Struvite Recovery Lessons Learned

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Frederick Winchester Service Authority
Plant Overview

- 2010 - $50M upgrade to ENR to meet Chesapeake Bay requirements
- 12.6 MGD design, 8.0 MGD average, 16.0 MGD peak
- Permitted for monthly averages of 7.1 mg/l BOD; 10 mg/l TSS, 3.0 mg/l Ammonia, 0.197 mg/l total phosphorus annual average

Design Loads

Parameter	Influent (mg/l / lbs/d)
TSS	158 / 16,603
CBOD	169 / 17,759
TKN	25.7 / 2,704
Ammonia	14 / 1,473
Total P	4.6 / 484

Frederick-Winchester Service Authority

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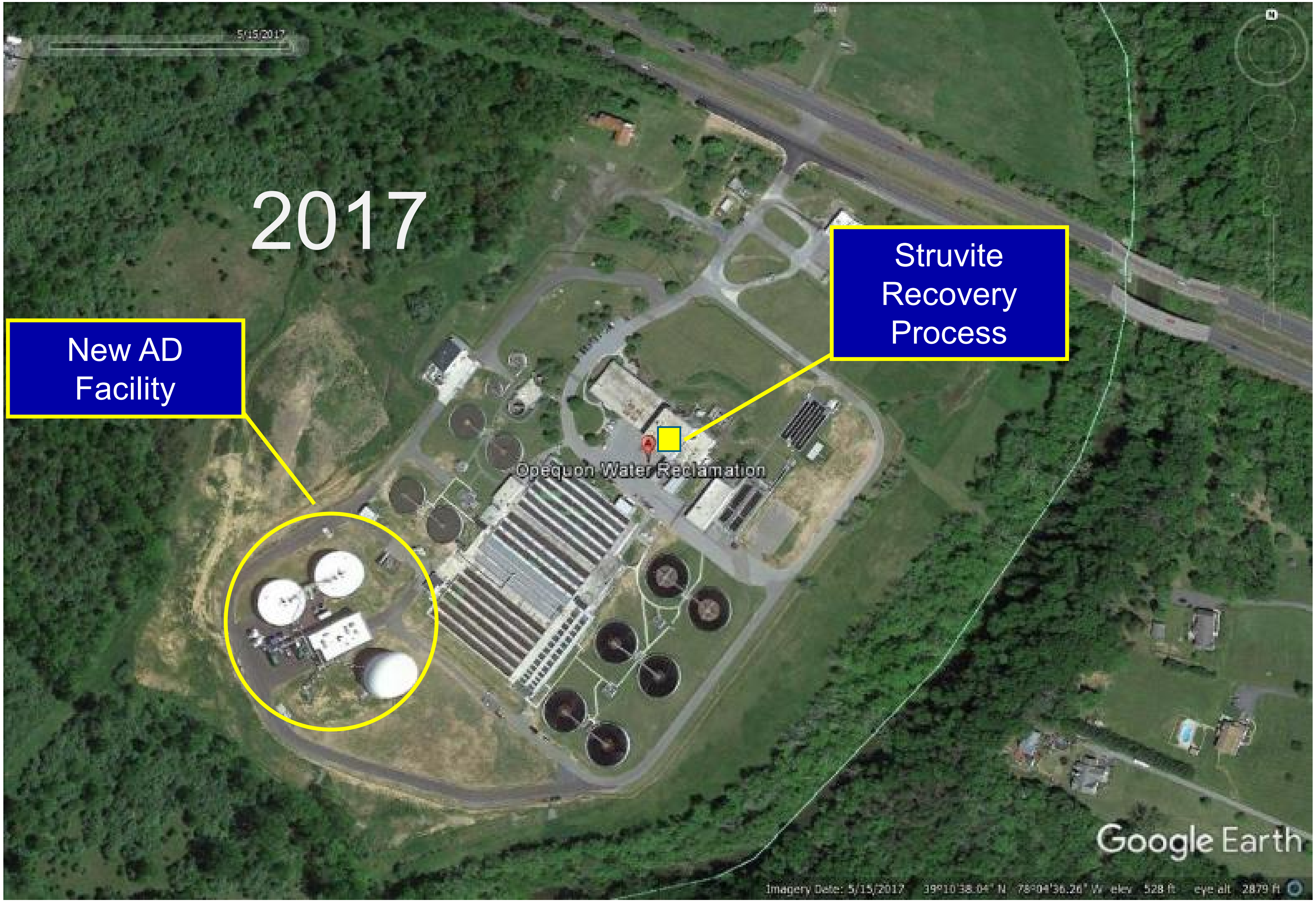
Needs

