



# The Industrial User and POTW Relationship: Working Collaboratively Towards Permitting A New Pharmaceutical Discharge

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Jocelyn Russell

January 26, 2022

# Agenda



- Project Background



- Treatability Testing



- Biological Bench Testing



- Permitting Pharmaceutical Discharge

# Background

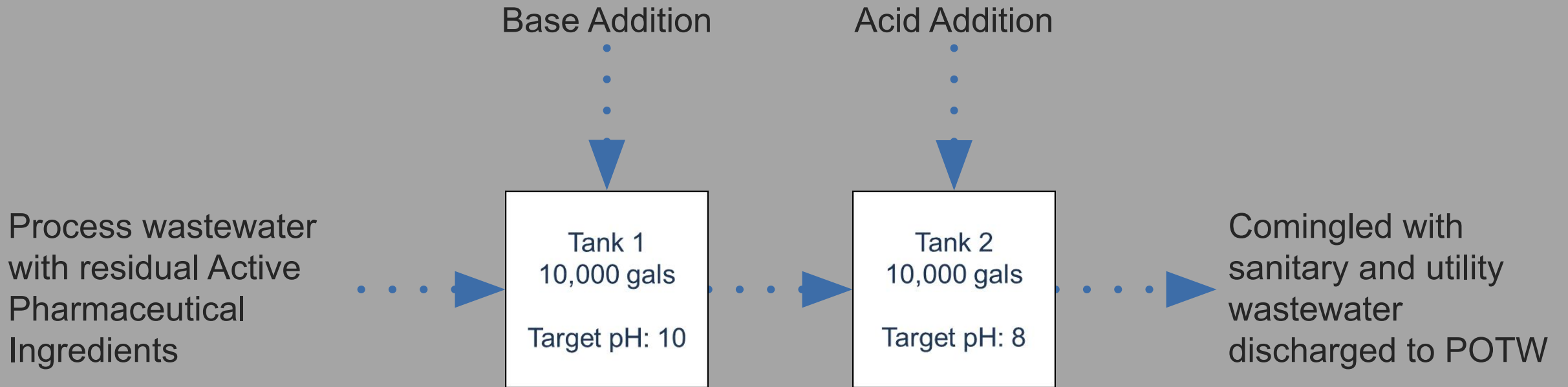


Pharmaceutical manufacturer (The Client) was preparing to manufacture a new medication.

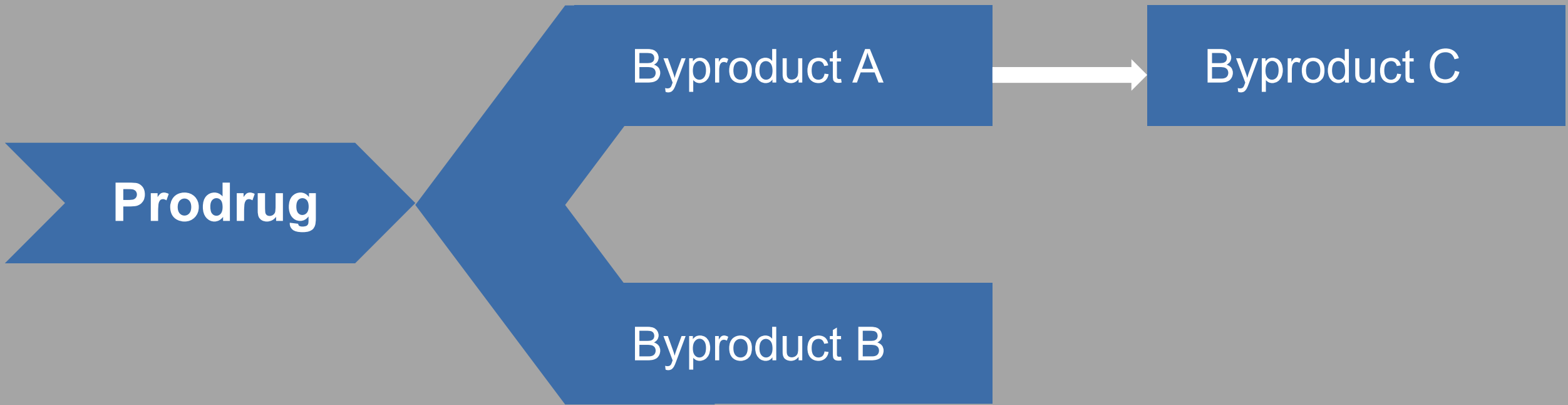


Minimal mass of the residual prodrug to be discharged into process wastewater from equipment rinsing.

