DESIGNING A FEASIBLE AND BENEFICIAL REUSE PROCESS

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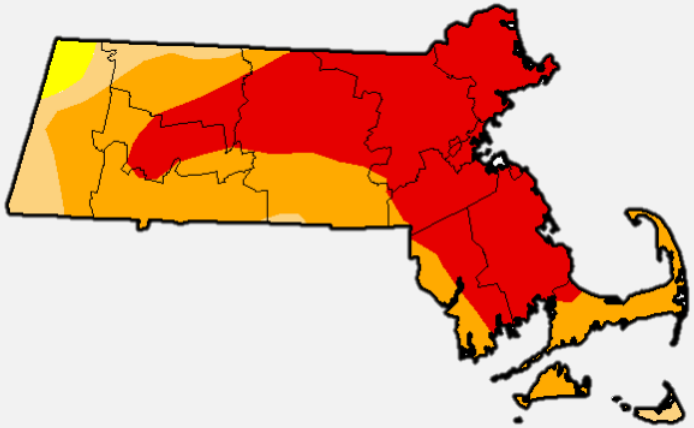
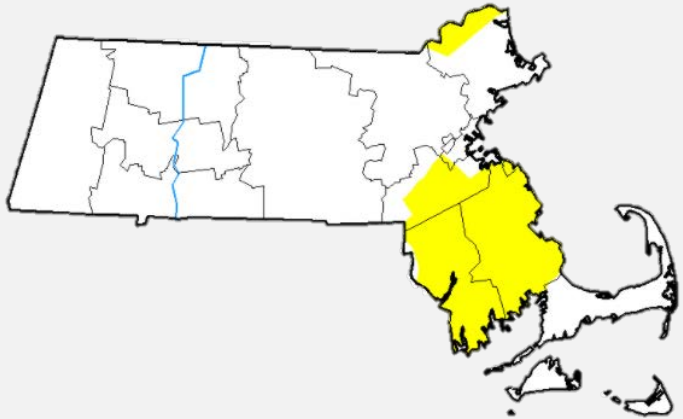
Need for Wastewater Reuse

