OPTIMIZATION OF ENERGY AND WATER QUALITY COSTS FOR DRINKING WATER UTILITIES

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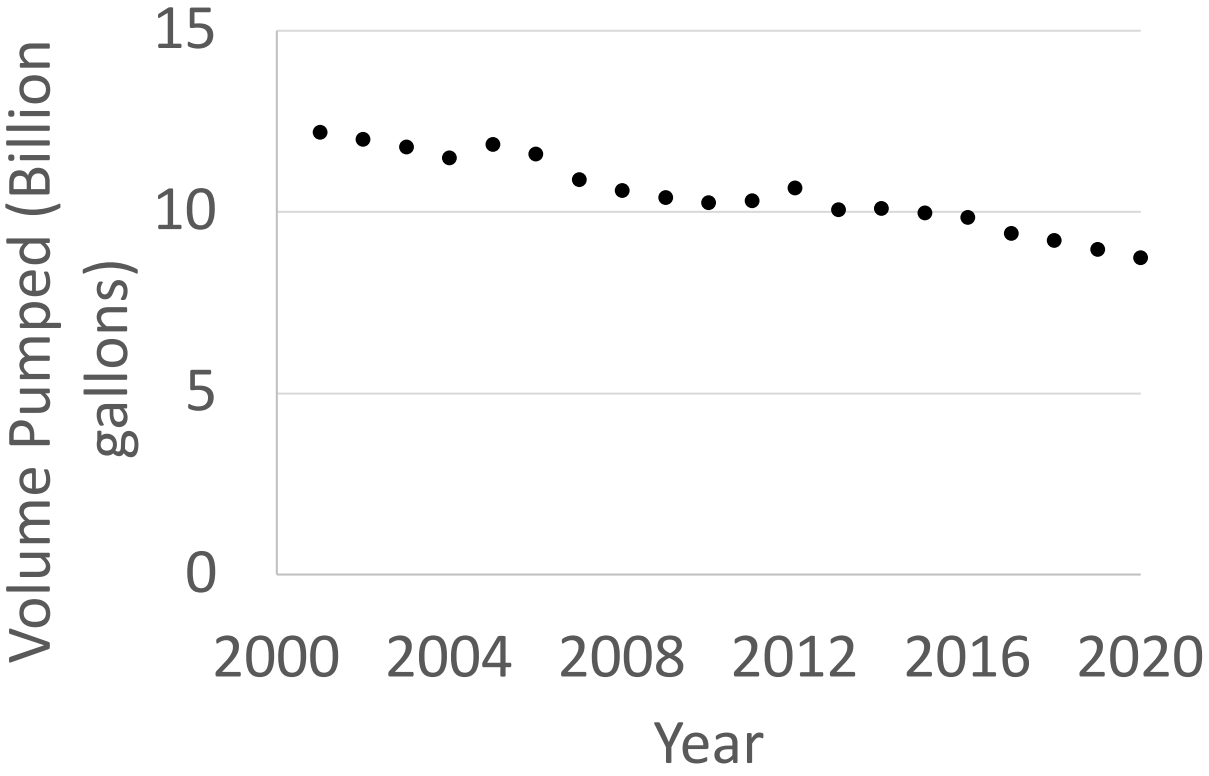
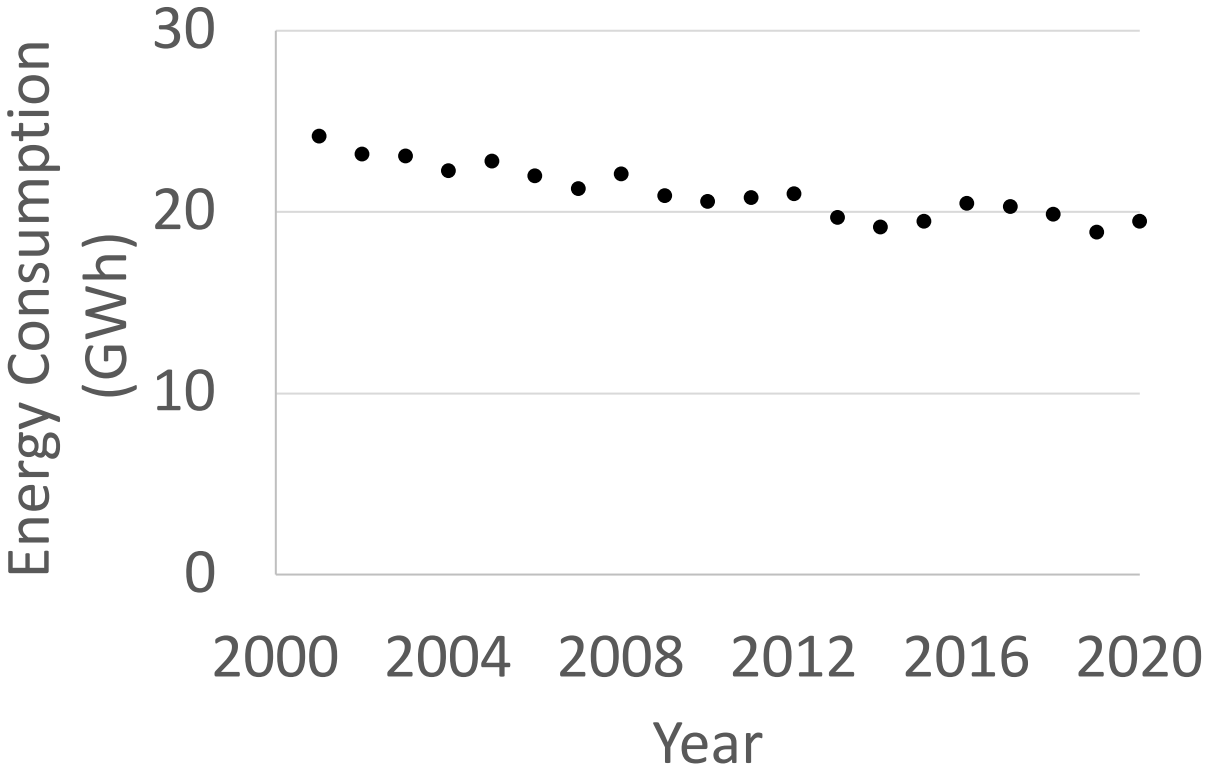
Objectives

