DON'T STOP ME NOW: Implementing MBR Upgrades without Interrupting Operations

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COMMITMENT & INTEGRITY DRIVE RESULTS

Agenda

- Plant Background
- Original Design Parameters
- Existing Plant Operating Conditions
- Required Upgrades
  - Effluent TDS Reduction (Completed)
  - MBR Membrane Replacement (Pending)
- Challenges of Required Upgrades

Victorville, CA IWTP Background

- **1992:** George Air Force Base closed
- Development of the Southern California Logistics Airport (SCLA) on site, including industrial park
- **2008:** Dr. Pepper Snapple, now Keurig Dr. Pepper Inc. (KDP) announce construction of $125M plant at site
- **2010:** IWTP and KDP Plant online

City of Victorville, CA IWWTP Influent Flows

- Plant influent
  - Dedicated industrial wastewater collection system
  - Sanitary wastewater collection system
  - Federal prison
- Sanitary wastewater treated by Victor Valley Wastewater Reclamation Authority (VVWRA) prior

		INFLUENT		
Flow	Units	Industrial	Sanitary	Prison
ADF	MGD	0.95	1.25	0.25
MDF	MGD	1.05	1.9	0.4
PHF	MGD	1.14	2.13	1.13
COD	mg/L	6170	500	500
TSS	mg/L	100	1000	1000
TKN	mg/L as N	<10	40	40

Engineering Report for the Production, Distribution and Use of Recycled Water, 2010

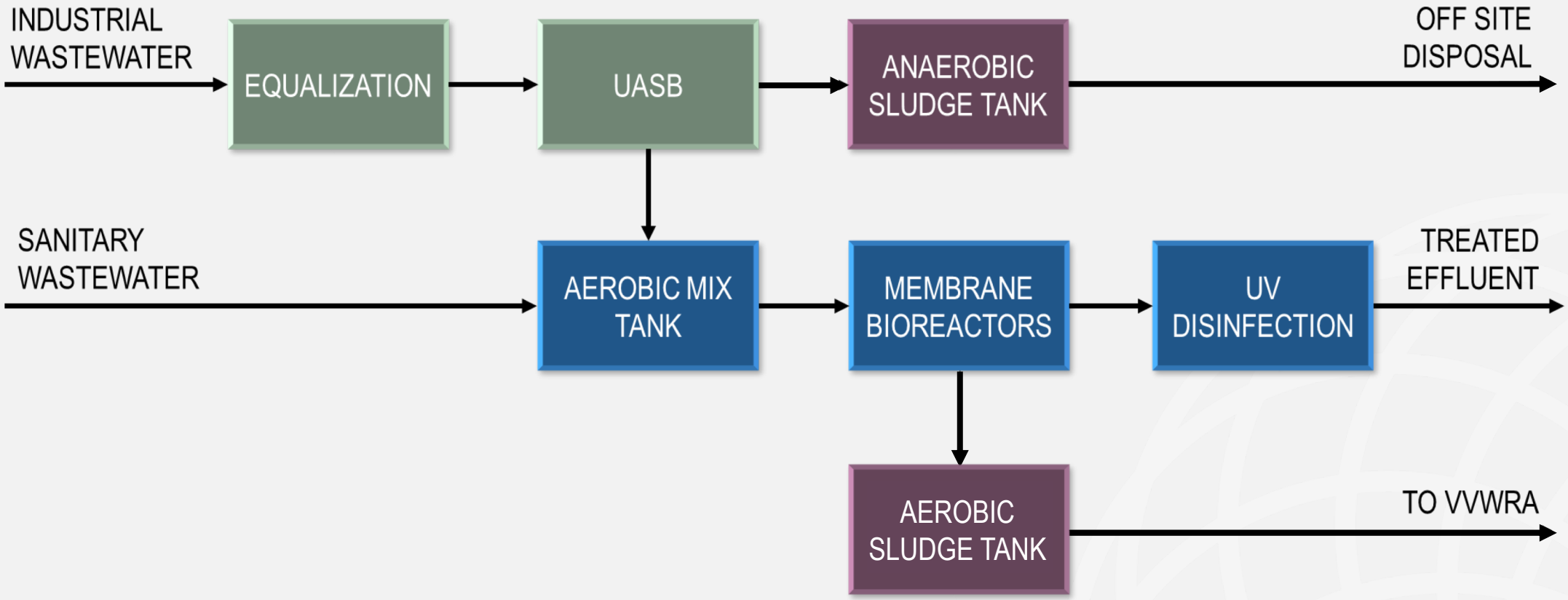
City of Victorville, CA IWWTP Effluent Criteria