# Existing Pretreatment System



# Prodrug Hydrolytic Pathway



# Overall Project Objectives



- Can the Client's existing pretreatment system be used for pretreatment of the prodrug prior to discharging wastewater to the POTW?
- Will the prodrug or degradation byproducts inhibit nitrification or impact the POTW's whole effluent toxicity?



# Project Process







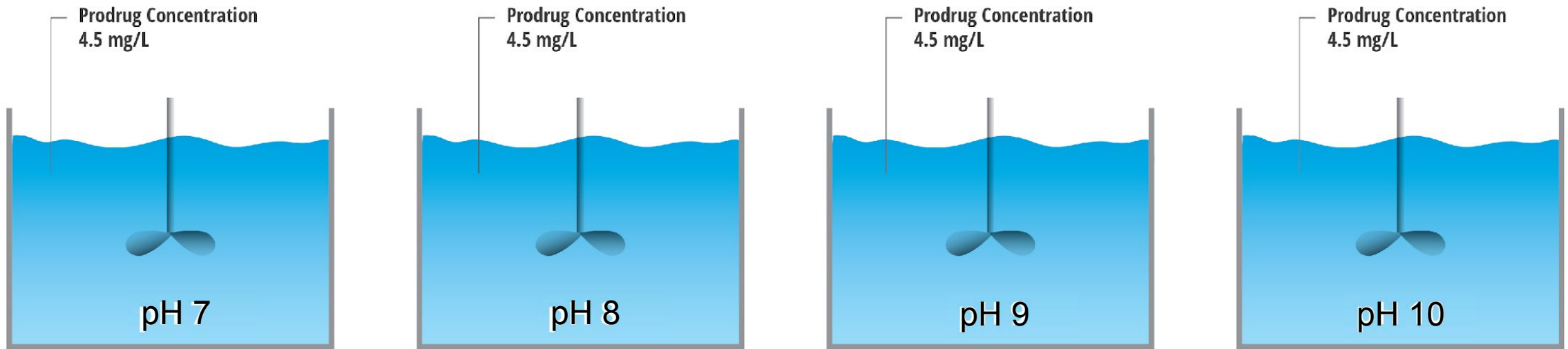
# Treatability Testing Objectives

- Will the Client's existing pretreatment system be capable of treating the new prodrug via hydrolysis?
- What will the concentrations of the prodrug and byproducts leaving the pretreatment system be?





# Treatability Testing Protocol



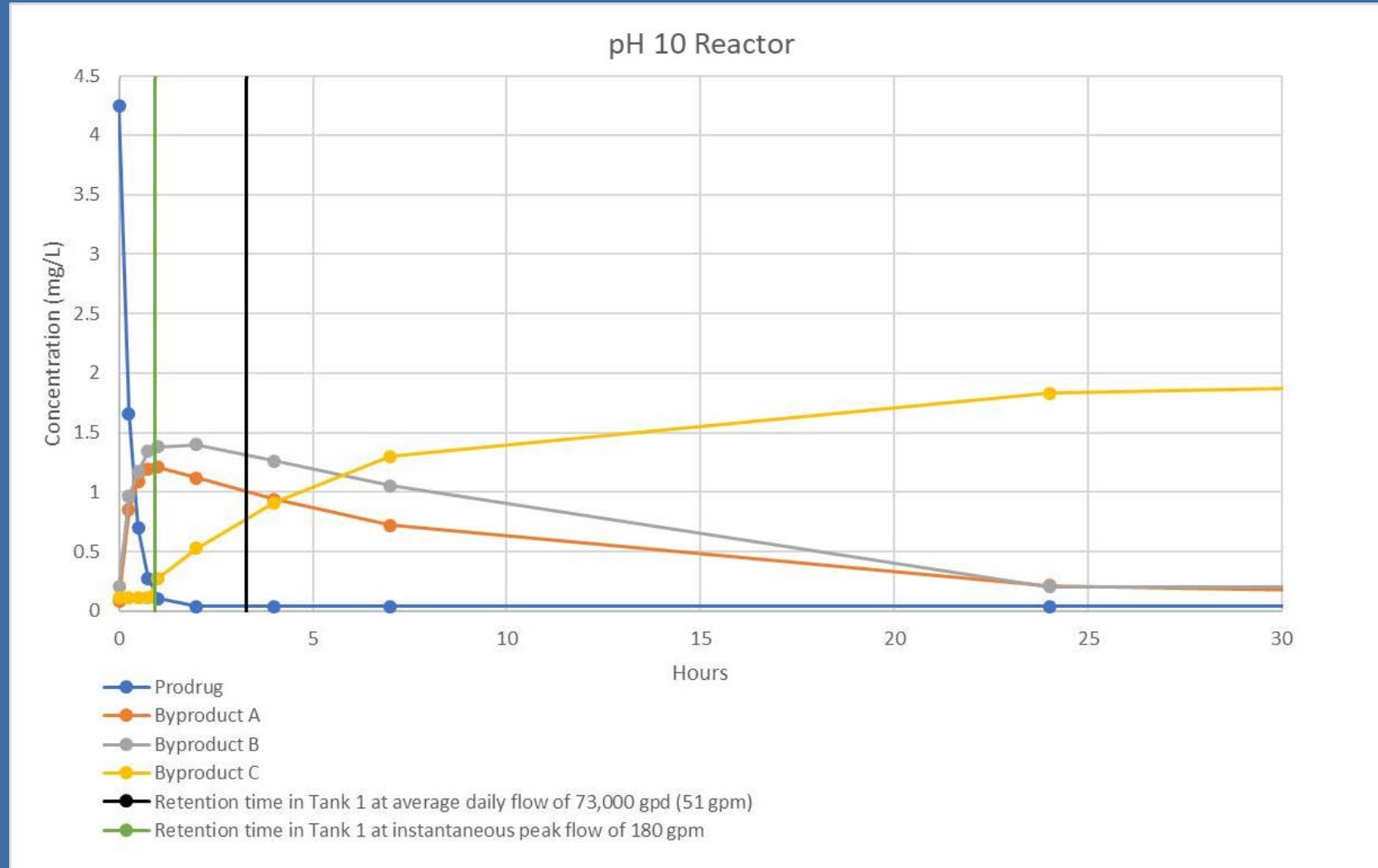
Sample at 10 time intervals:  
15 minutes - 72 hours