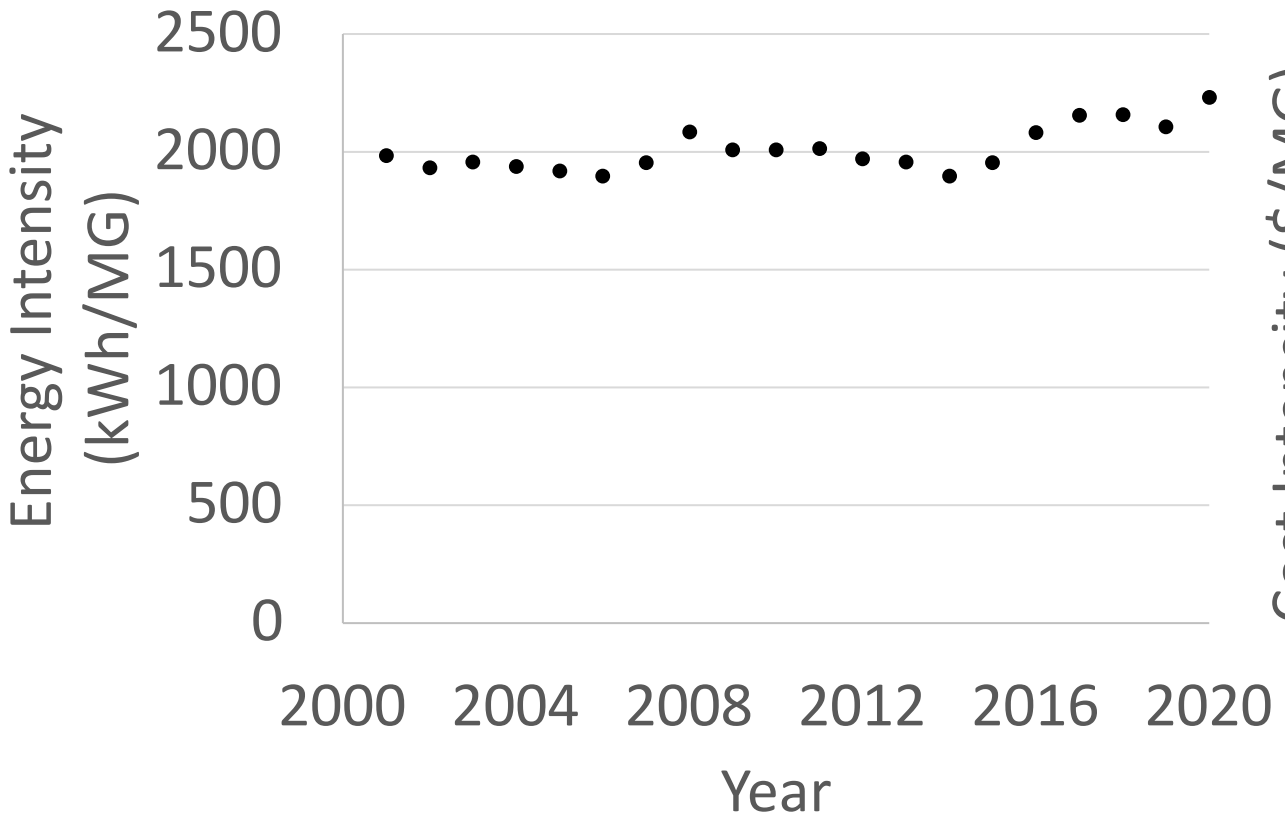
- Develop procedure that optimizes pump schedule to minimize energy and energy related costs
- Develop procedure that accounts for water quality costs as part of the optimization
- Develop computer application that utility staff can use to evaluate minimum cost for different operating scenarios

