Stantec

Knock Out, Drag Out Fight: Centrifuge vs. Belt Filter Press - Title for Best Dewatering Technology to Squeeze Biosolids at William. E. Dunn Water Reclamation Facility

NC One Water Conference

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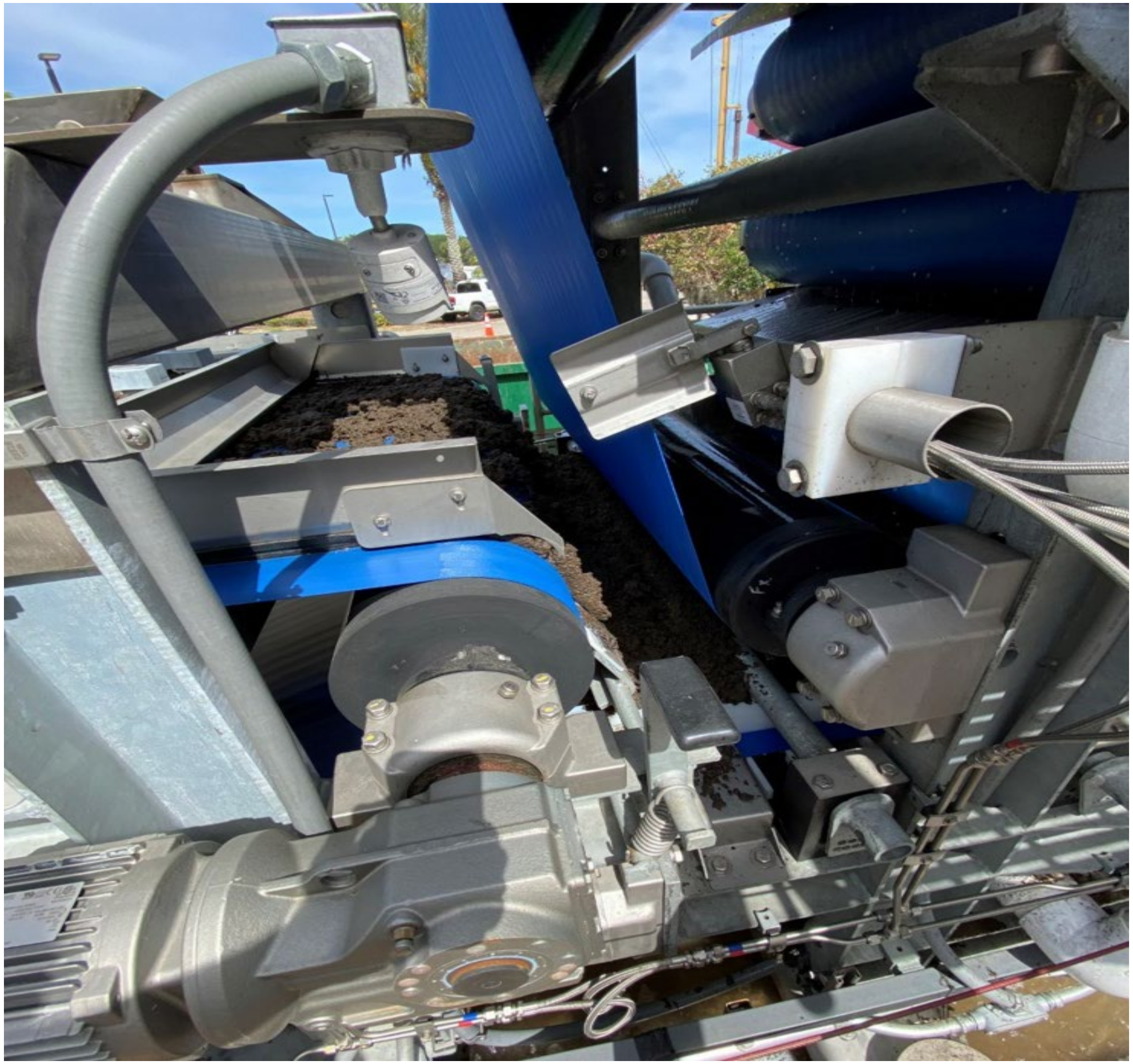
Pinellas County

NC ONE WATER

NO WATER NO JAVA

2024 ANNUAL CONFERENCE NOVEMBER 3-6, 2024 RALEIGH, NC



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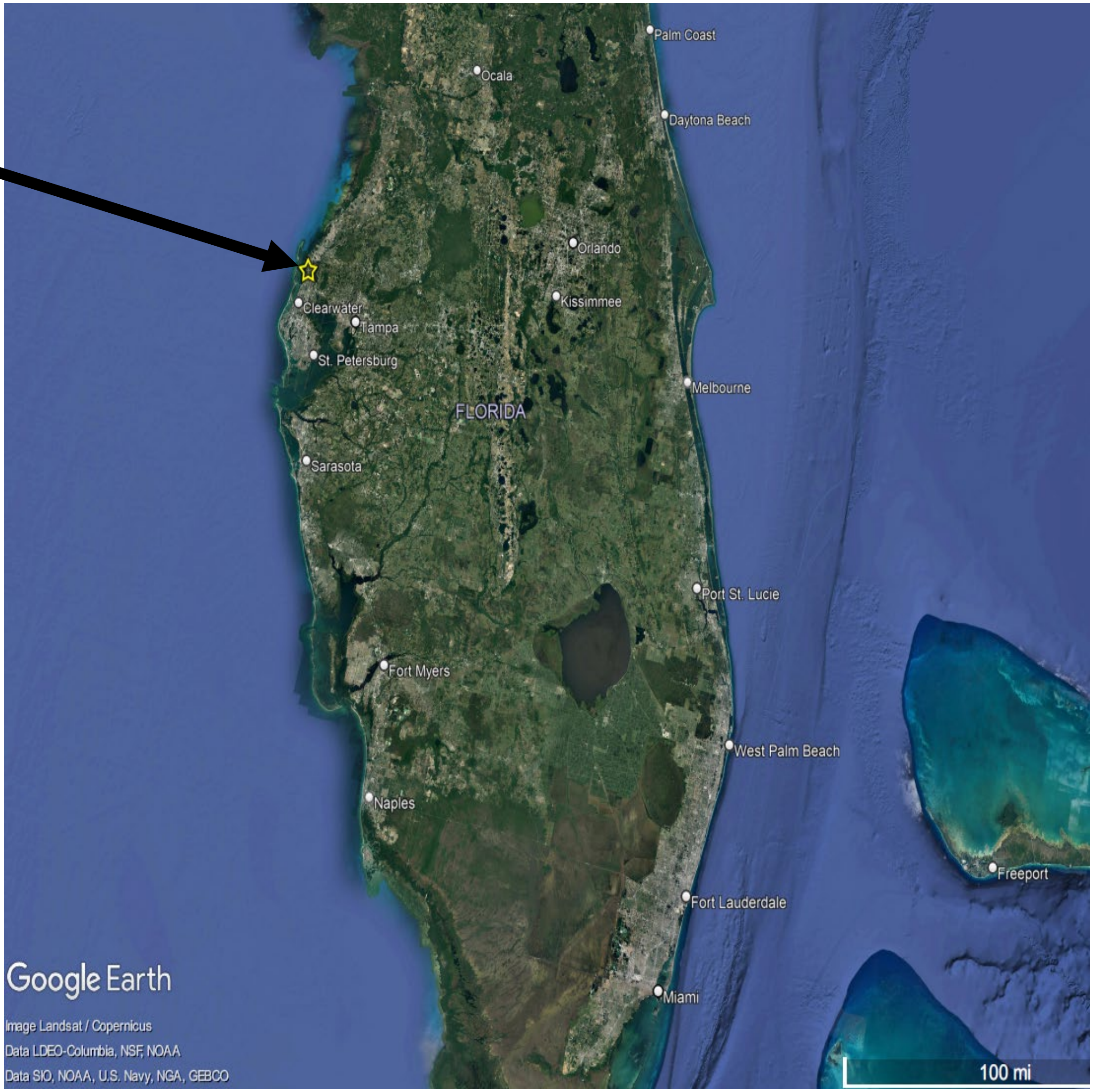
WEDWRF Facility Background

