IMPROVING THE HOCKING WITH CSO REDUCTION AND ADVANCED TREATMENT TECHNOLOGY

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City of Lancaster

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Agenda

- **Project Background**
- **Upper Hocking Pump Station**
- **Upper Hocking WPCF**
  - Wet Stream Processes
  - Solids Handling Processes

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CITY OF LANCASTER

Project Background

City of Lancaster, OH Collection System

- **Population Served ~ 38,780**
- **225.5 Miles of Sanitary Sewer**
- **12.3 Miles of Combined Sewer**

Lawrence St. WPCF

- Average Flow ~ 6.0 mgd
- Peak Capacity – 18 mgd

Project History

1995 – Began Sewer System Capacity Evaluation

- Developed system model, addressed basement flooding

1997 – NPDES Permit

- System Operational Plan – March 1998
- System Characterization Report – Dec 1999
- Long Term Control Plan – June 2000

2003 – NPDES Permit

- Long Term Control Plan Addendum – March 2005
  - Addressed four major CSOs

2007 – NPDES Permit

- Lake /Allen/Maple Sewer Separation – Feb 2009
- Upper Hocking Water Pollution Control Facilities – Dec 2011
- Phase II Long Term Control Plan – March 2014

To Date 24 of 33 CSOs eliminated

CSO Planning

Lake /Allen/Maple Sewer Improvement

- Completed in 2008

Upper Hocking Water Pollution Control Facilities

- Completed in 2011

Flow Monitoring/Phase II Long Term Control Plan

- Flow Monitoring Report to OEPA in January 2014
- Submit Phase II LTCP to OEPA by March 2014

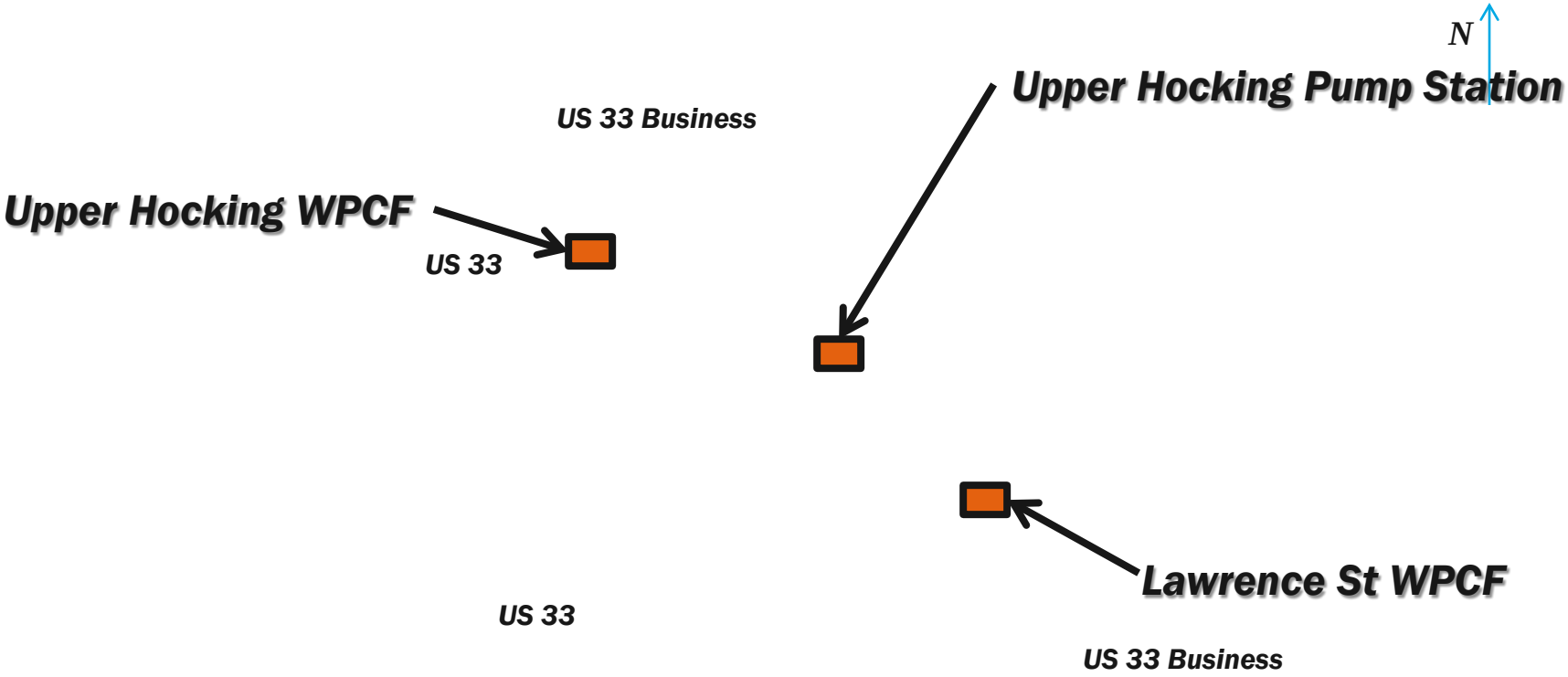
Broad Street Express Sewer

- Completed May 2016

19 other proposed projects for CSO reduction in the future

Key Projects for CSO Reduction

Collection System – Service Areas



Lawrence St. WPCF - Combined

Lawrence St. WPCF - Separate

Upper Hocking WPCF - Separate

Upper Hocking WPCF - Separate

Upper Hocking Water Pollution Control Facilities

Summary of New Facilities

Upper Hocking WPCF

- 2.0 mgd (ADF) Water Pollution Control Facility – to treat separately sewered areas only.

Upper Hocking Pump Station

- Remote 8.0 mgd (peak) Pump Station and force mains – to divert flow from separately sewered areas to the new WPCF

Schedule

Construction Began – January 2009

Startup – July, 2011

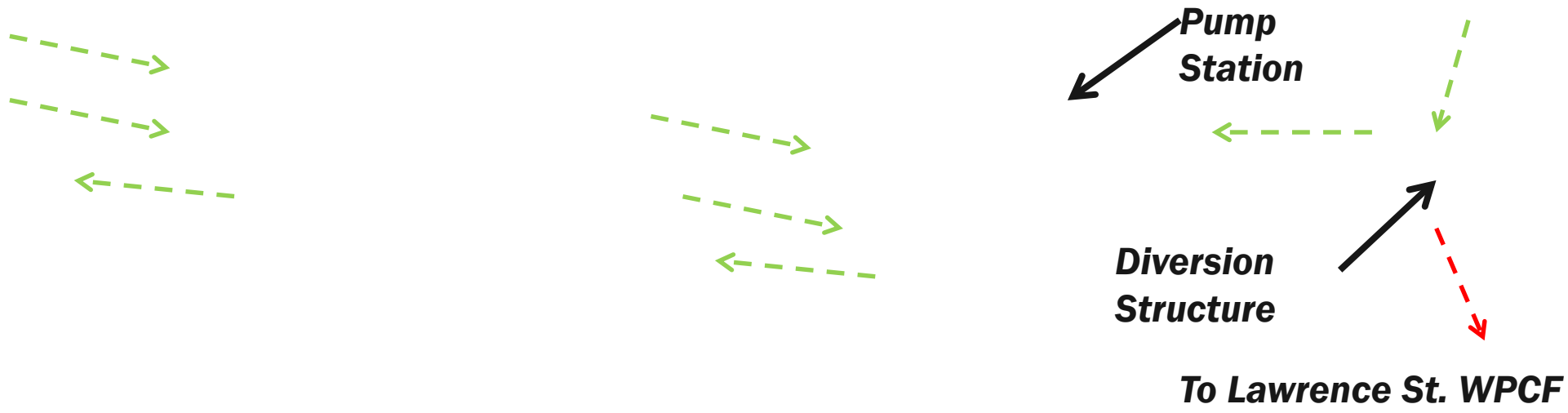
Construction Cost – $36 Million

Upper Hocking Water Pollution Control Facilities

Construction of the Upper Hocking Water Pollution Control Facilities served to:

- Intercept and provide full secondary treatment for selected separate sewer areas prior to entering combined sewer system
- Reduce combined sewer overflow volume
- Accommodate new growth along US 33 Bypass corridor and northwest side of City

