Triple Crown of Energy Efficiency

MWRA Braintree-Weymouth Pump Station

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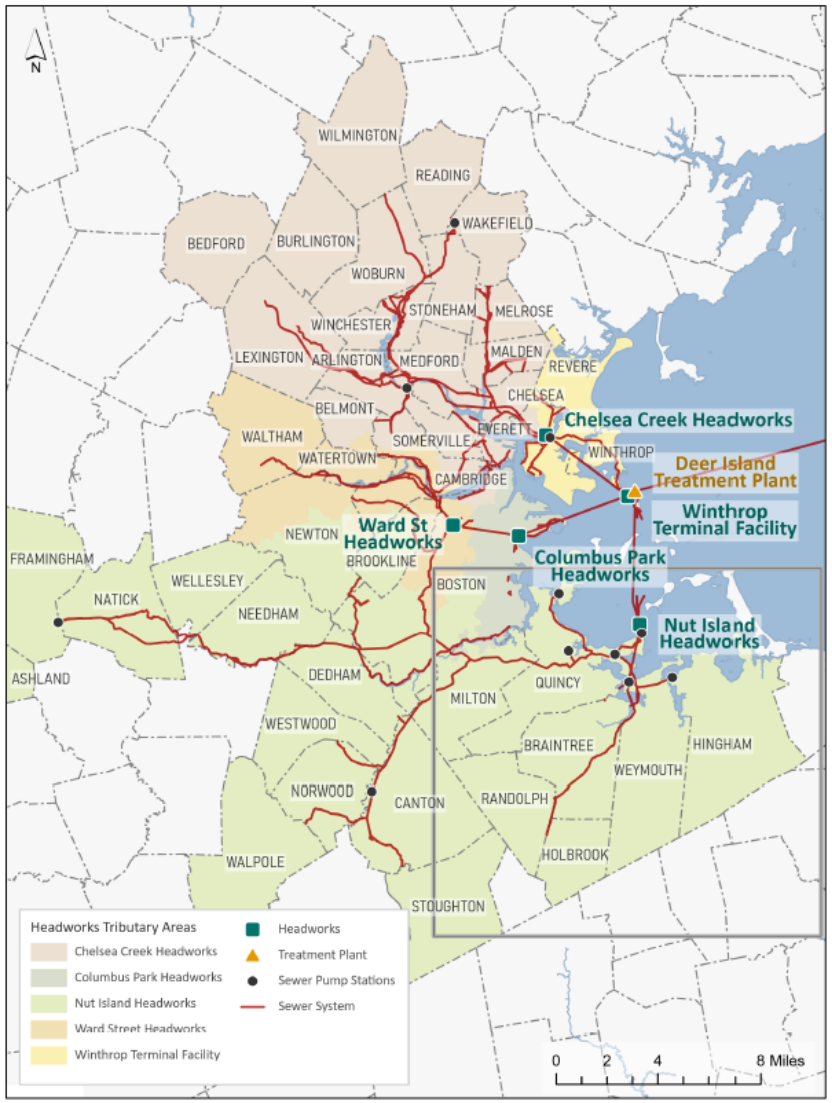
Engineering a Better Environment

Presentation Overview

Background
Issues Experienced
Design
Solutions
Energy Design Journal
Sustainability Initiatives

Background



MWRA Wastewater Collection System

- 43 communities
- 2.5 million customers
- 360 MGD ADF
- 12 pump/lift stations
- 4 headworks
- 19 miles of tunnels
- Deer Island WWTF

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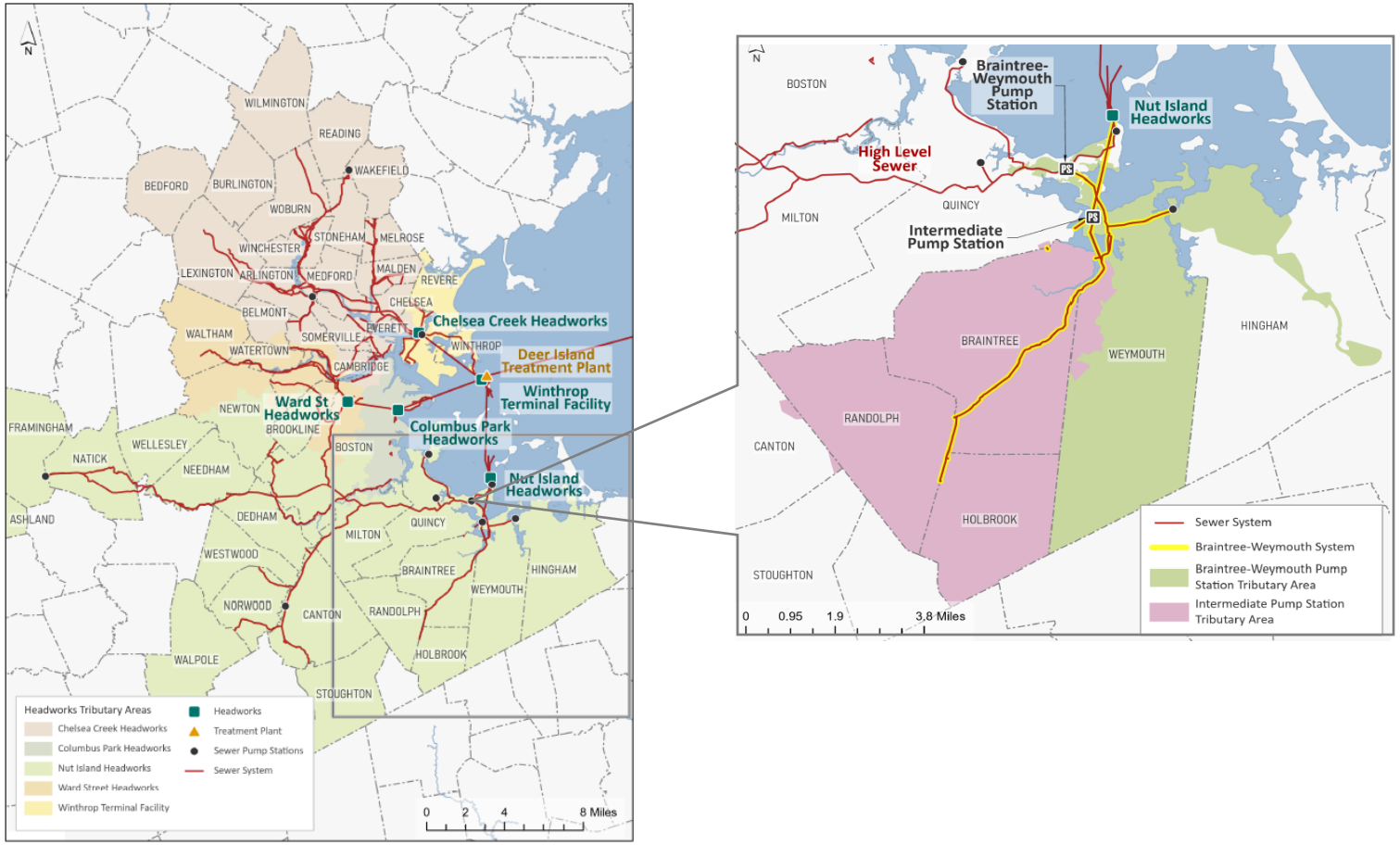
Background