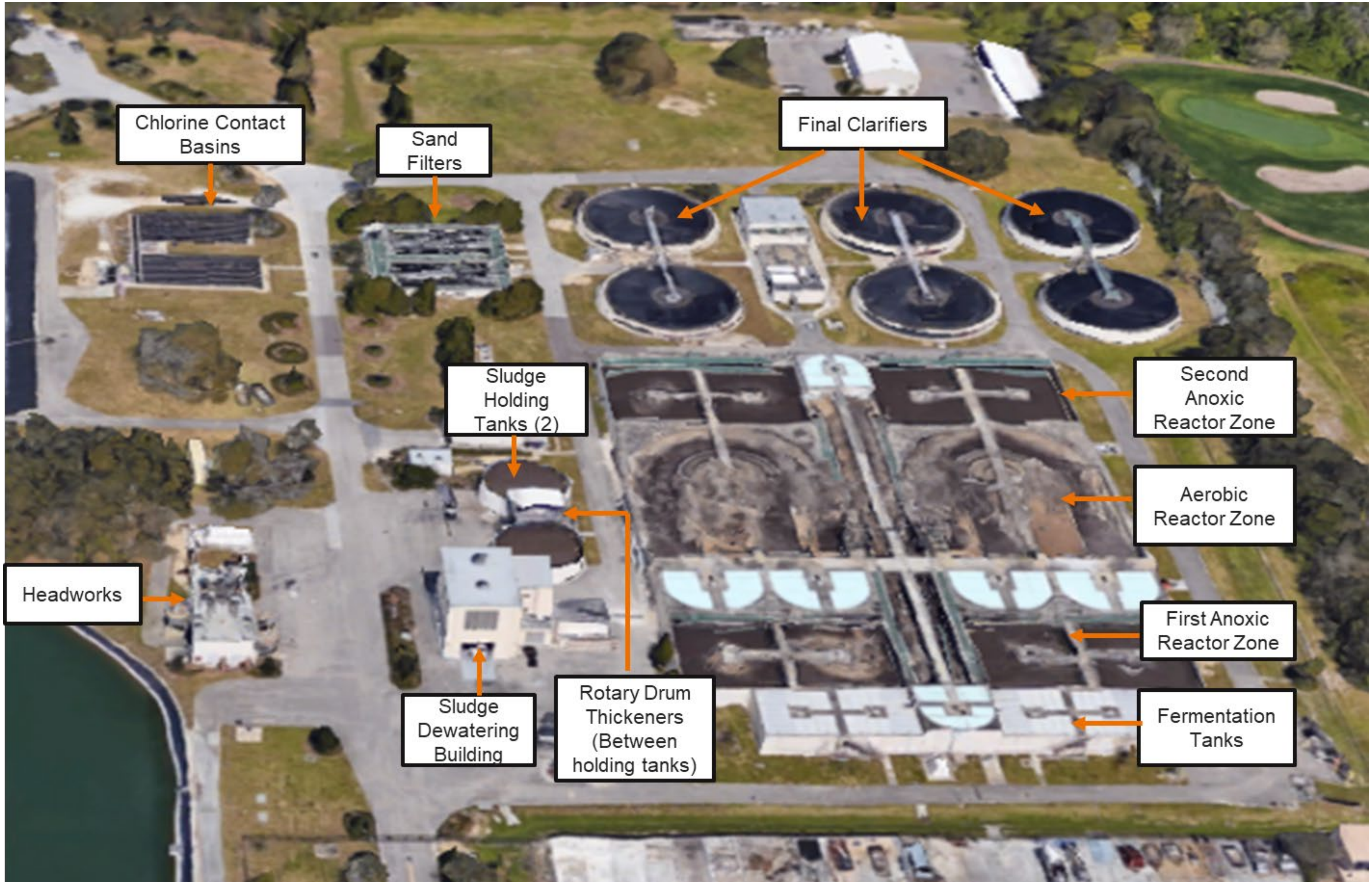
Facility Background

William E Dunn Water Reclamation Facility, Pinellas County, Florida

Parameter	Value
Annual Average Daily Flow	6.5 MGD
Ultimate Design Capacity	9.0 MGD
Biological Nutrient Removal Process	5-stage-Bardenpho
Existing Solids Thickening	Rotary Drum Thickeners (RDT)
Existing Solids Dewatering	Belt Filter Press
Existing Solids Disposal	Offsite thermal drying



Facility Overview



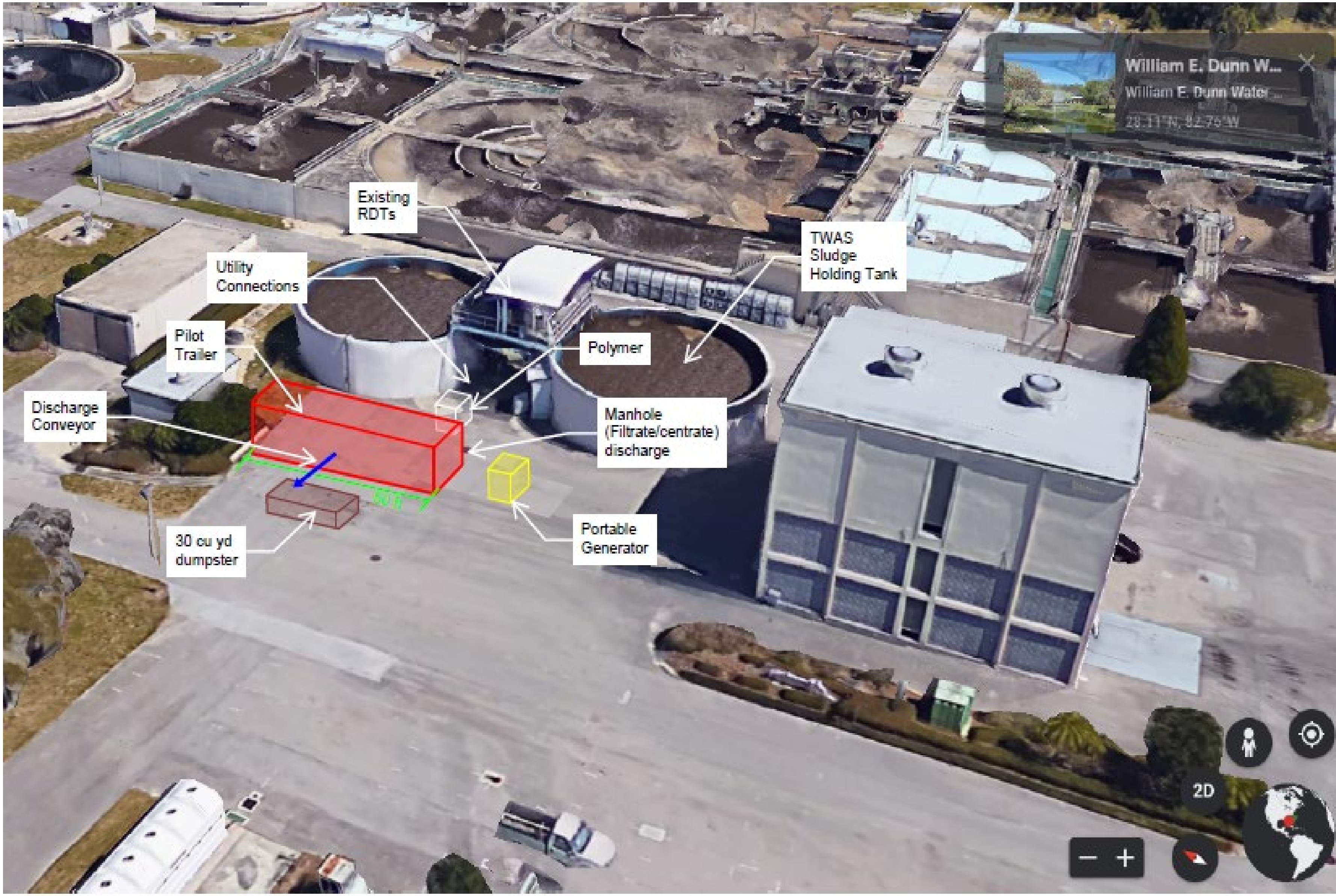
Pilot Testing Objective

Pilot Testing Objectives

- Evaluate the performance of BFP and Centrifuge to dewater TWAS and WAS by bypassing the RDT
- Optimize the polymer dosage range to maximize cake solids and solids capture
- Perform life cycle cost analysis for full scale dewatering improvement alternatives

