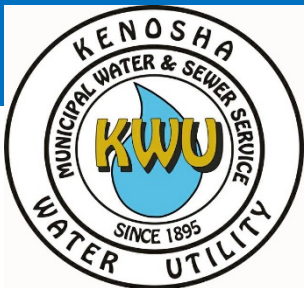


October 18, 2018

Influent Screening Evaluation and Implementation

WWOA Annual Conference



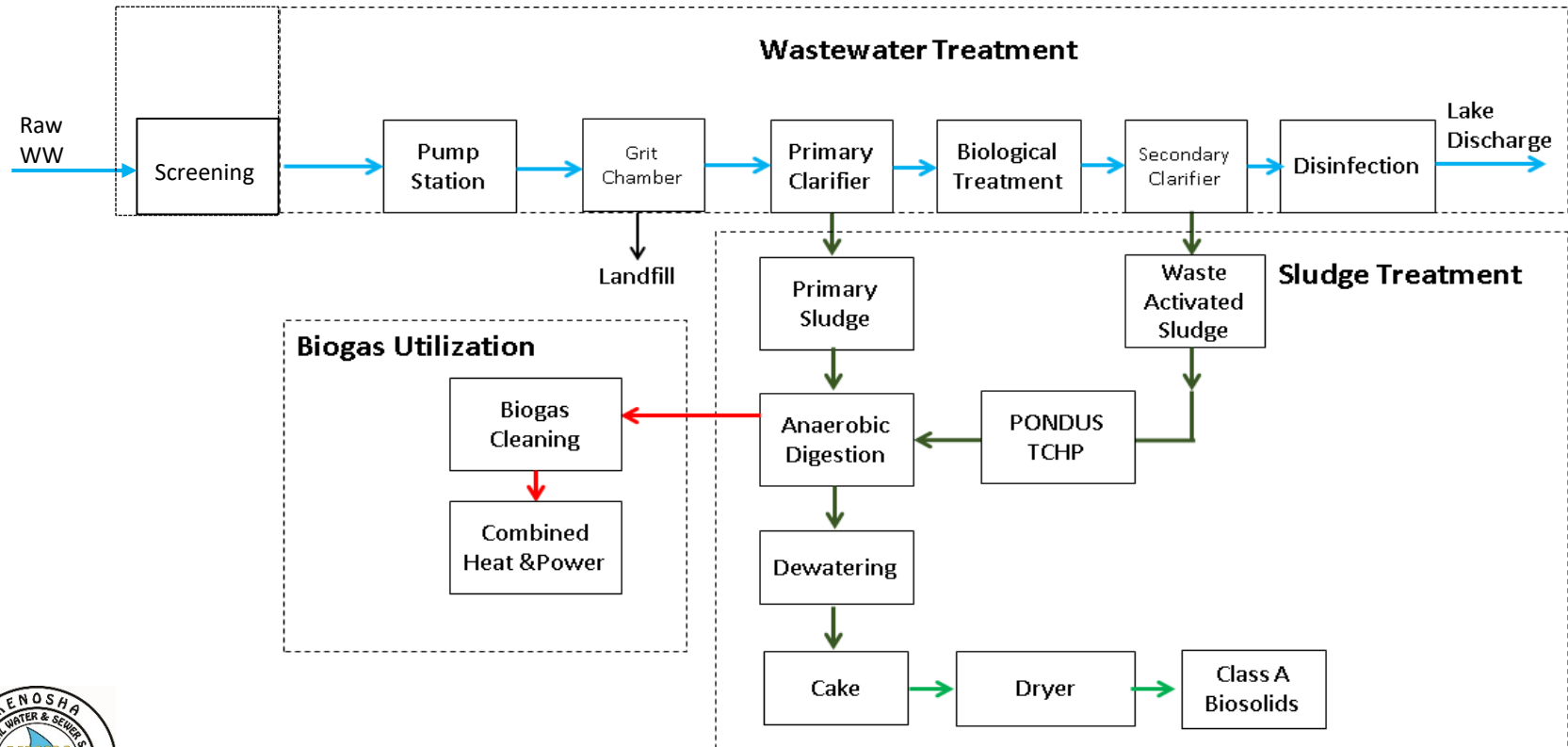
Introduction

- Location - Kenosha WWTP
- From past to present in the screenings facility:
 - Original Screening Facilities
 - Project Planning
 - Screening Technology Evaluation
 - Design and Installation
 - Operations



