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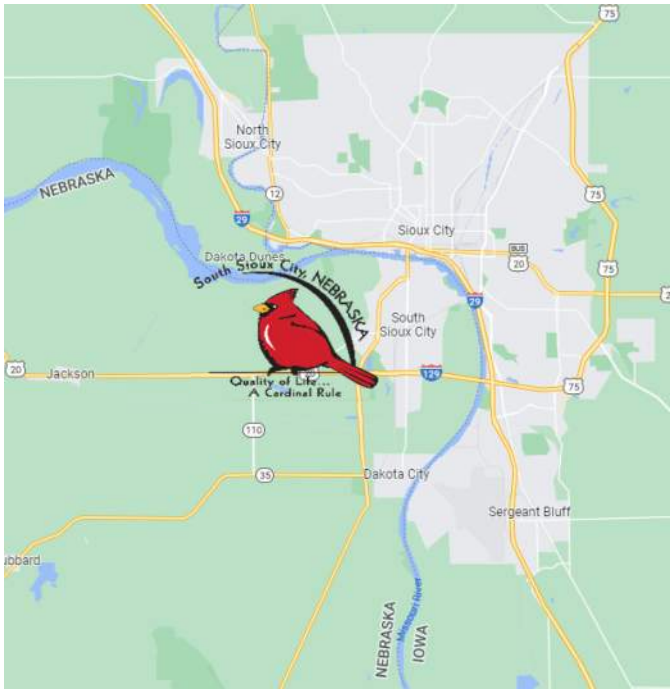
LA DWP Los Angeles Department of Water & Power

We will begin our presentation in a few minutes…

Leadership and Excellence in Environmental Engineering and Science



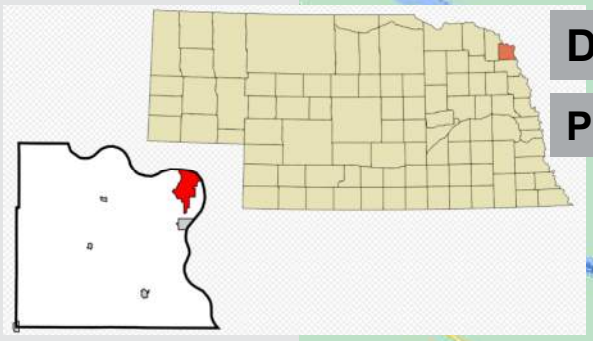
South Sioux City WWTF Improvements

Dillon Devitt, PE, BCEE

NOVEMBER 13, 2024

01 BACKGROUND

BACKGROUND



Dakota County

Population ~ 13,000

Metropolitan area includes:

- Sioux City, IA
- Sergeant Bluff , IA
- Dakota City, NE
- North Sioux City, SD

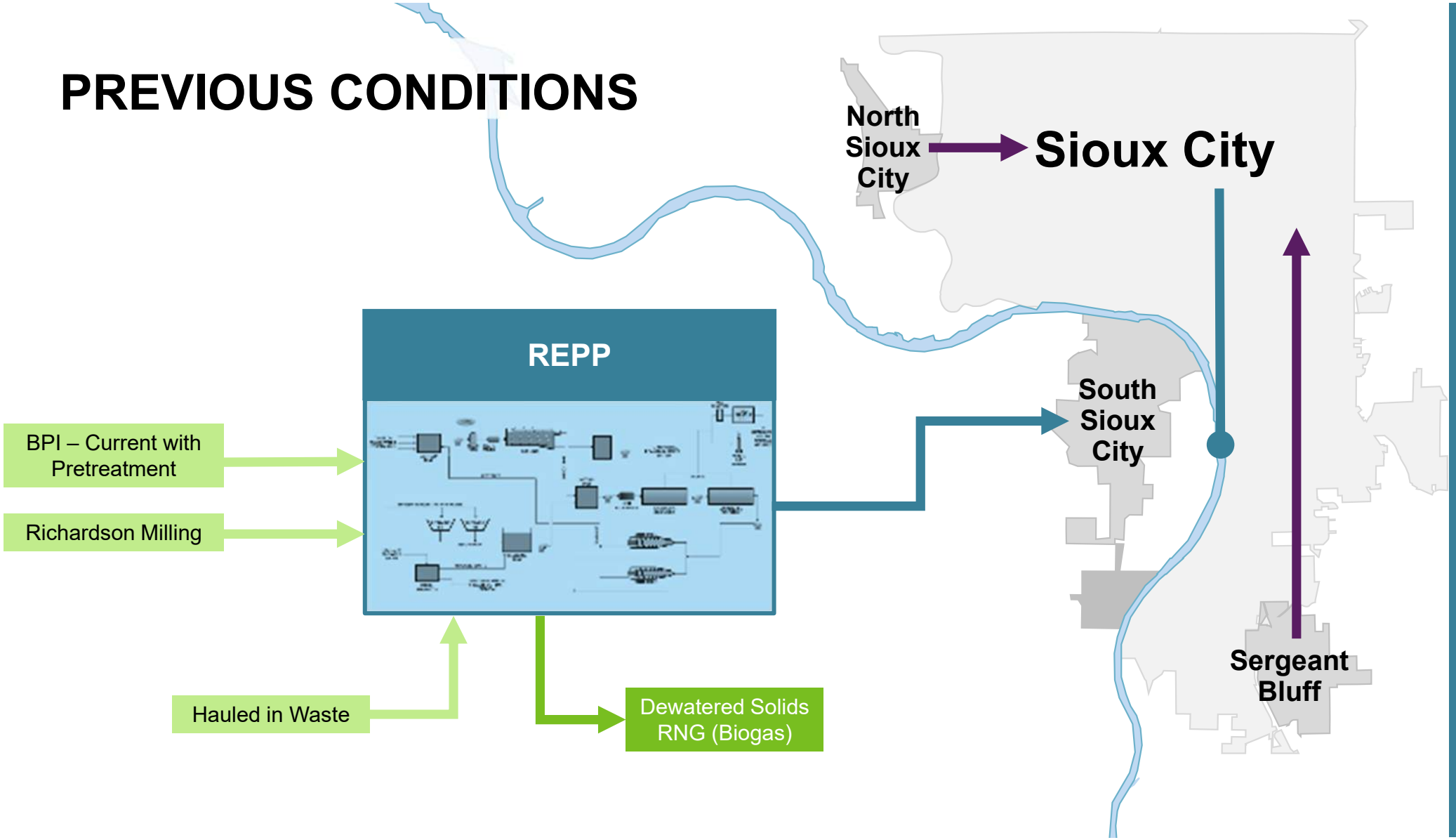
Metro population: 170,000

Richardson Milling
Oat Milling

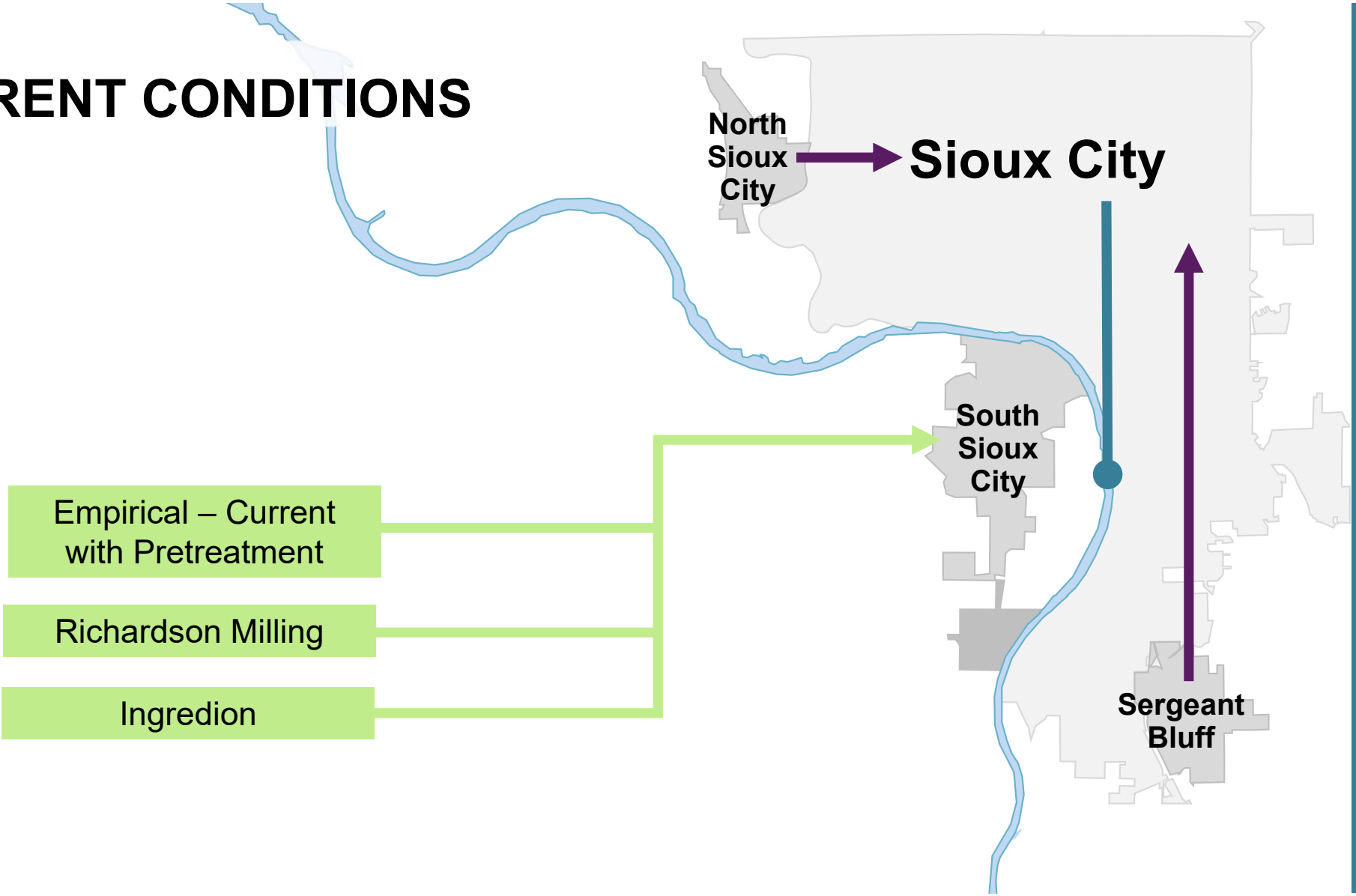
Ingredion
Pea Protein

Empirical – BPI
Beef Processing

PREVIOUS CONDITIONS



CURRENT CONDITIONS



02 PROJECT NEEDS & OBJECTIVES

PROJECT NEEDS

- Pretreatment facility out of operation
- Capacity restrictions from Sioux City
- Limit future growth of industries
- Rate increases
- Self reliance

OVERALL OBJECTIVES

- Identify the most cost-effective (life cycle cost) treatment plant to serve South Sioux City, the industries involved, and potentially the other sister cities
- Develop strategies to utilize existing infrastructure where possible
- Plant must be implementable, expandable, and flexible
- Plant must accommodate future nutrient removal, not generate odors, and be energy efficient

03 FEASIBILITY STUDY

INDUSTRIAL STAKEHOLDERS

Business Name	Type
Empirical – BPI	Beef Processing
Ingredion	Pea Protein
Richardson Milling	Oat Milling

Parameter	Units	Maximum Month	Annual Average
Flow	MGD	2.34	2.01
Flow	gpm	1,625	1,394
$cBOD_5$	lb/day	74,800	61,000
TSS	lb/day	26,400	22,800
TKN	lb/day	3,900	3,200
TP	lb/day	1,500	1,200
FOG	lb/day	3,500	3,100
$cBOD_5$	mg/L	3,830	3,640
TSS	mg/L	1,350	1,360
TKN	mg/L	200	191
TP	mg/L	76.9	71.7
FOG	mg/L	179	185