Braintree-weymouth facilities

- 73 MGD peak capacity
- Intermediate pump station (IPS) – 45 MGD
- Braintree-Weymouth pump station – 28 MGD
  - Serves Quincy, Weymouth, and Hingham
  - 60” Braintree Weymouth interceptor / 30” Quincy interceptor
  - Discharge to high-level sewer to nut island

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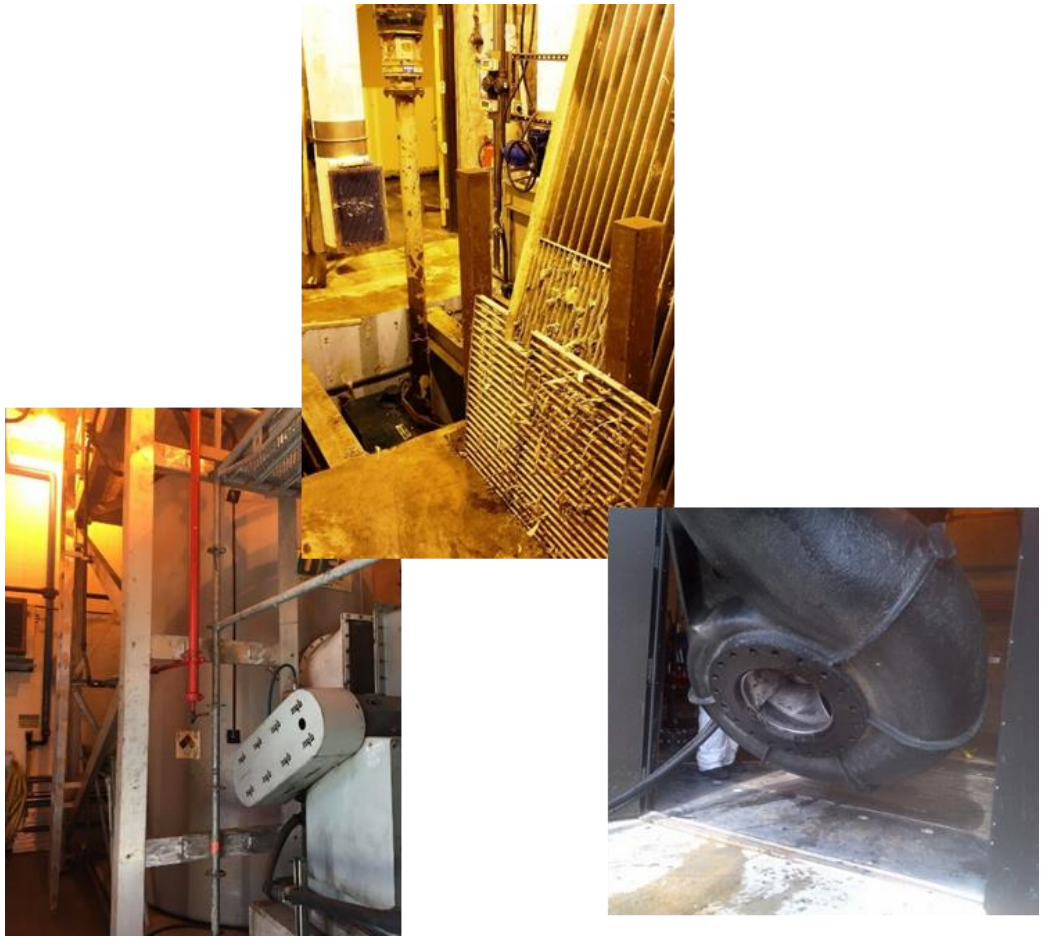
Background

Braintree-Weymouth pump station

- Major process equipment
  - Two channel grinders
  - Three submersible pumps (14-mgd each)
  - Dual-bed carbon odor control system
- SCADA with full remote-control capability
- Floodproofing