Upper Hocking Facilities – Sewer Separation



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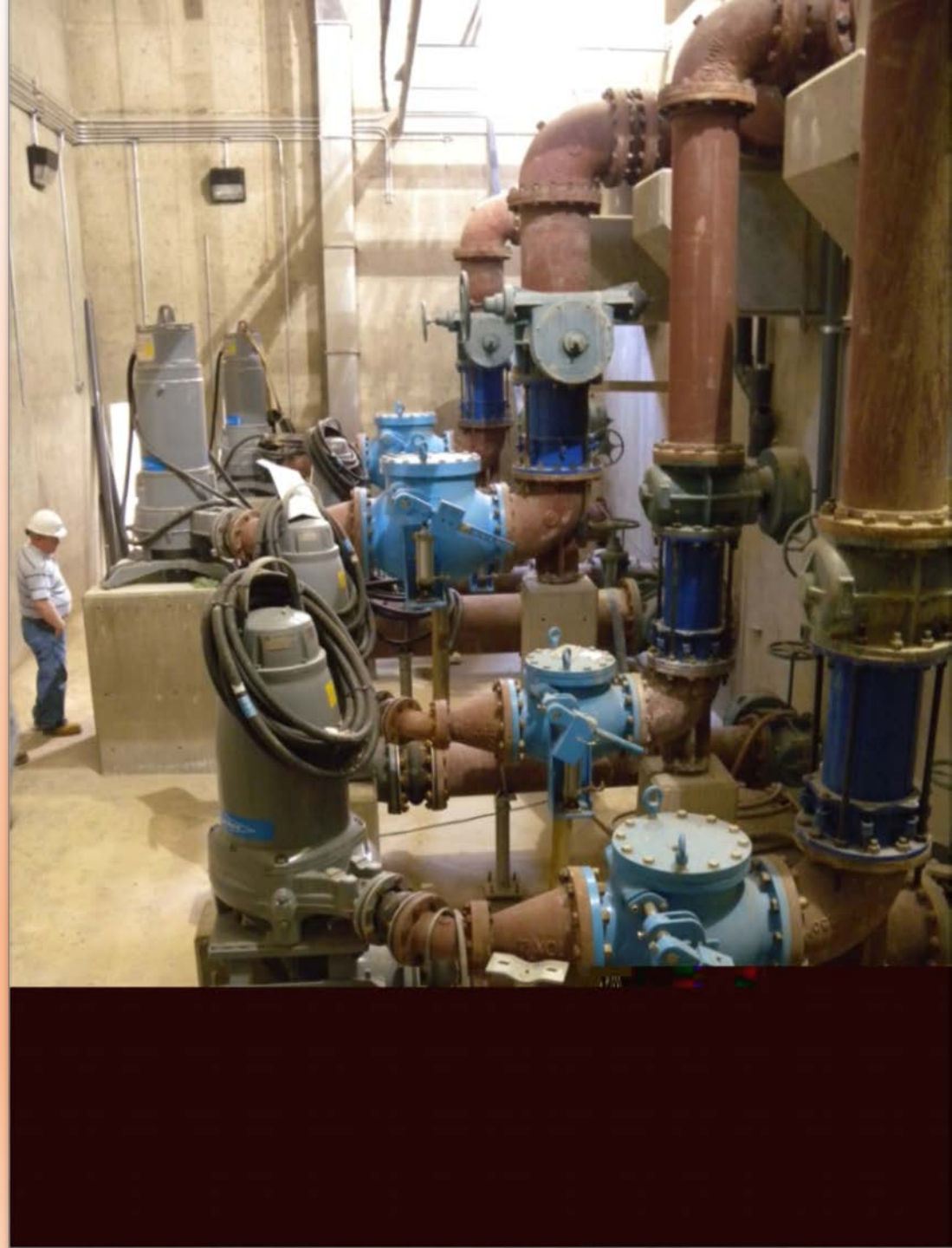
UPPER HOCKING PUMP STATION

Upper Hocking Pump Station

- **Capacity**
  - Firm – 8.0 mgd
  - Average ~ 1.7 mgd
  - Minimum ~ 0.4 mgd
- **Wet pit/dry pit style**
- **Self-cleaning trench wet well**
- **Manual bar rack**
  - (2 –inch spacing)
- **Five dry pit submersible pumps**
  - Two larger pumps ~ 5 mgd
  - Three smaller pumps ~ 2 mgd



Upper Hocking Pump Station

- **Odor Control**
  - Biofilter
  - Chemical addition to force mains
- **Standby Diesel Generator**
- **Dual force mains**
  - 14 inch and 18 inch – 14,000 ft. of each
  - Ductile iron
  - Pigging
  - HDPE at stream and railroad crossings (directional drill)
    - 3 locations

Upper Hocking Pump Station

- **Aesthetics**
  - Architecture and landscaping to blend with surrounding highly commercial area
- **Telemetry**
  - Radio communication
  - Overall pump station control system
  - Critical data interfaces with Upper Hocking WPCF control system

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UPPER HOCKING WATER POLLUTION CONTROL FACILITY

Upper Hocking WPCF – Flow Rates

Peak Flow Through Preliminary Treatment – 8.0 mgd

Design Flows Through Secondary Treatment

- Average Daily Flow Rate – 2.0 mgd
- Minimum Flow Rate – 0.4 mgd
- Peak Monthly Flow Rate – 3.5 mgd
- Peak Daily Flow Rate – 6.0 mgd
- Peak Hourly Flow Rate – 6.0 mgd
  - Maximum flow limited by membrane

Currently Average Daily Flow Rate – 1.3 mgd

Upper Hocking WPCF – Effluent Limits

- **NPDES Effluent Limits**

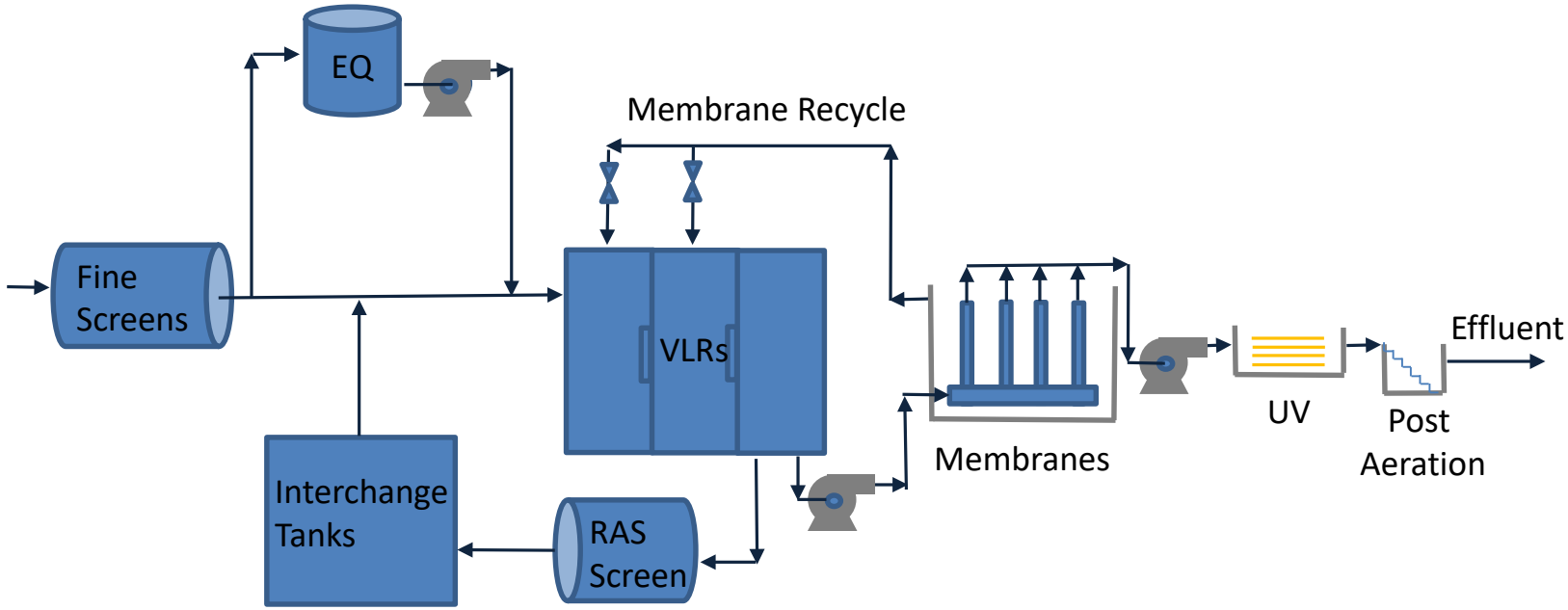
	Monthly	Weekly
$CBOD_5$	10 mg/l	15 mg/l
TSS	12 mg/l	18 mg/l
NH_3-N (Summer)	1.5 mg/l	1.0 mg/l
NH_3-N (Winter)	4.5 mg/l	3.0 mg/l
E Coli (Summer)	161/100 ml	62/100 ml
DO	6.0 mg/l minimum continuous	

