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30th Annual IAWEA Biosolids Conference
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Waterloo Biosolids Upgrades: Eliminating Bottlenecks and Improving Operations and Reliability

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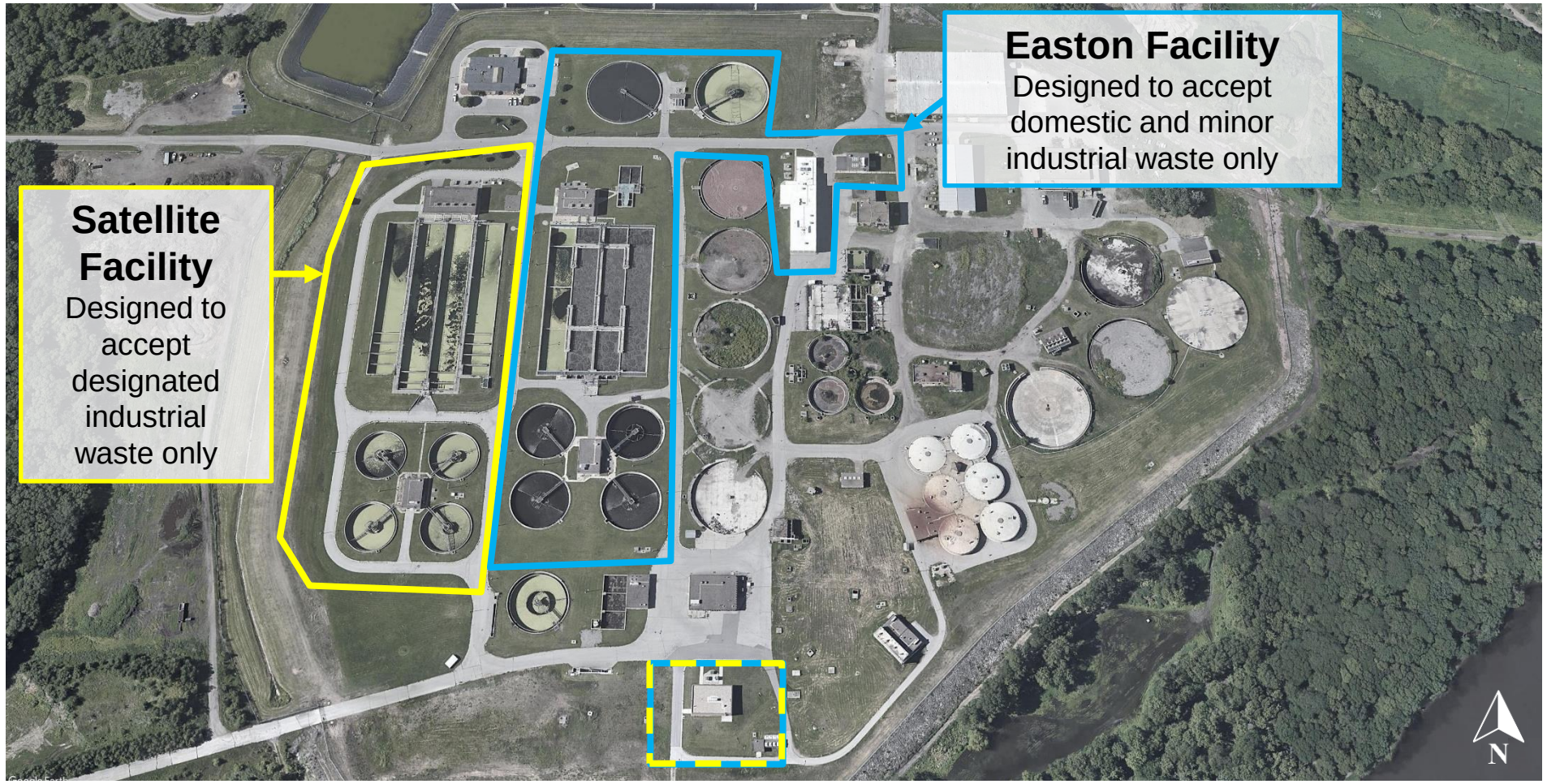
Agenda

- Introduction and Project Background
- Planning Recommendations
- Challenges, Design Objectives, and Process Improvements
- Project Cost and Status
- Construction Photos
- Lessons Learned
- Summary

Wastewater Treatment Plant (WWTP) Site Overview



Current mode of operation combines and treats waste only with the Easton Facility

Facility Design Overview

	Satellite – Industrial	Easton – Domestic
Year Built	1997	2000
Treatment Type	Extended Air Activated Sludge	Conventional Activated Sludge
Average Dry-Weather (ADW) Flow	5.3 million gallons per day (MGD)	12.7 MGD
Average Wet-Weather (AWW) Flow	8.1 MGD	26.7 MGD
Municipal Wastewater	11.1 MGD	36.6 MGD
5-Day BOD Load	58,000 lbs/day	30,000 lbs/day
Total Kjeldahl Nitrogen (TKN) Load	13,550 lbs/day	7,500 lbs/day