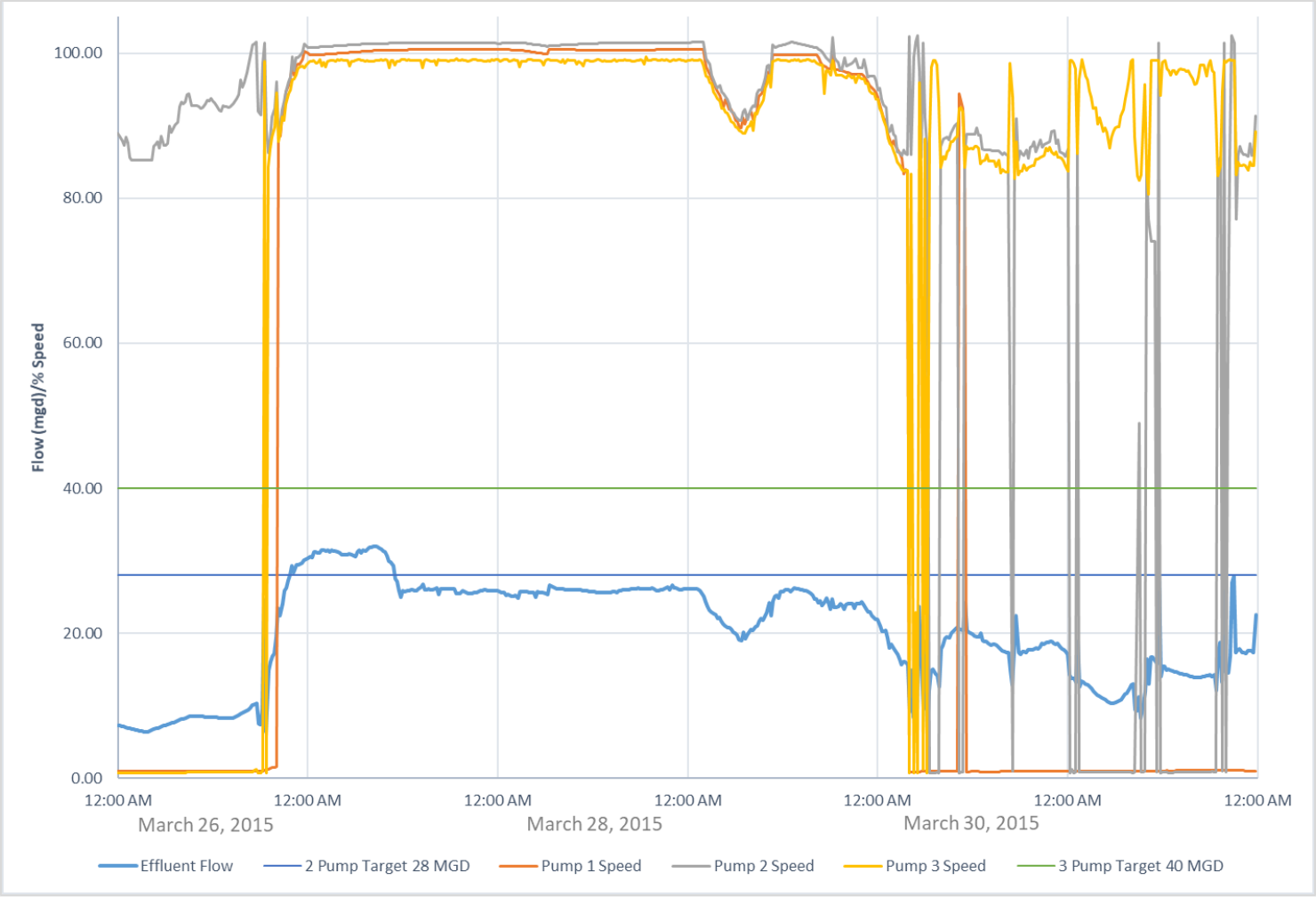
Issues Experienced



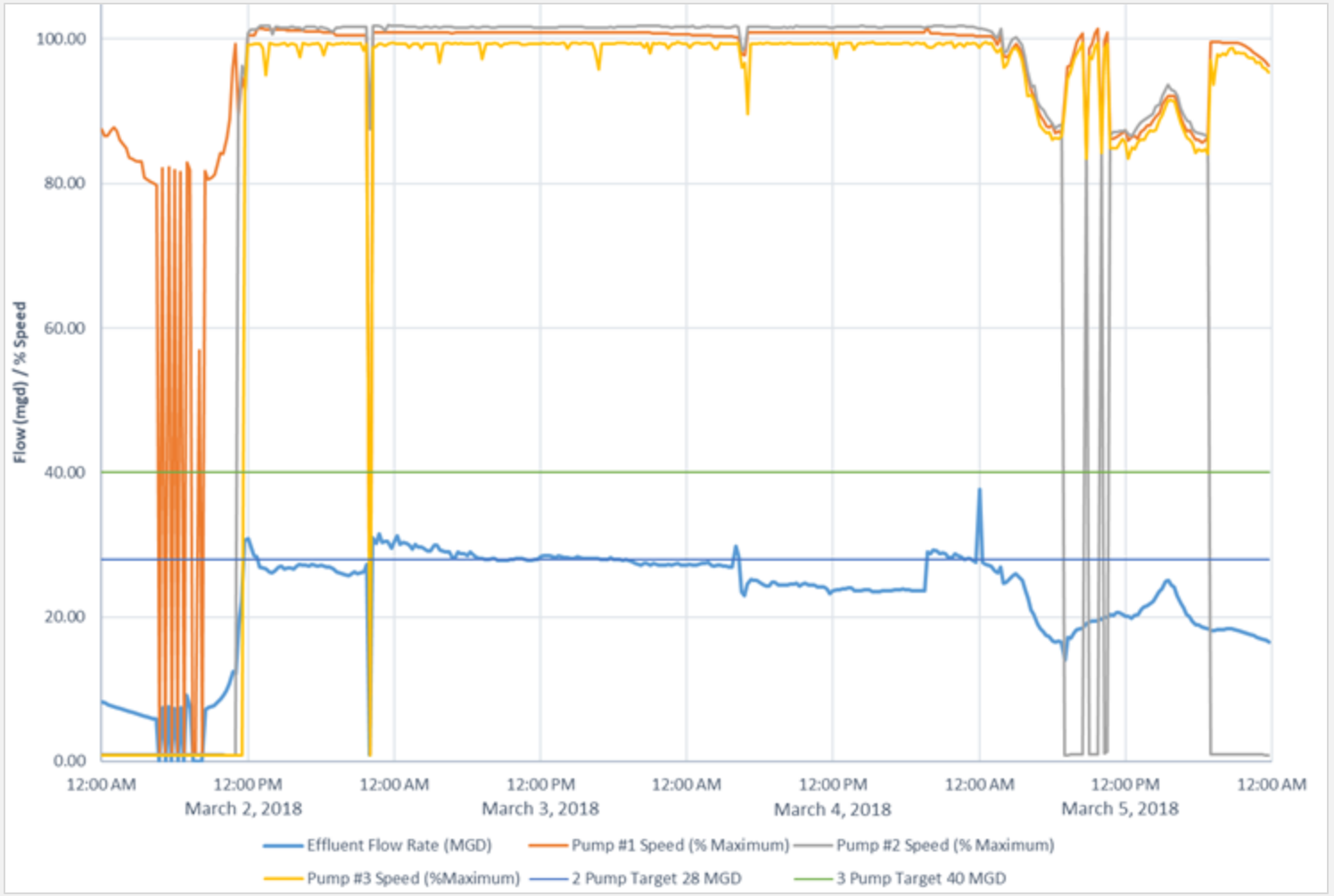
Facility Operational and Maintenance Issues

- Ineffective grinders; leading to solids buildup in the wet well.
- Manual screens inserted during high weather flows
- Bound-up pumps, reduced pump performance, and high pump wear rates
- Portable Pumps kept onsite
- Inefficient at low pump-speed flows
- Challenges with equipment removal
- Ventilation/odor control limitations resulting in high hydrogen sulfide levels

Ragging & Pump Capacity – March 26 through 31, 2015



Ragging & Pump Capacity – March 2 through 4, 2018



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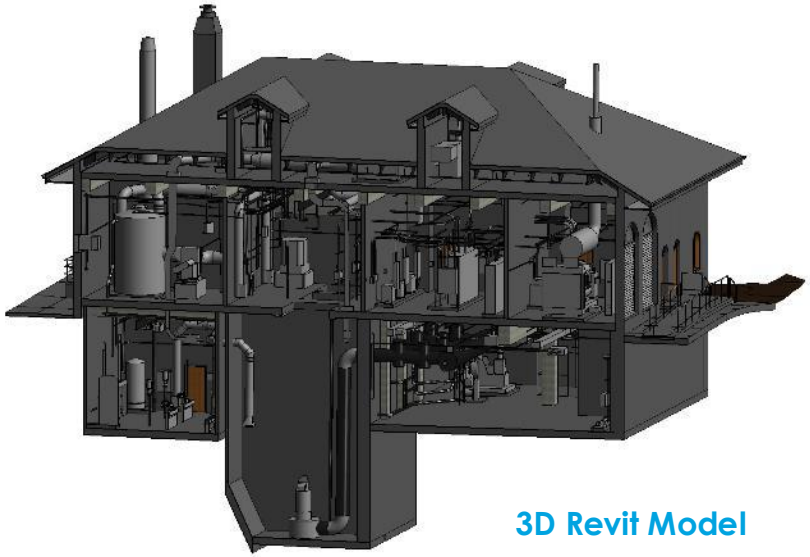
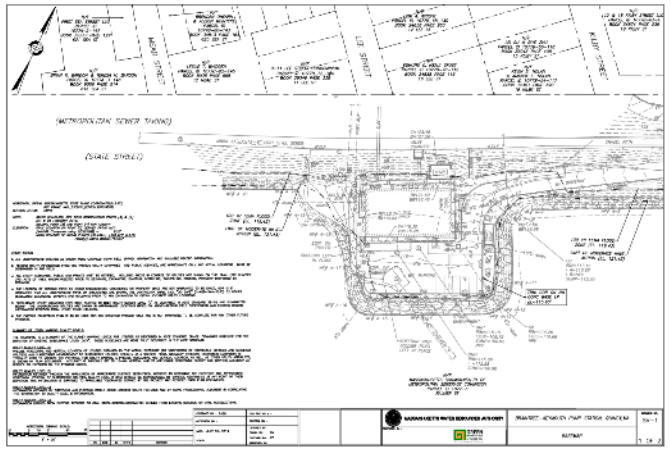
Survey and Mapping