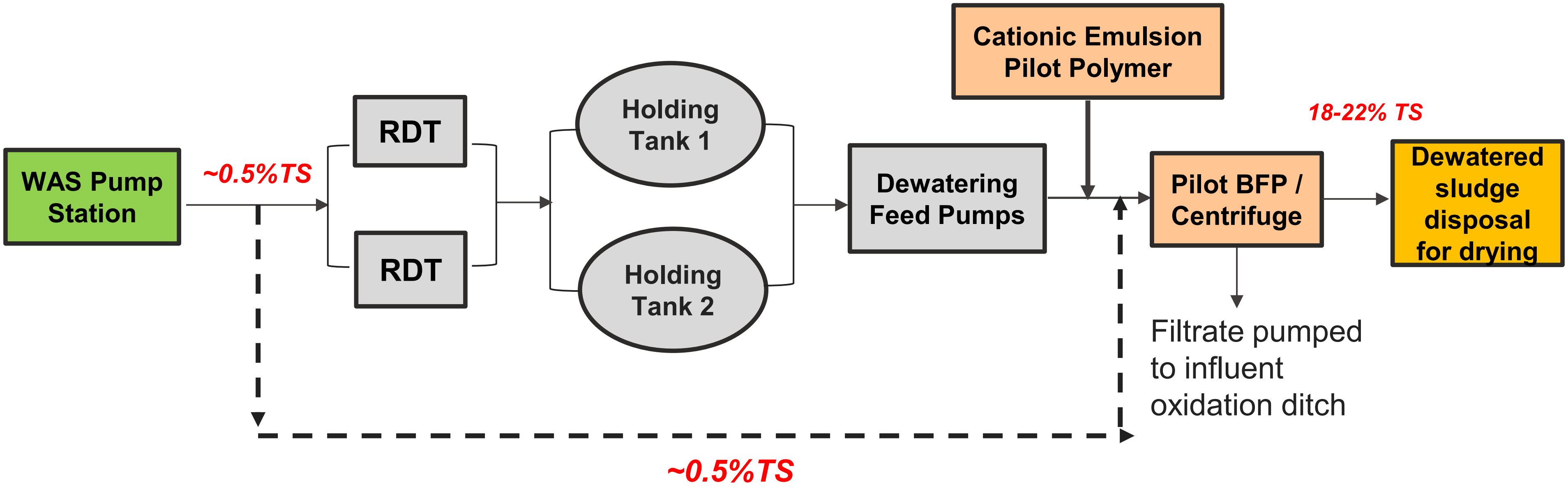
Pilot Testing Overview

Pilot equipment Set-up



Pilot Evaluation PFD

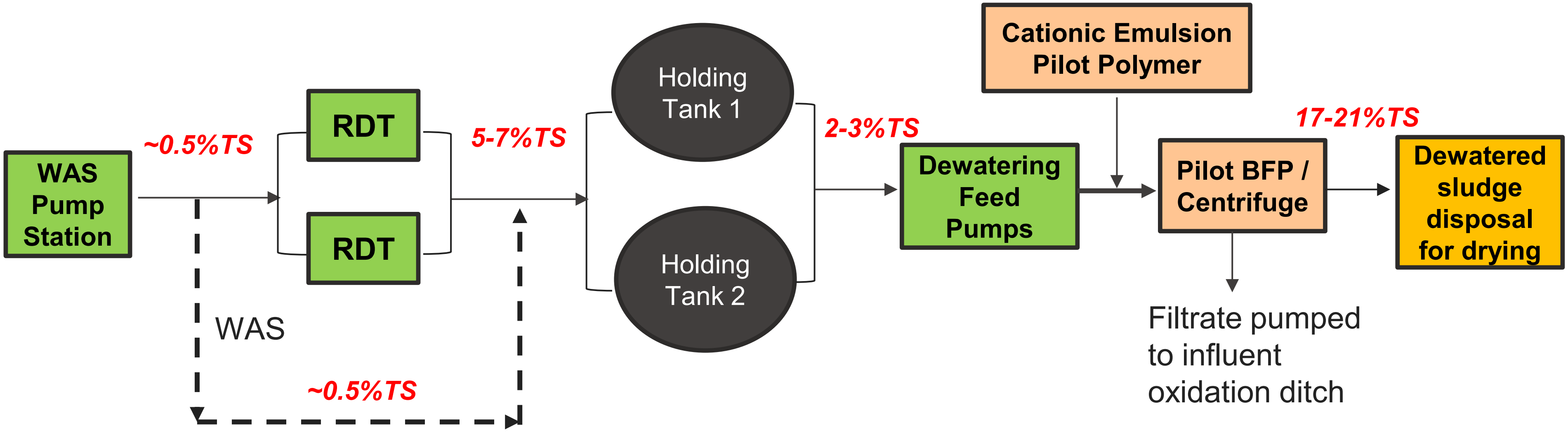
Option 1 – Dewatering Waste Activated Sludge



Completely Bypassing RDT

Pilot Evaluation PFD

Option 2 – Dewatering Thickened Waste Activated Sludge



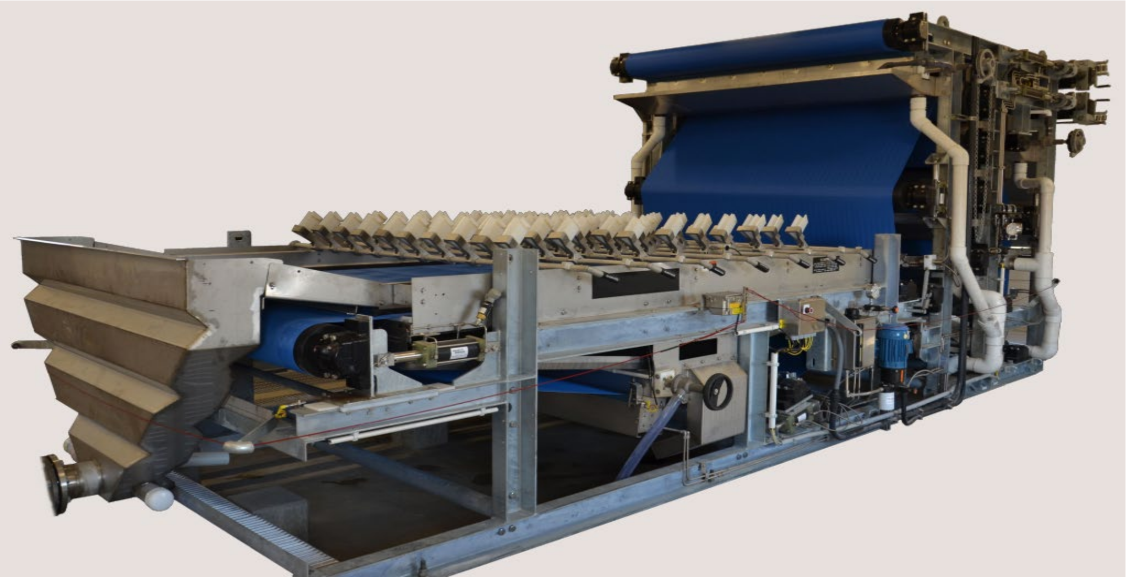
Portion of WAS Bypassing RDT

Pilot Testing Summary

Alfa Laval – 3-Belt Filter Press Summary

Pilot Testing Period - April 18 – April 27, 2023

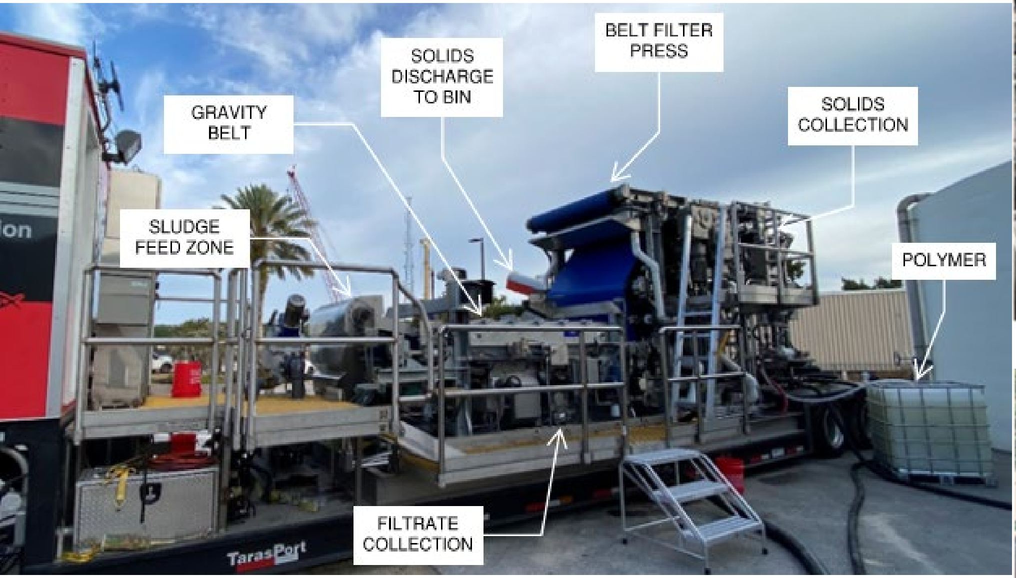
Parameter	WAS (~0.5% TS)	TWAS (~2.5% TS)
Testing Period	April 18 – 20, 2023	April 25 – 27, 2023
Hydraulic Loading (gpm)	170 – 225	50 – 73
Solids Loading (lb/hr)	436 – 942	600 – 1,000
Polymer	Clarifloc SE – 1692 (Existing plant polymer) and Clarifloc C-6266	Clarifloc C-6266
Polymer Dosage (lb/ton)	10 – 17	7 - 12



Alfa Laval AS-H Belt Press KPZ (1.3 m)

Pilot Testing Summary

Alfa Laval – 3-Belt Filter Press



(a) TWAS gravity belt (b) Dewatering (c) Dewatered TWAS cake solids
(d) Combined filtrate and wash water flowing into sump.