Anaerobic Lagoon

Tyson Waste Stream

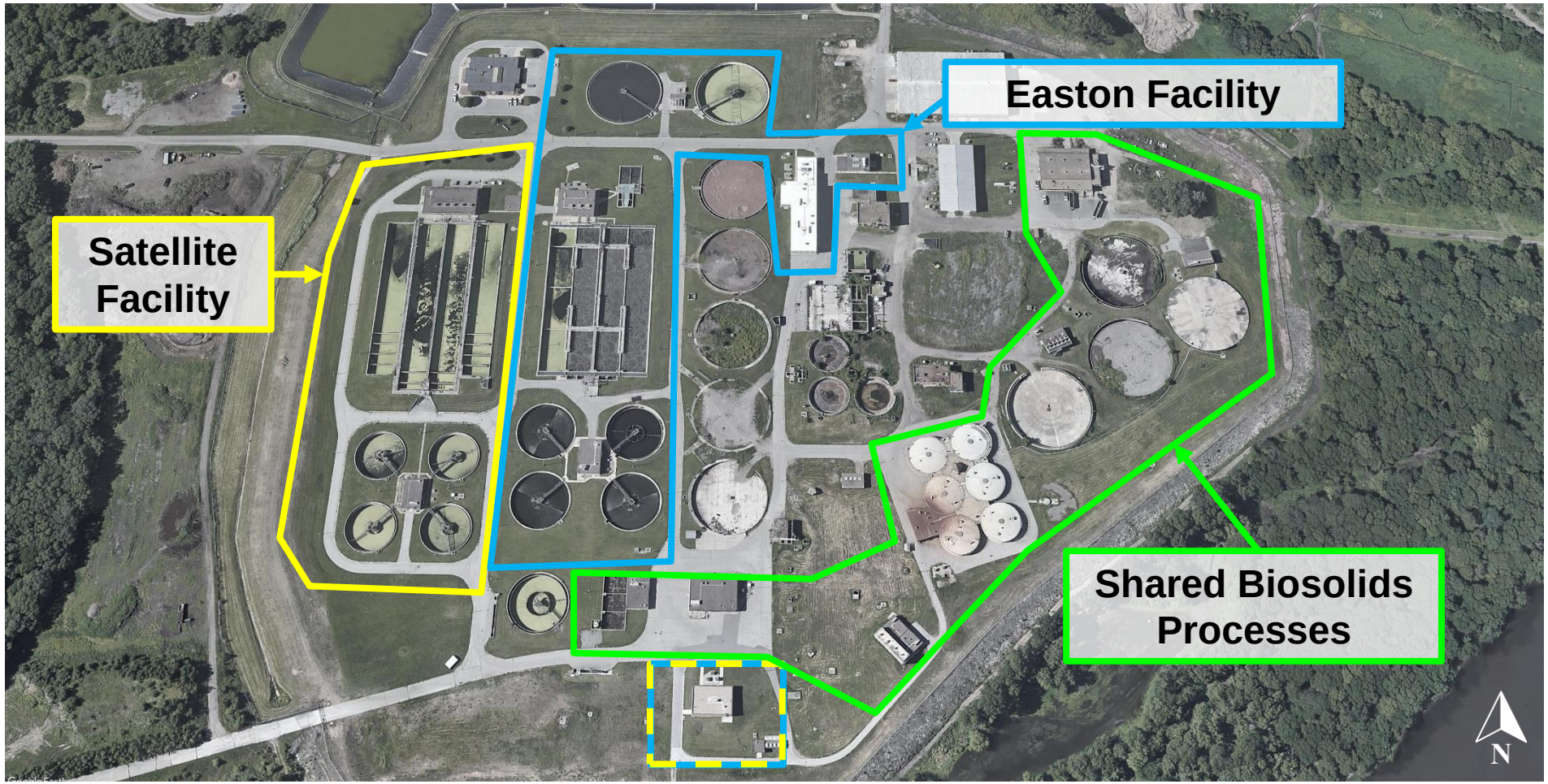
- PE in 324,000
- 90% BOD removal
- 74% TSS removal
- PE out 32,000

Discharge combines with wastes from tannery to make up satellite influent

Map Data: Google

PE – Population equivalent
BOD – Biological oxygen demand
TSS – Total suspended solids

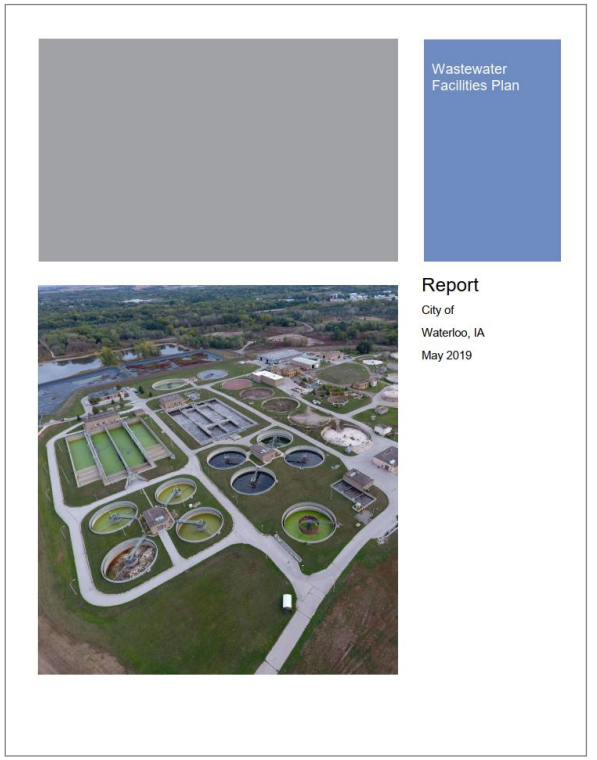
Wastewater Treatment Plant Site Overview