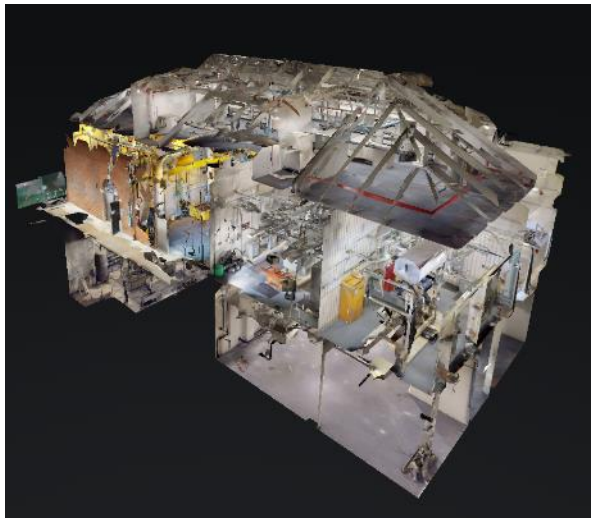
Raw 3D Point Cloud



3D Revit Model



Conventional Site Survey



Matterport 3D Imaging

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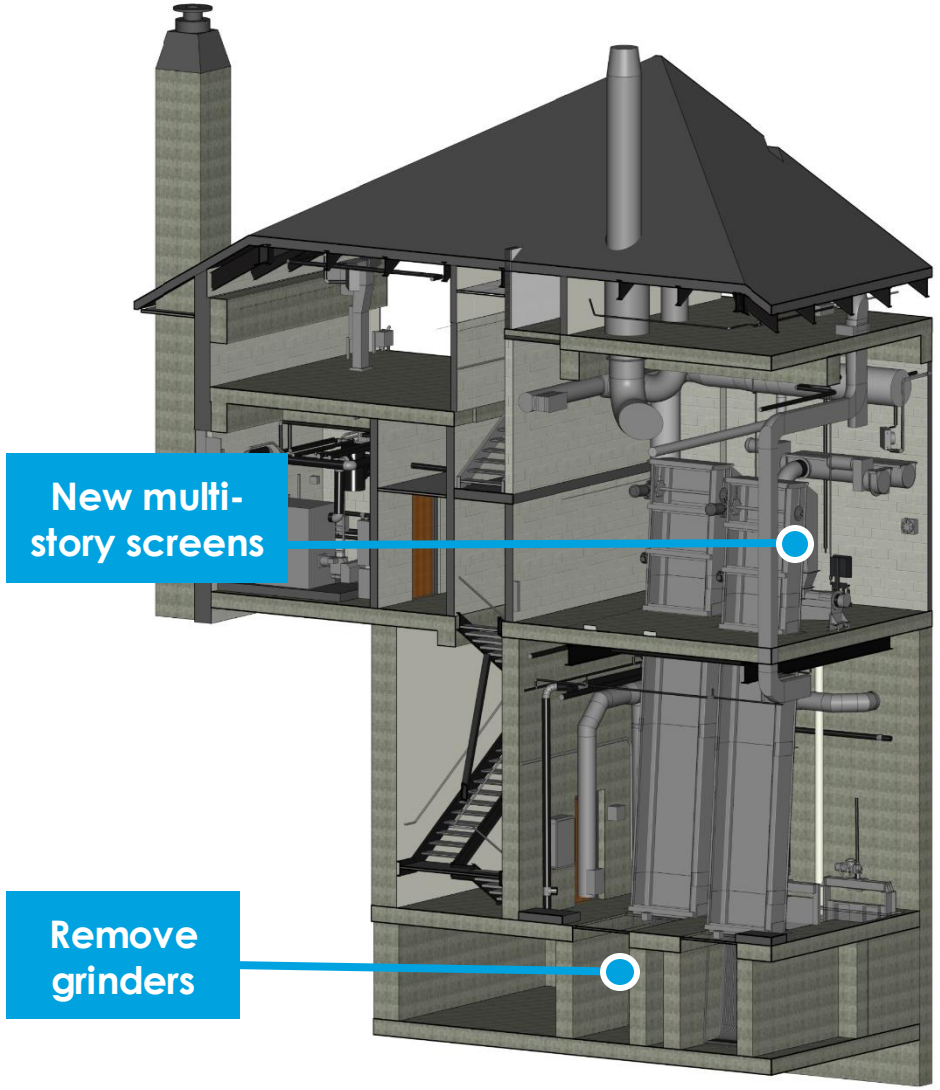
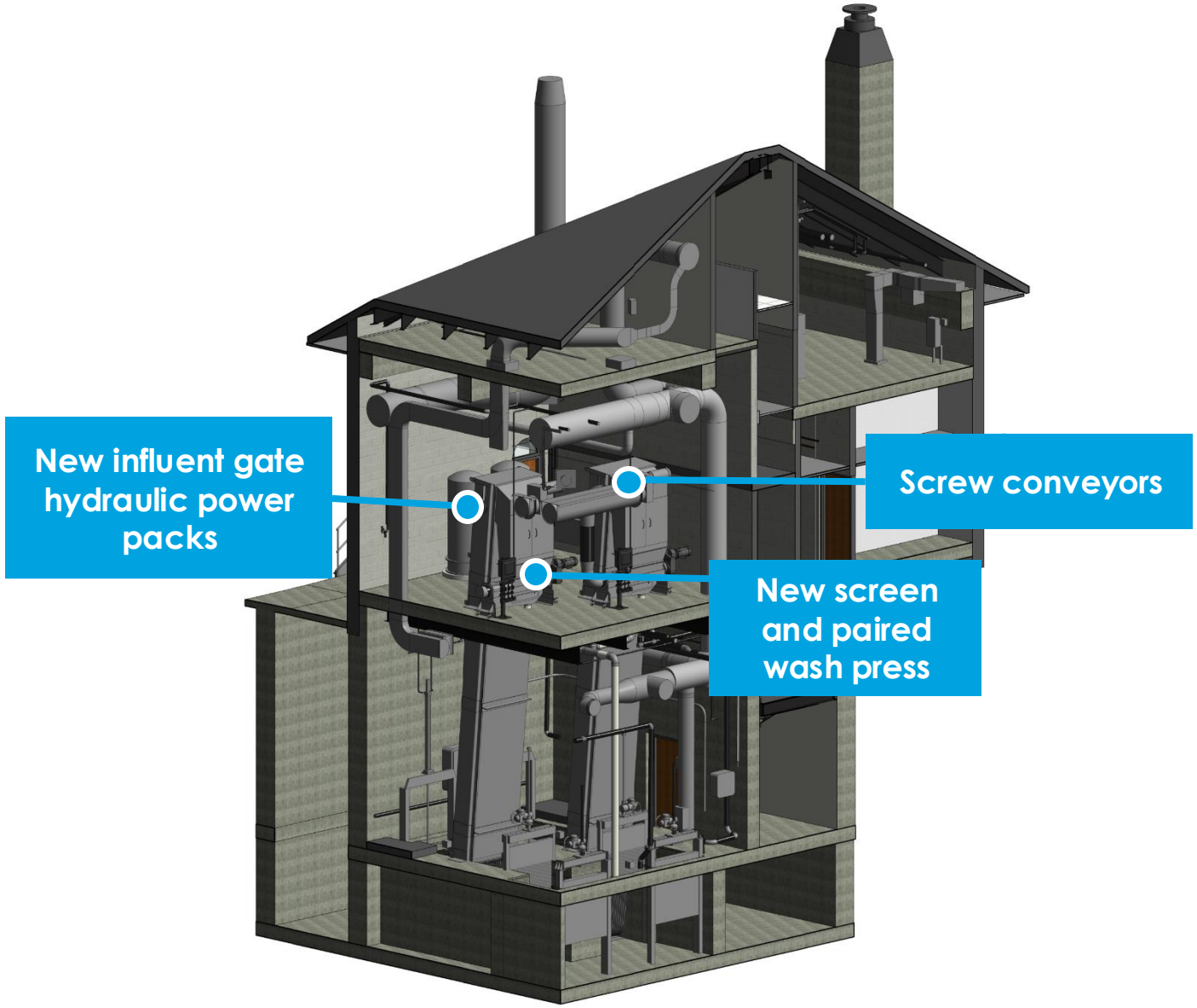
Screening/Conveyance





