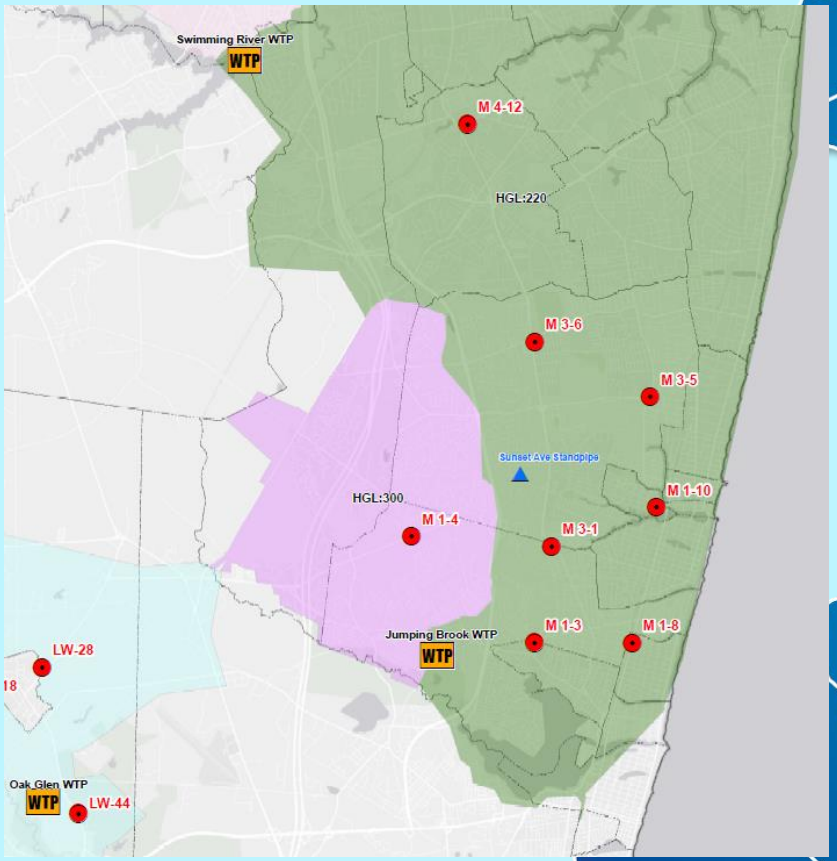
Investigation of Alternatives to Reduce DBPs at New Jersey American Water Company Jumping Brook WTP

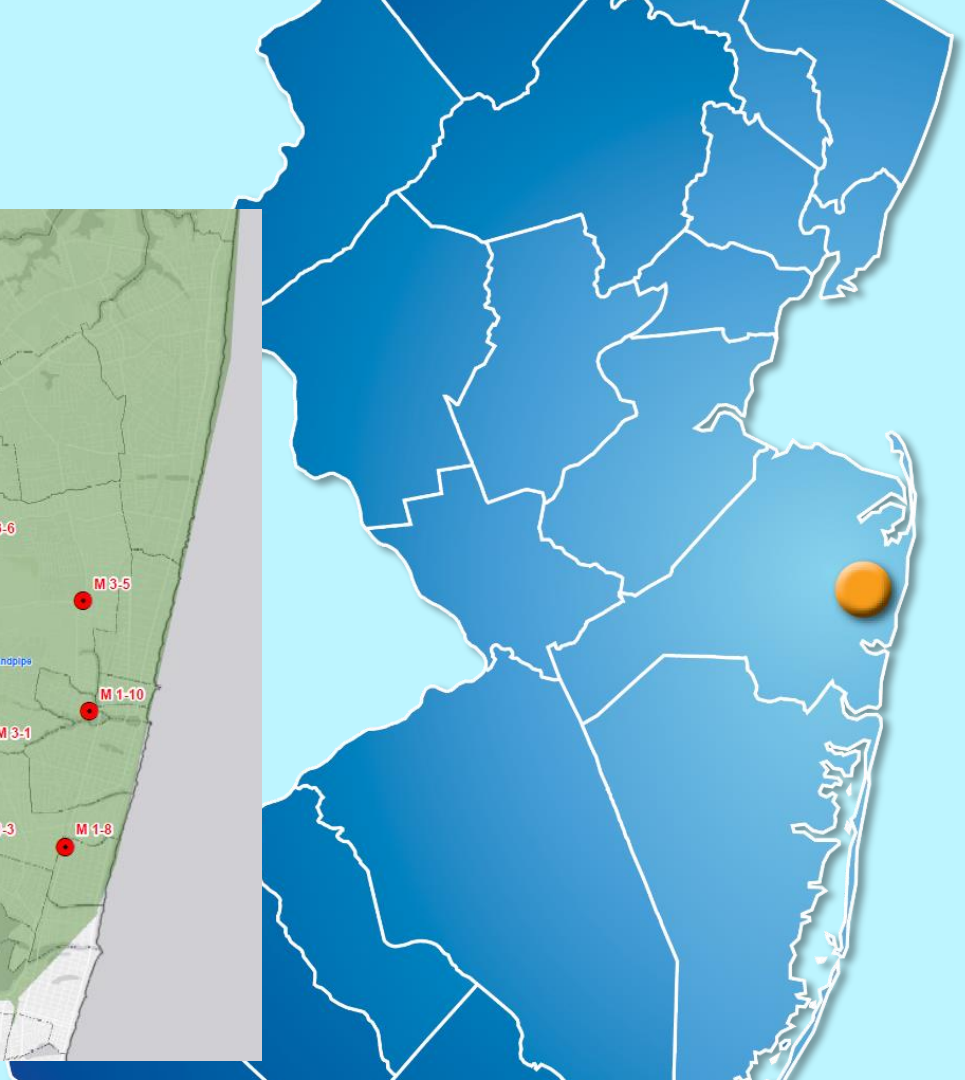
NJAWWA Webinar Series
August 4, 2020

NEW JERSEY AMERICAN WATER

Jacobs Challenging today. Reinventing tomorrow.