September 20, 2016

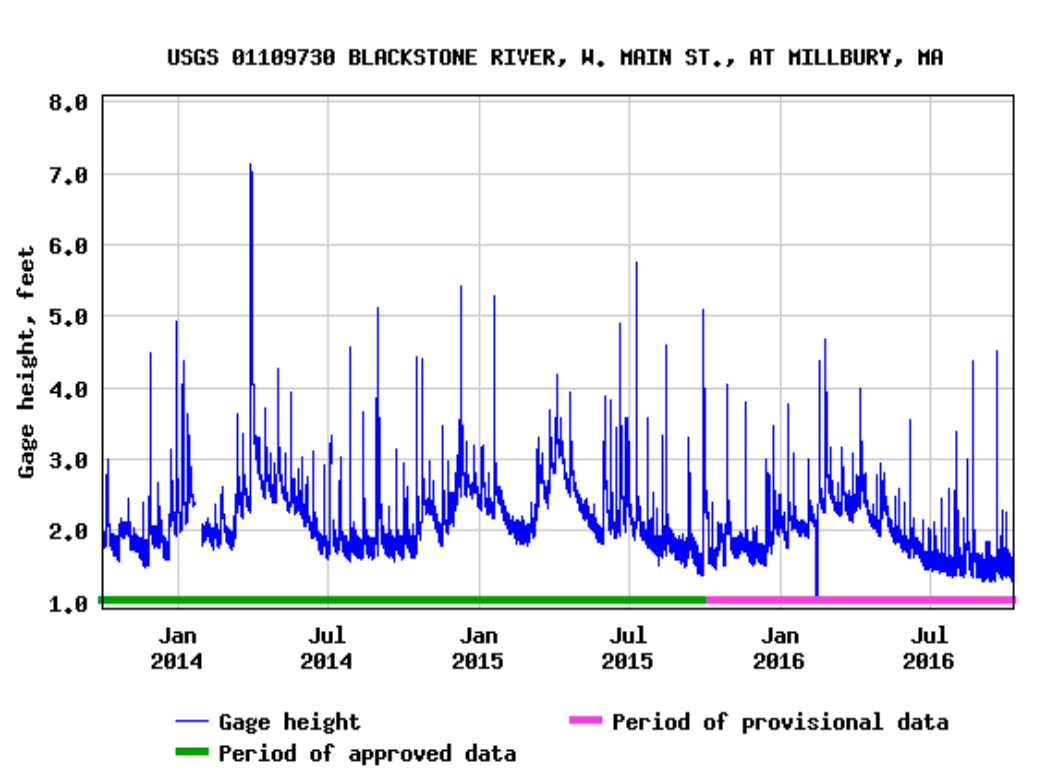


September 13, 2017

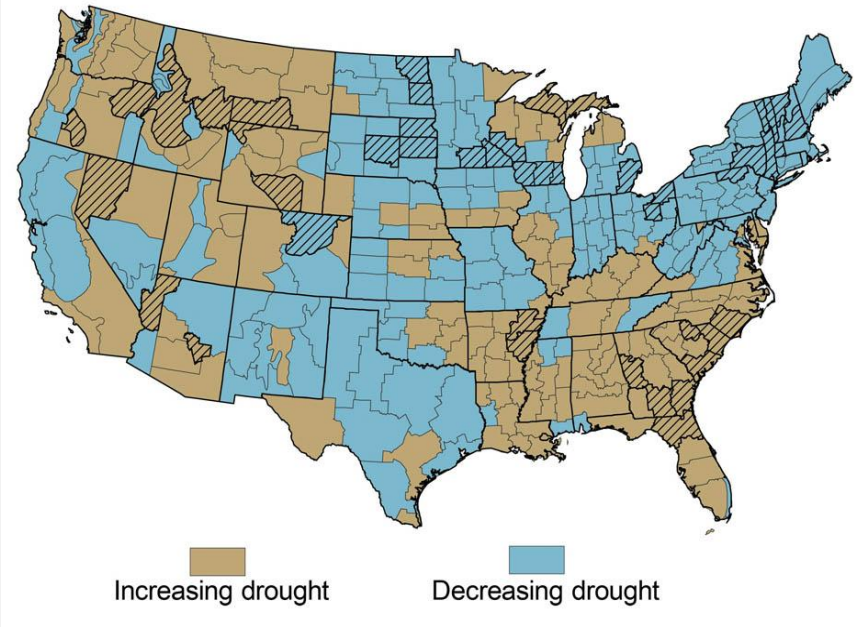


http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?MA

Need for Wastewater Reuse



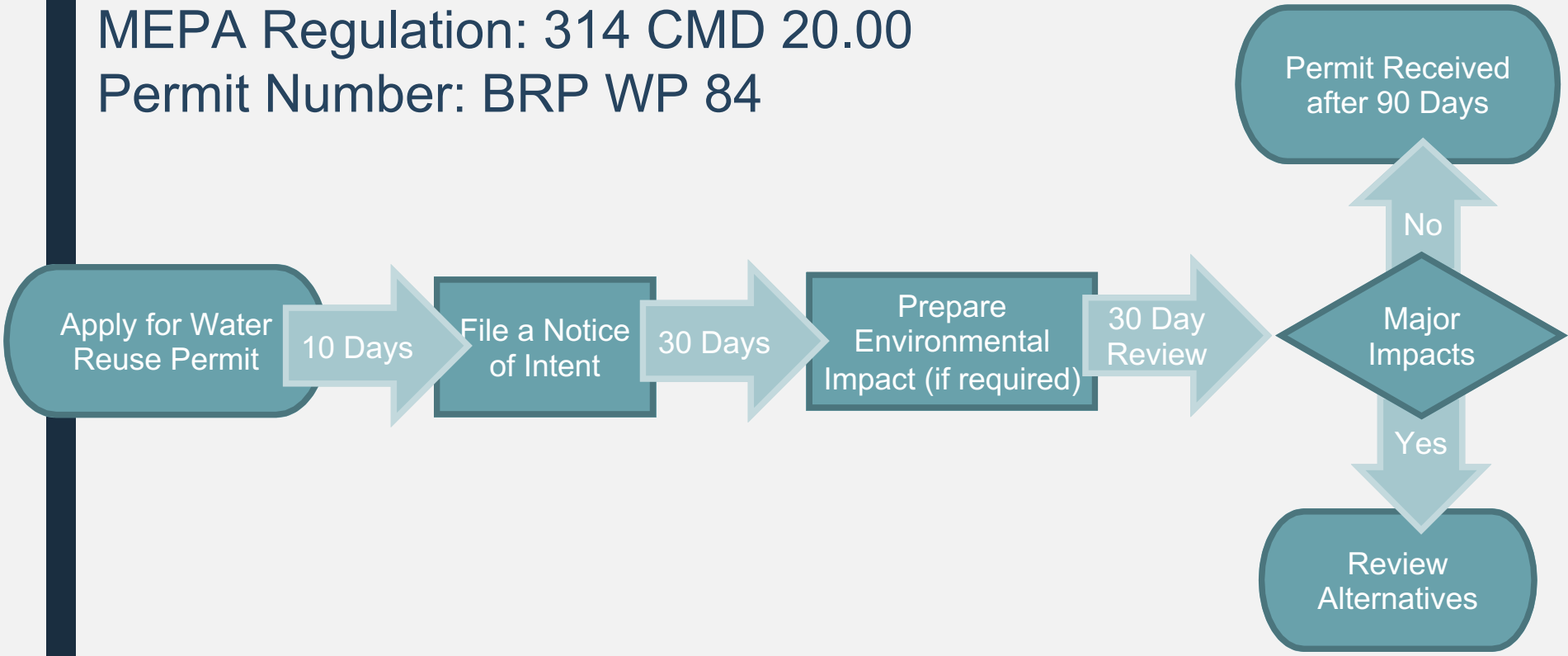
Need for Wastewater Reuse



Drought Conditions across the United States from 1958 to 2007

Regulations Surrounding Wastewater Reuse

MEPA Regulation: 314 CMD 20.00
Permit Number: BRP WP 84



Regulations and Reuse Water Classes

Class A

Class B

Class C

Regulations and Reuse Water Classes

Class A	pH = 6.5-8.5 BOD < 10 mg/l TSS < 5 mg/l Turbidity < average of 2 NTU within a 24-hour period, cannot exceed five NTU more than 5% of the time within a 24-hour period, and cannot exceed ten NTU at anytime Total Nitrogen < 10 mg/l Median of no detectable fecal coliform/100 ml over continuous seven-day sampling periods, not to exceed 14/100 ml in any one sample Other parameters as specified by the Department
Class B	pH = 6.5-8.5 BOD < 30 mg/l TSS < 10 mg/l Total Nitrogen < 10 mg/l Median of 14 detectable fecal coliform/100 ml over continuous 7-day sampling periods, not to exceed 100/100 ml in any one sample Other parameters as specified by the Department
Class C	pH = 6.5-8.5 BOD < 30 mg/l TSS < 30 mg/l Total Nitrogen < 10 mg/l Median of 200 detectable fecal coliform/100 ml Other parameters as specified by the Department

