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Primary Sludge Grit Removal for the Evansville Water and Sewer Utility

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Evansville
WATER AND SEWER UTILITY

BACKGROUND

Evansville East WWTP

- Evansville, Indiana
- Design Capacity of 18 MGD / 22.5 MGD Peak
- Expansion to increase peak flow to 40 MGD

Evansville East WWTP

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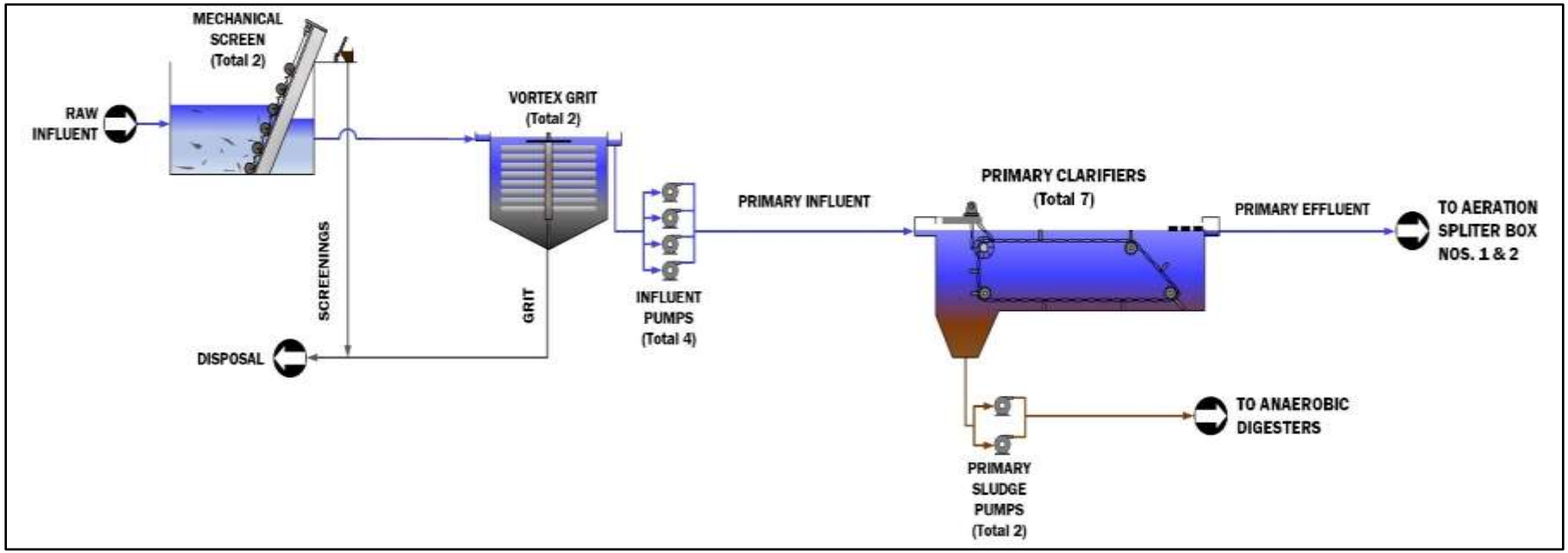


Grit Issues

- Change order to remove large deposits of grit during digester cleaning
- Difficult pumping conditions for grit pumps due to depth of grit basins
- Large amounts of grit bypass removal system and settle in primary clarifiers

How bad is it?