Pilot Testing Summary

Andritz – Centrifuge Summary

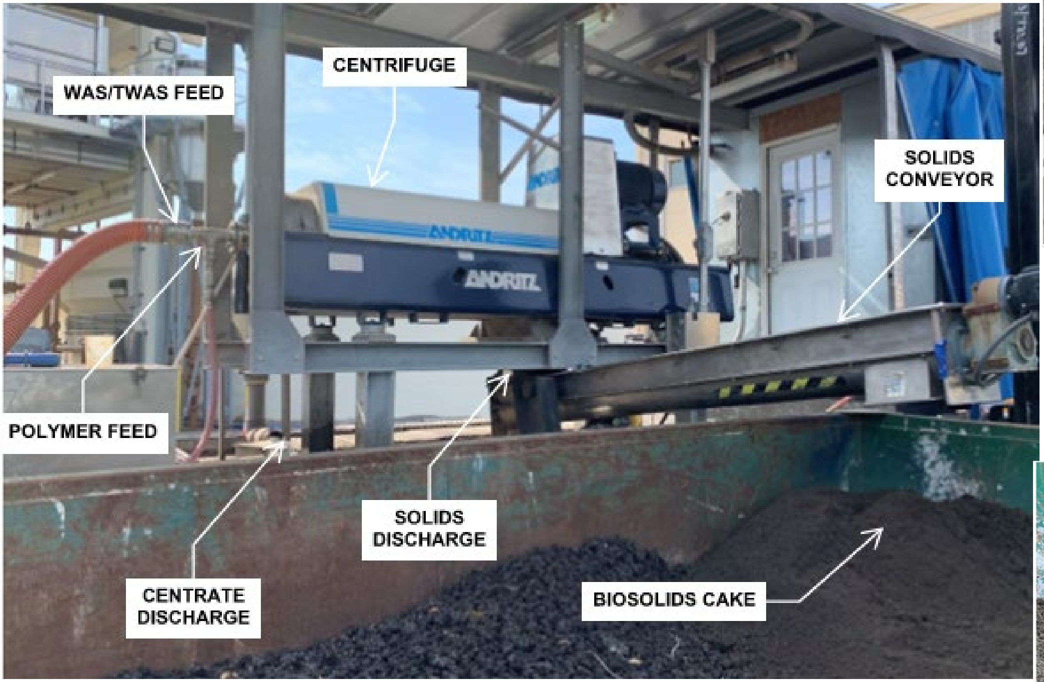
Pilot Testing Period - May 8 – May 17, 2023

Parameter	WAS (~0.5% TS)	TWAS (~2.5% TS)
Testing Period	May 8 – 10, 2023	May 15 – 17, 2023
Hydraulic Loading (gpm)	70 - 130	25 – 65
Solids Loading (lb/hr)	210 - 390	280 – 950
Polymer	Clarifloc C-6262, Clarifloc C-6266, and Zetag 8840 FS	Clarifloc C-6262, Clarifloc C-6266, and Zetag 8840 FS
Polymer Dosage (lb/ton)	15 – 64	19 – 45

ANDRITZ Decanter High Performance Centrifuge (D4L)

Pilot Testing Summary

Andritz – Centrifuge



(a)

(b)

Centrate from (a) WAS and (b) TWAS

(a)

(b)

Dewatered cake from (a) WAS and (b) TWAS

Pilot Testing Summary

Alfa Laval – Centrifuge Summary

Pilot Testing Period May 23 – June 6, 2023

Parameter	WAS (~0.5% TS)	TWAS (~2.5% TS)
Testing Period	May 23 – 25, 2023	June 5 – 6, 2023
Hydraulic Loading (gpm)	100 - 140	100
Solids Loading (lb/hr)	235 - 350	1,400 – 1,500
Polymer	Clarifloc C-6266	Clarifloc C-6266
Polymer Dosage (lb/ton)	13 - 36	28 – 32

Alfa Laval ALSYS G3-75 Centrifuge

Pilot Testing Summary

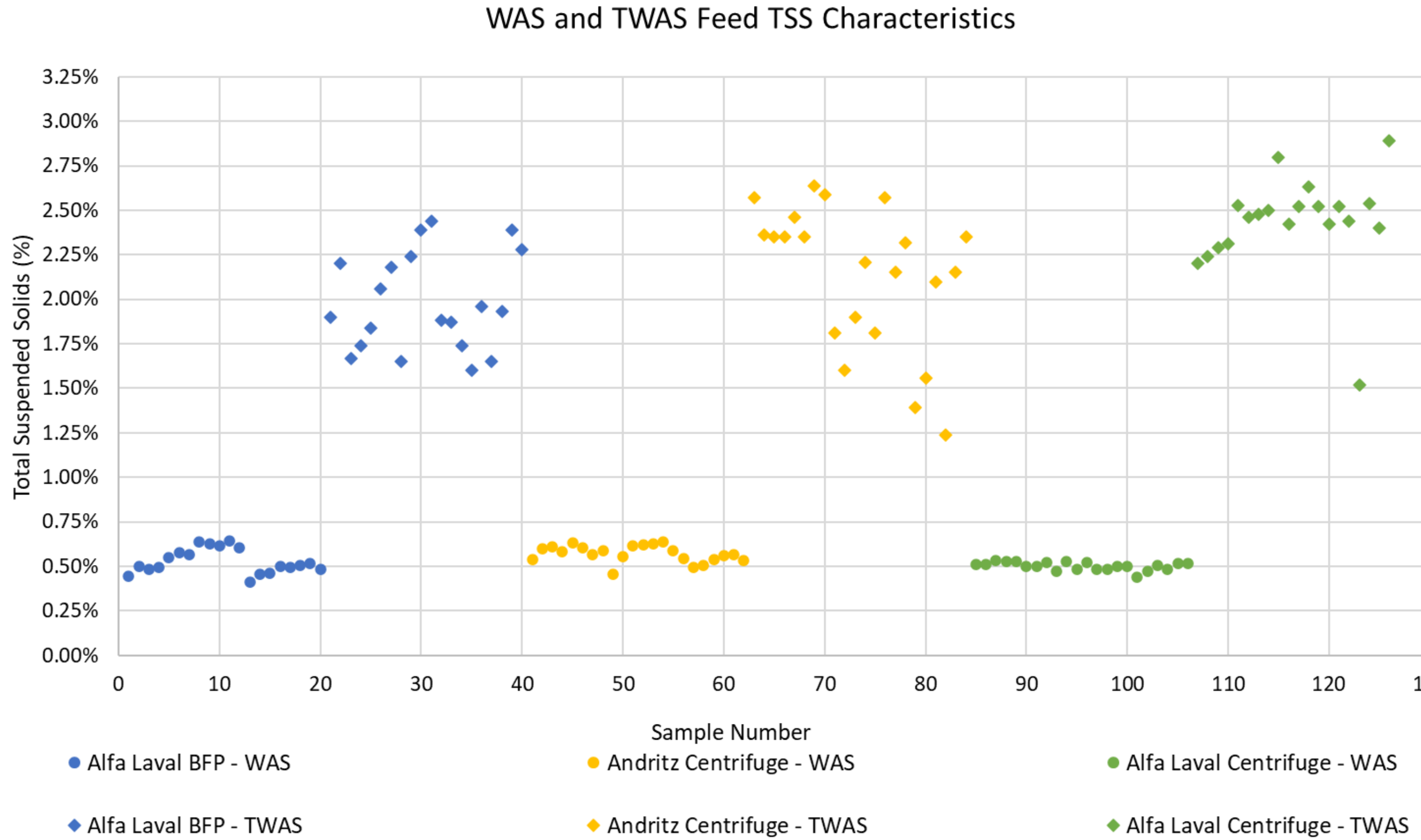
Alfa Laval – Centrifuge

(a) (b) (c)