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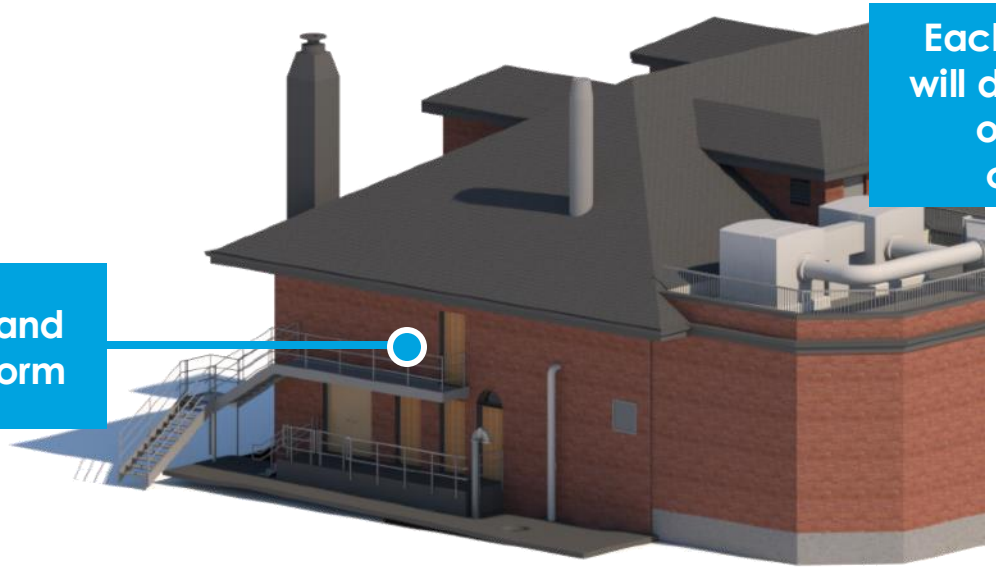
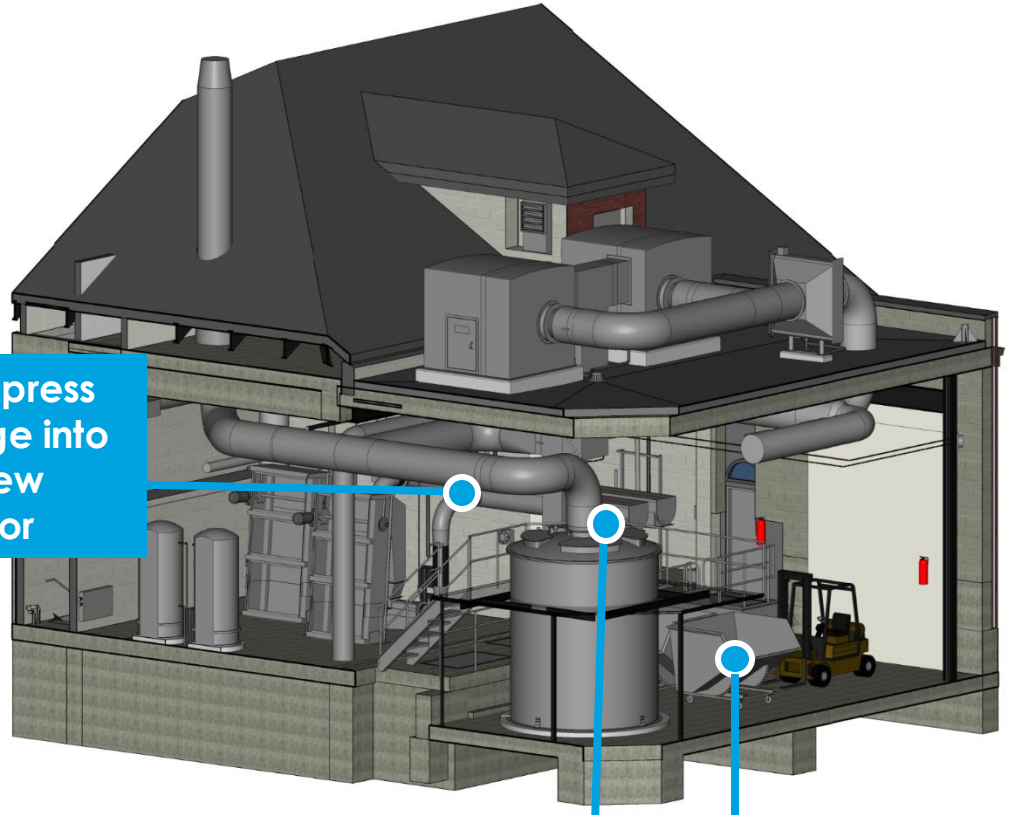
Screening Building Addition