- Grit sampling performed on primary sludge at various flow rates

Grit Sampling

- Grit sampling performed on primary sludge at various flow rates

Trial No.	Date	Time	Flow (MGD)	Concentration (lb/MG)	Daily Load (lb)
Trial 1	6/13/2018	8 am	16.7	43,658	3,056
Trial 2	6/13/2018	10 am	16.7	10,631	744
Trial 3	7/19/2018	8 am	8.5	34,780	2,435
Trial 4	8/24/2018	8 am	8.8	1,287	90
Trial 5	8/24/2018	11 am	8.8	759	53
Typical	-	-	-	500-5,000	35-350

Grit Sampling

Micron	US Sieve No.	Trial 1 (% Capture)	Trial 2 (% Capture)	Trial 3 (% Capture)
53	270	100	100	100
74	200	99.40	99.19	99.67
105	140	97.35	96.86	98.74
149	100	86.73	89.19	96.28
210	70	71.31	75.57	88.67
297	50	42.33	50.55	66.65
841	20	2.53	3.44	5.59
1680	12	1.29	1.97	3.16
3180	1/8	0.65	1.08	0.95
6300	1/4	0.18	0.46	0.13

Primary Sludge Grit Removal

WHEN, WHY, AND HOW?

When to Consider?

- Best for grit to be captured in the headworks to prevent wear on downstream equipment – are there other options?
- Significant grit buildup in digesters
- Ineffective grit removal from influent stream
- Increased grit loading during storm flows

How to Implement?

- Separation of grit from primary sludge can be difficult due to the viscosity of the sludge
- Primary sludge needs to be thinned to <1%
  - Selecting the right technology
  - Thickening process prior to digestion

Why Primary Sludge Grit Removal?

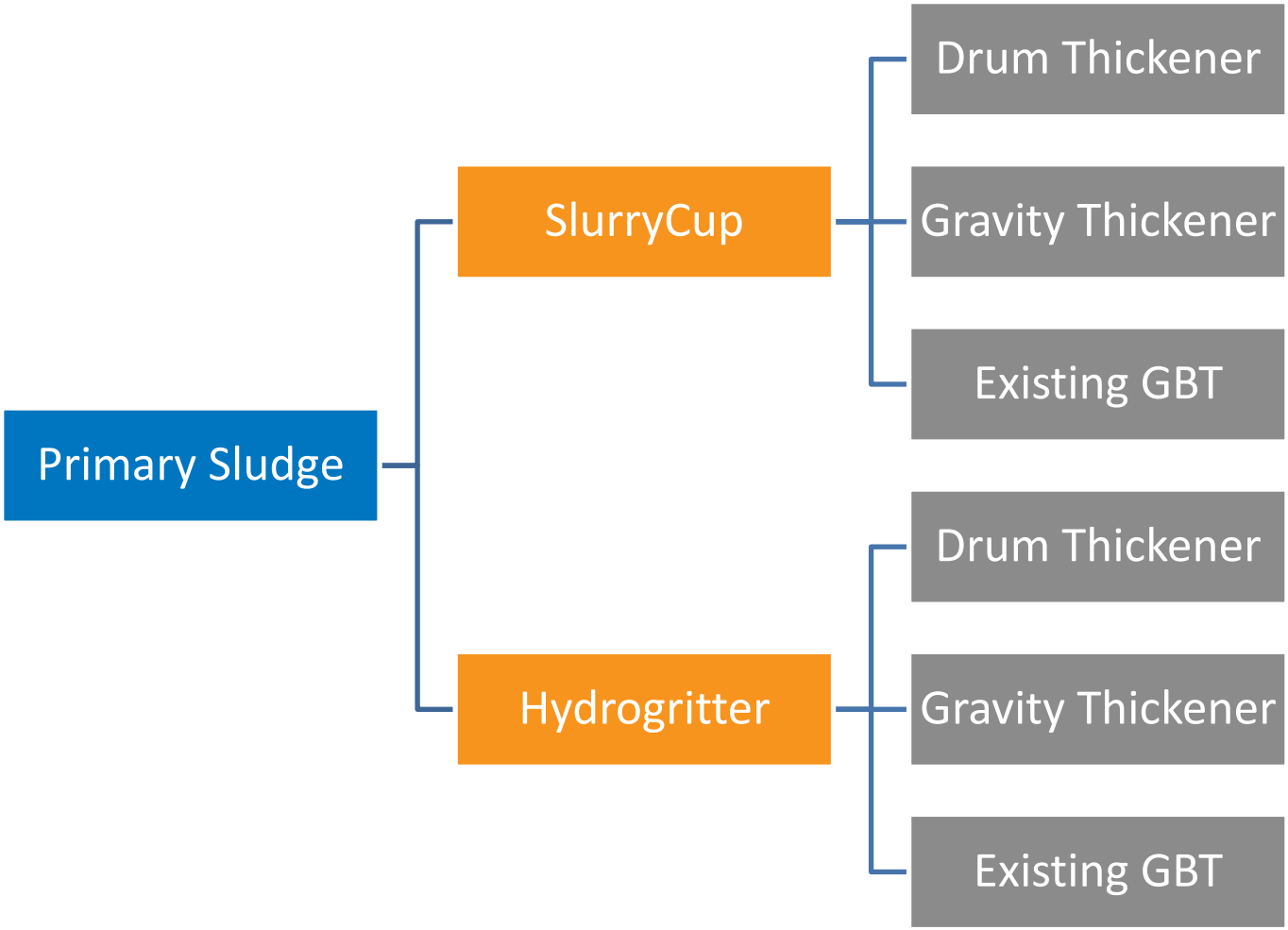
- Need to remove the grit
- Improved primary clarifier settling
- Improved primary sludge distribution to digesters