- **Additional Effluent Goals**

	Monthly	Weekly
Total Phosphorous	1.0 mg/l	1.5 mg/l
Turbidity	0.2 NTU	0.2 NTU

Wet Stream Processes

- Influent Fine Screening
- Equalization
- Aeration Process (Vertical Loop Reactors)
- Membrane Bioreactors
- UV Disinfection
- Post Aeration



Preliminary Treatment – Fine Screening

Influent Fine Screens:

- Fine screening critical for protection membrane life
- 2 units each rated for 8 mgd
- Internally-fed rotary drum screens
- 2 mm perforations

Screenings Washer Compactors:

- 1 per screen
- Discharge to truck/container below

Preliminary Treatment – Equalization

Equalization Tank:

- Volume – 1 million gallons
- Contain all flows in excess of 6 mgd
- Wastewater pumped to VLRs
- Jet mixing system
  - 2 pumps
  - Jet diffusers

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Process Aeration – Vertical Loop Reactors

Three VLR basins

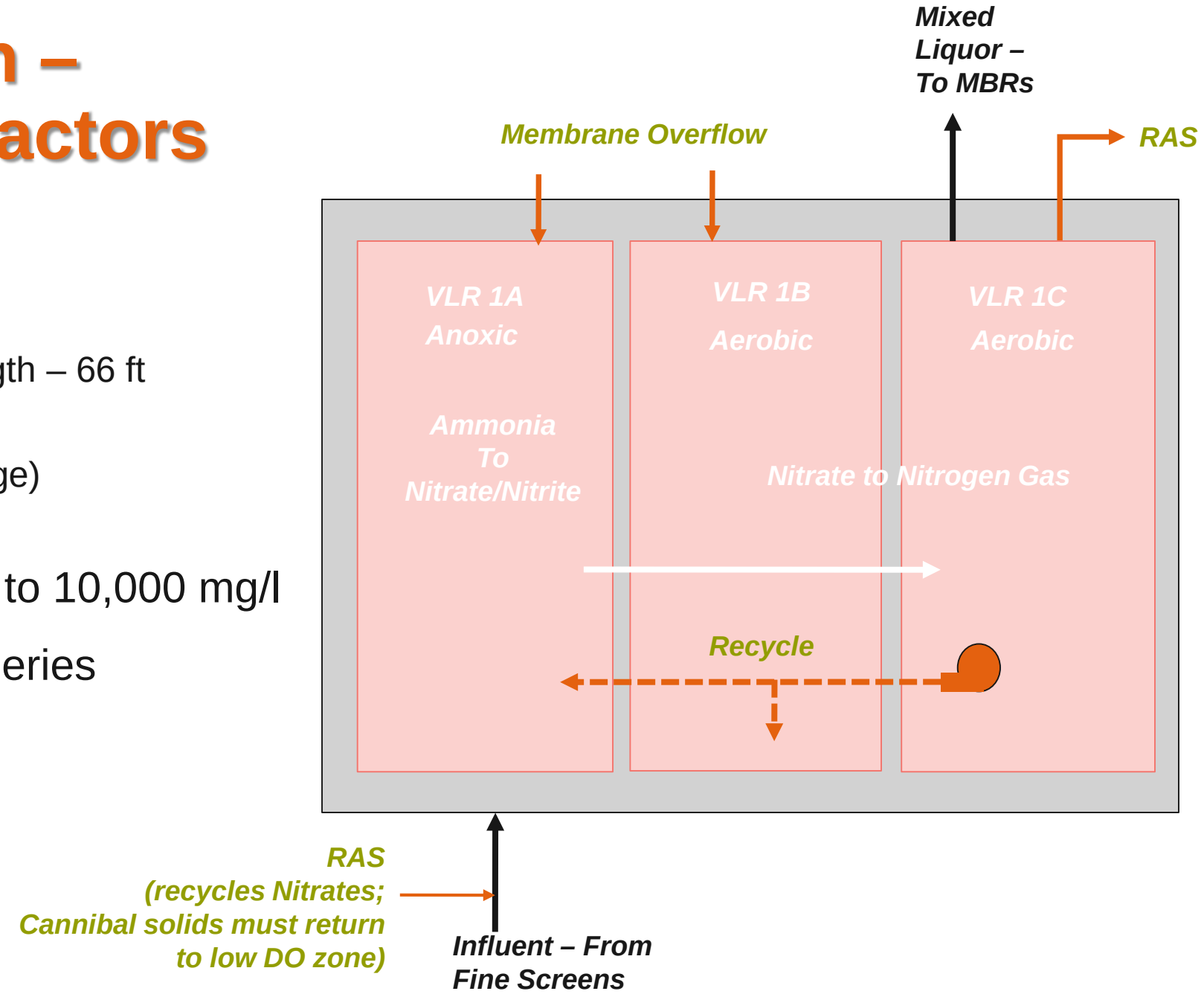
Dimensions

- Width – 30 ft, Depth – 20 ft, Length – 66 ft
- Volume – 285,000 gal each
- HRT – 10.3 hours (design average)
- SRT – 49 days (design average)

MLSS concentration – 7,000 to 10,000 mg/l

Basins generally operate in series

- VLR 1A – anoxic zone
- VLR 1B and 1C – aerobic
- Total nitrogen removal

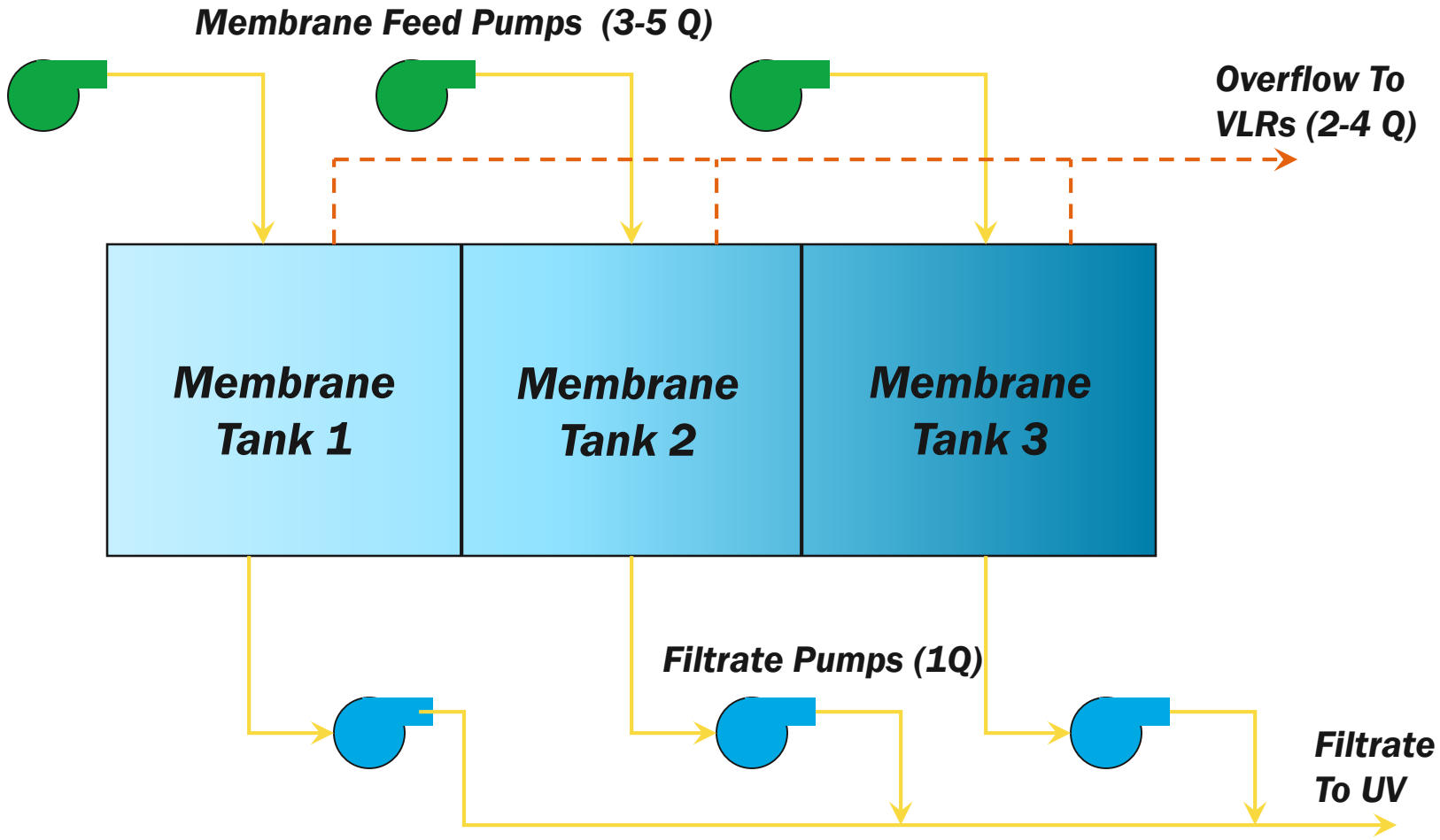


Membrane Bioreactors (MBRs)