Wheelabrator Technologies

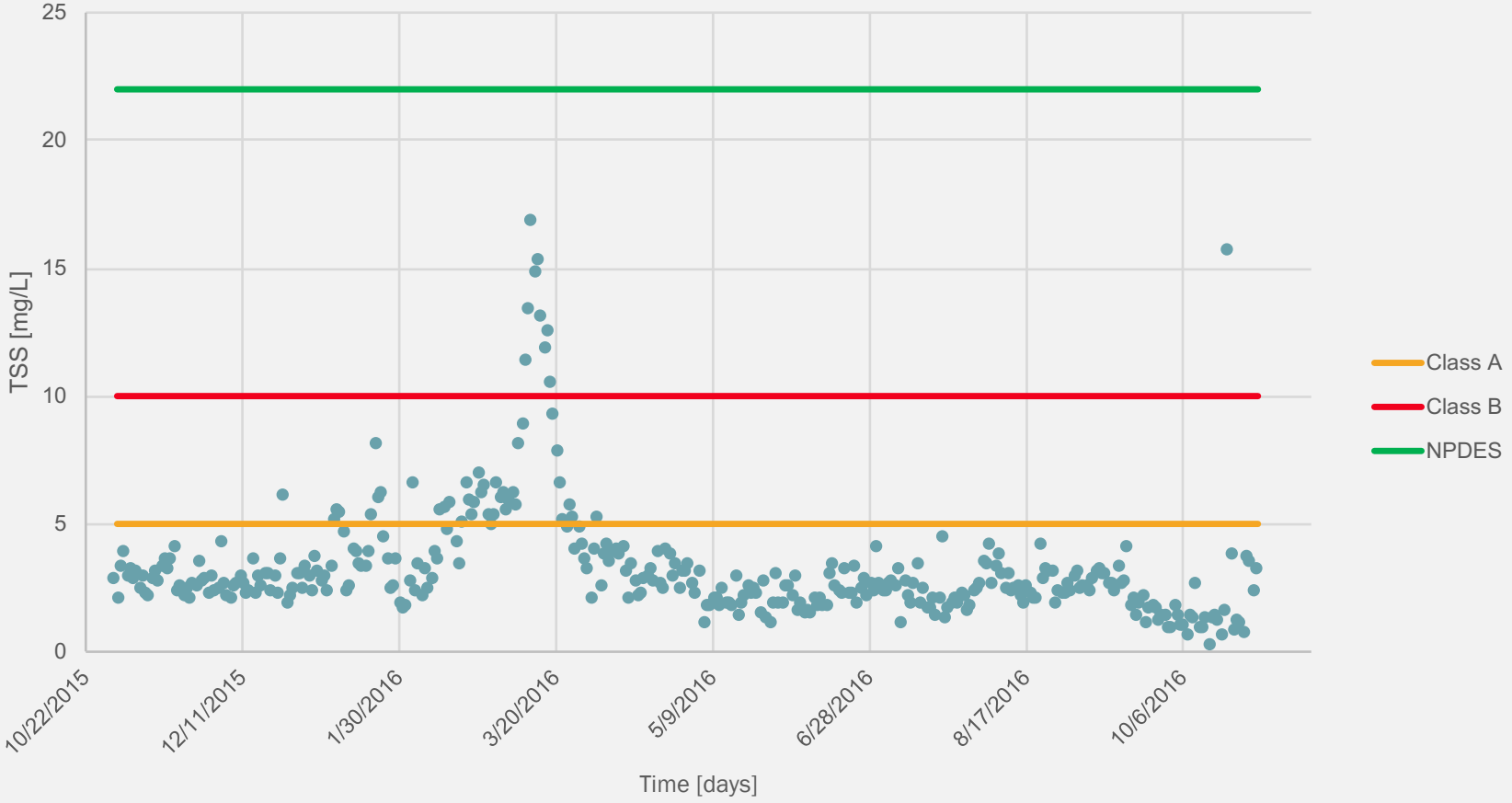
800,000 gallons

Water Use by Type
Cooling Tower
Potable Water
Boiler Water
Fire Suppression

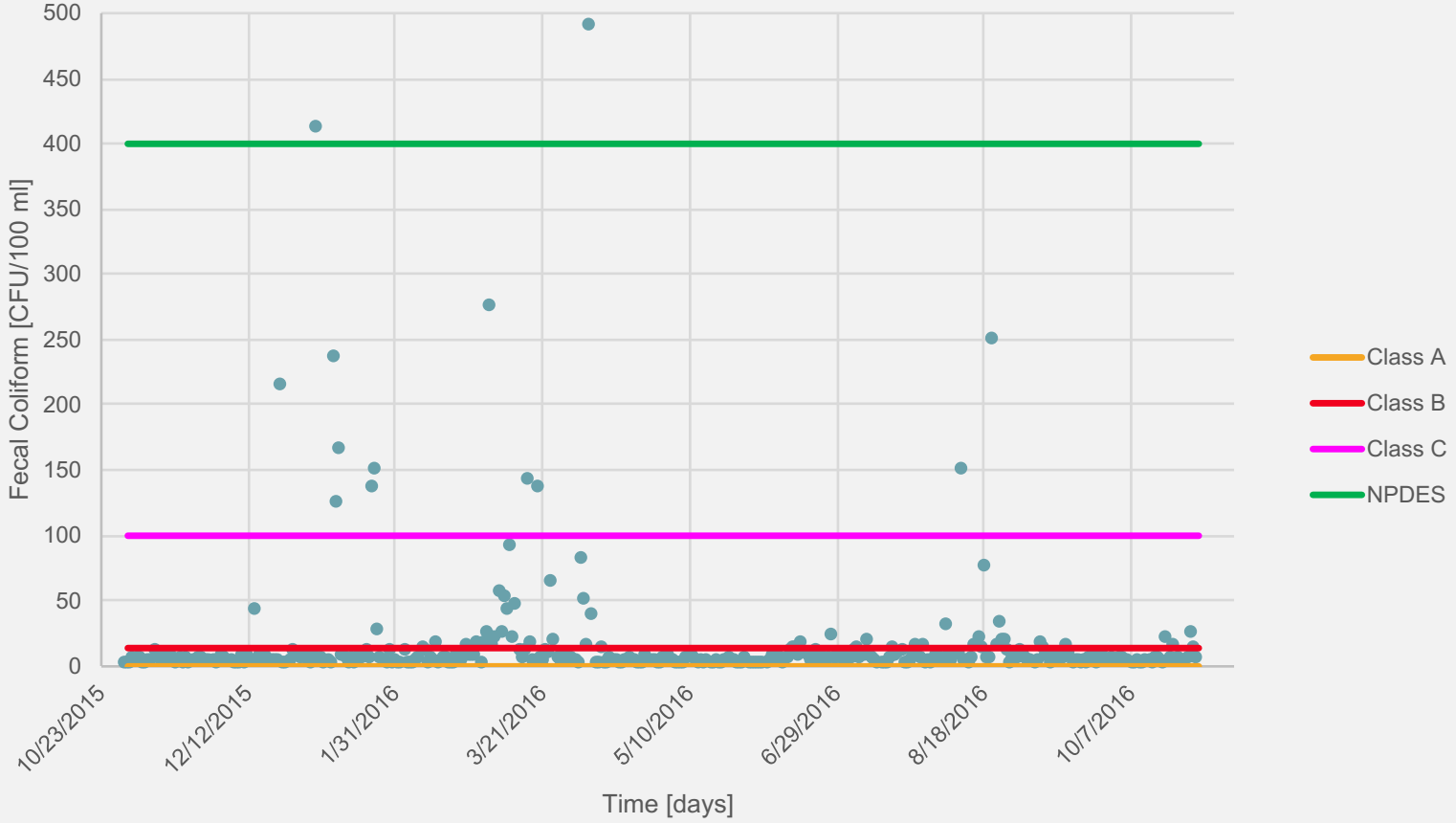
Determining Parameters of Concern

Parameter	Cass A Regulations	Exceedances of Class A Levels
pH	6.5 - 8.5	None
BOD	<10 mg/L	1 exceedance
TSS	<5 mg/L	96 exceedances
Turbidity	< 2 NTU ave; 5 NTU max	None
Total Nitrogen	<10 mg/L	3 exceedances
Fecal Coliform	0/100 mL ave; 14/100 mL max	Always exceeds

