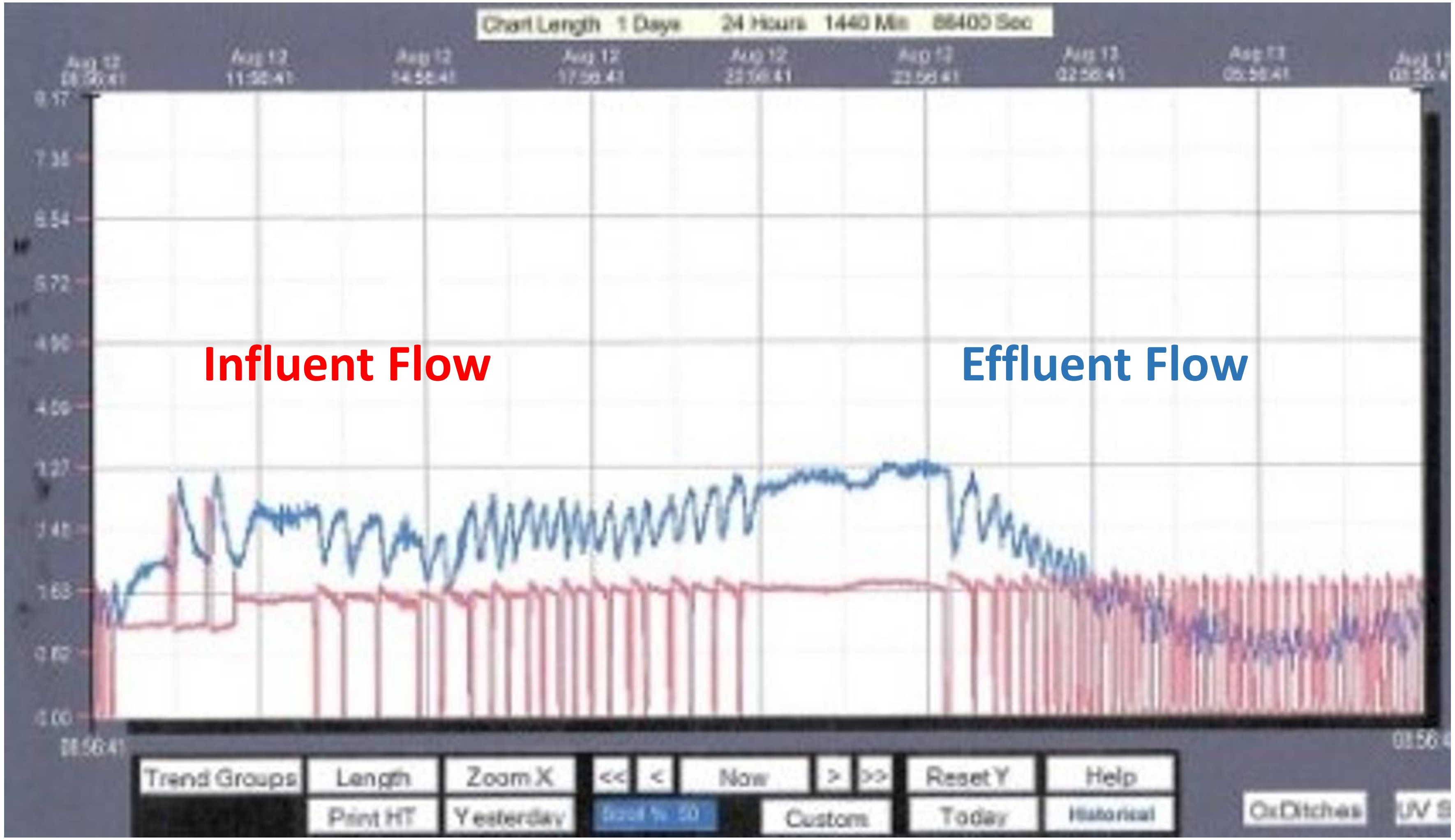
- Lead pump starts at reduced speed (49% of full speed)
- Lead pump ramps up as level rises
- Lag pump starts at reduced speed when level is rising and lead pump hits 60hz speed
- Lead and lag pump speeds are matched and adjusted equally as level varies