New egress and outside platform



Each wash press will discharge into own screw conveyor

Screw conveyors will discharge directly to same container

Three 4-cy containers

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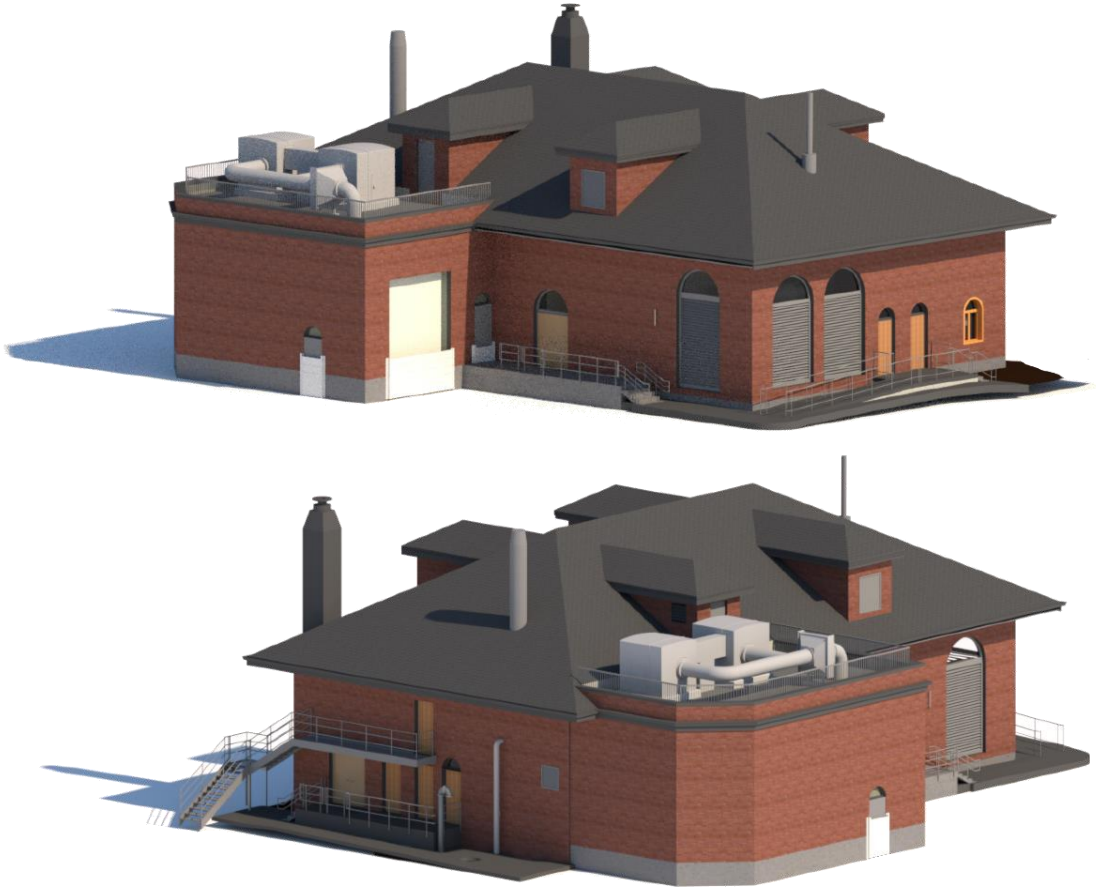
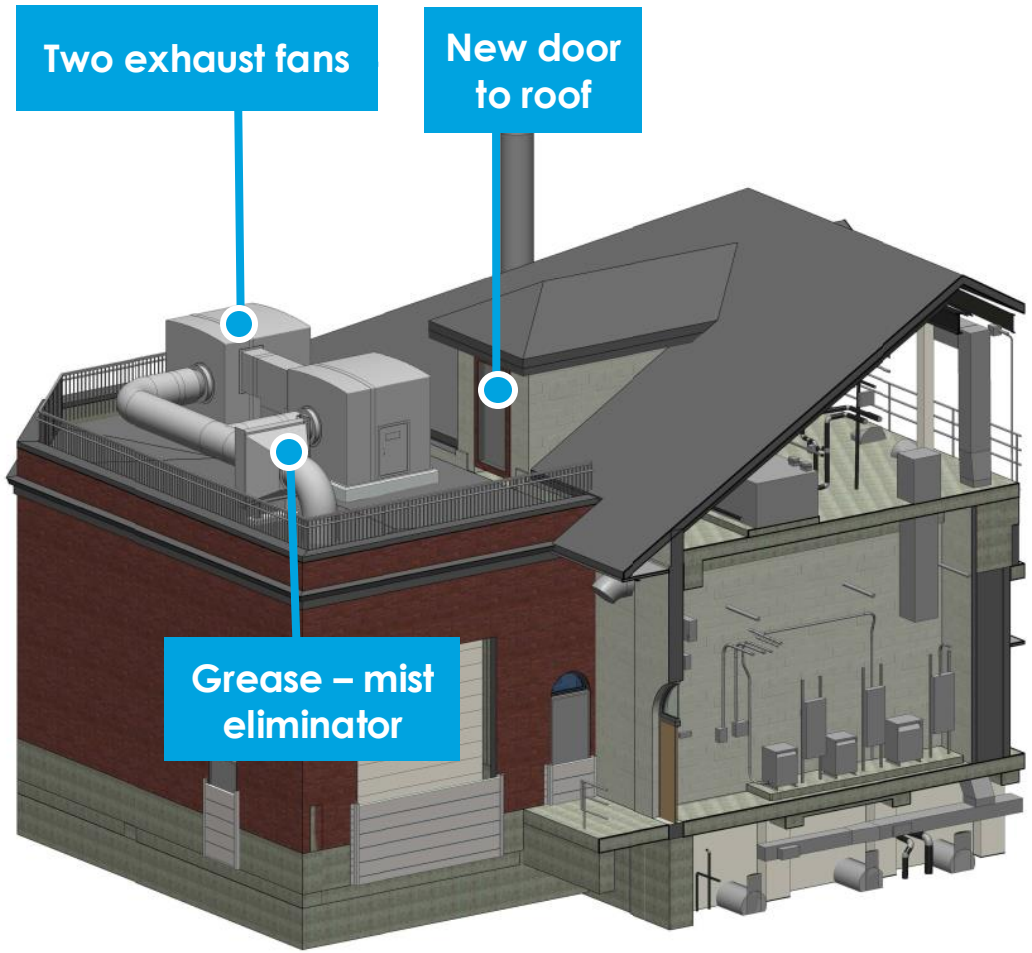
Building Addition

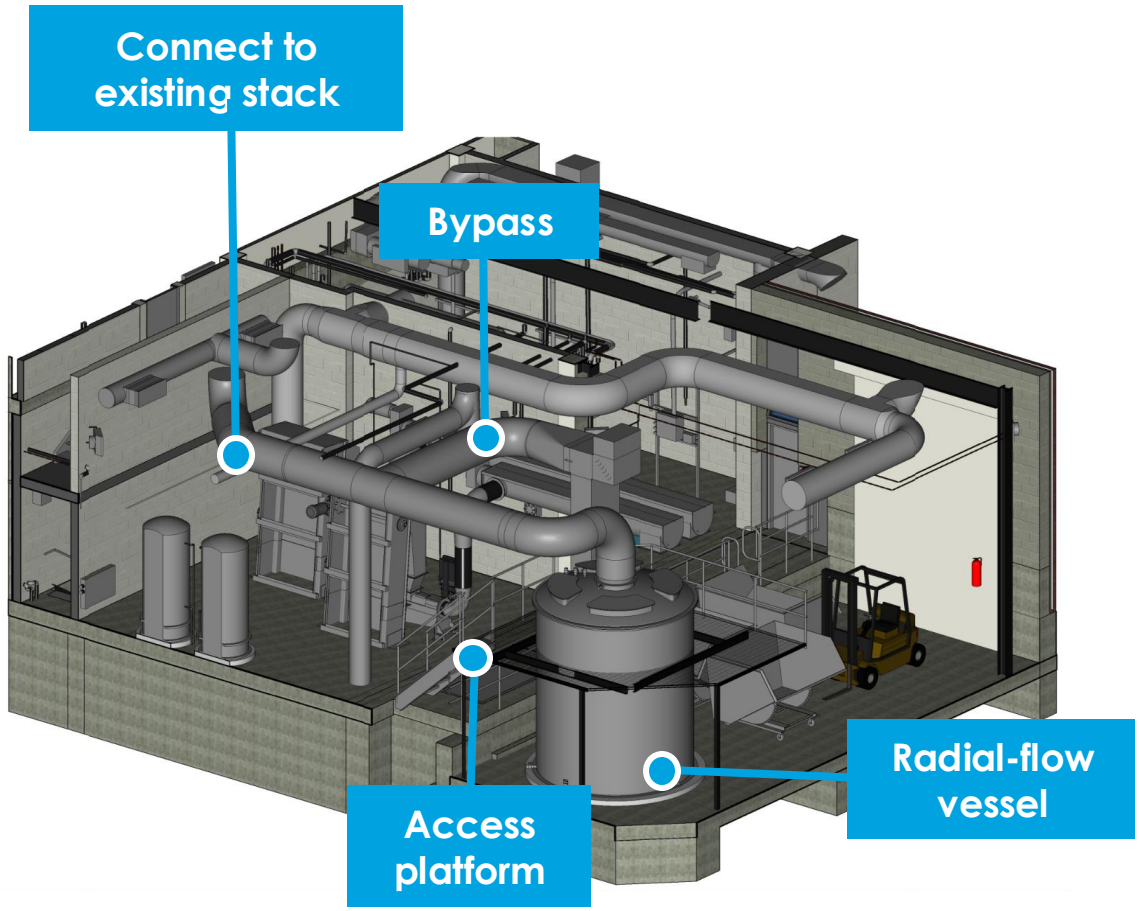


Design

- Building addition
  - 26-ft x 42-ft
  - Match existing architecture
  - Access roof thru second floor dormer
  - Manual hoist on roof
  - Pump room monorail and hoist extended into building addition
  - Flood protection
  - Micropile foundation