(a) Alfa Laval ALSYS G3-75 Centrifuge, (b) Centrate, and (c) Dewatered Cake

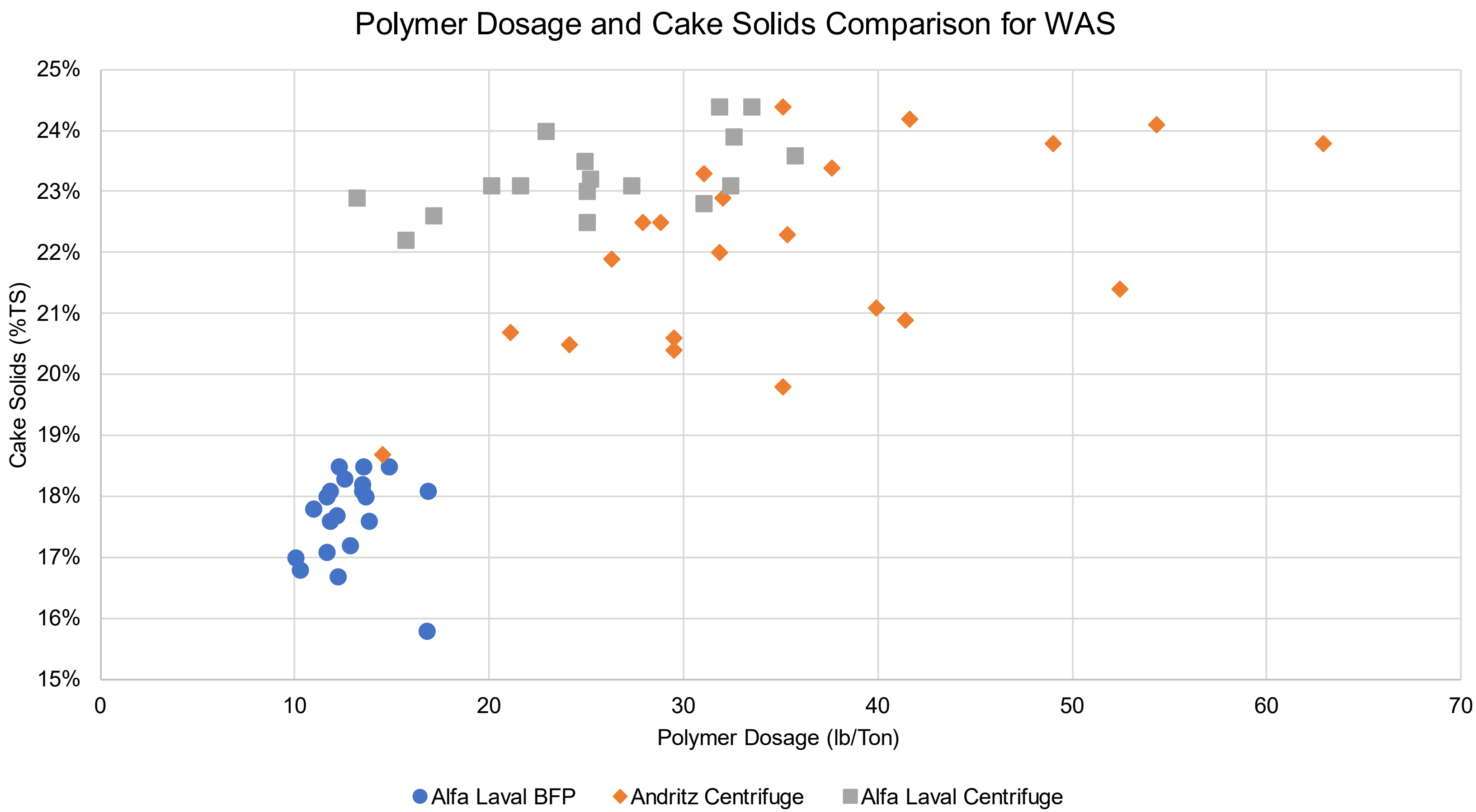
Pilot Testing Results

Pilot Testing Results



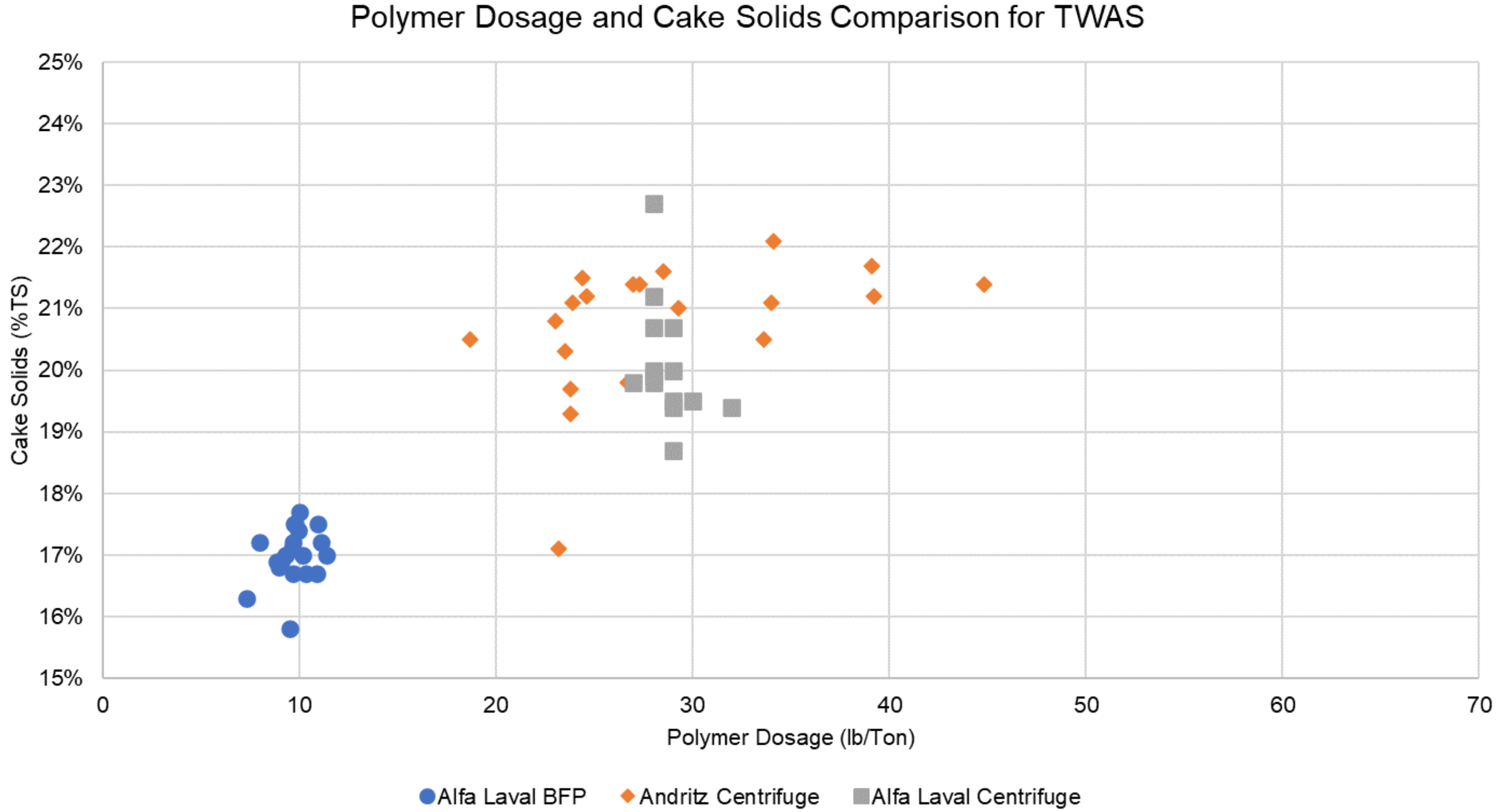
Manufacturer	Equipment	Average WAS Feed TSS (%)	Average TWAS Feed TSS (%)
Alfa Laval	Belt Filter Press	0.52	1.88
Andritz	Centrifuge	0.57	2.13
Alfa Laval	Centrifuge	0.50	2.43

Pilot Testing Results



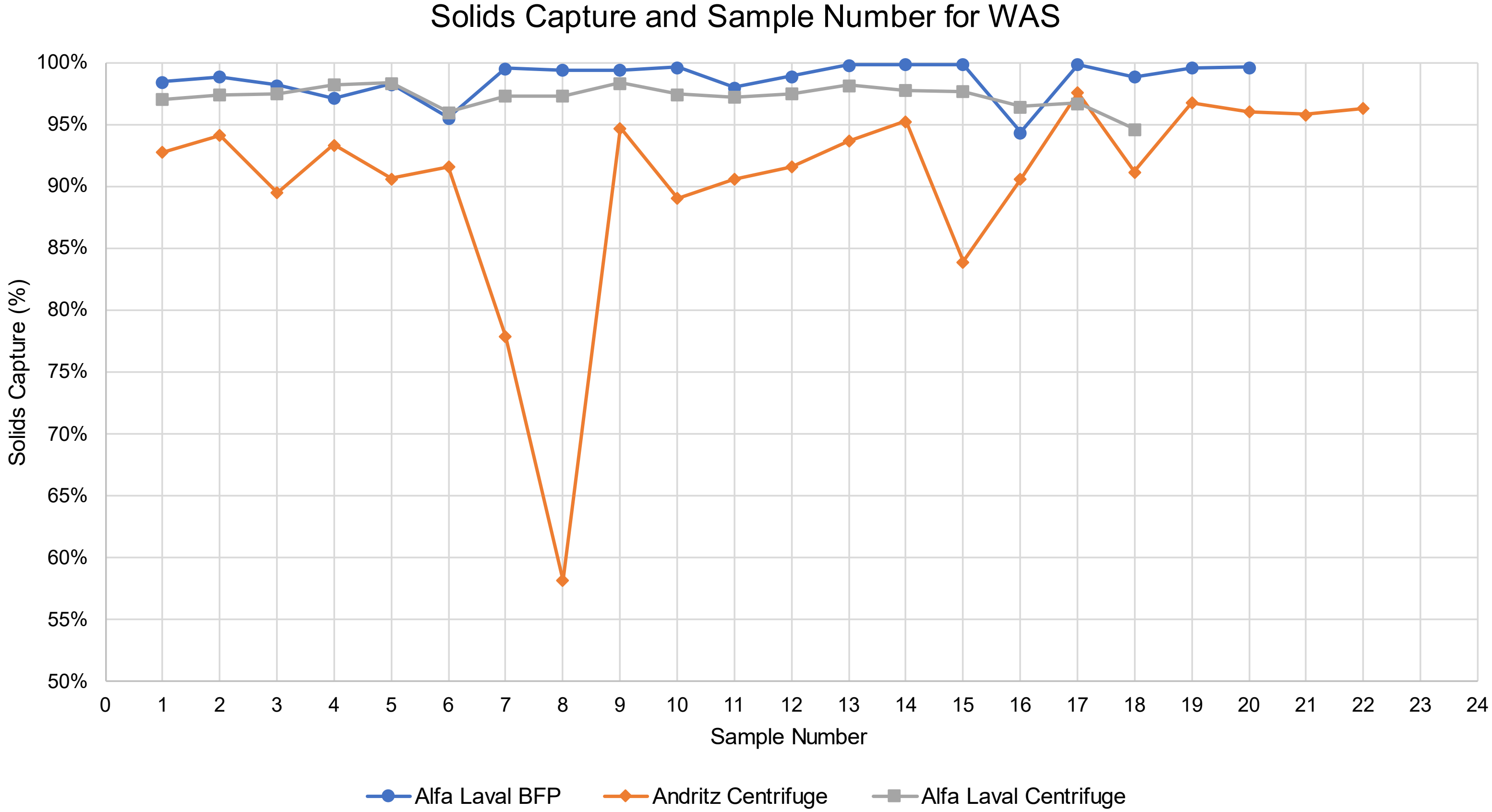
Manufacturer	Equipment	Average WAS Cake Solids (%TS)	Average WAS Polymer Dosage Active (lb/Ton)
Alfa Laval	Belt Filter Press	17.7	12.8
Andritz	Centrifuge	22.1	35.5
Alfa Laval	Centrifuge	23.2	25.6