Jumping Brook WTP





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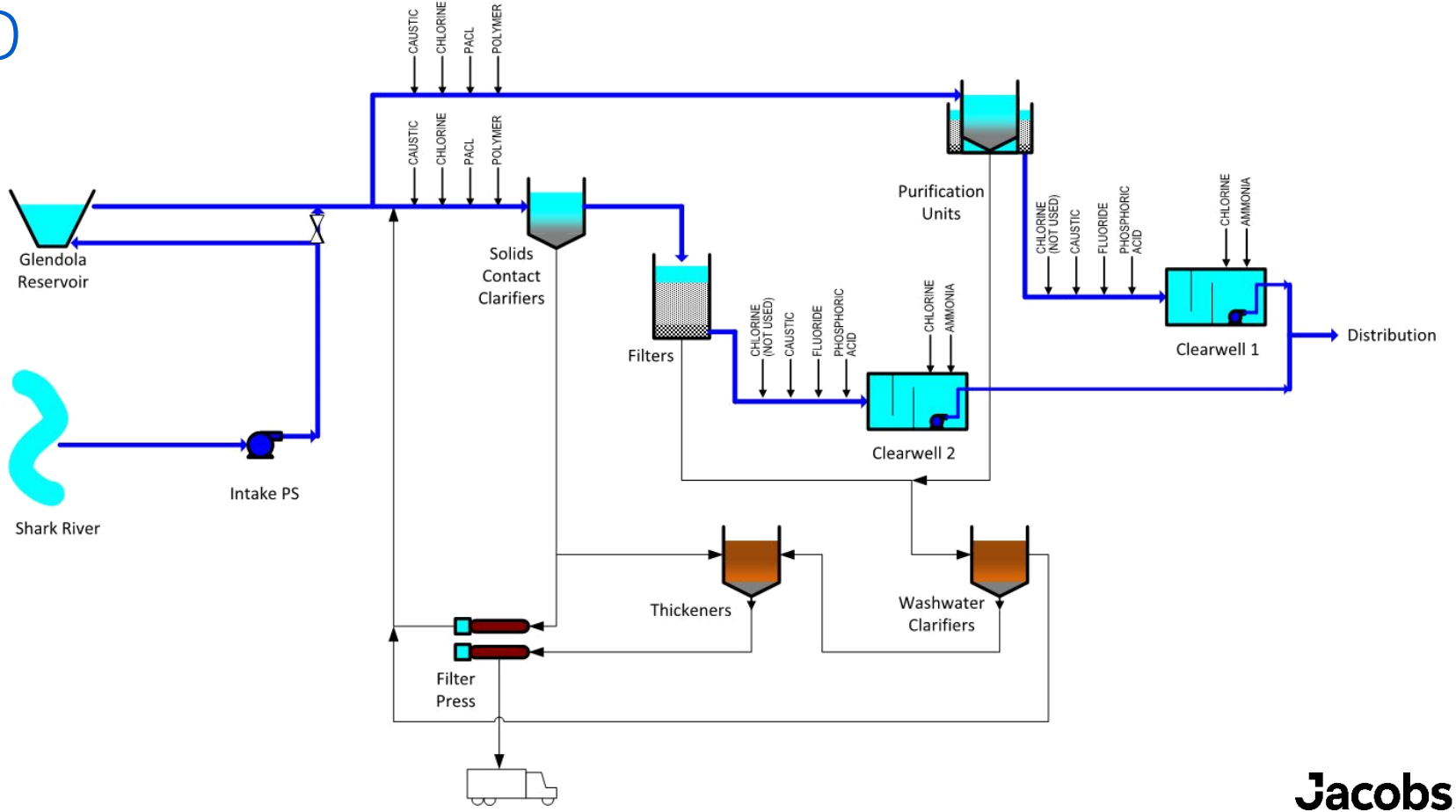
Jumping Brook PFD



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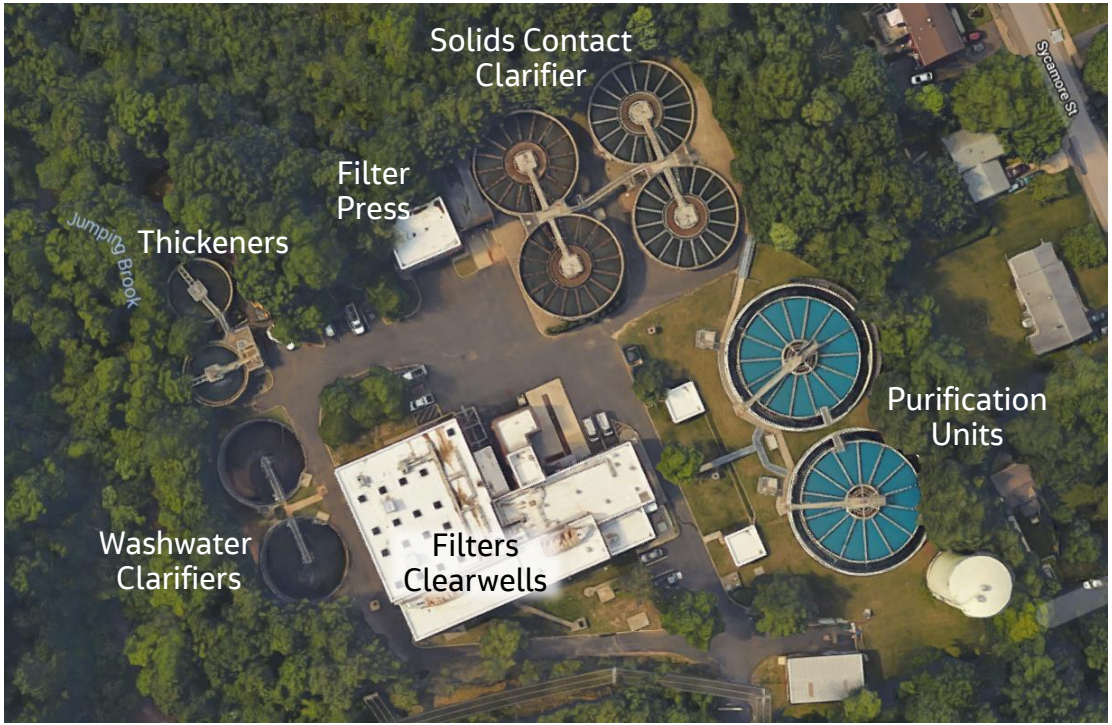
NJAWC Jumping Brook WTP



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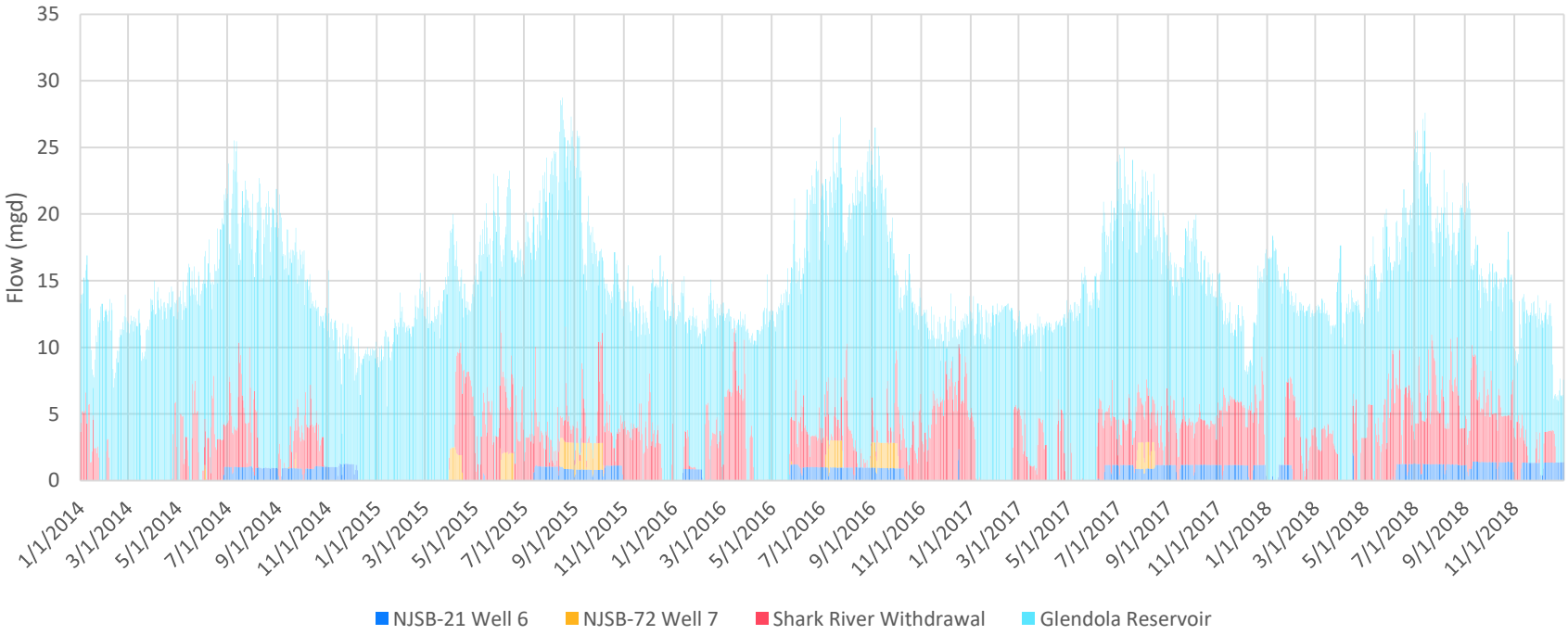
Problem Statement