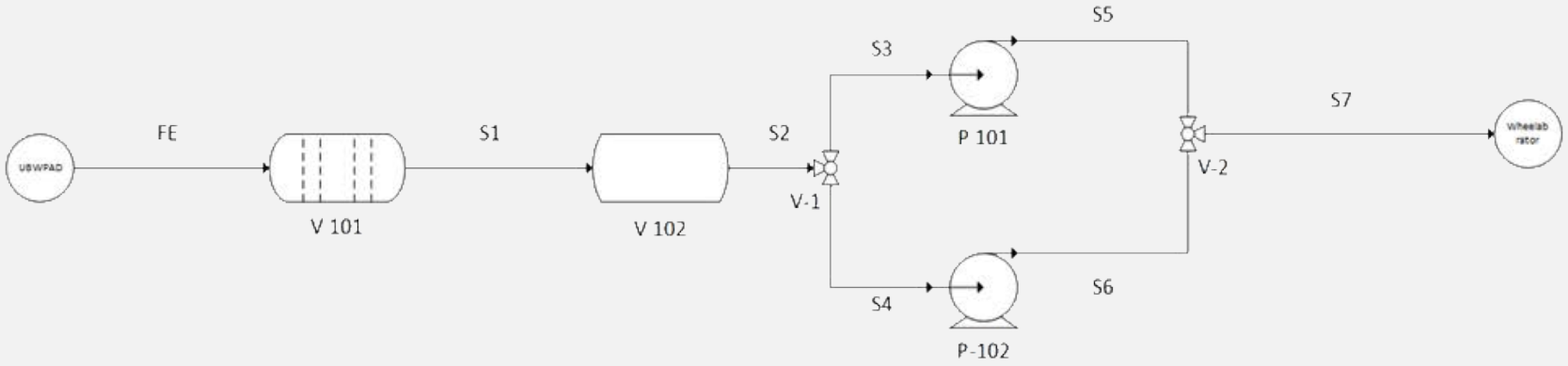
Total Suspended Solids: 2015-2016

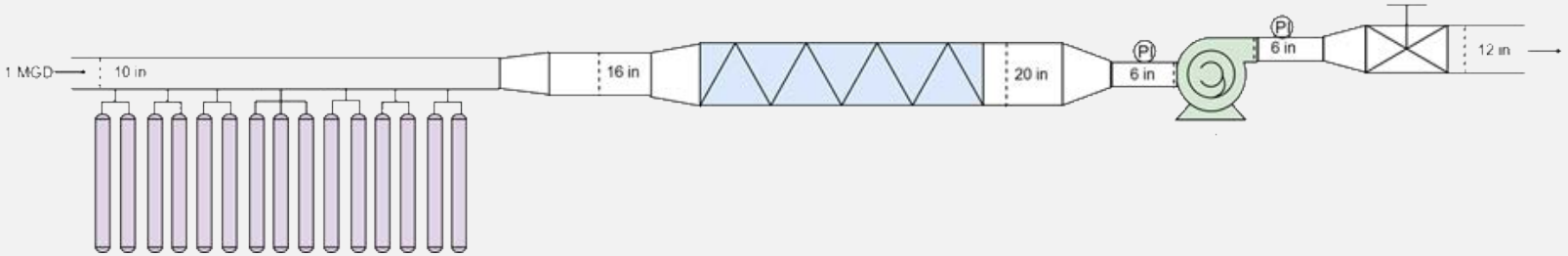


Fecal Coliform Levels: 2015-2016



Resulting Design

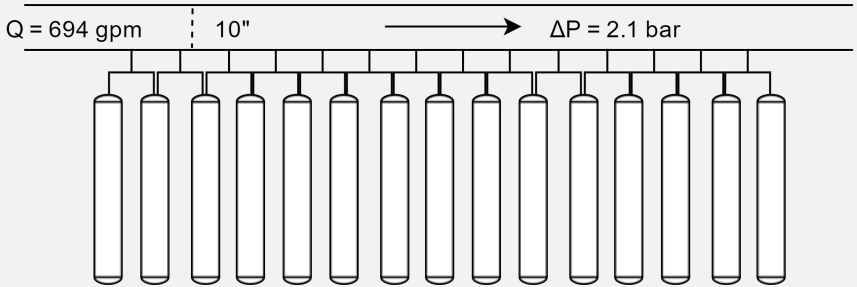





Blackstone River
Southwest Cutoff
(Route 20)
Southwest Cutoff

Ultrafiltration Unit

DOW IntegraFlux SFP-2880XP (or equivalent)

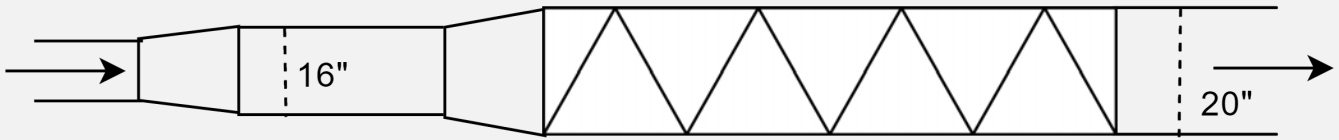


Unit Design Specifications
Filtrate Flux: 40 gallons/ft^2/day
Flow Rate per Module: 22.4 gpm
Filtration Area (per Module): 829 ft^2
Total Unit Area: 25,000 ft^2
Number of Units: 31

Unit Operating Conditions

Parameter	Typical	Maximum
Turbidity, NTU	< 50	300
TSS, mg/L	< 50	100
TOC, mg/L	< 10	40
COD, mg/L	< 20	60
Cl_2 Continuous, mg/L	0.5	200
Oil/Grease, mg/L	0	< 2
pH Continuous	6 to 9	2 to 11
Temperature, °C	25	40
Particle Size (micron)	< 150	300

Ultraviolet Disinfection

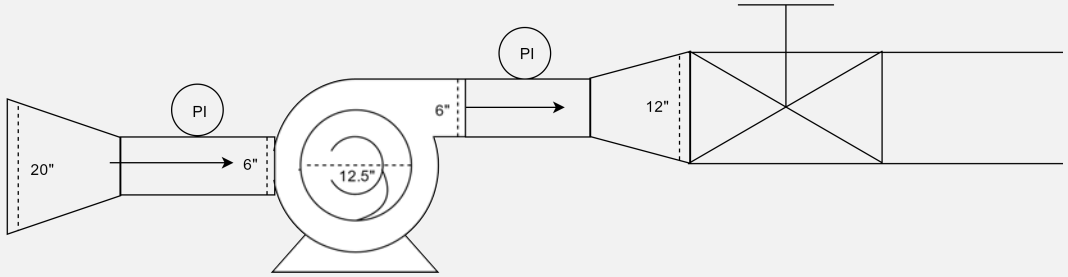


UVLW-30800-24 from Evoqua (or equivalent)

<u>Unit Design Specifications</u>
Diameter: 20 inch
Length: 10 ft
Dosage: 80 mJ/cm^2
Exposure time: 0.006 seconds
Number of Bulbs, 800 W: 30

Pumping Station

Gorman-Rupp 6”x6” stainless steel self-priming centrifugal pump (or equivalent)



<u>Unit Design Specifications</u>
Max operating pressure: 123 psi
Motor: 50 hp
Size: 6”x6”
Impeller diameter: 12.5”