Biosolids processes shared by both plants = <u>critical</u>

Planning for This Project Started in 2016

- Department of Natural Resources required Waterloo (and other Iowa communities) to complete a Nutrient Reduction Plan by Spring 2017
- City hired Stand Associates, Inc.® to complete the Nutrient Reduction Plan and an overall WWTP Facilities Plan
- Facility Plan and Nutrient Plan were completed in early 2017
- Biosolids Improvements and Immediate Needs identified as Phase 1 with a $16 million value



Why Are We Doing This Project?

Improvements to biosolids processes are needed to:

- Replace aging infrastructure and equipment
- Improve hydraulic constraints/bottlenecks and internal recycle loads that affect process stability and performance
- Add flexibility
- Improve safety
- Reduce operating costs

Wastewater equipment typically has a 20-year planned life,

last major update to most processes was 25 years ago

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Long Piping Run Results in Primary Sludge/Scum Pumping Problems

Challenge:

- Hydraulic constraints related to long pipe runs make it difficult to pump primary sludge, especially at higher solids contents
- Loss of flow when primary sludge solids content exceeds 3%

Design Objective:

- Improve primary sludge pumping
- Allow thicker primary sludge to blend tank

Primary sludge is currently pumped more than 1,600 feet across the site

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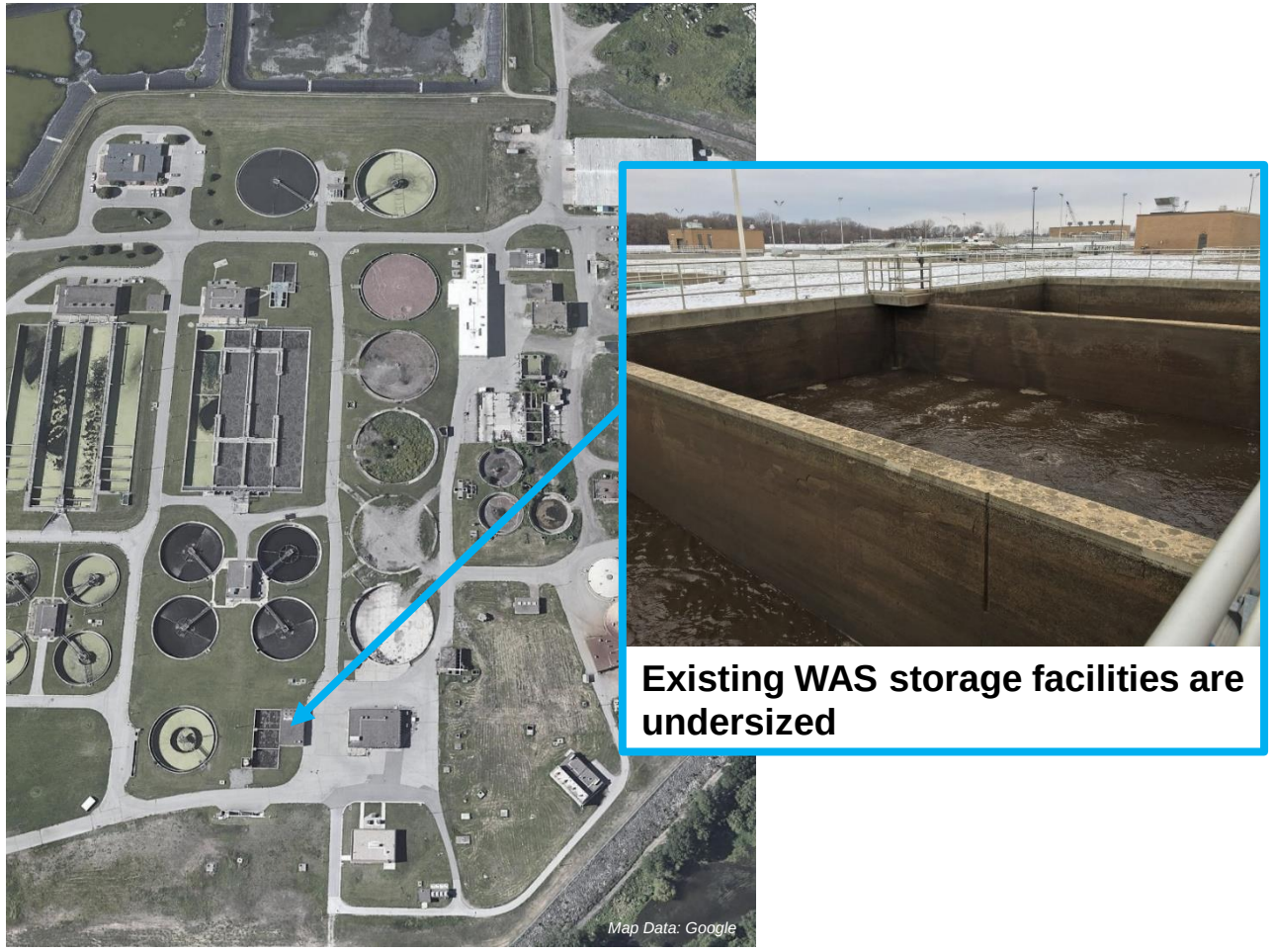
Limited Waste Activated Sludge (WAS) Storage

