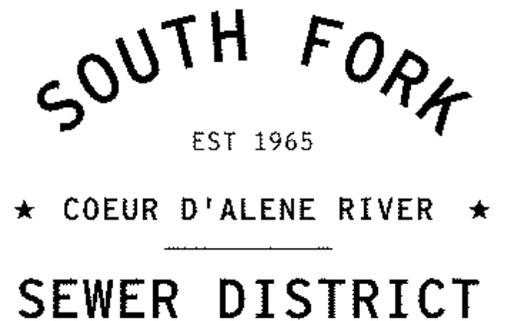


Silver Valley Wastewater

Page WWTP Phosphorus Reduction and Metals Treatment

Pete Stayton

ISPE June 12, 2025



Outline

- Overview of South Fork CDA River Sewer District
- The Problem
- The Solution
- Implementation

- Sewer District established 1965
- Serve 22 separate towns and communities
- Service population 7,055
- 57 miles of pipe (18 miles of interceptor)
- 1,200 manholes
- 7 lift stations
- 2 wastewater treatment plants

SOUTH FORK

EST 1965

★ COEUR D'ALENE RIVER ★

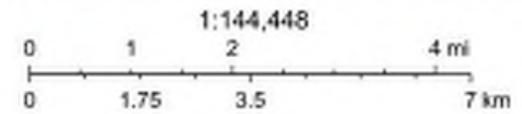
SEWER DISTRICT





2/19/2025, 8:10:49 AM

-  World Transportation
-  City Boundaries (1965)
-  Boundary with Annexations (Post-Formation)

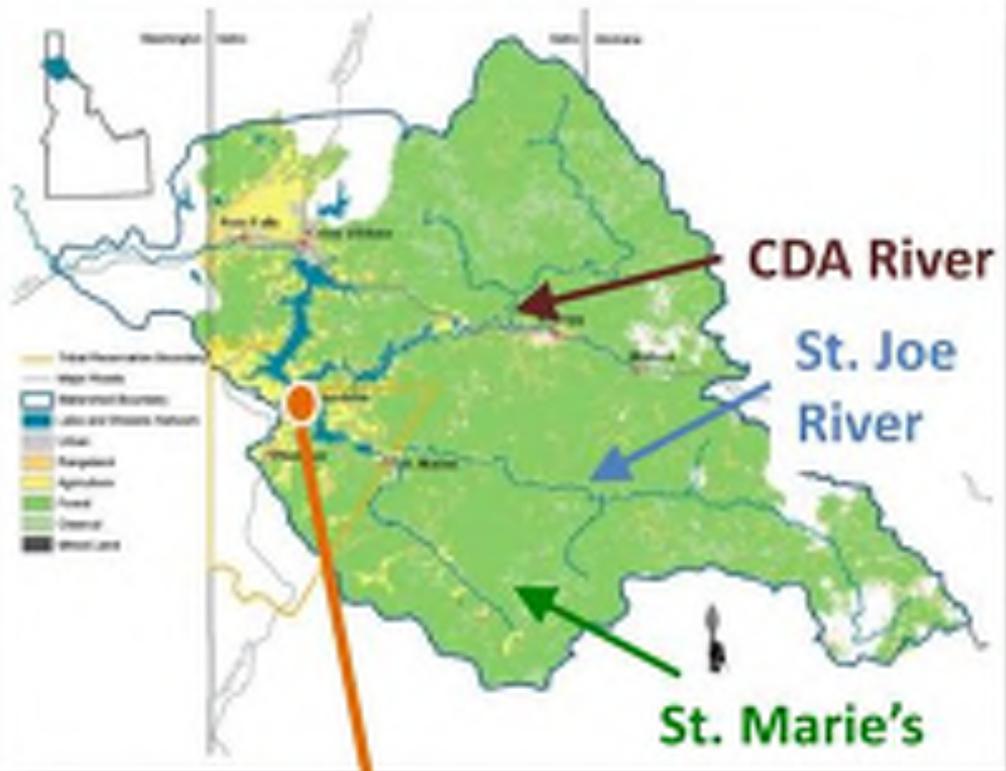


Esri, HERE, Earthstar Geographics

The Problem...

- 75 million metric tons of lead, cadmium, zinc and arsenic deposited in lake bottom
- Logging, farming, construction contribute sediment and nutrients (nitrogen & phosphorus)





Lake acts as a sink for metals and nutrients



Images courtesy of IDEQ

Lake Metabolism:

Nutrients, Carbon, Oxygen

- Nutrients (N, P) = Plant growth
- Plants decompose = Reduced oxygen
- No oxygen (hypoxia) = Metals release
- Higher metals = reduced lake productivity
- Tipping point when lake becomes eutrophic

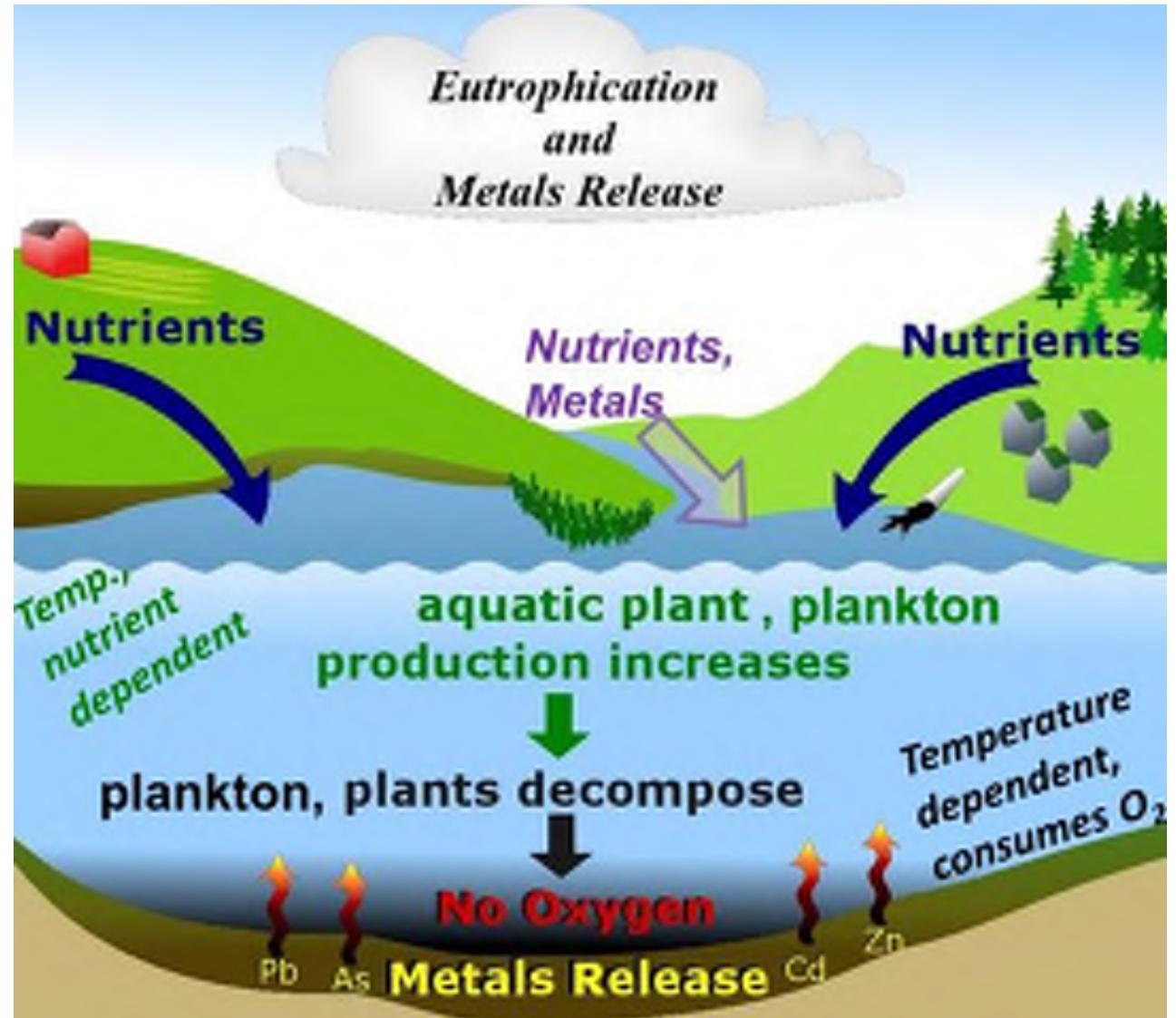
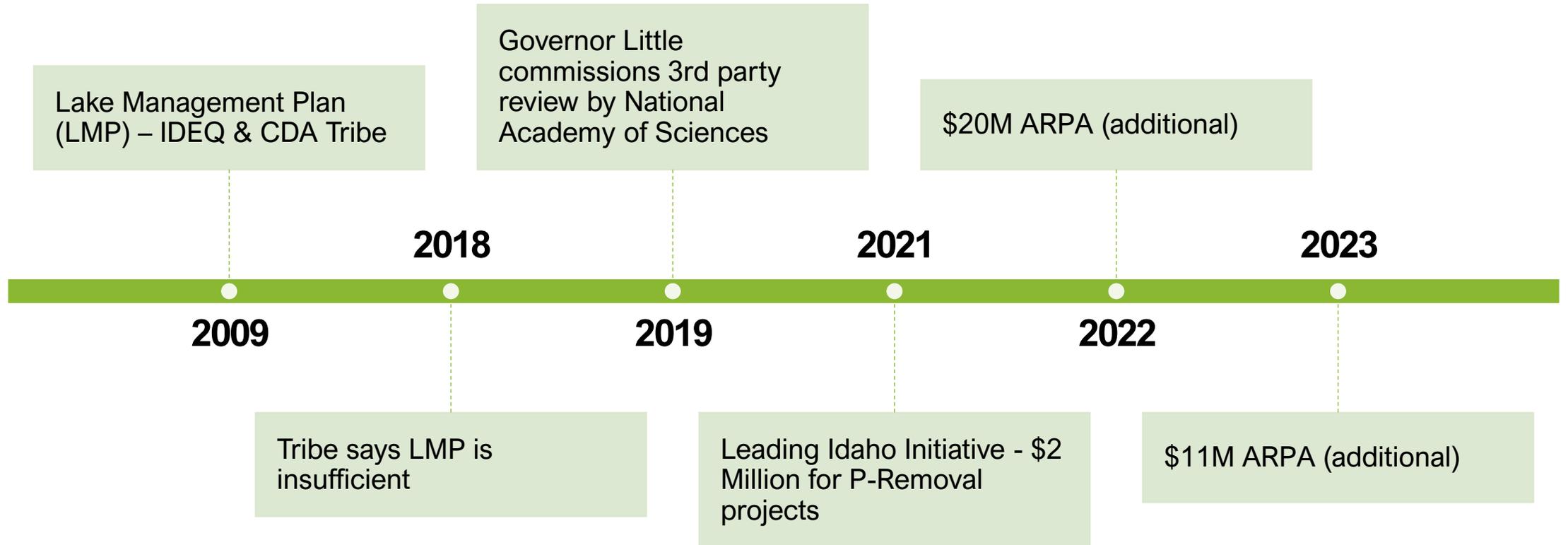


Image courtesy of IDEQ

Coeur d'Alene Lake Advisory Committee



Page Wastewater Treatment Plant

- Dry Weather ADF = 1.8 mgd
- Max Month Flow = 6.4 mgd
- Peak Day Flow = 13.0 mgd (peaking factor = 7.2)
- Average effluent phosphorus
 - 1.5 mg/L
 - 21.4 lb/d
 - 7,800 lb/yr

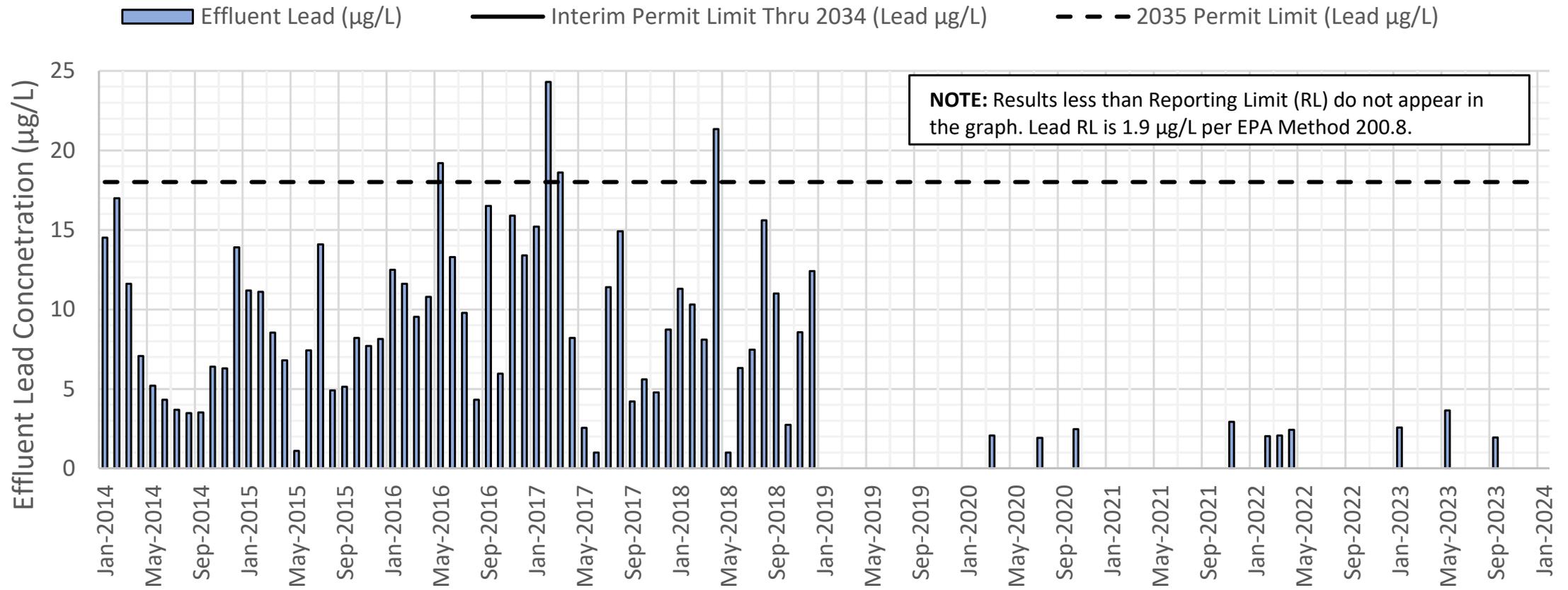


Problem #2: Heavy Metals Limits



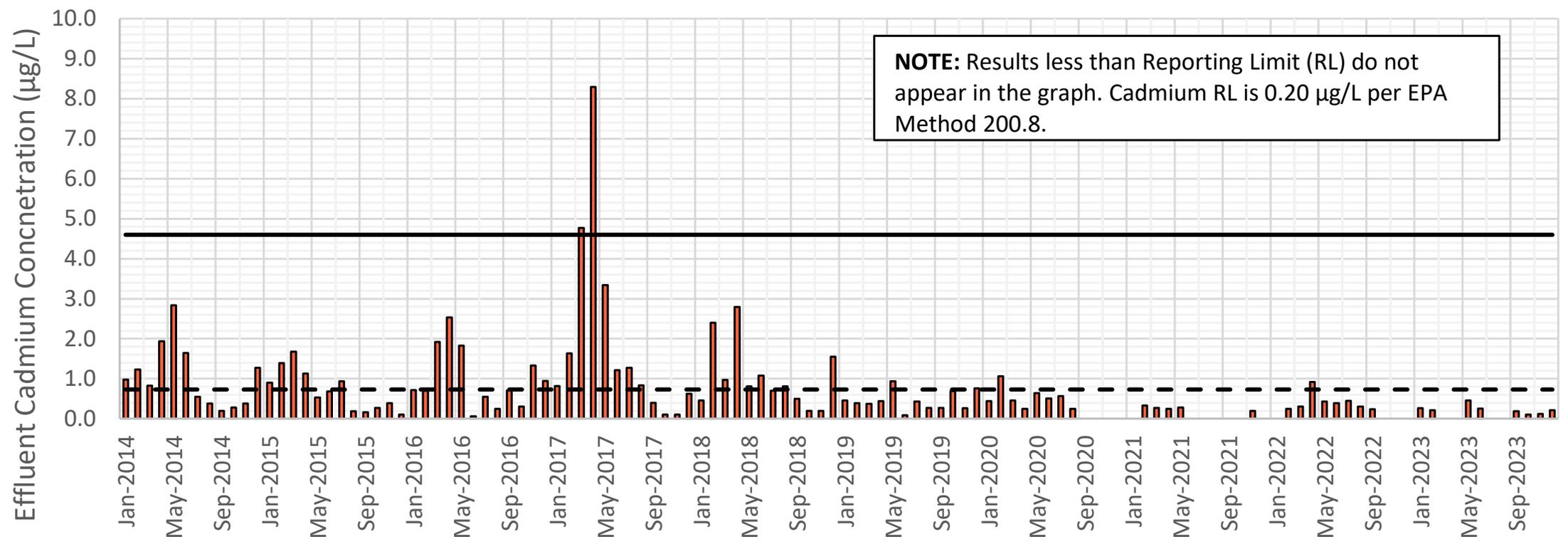
Final Numeric Effluent Limits – Water Quality-Based – Effective January 1, 2035							
Cadmium <i>Effective January 1, 2035</i>	µg/L	0.73	—	1.7	Effluent	1/month	24-hour composite
	lb/day	0.026	—	0.060			
Lead <i>Effective January 1, 2035</i>	µg/L	18	—	39	Effluent	1/month	24-hour composite
	lb/day	0.65	—	1.4			
Zinc <i>Effective January 1, 2035</i>	µg/L	107	—	168	Effluent	1/month	24-hour composite
	lb/day	3.8	—	6.0			