Darcy-Weisbach Equation

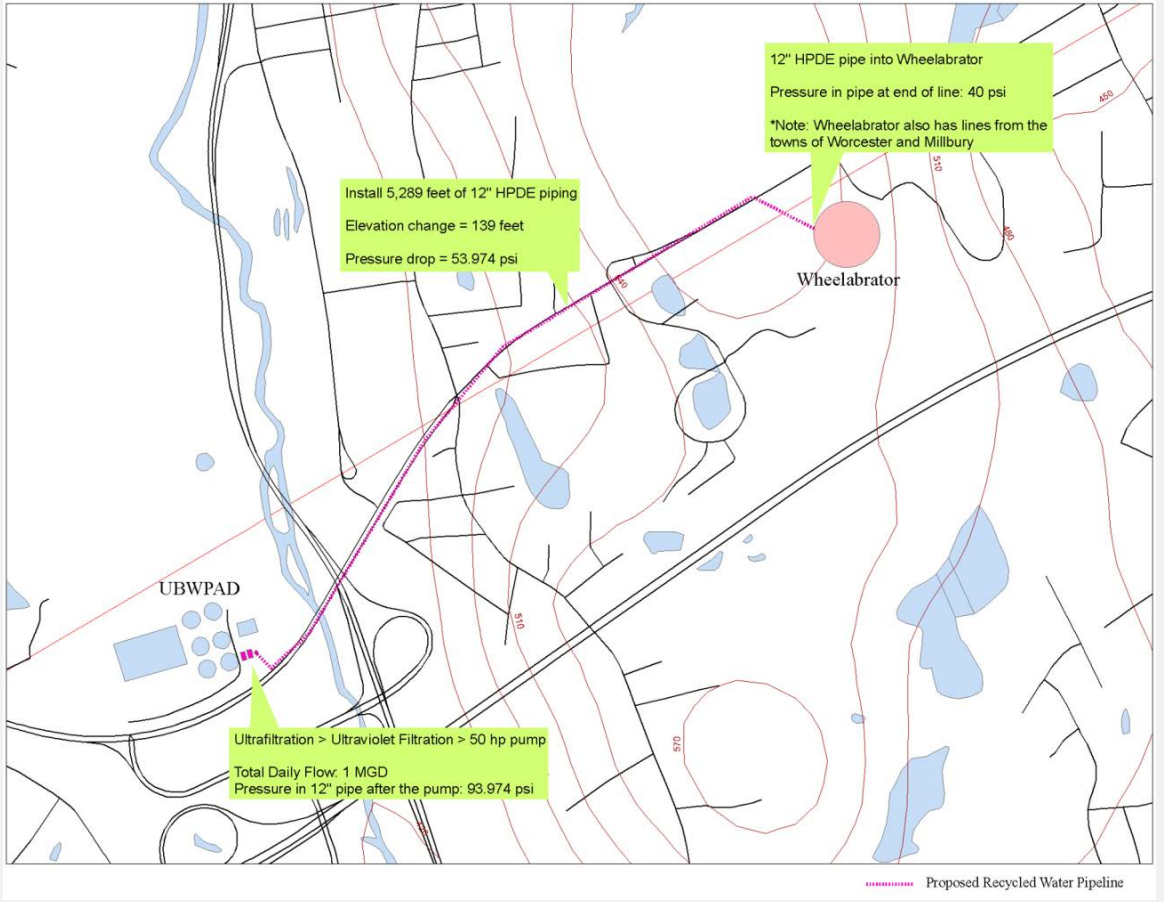
$$h_f = f\frac{Lv^2}{2Dg}$$

Pipe Route

Piping to follow US Route 20

Length: 5,289 feet

Material: HDPE

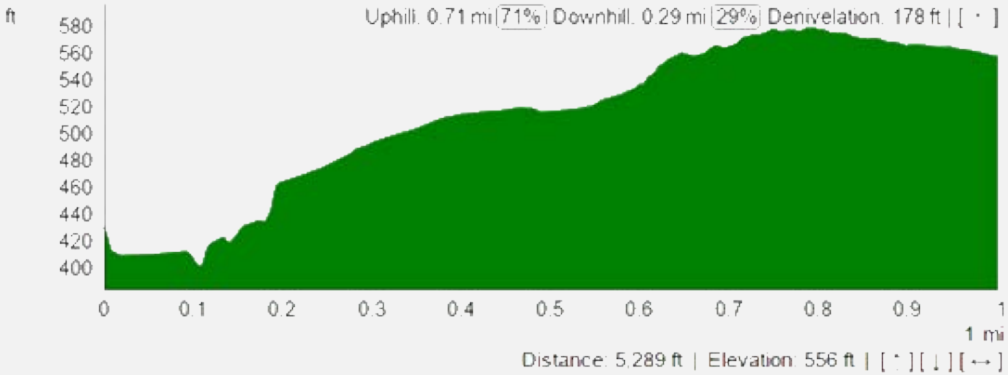


Piping

Hazen-Williams Equation