Membrane Bioreactors Selected:

- Superior effluent quality
- Discharges to Hocking River just upstream of the City of Lancaster
- With plant expansions, future discharge limits may be stricter because of low flow in stream
- High level of automation, minimum staff attention
- Takes less space than conventional clarifiers
- More reliable solids separation performance
- Eliminates need for filters
- Easily expandable
- Potential for effluent reuse at industrial park

Membrane Bioreactors (MBRs)

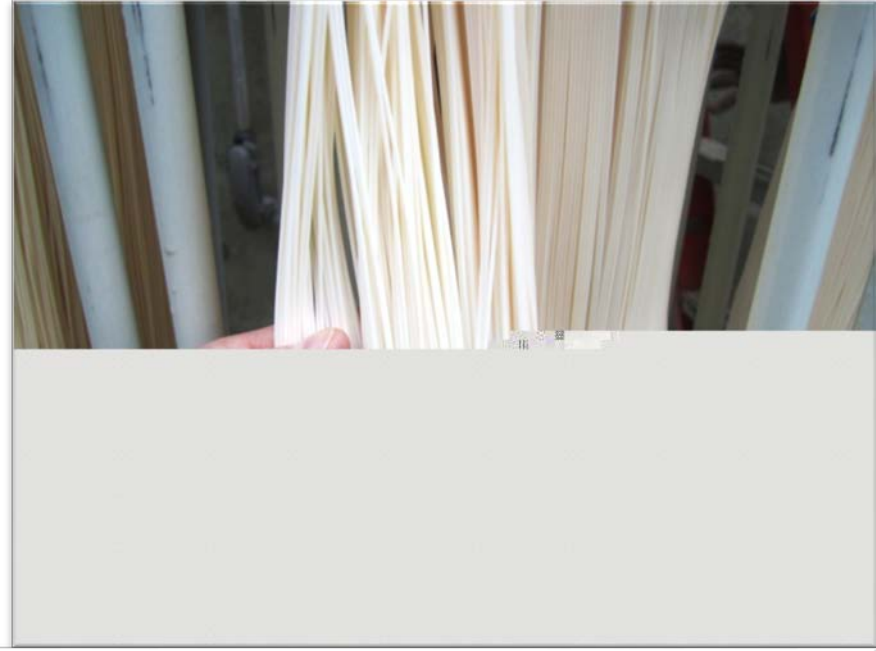


Membrane Bioreactors (MBRs)

Membrane Bioreactors

- Tanks – 3 each
- Dimensions:
  - 25’ x 15.75’ x 9.22’ D
- Volume – 77,646 gal each
- Racks per tank – 17
- Module per rack – 16
- Module per tank - 272

Membrane Bioreactors (MBRs)