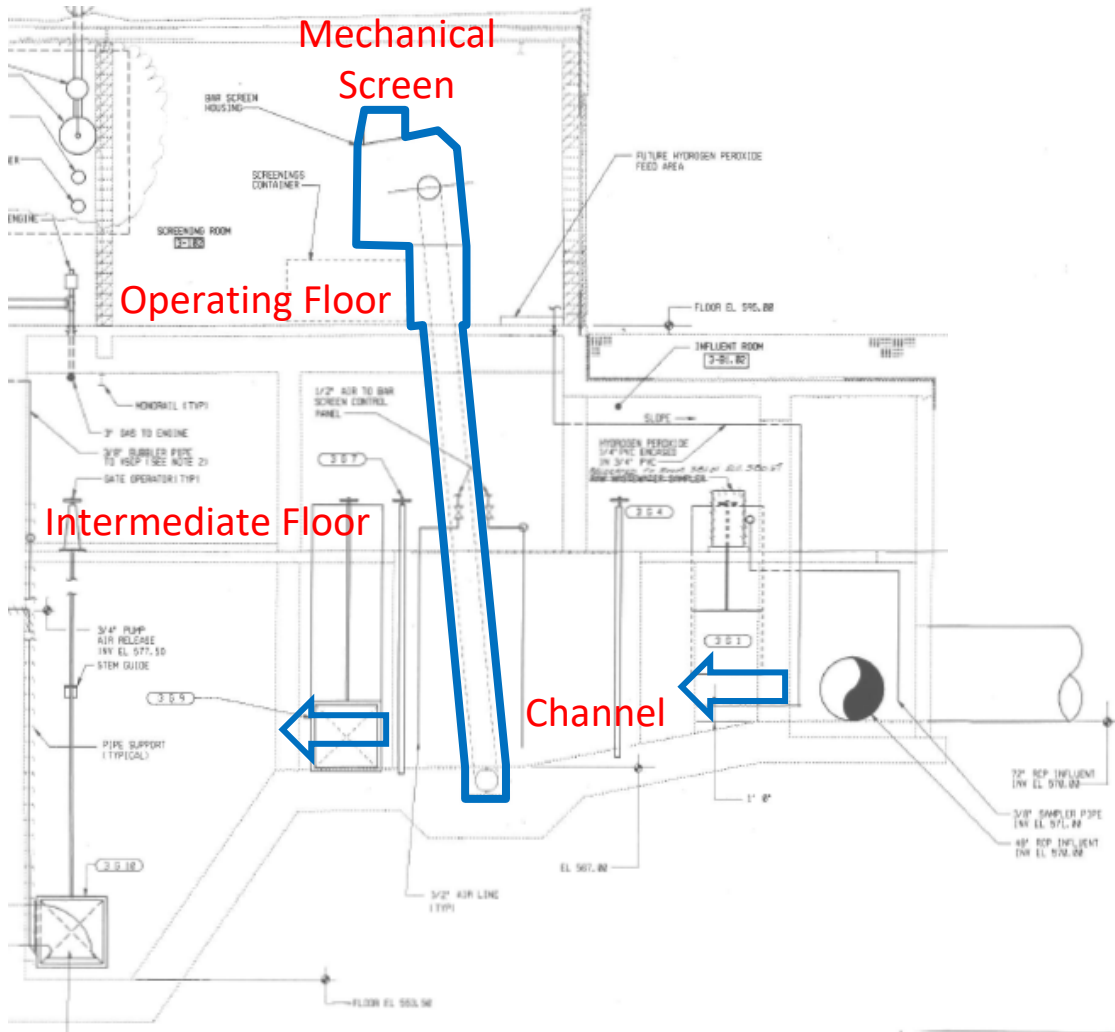
Kenosha WWTP

- Average Flow 25 MGD
- Peak Hour Flow 100 MGD



Original Screening Facilities

Original Facilities

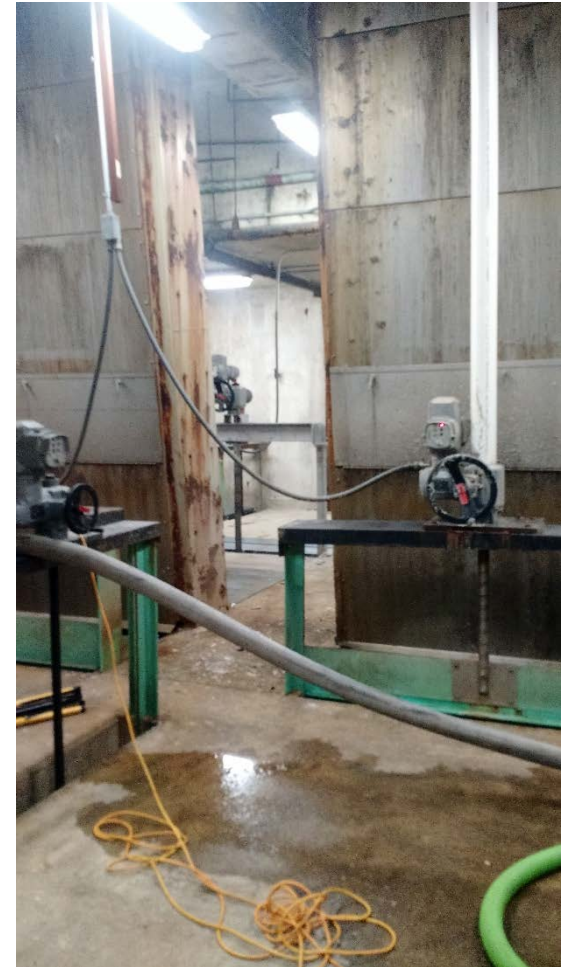


- Facility constructed in 1982
- Two mechanical rake screens
 - Originally 3/4-inch, modified to 1/2-inch bars in early 2000s
 - 28 feet from channel invert to operating floor
 - 84 degree incline
- Electrically operated isolation gates
- Two bypass channels
- Screens rebuilt in 2009

Original Facilities



Operating Floor



Intermediate Floor

Original Facilities



Broken rake



Chain coming out of channel due to broken stub shaft

Screen bars at 1/2-inch spacing

Issues/Concerns

- Rags and undesirable materials throughout the plant
 - Primary clarifiers
 - Primary sludge processing equipment
 - Digesters
 - Class A biosolids
- Age and reliability
- Frequent failures of screens with shafts breaking



Project Planning

Project Goals

- **Screenings Capture** (Goal: Reduce screenings in WWTP)
 - 1/4-inch (6 mm) openings
 - High screenings capture rate
- **Operation** (Goal: Reduce operator attention to equipment)
 - Capable of handling large debris
 - Improved automation of screen operation/speed with additional level monitoring in screen channel
- **Maintenance** (Goal: Minimize and simplify maintenance activities)
 - Minimal number of wear parts below water level
 - Simple screenings washer/compactor system