EVANSVILLE DESIGN

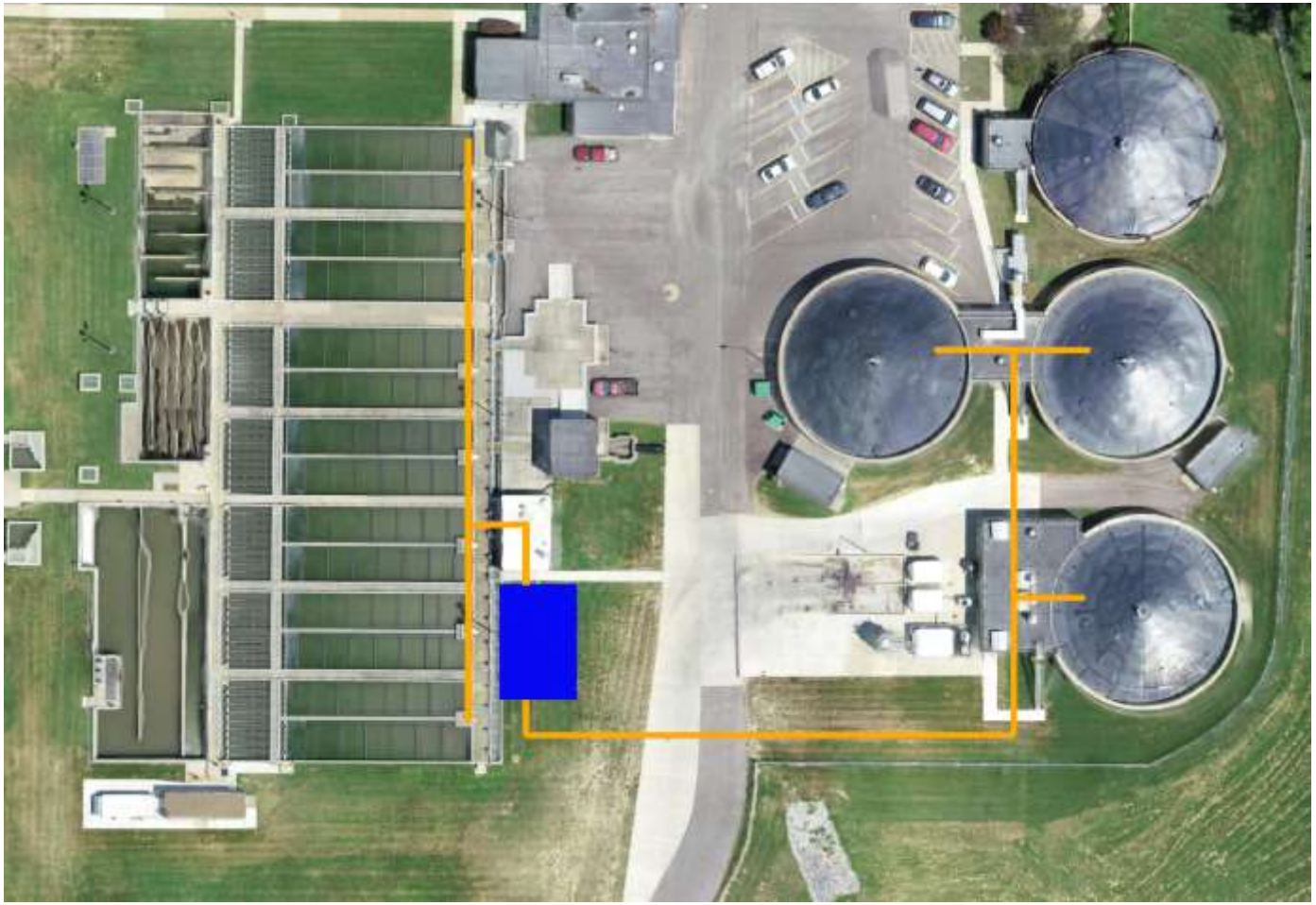
Design Considerations

- Increased, more continuous pumping required to thin primary sludge stream
- Actuated valves to control primary sludge draw from 7 primary clarifiers
- Alternatives analysis of equipment suited for separated grit from primary sludge
- Thickening of primary sludge prior to digestion
- Automated primary sludge feed controls to 3 primary digesters
- New building
- Odor control