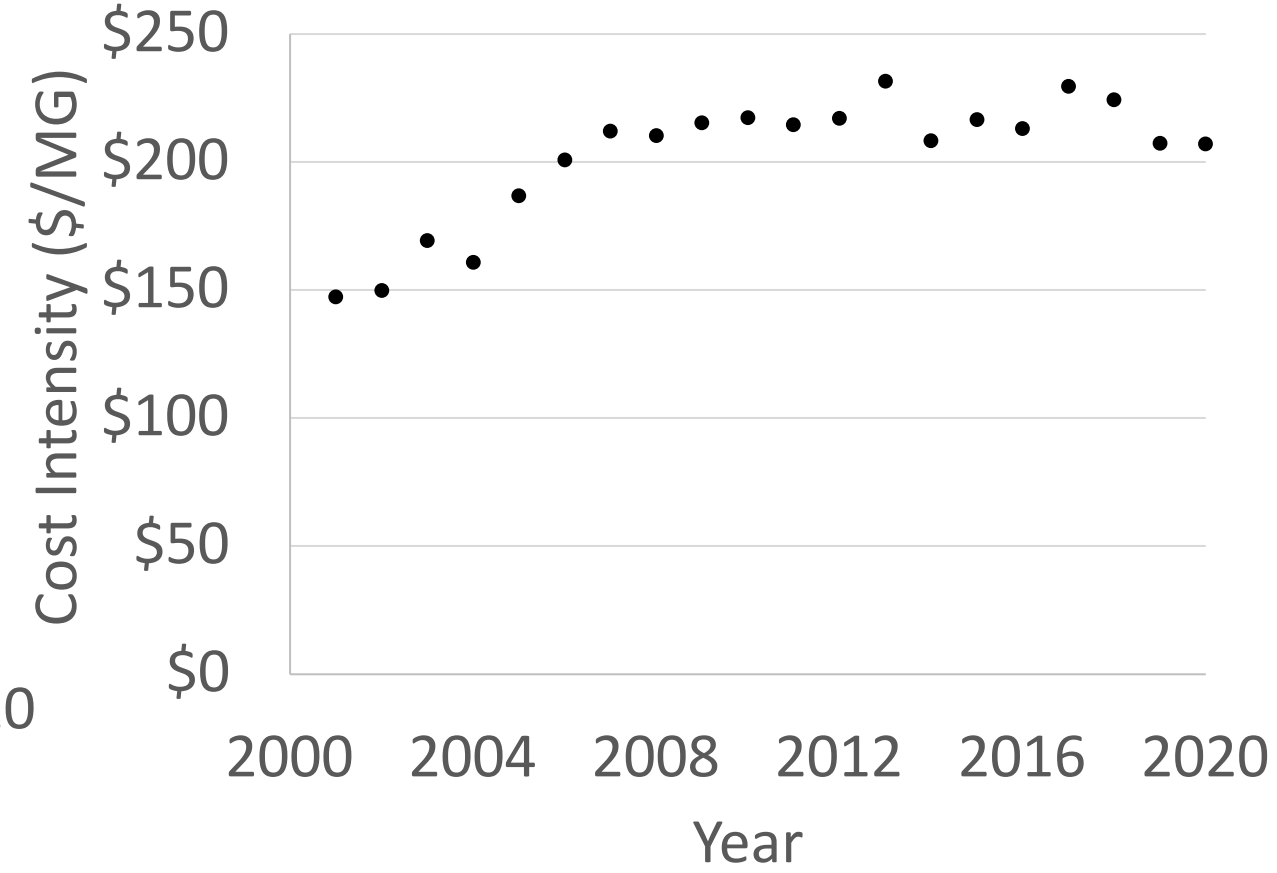
MWU Historical Patterns





MWU Historical Patterns





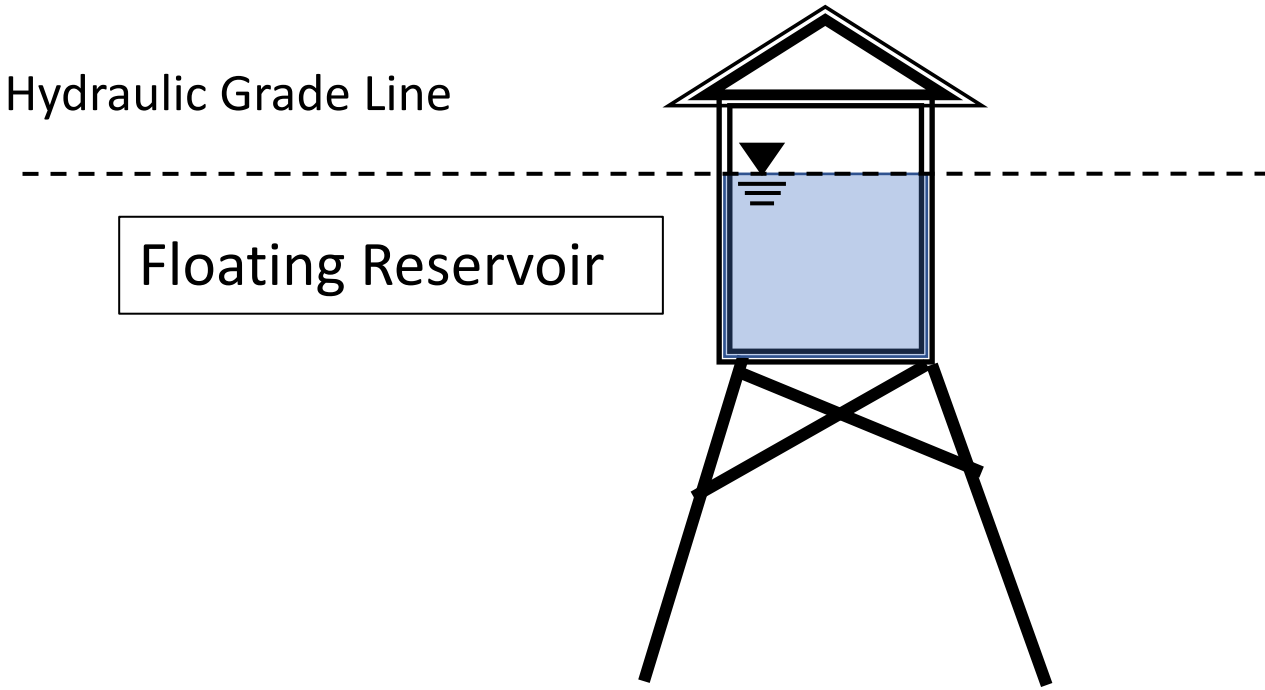
MWU Energy and Energy Cost Saving Strategies