Influent Pump Station Improvements

- Pump Startup
- Flowrates without new grit removal (reduced head, higher flow)
- Flowrates with new grit removal (increased head, design flow)
- Testing
  - Availability of water
  - Plant capability to accommodate full flows
  - Need to fill wetwell completely

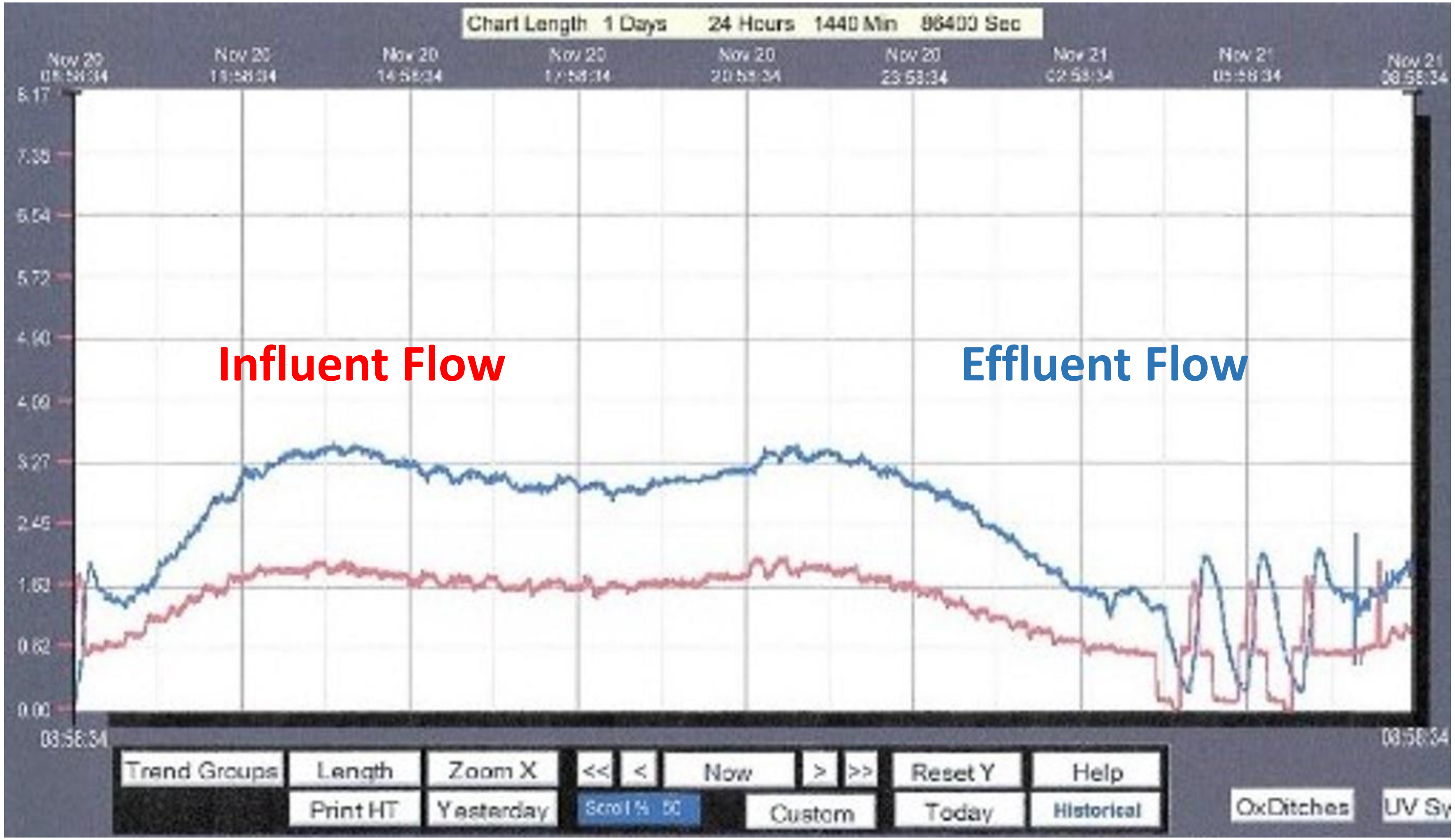
Influent Pump Station Improvements



BEFORE PROJECT

- Erratic flow patterns due to starting and stopping of pumps
- Negative impacts to downstream processes