- Compliance with Stage 2 D/DBP Regulation
- A change in raw water quality resulted in an exceedance of TTHMs Operational Evaluation Level (OEL) at some sites in 2018
- Short term and Long term solutions needed

Flow


35
30
25
20
15
10
5
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Flow (mgd)
1/1/2014
3/1/2014
5/1/2014
7/1/2014
9/1/2014
11/1/2014
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5/1/2015
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11/1/2018
NJSB-21 Well 6
NJSB-72 Well 7
Shark River Withdrawal
Glendola Reservoir

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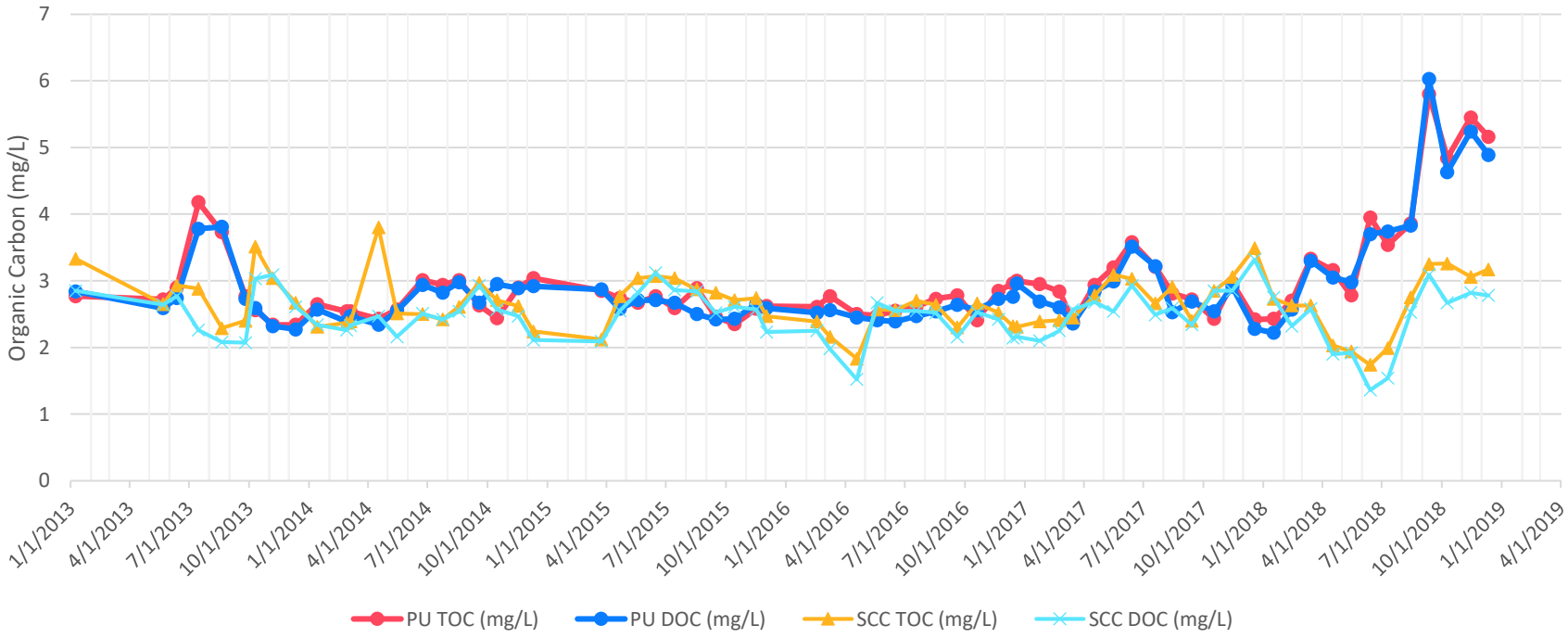
Raw TOC



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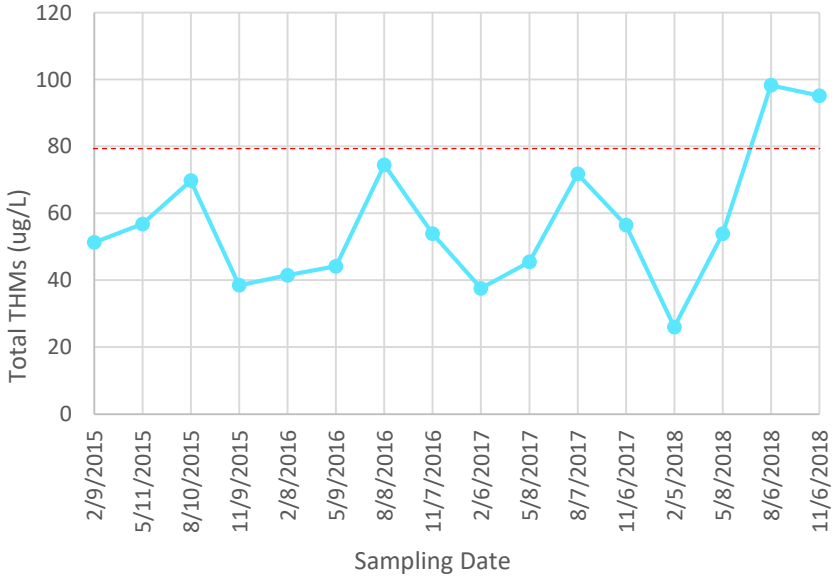
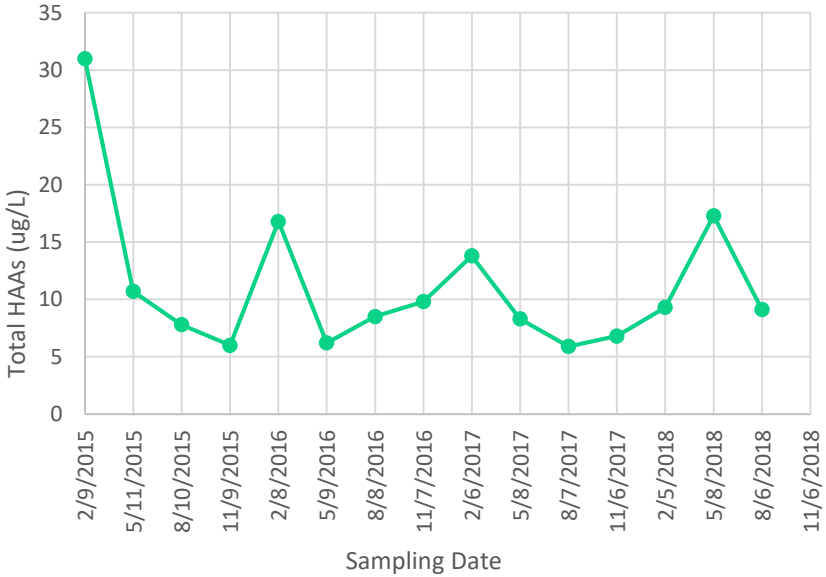
DBP – Jumping Brook Effluent

- TTHMs



- HAAs



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Project Goals

- Identify an immediate term (2 months) approach to comply with OEL
- Assess short and long term options for ongoing compliance
- Identify option for Stage 2 D/DBP compliance while maintaining primary disinfection

Project Goals

- Assess a wide range of alternatives
- Select alternative that provides the greatest value for the investment based on the project-specific goals.