Reduced Energy

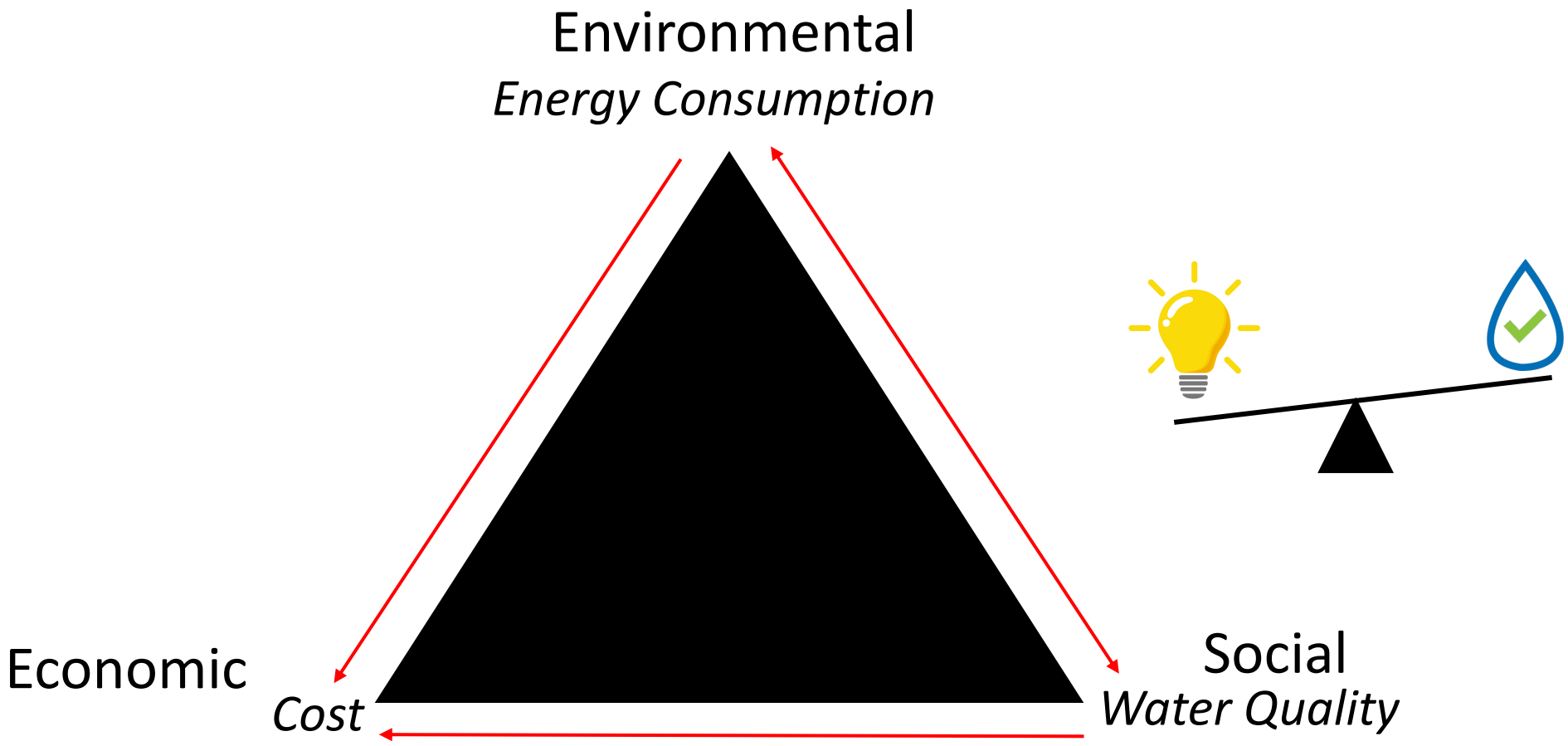
- Lowest Energy Well
- Optimal Flow Rate