Page WWTP Effluent Lead Concentration, total recoverable (2014-2023)



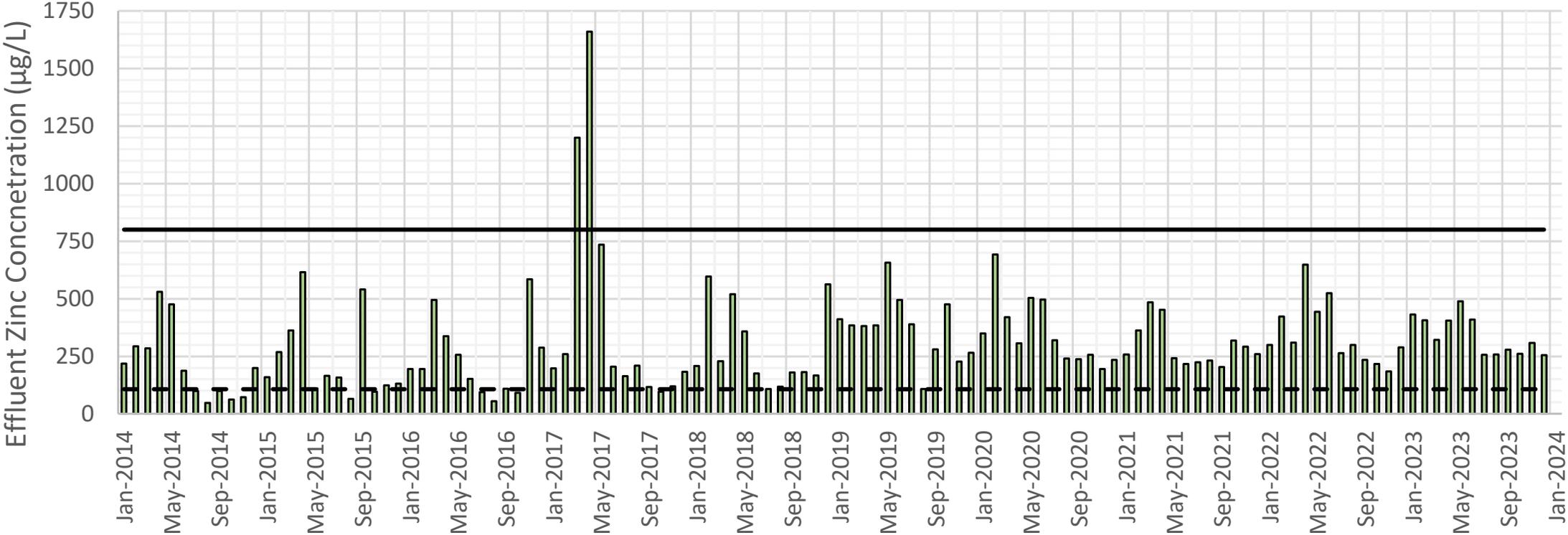
Page WWTP Effluent Cadmium Concentration, total recoverable (2014-2023)

█ Effluent Cadmium (µg/L)
 Interim Permit Limit Thru 2034 (Cadmium µg/L)
 2035 Permit Limit (Cadmium µg/L)



Page WWTP Effluent Zinc Concentration, total recoverable (2014-2023)

Effluent Zinc (µg/L) Interim Permit Limit Thru 2034 (Zinc µg/L) 2035 Permit Limit (Zinc µg/L)



Project Goals



Phosphorus Reduction (voluntary)

Maximize phosphorus removed
per dollar spent

Target 80-90% P removal

Future permitting to be
determined – ideally seasonal
average ppd



Improved heavy metals treatment

Leverage P-removal process for
future metals compliance



Minimize operational complexity O&M costs

Small operations staff

Keep rates low

All ARPA funding **must** be spent by Dec. 31, 2026

Design Criteria

- ADF 2.4 mgd
- Peak 3.2 mgd
- $Q > 3.2$ mgd secondary treatment only

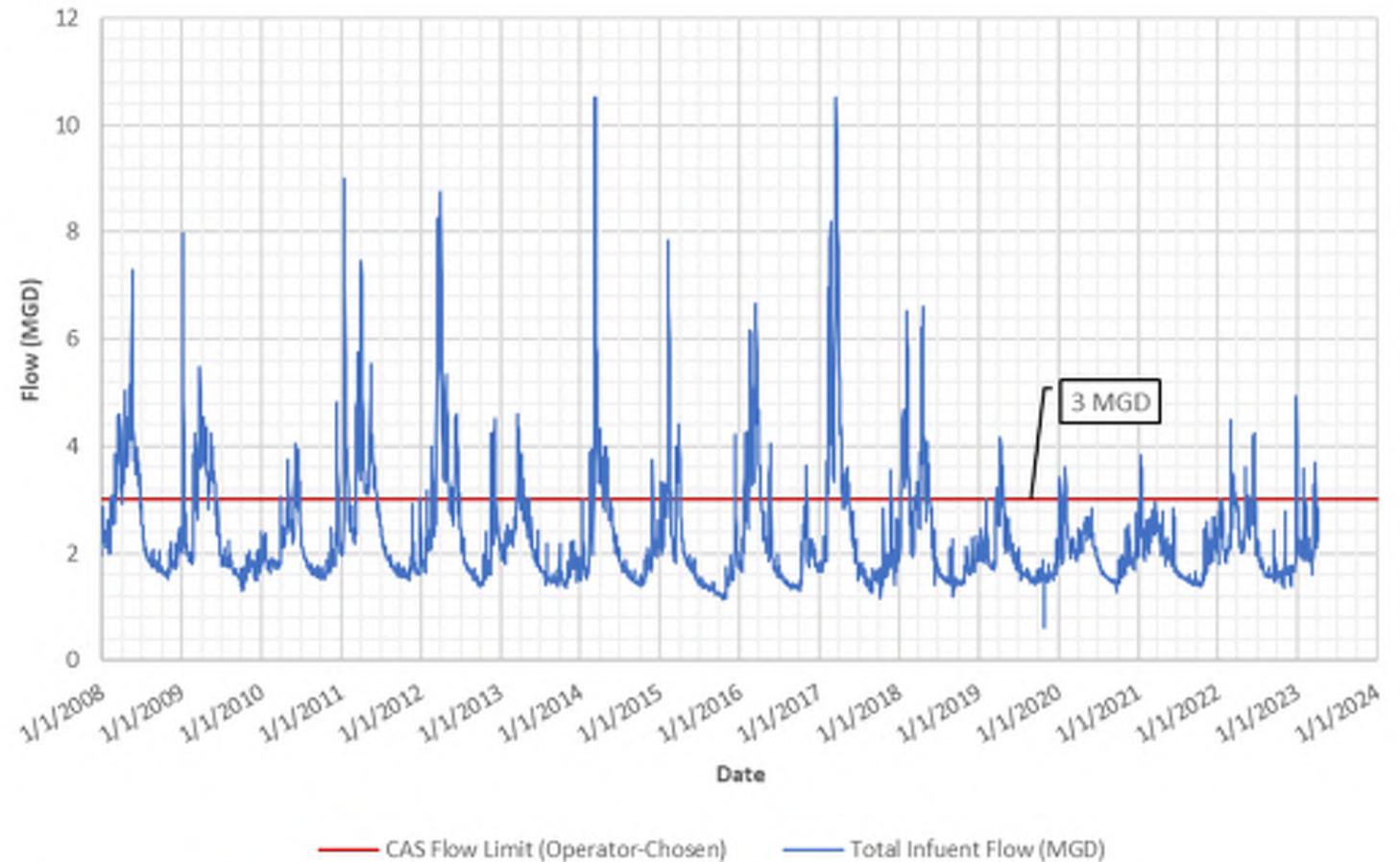


Figure 1 Influent Flow Relative to the AS Capacity

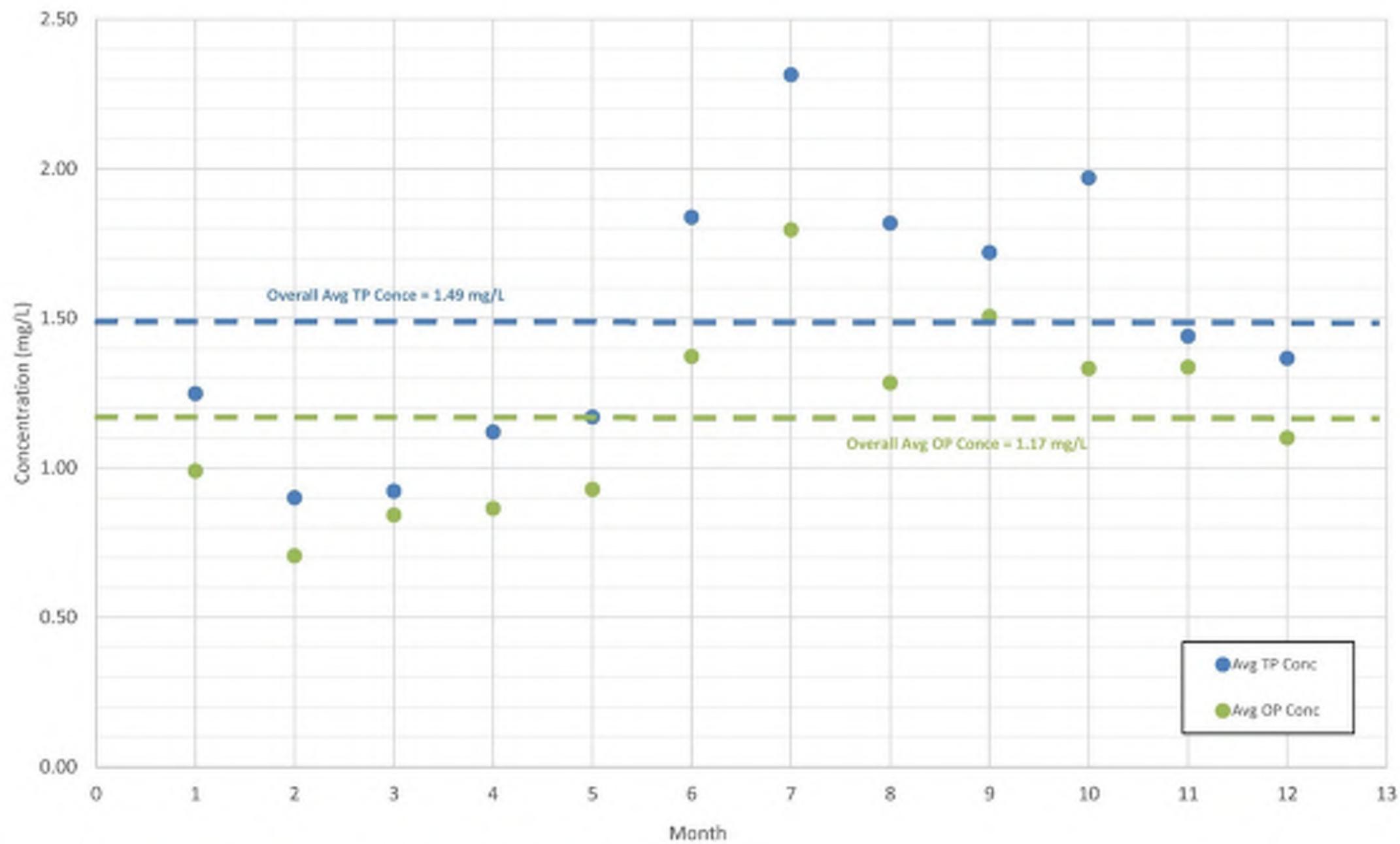
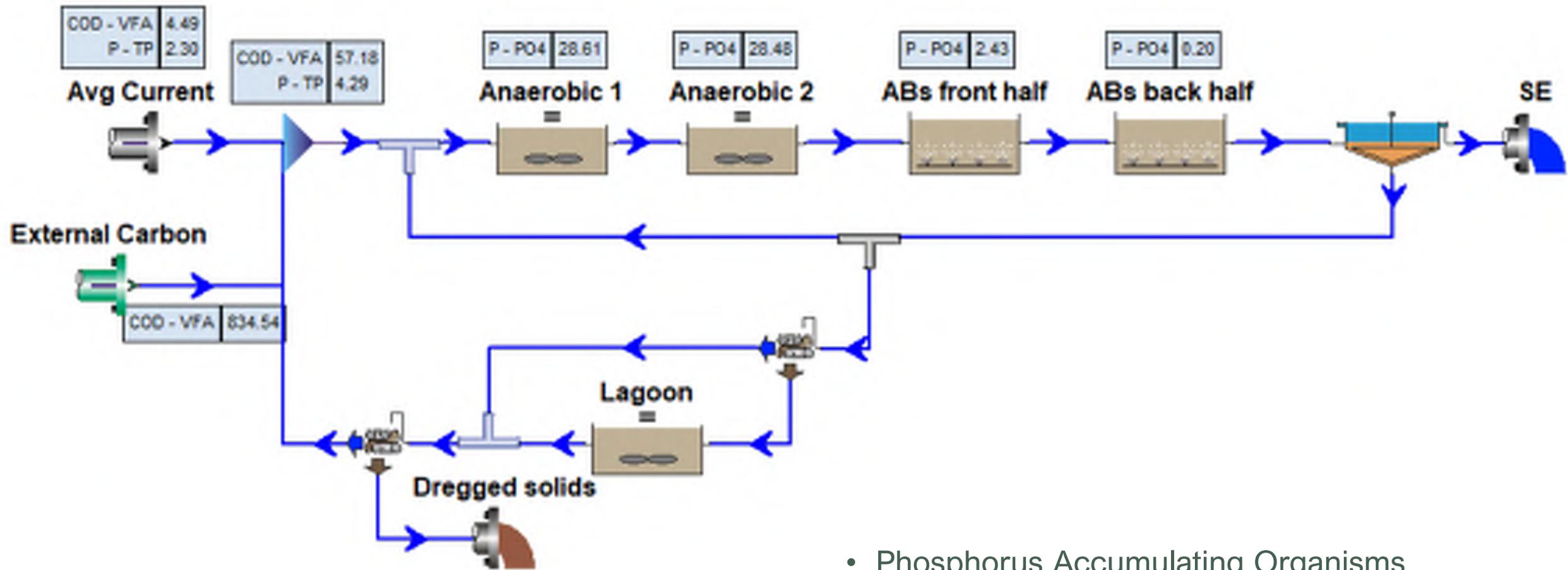


Figure 4 Page WWTP Effluent P Concentrations

Basic Process Alternatives

Biological
phosphorus removal
(BPR)

Chemical
precipitation – lime
or metal coagulants
to form hydroxide
sludge



Biological Phosphorus Removal (BPR) Conversion

- Phosphorus Accumulating Organisms (PAOs)
- Release phosphorus in anaerobic zone
- Uptake excess P in aerobic zone (aka "luxury uptake")
- P removed in wasted biosolids