FEASIBILITY STUDY: ALTERNATIVES

1

ALTERNATIVE 1

Covered Anaerobic Lagoons

Conventional Activated Sludge

Ultraviolet Disinfection

WAS Storage

2

ALTERNATIVE 2

Covered Anaerobic Lagoons

Aerobic Granular Sludge

Ultraviolet Disinfection

WAS Storage

3

ALTERNATIVE 3

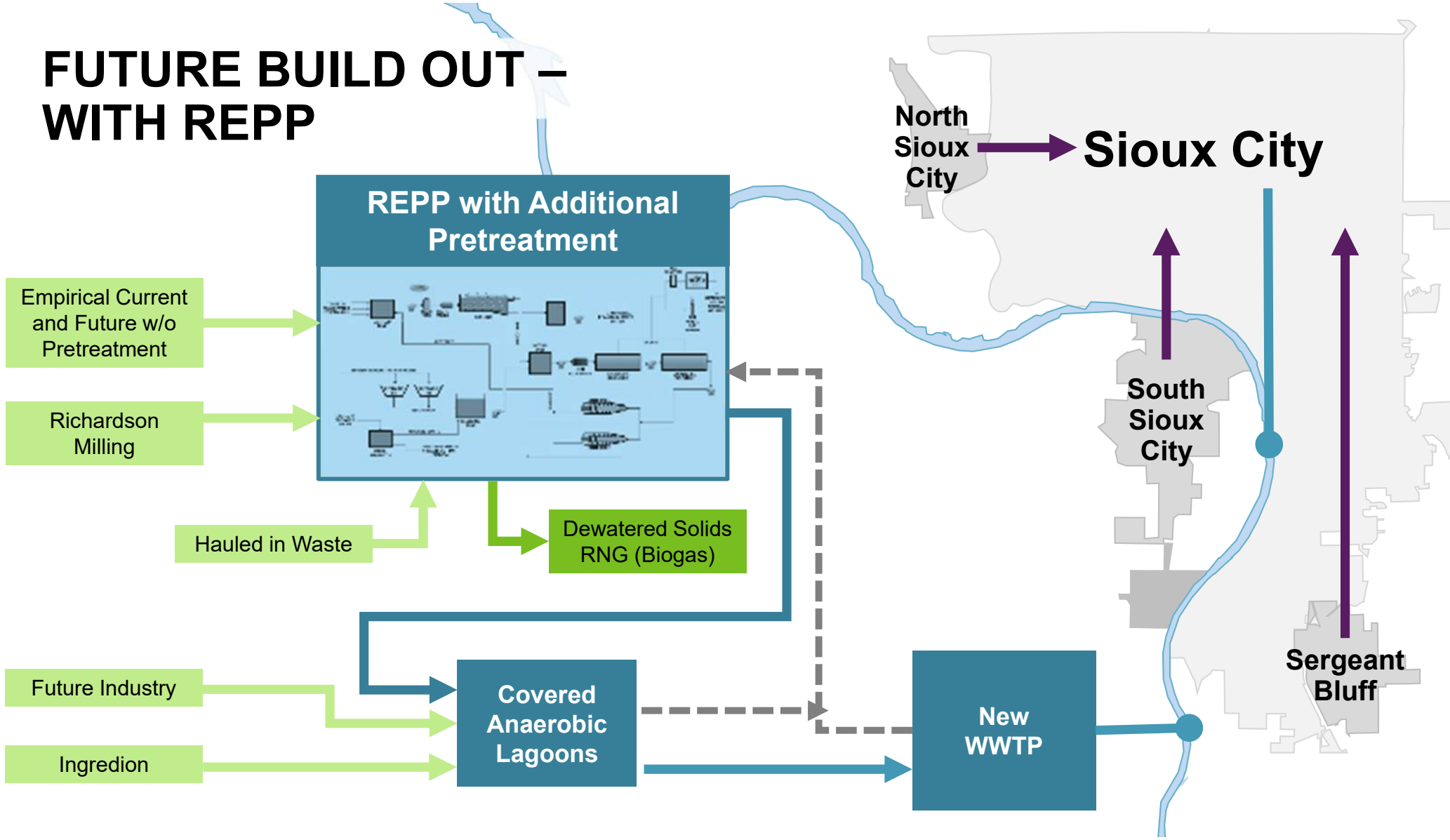
Anaerobic Membrane Bioreactors

Membrane Aerated Bioreactors

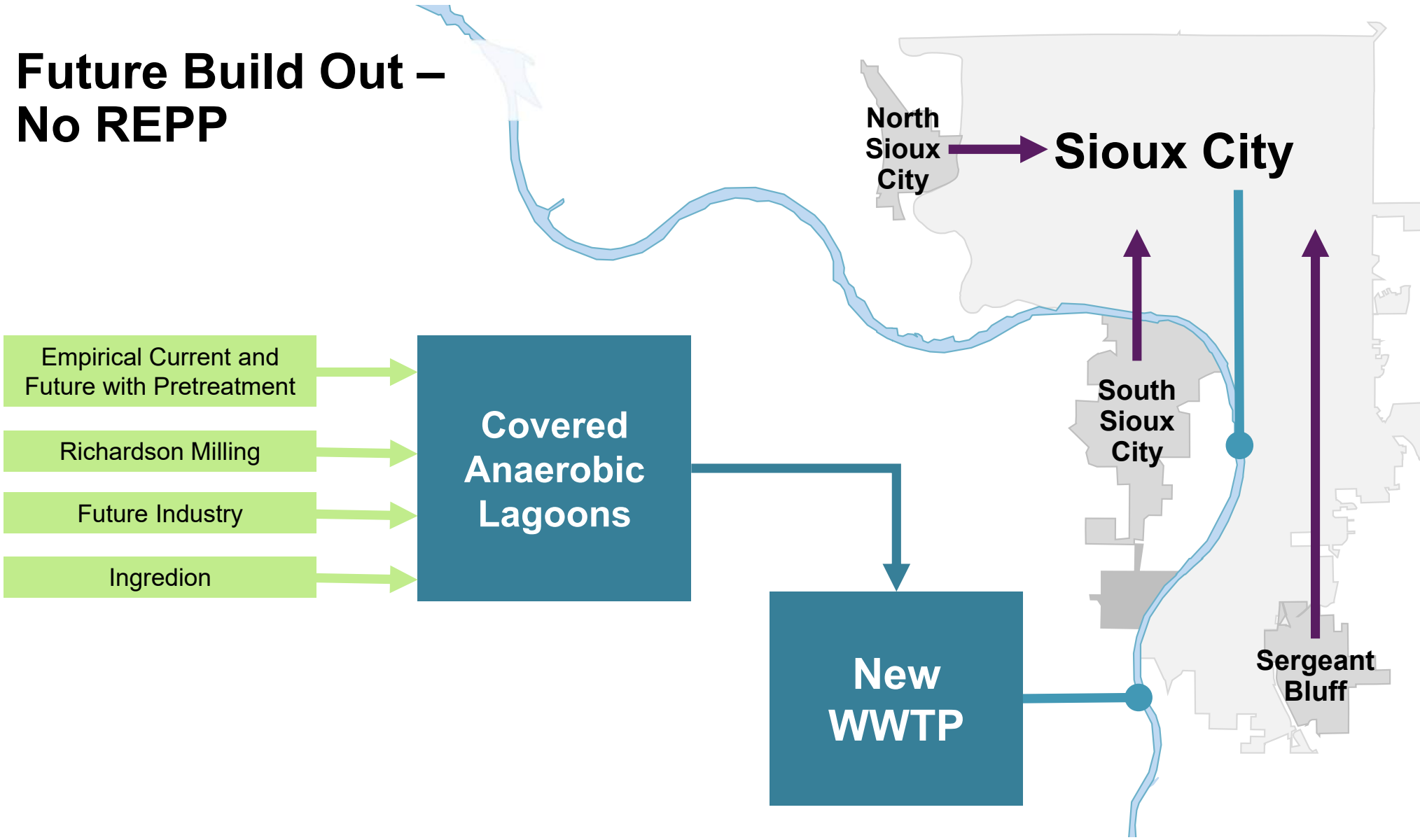
Ultraviolet Disinfection

Most cost effective – OPCC $ 33M

FUTURE BUILD OUT – WITH REPP



Future Build Out – No REPP



WHY AGS FOR SOUTH SIOUX CITY?

New Greenfield Plant

Smaller Footprint

Lowest Life Cycle Costs

Flow and Load Equalization Upstream – Not limited by peak flows and can handle higher organic strength wastewater

Modular and Expandable – Future Industries and Residential

Energy Efficient (20% less than typical BNR)

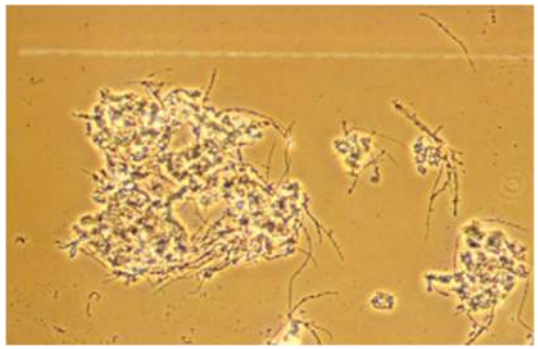
04 AGS OVERVIEW

INTENSIFIED ACTIVATED SLUDGE

Intensify: escalate; boost, increase; strengthen, augment; amplify, expand, magnify

Intensification: doing more within the same volume/footprint, the same concrete. More treatment capacity, better performance, enhanced treatment

0.1 – 0.3 mm



Granules are 2-5 mm in size, settle VERY FAST

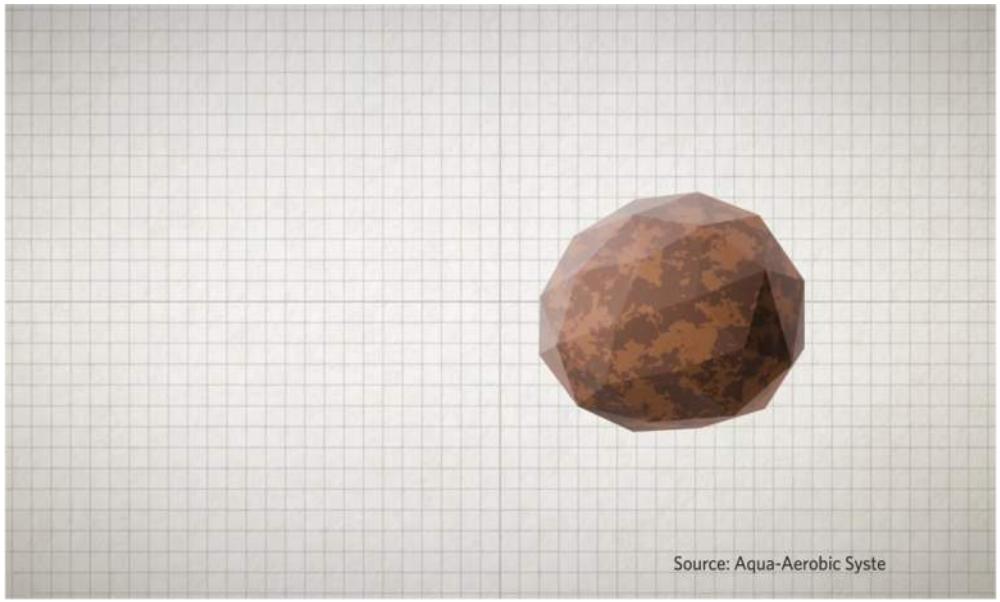
2 - 5 mm

Activated Sludge Intensification

Intensification reduces capital investment, increases capacity, and saves operating cost

WHAT IS A GRANULE?

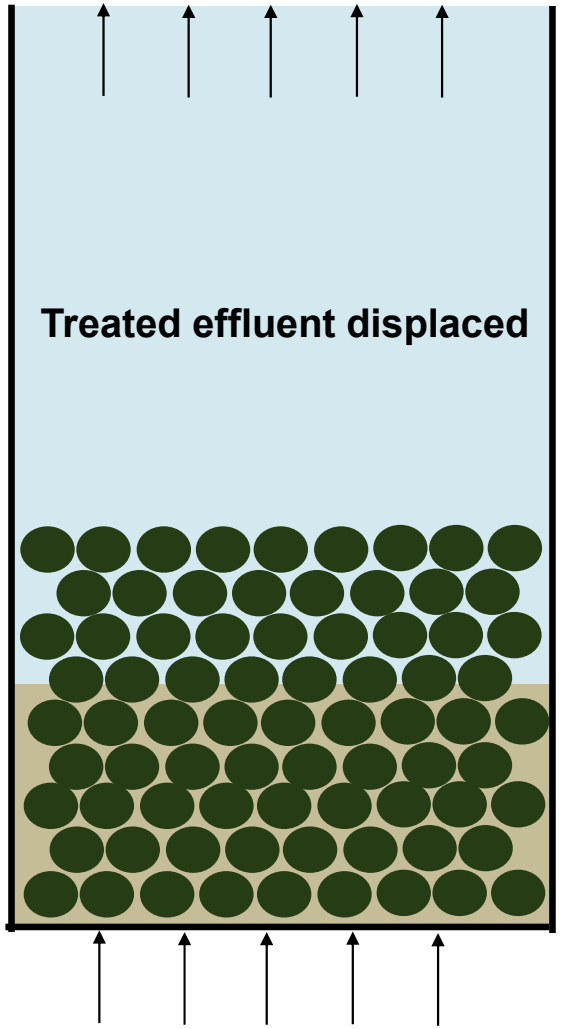
- Layered microbial community
- Not perfectly spherical
- Complex structure with voids & channels
- Faster settling than floc (SVI 5 vs 30)
  - Target SVI 5 < 60
  - Less than 30% difference between SVI 10 < 30



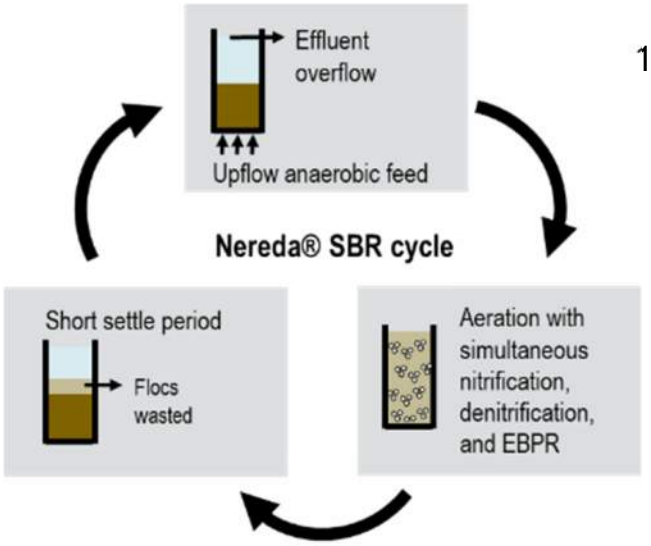
HOW DO GRANULES FORM?