Influent Pump Station Improvements



AFTER PROJECT

- Smoother flow patterns excepting early morning hours
- Reduced negative impacts on downstream processes

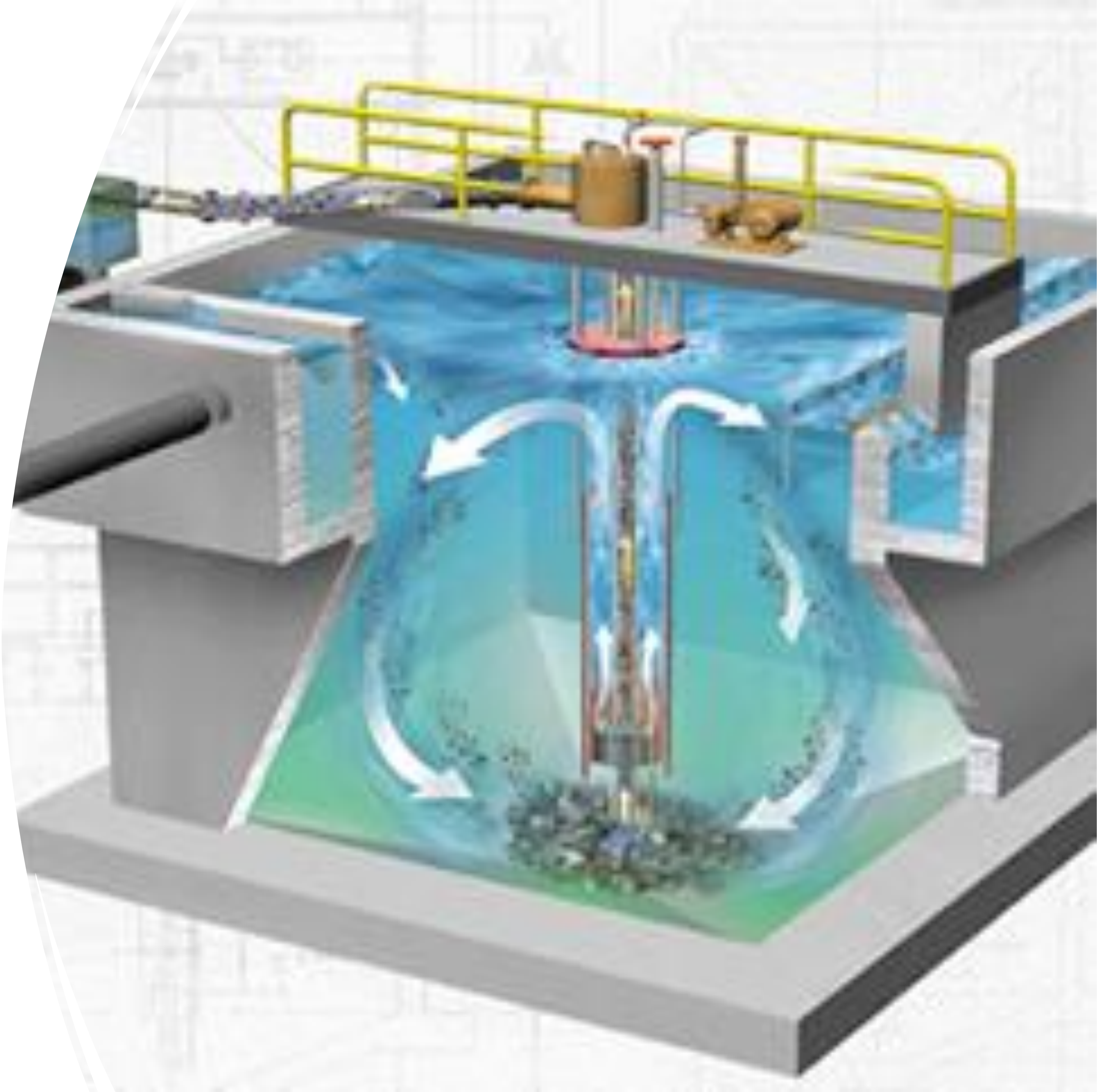
Influent Pump Station Improvements - Summary