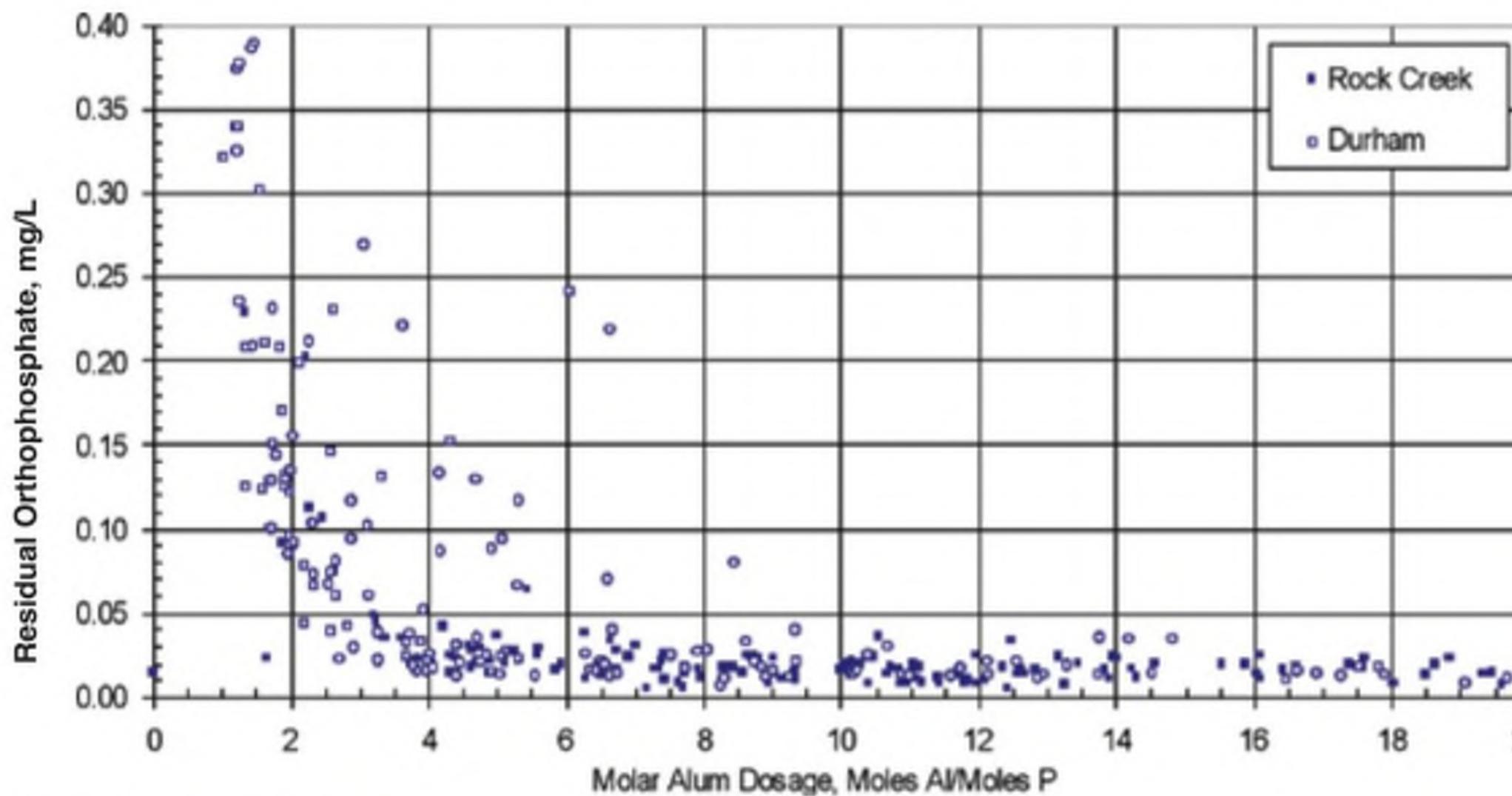
Biological Phosphorus Removal (BPR) Conversion

- Lined earthen aeration basin not practical to retrofit with Anaerobic
- Current WAS disposal to stabilization lagoon could release phosphorus back to influent – would require mechanical dewatering exceeding project budget
- Low influent BOD and volatile fatty acids would likely require supplemental carbon
- May require P-removal polishing to meet effluent targets

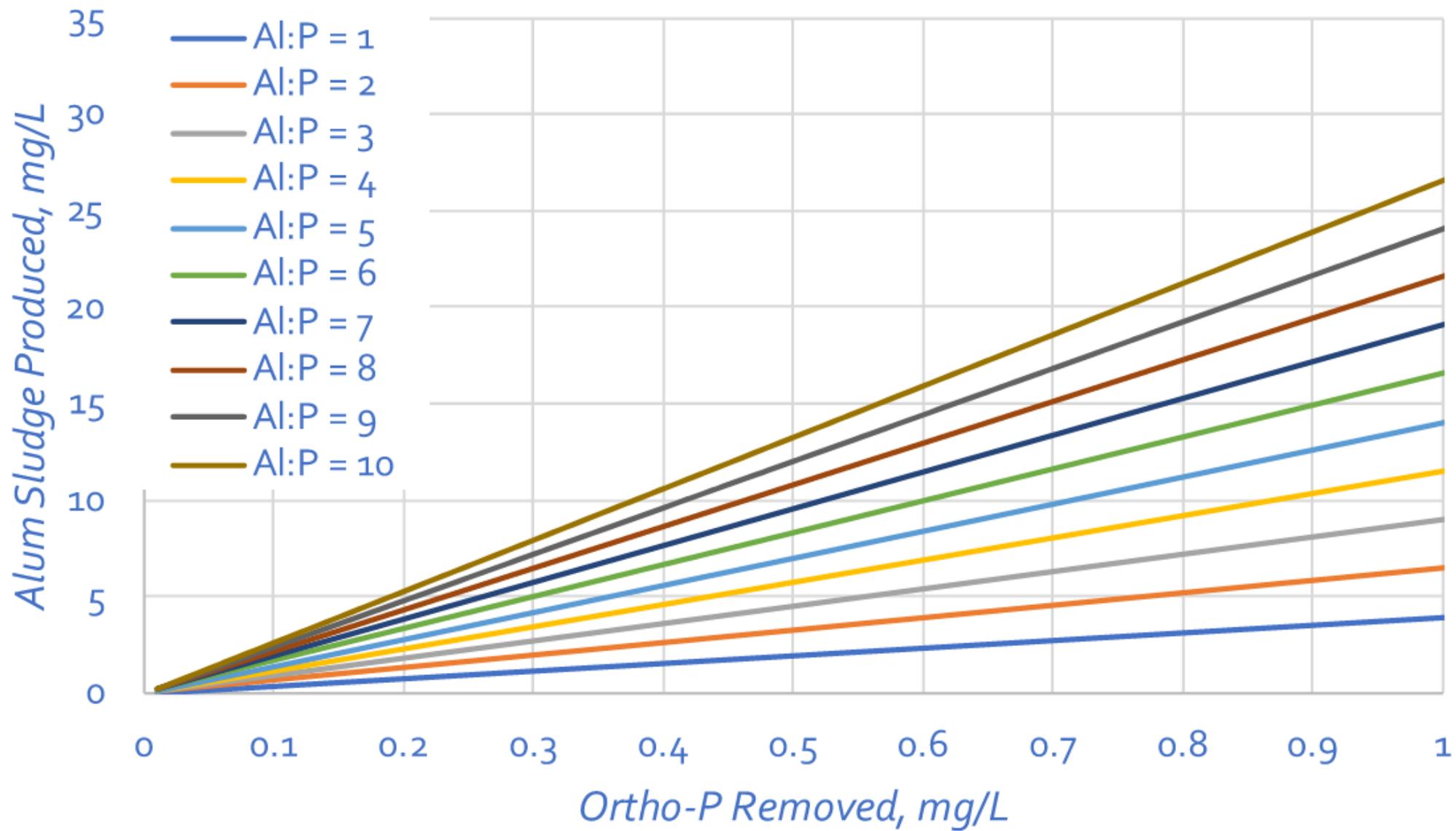
Chemical Precipitation

- Metal coagulant (aluminum or iron based) forms hydroxide sludge
- Hydroxide sludge adsorbs soluble phosphorus creating a particle that can settle or be filtered





Source: Johnson et al., 2010²



Universe of Treatment Technologies

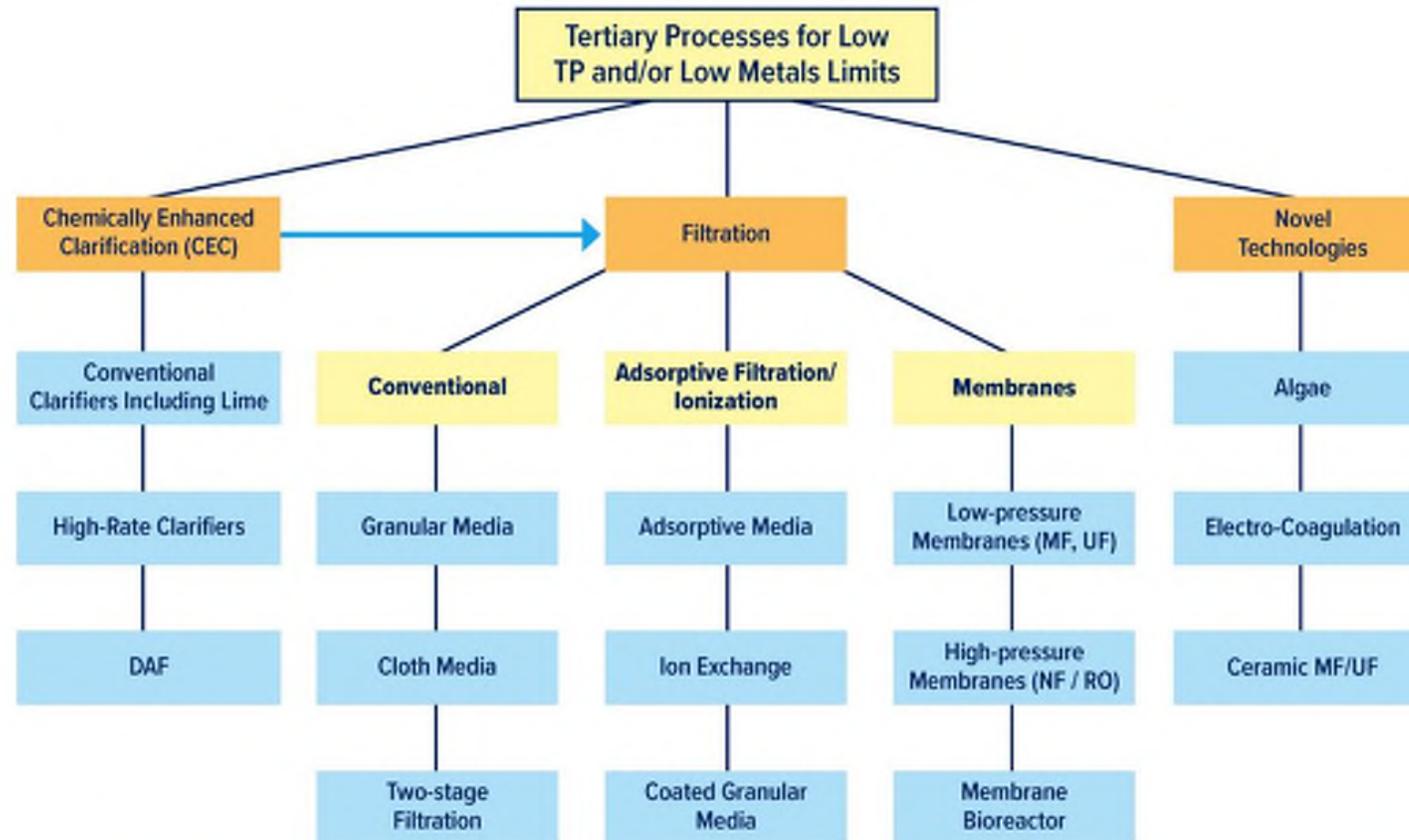


Figure 8 Tertiary Phosphorus and/or Metal Removal Processes

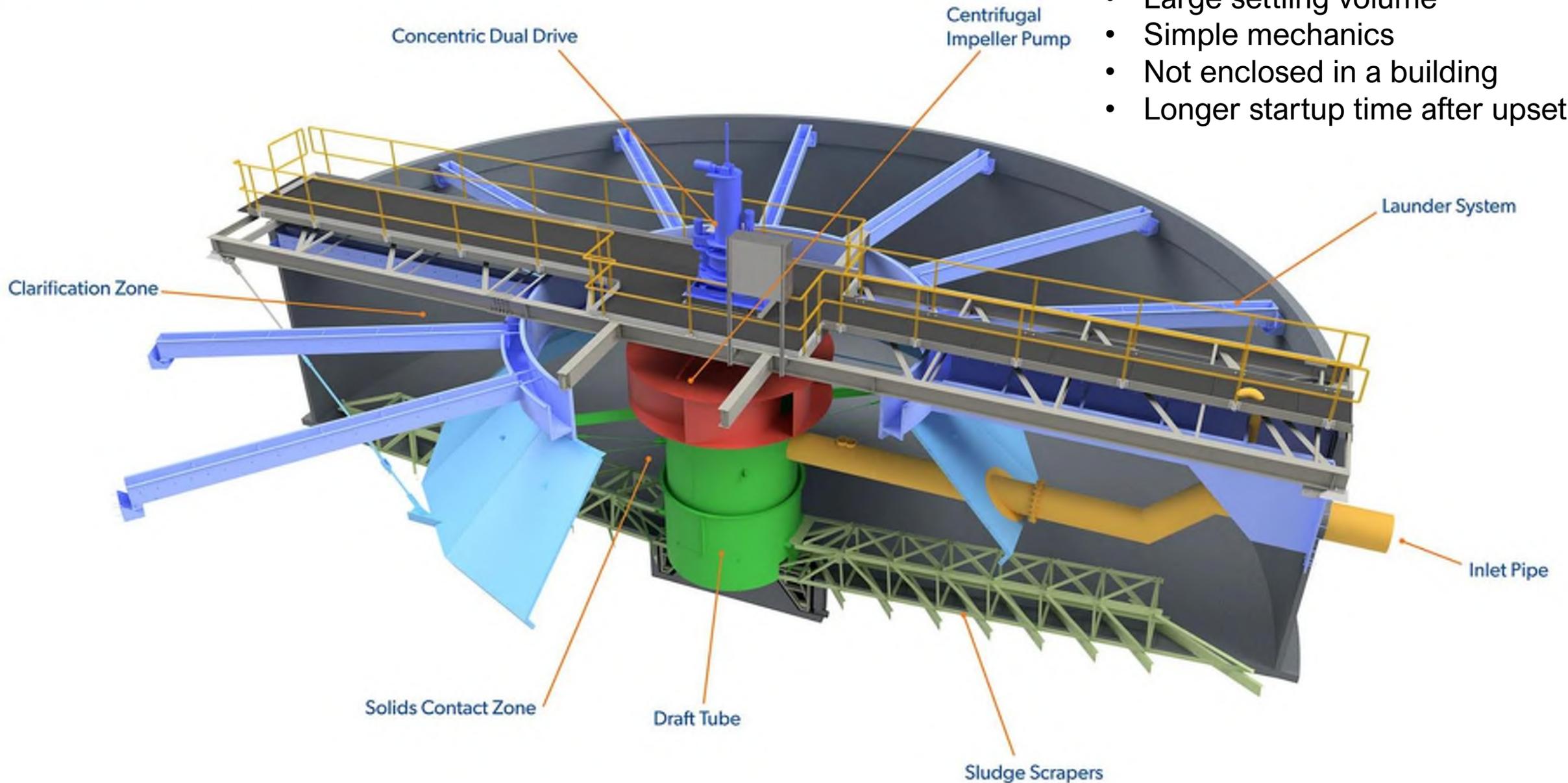


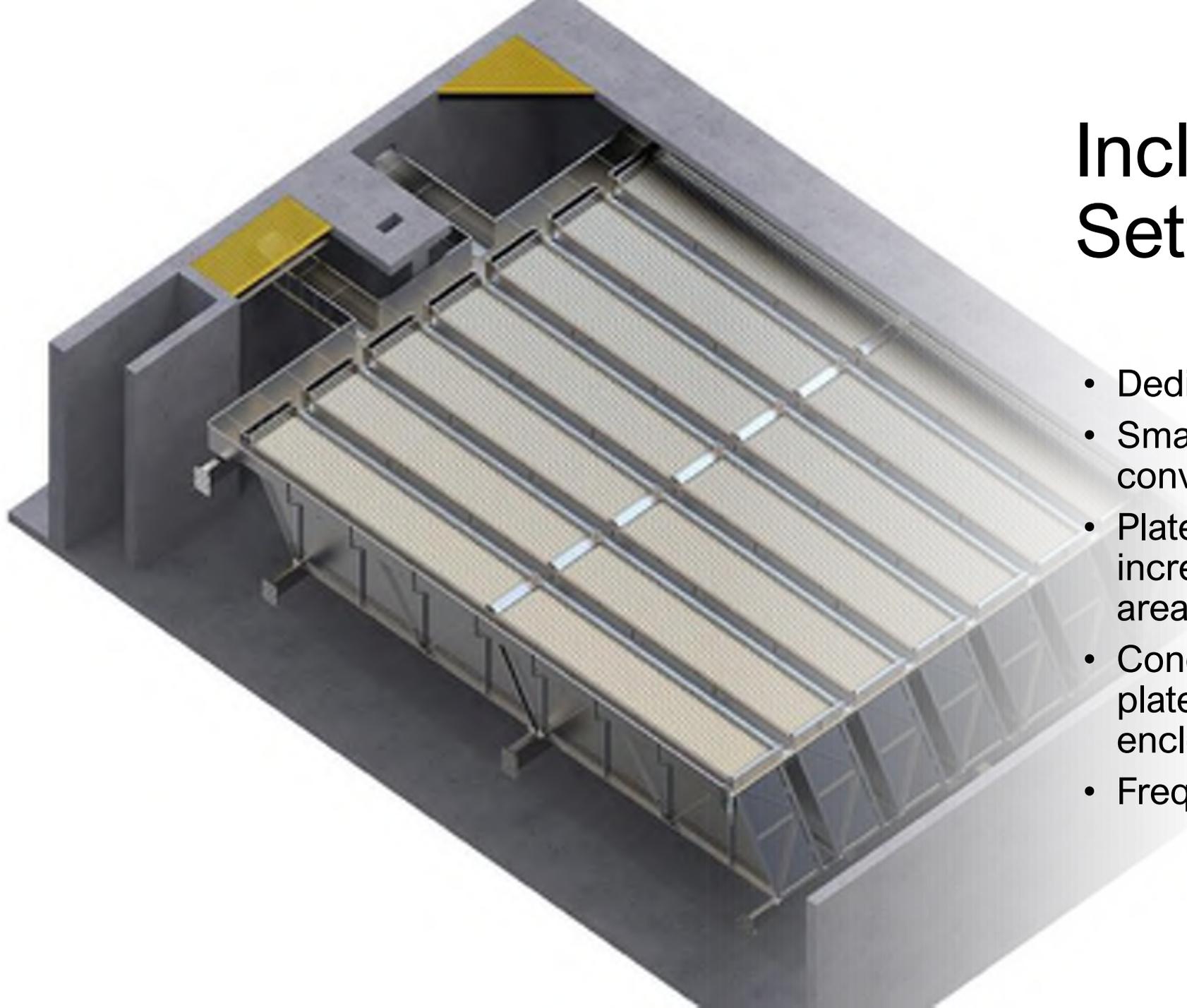
Preferred Alternatives

- **BPR Conversion** – Not practical due to retrofit challenges and need for carbon supplementation
- **Conventional Clarification**
 - Solids Contact Clarifiers
 - Lamella Plate/ Tube Settlers
- **High Rate Clarification**
 - Dense Sludge
 - Ballasted Flocculation
- **Filtration**
 - Cloth or screen disk filters
 - Continuous backwash upflow filters