- Lime stabilized sludge
- Frame Press dewatering
- Centrifugal blowers, oversized
- No DO control on aeration
- HVAC issues in main building
- Escalating costs for chemicals & electricity


5/15/2017
2017
New AD Facility
Struvite Recovery Process
Opequon Water Reclamation
Google Earth
Imagery Date: 5/15/2017 39°10'38.04" N 78°04'36.26" W elev 528 ft eye alt 2879 ft

Why was struvite recovery process added to this project?

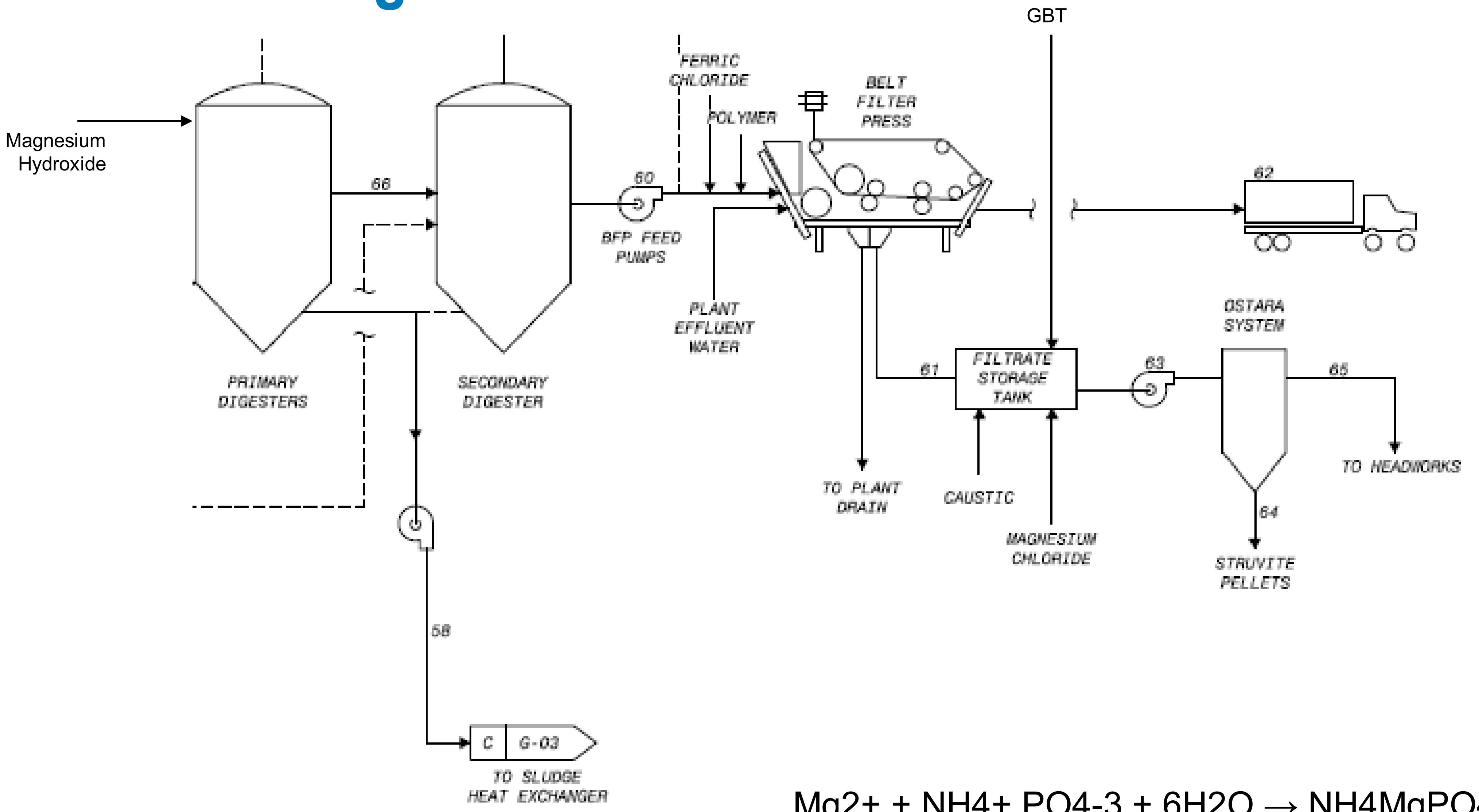
1. Struvite formation may occur with a biological phosphorus removal is combined with anaerobic digestion
2. As this project included an extensive hauled waste program, they wanted to have wide range of feedstocks to select in order to maximize new revenue
3. Phosphorus recycle loads from dewatering increase ferric oxide consumption to meet effluent limits