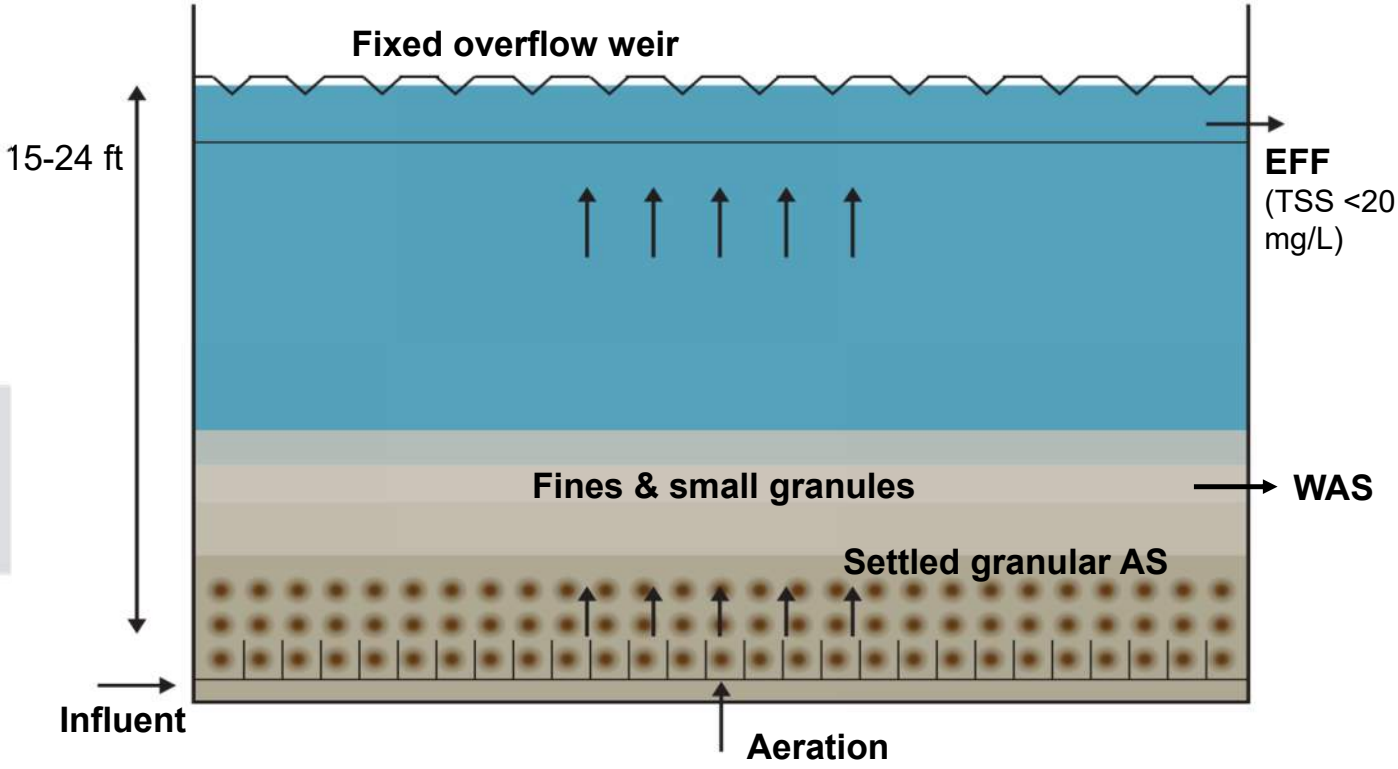
Two Primary Methods:

1. Hydraulic Selection
   - Settle denser granules
   - Selective wasting of lighter floc (midtank)
2. Biological Selection
   - Select for PAOs (form EPS)
   - Slow up-flow feeding through settled granules
   - Provides high F/M contacting and preferential feeding



