Influent Screening Evaluation and Implementation

WWOA Annual Conference

October 18, 2018
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
Hydraulic Evaluation

- Evaluated screening facility and collection system hydraulics to:
  - Determine operating levels in screening facility
  - Estimate impact on EQ basins in collection system
  - Estimate impact on sewer backups during wet weather
  - Establish maximum headloss for screen vendors
Constructability

- Relocation of some gates and minor modifications required at less than 75 degrees
- Major structural modifications required at less than 70 degrees
## Project Criteria

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Screens</td>
<td>2</td>
</tr>
<tr>
<td>Design Flow Rate</td>
<td>100 MGD</td>
</tr>
<tr>
<td>Design Flow Rate per Screen</td>
<td>50 MGD</td>
</tr>
<tr>
<td>Opening Size</td>
<td>1/4” (6 mm)</td>
</tr>
<tr>
<td>Screenings Capture Ratio</td>
<td>Greater than 70%</td>
</tr>
<tr>
<td>Headloss Requirement</td>
<td>10 inches or less at 30% blinded condition</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Must be inclined 70° to 90° and fit within a 6’-0” wide channel</td>
</tr>
</tbody>
</table>

- 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

<table>
<thead>
<tr>
<th>Technology</th>
<th>Est. Equipment Cost</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Rake Screen</td>
<td>$640,000</td>
<td>Eliminated due to lower screenings capture</td>
</tr>
<tr>
<td>Reciprocating Rake Screen</td>
<td>$720,000</td>
<td>Eliminated due to lower screenings capture, rate of screenings removal</td>
</tr>
<tr>
<td>Step Screen</td>
<td>Not evaluated</td>
<td>Eliminated due to installation angle</td>
</tr>
<tr>
<td>Center-Flow Band Screen</td>
<td>$850,000</td>
<td>Eliminated due to cost</td>
</tr>
<tr>
<td>Through-Flow Band Screen</td>
<td>$695,000</td>
<td>Hydraulics a concern, but addressed with lower install angle at 70 degrees, some facility modifications required</td>
</tr>
</tbody>
</table>
Design and Installation
## Schedule

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