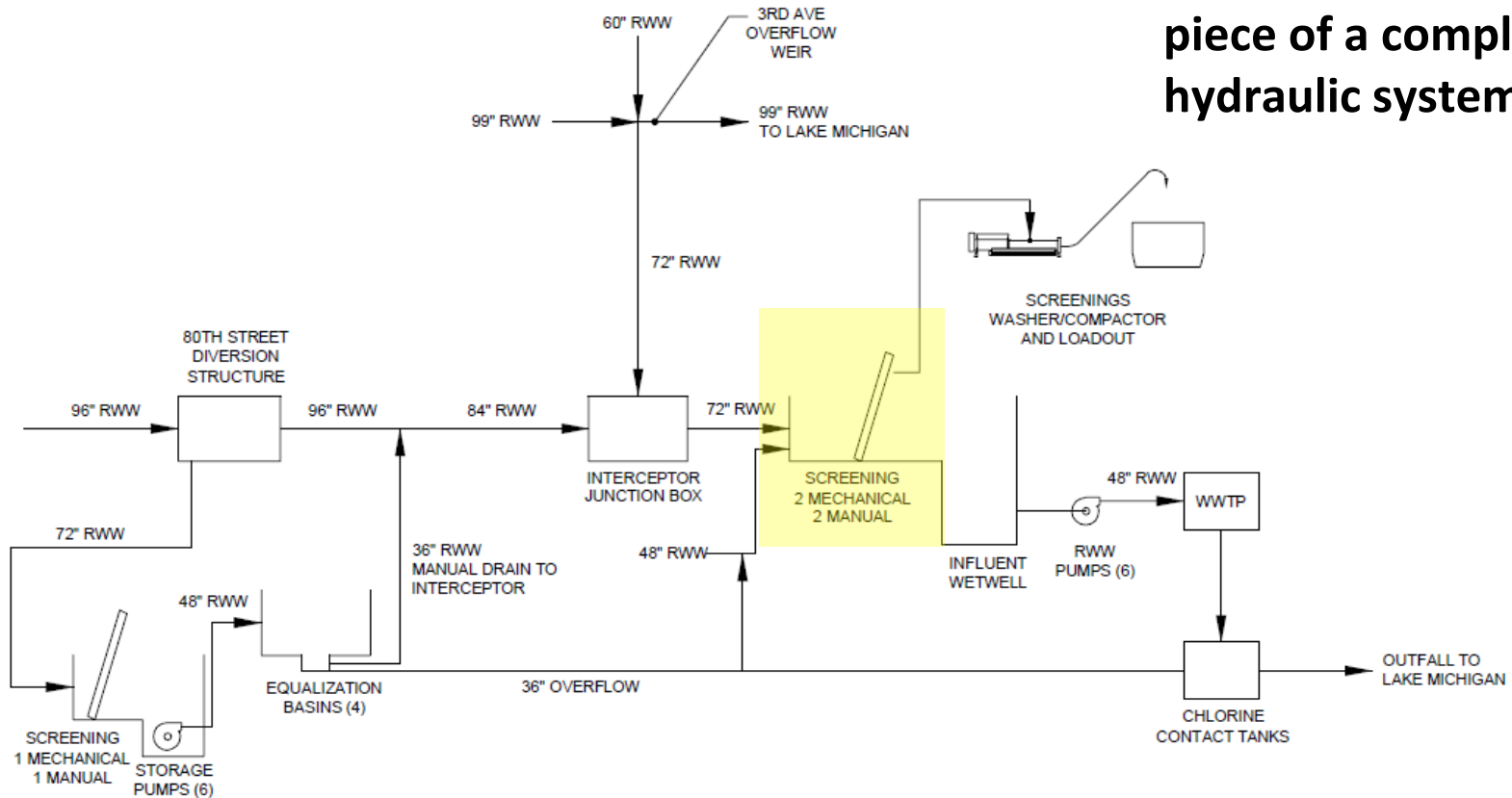
Project Goals

- **Constructability** (Goal: Reduce construction cost)
 - Delivered to site in pieces capable of fitting through overhead door
 - Fit within existing structure without extensive structural modifications
- **Hydraulic Capacity** (Goal: Reduce risk of sewer backups)
 - Minimize screen headloss
 - High rate of screen cleaning to reduce headloss from screen blinding
 - Operation of screens at peak design flow rate without overflowing to bypass bar rack channels



Hydraulic Evaluation Flow Schematic

- Screening is a critical piece of a complex hydraulic system



Project Criteria

Number of Screens	2
Design Flow Rate	100 MGD
Design Flow Rate per Screen	50 MGD
Opening Size	1/4" (6 mm)
Screenings Capture Ratio	Greater than 70%
Headloss Requirement	10 inches or less at 30% blinded condition
Dimensions	Must be inclined 70° to 90° and fit within a 6'-0" wide channel

- **Target screening capture ratio developed through a review of the 2011 UKWIR Screen Evaluation Report**

Screening Technology Evaluation

Technologies

Multi-Rake Screen

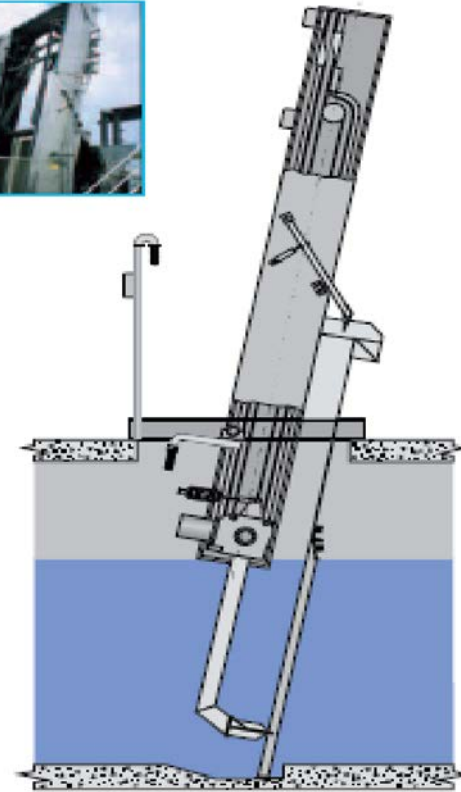
- Vertical bars w/ evenly spaced openings
- Set of rakes with teeth pull screenings to top
- Screenings removed by wiper or scraper mechanism
- Typical setting angle 75 to 90 degrees
- Main benefits:
 - Flow capacity, durability, rapid material removal
- Main challenges:
 - Lower screenings capture – long material can pass through narrow bar spacing, material disturbed below water surface (Est. 1.5 to 2X increase in screenings)