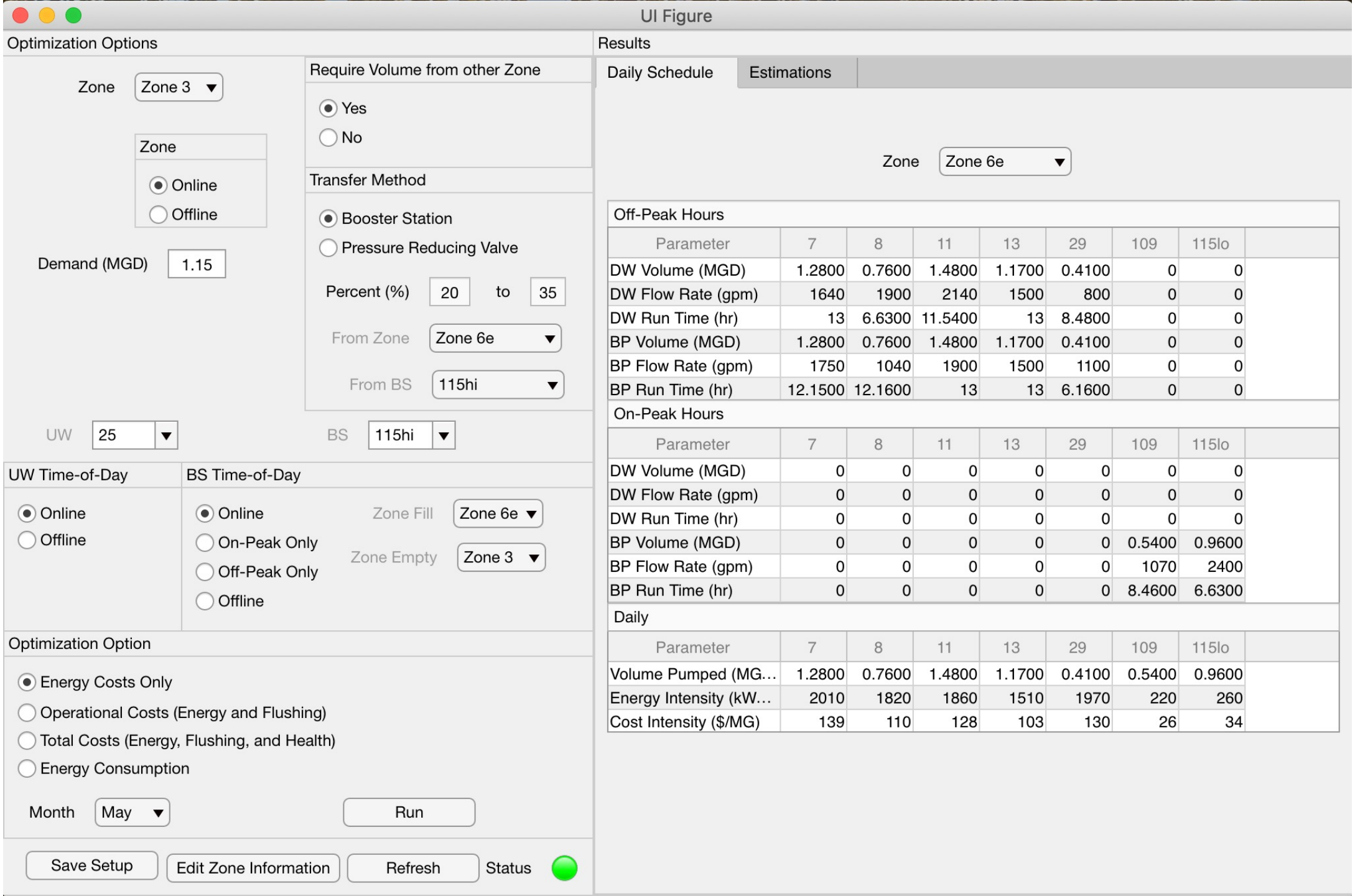
Reduced Energy Costs

- Complete Off-Peak
- Partial Off-Peak



Drinking Water Utilities Objectives




UI Figure
Optimization Options
Zone
Zone 3
Zone
Online
Offline
Demand (MGD)
1.15
Require Volume from other Zone
Yes
No
Transfer Method
Booster Station
Pressure Reducing Valve
Percent (%)
20
to
35
From Zone
Zone 6e
From BS
115hi
UW
25
BS
115hi
UW Time-of-Day
Online
Offline
BS Time-of-Day
Online
On-Peak Only
Off-Peak Only
Offline
Zone Fill
Zone 6e
Zone Empty
Zone 3
Optimization Option
Energy Costs Only
Operational Costs (Energy and Flushing)
Total Costs (Energy, Flushing, and Health)
Energy Consumption
Month
May
Run
Save Setup
Edit Zone Information
Refresh
Status
Results
Daily Schedule
Estimations
Zone
Zone 6e
Off-Peak Hours
Parameter 7 8 11 13 29 109 115lo
DW Volume (MGD) 1.2800 0.7600 1.4800 1.1700 0.4100 0 0
DW Flow Rate (gpm) 1640 1900 2140 1500 800 0 0
DW Run Time (hr) 13 6.6300 11.5400 13 8.4800 0 0
BP Volume (MGD) 1.2800 0.7600 1.4800 1.1700 0.4100 0 0
BP Flow Rate (gpm) 1750 1040 1900 1500 1100 0 0
BP Run Time (hr) 12.1500 12.1600 13 13 6.1600 0 0
On-Peak Hours
Parameter 7 8 11 13 29 109 115lo
DW Volume (MGD) 0 0 0 0 0 0 0
DW Flow Rate (gpm) 0 0 0 0 0 0 0
DW Run Time (hr) 0 0 0 0 0 0 0
BP Volume (MGD) 0 0 0 0 0 0.5400 0.9600
BP Flow Rate (gpm) 0 0 0 0 0 1070 2400
BP Run Time (hr) 0 0 0 0 0 8.4600 6.6300
Daily
Parameter 7 8 11 13 29 109 115lo
Volume Pumped (MG… 1.2800 0.7600 1.4800 1.1700 0.4100 0.5400 0.9600
Energy Intensity (kW… 2010 1820 1860 1510 1970 220 260
Cost Intensity ($/MG) 139 110 128 103 130 26 34