Solids CONTACT CLARIFIER™

- Large footprint
- Large settling volume
- Simple mechanics
- Not enclosed in a building
- Longer startup time after upset



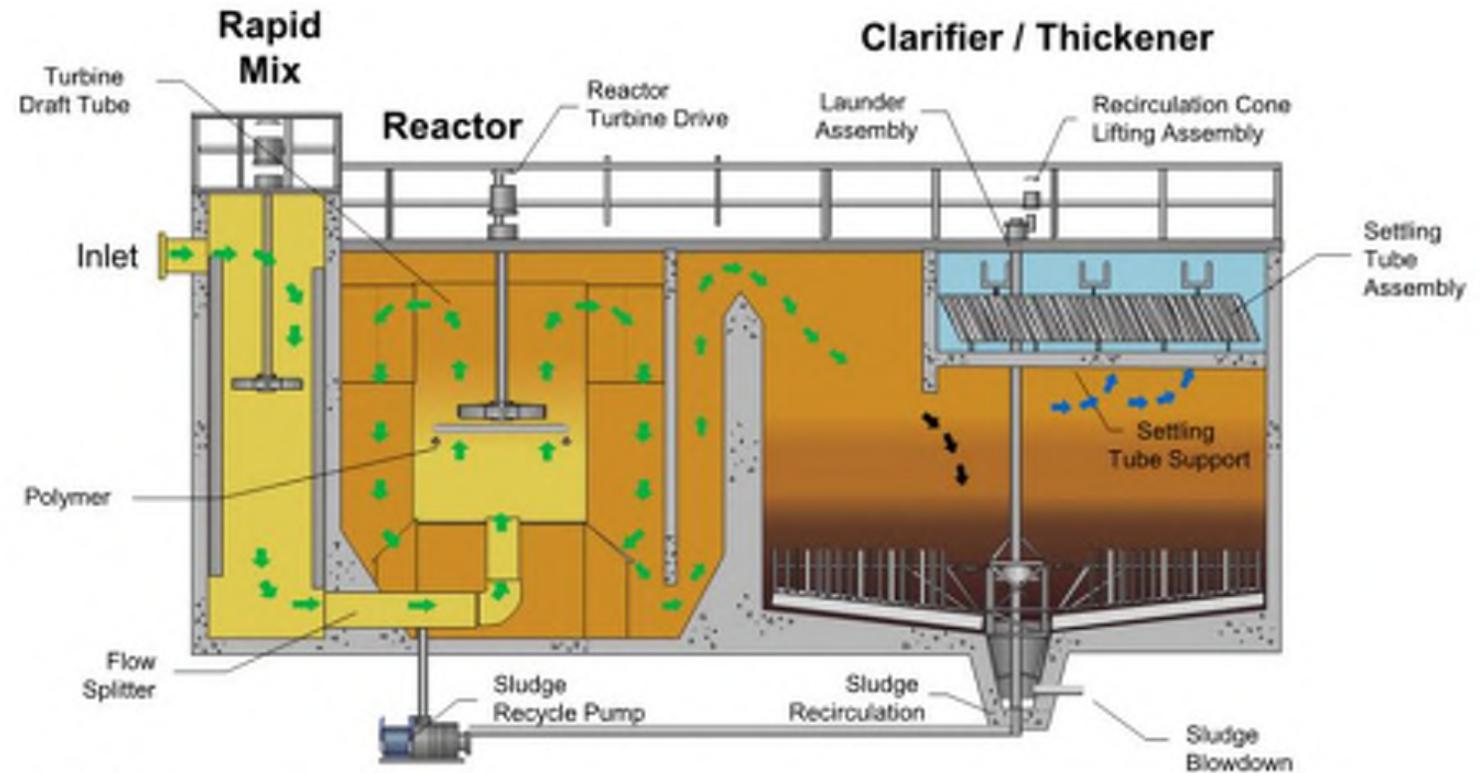


Inclined Plate Settler

- Dedicated flocculation basin
- Smaller footprint than conventional clarifier
- Plates or tubes provide increased settling surface area
- Concerns with freezing on plates/ tubes, may need to enclose in building
- Frequent washdown

Dense Sludge (High-Rate Clarification)

- Conventional flocculation
- Lamella settlers
- Chemically enhanced sludge
- Quick reaction to process changes
- Compact footprint
- Needs to be in a building (in N. Idaho)
- Significant operational effort

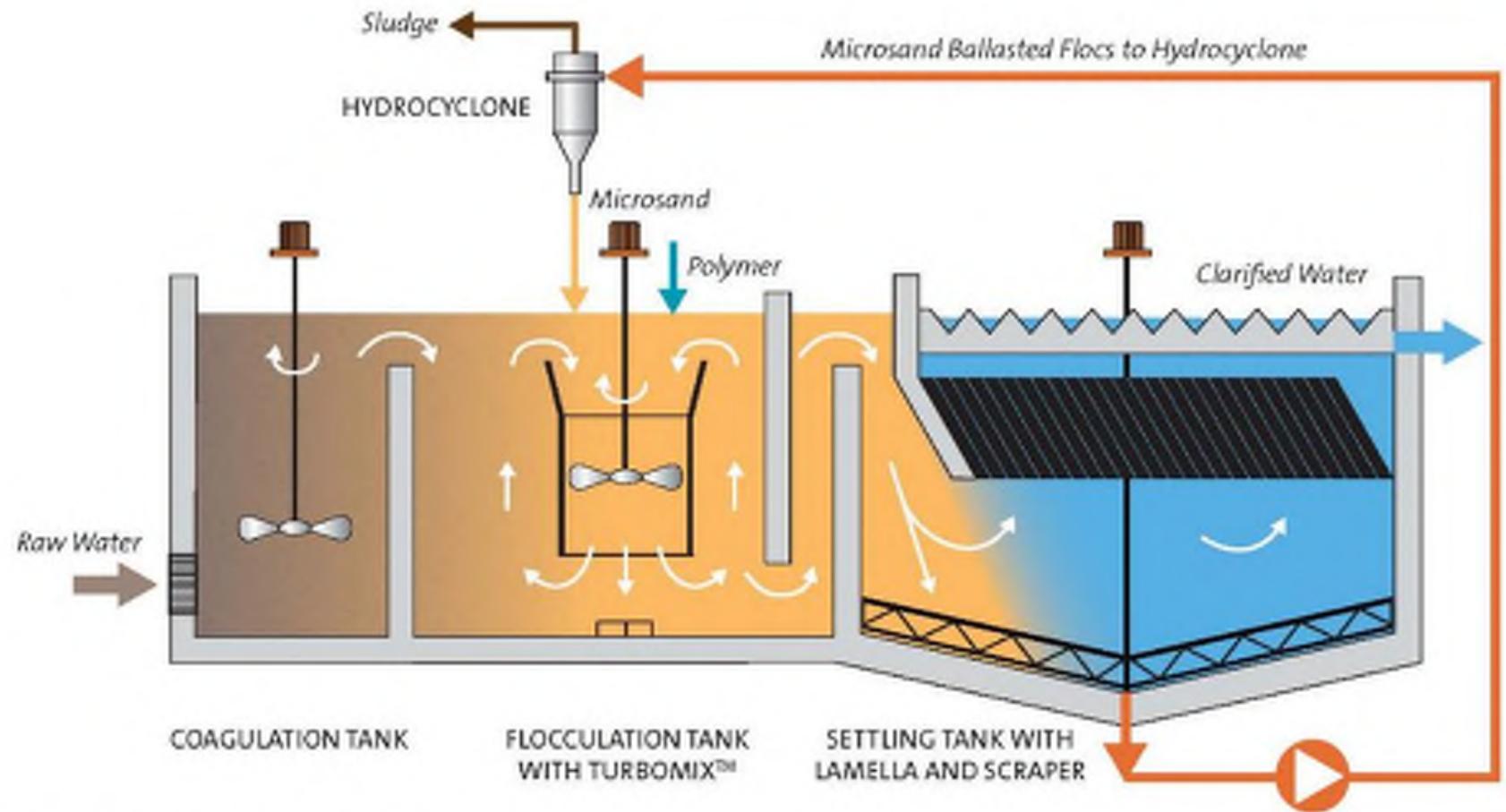


Source: Suez

Figure 12 Densadeg® Process Flow Diagram

Ballasted Flocculation (High-Rate Clarification)

- Microsand ballast to increase floc
- Ballast is separated and returned to process
- Lamella settlers
- Ballast loss requires periodic replenishing
- Significant operational effort

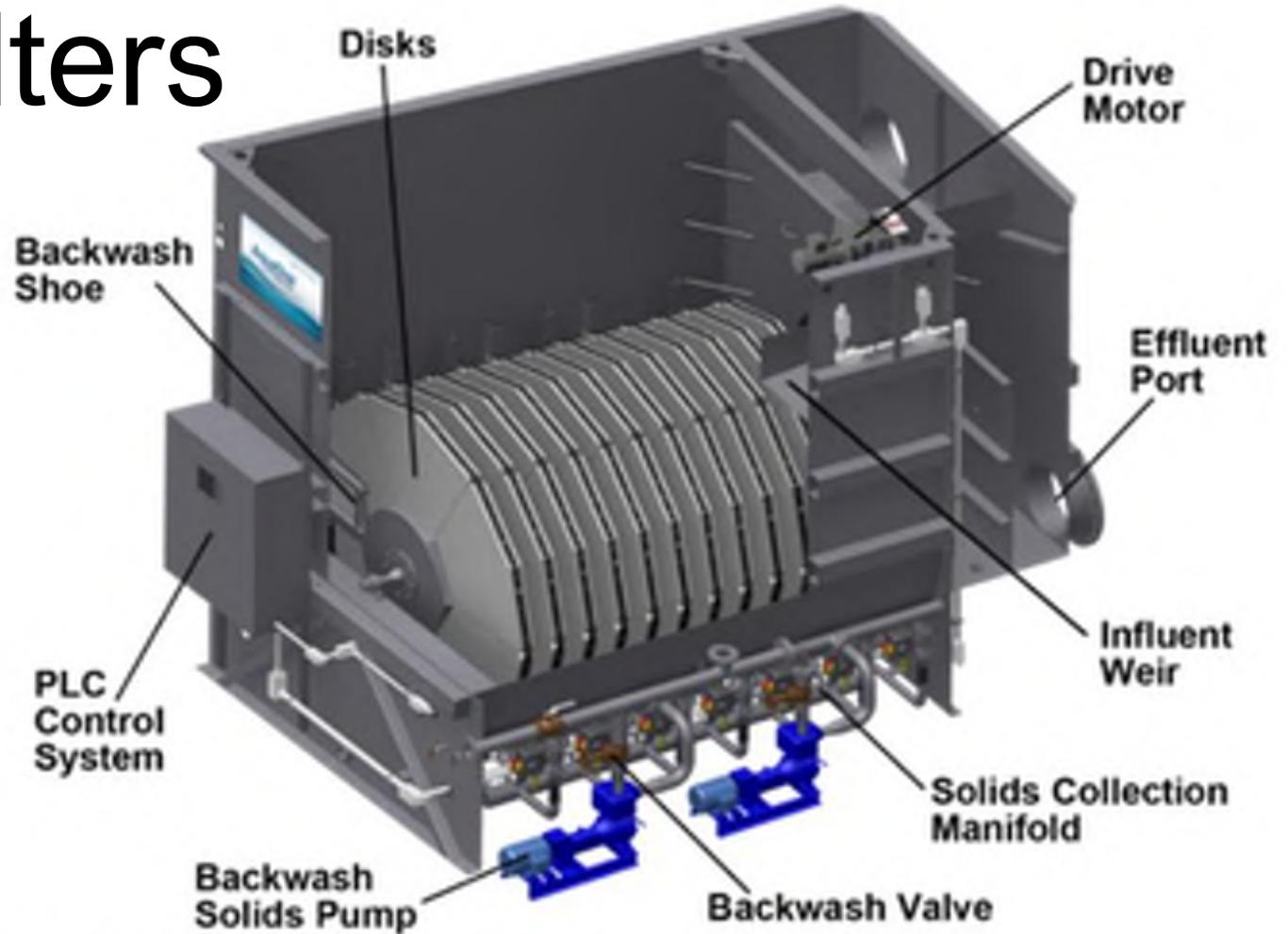


Source: Veolia Water Technologies

Figure 13 Actiflo® Ballasted Clarification Process

Cloth Disk Filters

- Pile fiber cloth or woven disk media to separate suspended solids
- High filtration area in small footprint
- Backwash to remove solids buildup
- Alum dose required to achieve 90% removal creates heavy solids load on filters

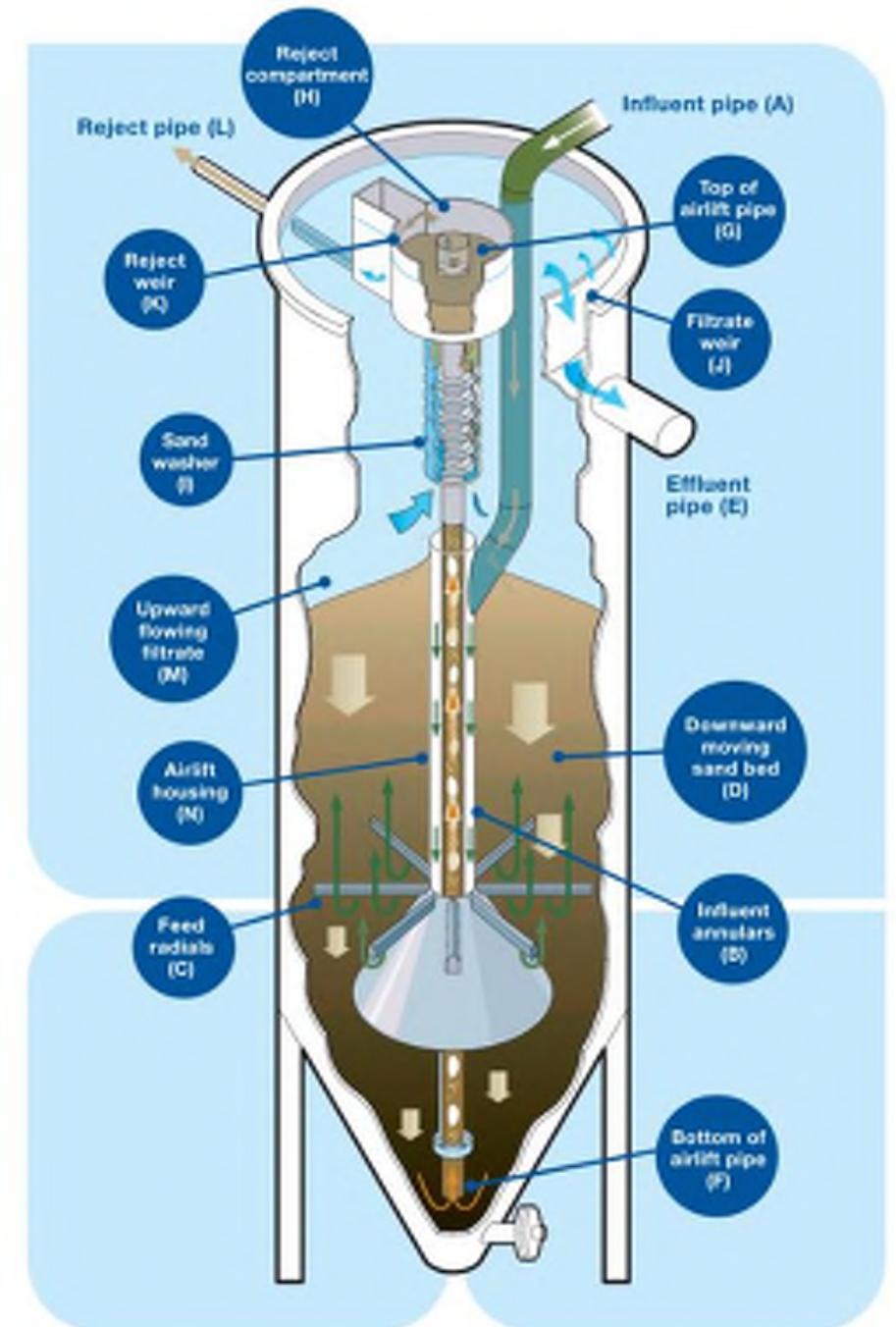


Source: AASI

Figure 15 Cloth Disk Filter System

Continuous Backwash Upflow Filters (CBUF)