Envirotec Magazine

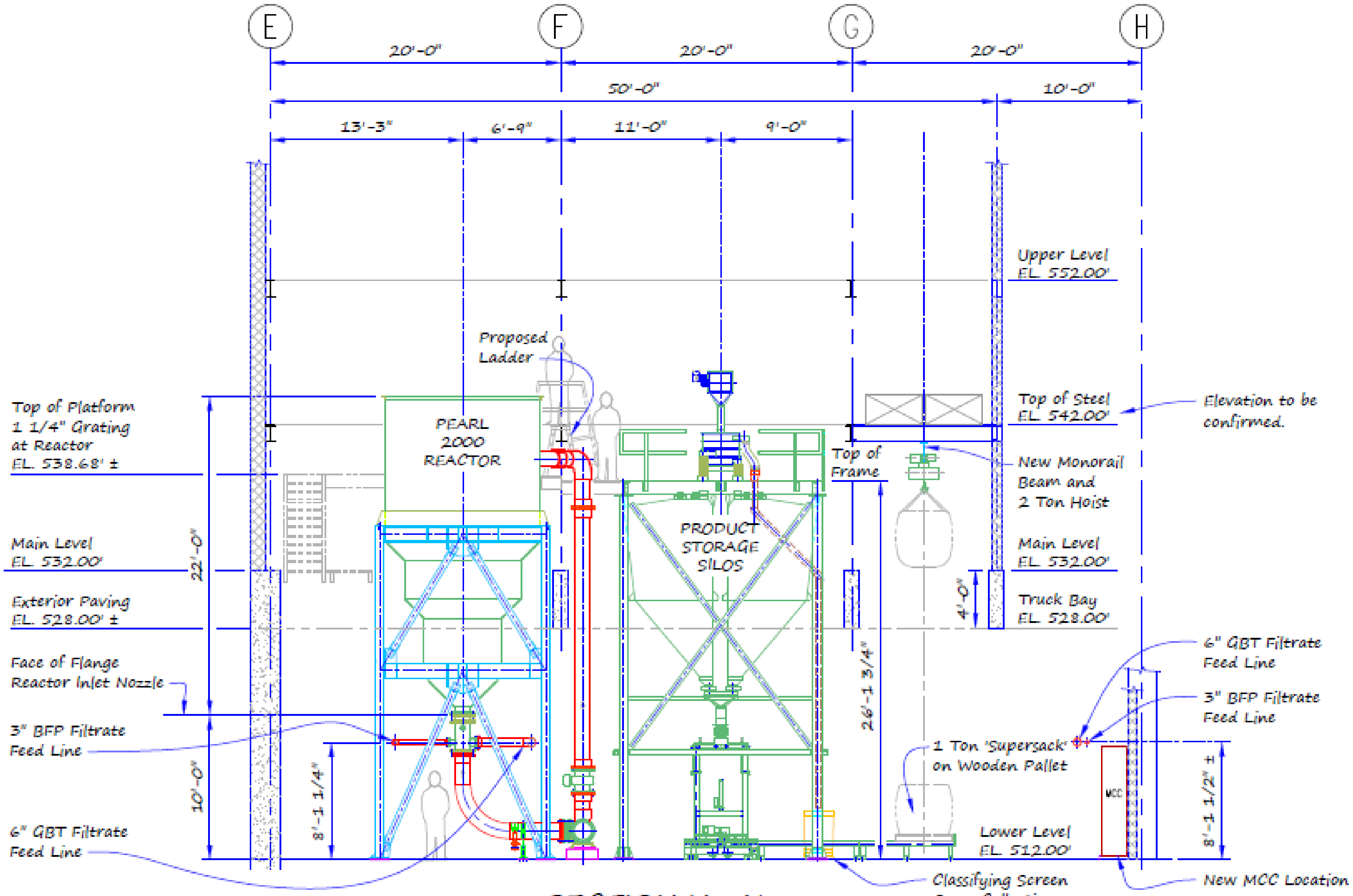
Basis of Design

Parameter	Value	Unit
Design Flow	718	gpm
Ortho-phosphorus	390	Pounds per day
Ammonia	495	Pounds per day
Phosphorus removal efficiency	90	%