A LOOK AT HOW IT FUNCTIONS: REACTOR

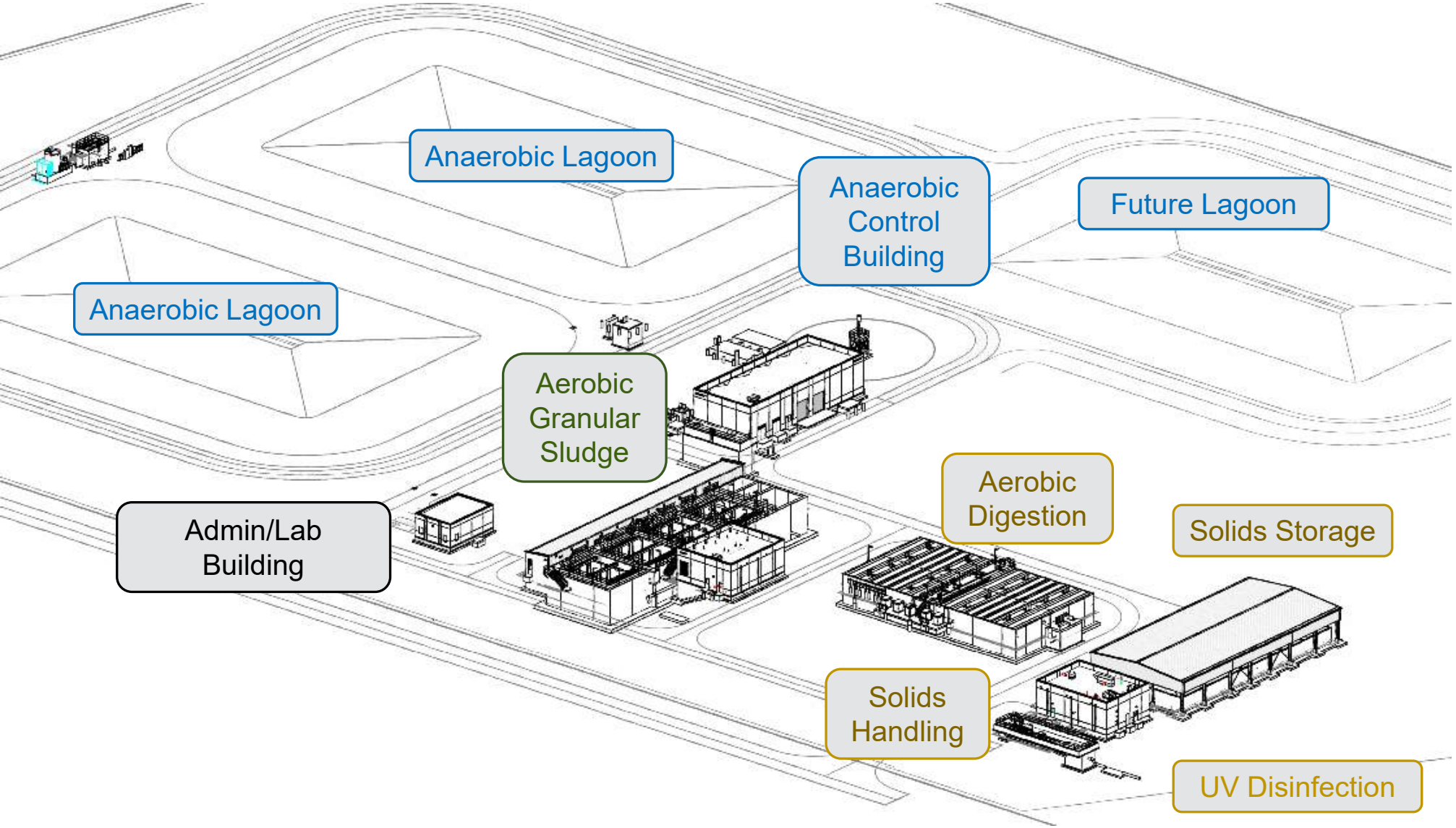




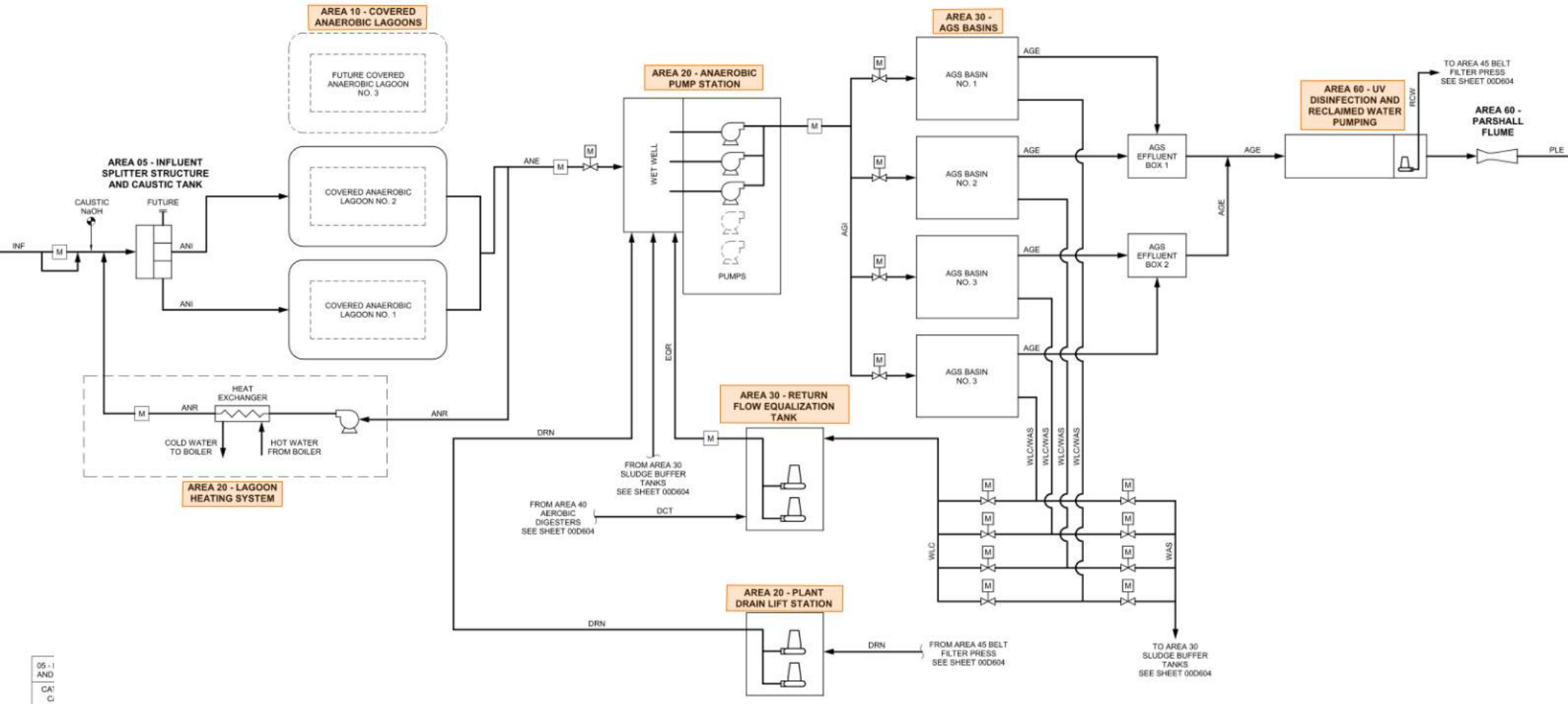
05 DESIGN

TREATMENT EFFLUENT LIMITS

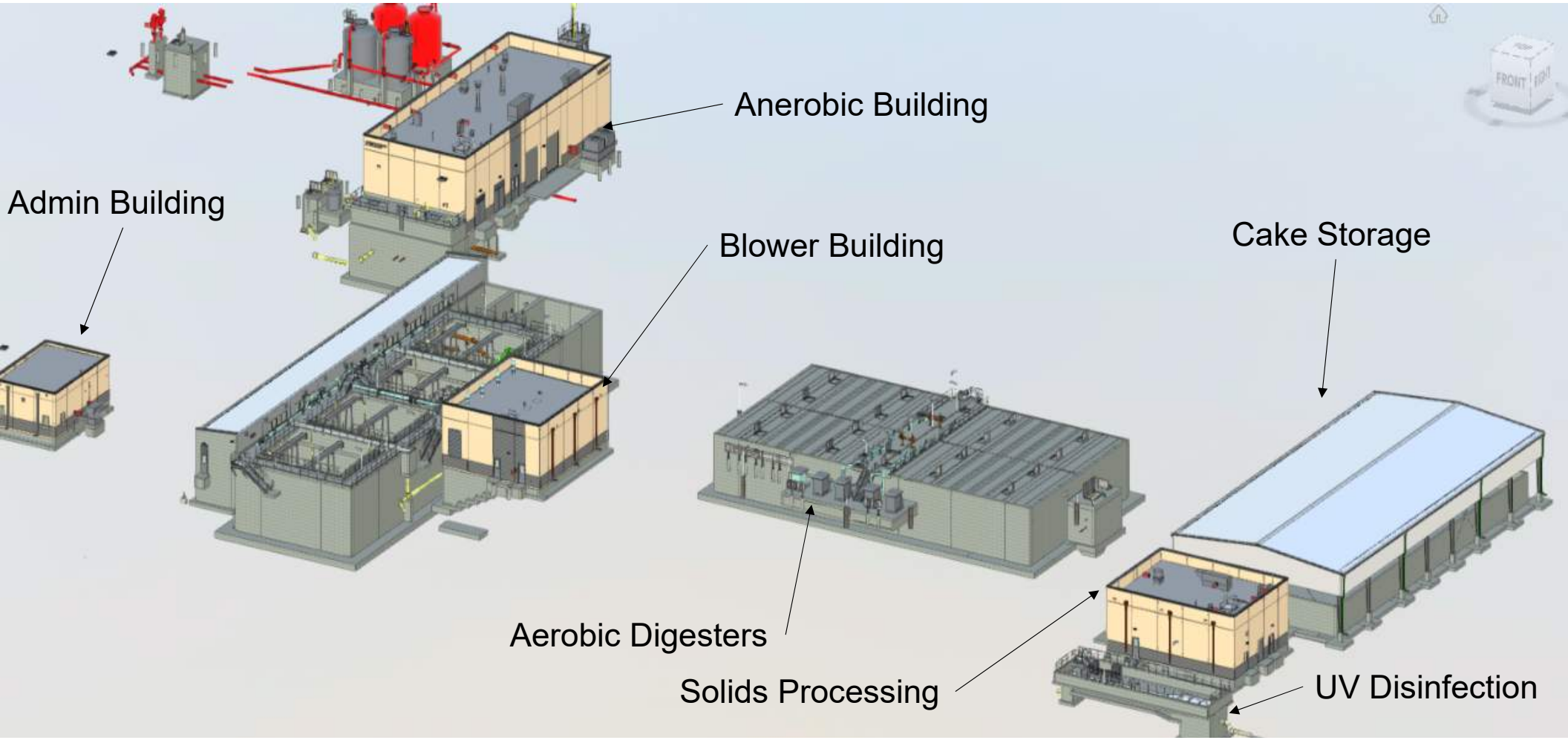
Parameter	Monthly Average	Maximum
Carbonaceous Biochemical Oxygen Demand (5-day)	25.0 mg/L 1,460 lb/d	40.0 mg/L 2,336 lb/d
Total Suspended Solids	30.0 mg/L 1,752 lb/d	45.0 mg/L 2,629 lb/d
pH	6.5 S.U.	9.0 S.U.
Fats, Oils, and Grease (FOG)	10 mg/L	10 mg/L
Spring Ammonia	66 mg/L	100 mg/L
Summer Ammonia	78 mg/L	157 mg/L
Winter Ammonia	69 mg/L	140 mg/L


Anaerobic Lagoon
Anaerobic Control Building
Future Lagoon
Anaerobic Lagoon
Aerobic Granular Sludge
Aerobic Digestion
Solids Storage
Admin/Lab Building
Solids Handling
UV Disinfection

PROCESS FLOW DIAGRAM

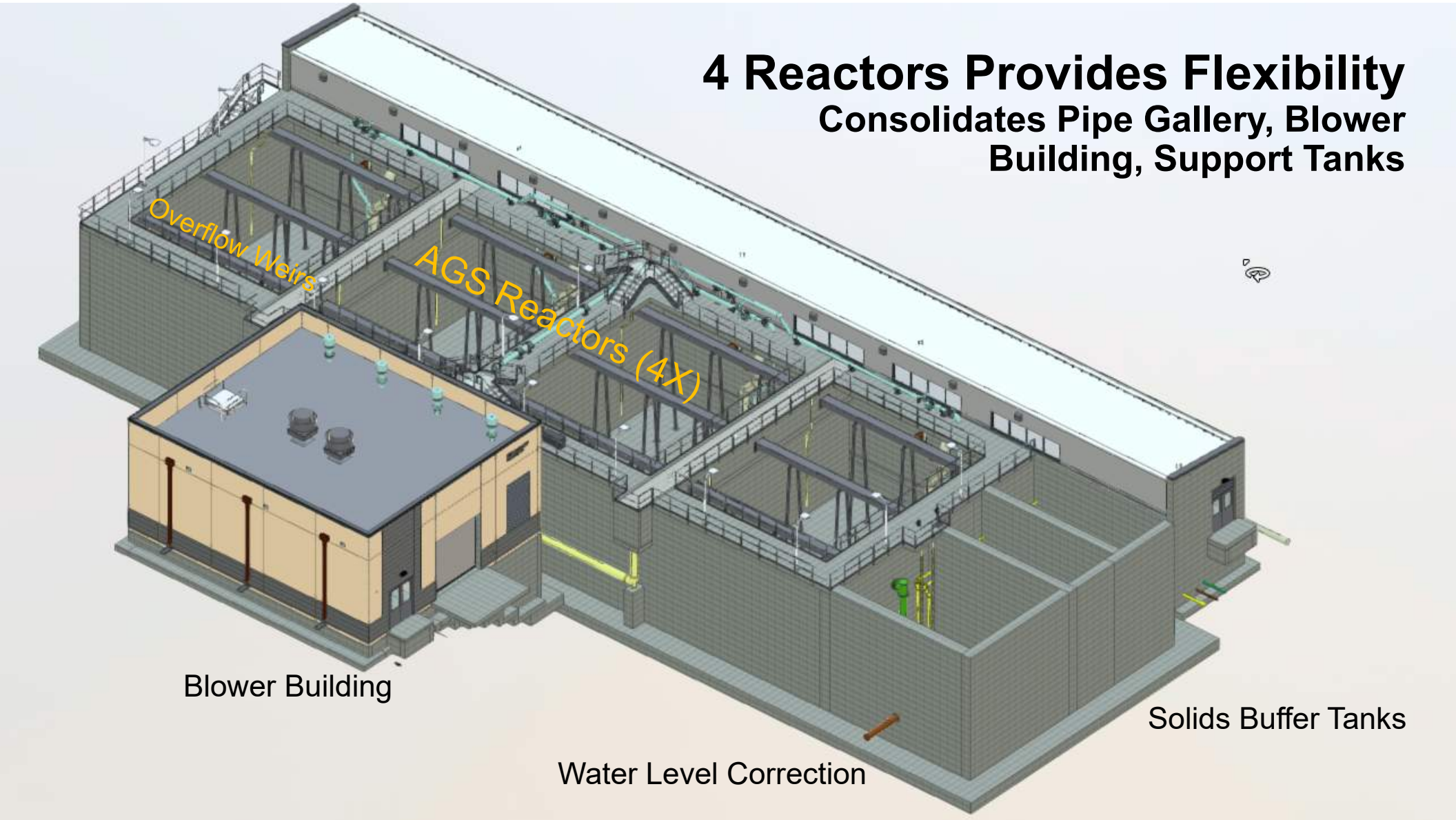


SOUTH SIOUX CITY SITE MODEL



4 Reactors Provides Flexibility

Consolidates Pipe Gallery, Blower Building, Support Tanks

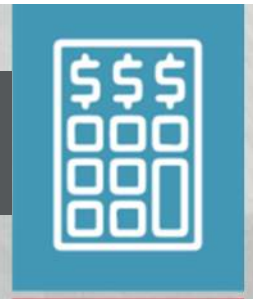


06 BIDDING & MARKET CONDITIONS

Engineer's Estimate
$33,000,000

Bid Opened: February 25, 2021
Texas Storms: February 10-11, 13-17, and 15-20

3 Bids Received
John T Jones: $39,215,000
Eriksen Construction: $40,133,322
Hawkins Construction: $42,865,775



MARKET CONDITIONS

- Bids Opening in February 2021
- COVID supply chain issues
- Right after Texas Storm
- Supplier quotes were valid for only 2 weeks
- PVC, HDPE had a 40-50% rise in that month
- Rebar/ pre engineered metal building, iron, handrails, metals – 40% higher
- Local market for subs, electrical labor is competitive
- Gas prices

PROJECT FUNDING

- $1 million VE options were identified
- Additional SRF loan money was acquired
- Project has $12 million EDA grant funding

PROJECT STATUS

- Received Bids – February 25, 2021
- Notice of Award – April 16, 2021
- Notice to Proceed – June 2, 2021
- Construction Complete – June 2023
- WWTF Expansion Design started - July 2023