Analyze samples for Prodrug and Byproducts



# Treatability Testing Results





# Treatability Testing Results

- Prodrug degradation proceeds quickly at pH 10,
- Safety factor of 2 over projected Prodrug discharge rates.
- Prodrug and byproducts will continue to degrade in Tank 2 when the pH is reduced to approximately pH 8

Projected Effluent Concentrations from Pretreatment System

Flow Condition	Prodrug (mg/L)	Byproduct A (mg/L)	Byproduct B (mg/L)	Byproduct C (mg/L)
Peak Instantaneous Flow Rate	0.1	1.2	1.4	0.35
Average Flow Rate	<0.0761	1.0	1.3	0.75

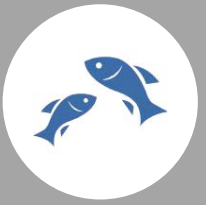
# Biological Bench Testing Objectives



- Will discharge of residual concentrations of the prodrug and its' byproducts inhibit nitrification at the POTW?
- Will discharge of residual concentrations of the prodrug and its' byproducts impact the POTW 's whole effluent toxicity?
- Does removal of the prodrug and its byproducts occur in the POTW?



# Biological Testing Conditions



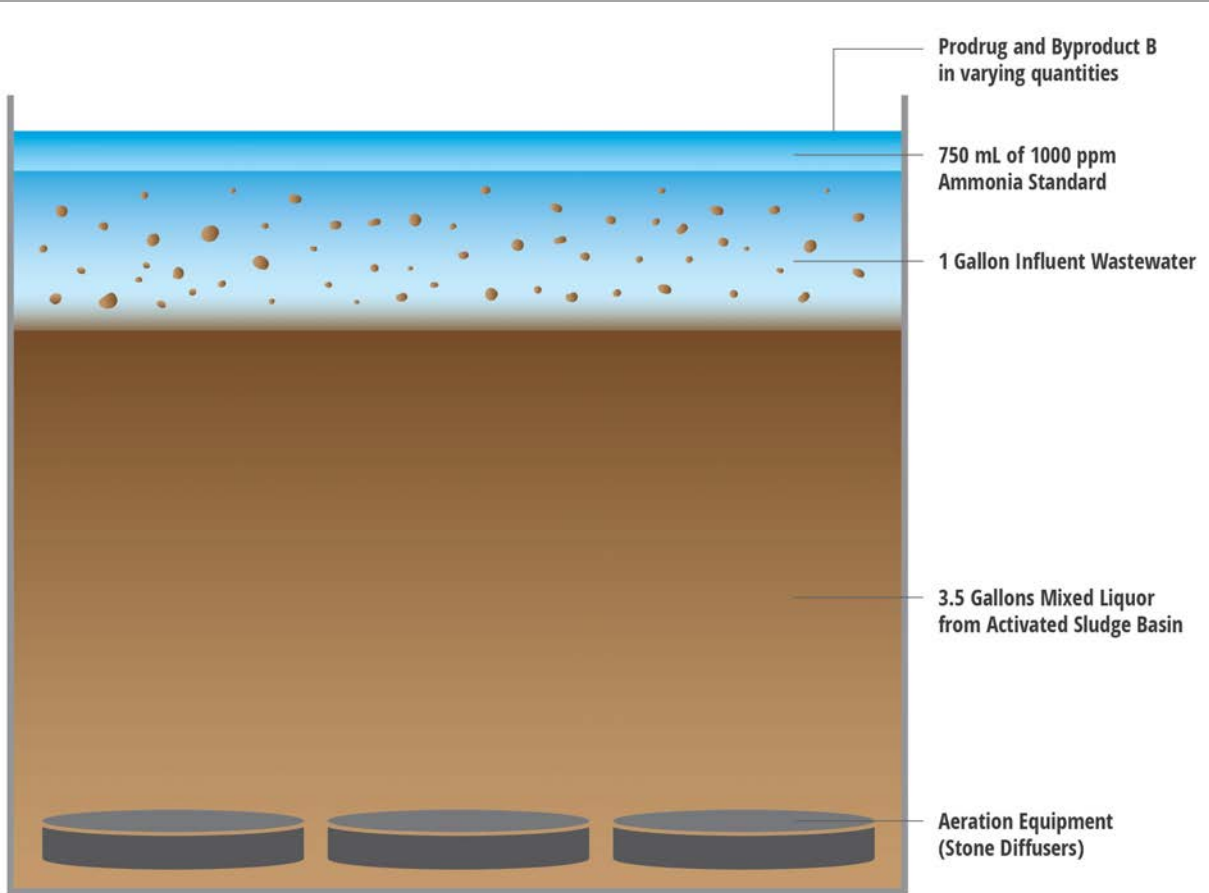
Control Reactors

Condition 1 Reactors

Condition 2 Reactors

Condition 3 Reactors

# Biological Testing Conditions



## Prodrug and Byproduct B Concentrations simulated in POTW WWTP Influent

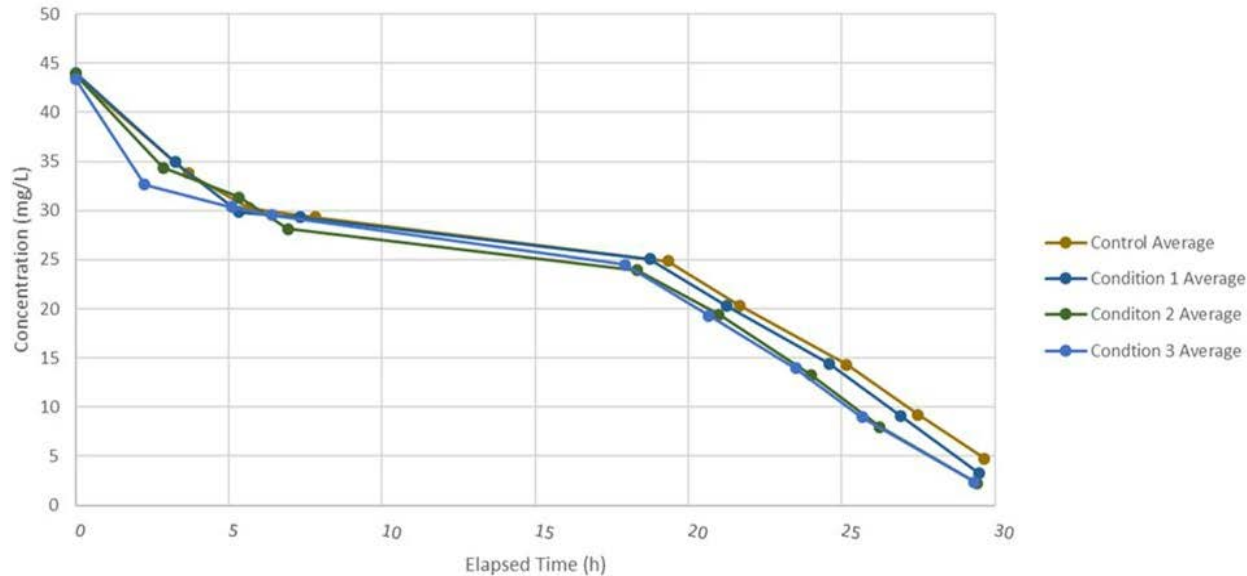
Test Condition	Prodrug (ug/L)	Byproduct B (ug/L)
1-Peak flow through manufacturer's pretreatment system	1.0	14.4
2- No pretreatment, Discharge of wastewater directly to sewer	42.6	0.0
3-Concentrations 2.5x's the laboratory MDL	200	1,000