A defensible, comprehensive decision model was used to evaluate and rank the options

- Constraints
  - Maintain primary disinfection ahead of filters
  - Chloramine disinfection in distribution
  - Oxidant needed for Mn

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Project Approach

- Frame the Project
- Identify Treatment Alternatives (22)
- Rate performance against goals
- Rank treatment alternatives with Weighted Criteria
- Develop Conceptual Designs and Costs (10)
- Prepare Cost/Benefit Analysis

Project executed in 7 months, with short term alternatives identified in month 3

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Developing Alternatives

Short Term Operational Changes

1 - Eliminate pre-chlorination.
Provide alternate method for primary disinfection.
Permanganate or alternate oxidant.

2 - Provide additional TOC removal and
maintain current chlorine application as oxidant and disinfectant

4 - Major physical plant/process changes

5 – Shark River treatment

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Short Term Operations

- Application of PAC to raw water at Glendola Reservoir location is ongoing
- Install GAC in dual media filters for THM adsorption
- Limit use of Shark River - install on-line TOC monitoring and analyze rainfall data could enable a more selective use of this source

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22 Options Rated

Treatment Change	Alternative	Treatment Description	Short-Term / Long-Term Alternative
1 - Eliminate pre-chlorination. Provide alternate method for primary disinfection. Permanganate or alternate oxidant.	1A	Chlorine dioxide at reservoir with pipeline contactor for oxidation/disinfection[1]	Short-Term/Long-Term
	1B	Ozone at reservoir with pipeline contactor	Long-Term
	1Ca	Pre-UV at reservoir with permanganate addition on plant raw water for oxidation. Chlorine applied to clearwell.	Long-Term
	1Cb	Post-UV downstream of clearwells with permanganate addition on plant raw water for oxidation. Chlorine applied to clearwell.	Long-Term
	1D	Permanganate at intake for oxidation. Chlorine after filters. New clearwell across the street from the plant, maintain chlorine for disinfection	Long-Term
2 - Provide additional TOC removal and maintain current chlorine application as oxidant and disinfectant	2A	Permanganate at intake for oxidation. Ferric chloride as alternate coagulant[1]	Short-Term
	2B	PAC addition at reservoir seasonally[1]	Short-Term
	2C	MIEX at reservoir	Long-Term
	2D	MF/UF and NF/RO at reservoir	Long-Term
	2E	Anion Exchange at reservoir	Long-Term
3. Plant operation changes	3A	Change GAC filter media annually[1]	Short-Term
	3B	Discontinue Shark River use	Short-Term
4 - Major physical plant/process changes	4Aa	New clarification process (e.g., DAF)/Ozone/Additional filters	Long-Term
	4Ab	New clarification process (e.g., DAF)/Chlorine Dioxide/Additional filters	Long-Term
	4Ac	Permanganate/New clarification process (e.g., DAF)/Intermediate Chlorine/Additional filters	Long-Term
	4B	Permanganate/New clarification process (e.g., DAF)/MF/UF/Chlorine	Long-Term
	4C	NF/RO downstream of existing clarification - partial stream treatment for DBP removal	Long-Term
	4D	GAC adsorbers post-filtration - partial stream treatment for DBP removal	Long-Term
5 - Provide treatment for Shark River only including feed to Glendola Reservoir[2]	5A	GAC with solids removal pretreatment (MF)	Long-Term
	5B	Ozone on Shark River to plant	Long-Term
	5C	MF/UF and NF/RO on Shark River to Glendora reservoir	Long-Term
	5D	MIEX on Shark River to Glendora reservoir	Long-Term

UV, ClO_2, ozone, new clearwell

PAC, MIEX, membranes

DAF + ozone or ClO2, Membranes, GAC adsorbers

Ozone, membranes, MIEX

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Assessment Criteria and Weighting Values

Stage 2 D/DBP Compliance Compliance	10
Ease of Operation	7
Flexibility for Future Regulatory	7
Limit Residuals Production	7
Footprint	6
Hydraulic Impacts	5
Ability to Address Manganese	5

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Top Ranked Alternatives by Treatment Category

		Weighting	10	7	7	7	6	5	5	
Treatment Change	**Alternative**	**Treatment Description**	**Stage 2 D/DBP Compliance**	**Ease of Operation**	**Flexibility for Future Regulations**	**Limit Residuals Production**	**Footprint**	**Hydraulic Impacts**	**Ability to Address Manganese**	**% of Total Points**
1 - Eliminate pre-chlorination. Provide alternate method for primary disinfection. Permanganate or alternate oxidant.	1B	Ozone at reservoir with pipeline contactor	5	1	3	5	5	5	3[5]	77.9%
	1Ca	Pre-UV at reservoir with permanganate addition on plant raw water for oxidation. Chlorine applied to clearwell.	3	1	3	5	5	3	3	65.1%
	1D	*Permanganate at intake for oxidation. Chlorine after filters. New clearwell across the street from the plant, maintain chlorine for disinfection*	*1*	*3*						*42.1%*
2 - Provide additional TOC removal and maintain current chlorine application as oxidant and disinfectant	2C	MIEX at reservoir[1]	4	1						53.2%
	2D	MF/UF and NF/RO at reservoir	4[4]	1	3[4]	1	5	1	4	55.3%
4 - Major physical plant/process changes	4Aa	New clarification process (e.g., DAF)/Ozone/Additional filters	5	1	3	3	3	3	5	66.8%
	4B	Permanganate/New clarification process (e.g., DAF)/MF/UF/Chlorine	5	1	3	3	3	3	4	64.7%
5 – Shark River treatment	5B	Ozone on Shark River to plant	2[3]	1	3	5	5	3	3	60.9%
	5C	MF/UF and NF/RO on Shark River to Glendora reservoir	3	1	3	1[2]	5	1	3	48.9%
	5D	MIEX on Shark River to Glendora reservoir	3	1	1	3	5	3	1	48.9%