UI Figure

Billing Structures | Booster Stations | Zones

Zone Information | Pump Group Information

Zone
- Zone 3
- Zone 4
- Zone 6e

Unit Well
- 7
- 8
- 11
- 13

Add UW | Delete UW

Test UW | Save UW

Billing Rate Structure
- MGE CG-2
- MGE CG-4

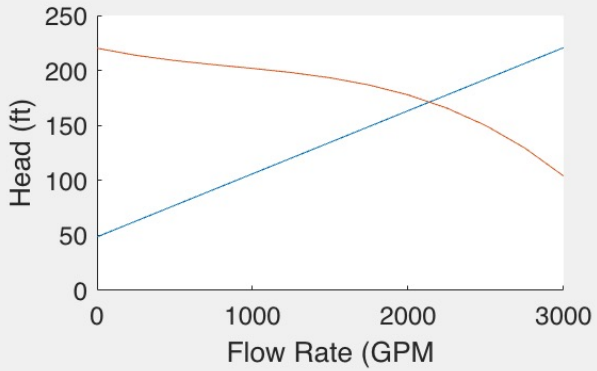
Additional energy intensity (Fixed + Treatment) required to meet billing energy intensity

Additional Energy Intensity (kW/MG) 79

DW SHC | DW PC | BP SHC | BP PC

Flow Rate (gpm)	Head (ft)
0	48.6800
250	63.0190
500	77.3580
750	91.6970
1000	106.0360
1250	120.3750
1500	134.7140