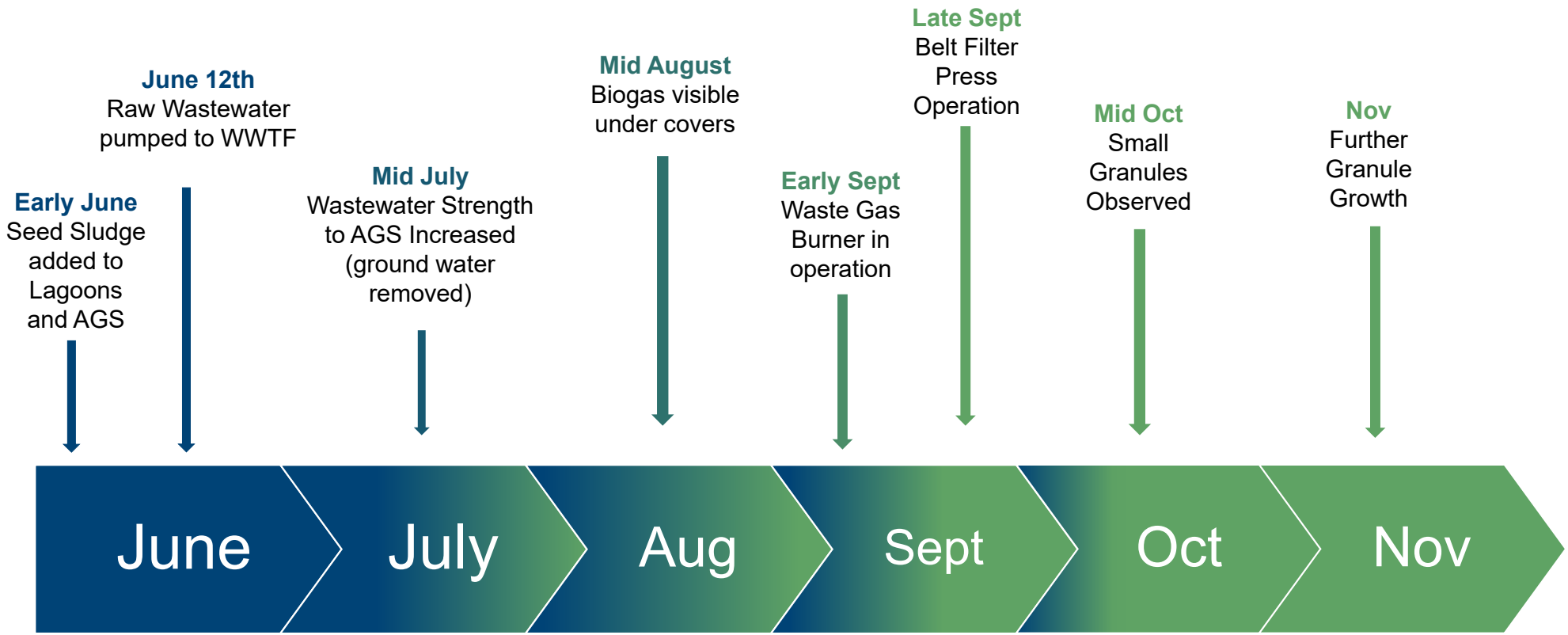

AGS TANKS
AND PIPE
GALLERY


AGS PIPE
GALLERY


AEROBIC
DIGESTERS

07 START-UP

Timeline of Startup - 2023



SEEDING

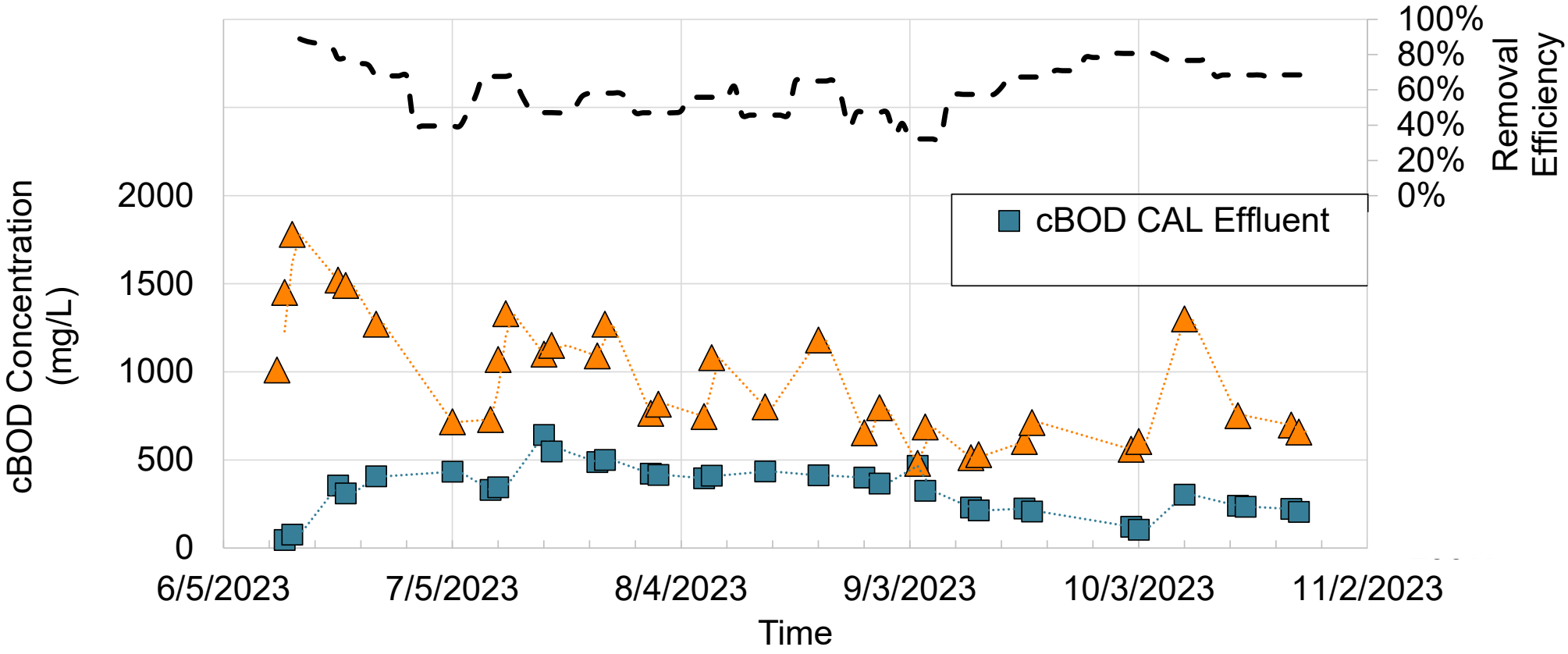
START UP OPERATIONAL MONITORING

- Covered Anaerobic Lagoon (CAL)
  - Operating Temperature: 90-95 °F
  - Caustic dosing for pH control
    + Maintain residual alkalinity for AGS
  - Water quality: Volatile acids, pH, cBOD, COD
  - Sulfates in anaerobic influent reduced to hydrogen sulfide
  - Quaternary Ammonium Compounds (Quat) measured (6 mg/L)
- AGS
  - D.O., ORP
  - MLSS
  - Settle timing and cycle structure.
  - Wasting visual checks
  - Water quality: COD, cBOD, TKN, NH3, FOG

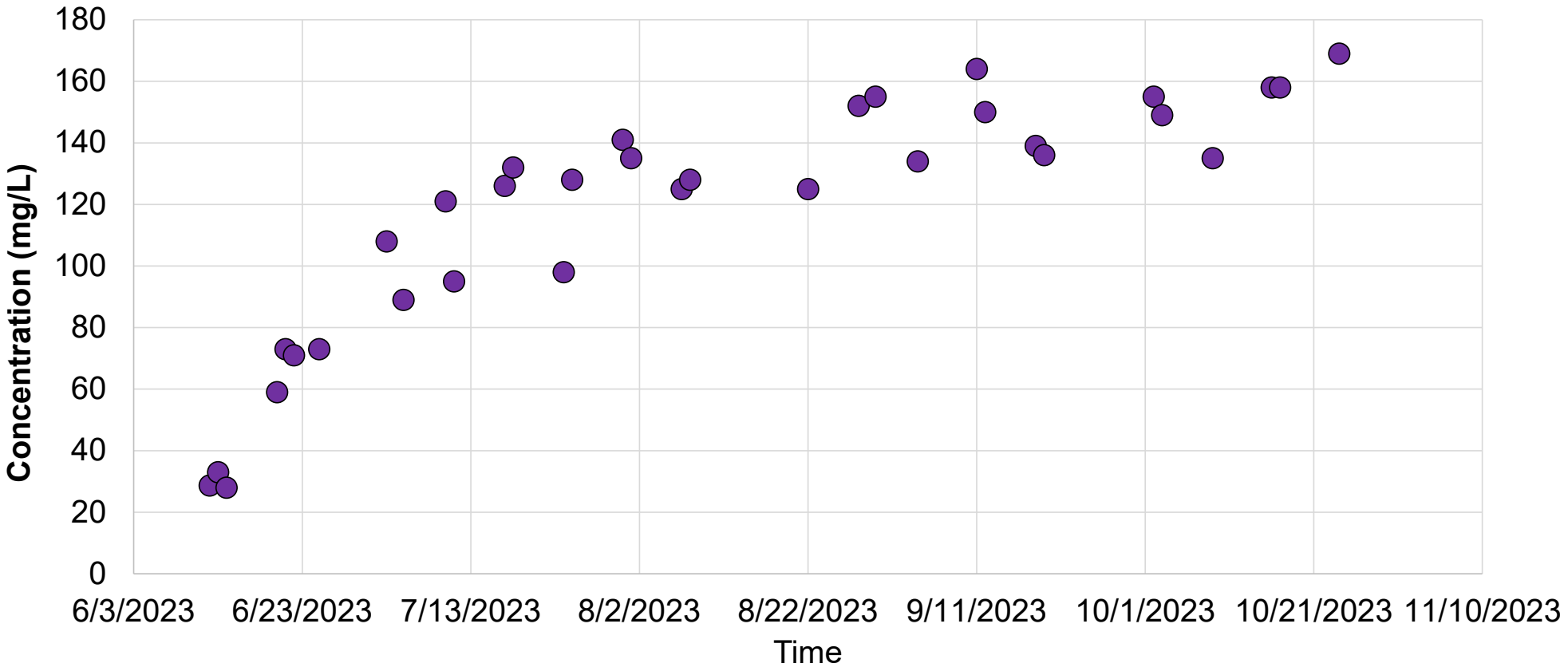
CAL PRETREATMENT TARGETS AND PERFORMANCE

Parameter	Treatment Target	Measured Current Performance
$cBOD_5$	80%	75%
TSS	70%	80%
TKN	10%	18%
FOG	90%	90%

CAL cBOD REMOVAL



CAL EFFLUENT AMMONIA TO AGS



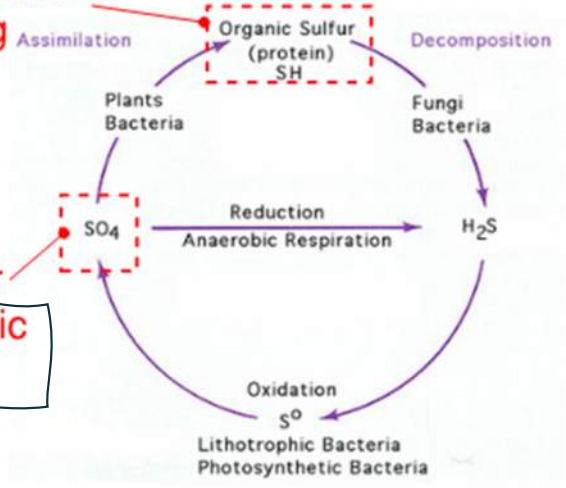
SEPTEMBER 5th 2023

THE SULFUR PROBLEM

1. Original Design Assumptions
    1. Average Biogas Generation → 460 scfm
    2. Biogas H2S → 2,000 – 3,000 ppmv (based on other lagoon experience)
    3. Proprietary H2S biogas Scrubbing vessel (Activated Carbon style) → life 1.5 years

2. Current Operating Biogas data
    1. Average Biogas Generation → 200 scfm
    2. Biogas → 14,000 to 20,000 ppmv H2S (grab samples)
    3. Existing Scrubber → life, around 4 months, removal efficiency questionable.

Industrial Wastewater
- Meat Packaging
- Pea Protein



- Drinking water
- Industry sulfuric acid usage

Analytical Results

Sample ID: **Before Flare 1**
Lab ID: 2405350001
Sampling Location: City of South Sioux Waste Water Plant

Method: **Light Hydrocarbons by GC-FID** **Media:** SKC 232-01, Tedlar Bag 1L
Dilution: 100 **Sampling Parameter:** Air Volume 1 L

Analyte	Result (ppm)	RL (ppm)
Methane	**660000**	1000

Method: **Sulfur Gases Scan** **Media:** SKC 232-01, Tedlar Bag 1L
Dilution: 50000 **Sampling Parameter:** Air Volume 1 L

Analyte	Result (ppm)	RL (ppm)
Hydrogen sulfide	**20000**	350

OSHA Health Hazards Guidelines

Concentration (ppm)	Symptoms/Effects
0.00011-0.00033	Typical background concentrations
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death

SULFUR MANAGEMENT OPTIONS

1. Source Control → Reduce sulfuric acid usage at the industries.
    1. Pilot Testing in planning stage.
2. Install full treatment Chemical Biogas scrubbing system.
    1. Large capitol costs $4.0 – 5.0 Million
3. Install partial treatment Chemical Biogas scrubbing system and Control pH.
    1. Large capitol costs $2.0 – 3.0 Million, plus $0.75 Million/year in chemical cost
4. Control pH ~8.0, continue to use existing scrubber
    1. Large O&M costs ~ $1.0 - 1.5 Million/year in chemical and media costs.

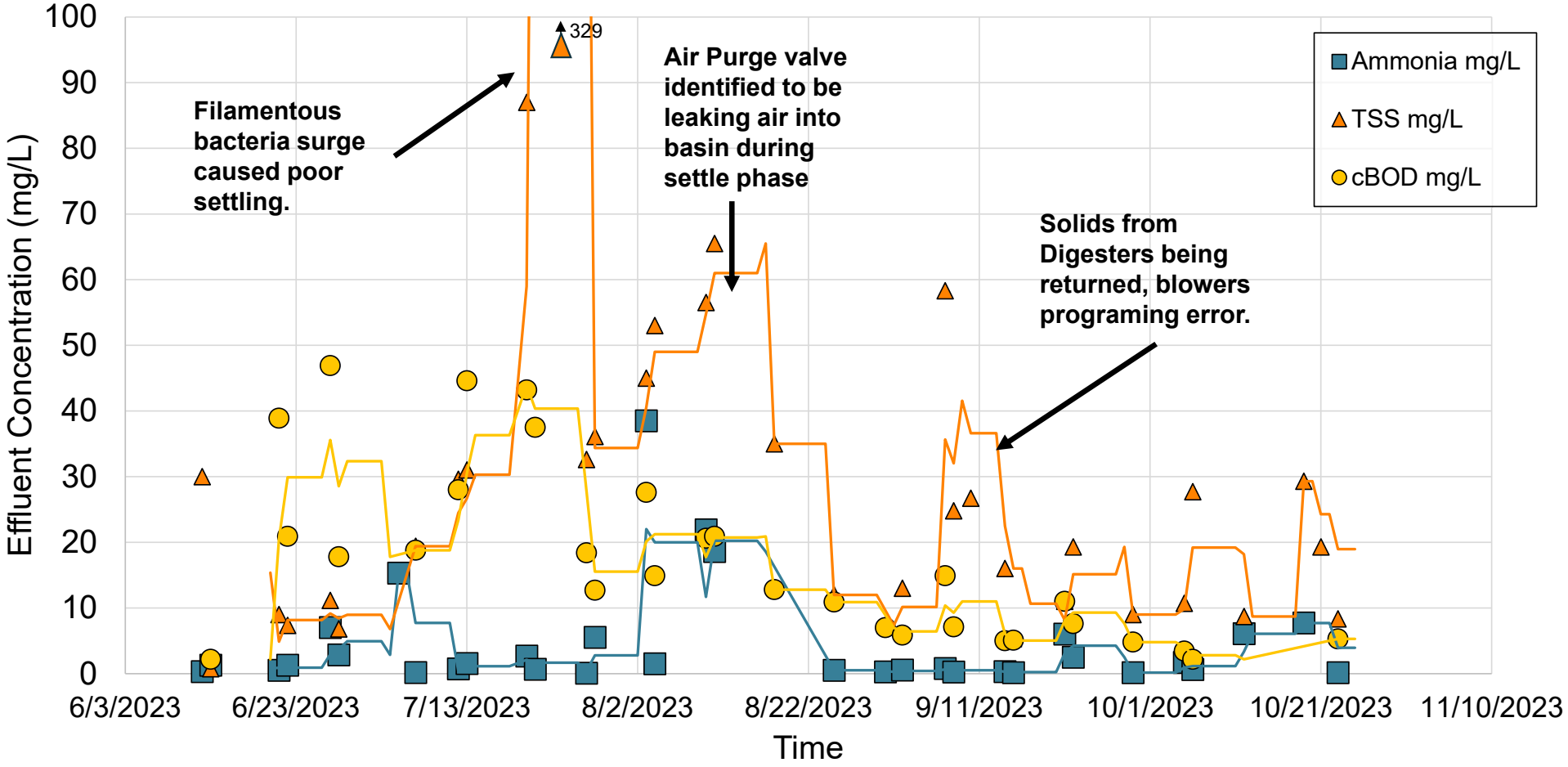
<u>Solution is most likely a combination of Options.</u>