Challenge:

- Current WAS storage facilities are undersized (less than 1 day of storage)
- Thickening required 7 days per week
- Impacts activated sludge process control
- Recent equipment failures = downtime and bottlenecks

Design Objective:

- Increase WAS storage volume



Existing WAS storage facilities are undersized

Existing Tanks Were Repurposed to Increase Process Flexibility and Eliminate Bottlenecks

Step 1:
Repurpose existing tank for WAS storage

Step 2:
Repurpose existing WAS storage for primary sludge holding

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WAS Storage – Loadings and Detention Time (in days)

Process Improvements:

- Add 1 million gallons of storage, significantly increasing storage time
- Replace existing pumps, blowers, and other equipment

Scenario (WAS Production)	Detention Time with Existing Tanks (days)	Detention Time with New Tank (days)
Current Average Day (360,000 gal)	0.7	3.5
Current Max Month (650,000 gal)	0.4	2.0
Projected 2040 Average Day (425,000 gal)	0.6	3.0
Projected 2040 Max Month (767,000 gal)	0.4	1.7

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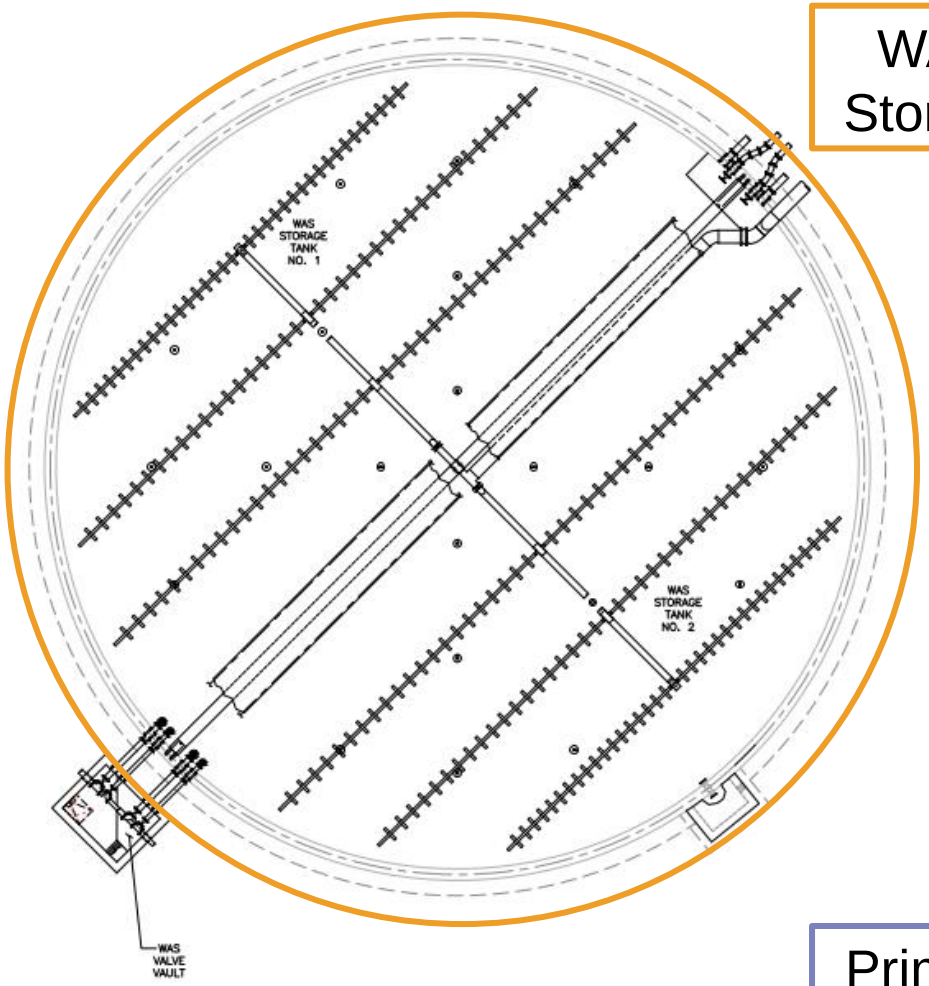
Construction Photos