Nitrogen Removal	38	%

Process Flow Diagram



$$Mg^{2+} + NH_4^{+}\ PO_4^{-3} + 6H_2O \rightarrow NH_4MgPO_4\bullet 6H_2O$$

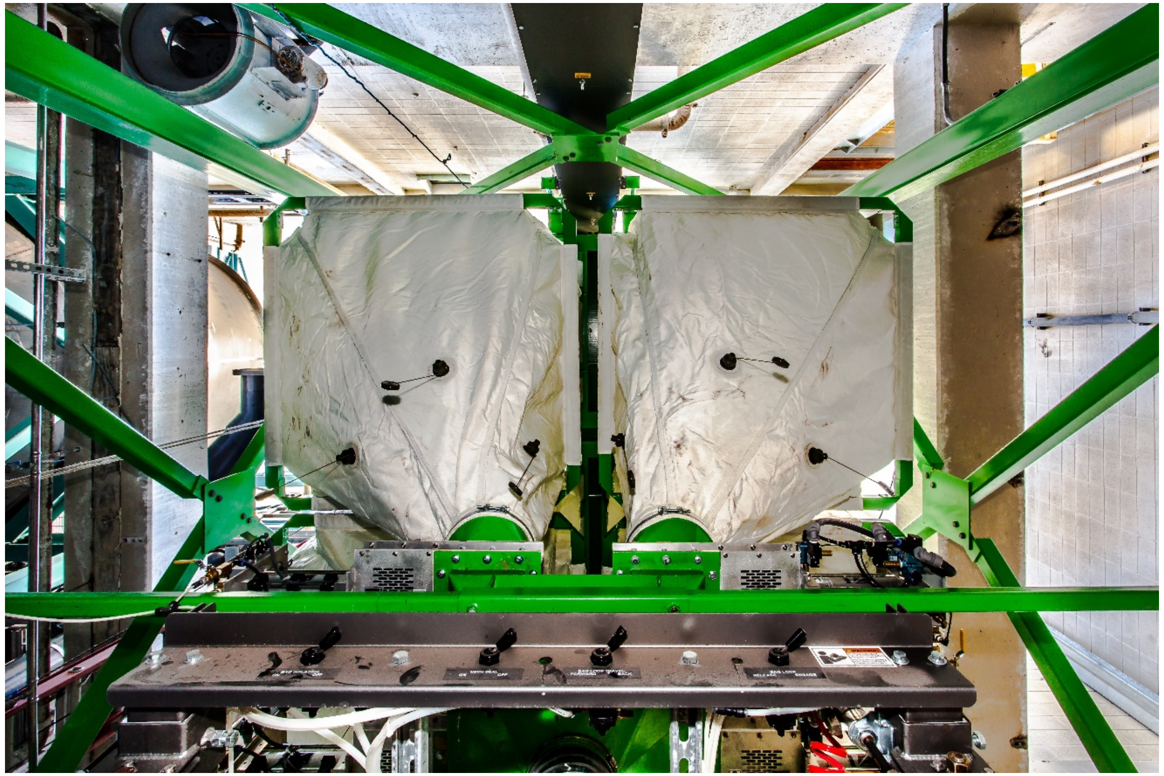


SECTION 'A-A'

1/8"=1'-0"