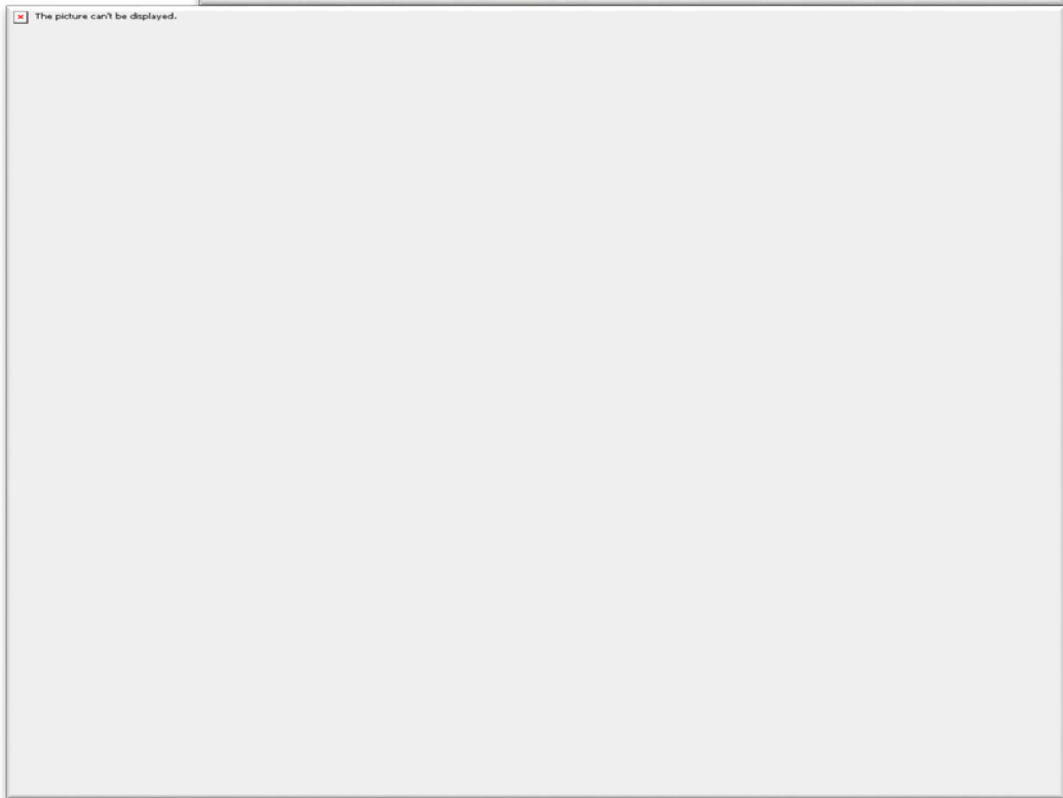


Three tanks rated for 2 mgd (peak) each

Composed of vertical membrane cartridges

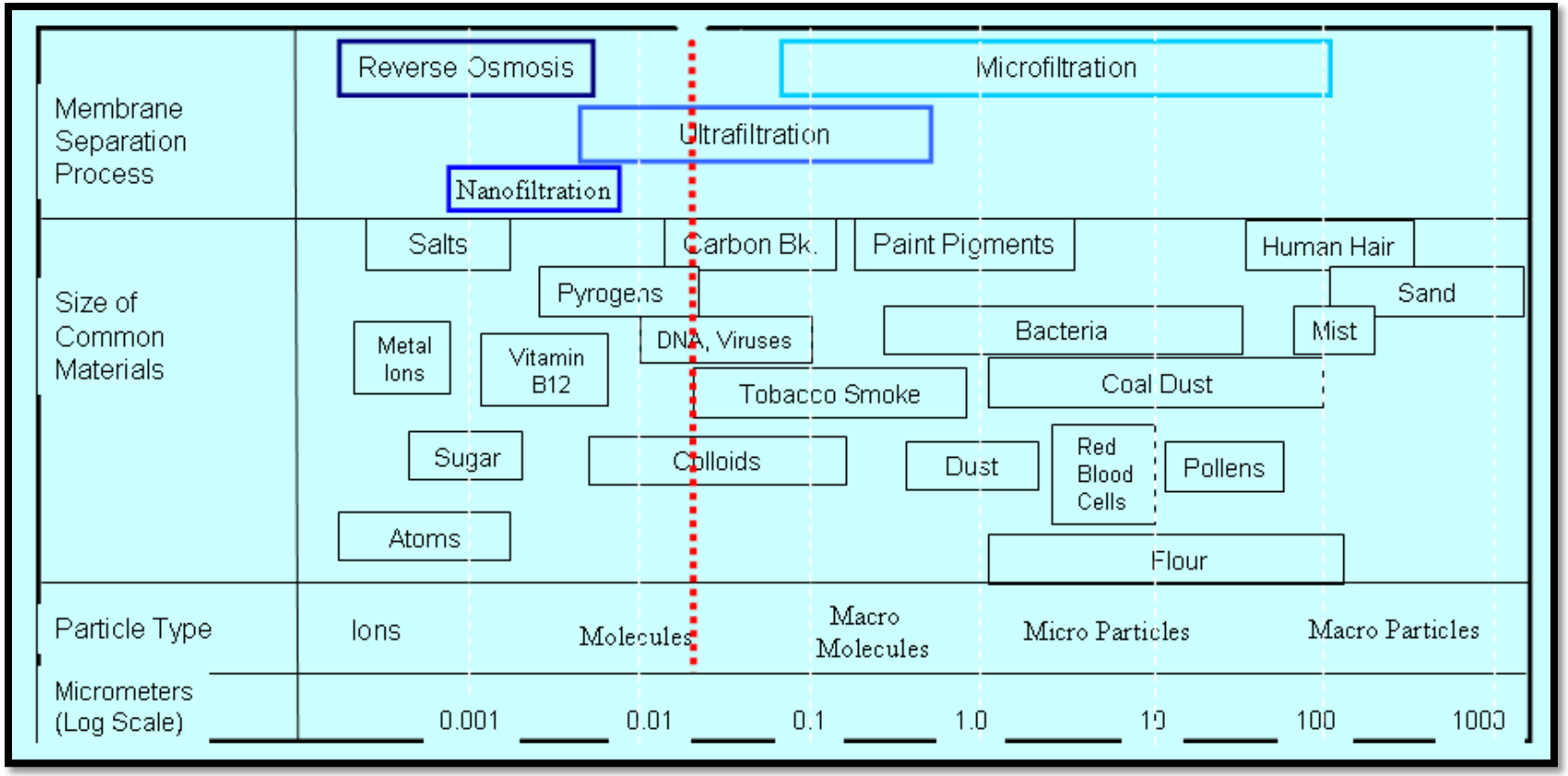
Siemens hollow fiber membranes

- Membrane pore size: 0.1 microns
- (0.0001 mm)
- Membrane material - Polyvinyldiflouride



Membranes

Pore Size 0.1 microns – Ultrafiltration



Process – Membrane Bioreactors

Cleaning Processes

- Relaxation
  - Stop filtration (filtrate pumps)
  - Removes caked solids from membranes
  - 60 seconds for every 12 minutes
- Sodium Hypochlorite Maintenance Clean
  - 300 ppm sodium hypochlorite
  - Every 7 days
  - Removes biologicals from inside of membranes
- Sodium Hypochlorite Clean-in-Place
  - 1500 ppm sodium hypochlorite
  - Removes biologicals from outside of membranes
  - Every 90 days
- Citric Acid Clean-in-Place
  - 2 percent citric acid
  - Removes mineral buildup from outside of membranes
  - Every 90 days

Disinfection, Post-Aeration, P Removal

Ultraviolet Disinfection

- Trojan 3000+
- Low pressure, high output
- Not in use as long as Fecal Coliform is maintained. Must be loaded and ready

Post Aeration

- Step aeration
- Dissolved oxygen requirement – 6 mg/l

Phosphorous Removal

- Design allowed for for Chemical addition
- 1 mg/l goal
- Currently monitoring and reporting, but no current limit

Upper Hocking WPCF – Water Quality

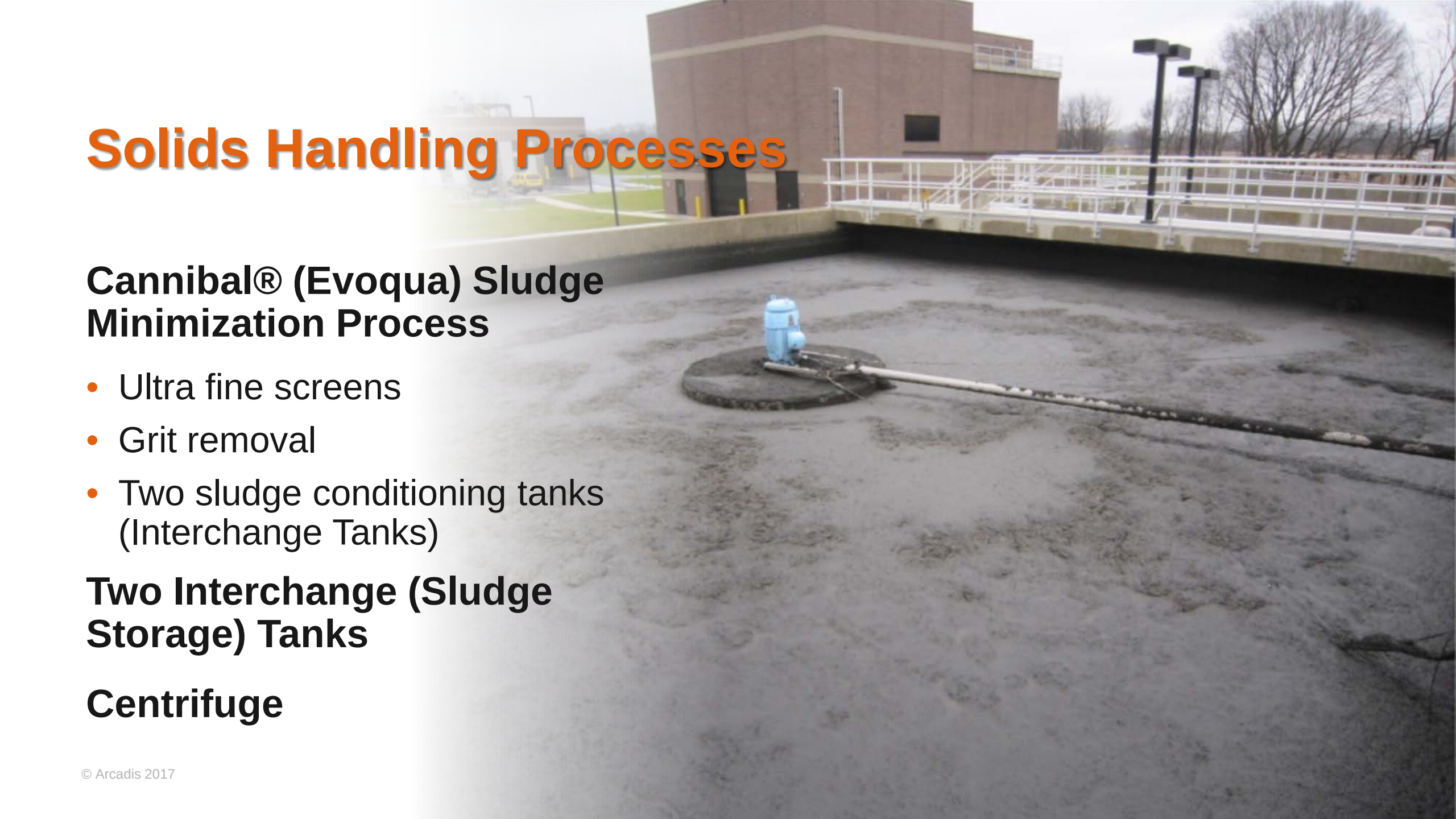
- **Average Influent Characteristics**

	$CBOD_5$ (mg/l)	TSS (mg/l)	TKN (mg/l)	NH3-N (mg/l)	TP (mg/l)
Average from 2016	181.3	312.4	38.1	22.97	6.9

- **Average Effluent Characteristics**

	Flow (mgd)	$CBOD_5$ (mg/l)	TSS (mg/l)	NH3-N (mg/l)	TP (mg/l)	E. Coli (cfu/100ml)	Nitrate/ Nitrite (mg/l)
Average from 2016	1.3	<2.68	<1.75	<0.56	2.11	9	5.23

Solids Handling Processes



Cannibal® (Evoqua) Sludge Minimization Process

- Ultra fine screens
- Grit removal
- Two sludge conditioning tanks (Interchange Tanks)

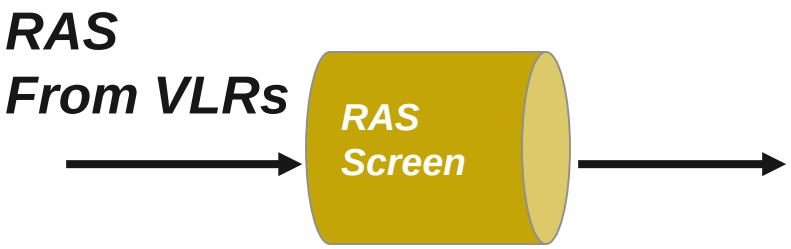
Two Interchange (Sludge Storage) Tanks

Centrifuge

The Cannibal® Process

- **Mixed liquor is conditioned by ORP control in a sidestream process to minimize waste sludge**
  - Sidestream process promotes growth of facultative bacteria which are then fed back to VLRs
  - Standard digestion produces 0.6 to 0.7 lbs solids/lbs BOD treated
  - Cannibal reduces biological yield to 0.28 lbs solids/lbs BOD treated