Pre-construction condition at new WAS storage tank

Progress photo – old equipment removed and divider wall installed

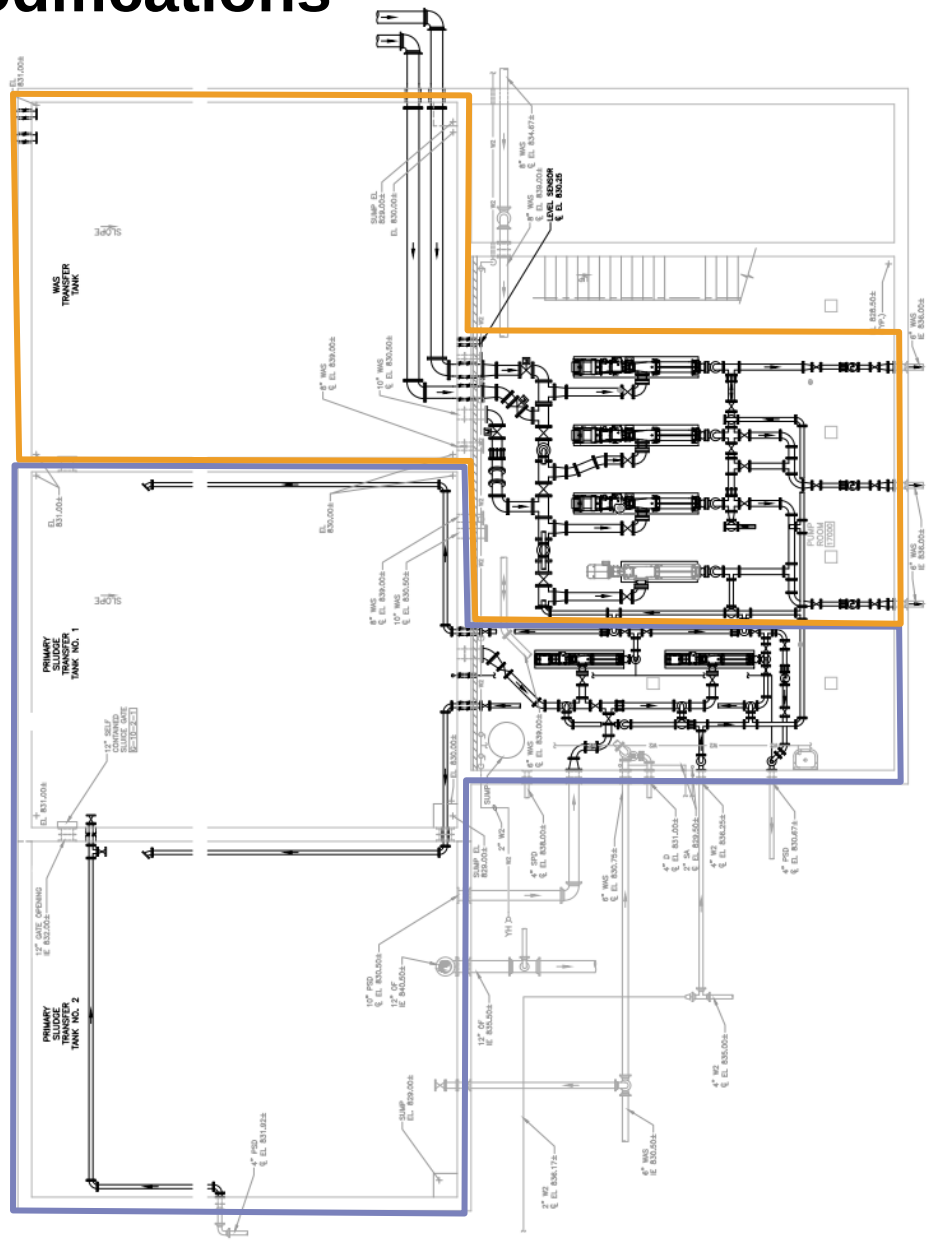
New WAS Storage Tank in Operation

WAS Storage and Primary Sludge Modifications



WAS Storage

Primary Sludge



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Progress on Primary Sludge Tanks

New Chemical Feed Building Improves Safety and Provides Permanent Storage Area and Application Points

Challenge:

- Ferric chloride is currently used to control corrosive and toxic gas formation
- No permanent ferric storage on site
- Bulk storage tank located outdoors
- Totes were filled and moved manually to application points = safety concern

Original chemical storage facilities

Chemical Storage Building Photos

Process Improvements:

- New building with containment, fire protection system = improved safety
- New feed location so chemical addition impacts more processes

New chemical storage building

Tank fill with spill containment

Removable panels allow for future storage tank expansion

Design Includes Safety Measures

Process Improvements:

- Bulk chemical storage and feed system improves chemical handling

5,400-gallon storage tanks

Chemical pump skids

Containment and leak detection system

Dewatering Equipment Reaches the End of Its Useful Life

Challenge:

- Ongoing equipment failure = process stress, cost for repairs and labor
- Issues with Hydrogen Sulfide
- High loadings in filtrate

Existing dewatering equipment includes two belt filter presses installed in 1990 and one belt filter press installed in 2015

Dewatered Sludge Handling Expansion Is Needed

Challenge:

- Dewatered sludge is disposed using contract hauler
- Sludge hauling is a significant operating cost

Design Objective:

- Replace aging dewatering equipment
- Reduce costs by producing drier dewatered sludge
- Provide improved loading area for contract hauler

Previous biosolids loading area at the Waterloo WWTP site

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Centrifuge Equipment Was Selected After Alternatives Analysis and Pilot Testing Was Conducted

- Belt Filter Presses, Screw presses considered as an alternative
- Pilot testing with Centrisys showed favorable results, driest sludge
- Footprint of centrifuge equipment significantly smaller than other options

	Screw Press	Belt Filter Press	Centrifuge
Present Value Capital Expenses	$3,762,750	$1,830,000	$2,170,200
Present Value O&M Expenses	$8,680,269	$9,548,388	$8,114,088
Total Opinion of Present Value	$12,443,019	$11,378,388	$10,284,288

20-year present worth cost, presented in 2018 dollars

Centrisys dewatering centrifuge pilot test setup at the WWTP, June 2018

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Pilot Testing Results Show Significantly Drier Dewatered Sludge

- Liquid polymer used during Centrisys pilot testing with good results
  - Existing dry polymer (✳) did not perform well – likely not optimized
- Polymer systems for dewatering and thickening operations also to be replaced

25-28% total solids expected

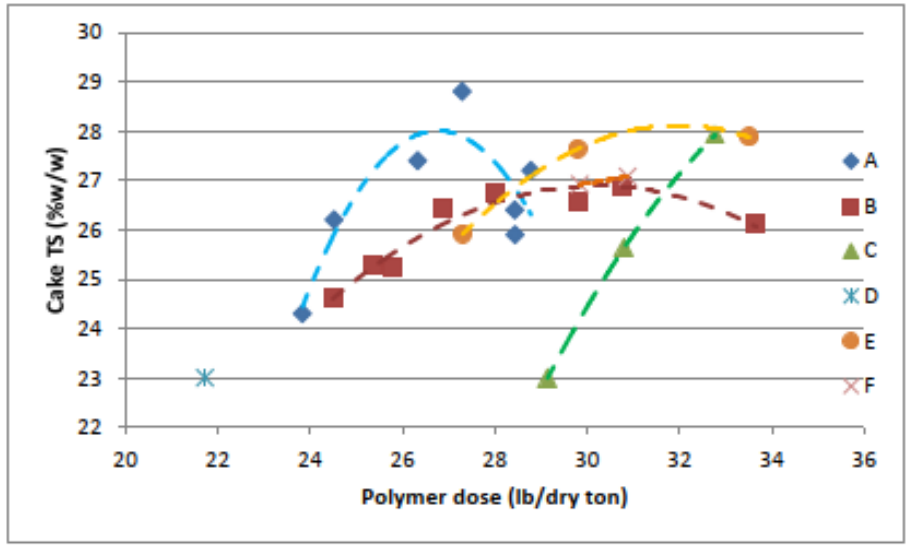

Figure 6. 70 GPM polymer curves
Source: Centrisys Pilot Test Report

Drier Sludge

Less Polymer Use

Polymer Properties			
Label	**Charge**	**Structure**	**MW**
A	High	Structured	High
B	Medium	Structured	High
C	Medium	Structured	High
D	–	–	–
E	Medium	Linear	Medium
F	High	Branched	Low

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Dewatering Centrifuges Provides Increased Capacity in a Smaller Footprint

Installation of new centrifuge dewatering equipment in progress

Emulsion System with Bulk Storage Replaces Dry Polymer System

New polymer feed equipment and bulk storage tanks

Example of Cost Savings From This Project

- Current sludge solids content: 16.5% → 18,288 wet tons/year
  (Actual data using existing equipment)

- Projected sludge solids content: 25% → 12,062 wet tons/year
  (Based on pilot study data)