Ranking is completed on merits – cost comes in later

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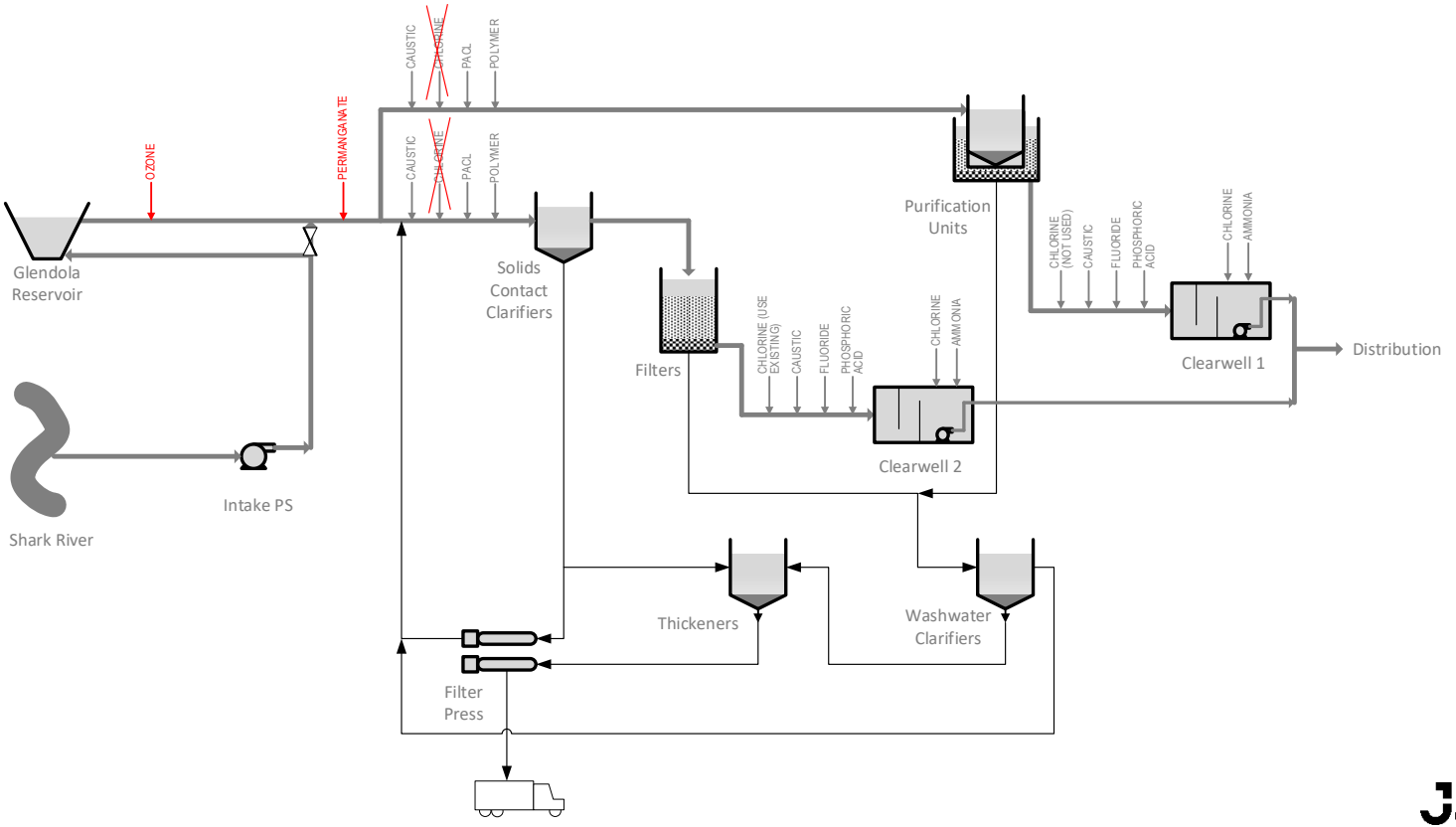
Alternative 1B: Ozone at Reservoir, Eliminate Pre-Chlorine



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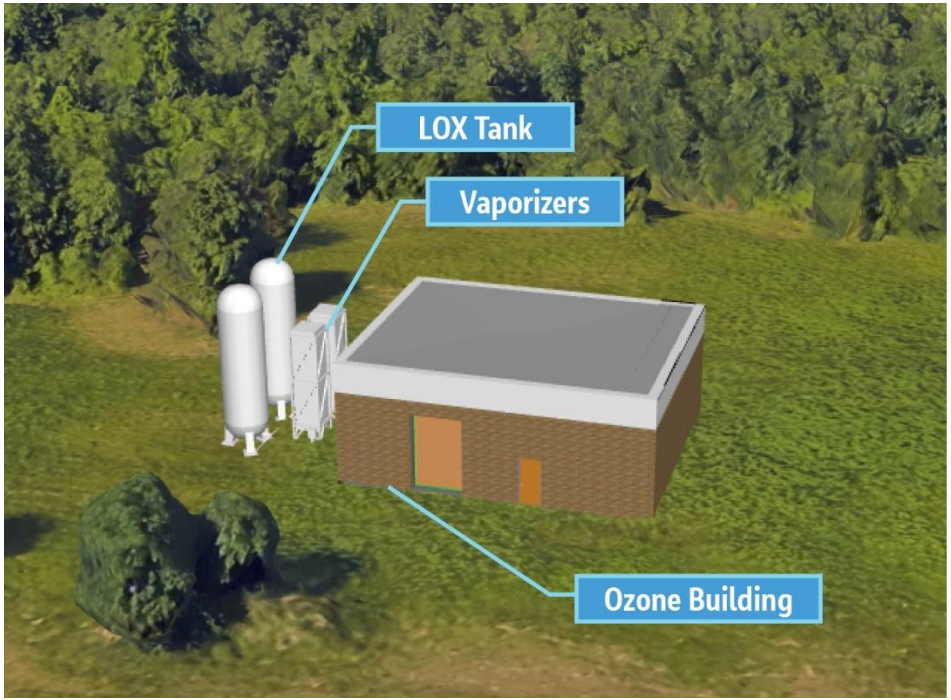
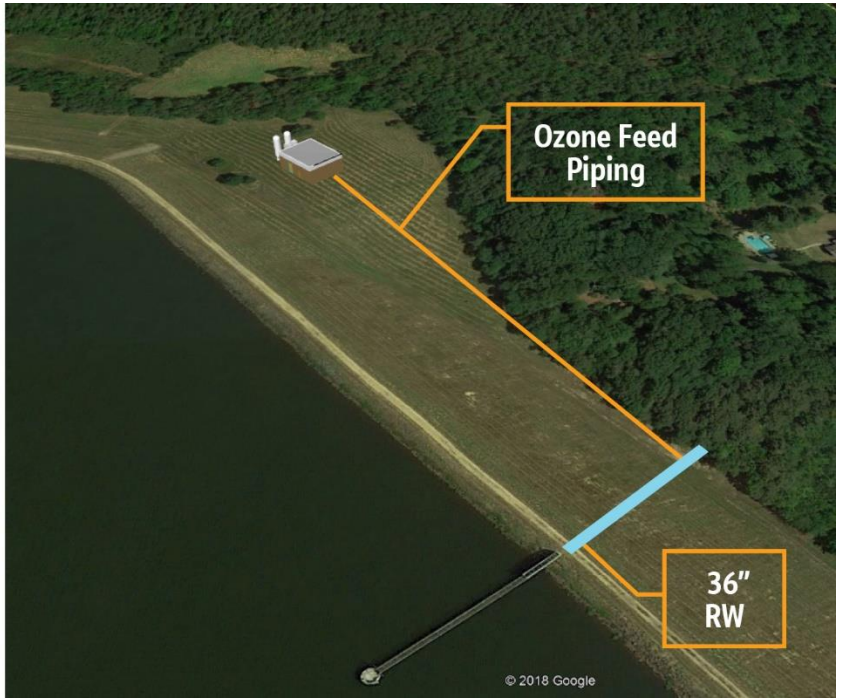
Alternative 1B: Ozone at Reservoir, Eliminate Pre-Chlorine Layout