- Conversion to submersible pumps greatly improved pump efficiency and allowed better pump turndown
- Wetwell modifications eliminated vortex and air entrainment issues
- Elimination of plant “slugging”
- Improved treatment plant performance

New Grit Removal Facilities

New Grit Removal Facilities

- Original Grit Removal Facilities
- One Rolling Grit Removal Basin
- Air induction at center creates "rolling" action
- Air Lift Pump
- One grit washer



New Grit Removal Facilities

- Why Replace?
- Old technology
- Equipment at end of useful life
- Location in Hydraulic Profile not compatible with plan for future equalization

New Grit Removal Facilities

- Incorporate stacked tray or "headcell" technology
- Unit specified to capture and retain 95% of all wastewater grit 75 micron and larger
- Structure set at higher elevation to allow for future equalization
- Unit sized for future expansion (Peak Flow 19 MGD)
- Existing grit removal remained in service until construction complete

New Grit Removal Facilities

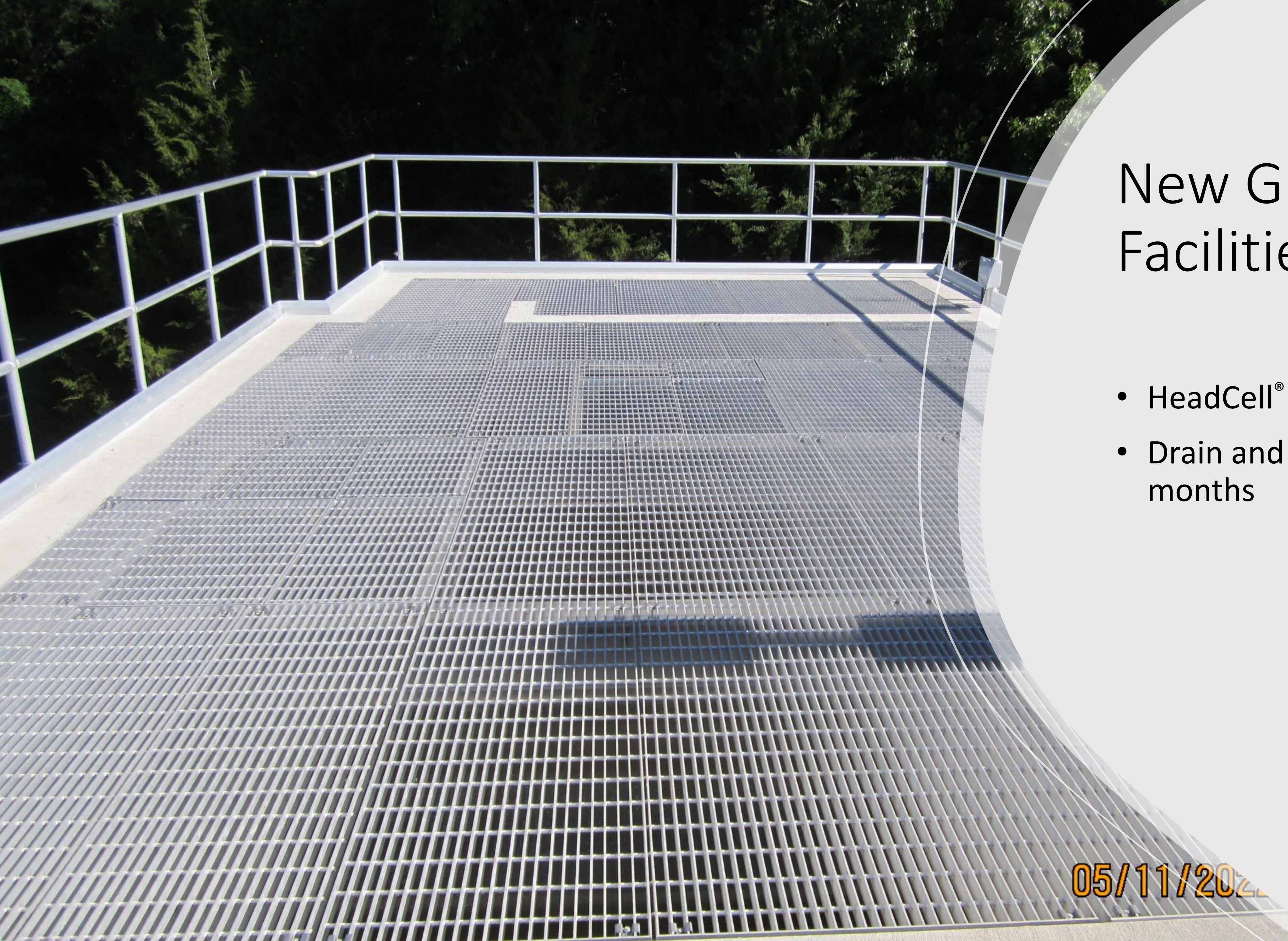
- New Grit Removal Facilities
- One Hydro International HeadCell® Grit Separator (no moving parts)
- Two Hayward-Gordon recessed impeller Grit Pumps
- Two Huber COANDA Grit Washing Plants