- Deep bed granular media filter
- Continuous backwash to remove filtered solids
- Small footprint, low headloss
- High backwash rate returned to influent
- Potential for solids to short-circuit media barrier

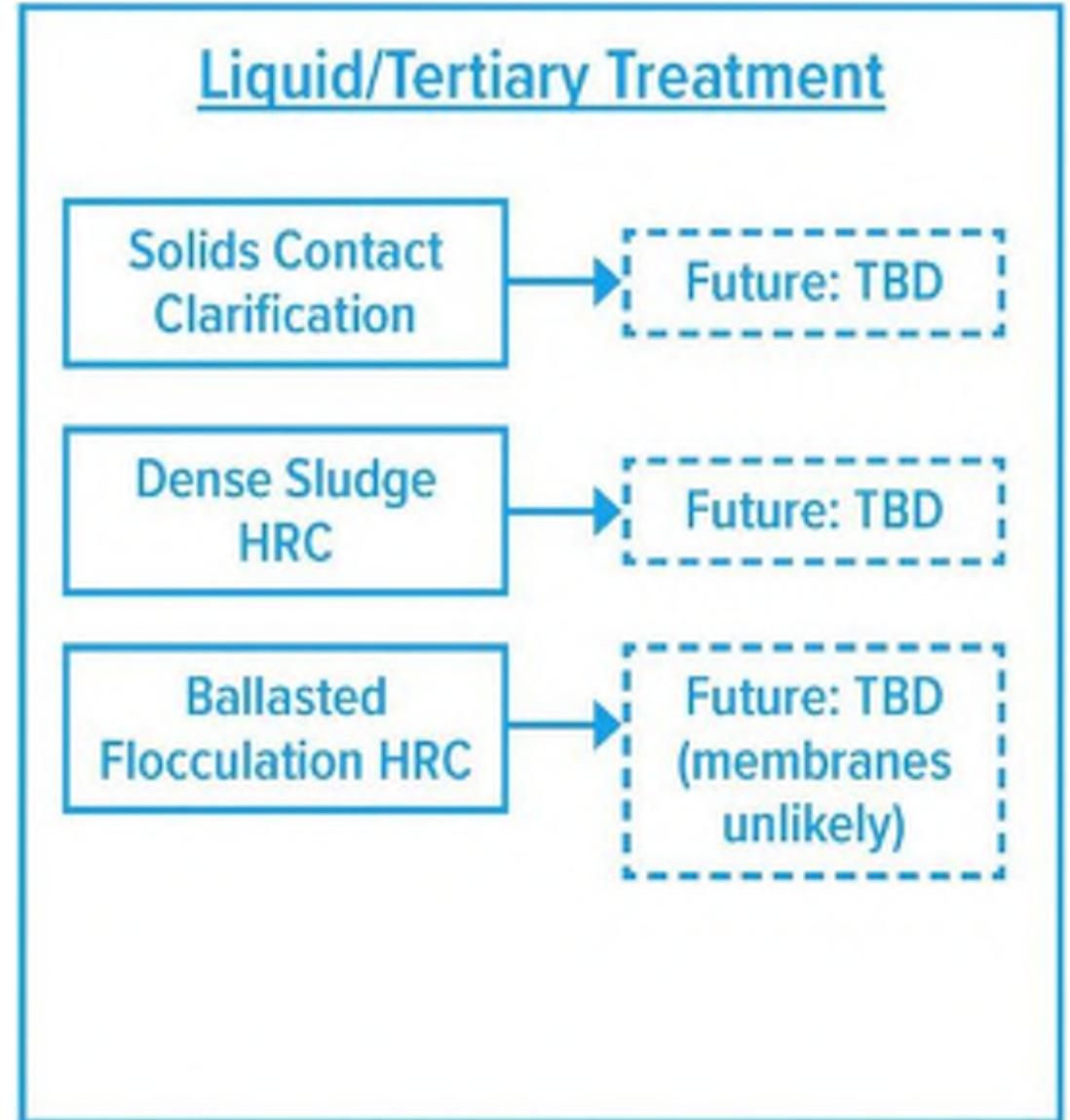


Alternatives Screening

- Filtration:
 - Great for polishing but not preferred due to high chemical solids
 - Consider in future to achieve final metals limits
- Facility tours with operations staff

Selected Alternative:

Solids Contact Clarifier



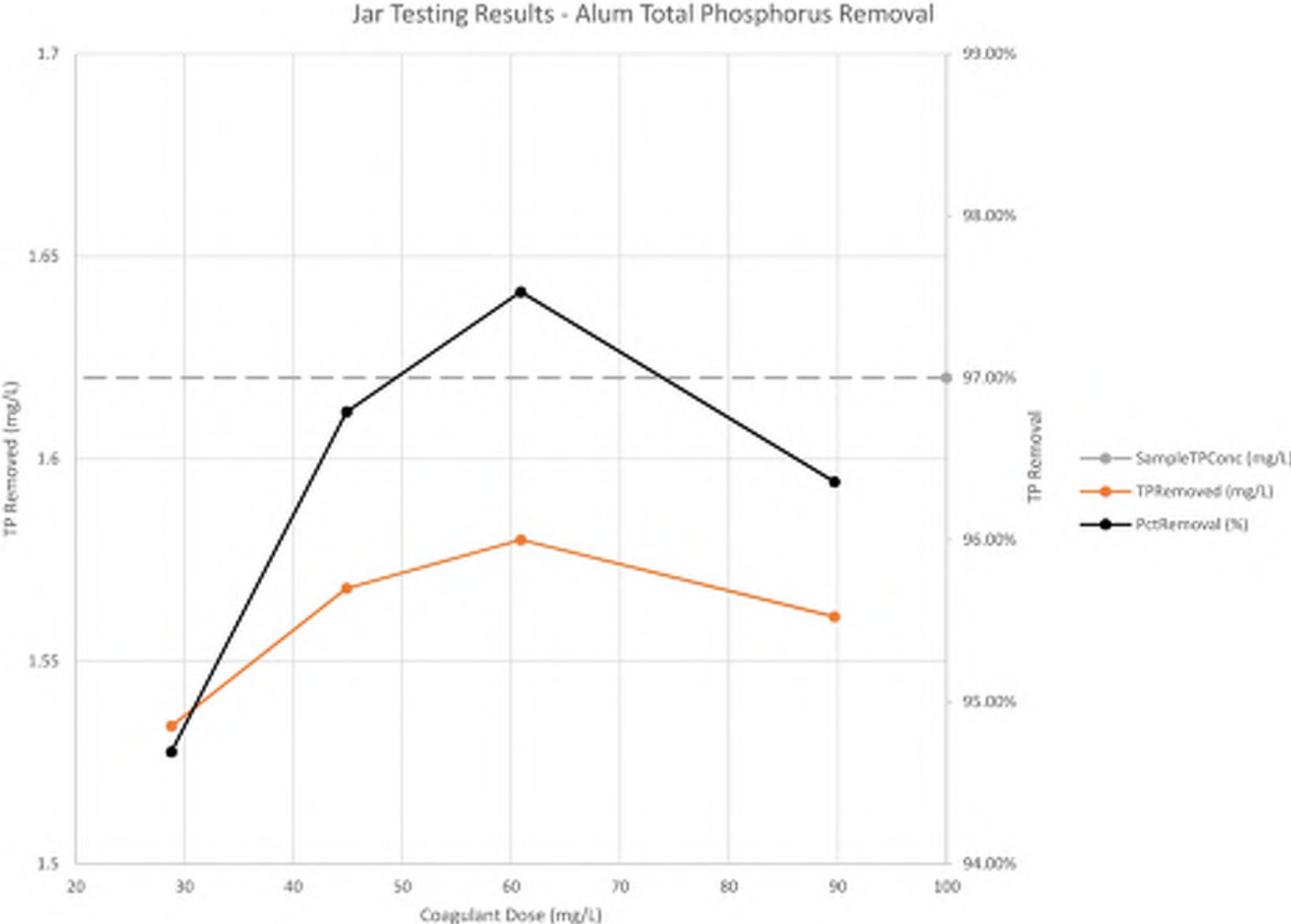
Solids Contact Clarifier



Jar Testing

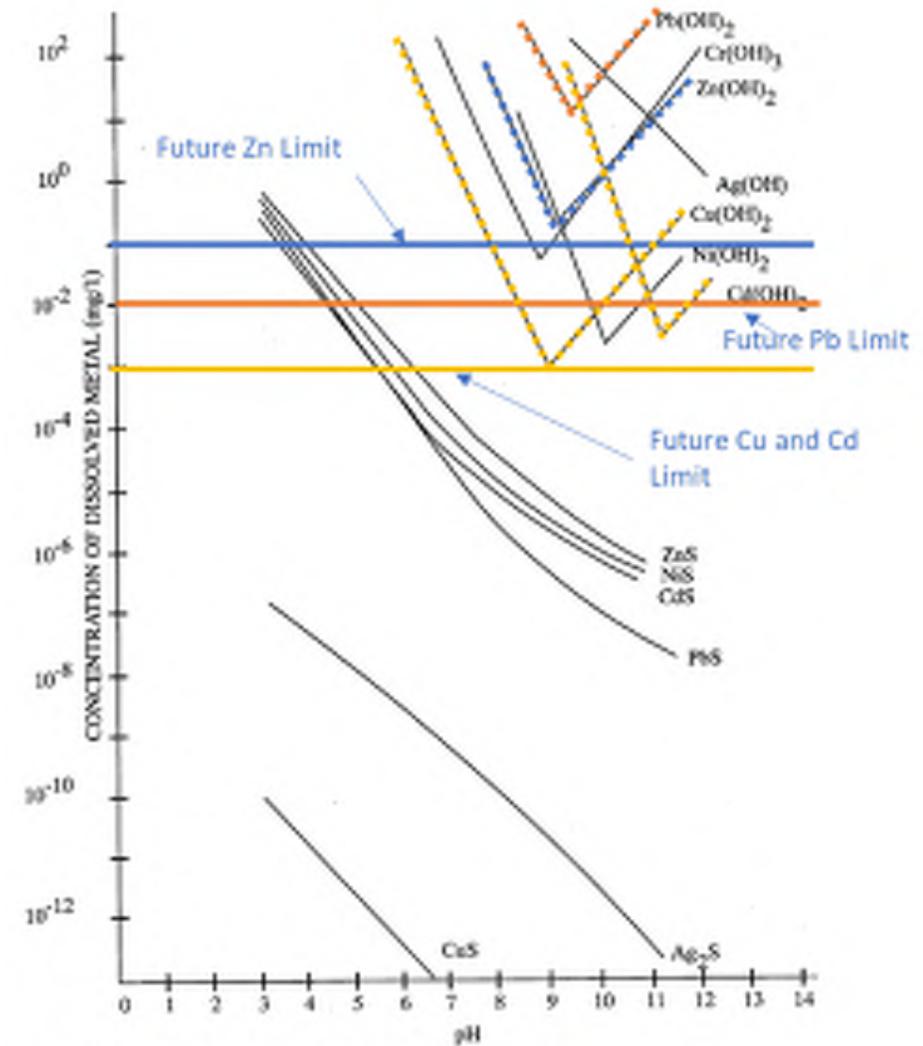


TP Removal - Alum



Metals Removal

- Chemical precipitation - similar to P-Removal
- Typically use lime and sodium hydroxide to raise pH
- Increase pH above minimum solubility (point that metals come out of solution)
- Sulfide precipitation
- Polishing step needed to meet future limits