- No direct discharge per original design; Plant effluent to meet CA Title 22 Water Recycling Criteria
  - Power plant cooling tower makeup water
  - Irrigation at golf course
- Change is discharge location:
  - Power plant is a peaking plant
  - Golf course closed
- Current discharge location:
  - Cooling tower makeup water (when online)
  - Percolation pond at VVWRA

EFFLUENT		
	Units	Value
pH	s.u.	6.5 to 8.0
Turbidity	NTU	< 0.2
BOD	mg/L	5
TDS	mg/L	325
Chloride	mg/L	50
Ammonia-N	mg/L	0.5
Nitrite-N	mg/L	0.2
Nitrate-N	mg/L	15
Phosphorus	mg/L	4
Total Coliform	MPN/100 mL	< 2.0

California Regional Water Quality Control Board Lahontan Region Board Order No. R6V-2010-0023

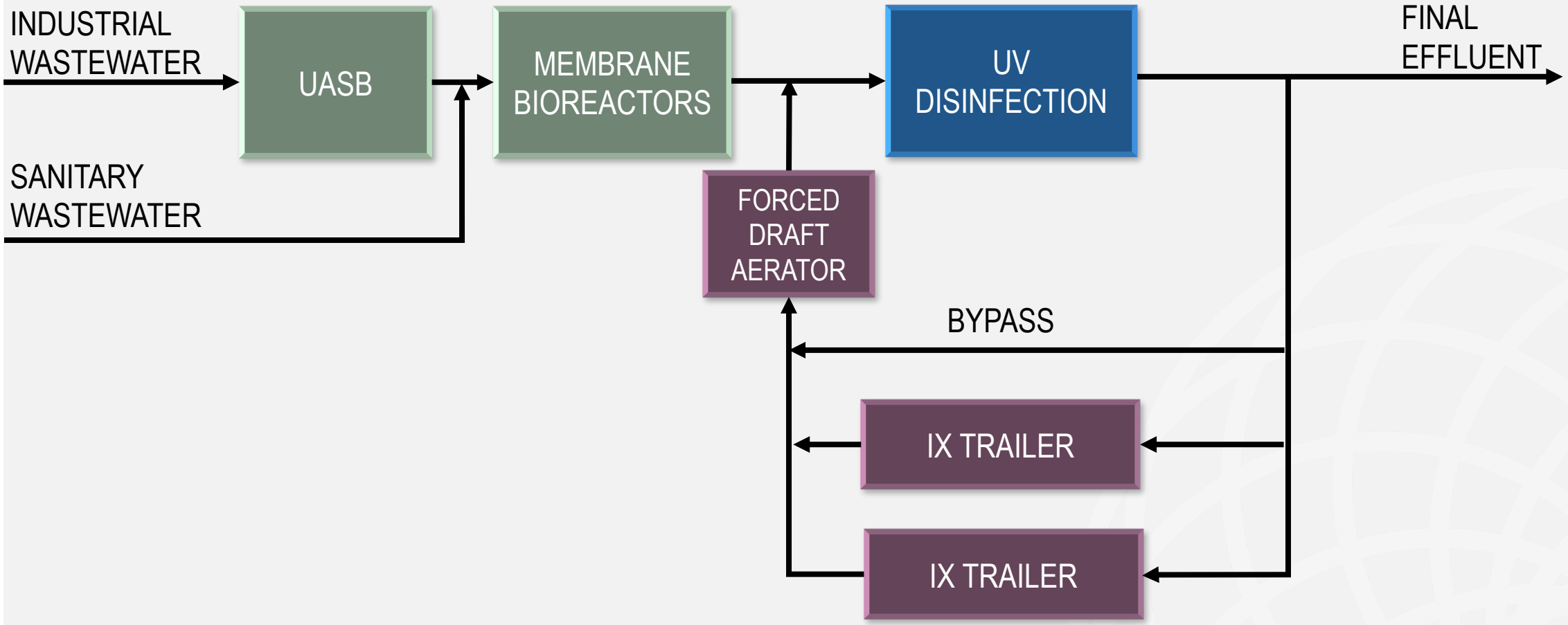
Victorville WWTP Unit Operations



City of Victorville, CA Revised Effluent Criteria

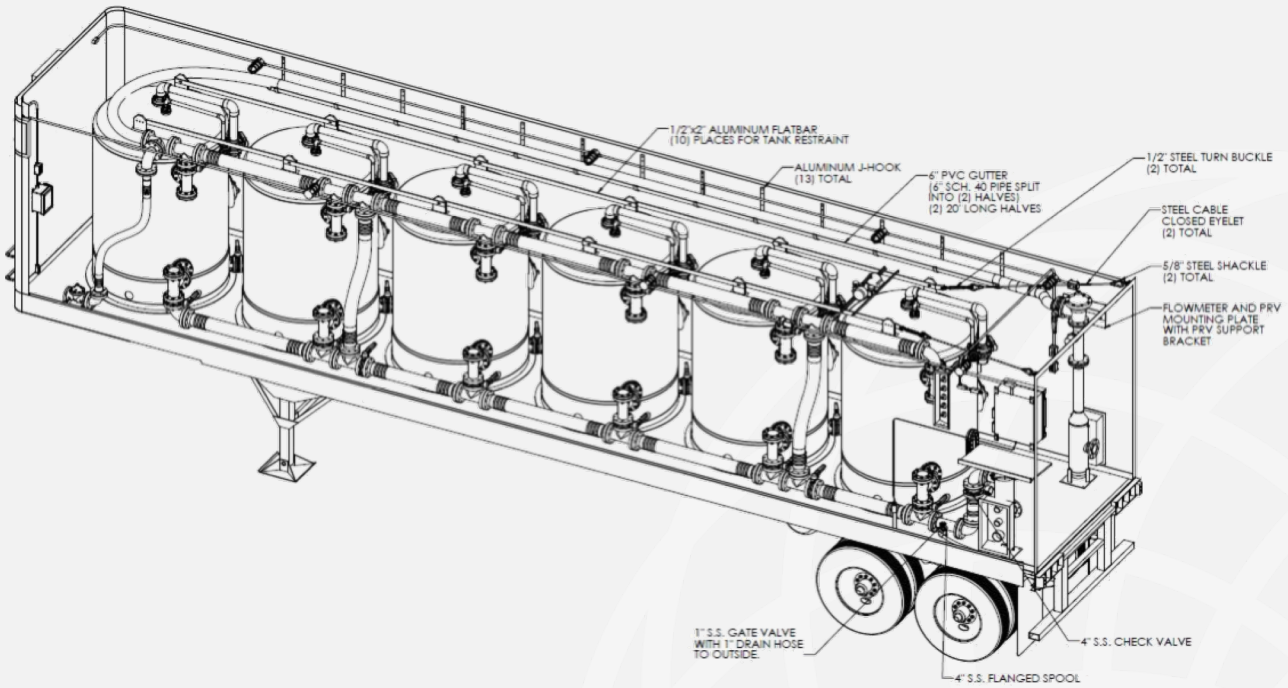
- 2012: Degraded GW Quality while discharging 0.07 MGD to percolation pond
  - TDS
  - Nitrate
- Reduced limits for discharge to percolation pond
  - TDS:
    - 0 MGD < Q < 0.15 MGD: 650 mg/L TDS
    - 0.15 MGD < Q < 0.5 MGD: 550 mg/L TDS
    - 0.5 MGD < Q < 0.88 MGD: 528 mg/L TDS
    - 0.88 MGD < Q < 1.5 MGD: 516 mg/L TDS
    - 1.5 MGD < Q < 2.5 MGD: 465 mg/L TDS
    - Cooling Tower Makeup Water: 450 mg/L TDS
  - Nitrogen: 6.1 mg/L TN