Feb 10, 2017 – Substantial Completion

Bagging and pellet storage

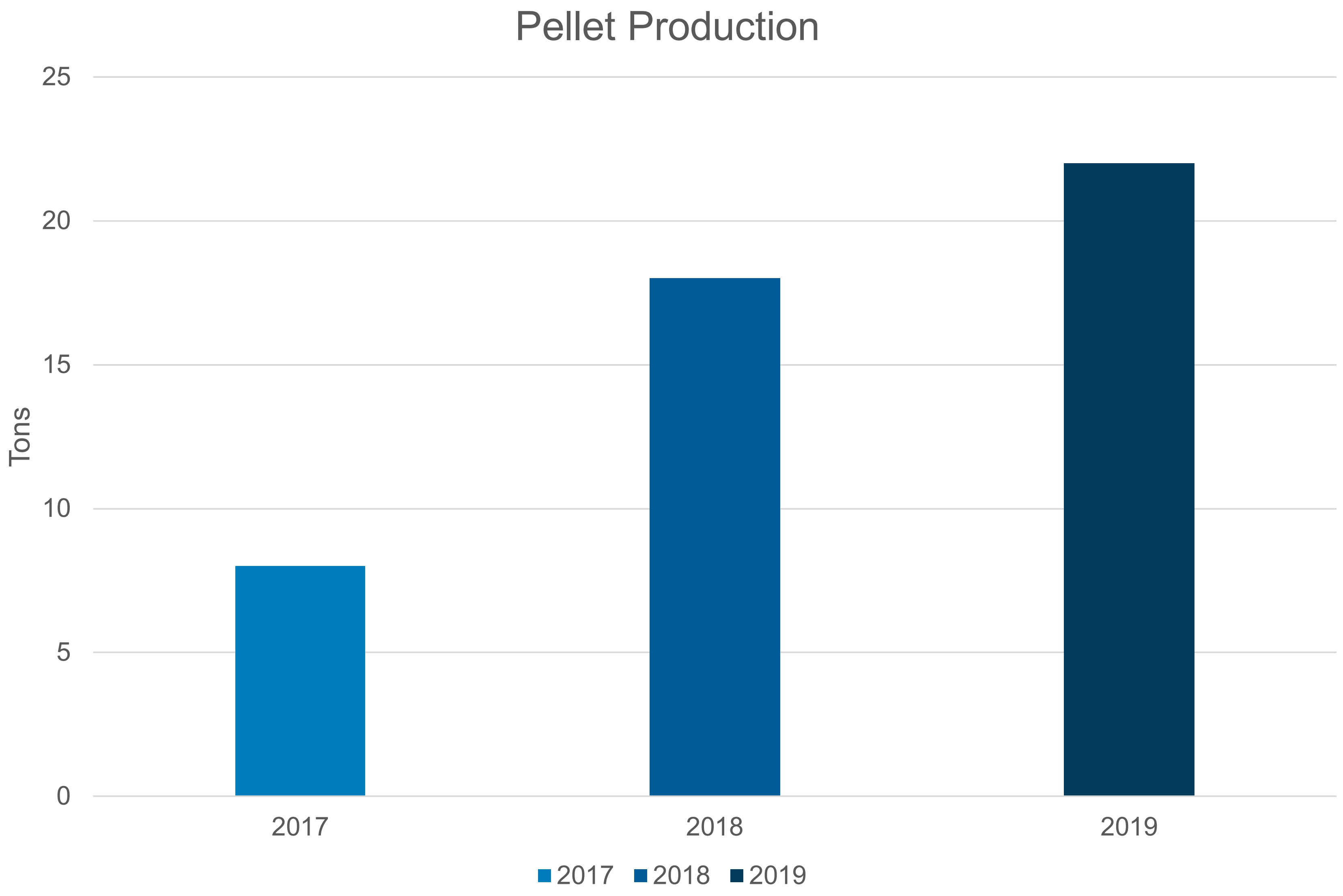


Annual Cost Optimization

Ran scenarios for different loading rates to optimize chemical feed design

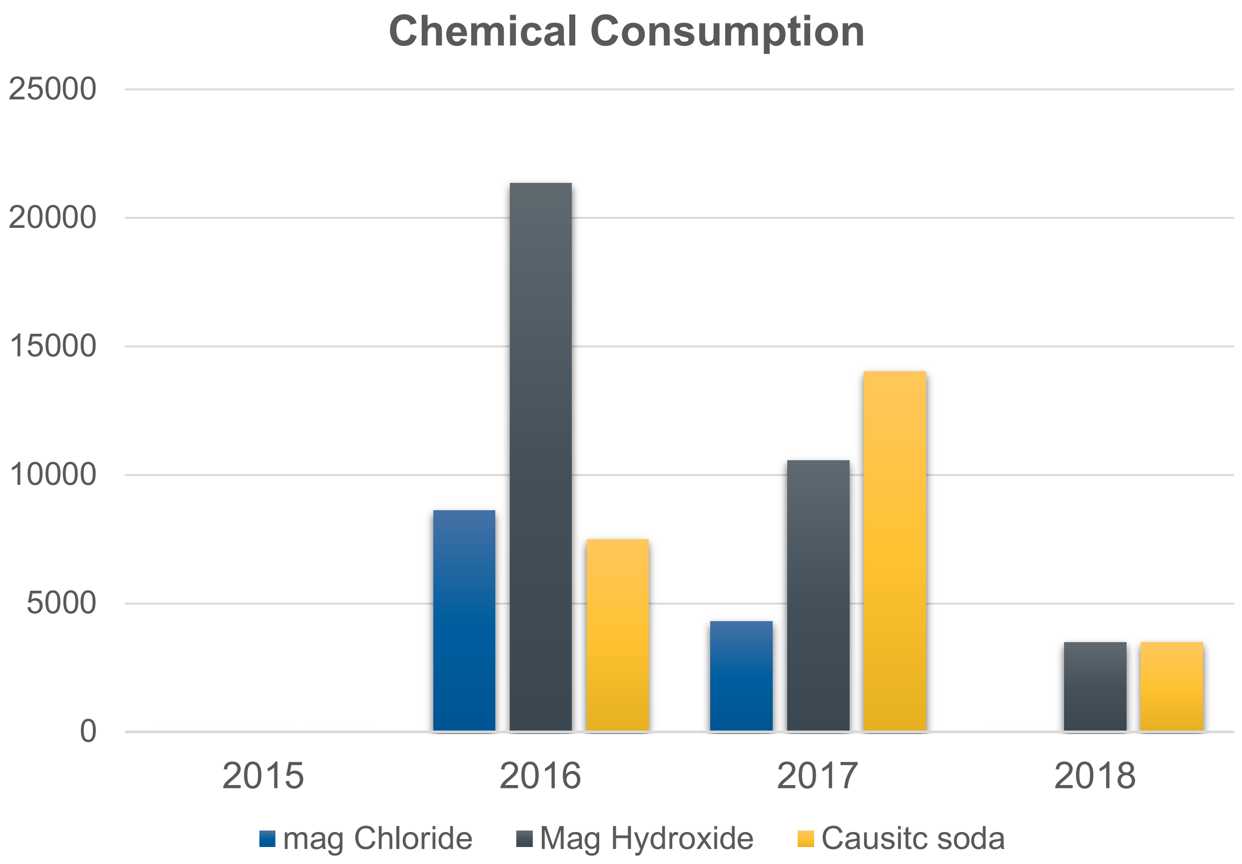
- Assuming different Phosphorus loads from startup to 20 year design life
- 0 to 100% centrate capture on Belt filter press
- 0 to 100% centrate capture on Gravity belt thickener
- Use magnesium chloride versus magnesium hydroxide
- With or without cost of power (due to CHP)

Annual Cost of Operations			
Results	Average Conditions	Worst Conditions - minimum struvite	Best Conditions – max struvite + zero cost of power
Base Case	($57,142)	($84,517)	$17,710
Base Case + No MgOH	($93,496)	($120,871)	($18,643)



Pellet Production
Tons
25
20
15
10
5
0
2017
2018
2019
2017 2018 2019

Chemicals


Chemical Consumption
25000
20000
15000
10000
5000
0
2015
2016
2017
2018
mag Chloride
Mag Hydroxide
Causitc soda

Changes

- $MgCL_2$ pump was inconsistent due to bad check valve
- Pellet production is better for smaller size
- Ensuring accurate lab data on the feed characteristics (PO_4-P and Mg in the BFP filtrate and GBT filtrate).

Lessons Learned

- More technology options available today
- Require active management
- Weekly calls
- Operator buy-in
- Keep current data in control system for optimum chemical dose
- Still below design loads

Also see: "Operating Experience with Ostara Struvite Harvesting Process", Authors: Steve Reusser, Alan Grooms, Aaron Dose, Ahren Britton, Ram Prasad

Thank You

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