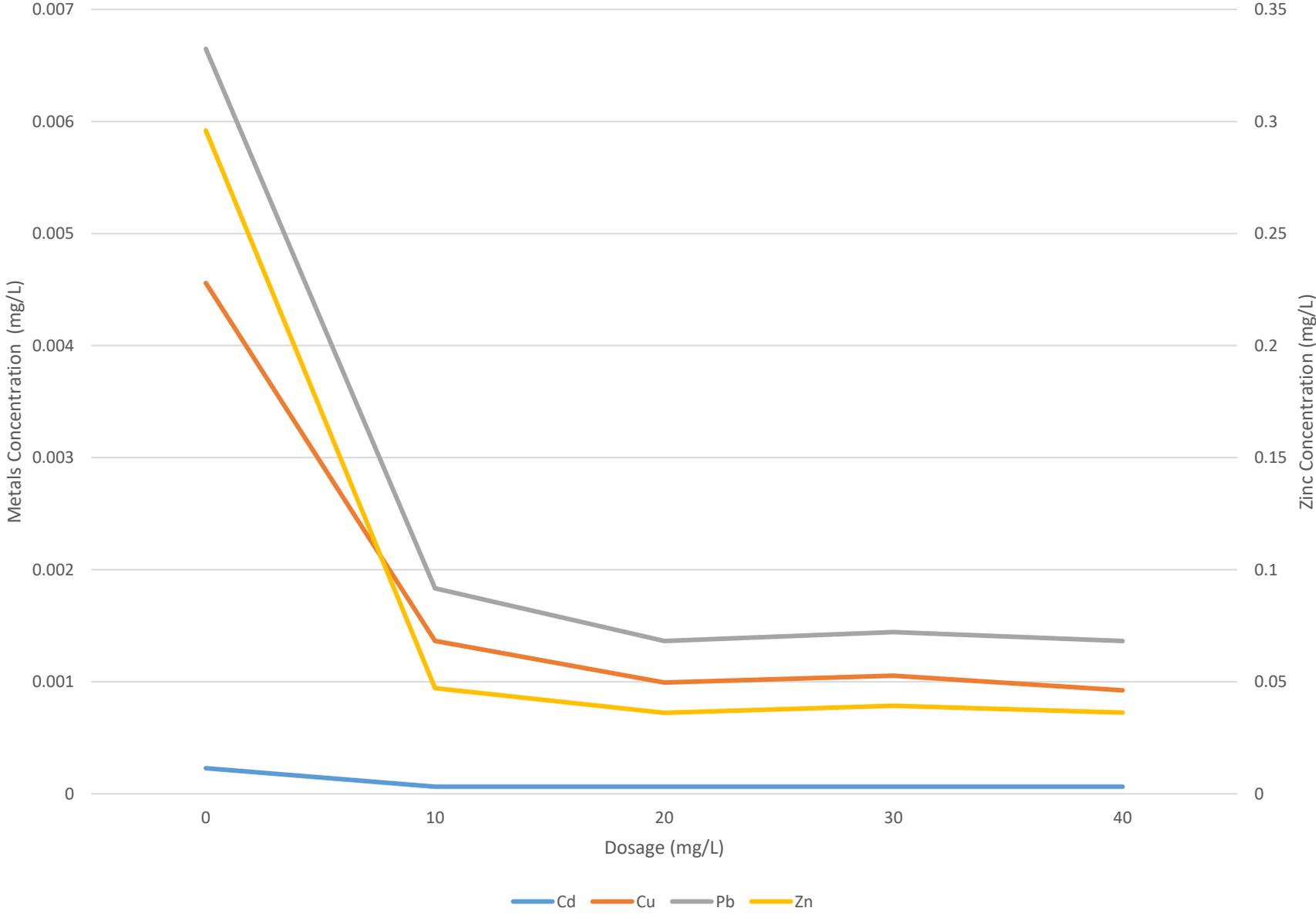


Source: Modified from EPA-600/2-82-011C, 1981

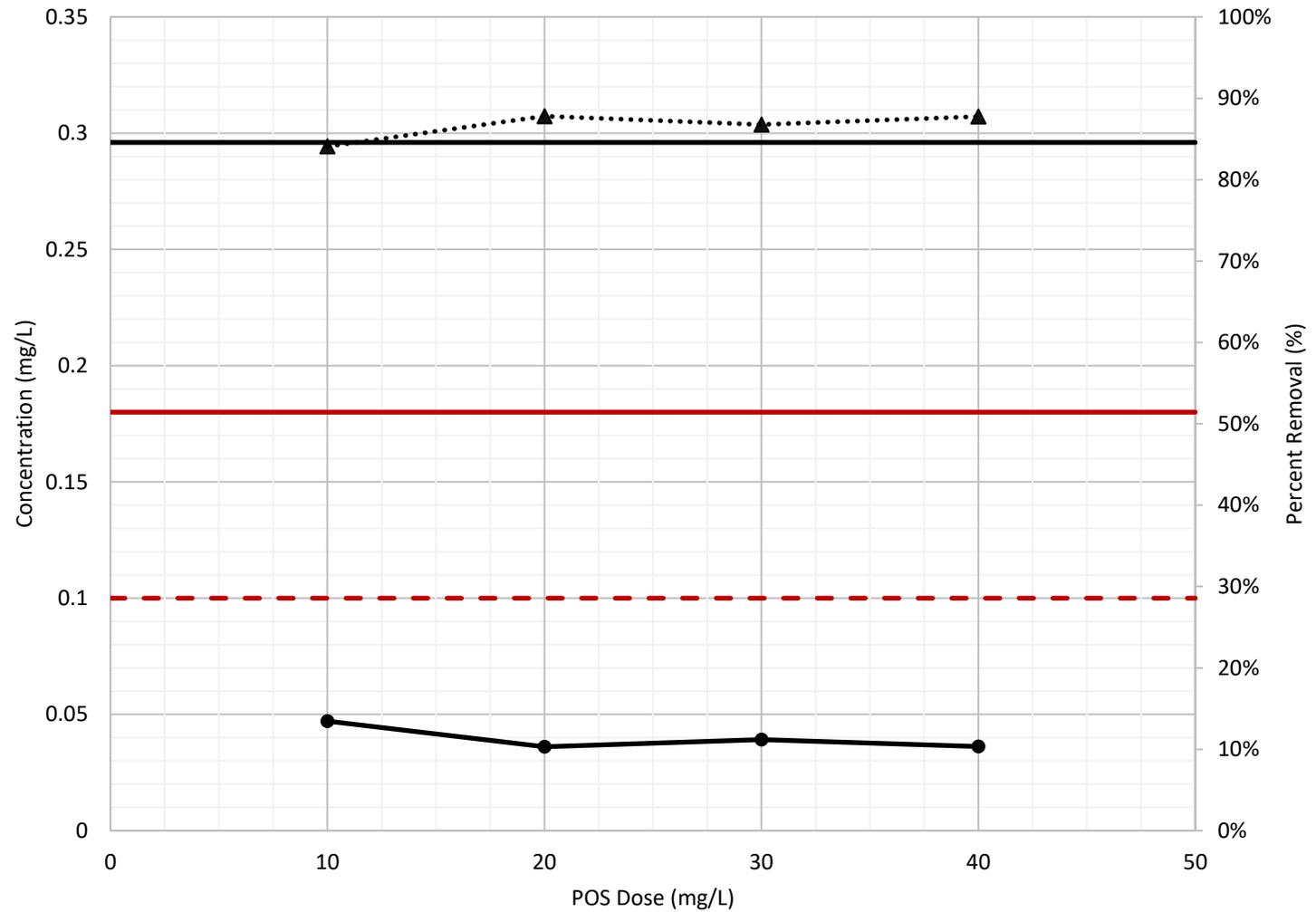
Figure 7 Hydroxide and Sulfide Heavy Metal Solubilities vs pH

Polyorgano Sulfide

Metal Removal with POS



Zinc Removal



— Initial Zn Conc (mg/L) ● SS Zn Conc (mg/L) - - Zn Mo Avg Limit (mg/L)
— Zn Daily Max Limit (mg/L) ▲ Zn PctRemoval (%)

Pilot Testing



Pilot Study Objectives



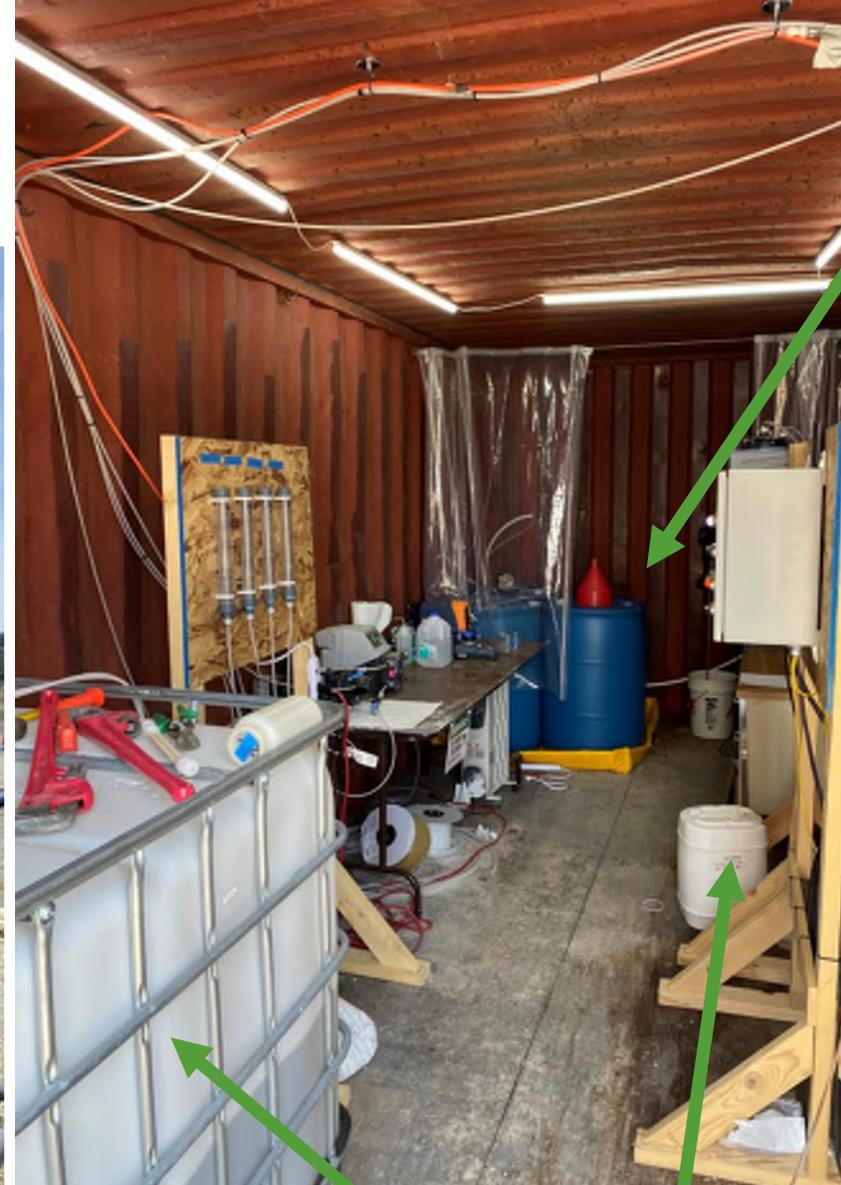
Demonstrate phosphorus removal performance of a SCC treatment and provide data to full scale SCC bidders to facilitate their provision of a performance guarantee. Target – 0.15 mg/l P