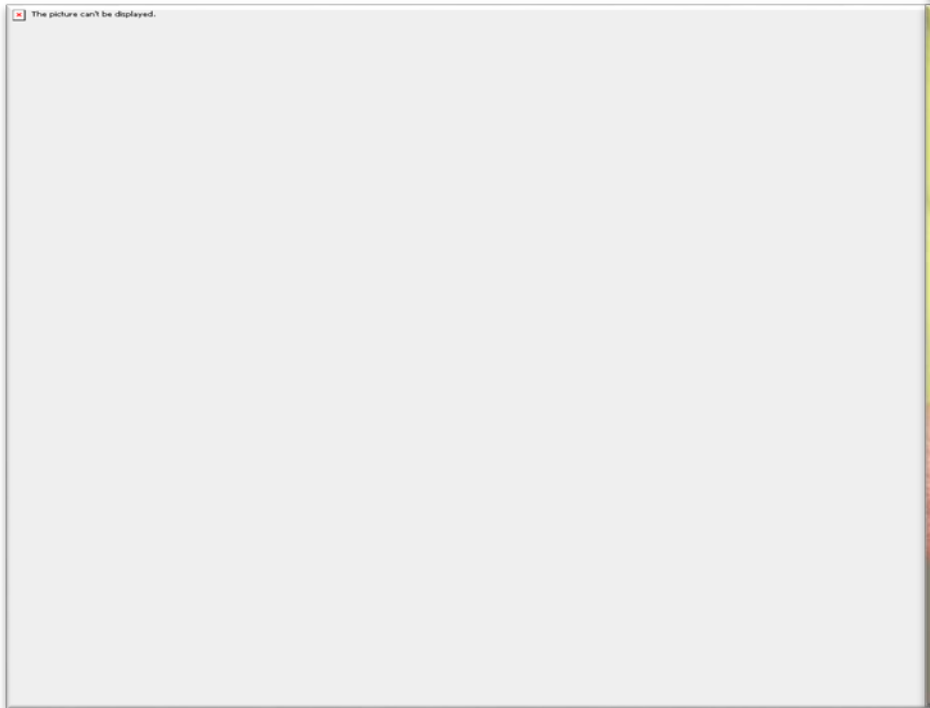
The Cannibal® Process



RAS Rotary Drum Screen

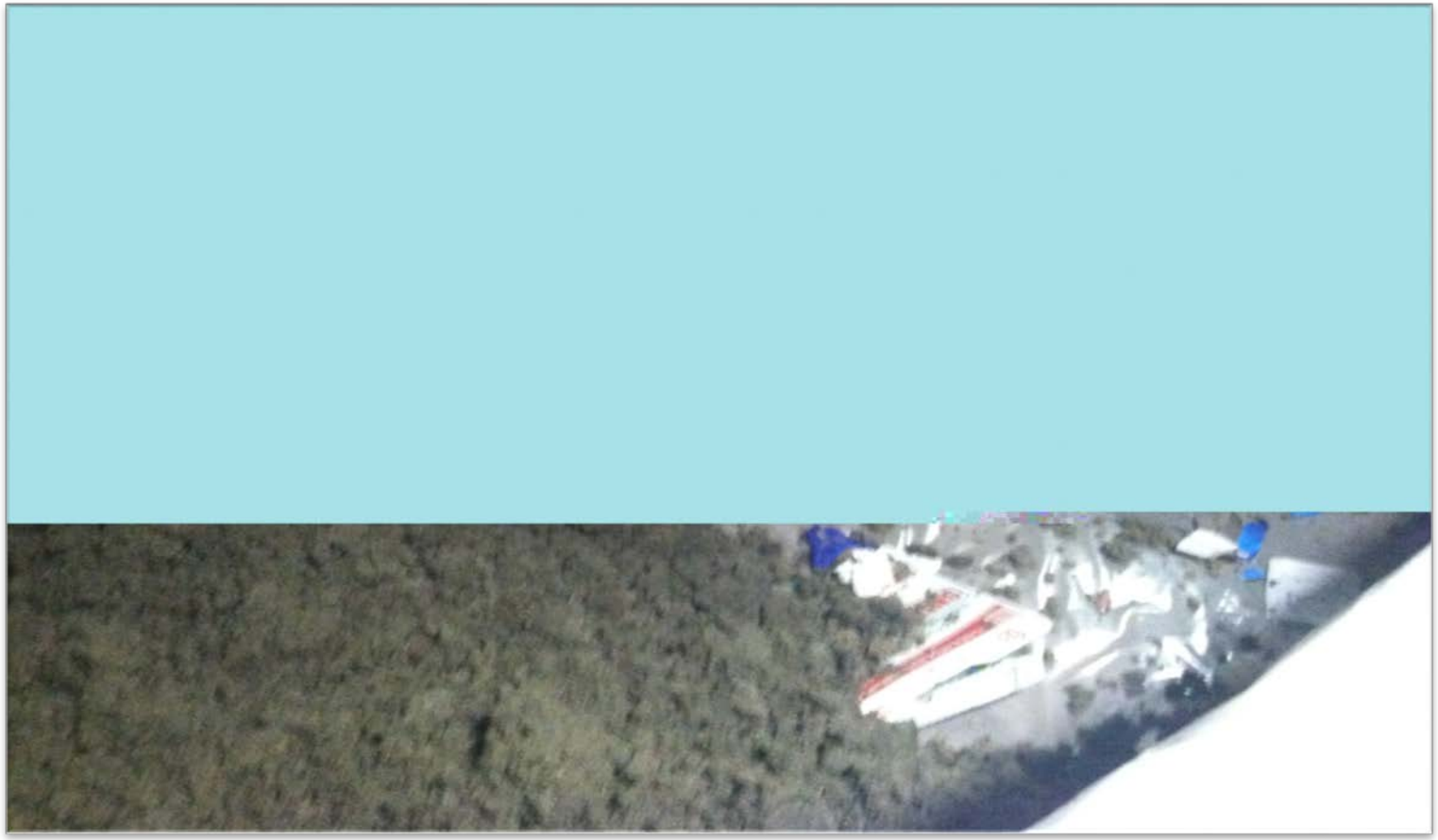
- 0.25 mm
- Wedgewire
- Removes:
  - Inerts and trash

Washer Compactor

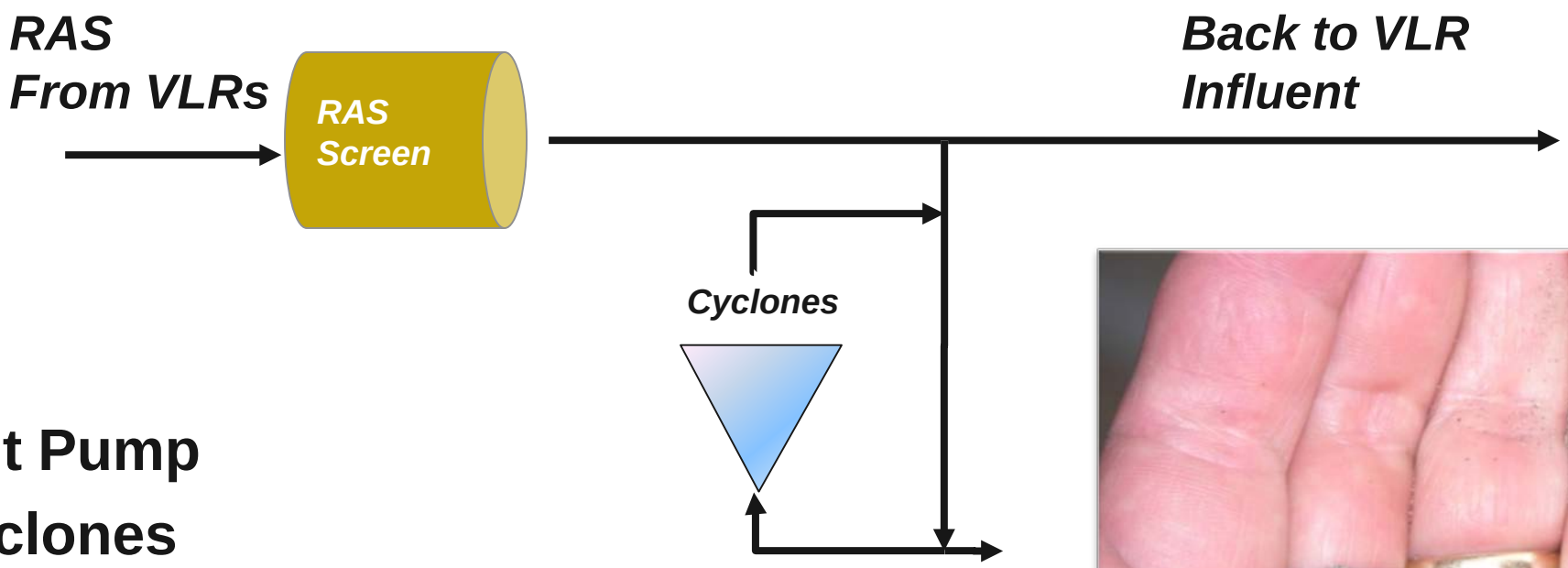


The Cannibal® Process – RAS Screening

- *Screens out trash, inerts, and non-biodegradable solids*
- *Screenings from approximately 44 hours of operation*
- *RAS screenings volume 4 to 5 times more than influent screenings*