Technologies

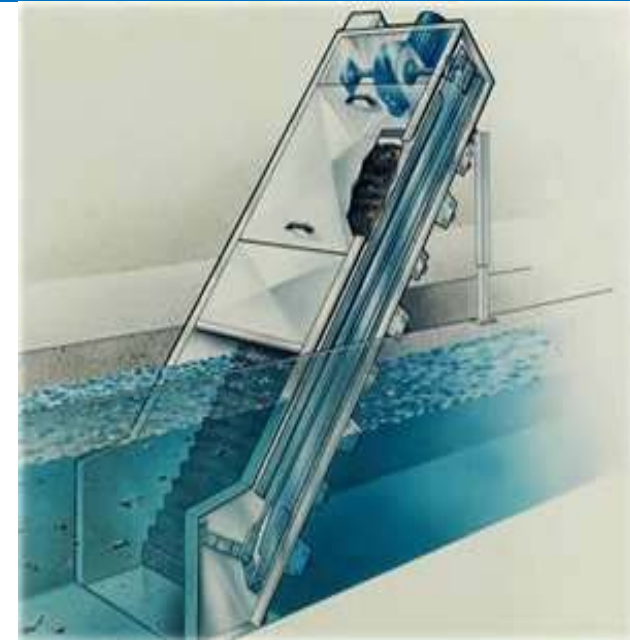
Reciprocating Rake

- Vertical bars w/ evenly spaced openings
- Rake assembly travels down and up equipment to collect screenings
- Screenings removed by wiper or scraper mechanism
- Typical setting angle 75 to 90 degrees
- Main benefits:
 - Flow capacity, durability
- Main challenges:
 - Rate of screenings removal
 - Lower screenings capture – long material can pass through narrow bar spacing, material disturbed below water surface (Est. 1.5 to 2X increase in screenings)



Technologies Step Screen

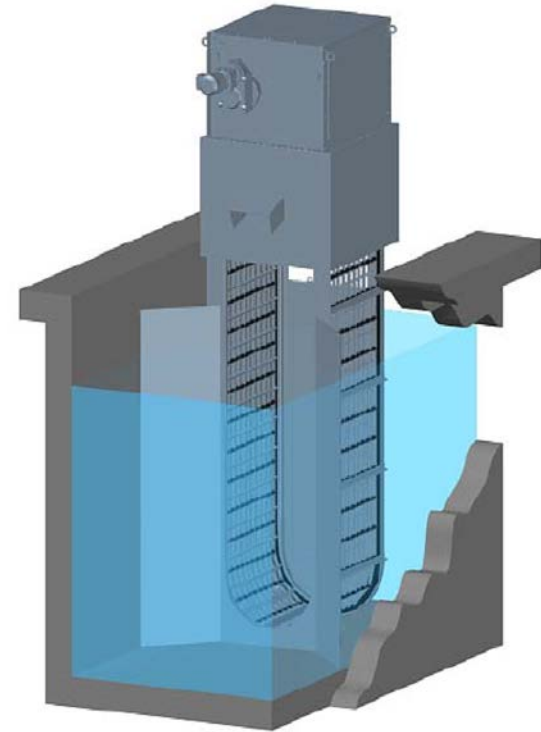
- Perforated or bar steps
- Moves vertically like an escalator
- Typical setting angle is 45 to 75 degrees
- Main benefits:
 - Flow capacity, rapid material removal
- Main challenges:
 - Setting angle, depth of structure



Technologies

Center-Flow Band Screen

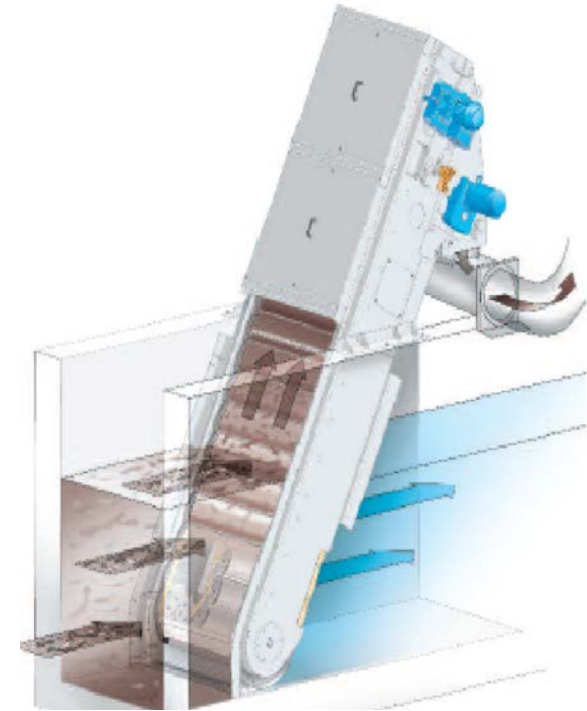
- Perforated plate or mesh screen
- Screen is parallel to influent flow
- Plates are moved vertically intermittently
- Screenings are sprayed into sluice system
- Setting angle is 90 degrees
- Main benefits:
 - Footprint, screenings capture (Est. 3 to 4X increase)
- Main challenges:
 - Debris removal, cost