$$h_f = \frac{10.44 \times Q^{1.85} \times L}{C^{1.85} \times D^{4.87}}$$

Change in elevation: 139 feet



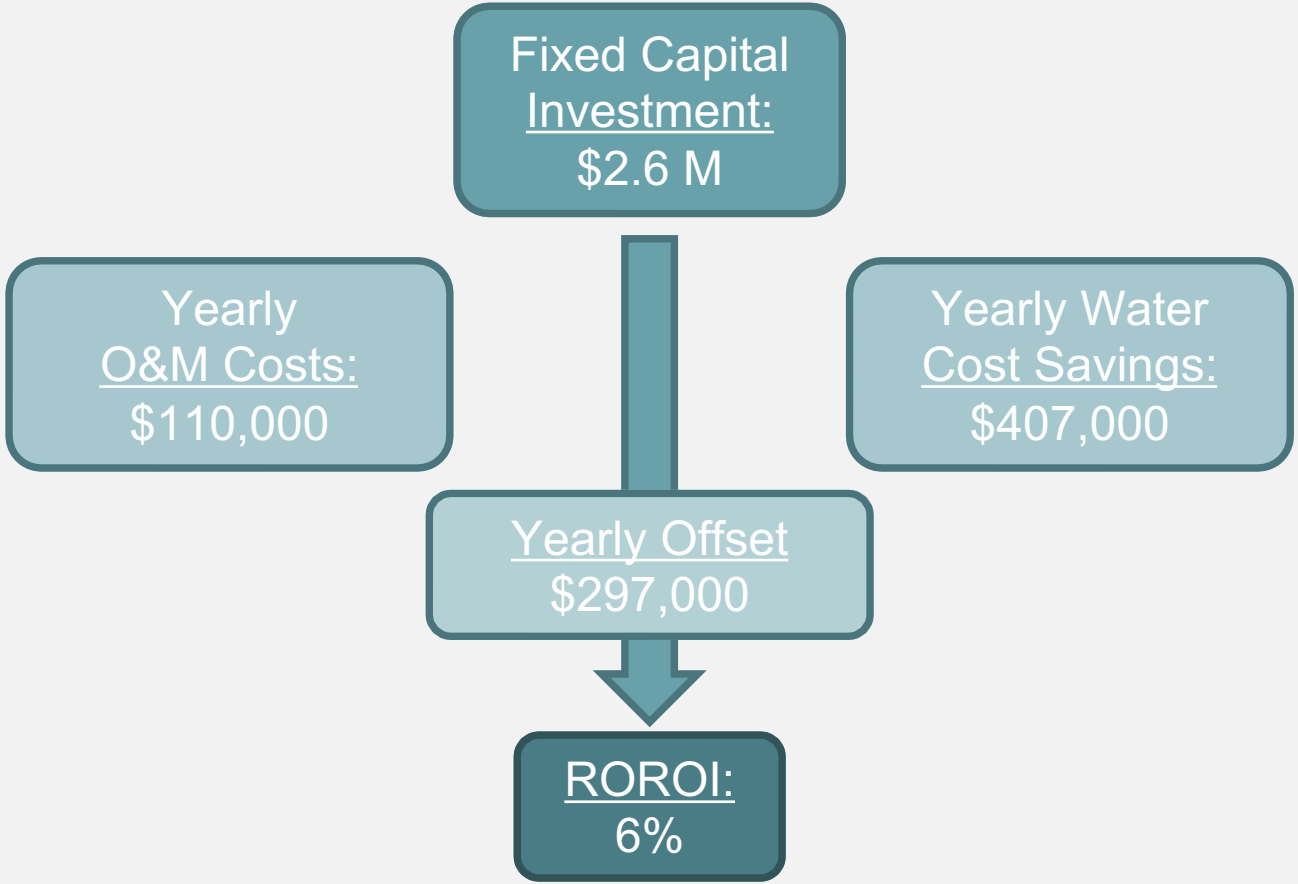
Pipe Specifications

- 12 inch diameter
- Consistent with current water mains
- Allow for future expansion up to 5 MGD