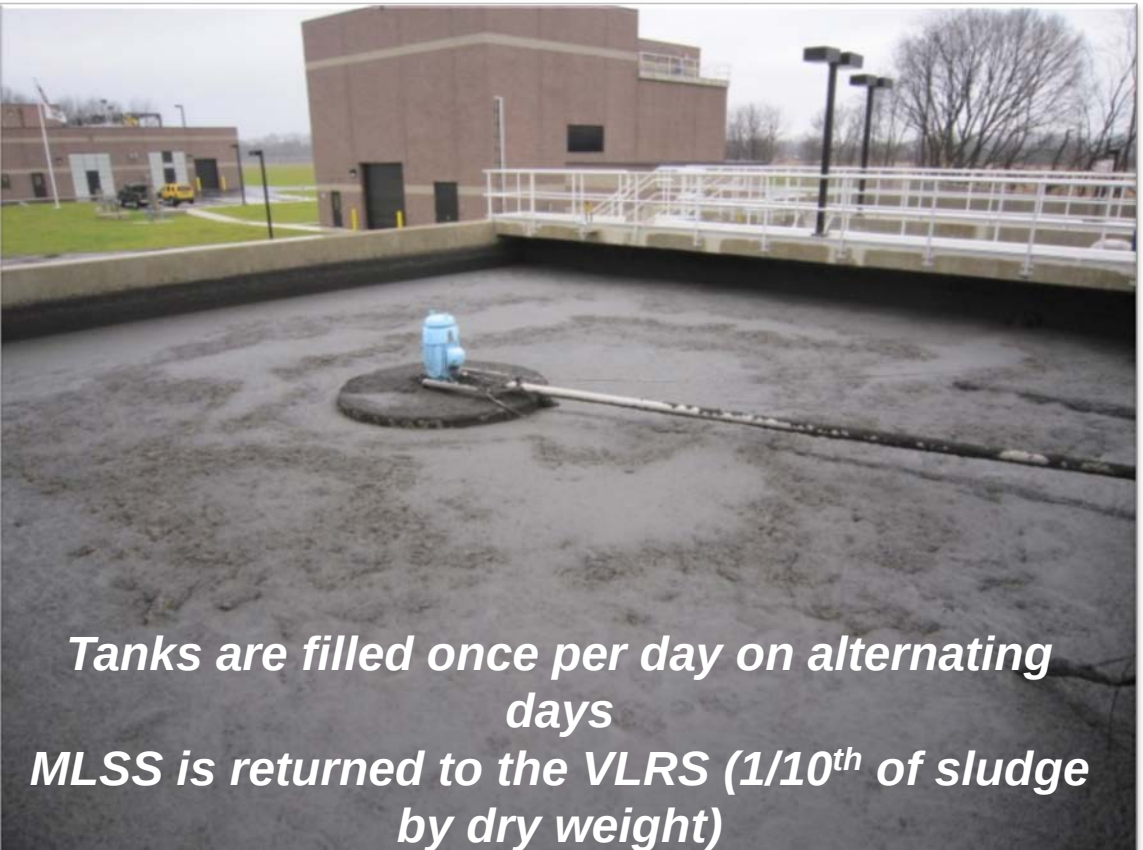


The Cannibal® Process – Grit Removal

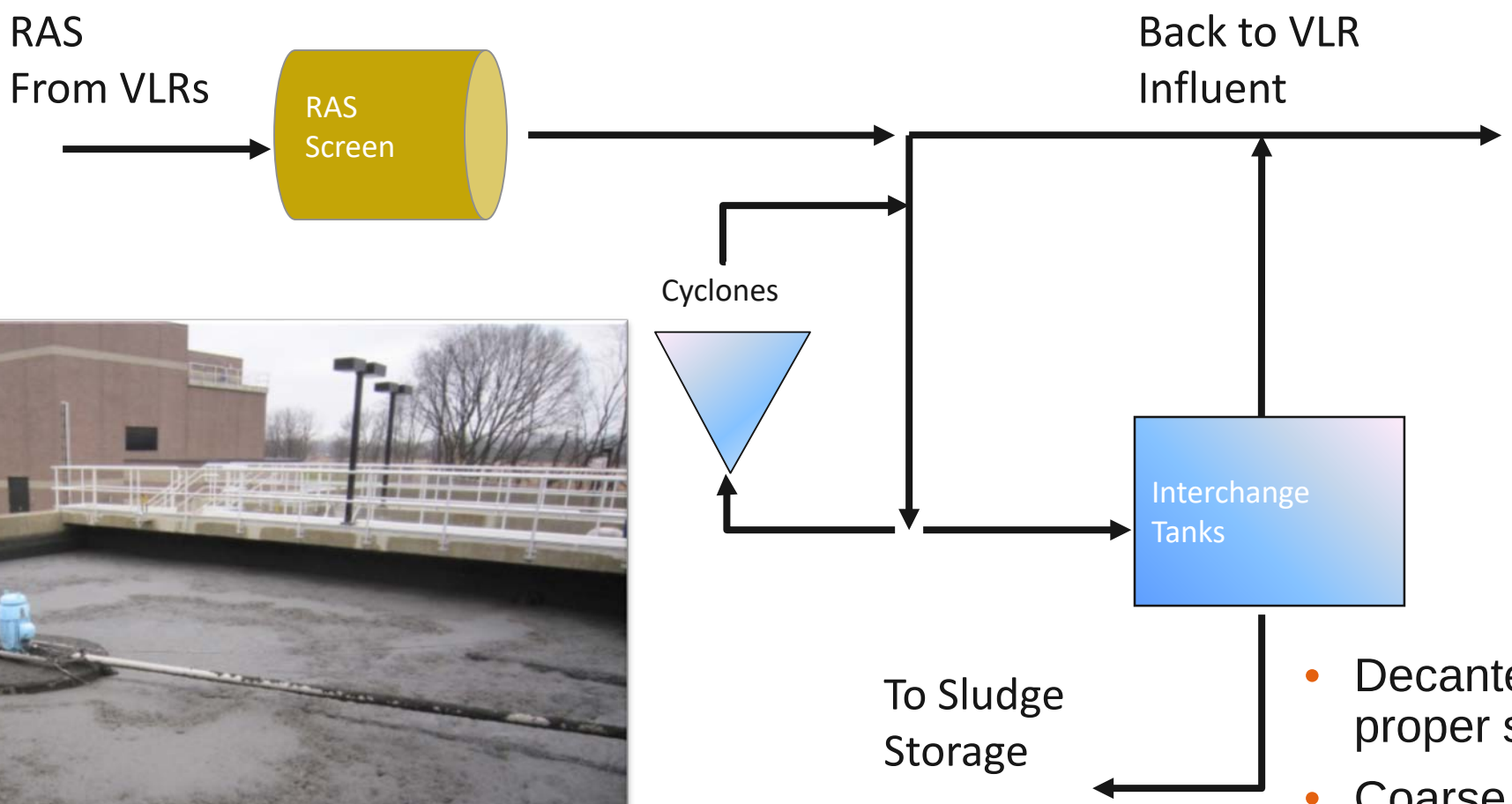


- **Grit Pump**
- **Cyclones**
  - Separate by specific gravity
  - Intermittent use based on plant conditions
  - Removes fine grit/inerts