AGS OPERATION

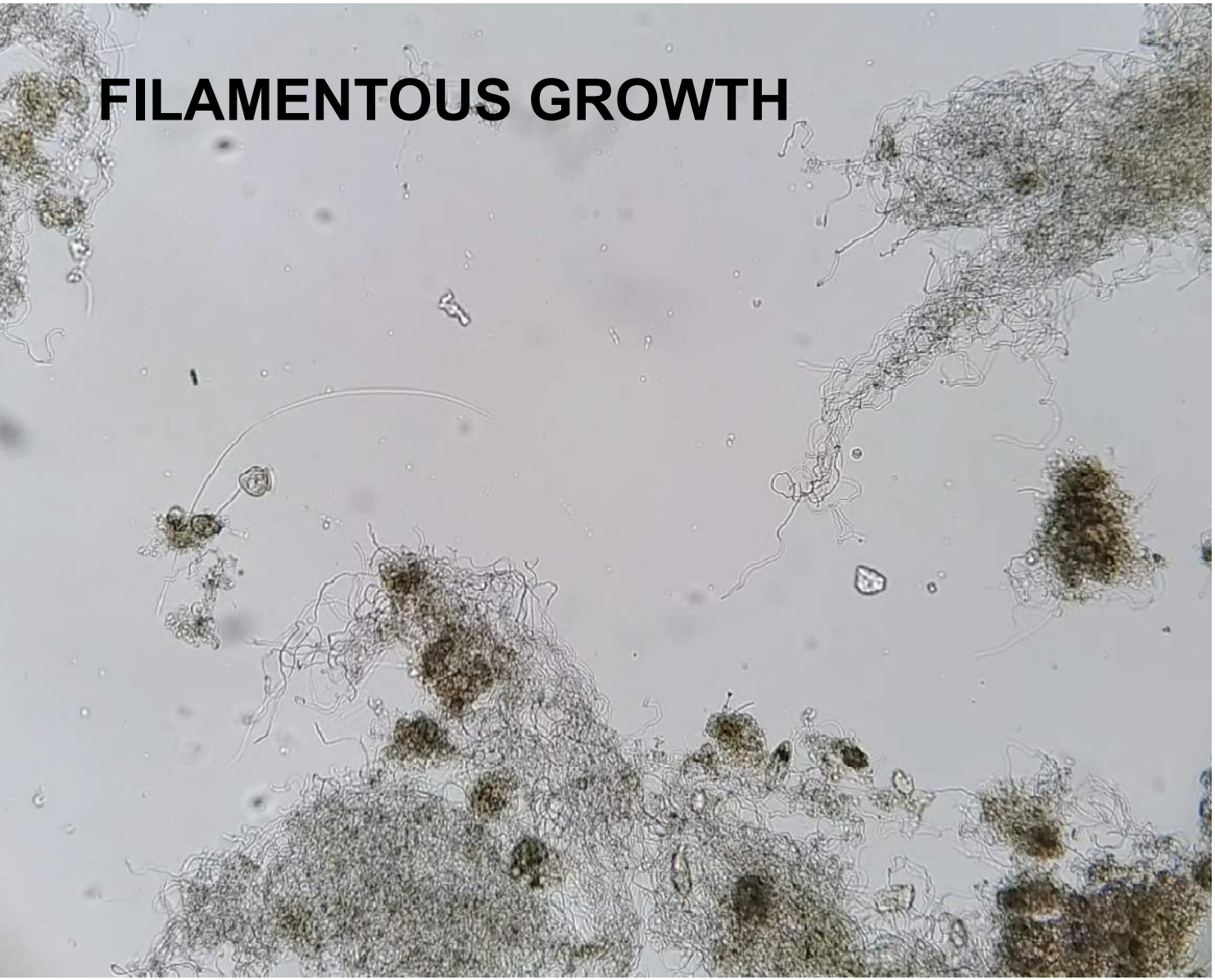
- MLSS concentration:
  - Design: 8,000 mg/L
  - Current: 3,500 – 4,500 mg/L
- Operating Cycle:
  - Fill: 1.5 hr
  - React: 3.5 hr
  - Settle/WAS: 40min
- Operating Temperature: 83-93 °F
- Aeration Control:
  - Ammonia based aeration control
  - Dissolved oxygen control