Edit DW SHC



DW Flow Rate (gpm)
- (•) Operating
- ( ) Constrained

Max 2140

Min 2140

BP Flow Rate (gpm)
- ( ) Operating
- (•) Constrained

Max 1900

Min 743.6

Graph DW | Graph BP

Water Quality Information

Utility | Non-Utility

Contaminant: Iron and Manganese

Cost per Unidirectional Flush ($) 4.376e+04

95th percentile allowable volume (MG) 2.31e+04

Ground Reservoir

Storage Capacity 0.15

Max Level (ft) 14

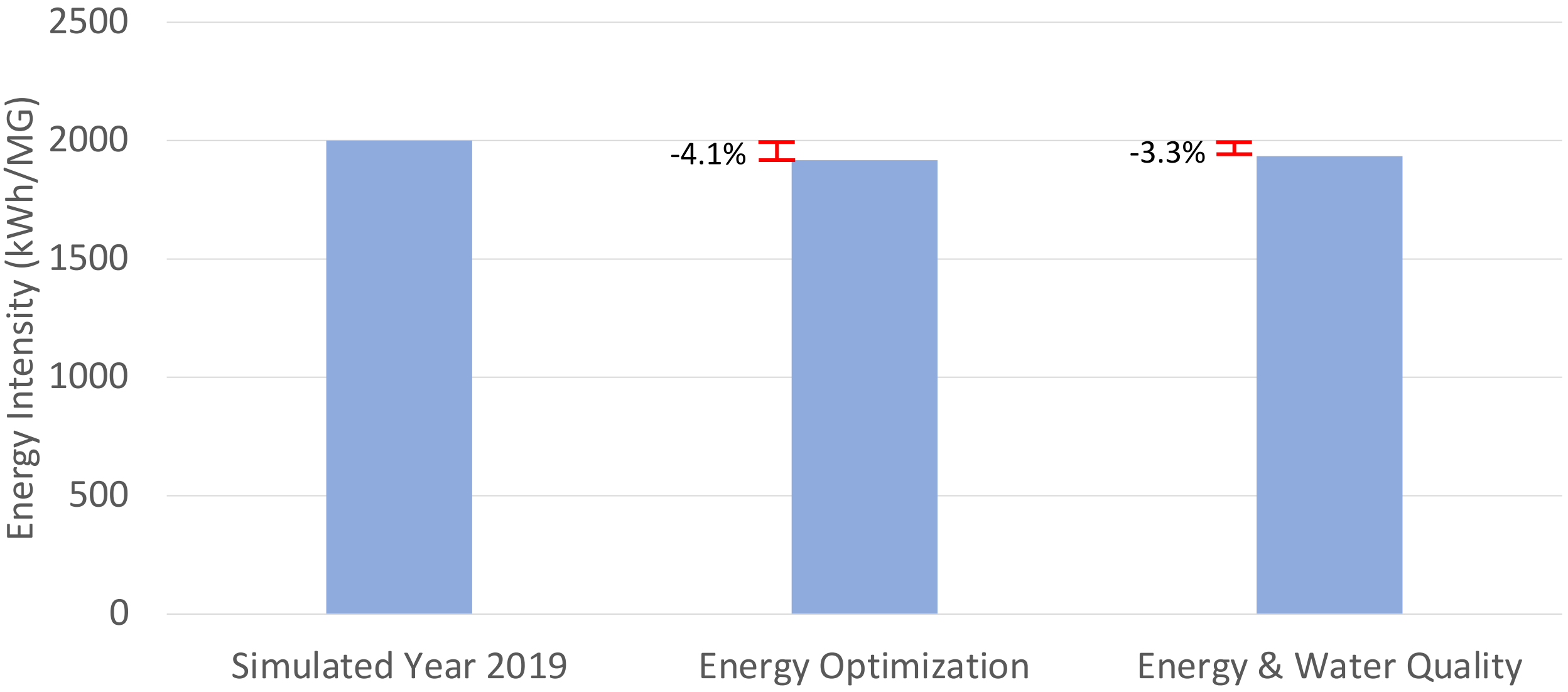
Min Level (ft) 9

Available Max (ft) 14