The Cannibal® Process – Interchange Tanks

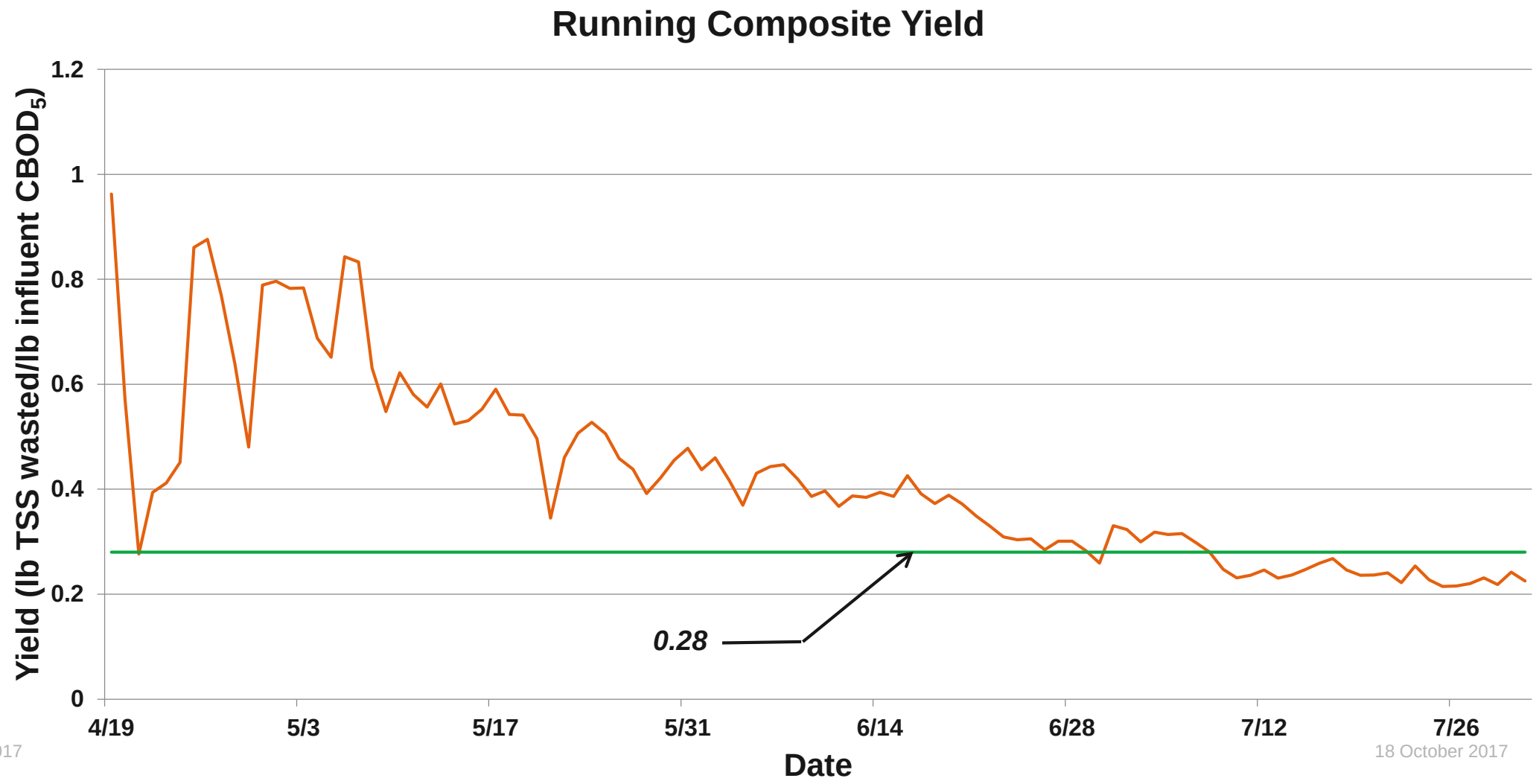


Tanks are filled once per day on alternating days
MLSS is returned to the VLRS (1/10th of sludge by dry weight)

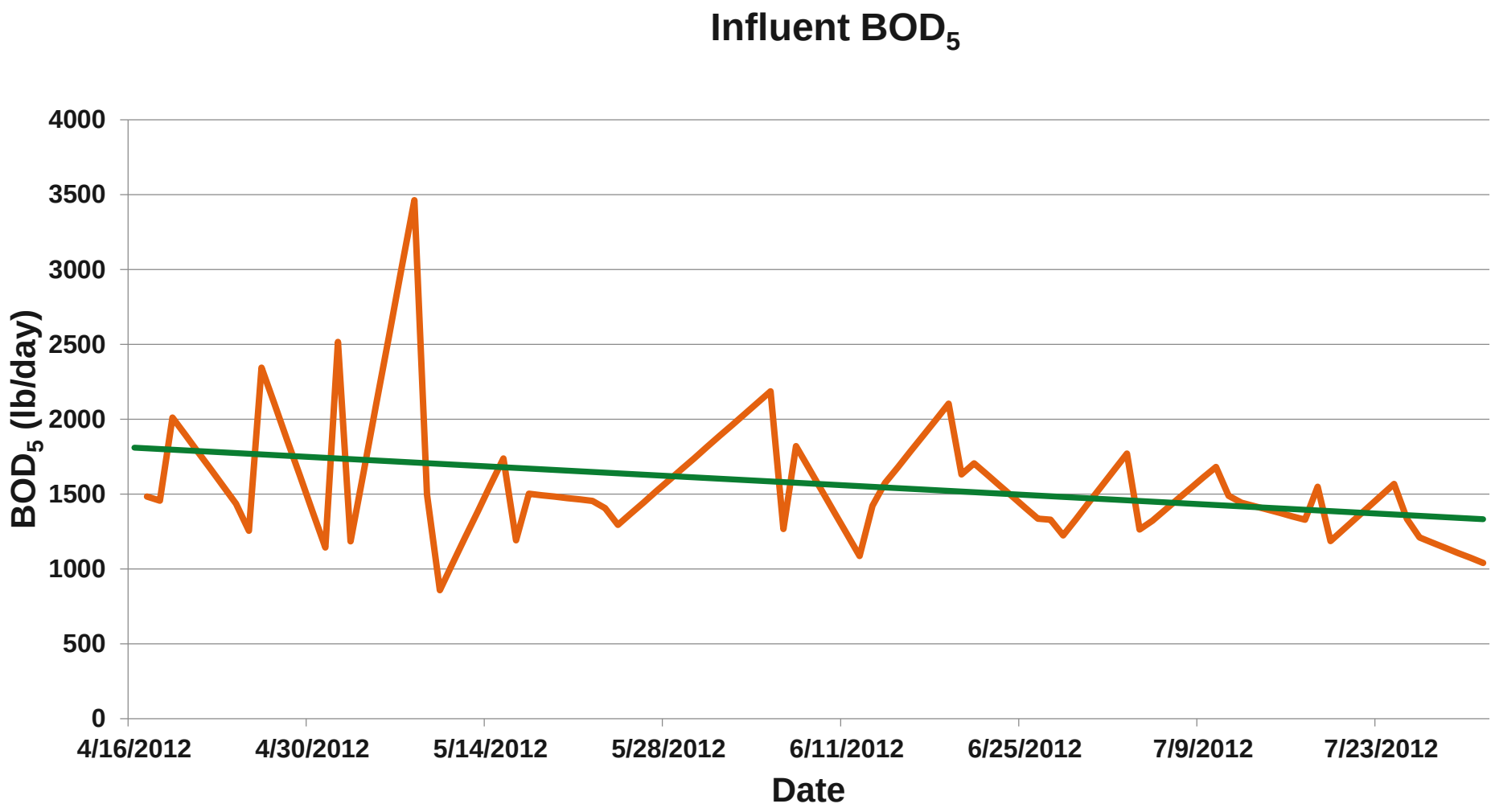


- Decanter – keeps the proper solids content
- Coarse Bubble Diffusers – controlled by ORP readings
- Floating Mixer

The Cannibal® Process – Solids Yield



Influent BOD_5 Loading



Dewatering

Dewatering Centrifuge

- Andritz D4LL
- Minimum Solids Capture: 95%
- Feed Concentration: 1 – 3 %
- Cake Solids Concentration: 20 %
- Currently Landfilling Biosolids
  - 168 dry tons of bio solids annually

Dewatering

20% +/- Biosolids
at Lawrence Street WPCF

20% +/- Biosolids
at Upper Hocking WPCF

Questions?

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Evoqua Video

http://www.evoqua.com/en/brands/Memcor/Pages/mempulse-mbr.aspx