Grit Removal/Thickening Options

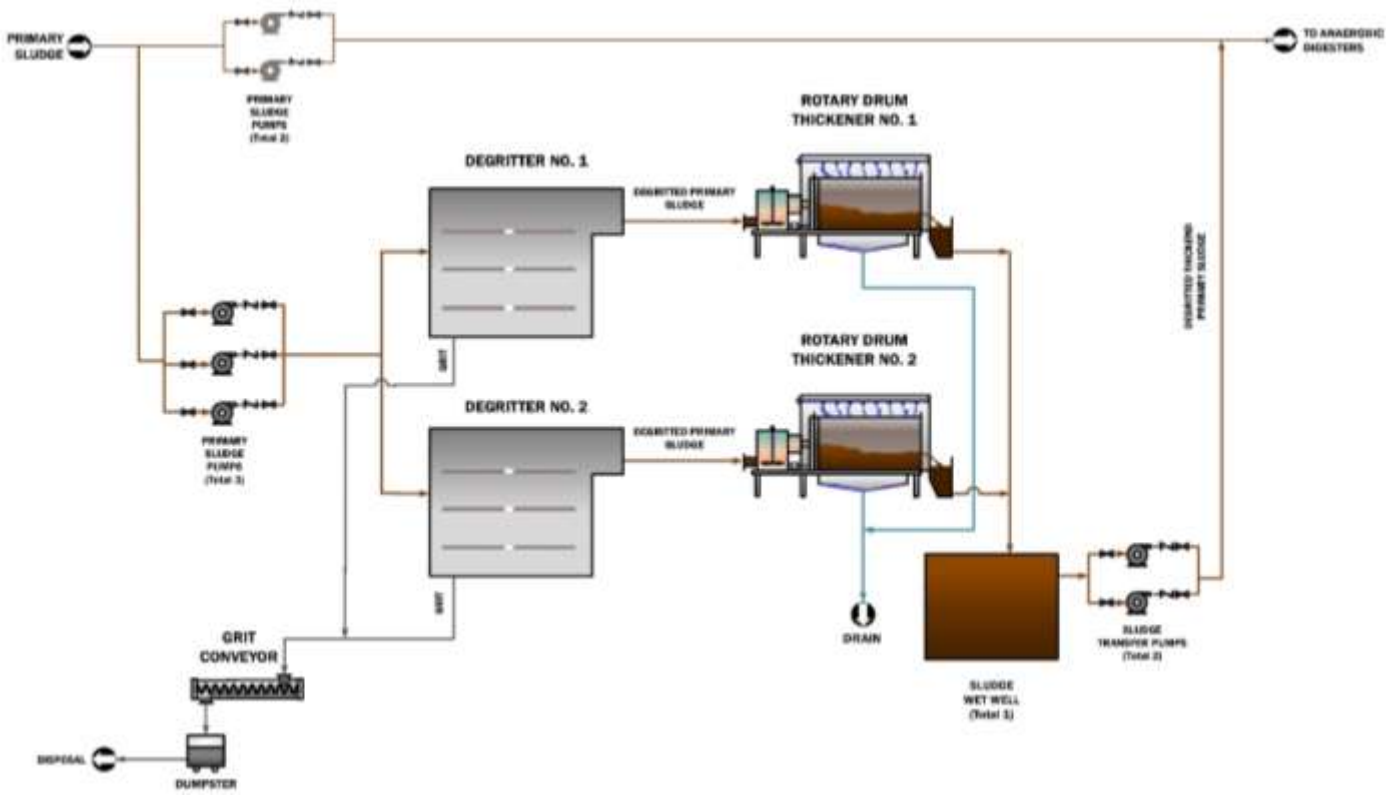


Site Plan



Primary Sludge Grit Removal

- Proposed process flow diagram



Primary Sludge Grit Removal

Advantages	Challenges
Reduced grit in digester	Increased pumping volume and time
Increase pumping thins sludge blanket in primary clarifiers & improves settling	Space required for grit removal, pumps, and thickening equipment
Thickening post grit removal reduces sludge volume	Maintaining proper sludge thickness for grit separation
Provides opportunity for greater control of primary sludge feed	Cost

DESIGN CHALLENGES

Design Challenges

Design Challenges

- Implementation of automated system
  - Hundreds of input/outputs
  - Heavy focus on P&ID
  - Developing control setpoints

Design Challenges

- Odors
  - WWTP located in sensitive location
- Process not widely used
  - How long to pump at each primary?
  - Pump all tanks at once vs one at a time

	Min Flow																