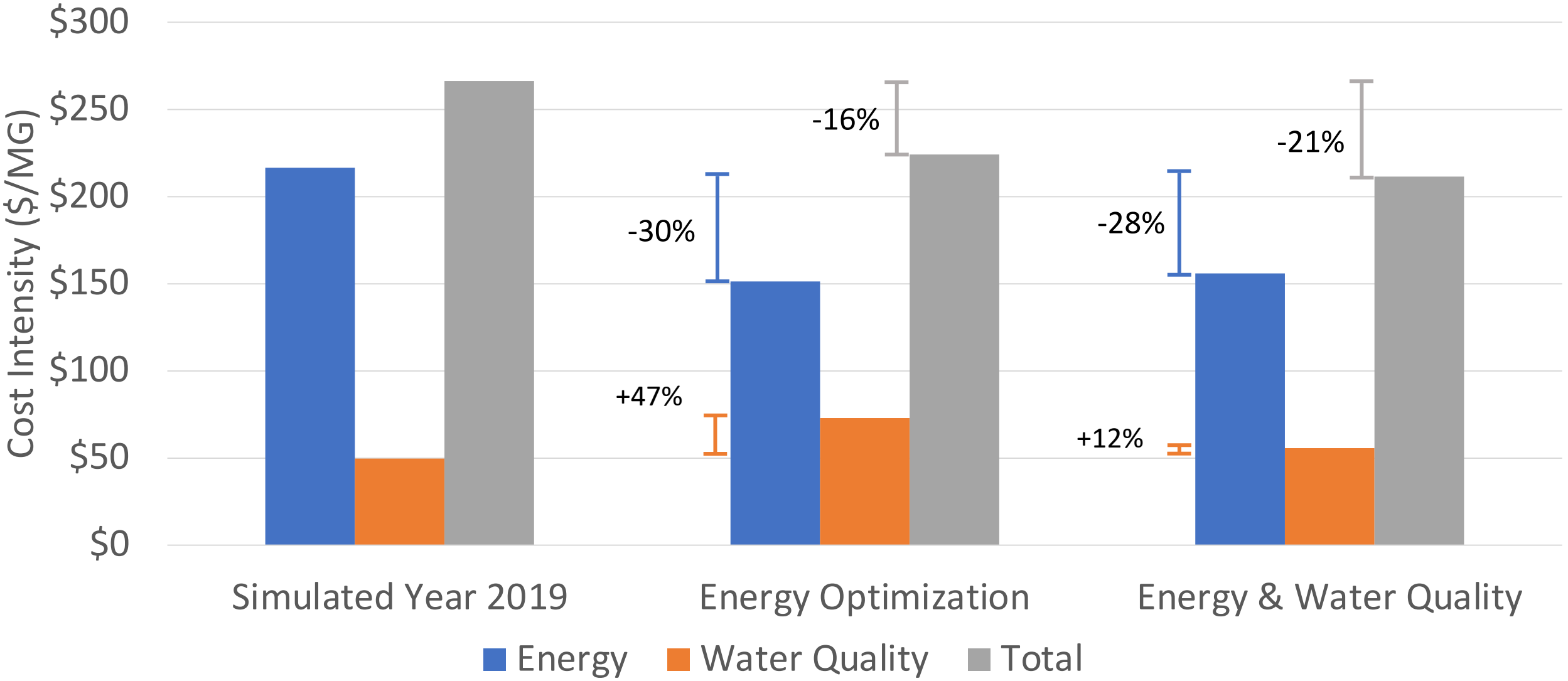
DW/BP Configuration
- (•) Normal (BP into Dist)
- ( ) DW into Dist

Close | Status | Reset to Original

Energy Optimization



Cost Optimization



Summary

- Off-peak pumping strategies can be used to save MWU's east side:
  - Approximately 30-35% energy related costs
  - Approximately 3-4% energy consumption

- Computer program is usable by staff and allows for flexible input parameters to optimize pumping schedule

Thank You!

Madison Water Utility