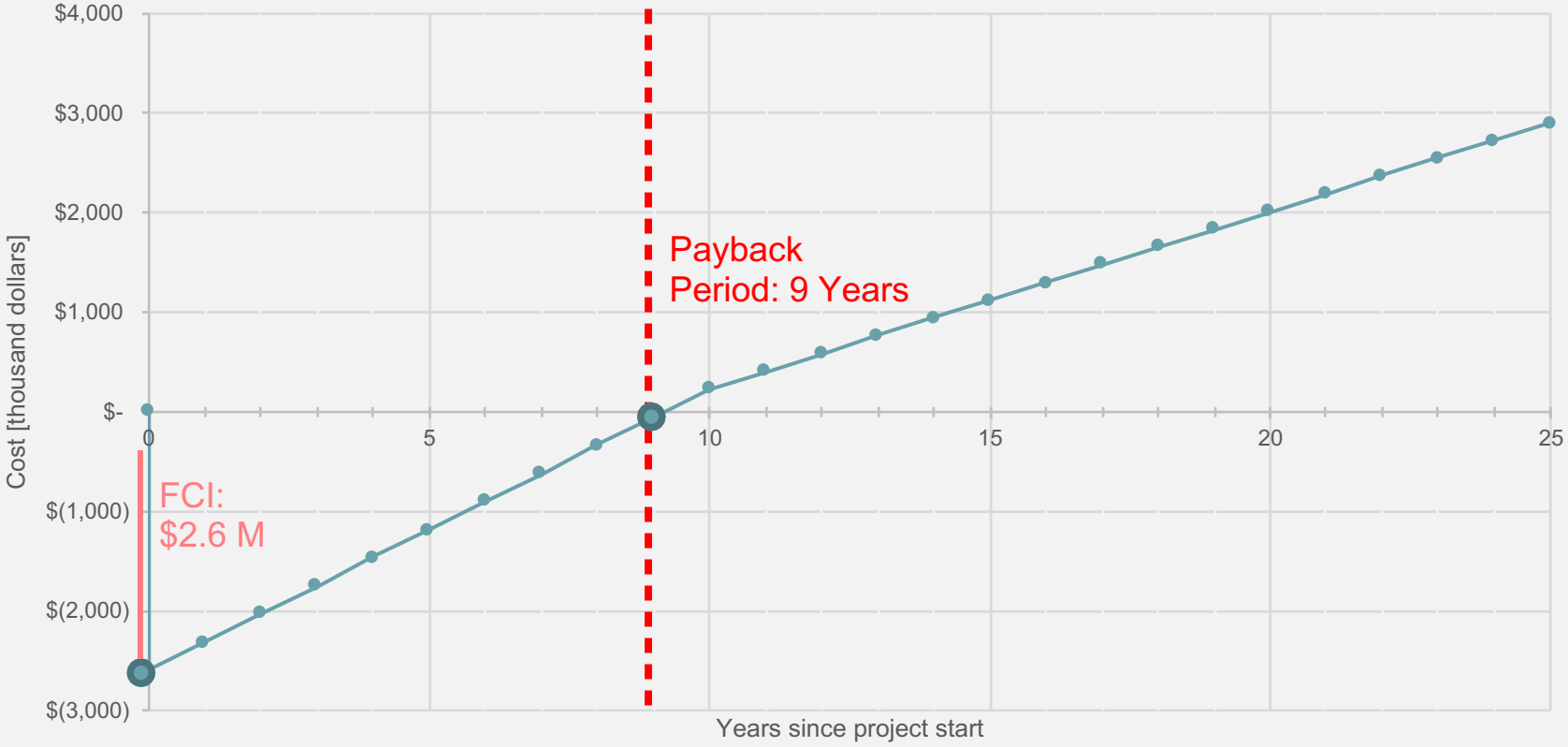
Recommendations to Ensure Water Quality

- Sampling Station(s)
  - *At both UBWPAD and Wheelabrator*
- Daily reports sent to Wheelabrator
- Wheelabrator maintains Worcester/Millbury Lines
- Sabotage Prevention
  - *Generator*
  - *Security Measures*
- File permit as soon as possible
- Apply for Federal or State grants to aid funding
- Determine payment and maintenance plans

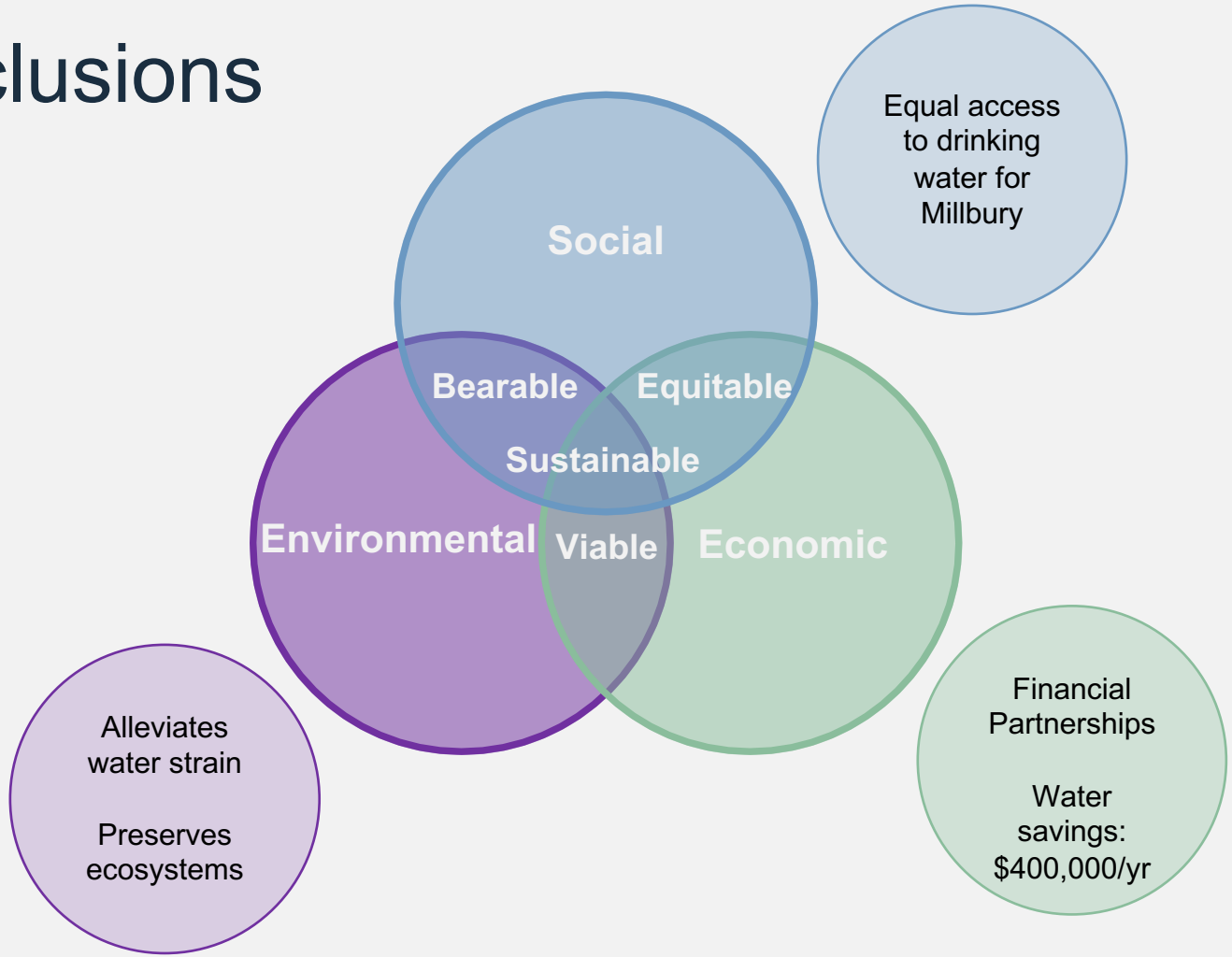
Estimated Cost Analysis



Payback Period



Conclusions



Acknowledgements

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WPI

UBWPAD

Wheelabrator
TECHNOLOGIES