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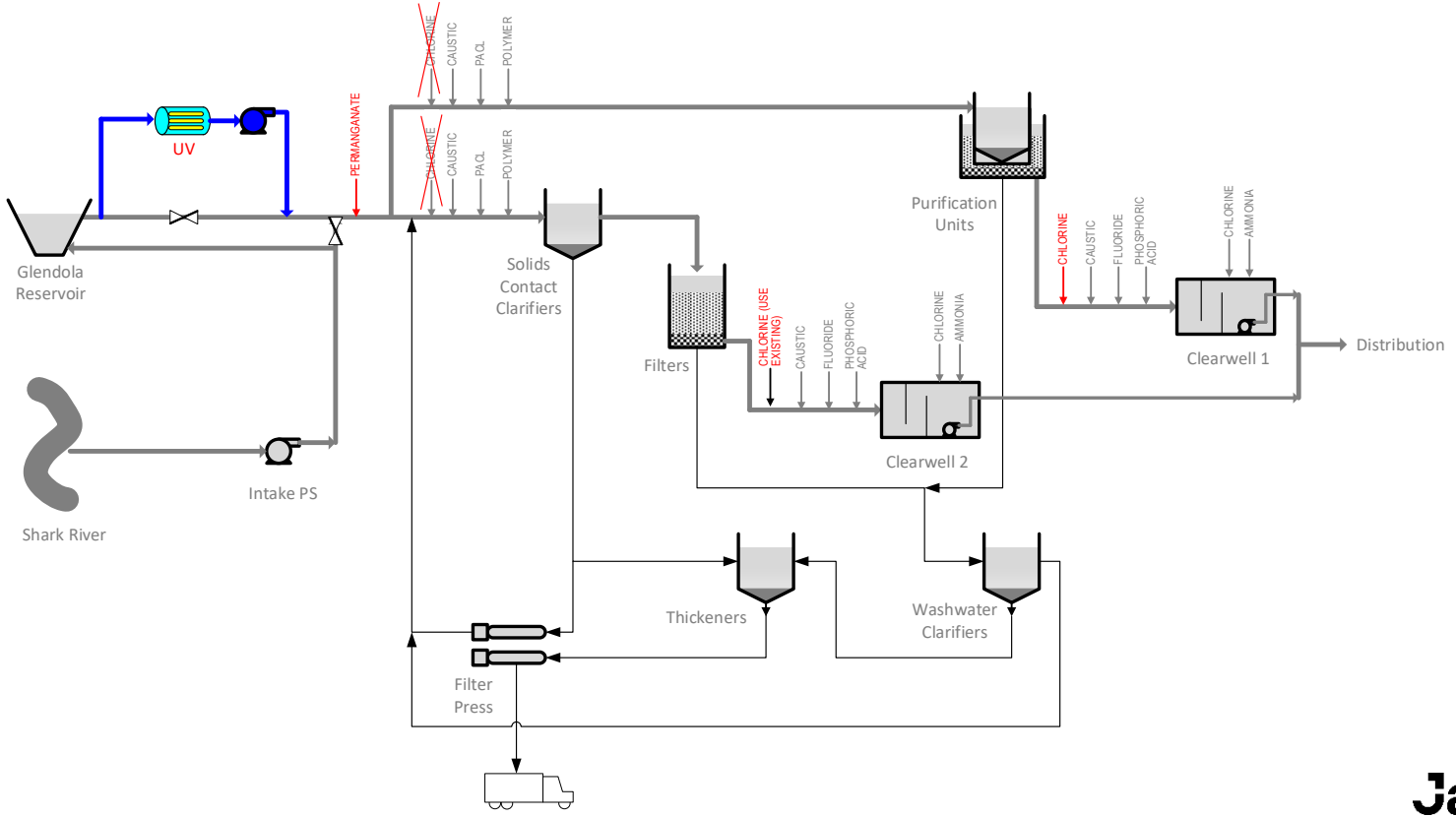
Alternative 1Ca: UV at Reservoir, Eliminate Pre-Chlorine



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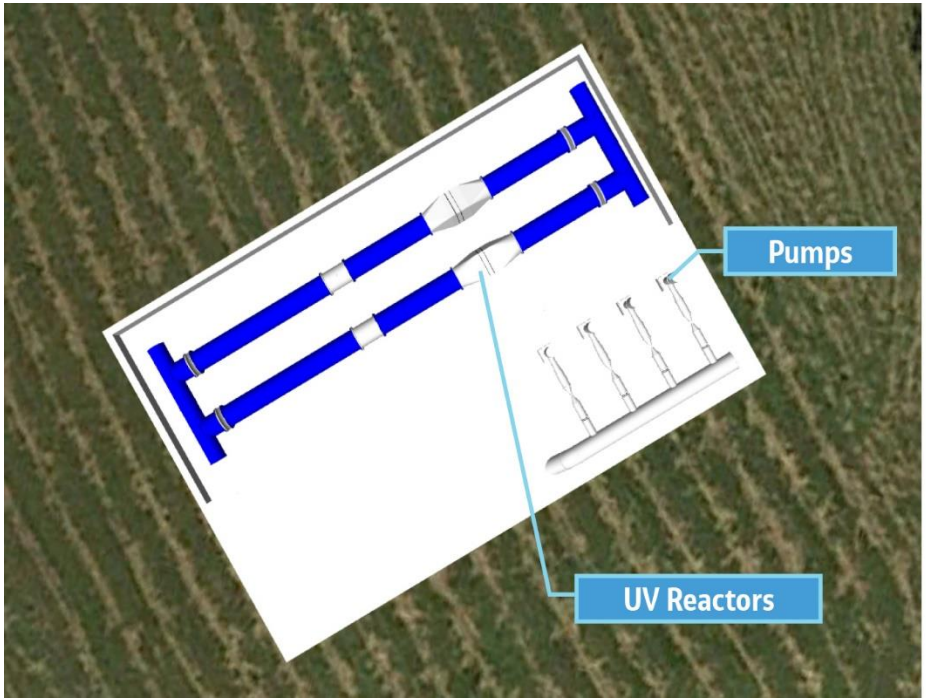
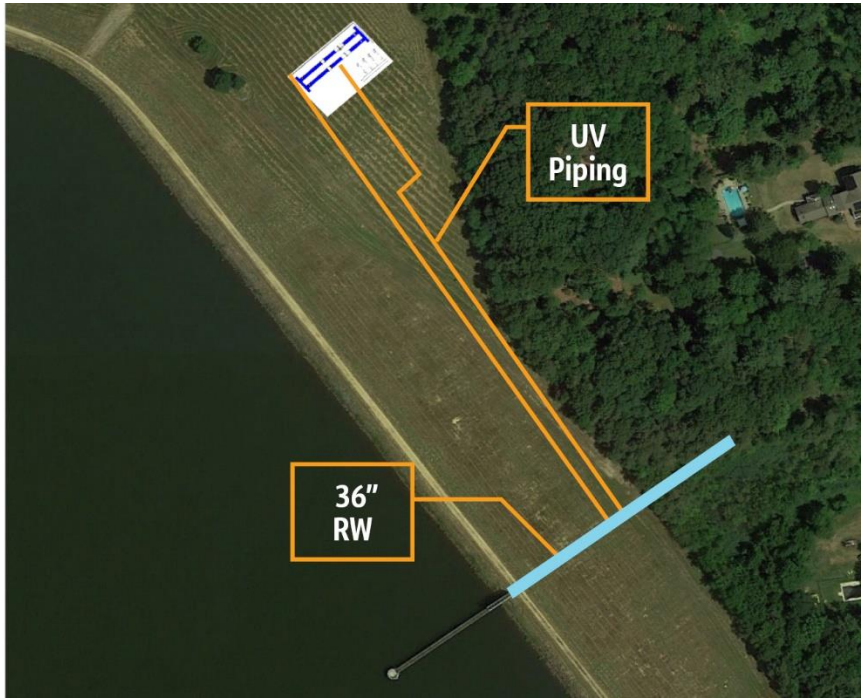
Alternative 1Ca: UV at Reservoir, Eliminate Pre-Chlorine Layout





