



2018 NEWEA SPRING MEETING AND EXHIBIT

Restoring Flood Resiliency with a 120 MGD Flood Pump Station in Lowell, MA

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LOWELL, MA



WEST FLOOD PUMP STATION



SITE LOCATION





SITE LOCATION





HISTORY OF WEST FLOOD PUMP STATION

- US ACOE Pump Station ca. 1940
- Pumped Combined Sewer Flows from Centralville
- Ran Very Few Times
- Not Operational for 30+ Years





HISTORY OF WEST FLOOD PUMP STATION

- VFW Highway Constructed 1950s
- North Bank Interceptor Constructed 1970s



HISTORY OF WEST FLOOD PUMP STATION

- Three 60-MGD, 42-inch Axial Flow Propeller Pumps
- Right-Angle Drives, 415 HP Gasoline Engines
- 16-inch Centrifugal "Jockey" Pump
- Concrete Wet Well, Discharge Channel
- Steel Frame Building, Brick Masonry



PROJECT MOTIVATION

- Restore the Pump Station to Operation
- Re-Certify Flood Damage Reduction System with ACOE
- File a LOMR with FEMA

Residents Cancel Flood





CRITICAL SUCCESS FACTORS

- Construction Schedule
- Minimize Cost ("Blue Moon" Facility)
- Enable Future Operation
 & Maintenance





PUMP STATION EVALUATION

- Concrete Sub-structure
 in Good Condition
- Building Required Rehabilitation
 - Roof Replacement
 - Door Replacement
 - Window Replacement
 - Masonry Rehabilitation
 - Steel Blast Cleaning and Coating, Cover Plating?
- Site Improvements



PUMP STATION EVALUATION

- Electrical, Plumbing, and HVAC – Complete Replacement
- Mechanical Equipment Replace or Rehabilitate?
 - Right Angle Drives
 - Pumps
 - Valves
 - Slide Gates
 - Engines Replace





PUMP STATION EVALUATION RECOMMENDATIONS

- Building Structure Rehabilitation \$600,000 - \$800,000
- Building Structure Replacement ~\$800,000
- Electrical, Plumbing, and HVAC – Complete Replacement





PUMP STATION EVALUATION RECOMMENDATIONS

- Rehabilitate Existing
 Pumps and Valves
- New Right-Angle Drives
- New Diesel Engines



Alternative	Pump Capacity	Engine/Motor	Drive Type	Pump, Motor/Engine, and Gear Cost	Soft- Starters and Main Electrical Distribution	Generator and Associated Electrical Equipment	Fuel Tank, Piping, and Additional HVAC	Total Costs
Pump Rehabilitation	60 MGD (25' TDH)	Electric Motor	Right-Angle	\$346,000	\$254,000	\$395,000	\$106,000	\$1,101,000
	60 MGD (25' TDH)	Diesel Engine	Right-Angle	\$385,500	\$36,000	\$68,000	\$219,000	\$708,500
Pump Replacement	30 MGD (17.3' TDH)	Electric Motor	Direct (Submersible)	\$444,000	\$261,000	\$380,000	\$0	\$1,085,000
			Right-Angle	\$611,550	\$203,000	\$224,000	\$106,000	\$1,144,550
		Diesel Engine	Right-Angle	\$696,300	\$36,000	\$68,000	\$205,000	\$1,005,300







 Replacement of Engines / Right Angle Drives







 Rehabilitation of 42-inch Pumps, Gate Valves, Flap Valves





Replacement of Slide Gates

- Outfall Channel
- Wet Well
- New Slide Gate in Pump Discharge Channel
- Replacement of Trash Rack
- New Flap Gate on Outfall





- New Diesel Generator
- New Diesel Tanks, Pump and Piping
- New Electric Service, Natural Gas Service (Heating)





- Structural/Architectural Building Improvements
- Site Improvements





- New Infrared Heaters
- Electrical Improvements
 - New Interior and Exterior Lighting
 - Security

Automation / SCADA





BEFORE AND AFTER







BEFORE AND AFTER





PROJECT CONSTRUCTION COST

- Contractor:
- Contract Value:
- Contract Duration:

Waterline Industries \$3.8M (of \$5.87M)*

16 months*

*Contract also included construction of an in-line interceptor storage facility at a nearby site





PROJECT CHALLENGES

• Site

- Located in Median of VFW Highway



PROJECT CHALLENGES

River Stage

- Existing Leaking Duckbill
- Submerged Low Outlet Pipe (Reportedly Plugged) Allowed River to Surcharge Into Outfall





PROJECT CHALLENGES

Pump Testing / Exercising

- Existing Pump Station Layout Did Not Allow for Pump / Engine Exercising
- Infrequent Operation





Needed to Validate Pump Performance

- No Existing Pump Curves
- Pump Discharge Flow
 Measurement Difficulties
- Pumping Water "In a Circle"
- Flow Measurement
 - Measure Water Depth in Pump Discharge Channel
 - Use Recirculation Wall Pipe as Measurement Device
 - Submerged Orifice
 - Circular Weir
 - Calculate Pressure for Low Flow Condition
 - Use Pressure Gauge for High Flow Condition















WATER LEVELS SHOWN BASED ON HIGH HEAD CONDITION, ASSUMING 100-YEAR RIVER LEVEL, WET WELL PUMP SHUTOFF LEVEL, AND EACH PUMP DELIVERING 60 MILLION GALLONS PER DAY OF FLOW.

SECTION VIEW DURING PUMP STATION OPERATION



Regular Maintenance

- Normal Maintenance/Walk-throughs
- Exercise of Pumps and Engines

SOP Diagrams

- For Operation of Facility During Flood Event
 - Helpful Due to Infrequency of Events (on order of decades)
- For Operation of Facility for Pump and Engine Exercise
 - Ability to Run Engines Loaded
 - Verify Readiness for Event





DRAFT West Flood Pump Station O&M Manual

Prepared For:

Lowell Regional Wastewater Utility Lowell, MA

June 2018



O&M – ACTION LEVEL TABLE

Merrimack River Flood Action Levels										
Based on Water Surface Elevations (WSE) at USGS Gage 01100000*										
Action Level		WSE (USGS Gage Datum)	Condition	Action						
Action	1	50.0	NWS action level	Monitor for flood alerts						
Minor	2	52.0	NWS minor flood level	Coordinate staff as needed						
Moderate	ЗA	54.0	NWS moderate flood level	Move interceptor flow control to West Station; visit West Station and Beaver St Closure						
	3B	>54.0	NWS moderate flood level + influent chamber depth reaches 13-ft	Maximize North Bank Interceptor flow to WWTP; prepare West Station pumps and gates for operation						
	3C	>54.0	NWS moderate flood level + influent chamber depth reaches 15-ft	Operate West Station flood pumps						
Major	4	58.0	NWS predicts water surface to reach major flood level	Install Beaver St Closure						
Major	5	62.0	Water surface within 2.0 feet of top of Rosemont levee	Evacuation						
N/A	6	48.0	River Level Receding	Perform Post-Event Inspection						
*USGS Gage 01100000 (Merrimack River below Concord River) located downstream of Hunts Falls Bridge: Current/Predicted stage: <u>https://water.weather.gov/ahps2/hydrograph.php?wfo=box&gage=lowm3</u>										







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BEFORE AND AFTER