Collect data to optimize chemical usage



Investigate metals removal from the SCC process

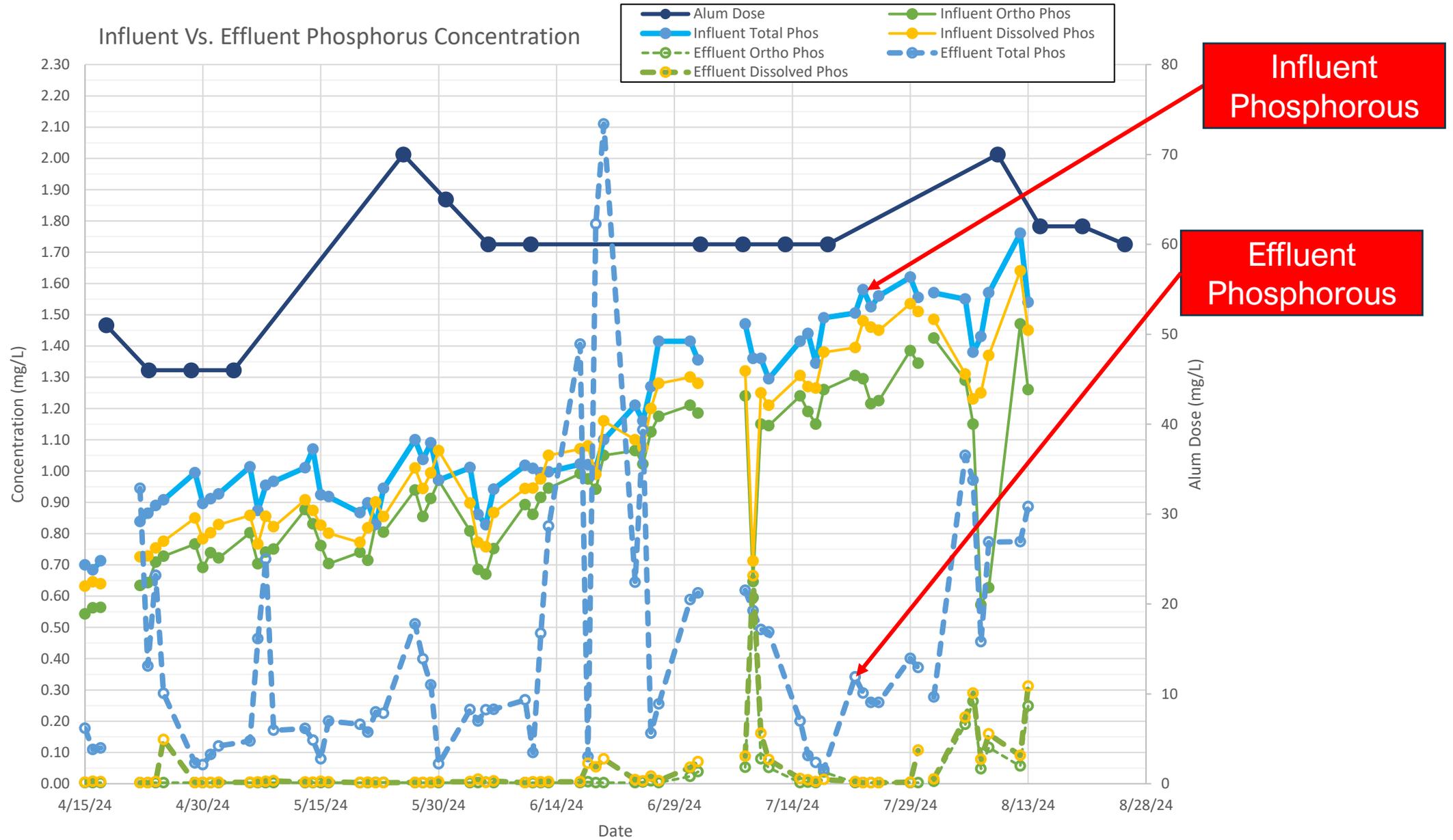


NaOH

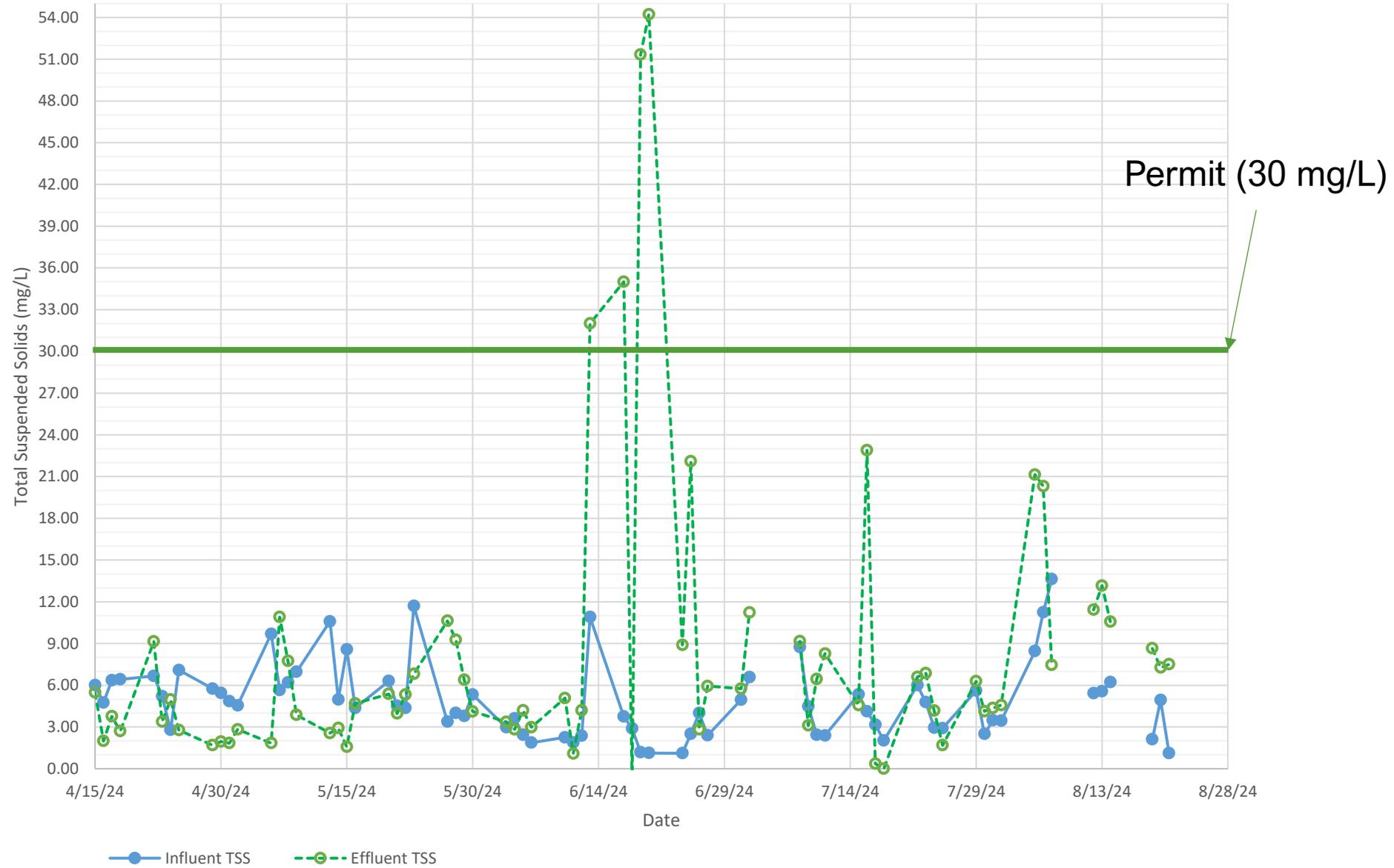
Alum

Polymer &
POS

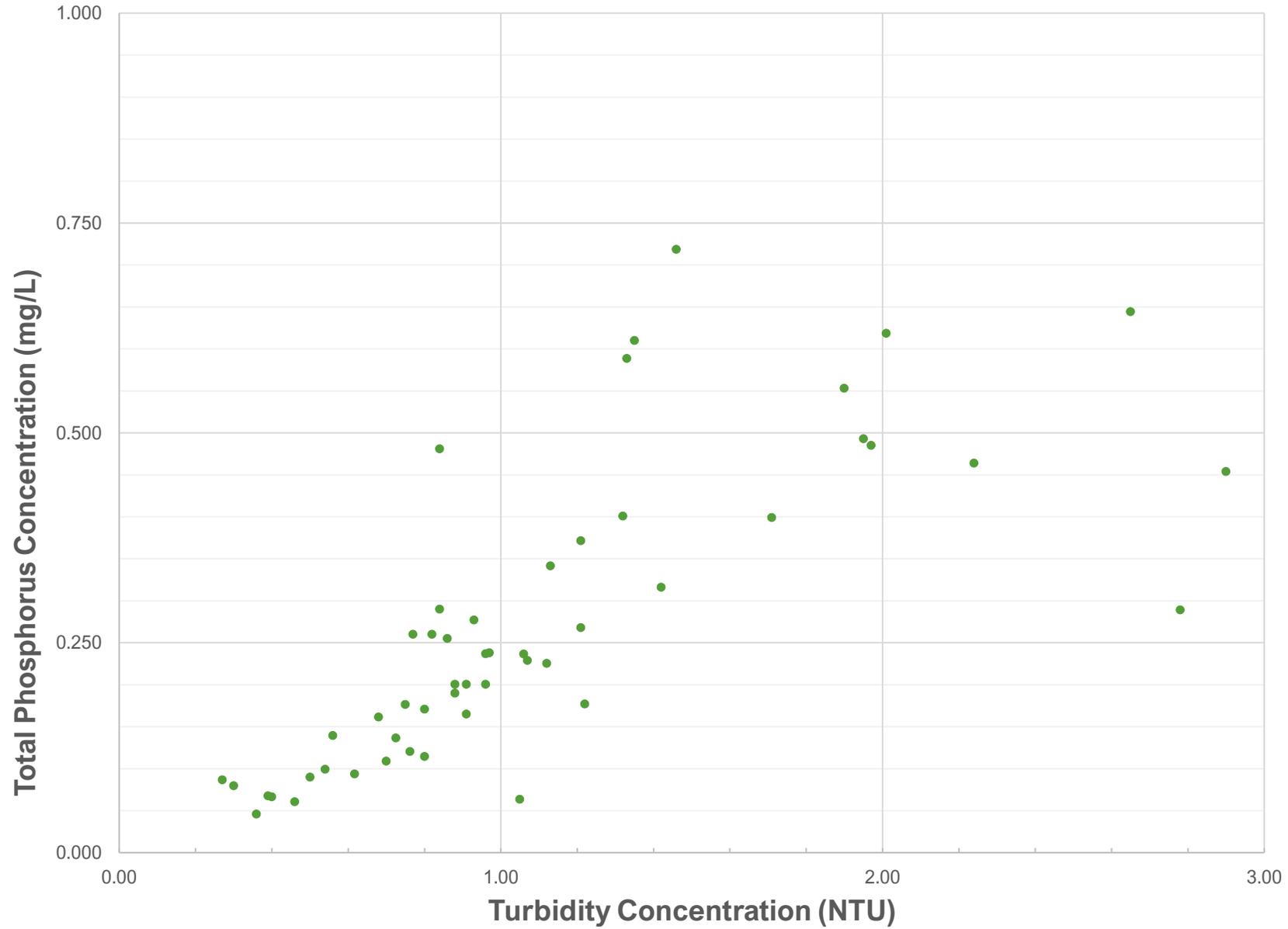
Pilot Results



Influent Vs. Effluent TSS Concentration



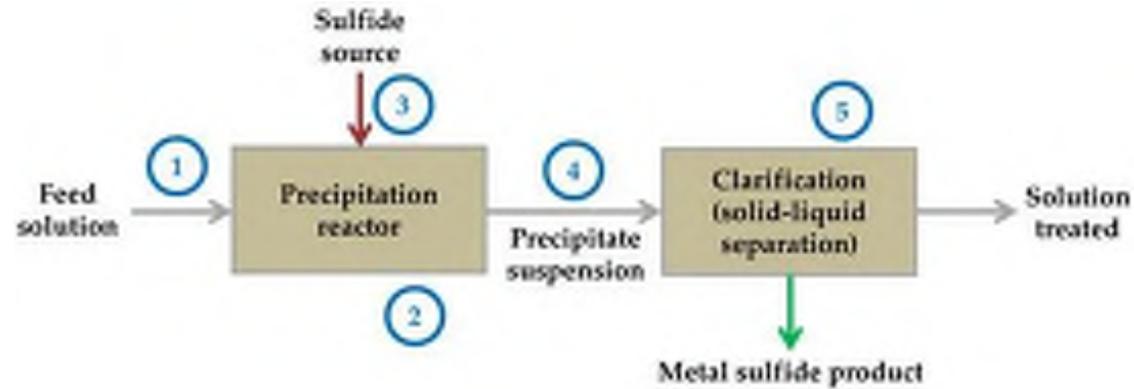
Effluent Total Phosphorus VS. Turbidity



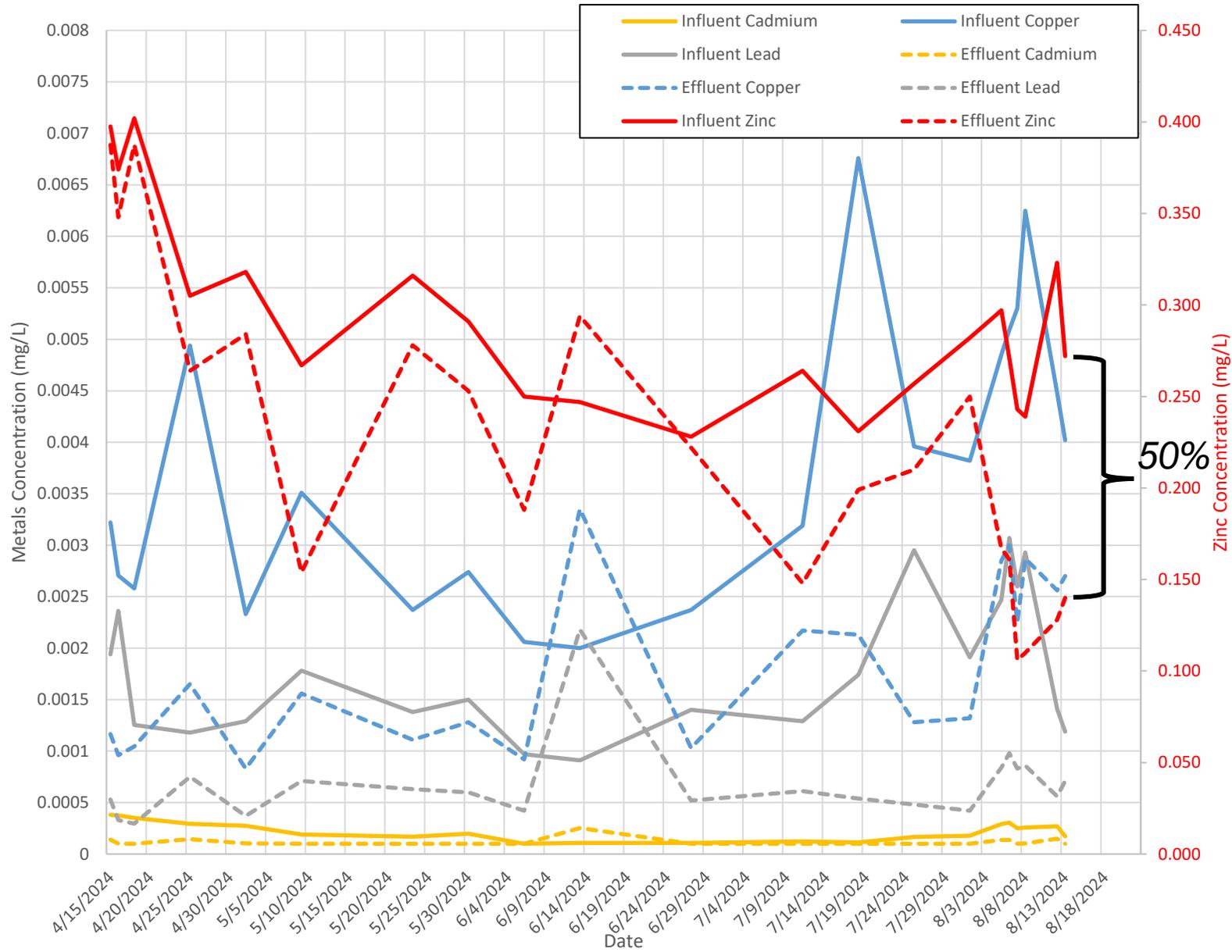
POS Dosage/Feeding

- Dosage: 5 parts POS to 1 part metal (concentration ratio)
- Instantaneous reaction at proper pH, 5-10 minutes if higher than intended pH

Figure 1 - Process for Treating and Feeding Solution



Influent Vs. Effluent Metals Concentration



Lessons Learned - Phosphorus

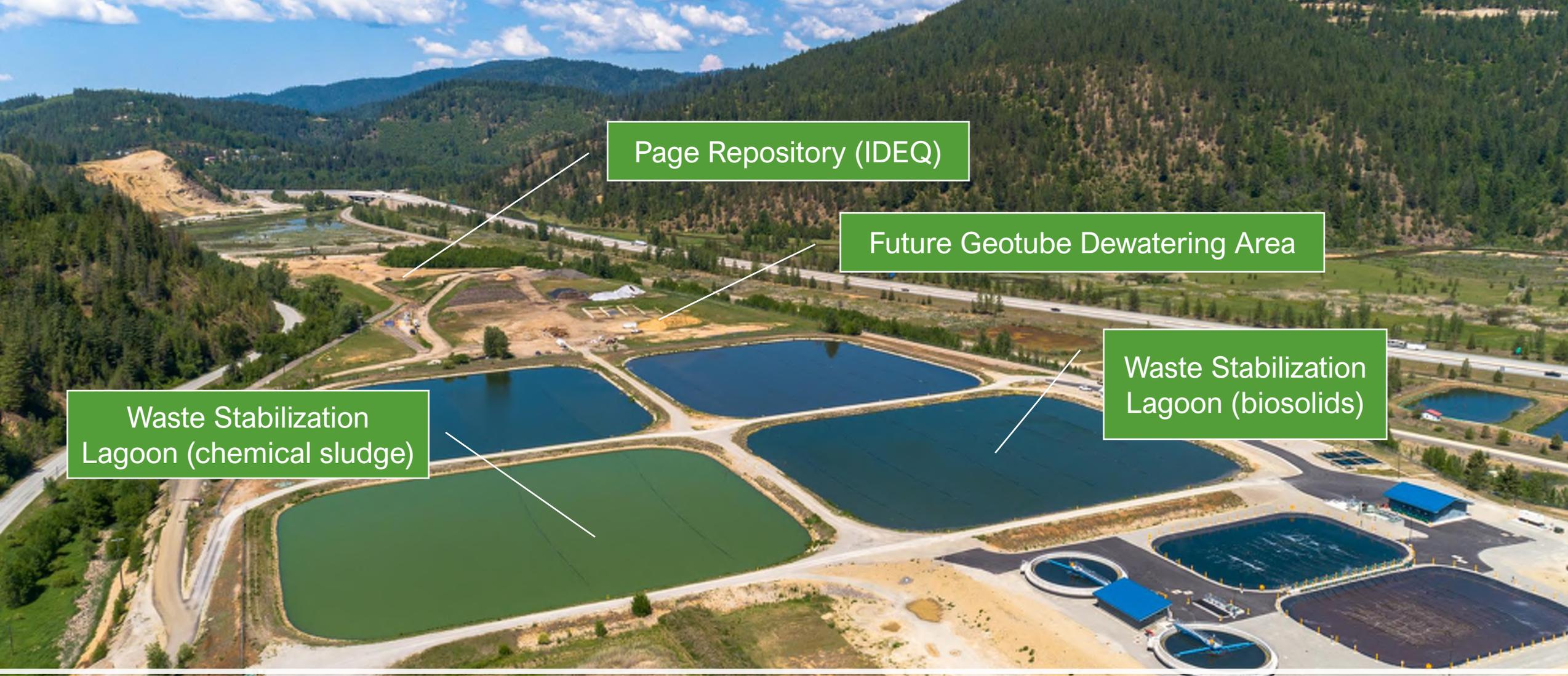
- Pilot scale issues
 - Outliers exist due to small scale which can cause more dramatic changes in readings
- pH control is tough at pilot stage
- Chemical dosing locations are critical
- Managing Solids Inventory in pilot is a challenge
- More reliable effluent target is 0.25 mg/l TP
- Wide temperature swings in pilot unit appeared to affect performance
- Important to balance chemical dosage to avoid bulking floc



Lessons Learned - Metals

- Pb, Cd removal is high with enhanced settling
- Zn removal requires POS
- POS + alum appeared to interfere and reduced performance for both.
- Increased pH helps metals removal





Page Repository (IDEQ)

Future Geotube Dewatering Area

Waste Stabilization Lagoon (chemical sludge)

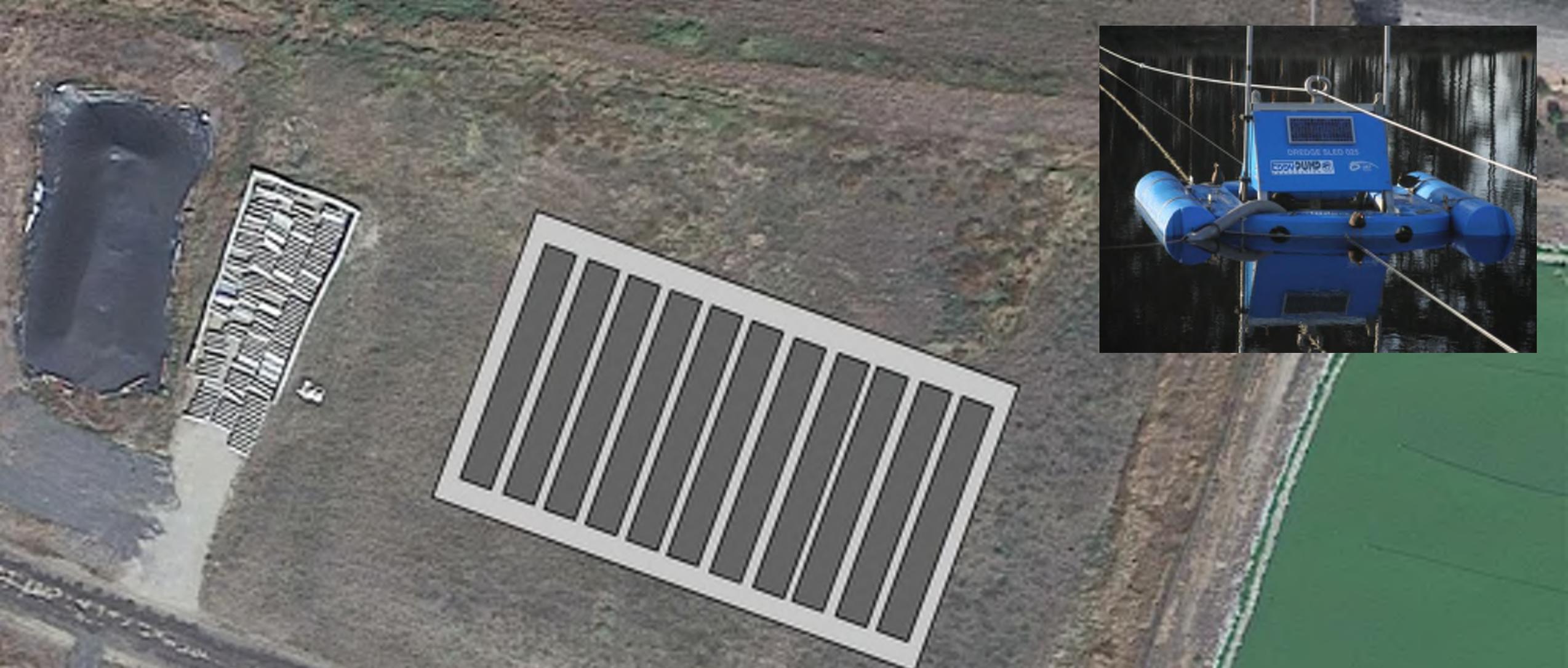
Waste Stabilization Lagoon (biosolids)

Sludge Handling





Lagoon Dredging



Sludge Dewatering



Sludge Dewatering



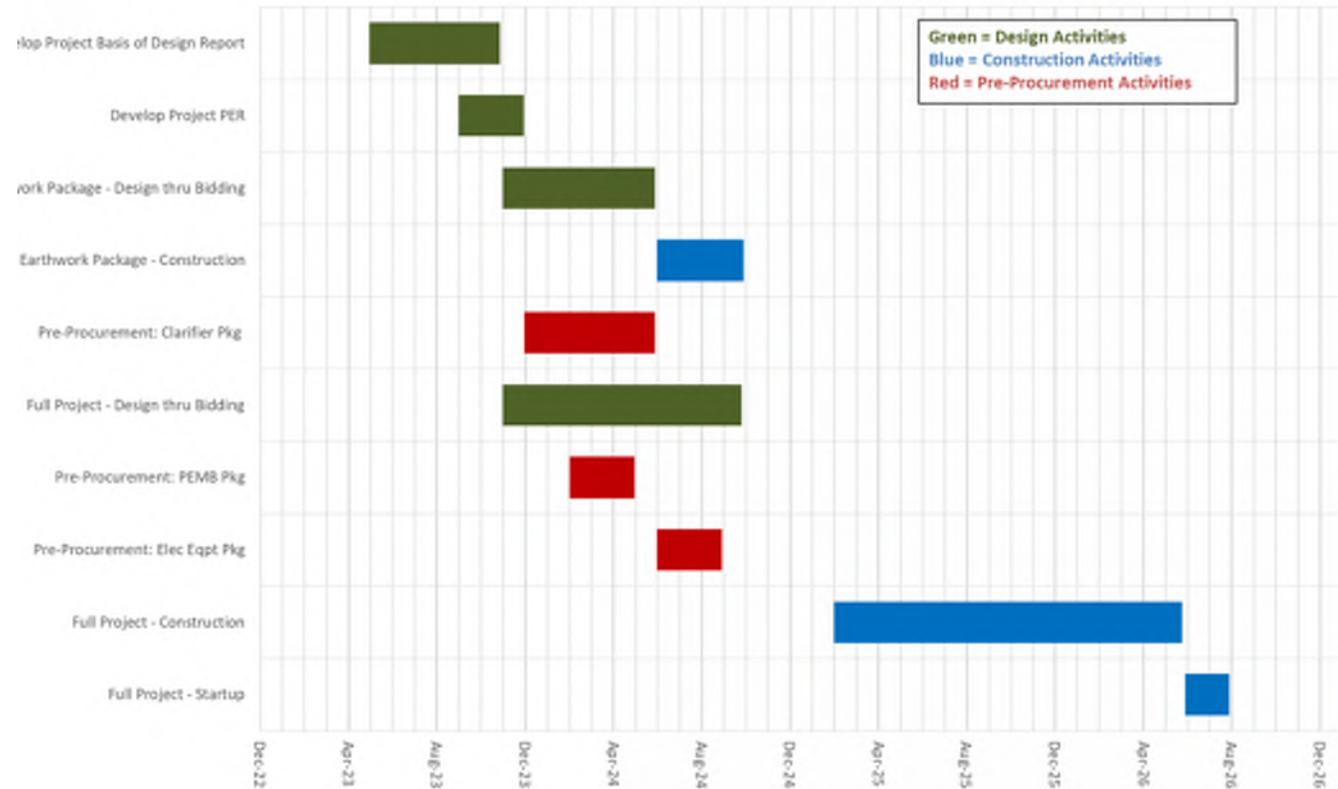


Geotube Dewaterability Testing



Project Phasing

Funding Deadline – Dec. 31, 2026



- Expedited planning and design process
- Multiple engineering firms - focused project “sprints”

Mitigate Project Risk

- Geotechnical challenges – 35-ft depth unconsolidated mine tailings
- Long Material Lead Times
 - PEMB
 - SCC
- Funding Deadline – September 2026



Pre-Procurement

October 2024:
Geotechnical
Improvements
(Big Sky Const.)