Pilot Testing Results



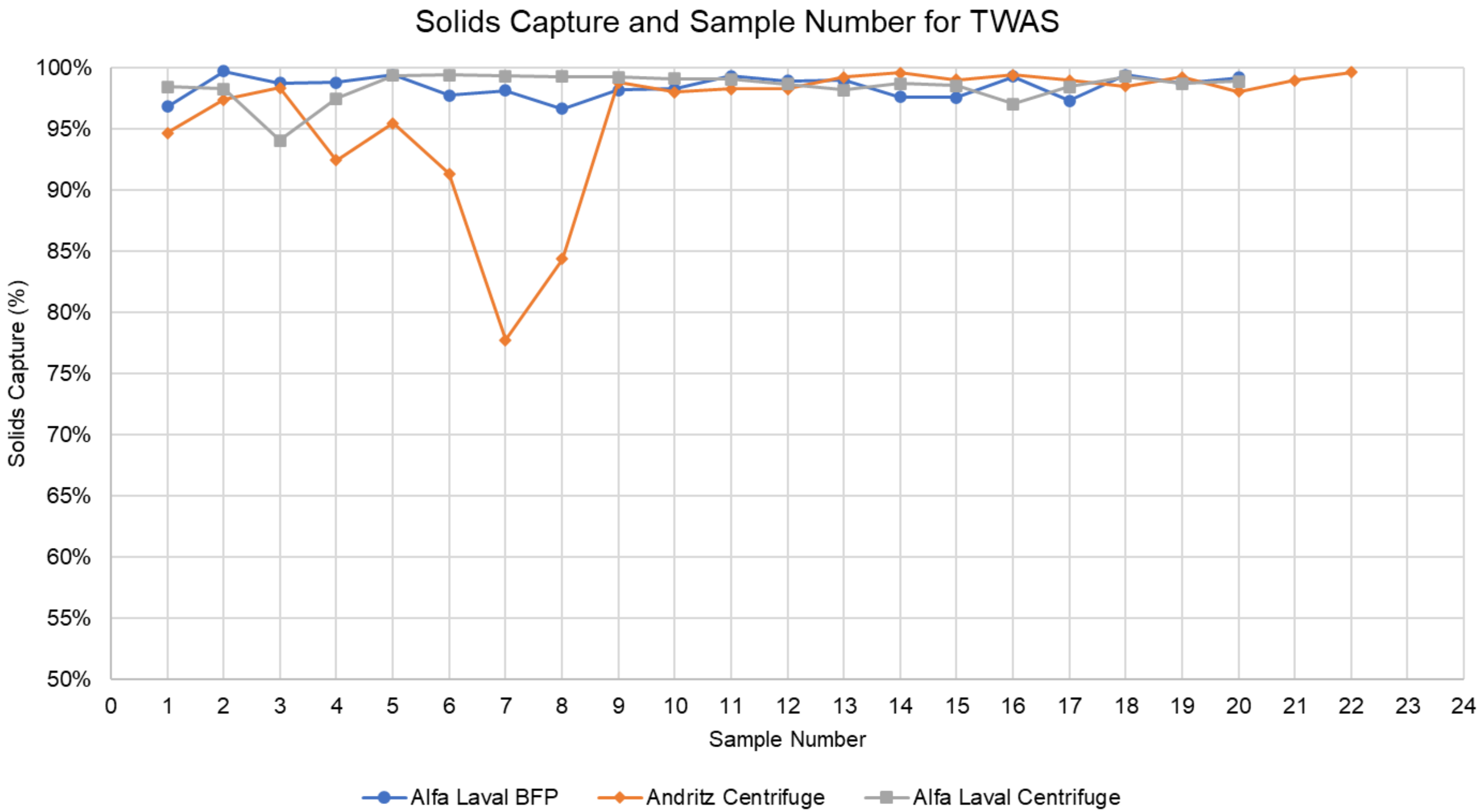
Manufacturer	Equipment	Average TWAS Cake Solids (%TS)	Average TWAS Polymer Dosage Active (lb/Ton)
Alfa Laval	Belt Filter Press	17.0	9.7
Andritz	Centrifuge	20.9	28.6
Alfa Laval	Centrifuge	20.0	28.7

Pilot Testing Results



Manufacturer	Equipment	Average Solids Capture for WAS
Alfa Laval	Belt Filter Press	98.7%
Andritz	Centrifuge	90.5%
Alfa Laval	Centrifuge	97.2%

Pilot Testing Results



Manufacturer	Equipment	Average Solids Capture for TWAS
Alfa Laval	Belt Filter Press	98.4%
Andritz	Centrifuge	96.2%
Alfa Laval	Centrifuge	98.5%

Pilot Testing Results Summary

- Both belt filter press and centrifuge can exceed the 17.5% cake solids requirement
- Both centrifuge and belt filter press can attain >= 95% solids capture

Belt Filter Press: Recommended Performance Criteria

3-Belt Filter Press		
Parameter/Feed	**WAS**	**TWAS**
Cake Solids (%TS)	18%	17.5%
Polymer Dosage (Active) (lb/Ton)	15	12
Solids Capture (%)	95%	95%

Centrifuge: Recommended Performance Criteria

Centrifuge		
Parameter/Feed	**WAS**	**TWAS**
Cake Solids (%TS)	22%	21%
Polymer Dosage (Active) (lb/Ton)	35	30
Solids Capture (%)	95%	95%

Solids Projection

Solids Loading Projections Summary

Based on Master Plan concentrations, flow projections and historical influent data/concentrations

Parameter	Value	WAS Solids Production Ratios				Estimated WAS Production Range (lbs./day)	Estimated WAS Processing Capacity Range (lbs./op hr)
		Avg WAS (lbs./day) / Influent (MGD)	Avg WAS (lbs./day)/ Influent TSS (lbs./day)	Avg WAS (lbs./day) / Influent BOD (lbs./day)	Avg WAS (lbs./day) / Influent TSS + Influent BOD (lbs./day)		
2040 Avg Day Flow	5.83 mgd	1,713	1.27	1.07	0.58	9,990 – 11,321	1,093 – 1,238
Permitted Flow	9.0 mgd					15,421 – 17,477	1,686 – 1,912

Solids production ratio based on influent TSS determined to be most conservative using permitted flow.

Adjusted for operating schedule: 4 days/ week @ 16 hrs/day

Used 2,000 lbs./hr. capacity for equipment sizing

- 2.5% TS for **TWAS** operation scheme: 153 gpm rounded to 160 gpm
- 0.5% TS for **WAS** operation scheme: 766 gpm, rounded to 800 gpm

Life Cycle Cost Analysis

Class 5 Opinion of Probable Construction Costs (OPCC)

- Alternative 1 – Dewatering TWAS using BFP (in existing building)
- Alternative 2 – Dewatering TWAS using Centrifuge (in existing building)
- Alternative 3 – Dewatering WAS using BFP (in modified existing building)
- Alternative 4 – Dewatering WAS using Centrifuge (in new dewatering building)

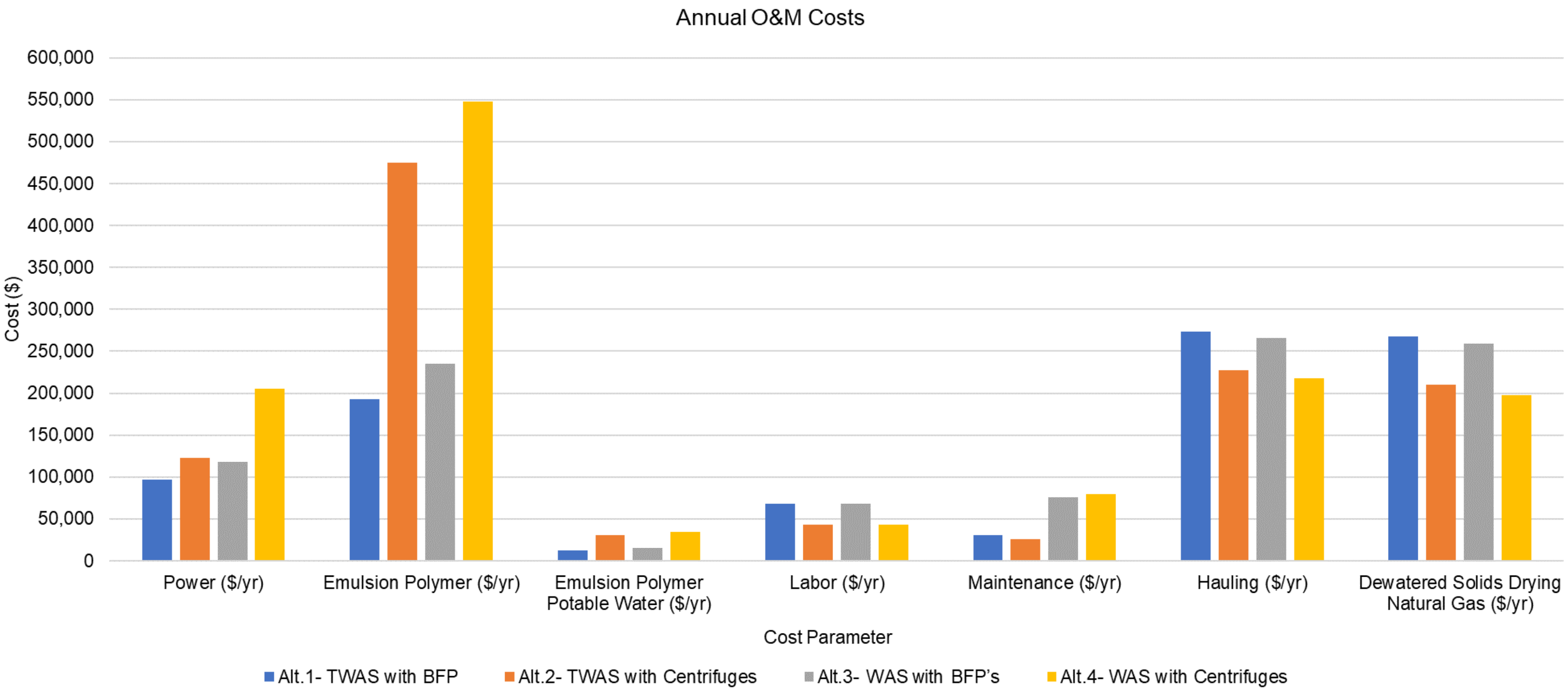
Alternative	Class V OPCC
1- Dewatering TWAS using BFP's	$4,776,733
2- Dewatering TWAS using Centrifuges	$4,575,055
3- Dewatering WAS using BFP's	$13,987,930
4- Dewatering WAS using Centrifuges	$18,584,483