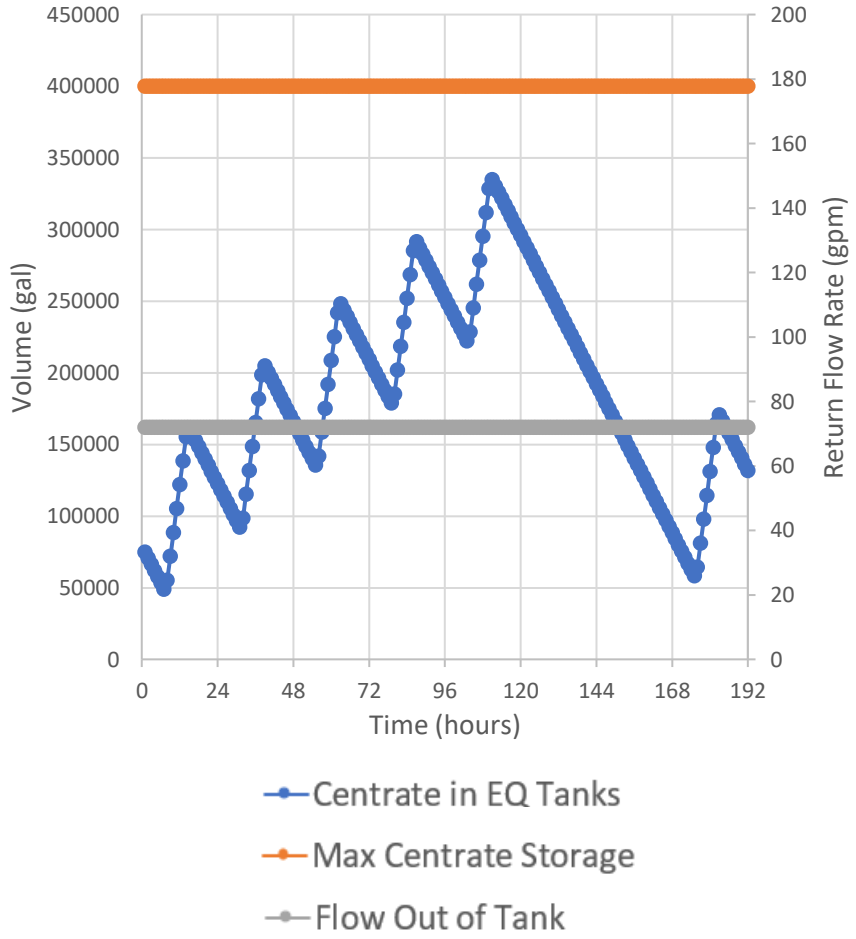
- Annual hauling cost savings = **$115,000** (34% reduction)

New Loadout Bay Increases Capacity and Improves Cake Conveyance

New biosolids loadout facilities

Centrate Equalization Addresses Intermittent, High Ammonia Shock Loads to the Aerobic Treatment Process

New centrate equalization tank adjacent to the dewatering building



Construction Photos

Pre-construction conditions at centrate tank

Progress photo – centrate tank excavation

Construction Photos

Progress photo – forming walls for centrate tank

Centrate Tank in Operation

Project Cost and Funding

Bid Information:

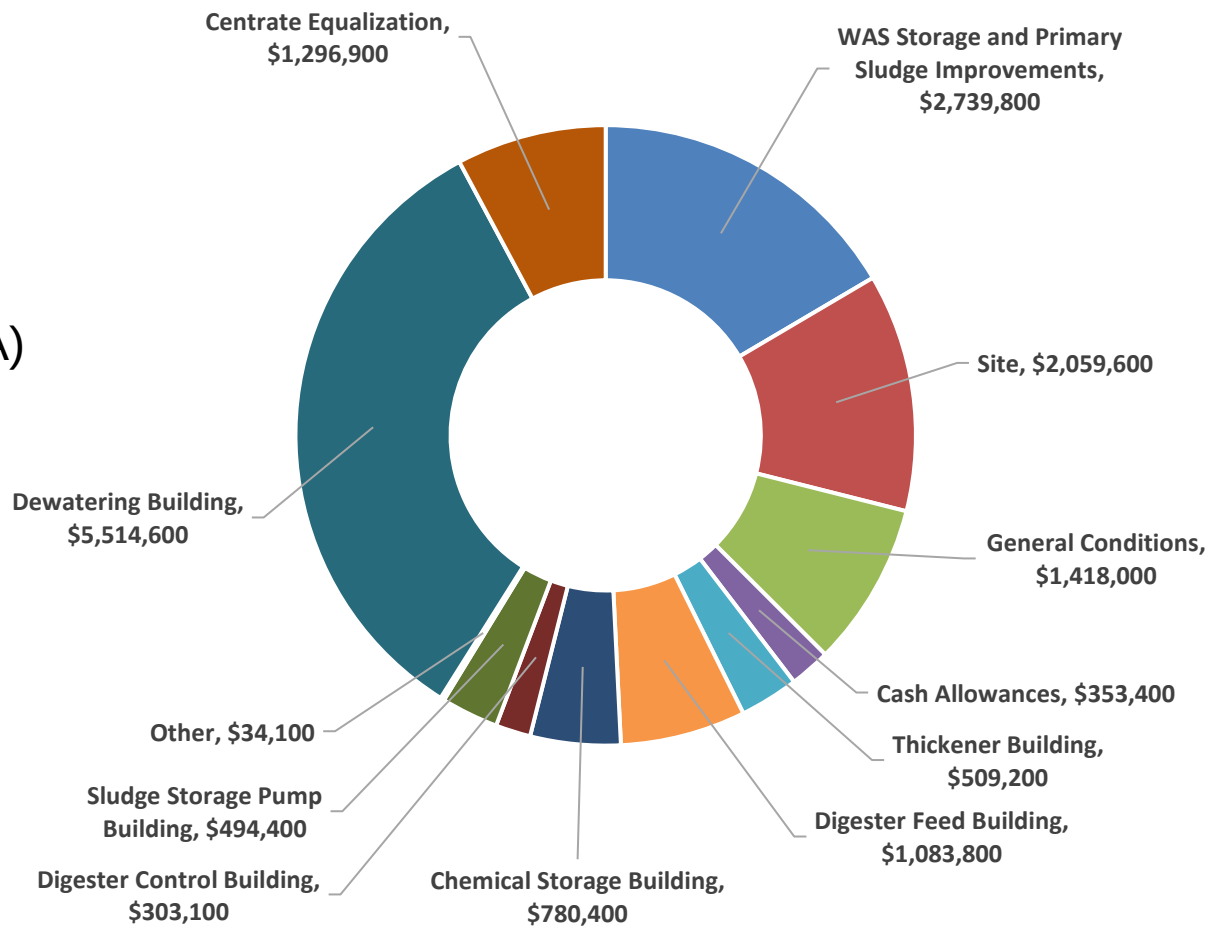
- Bid opening: January 23, 2020
- Low bidder: Woodruff Construction (Waterloo, IA)
- Low bid: $16,587,300