Technologies

Through-Flow Band Screen

- Perforated plate or mesh screen
- Plates are moved vertically intermittently
- Screenings are brushed or sprayed into a chute
- Typical setting angle is 60 to 85 degrees
- Main benefits:
 - Screenings capture (Est. 3 to 4X increase)
- Main challenges:
 - Hydraulics



Technology Summary

Technology	Est. Equipment Cost	Conclusion
Multi-Rake Screen	\$640,000	Eliminated due to lower screenings capture
Reciprocating Rake Screen	\$720,000	Eliminated due to lower screenings capture, rate of screenings removal
Step Screen	Not evaluated	Eliminated due to installation angle
Center-Flow Band Screen	\$850,000	Eliminated due to cost
Through-Flow Band Screen	\$695,000	Hydraulics a concern, but addressed with lower install angle at 70 degrees, some facility modifications required



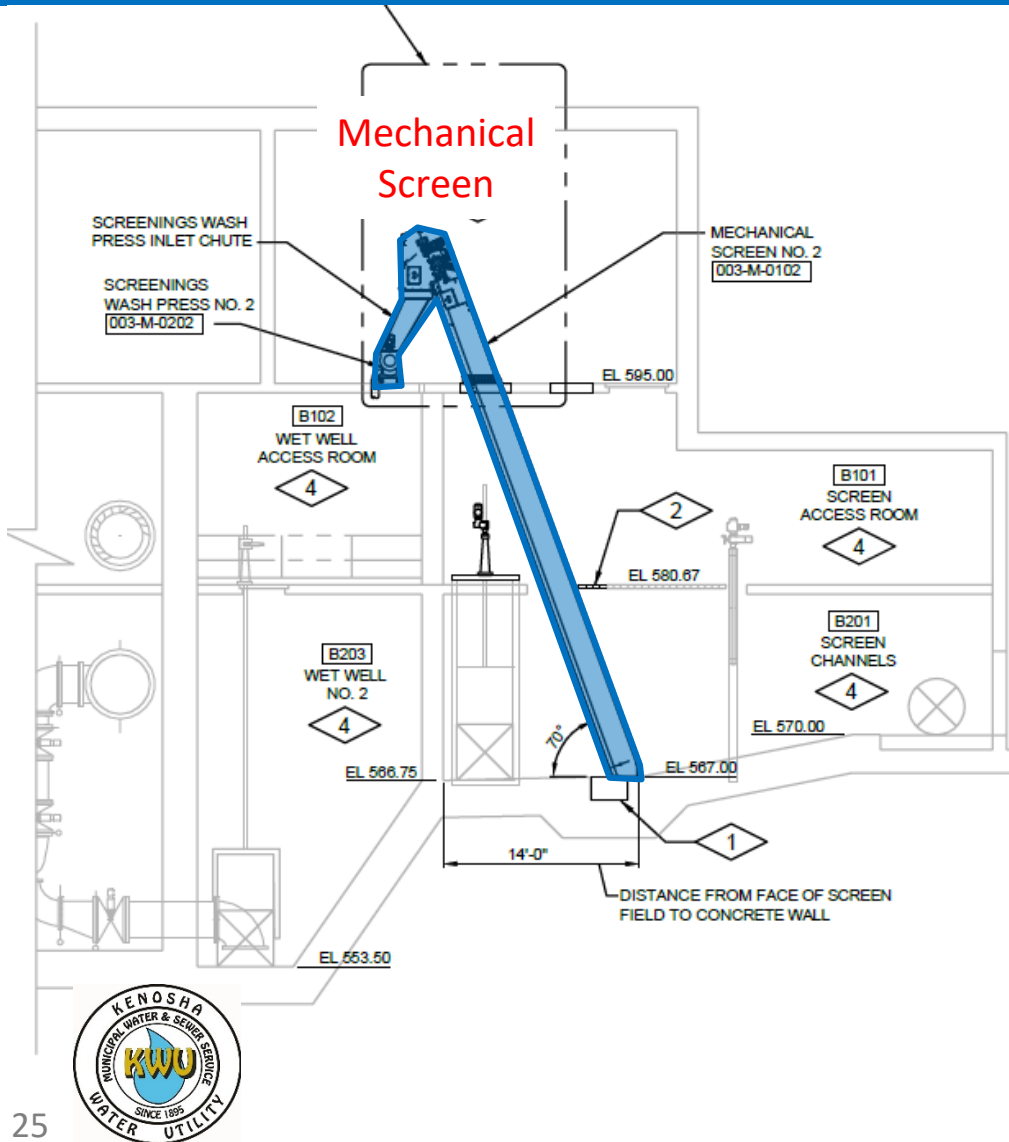
Design and Installation

Schedule

Major Tasks	Date Completed
Screen and Washer/Compactor Final Procurement Design	May 2016
Screen and Washer/Compactor Procurement Agreement	August 2016
Screen and Washer/Compactor Shop Drawing Approval	August 2016
Final Construction Plans and Specifications	September 2016
Construction Contract Start	October 2016
Screen No. 1 Startup	February 2017
Screen No. 2 Startup	April 2017



Screen Design



- Capacity: 50 MGD per screen
- Openings: 6 mm perforated plate
- Angle: 70°
- Self-adjusting cleaner brush
- Spray bar
- Normal tine spacing every 10th panel
- Manual reverse

Washer-Compactor

- Individual washer-compactor for each screen
- Washer-Compactor includes:
 - Screenings Hopper with level switch
 - Screw auger with brushes and perforated drain
 - Washwater spray bar on body of washer/compactor
 - Washwater valve on drain pan for flushing
 - Discharge pipe
 - Bagger on discharge