Accuracy range for Class 5 OPCC ranges from -20 to +30%

Annual O&M Costs

- Power unit cost - $0.095/kWh
- Labor cost – $20/hour per operator
- Neat Emulsion Polymer cost - $12.9/gal
- Maintenance – 2% /year of equipment cost
- Potable Water Cost - $5.26 /1,000 gal
- Dewatering System Maintenance Labor- 2% of Equipment Operation Time
- Routine Centrifuge Labor Time – 10 hr/day
- Routine BFP Labor Time – 16 hr/day
- Operational costs (power and polymer) for thickening system (Alternatives 1 and 2)
- Biosolids Hauling Cost - $15 / wet ton of solids[1].
- Natural Gas Drying Cost - $0.865/ Therm[2]

Annual O&M Costs



Net Present Value Analysis

$$NPV = Capital\ Cost + Annual\ O\&M\ Cost\ \frac{(1+r)^{n-1}}{r*(1+r)^{n}}$$

Time Period (n) – 25-years
Annual Discount Rate (r) – 3 %

Alternative	Net Present Value ($)
1- Dewatering of TWAS using BFP's	$21,193,000
2- Dewatering of TWAS using Centrifuges	$24,333,000
3- Dewatering of WAS using BFP's	$32,040,000
4- Dewatering of WAS using Centrifuges	$41,686,000

Conclusions

Conclusions

- Both Centrifuge and BFP can dewater the sludge to ≥17.5% TS
- Both Centrifuge and BFP have solids capture of ≥95%
- Polymer consumption for centrifuge was at least twice as much as BFP for both WAS and TWAS
- Continuing the use of existing thickening operation is more economical than dewatering WAS
- Alternative 1 (Dewatering TWAS with BFP) offers overall long- term cost savings and BFP is used in existing plant operations
- Based on discussions with County and overall considerations of facility implementation, capital costs, operating costs, and NPV evaluation, Alternative 1 was selected

Acknowledgements

Acknowledgements

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- Craig Osmanski – Engineering, WEDWRF
- Heather Canham – Chief Wastewater Plant Operator, WEDWRDF

Questions and Discussion

Stantec

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Appendix

Conceptual Layouts

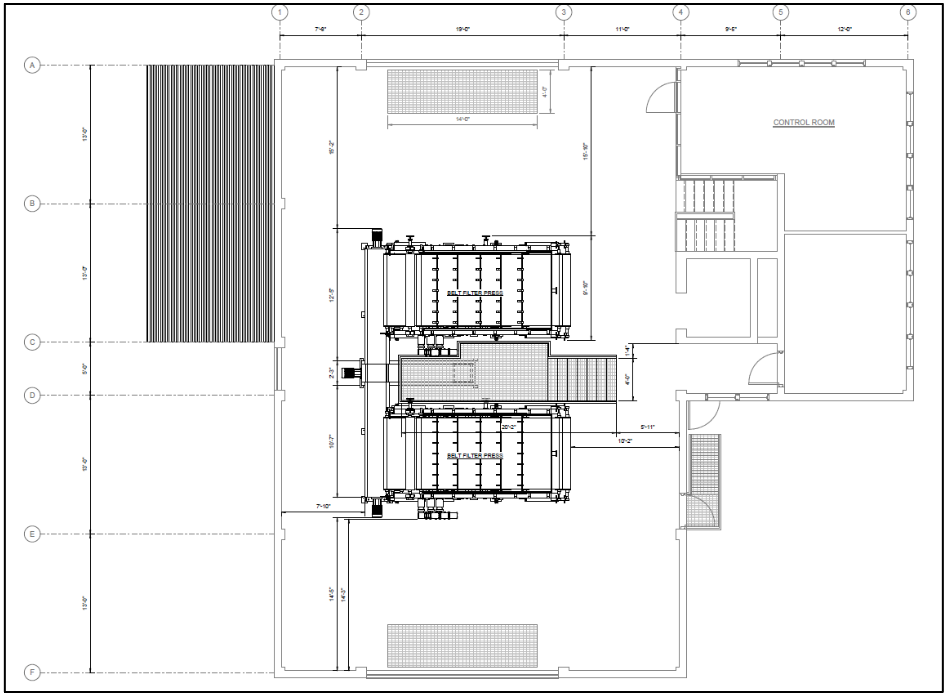
Alternative 1 – TWAS using BFP Layout

- No modifications to existing RDT thickening system and sludge storage tanks
- Upgrade of dewatering feed pumps
  - Use existing dewatering feed pipes from SHT to dewatering building

- Upgrade from dry polymer to emulsion polymer
  - Building extension allows for construction without affecting current operation

- Modification of conveyor system
- Utilize existing truck scale

- Requires temporary mobile dewatering unit during construction



Existing Dewatering building, 3rd floor Conceptual Layout, Belt Filter Press using TWAS

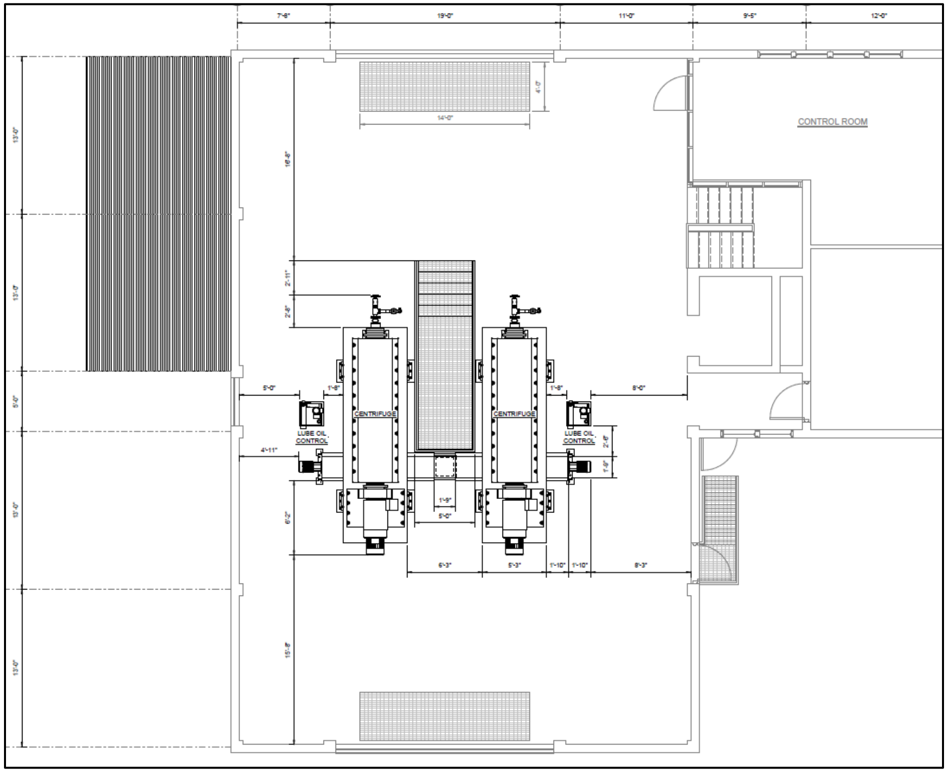
Conceptual Layouts

Alternative 2 – TWAS using Centrifuge Layout

- No modifications to existing RDT thickening system and sludge storage tanks
- Upgrade of dewatering feed pumps
  - Use existing dewatering feed pipes from SHT to dewatering building
- Upgrade from dry polymer to emulsion polymer
  - Building extension allows for construction without affecting current operation