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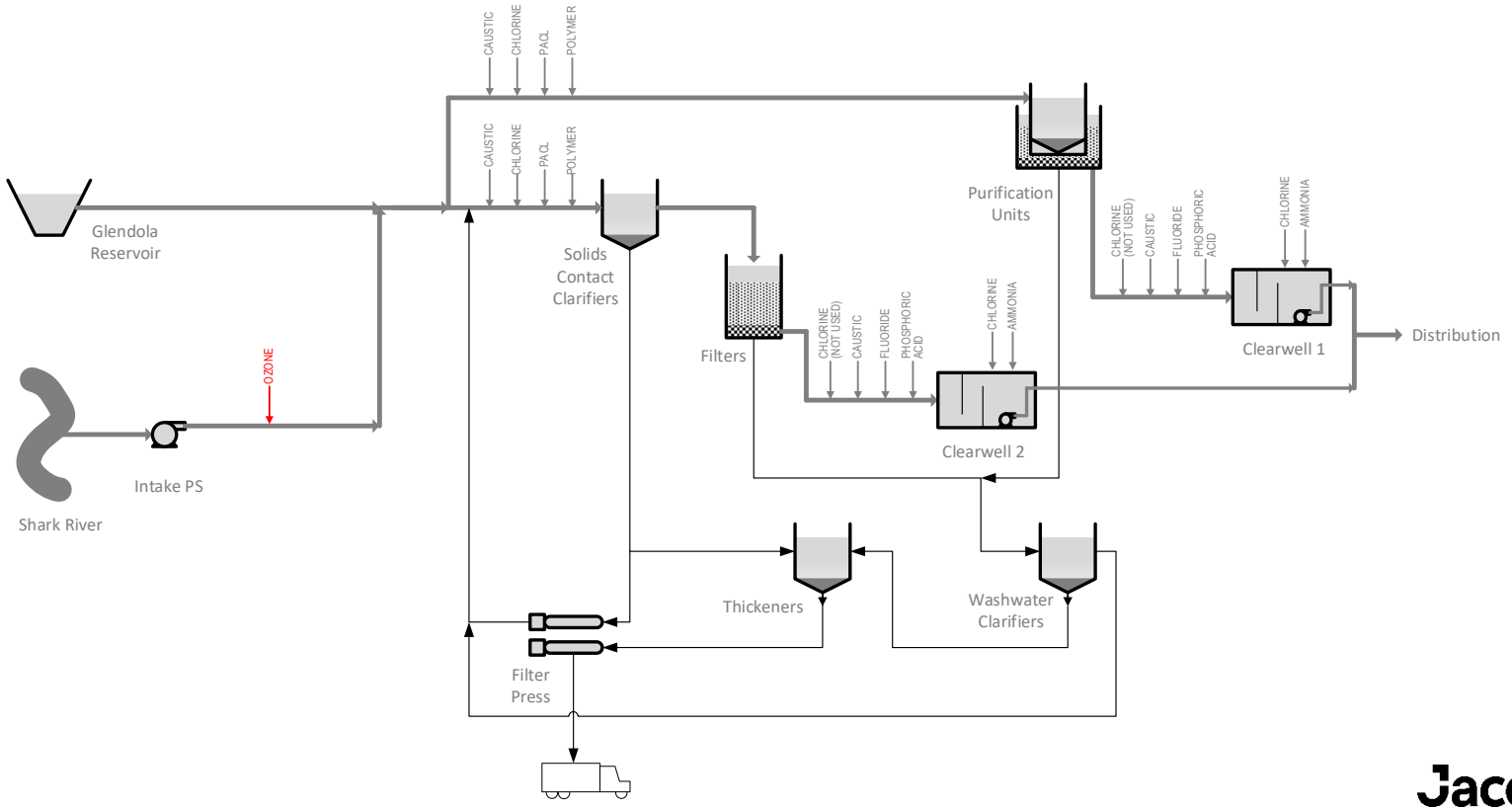
Alternative 5B: Ozone at Shark River



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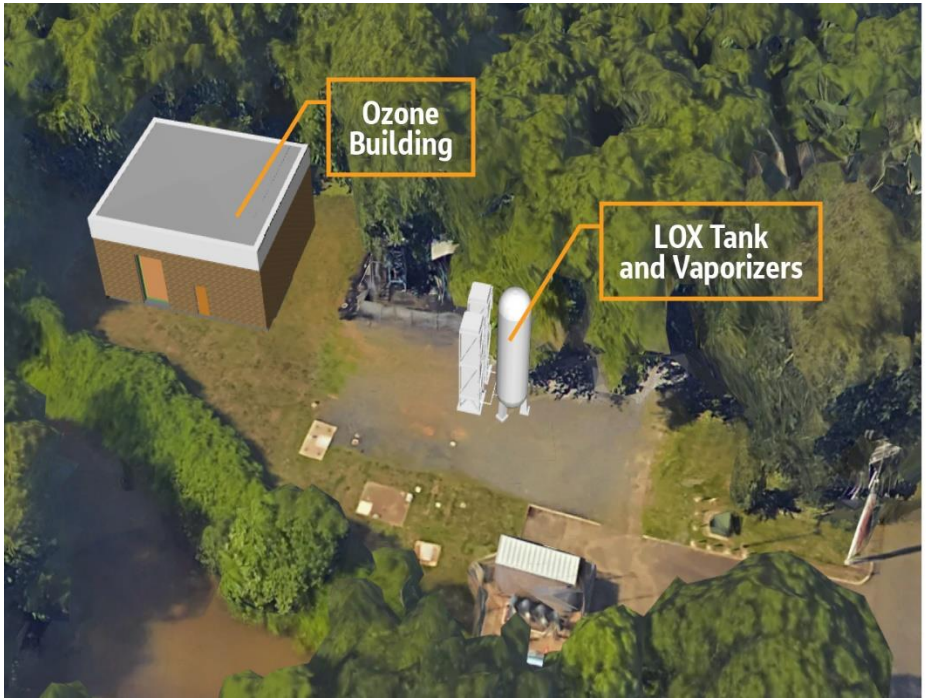
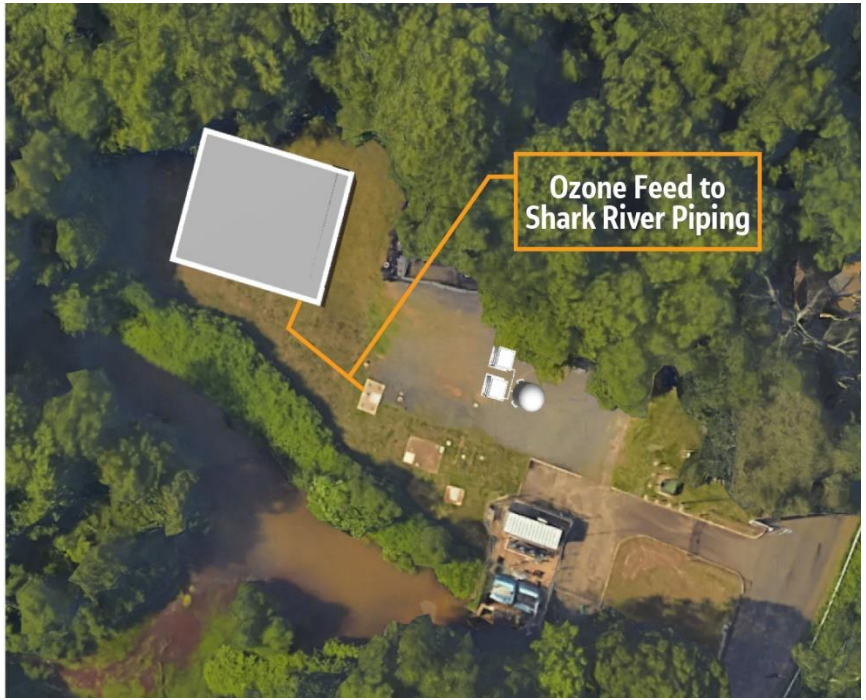
Alternative 5B: Ozone at Shark River Layout