Odor Control System





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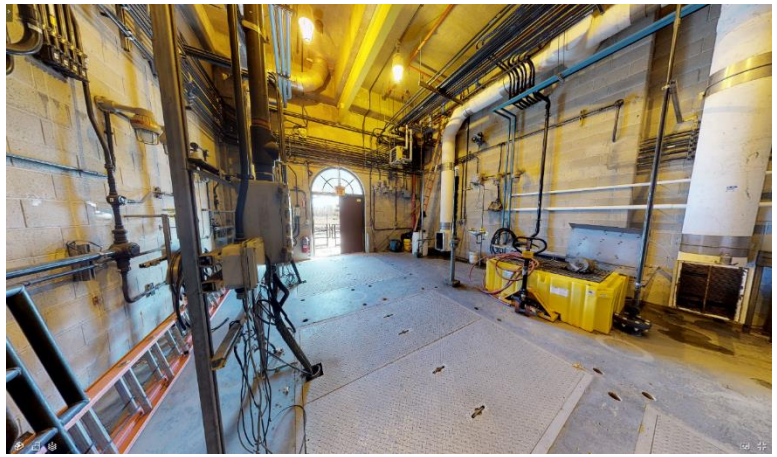
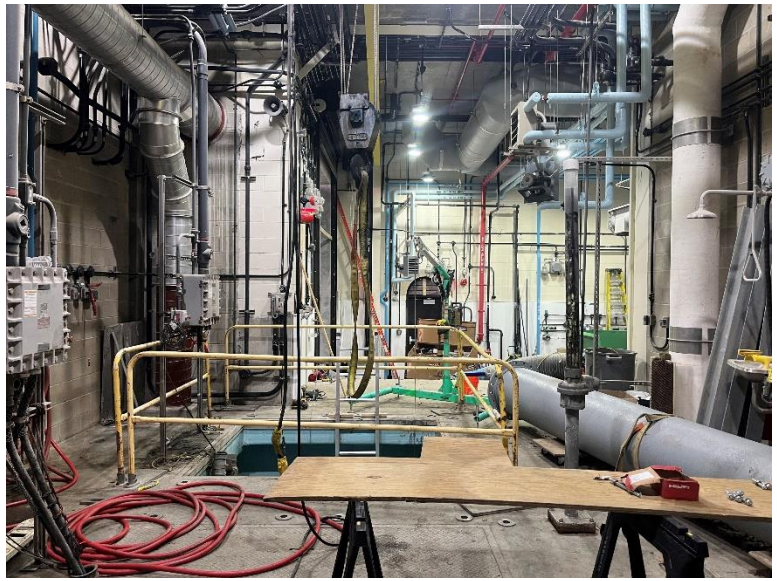
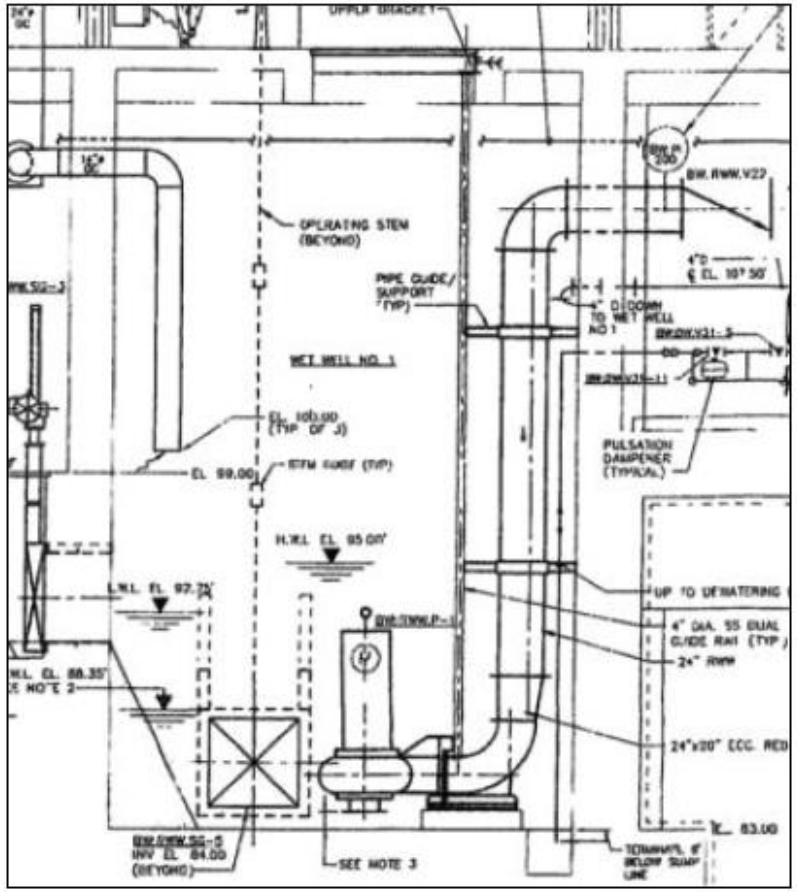
Pump Access Room

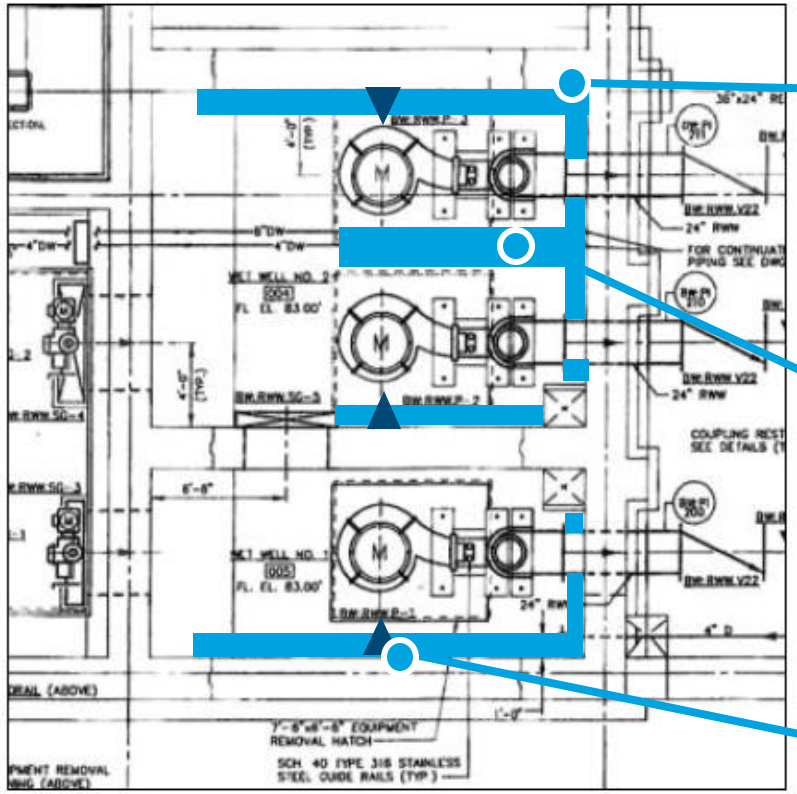




- Relocate conduit and open to new screening loading area
- Extend monorail over into screenings loading area