- Modification of conveyor system
- Utilize existing truck scale

- Requires temporary mobile dewatering unit during construction

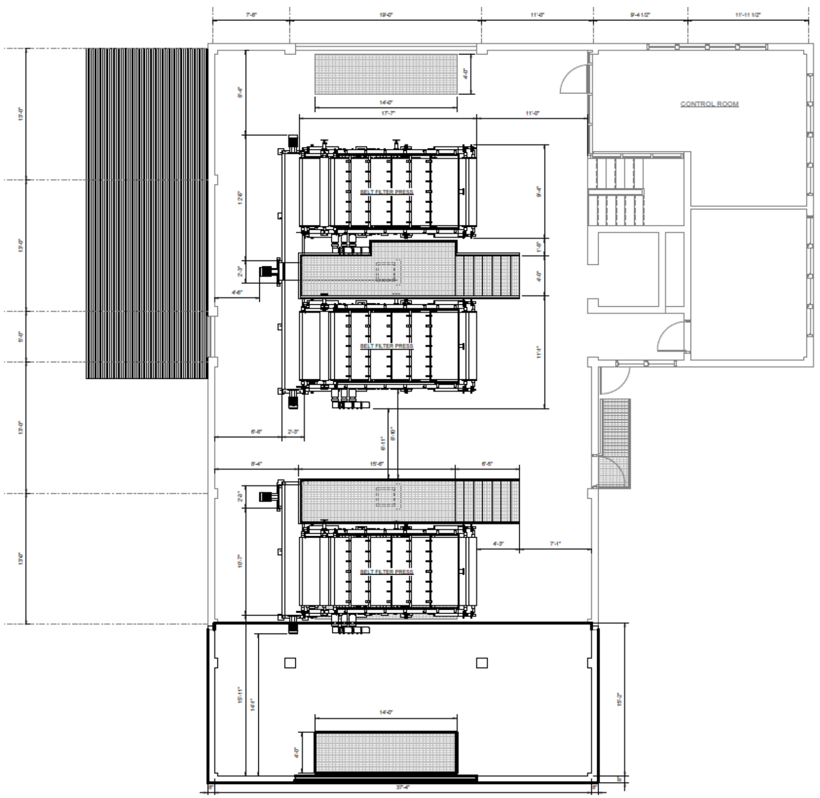


Existing Dewatering building, 3rd floor Conceptual Layout, Centrifuge using TWAS

Conceptual Layouts

Alternative 3 –WAS using BFP Layout

- Additional volume required for WAS storage (1.22 MG vs 0.44 MG existing)
  - Two new tanks to accommodate the total volume
  - Required new mixing/aeration system for the additional volume
  - Tanks located north of clarifiers
- Larger hydraulic requirement for dewatering equipment
  - Will require larger dewatering feed pumps
  - New dewatering feed pipes due to tank location
- Upgrade from dry polymer to emulsion polymer
  - Building extension allows for construction without affecting current operation
- Requires 3 installed BFP units (2 duty + 1 standby)
- Existing Dewatering Building expansion (to south) to accommodate extra unit
- Modification of conveyor system
- Utilize existing truck scale
- Requires temporary mobile dewatering unit during construction



Existing Dewatering building, 3rd floor Conceptual Layout, BFP using WAS

Conceptual
Layouts

Alternative 4 –WAS using Centrifuges, New Building Layout

- Additional WAS storage volume (1.26 MG vs 0.44 MG existing)
    - Assumed two new tanks to accommodate the total volume
    - New mixing/aeration system for the additional volume

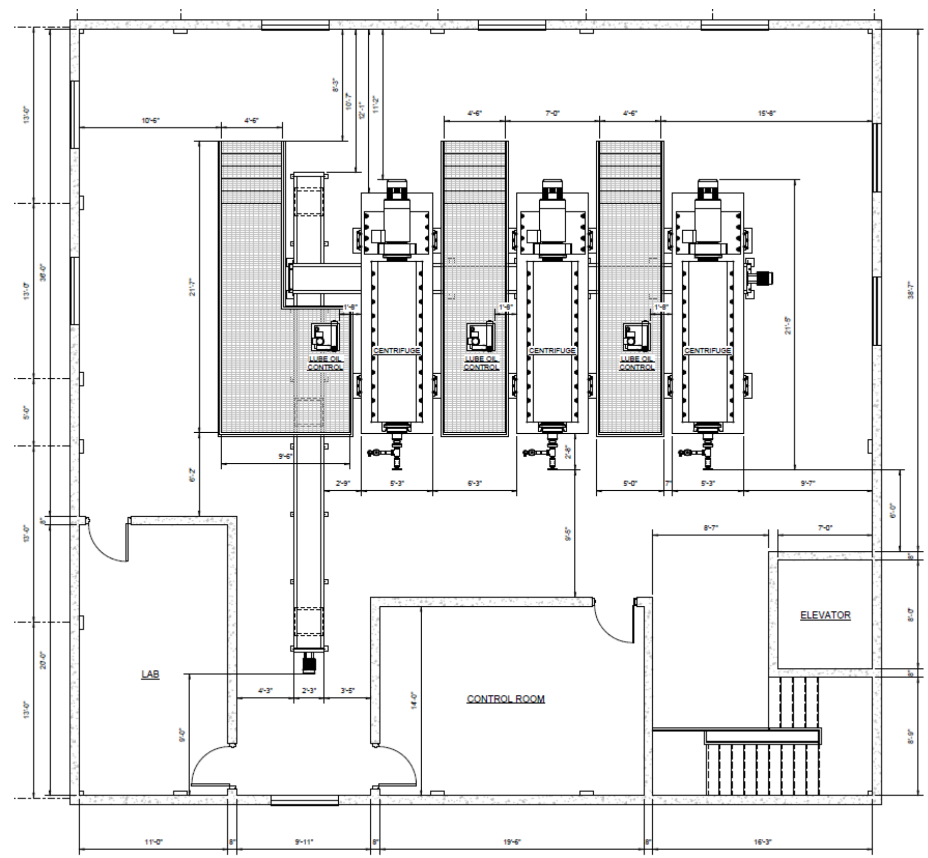
- New Dewatering Building due to structural modifications to existing building

- New building and WAS storage both proposed north of clarifiers

- Larger hydraulic requirement for dewatering equipment
    - Will require larger dewatering feed pumps
    - New dewatering feed pipes due to tank location
- Requires 3 installed units (2 duty + 1 standby)

- Upgrade from dry polymer to emulsion polymer

- New truck scale
- Does not require temporary mobile dewatering unit during construction

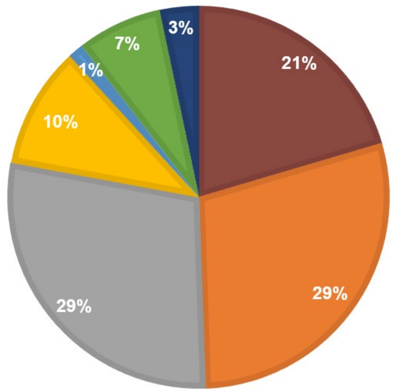


NEW Dewatering building, 2nd floor Conceptual Layout, Centrifuge using WAS

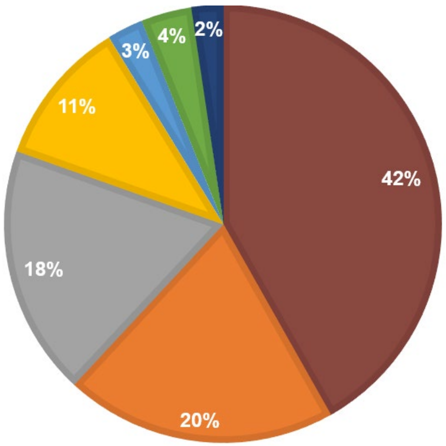
Annual O&M Costs

Annual O&M Costs Distribution

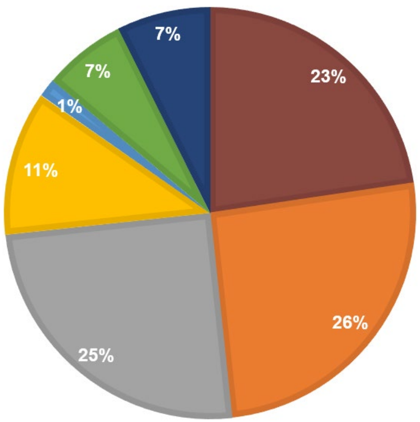
ALT 1 TWAS WITH BFP - $0.94M



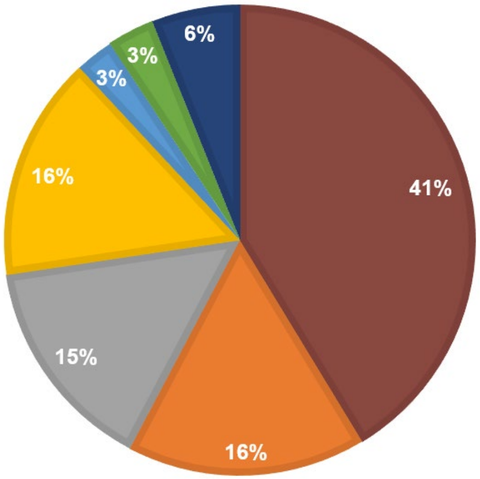
ALT 2 TWAS WITH CENTRIFUGE – $1.13M



ALT 3 WAS WITH BFP - $1.04M



ALT 4 WAS WITH CENTRIFUGE-



- Emulsion Polymer, $/yr
- Biosolids Hauling Cost, $/yr
- Natural Gas Drying Cost, $/yr
- Power, $/yr
- Emulsion Polymer Potable Water, $/yr
- Labor, $/yr
- Maintenance, $/yr