New Grit Removal Facilities

- Hydro-International HeadCell® Grit Separator
- Tray Diameter – 12 feet
- Number of Trays – 10
- Unit Peak Flow – 19 MGD
- Unit Average Flow – 6 MGD
- No modifications needed if plant is expanded to 6 MGD capacity

New Grit Removal Facilities

- HeadCell® Startup Issues
- Constructed out of flow path
- Yard Piping Modifications



New Grit Removal Facilities

- HeadCell® Startup Issues
- Drain and inspect every 6 months

New Grit Removal Improvements - HeadCell® Results

Table 4.1
Smith Creek RRF Headcell Performance Summary

Size Fraction (μ)	Trial No. 1 (% Removal)	Trial No. 2 (% Removal)	Trial No. 3 (% Removal)
>297	99.9	99.9	99.9
210< SF <297	100.0	100.0	100.0
149< SF <210	99.9	100.0	100.0
105< SF <149	99.8	99.9	99.9
74< SF <105	99.7	99.8	99.9
53< SF <74	99.6	99.8	99.9
All Sizes	99.8	99.9	99.9
≥ 74 μ	**99.9**	**99.9**	**99.9**

New Grit Removal Facilities

- New Hayward Gordon TORUS XR3 Recessed Impeller Pumps
- Two pumps installed to provide redundancy
- Capacity – 300 gpm at 21.5 feet total head
- Woods variable speed V-belt drives (No VFD's)
- Interconnected piping (suction and discharge)