Pumping System & Pump Access Room





Sloped concrete fill

Partial wall

Anti-rotation baffle

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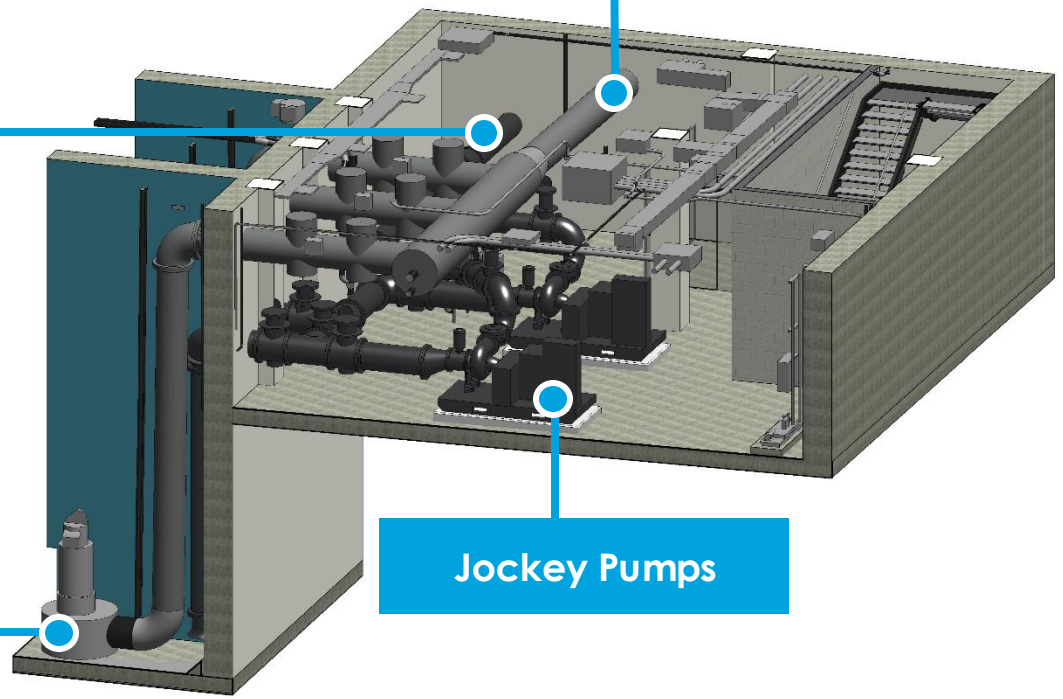
Jockey Pumps



Energy Design Journal

- Massachusetts Executive Order 484: Clean Energy and Efficient Buildings (2007) – Reduce greenhouse gas emissions
- Initiated facility energy audit program in 2009 for all facilities (BWPS 2012)
- MWRA developed standard procedures in 2014 to ensure that energy efficiency was embedded into all of MWRA's facility construction projects
- Procedures included the development of an Energy Design Journal for new projects to document and design the optimum energy efficient facility to "leave no stone unturned."

Triple Crown of Energy Efficiency

Sustainability Initiatives

- Process equipment
- Odor control
- Mechanical (HVAC)

Sustainability Initiatives

- Jockey pumps
  - Lower horsepower pumps on VFDs
  - More efficient at lower flows
  - Combined energy and maintenance cost savings
  - Maintenance cost savings $550,000 over the 20-year design period
  - Anticipated yearly energy savings: $10,000/yr (-79,000 kWh/yr)

Sustainability Initiatives

Jockey Pumps

	Equipment	Operation	Horsepower	Existing Annual Operating Hours	Proposed Annual Operating Hours	Annual Energy Impact (kWh)	Annual Energy Cost Impact
Existing	Submersible pumps	Fill/Draw	150	6,450	438	(475,000)	($60,000)
Proposed	Jockey pumps	Level Pace	60	-	8,300	396,000	$50,000
Savings						(79,000)	($10,000)

Sustainability Initiatives

- **Mechanical screens, wash presses, and conveyors**
  - **Replaced continuously operated grinders**
  - **Intermittent operation**
  - **Anticipated yearly energy savings: $2,000 (15,300 kwh/yr)**

Sustainability Initiatives

Mechanical Screens, Wash Presses, and Conveyors

	Equipment	Operation	Horsepower	Existing Annual Operating Hours	Proposed Annual Operating Hours	Annual Energy Impact (kWh)	Annual Energy Cost Impact
Existing	Grinders	Continuous	5	9,000	-	(32,300)	($4,100)
Proposed	Mechanical screen	Intermittent	5	-	2,700	8,300	$1,000
	Wash press	Intermittent	5	-	900	3,000	$400
	Conveyor	Intermittent	7.5	-	1,000	5,700	$700
Savings						(15,300)	($2,000)

Sustainability Initiatives

- Odor control
  - New odor control fans to be on VFDs
  - 2-speed operation – occupied/unoccupied
  - Anticipated yearly energy savings: $11,700 (93,100 kWh/yr)

Sustainability Initiatives

Odor Control

	Equipment	Operation	Horsepower	Existing Annual Operating Hours	Proposed Annual Operating Hours	Annual Energy Impact (kWh)	Annual Energy Cost Impact
Existing	OC fan	Continuous	25	8,760	-	(148,400)	($18,600)
Proposed	OC fan	Occupied/ Unoccupied	30		8,760	55,300	$6,900
Savings						(93,100)	($11,700)

Sustainability Initiatives

- Mechanical (HVAC)
  - Air handling unit makeup air rates
    - Occupied/unoccupied to match odor control
  - Modify valve room ventilation
    - Normal mode (>50°F) full outdoor air
    - Recirculation mode (<50°F); 75% recirculation
  - Anticipated yearly energy savings $2,300 (18,000kWh/yr)

Sustainability Initiatives

Mechanical (HVAC)

	Equipment	Operation	Horsepower	Existing Annual Operating Hours	Proposed Annual Operating Hours	Annual Energy Impact (kWh)	Annual Energy Cost Impact
Existing	Air handling unit	Continuous	5	8,760	-	(31,000)	($3,900)
Proposed	Air handling unit	Occupied/ Unoccupied	5	-	8,760	7,500	$900
	Recirculation fan	Continuous	0.75	-	8,760	5,300	$700
Savings						(18,300)	($2,300)

Results

Acknowledgements

Massachusetts Water Resource Authority

Energy Subconsultant

General Contractor

Contact Information

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THANK YOU

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