Funding:

- Iowa SRF Funds used to fund project
- Current interest rate: 2.0% (20-year loan)

Schedule:

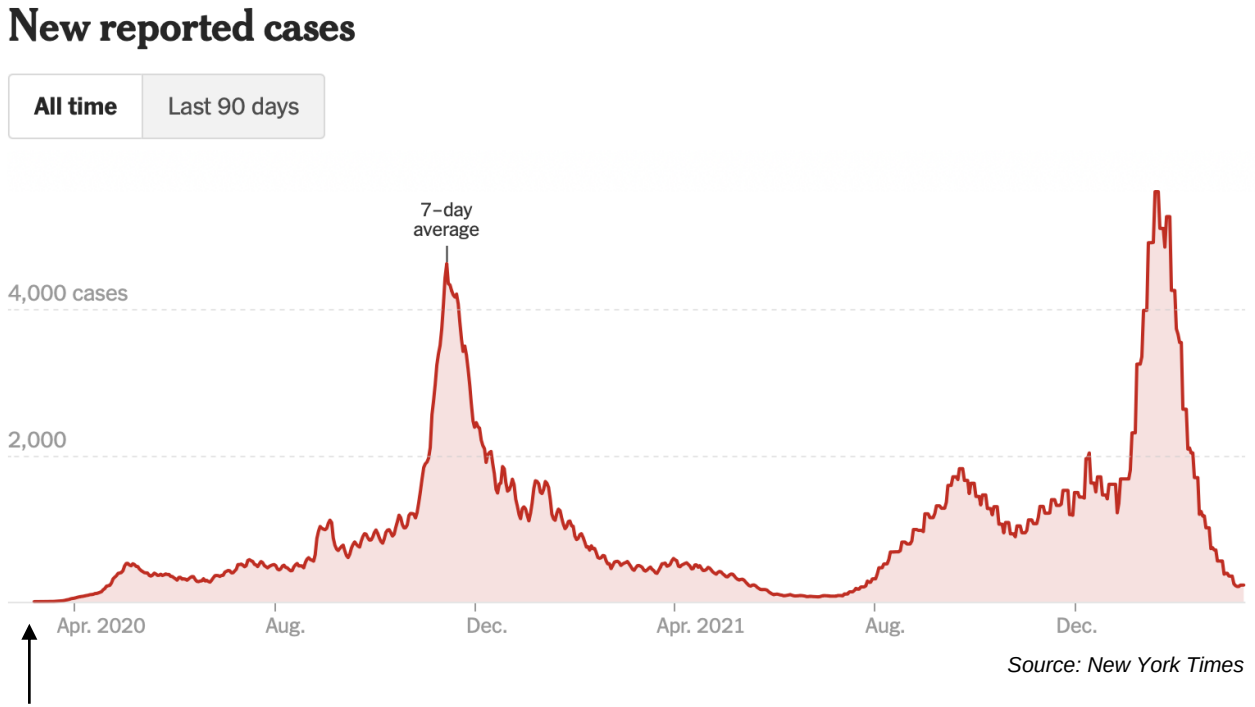
- Initial schedule: 24-month construction
- Schedule impacted by COVID-19
- Final completion expected June 2022



Breakdown of project costs

Curve Ball: COVID-19

- Impacted staff and construction
- Material lead times/availability impacted and may get worse
- Virtual meetings allowed collaboration during COVID
  - Small group in person – large group participating
  - Training held virtually to expand attendance; recording for future



Notice to Proceed: March 3, 2020

Construction Impacts Operations, But Not Effluent Limits

- Operations must continue, even while in flux
- Phasing and temporary measures important to keeping the plant running
- No project will go perfectly
  - Example: groundwater

More Lessons Learned

- Open communication and collaborative approach help to maintain relationships
- Reuse of existing space requires increased logistics, but has multiple benefits
- Construction-related services provide substantial benefits to City
  - Engineer provide eyes and ears on the ground
  - Enforce specifications; resolve issues in the field

Biosolids Modifications Project Addresses Critical WWTP Needs and Improves Treatment Resiliency

- Replace aging assets nearing the end of their useful life with equipment that can reduce operating and maintenance costs
- Work with existing infrastructure, when possible, to minimize costs while improving process performance and control
- Implement solutions to meet current treatment needs while allowing for adaptation to potential growth and regulatory changes in the future

Primary objective: protect health and safety of the community in an efficient and cost-effective manner

Questions and Answers

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