AGS during fill/decant cycle October 31st

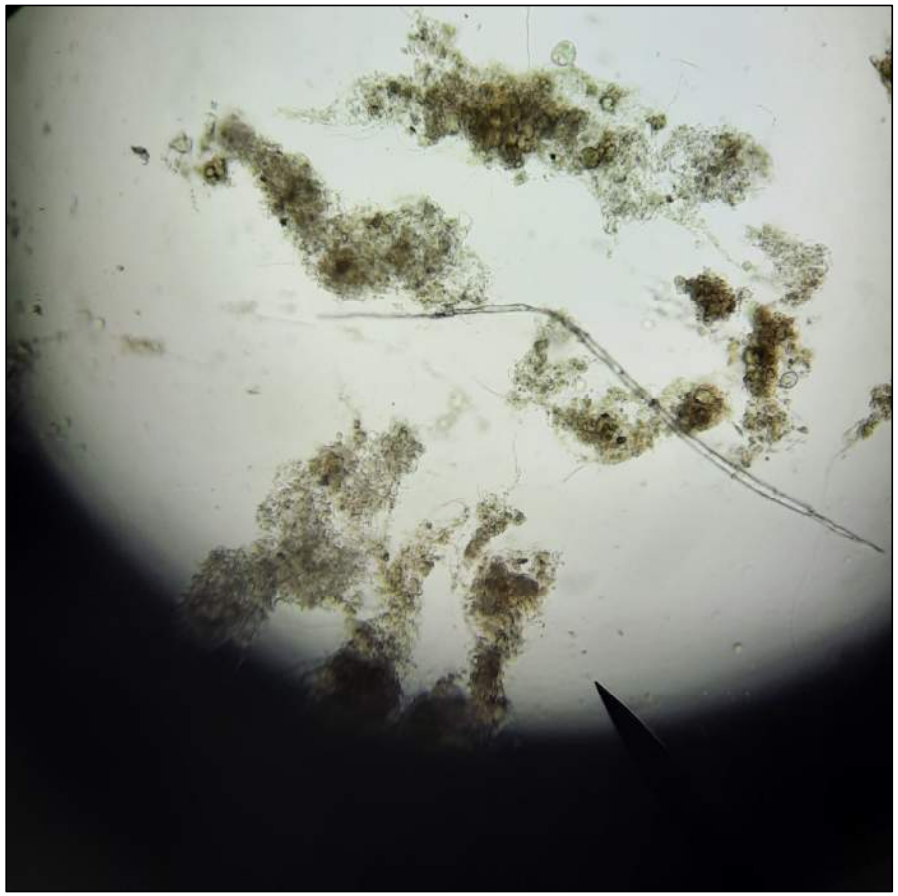
AGS STARTUP EFFLUENT QUALITY

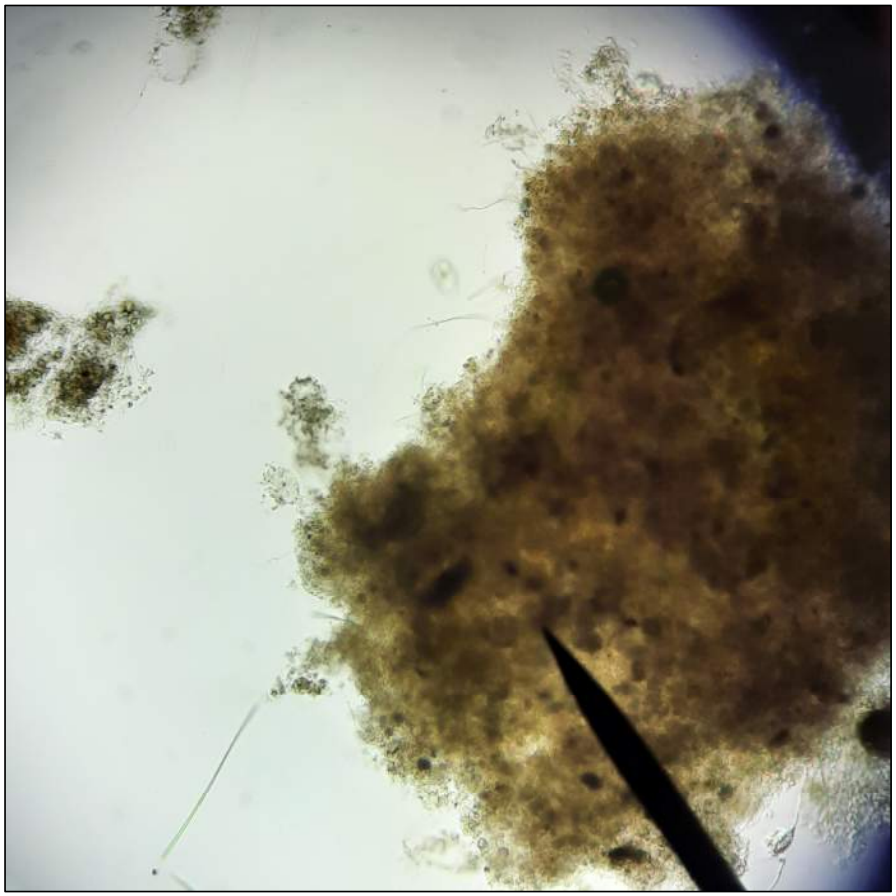


FILAMENTOUS GROWTH



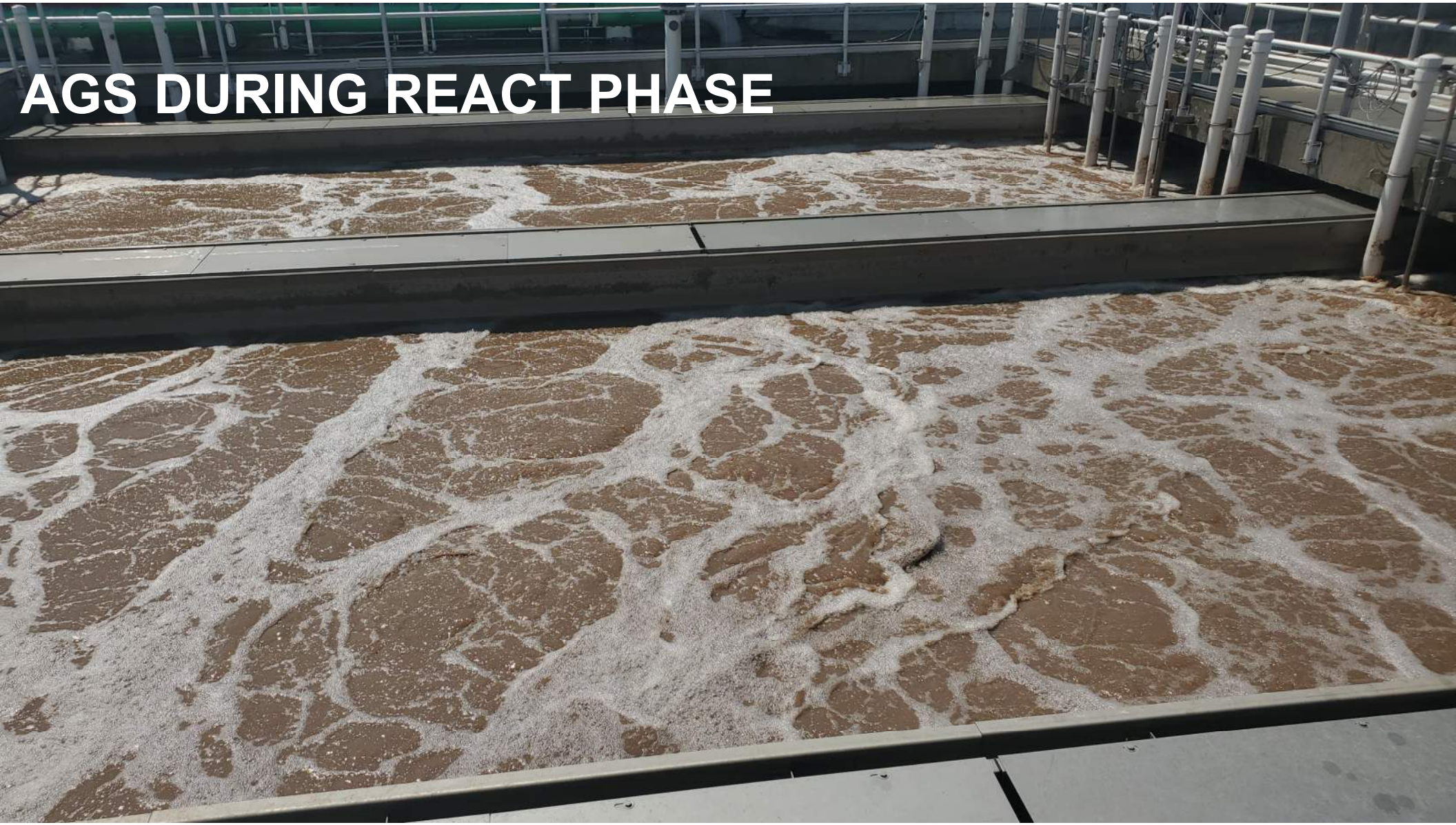
GRANULATION IN PROGRESS – 8/30





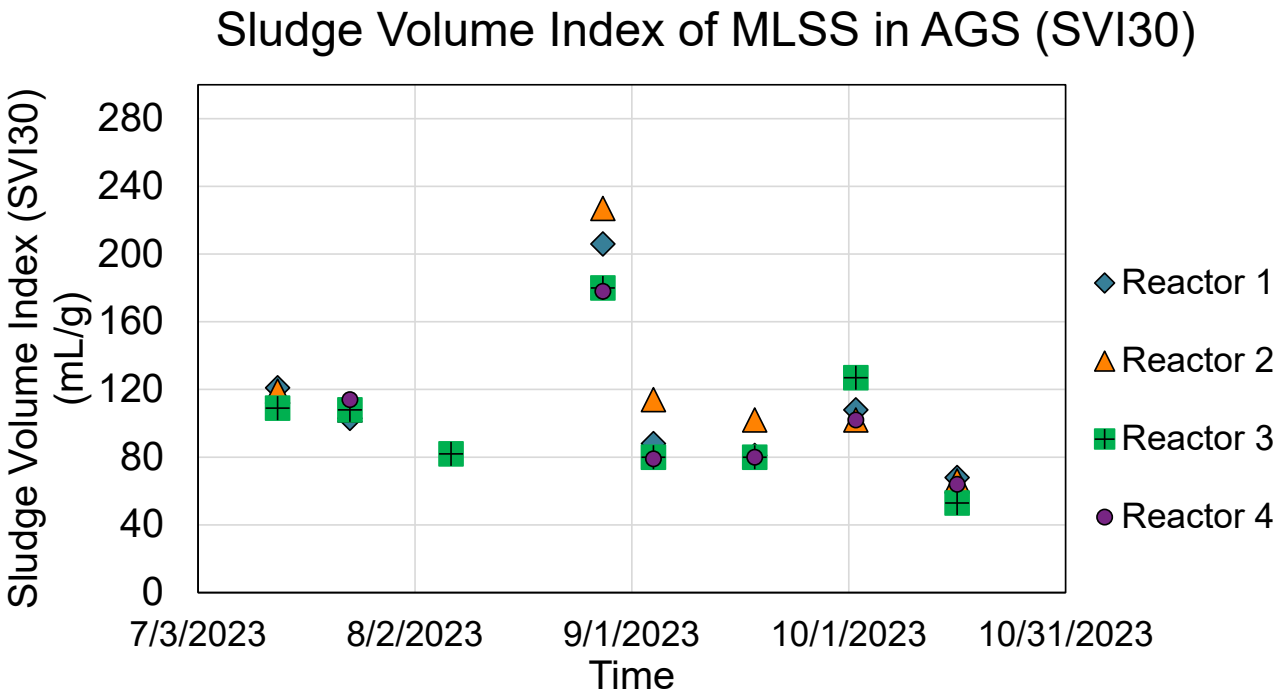
AGS DURING FILL/DECANT PHASE – OCT. 25TH

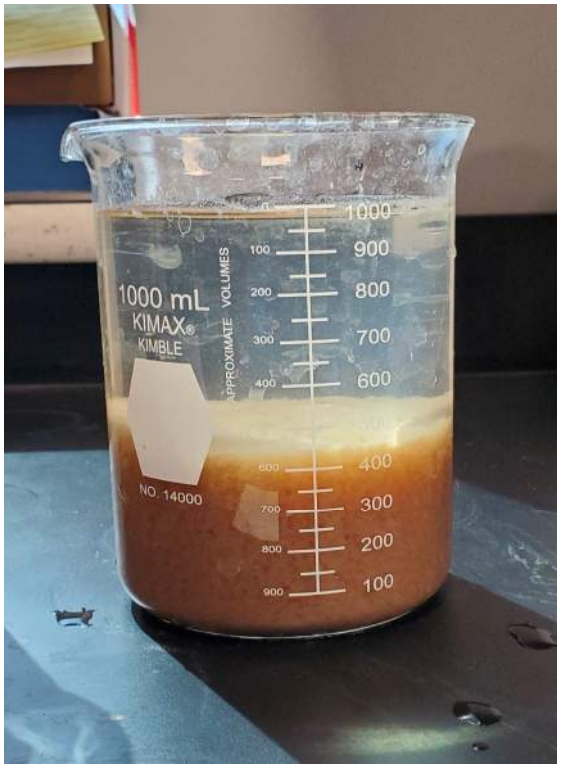
AGS DURING REACT PHASE



SETTLING AND WASTING

- Driving down settling times (45 to 30min)

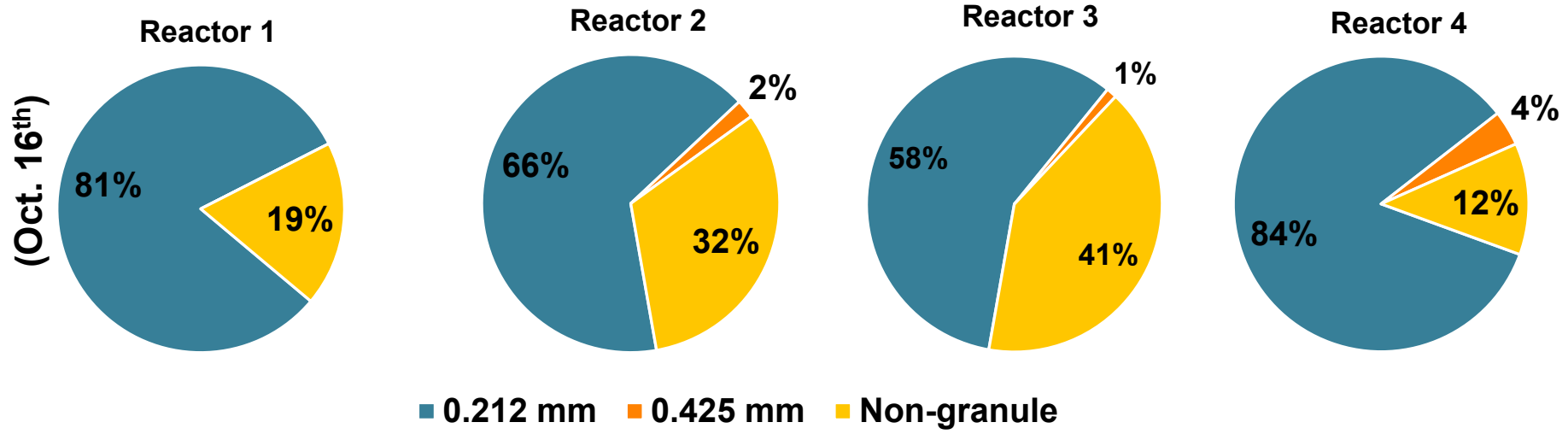




Settled Waste Activated Sludge

BABY GRANULES ARE GROWING – Oct 17TH

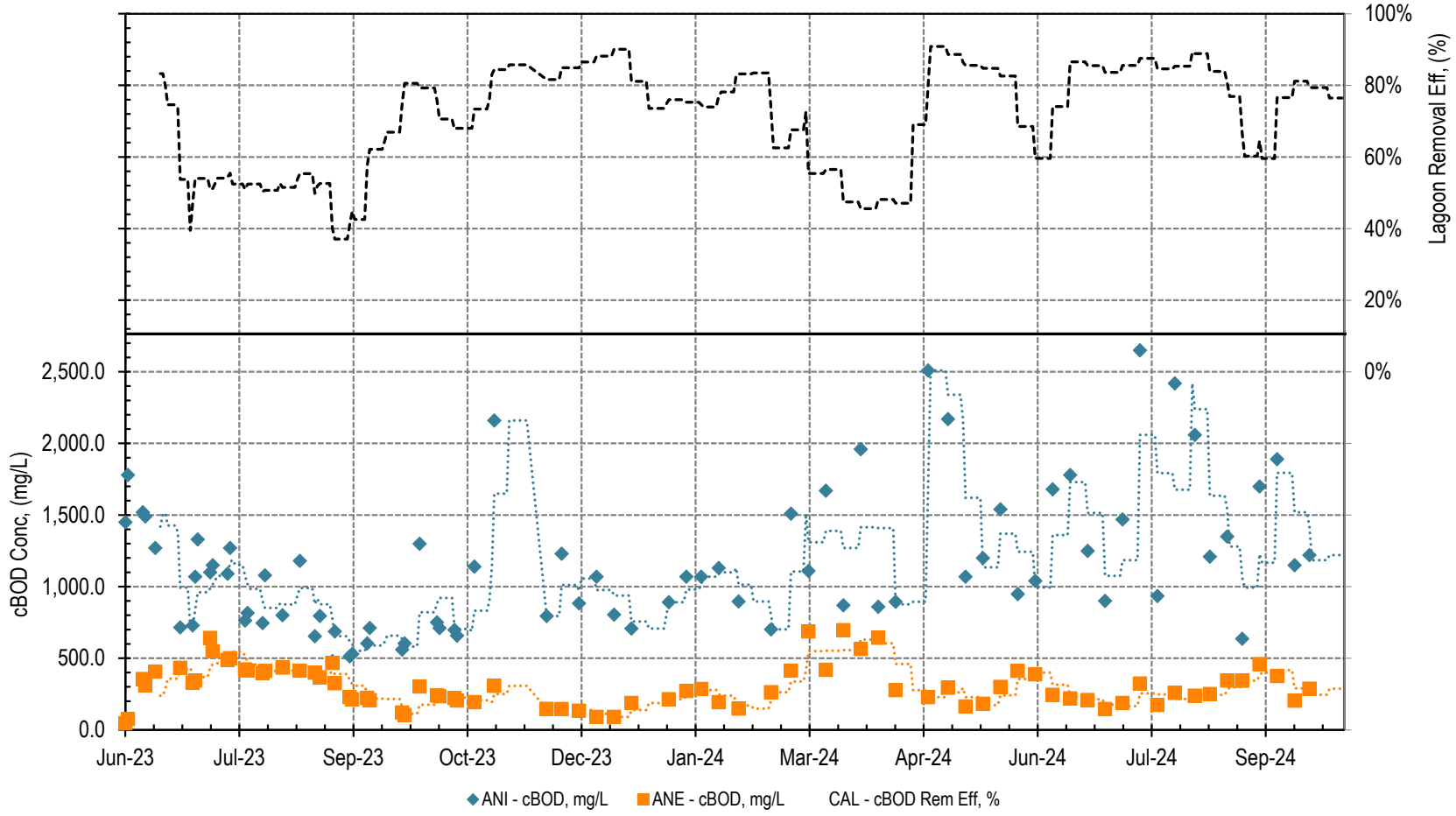
MLSS Distribution (Oct. 16th)