New Grit Removal Facilities

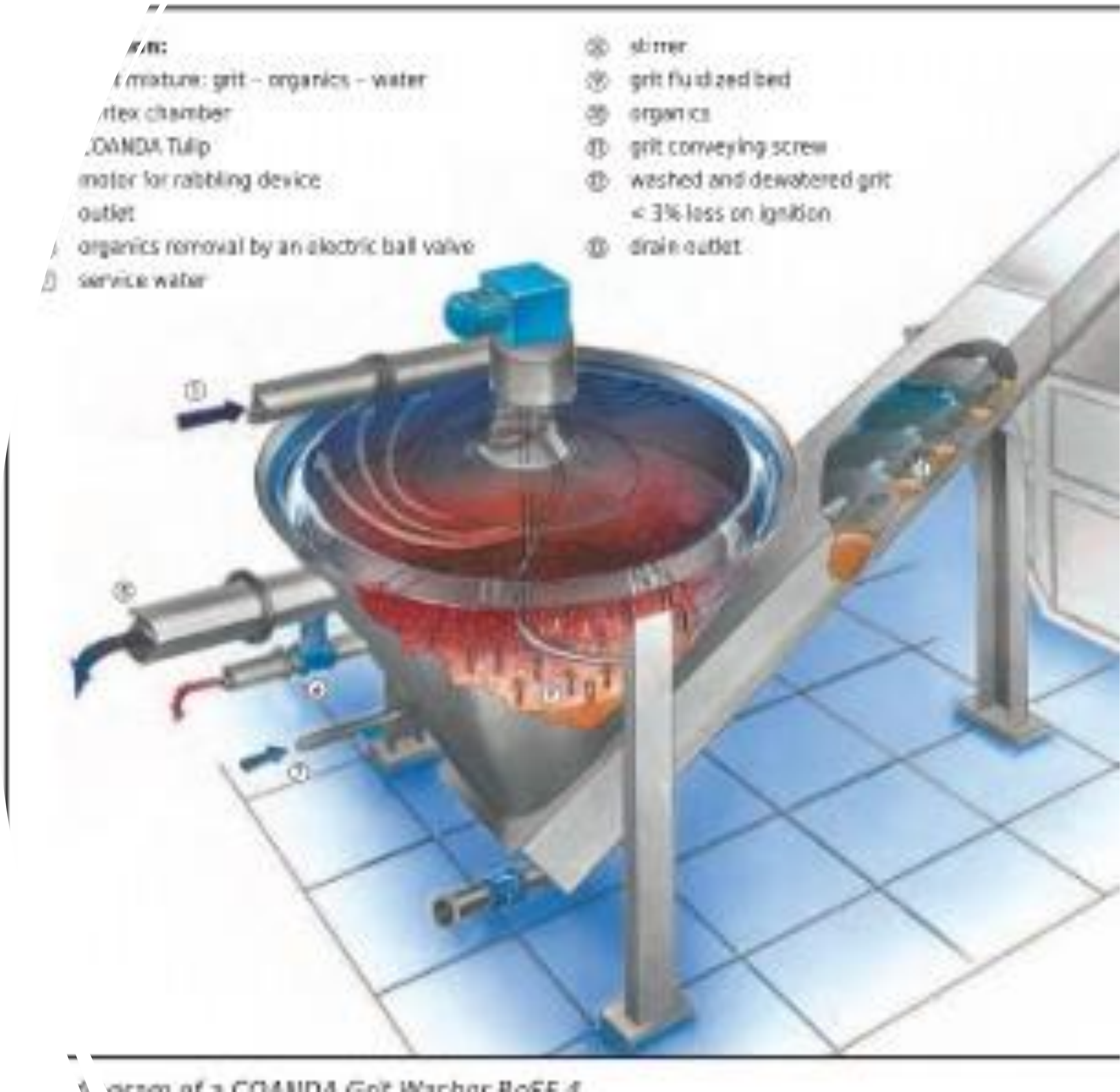
- Grit Pump Startup Issues
- Adjusting Pump Speed
- Variable Speed V-Belt Drive
- Seal Water

New Grit Removal Facilities - Summary

Pump Summary Items

New Grit Removal Facilities

- Huber COANDA RoSF4-2 Grit Washing Plant
- Two units
- Varying velocities in “tulip” (inverted cone) promote grit separation
- Fluidized bed for improved organics removal



New Grit Removal Facilities

- COANDA Startup Issues
- Feed Rate
- Feed Schedule
- Seeding
- Organics Removal Settings

New Grit Removal Facilities

- COANDA Startup Issues
- Trial and error process
- Unit Leveling

New Grit Removal Facilities

- COANDA results?
- Performance test not performed yet

New Grit Removal Facilities – Summary

- System Summary
- Lessons learned

Summary

- Project Costs
- Engineer's OPCC – $5,964,400
- Contract Bid Price – $5,612,888
- Final Contract Amount – $5,557,998

Questions?

Special Thanks To:

- Smith Creek RRF Staff
    - John Silveri
    - Dan Hackney
- Raleigh Water Construction Representative
    - Mark O'Grady
- CDM Smith – Design and Construction Administration
    - Ross Stroud, Project Manager and Lead Design Engineer
    - Dan Williams, Lead Designer and Construction Administration

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