October 2024:
Pre-engineered
Metal Building
(Ginno/ PBS)

December 2024:
Solids Contact
Clarifier
(WesTech)

Geotechnical Phase

- Early construction phase at 60% design to prep site
- Pre-qualified aggregate pier installers
- Reduce bidder uncertainty
- Reduce risk of inclement weather
- Expedite construction start



PEMB

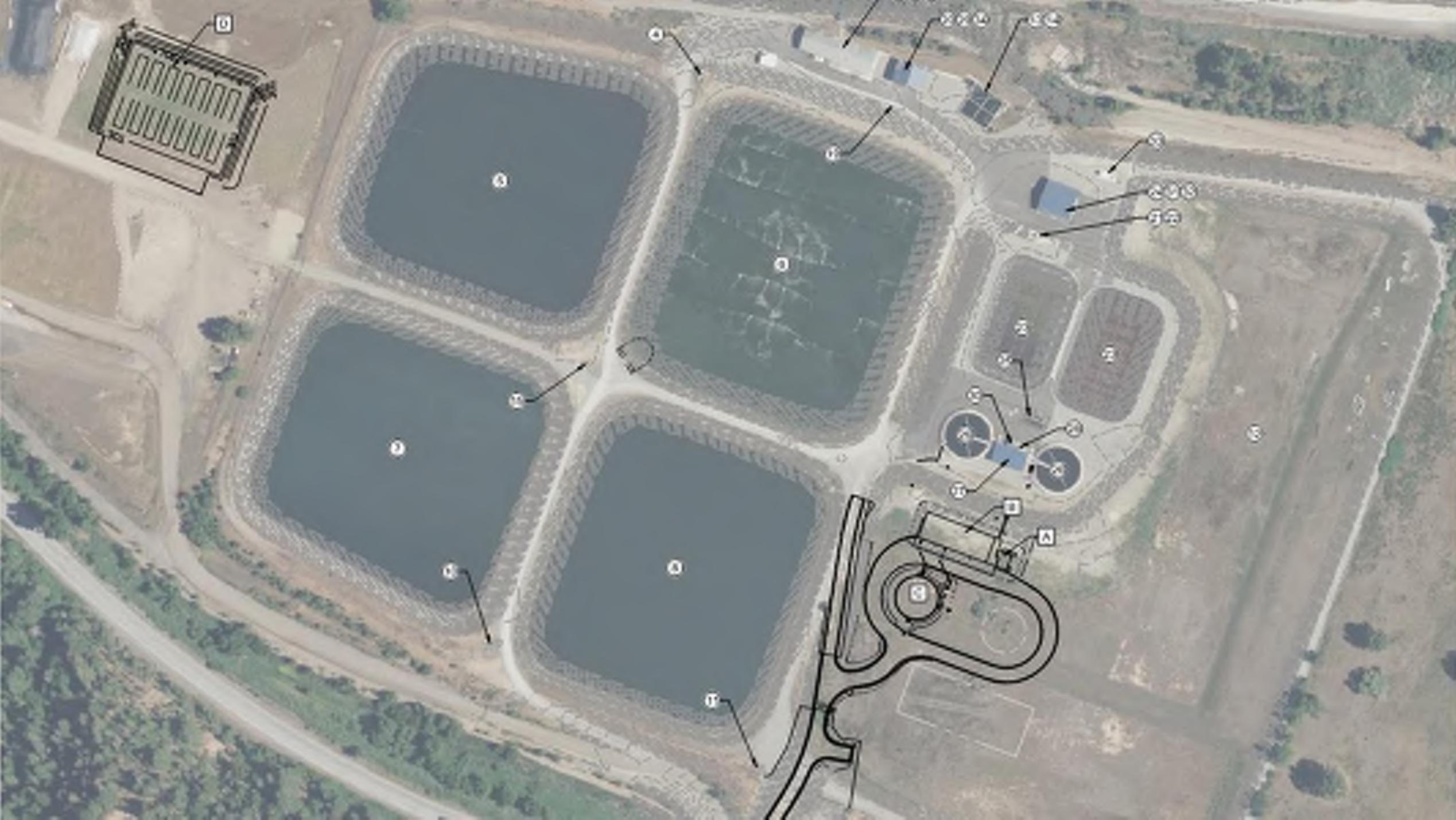
- Pre-Engineered Metal Building
- Price and qualification proposals (Category B)
- Building supplier coordination with structural engineer during design
- Owner purchase materials, Contractor install

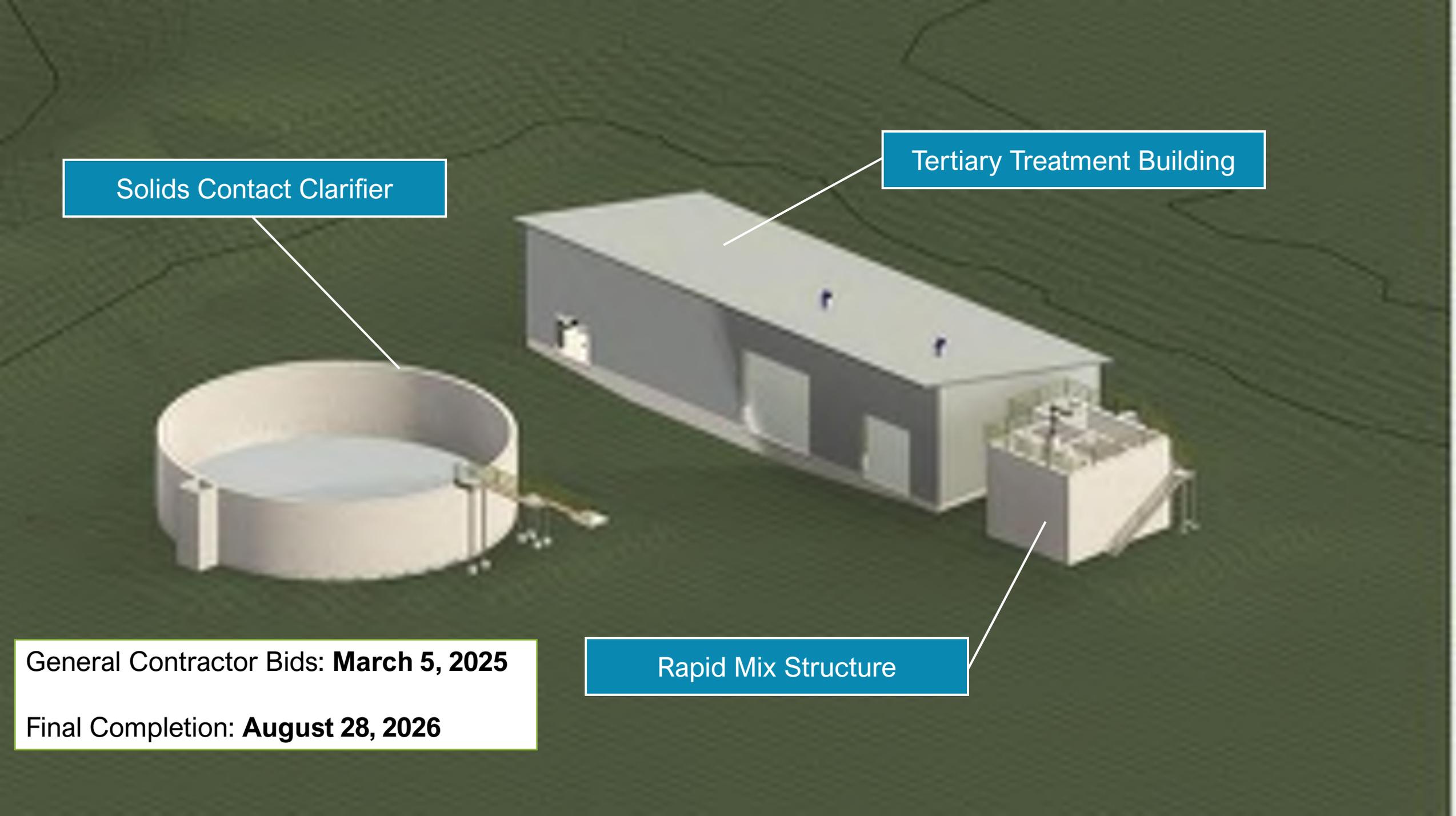


SCC

- Solids Contact Clarifier
- Early submittal review
- Early fabrication
- Optimize design







Solids Contact Clarifier

Tertiary Treatment Building

Rapid Mix Structure

General Contractor Bids: **March 5, 2025**

Final Completion: **August 28, 2026**



Project Budget

Phosphorus Reduction Grant:
\$17M

Davis-Bacon Wage Compliance:
\$1.2M

Smelterville Annexation:
\$3.2M

Total Project:
\$21.4M

Page WWTP Tertiary Treatment Project - Budget Summary

Funding	Orig. Budget	Current Budget
Leading Idaho Grant - Phosphorus Removal	\$ 17,000,000	\$ 17,000,000
Leading Idaho Grant Subaward Amendment - Prevailing Wage	\$ -	\$ 1,200,000
Total		\$ 18,200,000

Costs	Orig. Budget ¹	Current Budget
Design (J-U-B ENGINEERS, Inc.)	\$ 1,700,000	\$ 2,032,800
Construction Management Services (J-U-B ENGINEERS, Inc.) ³	\$ 1,700,000	\$ 1,429,200
Pilot Rental & Pilot Report (WesTech)	\$ -	\$ 23,932
Pilot Materials & Supplies, Legal, Misc. (SFSD)	\$ -	\$ 148,562
Soil Stabilization (Big Sky Construction)	\$ 1,656,800	\$ 793,729
SCC Procurement (WesTech)	\$ 2,552,300	\$ 1,069,130
SCC Procurement (CO#1 - Local Control Station)	\$ -	\$ 12,784
PEMB Procurement (Ginno) + Sales Tax	\$ 525,600	\$ 347,362
PEMB Canopy CO#1 (Ginno)	\$ -	\$ 11,385
Construction Wage Monitoring (Panhandle Area Council)	\$ 170,000	\$ 150,000
District-Provided Resident Project Representative ³	\$ -	\$ 318,875
Materials Testing and Special Inspections (TBD)	\$ 85,000	\$ 100,611
Building Permit		\$ 10,250
Phase II Construction (Clearwater Construction)	\$ 8,200,300	\$ 11,102,375
Construction Contingency (5%)	\$ 410,000	\$ 555,000
Total	\$ 17,000,000	\$ 18,105,995
Tertiary Treatment Project Funding Budget Balance		\$ 94,005

Smelterville Annexation - Budget Summary

Funding	Orig. Budget	Current Budget
Leading Idaho Grant Subaward Amend. - Smelterville Annexation	\$ -	\$ 3,200,000
Total		\$ 3,200,000

Costs	Orig. Budget	Current Budget
Hydraulic Analysis (J-U-B ENGINEERS, Inc.)	\$ -	\$ 39,000
Financial Impact Analysis (FCS Group)	\$ -	\$ 18,205
Total		\$ 57,205
Smelterville Annexation Funding Budget Balance		\$ 3,142,795

Project Classification	Priority Rating - Project Number	Project Description	Cost Est.	Cost Est.	Cost Est.	Future
			High Priority	Medium Priority	Low Priority	
Smelterville	1-1	Smelterville Collection System Cleaning & CCTV	\$ 100,000			
Smelterville	1-2	Smelterville Collection System GIS	\$ 25,000			
Smelterville	1-3	Data Logger for Smelterville Flow Meter	\$ 1,095			
Smelterville	1-4	Smelterville Hydraulic Analysis	\$ 39,000			
Smelterville	1-5	Smelterville Financial Analysis	\$ 18,200			
Smelterville	1-6	Connect Smelterville (design only)	\$ 100,000			
Smelterville	1-7	Smelterville WWTP Alternatives Evaluation & Design Package	\$ 50,000			
WWTP Maintenance	1-9	Lagoon Aeration	\$ 12,000			
WWTP Maintenance	1-10	Mini-Dredge	\$ 600,000			
WWTP Maintenance	1-11	Forklift	\$ 99,000			
WWTP Maintenance	1-12	CCC Coatings	\$ 7,500			
WWTP Maintenance	1-13	Chlorine Analyzers	\$ 75,000			
WWTP Maintenance	1-14	Seepage Test Lagoons	\$ 25,000			
WWTP Maintenance	1-15	Power to Page Lift Station	\$ 75,000			
WWTP Maintenance	1-16	Page Headworks Generator Auxiliary Tank	\$ 25,000			
WWTP Maintenance	2-1	Headworks Improvements (MCC & HVAC)	\$ 75,000			
WWTP Maintenance	2-2	Spare Influent Pump (40 hp)		\$ 40,000		
WWTP Maintenance	2-3	Septage Receiving, Automatic Gate & Security	\$ 100,000			
WWTP Maintenance	2-4	Page Lab Updates		\$ 50,000		
WWTP Maintenance	3-1	Line Lagoon			\$ 2,000,000	
WWTP Maintenance	1-25	Polymer Trailer	\$ 125,000			
WWTP Maintenance	1-26	Geotube bags	\$ 72,000			
WWTP Maintenance	1-27	Computer System & Network Upgrades	\$ 70,000			
WWTP Maintenance	1-28	Skidsteer	\$ 75,000			
Collection System Maintenance	1-17	Jet Truck	\$ 320,000			
Collection System Maintenance	1-18	Gulch Flow Meters	\$ 125,000			
Collection System Maintenance	1-19	Inflow Pans (District & Cities)	\$ 45,000			
Collection System Maintenance	1-20	Smartcovers	\$ 25,000			
Collection System Maintenance	1-21	Disconnect Sump Pumps	\$ 250,000			
Collection System Maintenance	1-22	Disconnect Roof Drains	\$ 250,000			
Collection System Maintenance	1-24	Push Camera & Locate Detectors	\$ 20,000			
Collection System Maintenance	2-5	Mr. Manhole		\$ 100,000		
Collection System Maintenance	3-2	Vac Truck			\$ 700,000	
Collection System Maintenance	3-3	CCTV Truck			\$ 350,000	
Collection System Maintenance	1-29	Tanker Truck	\$ 250,000			
Collection System Maintenance	1-30	ZipCam	\$ 70,000			
Future Permit Compliance	1-23	Hyporheic Discharge Analysis	\$ 300,000			
Future Permit Compliance	2-6	Metals Pilot		\$ 400,000		
Smelterville	F-1	Smelterville Connection (Construction)				\$ 500,000
Future Permit Compliance	F-2	WWTP Property Purchase	\$ 378,000			
Smelterville	F-3	Smelterville Lagoon Decommissioning				
Total Cost Est. (each priority)			\$ 3,802,000	\$ 590,000	\$ 3,050,000	\$ 500,000
Total All Project Costs (High, Medium, Low)			\$ 7,942,000			
Total All Project Costs (High, Medium)			\$ 4,392,000			



Questions