IX System Integration into Existing WWTP



Reduced TDS: Short-term TDS Solution

- Side stream IX in Mobile Trailer
  - Portion of effluent is cycled through IX so combined effluent is < 450 mg/L
  - Influent TDS dropped; short term solution economical longer
- Benefits:
  - Offsite regeneration



Reduced Nitrogen

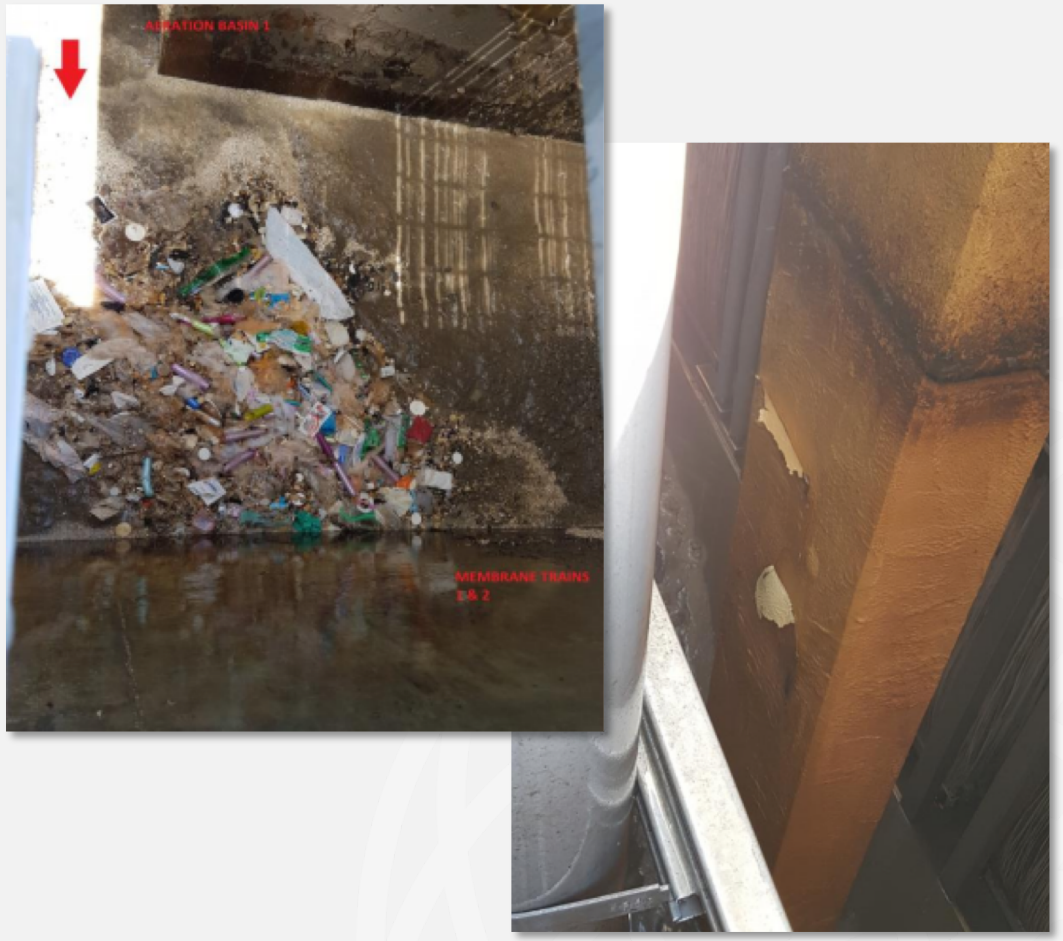
- Activated sludge/MBR plant designed with selectors (anoxic or aerobic)
  - Two (2) Trains: 0.065 MG Selector, 0.425 MG Aeration Basin
    - Coarse bubble aeration
    - Submersible mixer and coarse bubble diffusers in selector zone
  - Four (4) Train Membrane Tanks
    - Dedicated permeate and RAS Pumps
    - Four (4) aeration blowers to common header
- Cyclical Aeration – Entire Basin
  - 60 minutes aerated to 2 mg/L DO
  - 65 minutes aerated at minimum mixing energy

MBR Membrane Replacement Project

- MBR membranes installed in 2010, 10-year design life in membranes
- 2018: City contracted with Fibracast, LTD for replacement membrane supply
- Replacement membranes
  - Fewer cassettes
  - Lower aeration demand