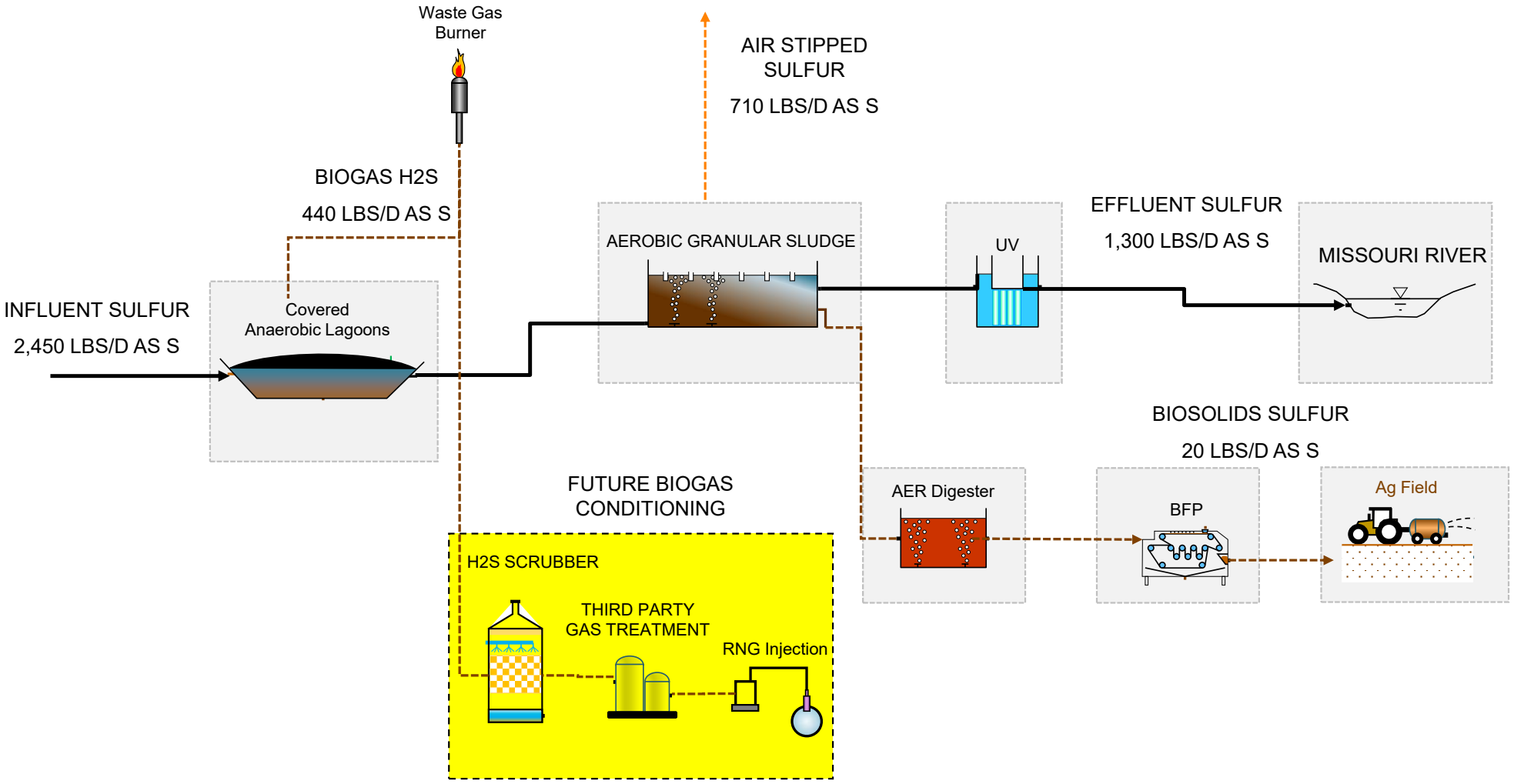

KOHLER

08 Looking Forward

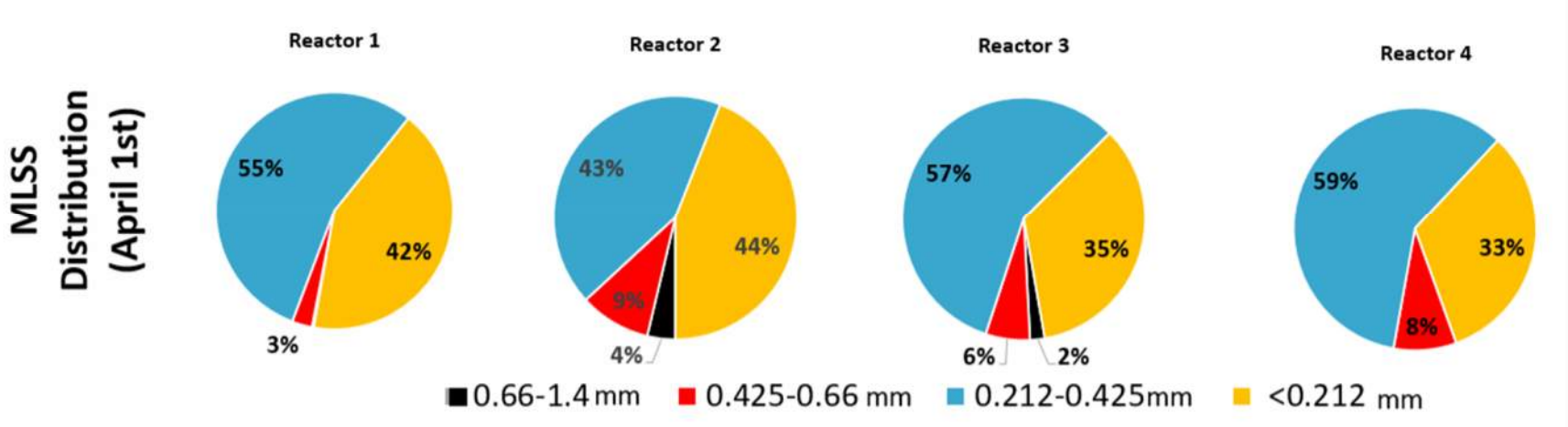
CAL cBOD Removal



FUTURE BIOGAS CONDITIONING

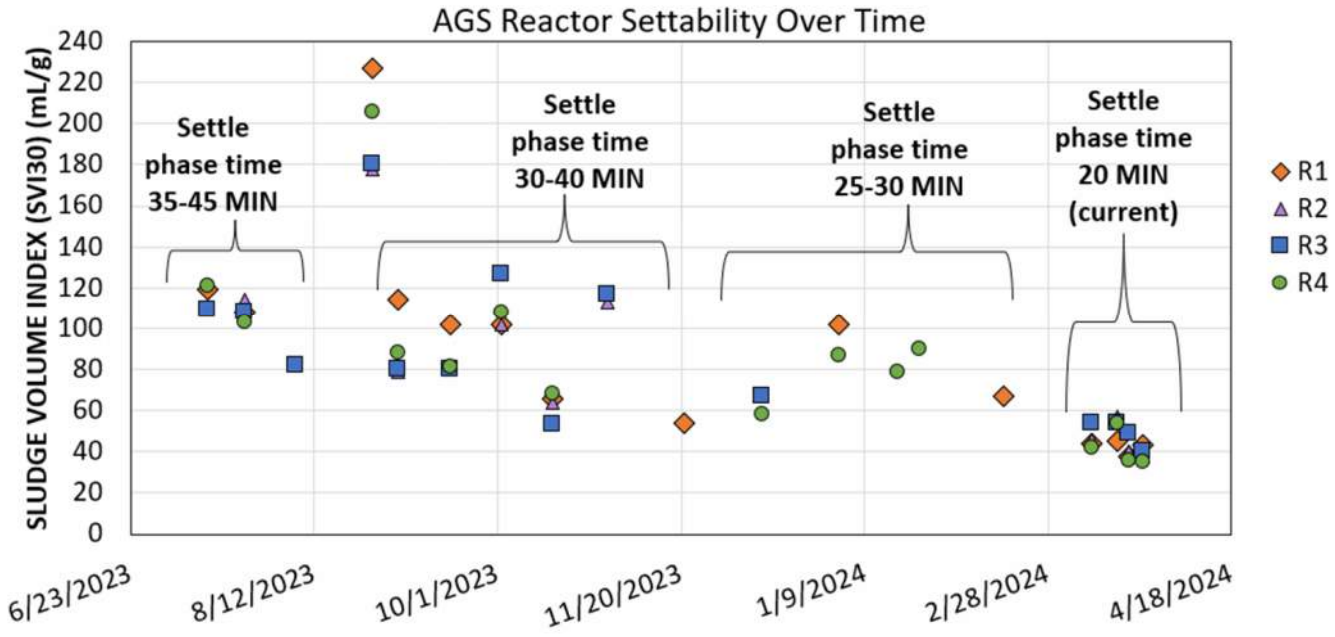


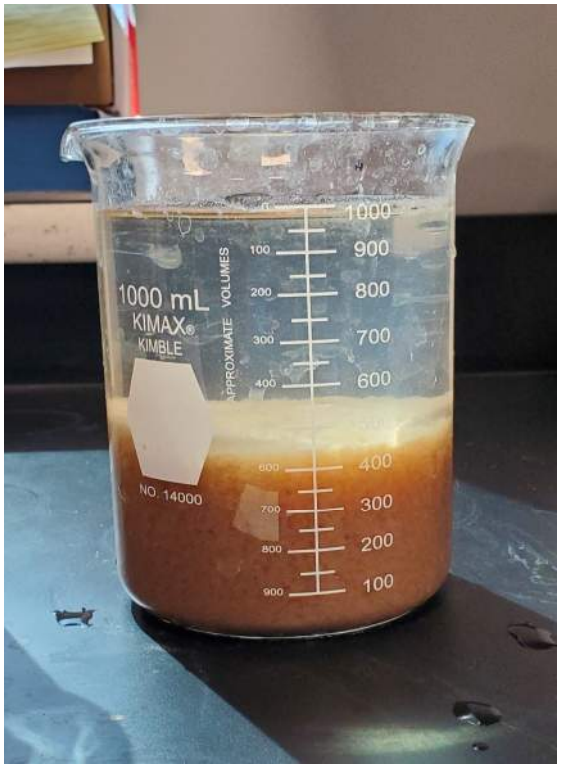
BABY GRANULES ARE GROWING – APRIL 1ST



Settling and wasting

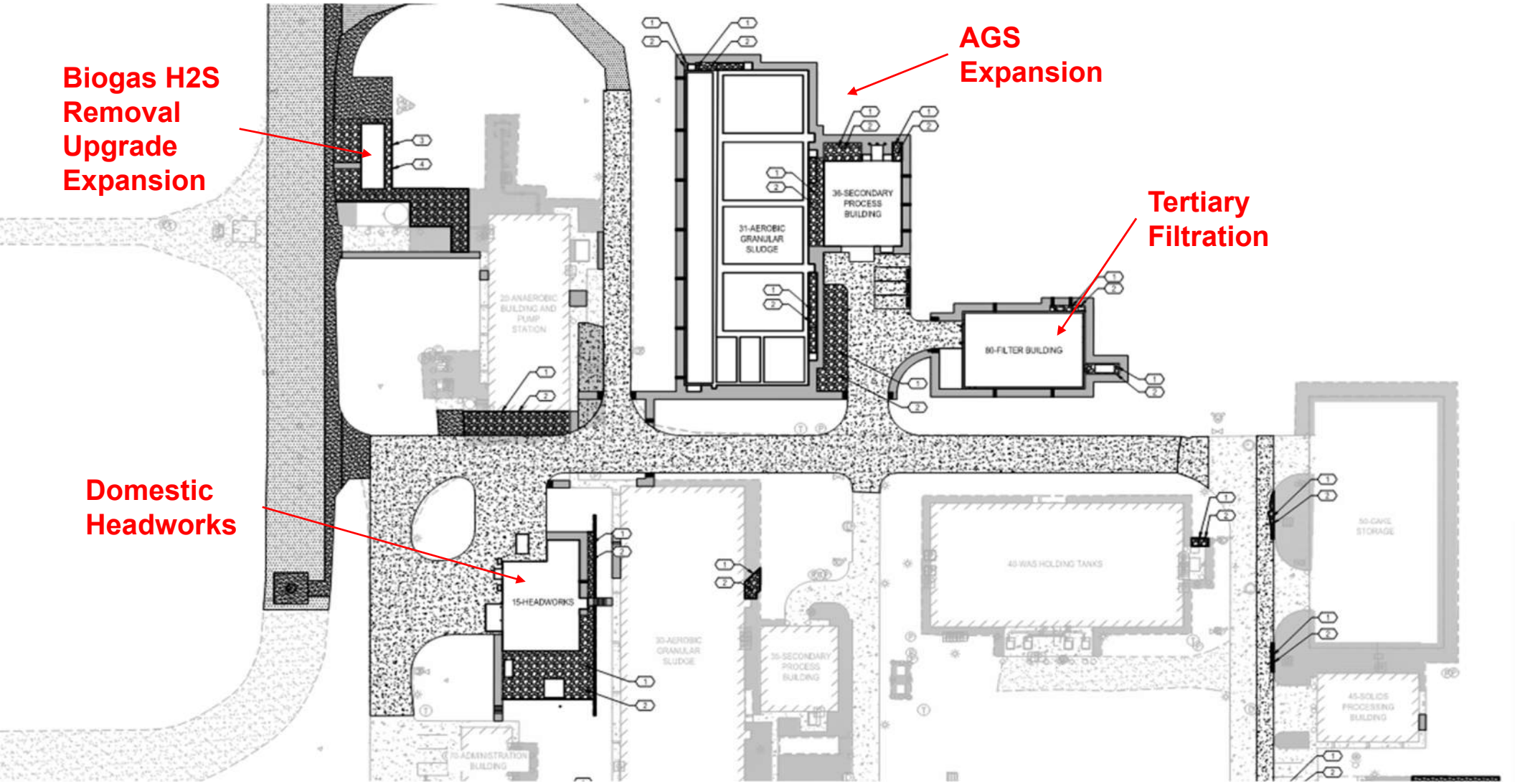
- Settleability has improved significantly with granulation
  - SVI30: 35-45 mL/g
  - SVI5: 50-60 mL/g





Settled Waste Activated Sludge

FUTURE DOMESTIC HEADWORKS AND AGS EXPANSION



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Questions?
Email Marisa Waterman at mwaterman@aaees.org with any questions you may have.

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