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Comparative Cost Estimate

Treatment Change	Alternative	Treatment Description	% of Total Points	Capital Cost	O&M Cost	Net Present Value*	Benefit/Cost (Benefit/$M)
1 - Eliminate pre-chlorination. Provide alternate method for primary disinfection. Permanganate or alternate oxidant.	1B	Ozone at reservoir with pipeline contactor with permanganate addition.	77.9%	$ 22,661,847	$ 418,000	**$ 30,855,000**	**2.5**
	1Ca	Pre-UV at reservoir with permanganate addition on plant raw water for oxidation. Chlorine applied to clearwell.	65.1%	$ 13,266,630	$ 143,000	**$ 16,069,000**	**4.1**
	1D	Permanganate at intake for oxidation. Chlorine after filters. New clearwell across the street from the plant, maintain chlorine for disinfection	42.1%	$ 17,984,031	$ 221,000	**$ 22,316,000**	**1.9**
2 - Provide additional TOC removal and maintain current chlorine application as oxidant and disinfectant	2C	MIEX at reservoir	53.2%	$ 41,506,569	$ 1,439,000	**$ 69,712,000**	**0.8**
	2D	MF/UF and NF/RO at reservoir	55.3%	$ 95,103,528	$ 5,144,000	**$ 195,928,000**	**0.3**
4 - Major physical plant/process changes	4Aa	New clarification process (e.g., DAF)/Ozone/Additional filters	66.8%	$ 71,759,688	$ 763,000	**$ 86,715,000**	**0.8**
	4B	Permanganate/New clarification process (e.g., DAF)/MF/UF/Chlorine	64.7%	$ 83,991,453	$ 2,715,000	**$ 137,207,000**	**0.5**
5 – Shark River treatment	5B	Ozone on Shark River to plant	60.9%	$ 17,391,387	$ 253,000	**$ 22,350,000**	**2.7**
	5D	MIEX on Shark River to Glendora reservoir	48.9%	$ 20,318,415	$ 473,000	**$ 29,589,000**	**1.7**

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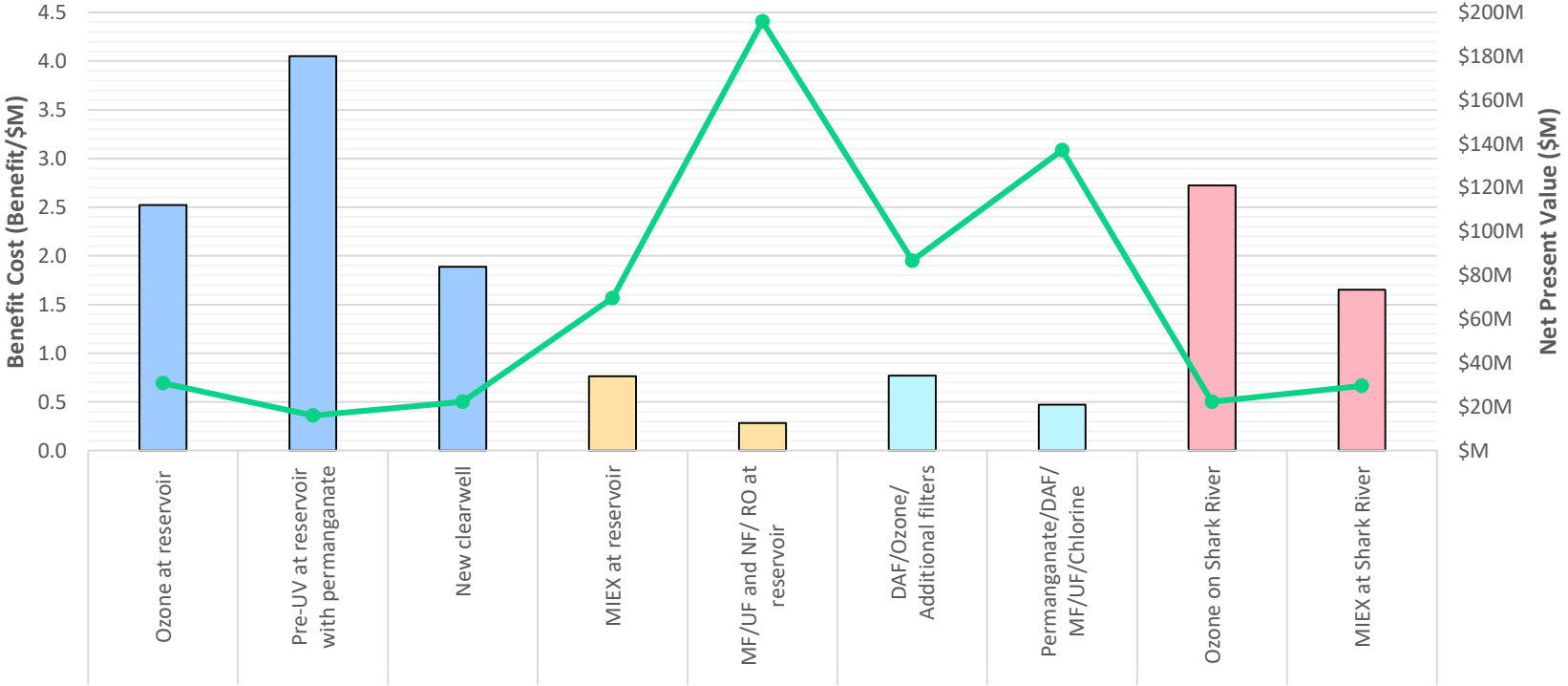
Benefit/Cost Analysis



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Next Steps

- TOC analyzer is in place on Shark River
- PAC continues to be fed at the source
- The findings for long-term treatment options are being used by NJAW in long term master planning for their Coastal North Water System.

Questions

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Thank you!

Linda Wancho

Linda.Wancho@Jacobs.com
862.242.7080

Chris Olson

Christopher.Olson@amwater.com
856.955.4887

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