MBR Replacement Challenges

- MBR and Aeration Tank Cleaning
  - Sand, mylar from nearby plane salvage yard, influent solids from high flow bypass of screen
- Lower aeration demand aeration control
  - Cyclical aeration vs. lower aeration rate
- Installing contractor logistics
  - Starts / stops
  - Coating repair
  - Three trains online to maintain plant hydraulic capacity



MBR Replacement Challenges

- Work within Membrane Tanks
  - Sequential, n+1 redundancy
- Meeting Effluent TN During Cleaning
  - 2 Aeration Tank-Acceptable; One Aeration Tank-Problematic
  - Approximately 1 week duration
  - Either nitrification or denitrification will loose performance depending on changes to cyclical aeration for effluent BOD, NH4 and TN
  - Options to optimize nitrification/denitrification needed
- Aeration control to new MBRs
  - Flow control to each train
  - Best option is to cut in isolation valves and dedicate one blower per MBR train
  - **Challenge: Maintaining effluent flow during cut in**

Options Eval. to Ensure Permit Compliance Ops

1. In-Situ Cleaning
2. Deaeration of the RAS
3. Side Stream Nitrification
4. Effluent Non-Compliance
5. Influent Plant Bypass

Option 1: In-Situ Cleaning

Two Variations

1. Commercial divers
2. Filtration of RAS

PROS

- Eff TN
- No loss in biomass / operational changes

CONS

- Does not address valve cut-in
- Hazardous work
- No visual inspection of the coarse bubble aeration diffusers
- Less thorough cleaning than completely draining tanks

Image by EastWestDive.com.au

Option 2: Deaeration of RAS

- Reduce recycled DO to selector in RAS to improve denitrification in selector
  - Via chemical addition
  - Via endogenous respiration

PROS

- Improve effluent performance within existing tanks
- No additional TDS for endogenous respiration option

CONS

- TDS addition that must then be removed before discharge
- Potential biological toxicity
- Still may not meet effluent permit limits
- Additional tankage and pumping capacity required for RAS stream endogenous respiration option

Option 3: Side Stream Supplement Nitrification

- Install a tank as temp reactor to grow nitrifiers.
- Quickly dismissed due to cons
- Maintain cyclical aeration in reactors to denitrify
- Augment nitrifier population with nitrifying reactor

PROS

- Plausible

CONS

- Far more difficult to implement / operate and costly than alternatives

Option 4: Effluent Non-Compliance

- Discharge effluent treated to the greatest extent possible within the existing plant
- Increase aeration cycle to ensure nitrification during work; likely result in permit exceedance for NO3

PROS

- Least impact on operations

CONS

- Out of compliance discharge anticipated

Option 5: Influent Plant Bypass

- Bypass sanitary influent via portable pump to reduce loading on the plant VVWRA so one train can meet discharge limits
- Plant continues treatment of industrial wastewater
  - Use equalization at KDP and plant while aerobic mix tank is cleaned

Image by Google Earth, 2019

Option 5: Influent Plant Bypass (cont.)

- Option is permitted by the VVWRA Nondomestic Wastewater Discharge Permit (Permit No. 2017-6121-09)
- Permit requires 10-days advance written notice

> 3. Bypass of Treatment Facilities
>
> ***Bypass is prohibited and the VVWRA may take enforcement action against a User for bypass***
>
> a) Unless the bypass is unavoidable to prevent loss of life, personal injury, or severe property damage.
>
> **b) Unless there were no feasible alternatives, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime.**

PROS

- Most feasible / economical / compliant option available to the plant

CONS

- Increased operations to monitor bypass pumping

Conclusion

- **OPTION 5: INFLUENT PLANT BYPASS SELECTED**
- Current status
  - Coordination with contractors for cleaning the tank is ongoing
  - Partial bypass is slated to occur during active cleaning operations to reduce overall plant loading
  - Valve cut-in to occur during bypass or while aeration system refills following cleaning
  - Tank cleaning and valve cut-in to occur in March, 2019
  - New membranes will be installed in Q2 2019
- This option not available to all treatment plants.
- Is an option for scalping plants that are common in the west

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Thank You! Questions?

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