Installation

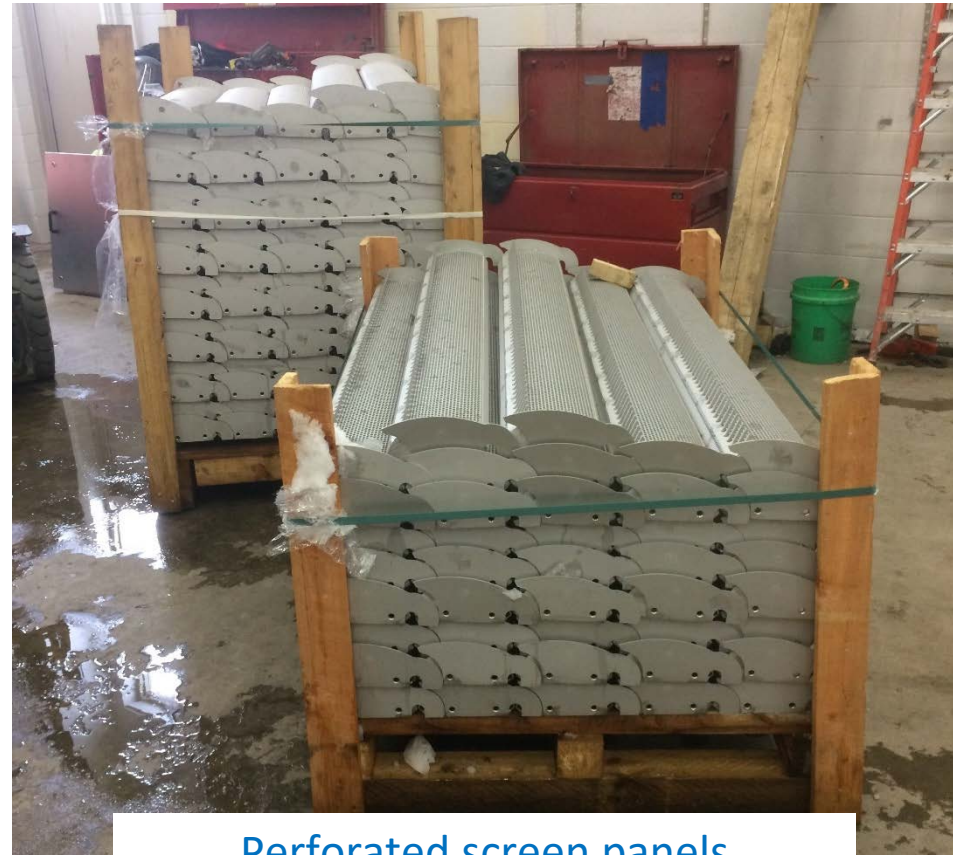


Screen delivered in multiple pieces

Installation



Screen installed without panels



Perforated screen panels

Installation



Self-adjusting cleaner brush



Washer-compactor

Transformation



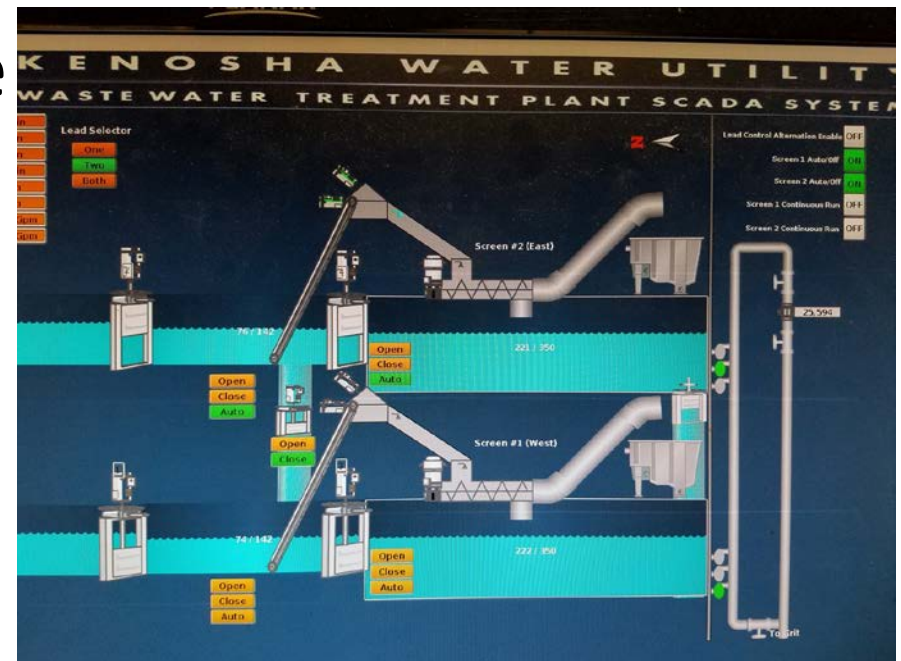
Operations

Start-up Concerns

- Would it remove grease?
- Would the tiny tongs work to remove debris?
- Was the slope great enough?
- Would it back up the system during rain events and cause us to go to the basin more often?
- Were the panels strong enough to handle incoming flow and debris?

Operations

- Controlled by level transducer in the channel before and after the screen to measure differential
- One screen on at a time
- Gates are automatic



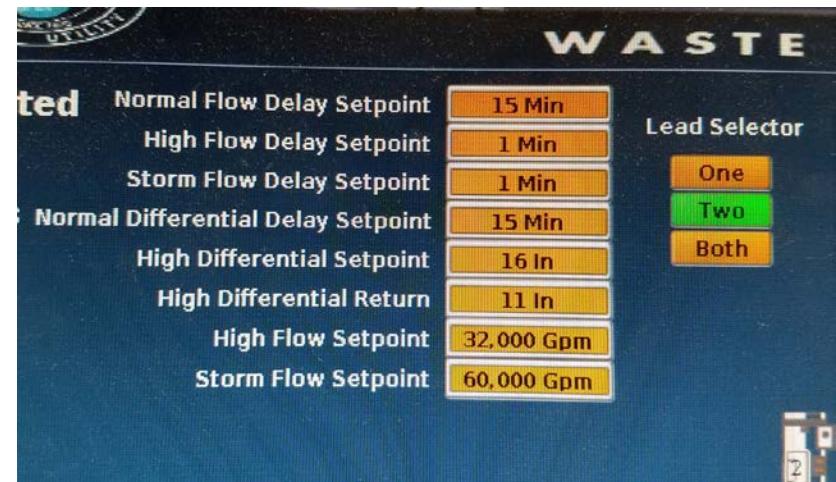
Operations

- Normal Flow
 - Screen operates when 8-inch differential level reached
 - Brush runs when screen runs
 - Spray bar runs 10 sec on, 45 off
 - Turns off at 7-inch differential.
 - Compactor runs based on timing and screen running. Runs in reverse for a short period of time. Adjustable for different flows.



Operations

- One screen runs until high differential or high flow setpoints are met, second screen turns on
- Both screens will go to higher speed and continuous run if storm flow setpoint is met
- Setpoints are adjustable



Operations

- Hopper used to be dumped 4x/week, now is dumped 12x/week. 1.5 cy hopper.
- During start of rain event = “Sewernami” – can be dumped 3x/shift of 8 hours
- Have not had a primary clarifier failure due to rags since put online.
- Improved biosolids with no wrappers



Operations – Items Removed



Operations – Items Removed



- PVC pipe
- Tree root
- Gravel
- Cheerios



Grease

- 2017 had tons of grease entering plant
- Grease ball in the channel turned into grease balls on the screens



Hopper Findings



Rain Event

- July of 2017 – Major Rain Event - 7 inches of rain
- Both screens operated at maximum 50 MGD



Summary

- Increased screenings removal
- Grit improved
- Aesthetics of primaries and aeration
- Biosolids improved



Questions?

Thank you!

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