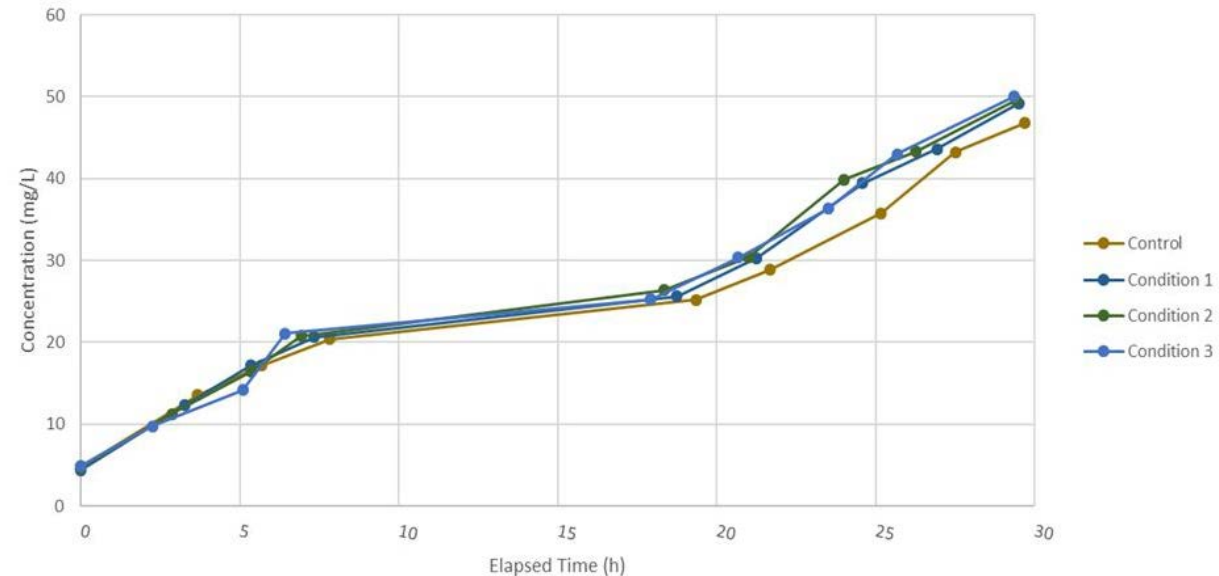
# Biological Bench Testing Results



## Mean Ammonia-Nitrogen Concentration



## Mean Oxidized Nitrogen Concentration



Impact on nitrification is evaluated by comparing the rate at which Ammonia-Nitrogen was converted to nitrate & nitrite in the control and test condition reactors.  
(Oxidized Nitrogen Generation Rate)



# Biological Bench Testing Results



- Results indicate the Prodrug and Byproduct B at the concentrations tested do not inhibit nitrification.

Statistical Evaluation of Mean Oxidized Nitrogen Generation Rate				
Approximate Hour Range	Mean Oxidized Nitrogen Generation Rate ( $\mu\text{g}/\text{h}/\text{mg}$ biomass)			
	Control	Condition 1	Condition 2	Condition 3
0 to 7.1 hours	0.96	0.94	0.91	0.95
18.6 to 29.5 hours	0.87	0.89	0.86	0.96

- Calculations were normalized to mass of biomass.
- **Condition 1** and **Condition 2** were not statistically different than the control reactors.

# Whole Effluent Toxicity



- **Condition 1** and **Condition 2** passed for both *Ceriodaphnia dubia* (water flea) and the *Pimephales promelas* (fathead minnow)
- The water flea WET test for **Condition 3** failed based on reproduction



# Percent Removal of Prodrug and Byproduct B



- Percent removal could not be determined
- Prodrug adsorbed to solids
- Matrix interferences



# Conclusions and Permitting



The Client's existing pretreatment system successfully degrades the prodrug.



The Prodrug and Byproduct B do not inhibit nitrification at the POTW at the concentrations tested.



Treated effluent at the concentrations tested does not impact WET for conditions that represent actual potential discharge conditions.



A permit limit of 435 grams per day was issued based on 60% of the Maximum Allowable Headworks Loading.

# Lessons Learned



Manufacturer desired to discharge water that could be safely managed by the POTW and protect the environment.



New discharge was a concern for the POTW. POTW did not want to negatively impact the WWTP performance or the environment.



With a team of consultant, industry and POTW working collaboratively, testing was performed, and a permit was issued in approximately 13 months.