PS Pump Rate (gpm)	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450
Flow to Thickener(gpm)	267	276	285	294	304	313	322	331	340	350	359	368	377	386	396	405	414
1.5%	0.30%	0.29%	0.28%	0.28%	0.27%	0.26%	0.25%	0.25%	0.24%	0.23%	0.23%	0.22%	0.22%	0.21%	0.21%	0.20%	0.20%
2.0%	0.41%	0.39%	0.38%	0.37%	0.36%	0.35%	0.34%	0.33%	0.32%	0.31%	0.30%	0.29%	0.29%	0.28%	0.27%	0.27%	0.26%
2.5%	0.51%	0.49%	0.47%	0.46%	0.45%	0.43%	0.42%	0.41%	0.40%	0.39%	0.38%	0.37%	0.36%	0.35%	0.34%	0.33%	0.33%
3.0%	0.61%	0.59%	0.57%	0.55%	0.54%	0.52%	0.50%	0.49%	0.48%	0.46%	0.45%	0.44%	0.43%	0.42%	0.41%	0.40%	0.39%
3.5%	0.71%	0.69%	0.66%	0.64%	0.62%	0.61%	0.59%	0.57%	0.56%	0.54%	0.53%	0.52%	0.50%	0.49%	0.48%	0.47%	0.46%
4.0%	0.81%	0.78%	0.76%	0.74%	0.71%	0.69%	0.67%	0.65%	0.64%	0.62%	0.60%	0.59%	0.57%	0.56%	0.55%	0.54%	0.52%
4.5%	0.91%	0.88%	0.85%	0.83%	0.80%	0.78%	0.76%	0.74%	0.72%	0.70%	0.68%	0.66%	0.65%	0.63%	0.62%	0.60%	0.59%
5.0%	1.01%	0.98%	0.95%	0.92%	0.89%	0.87%	0.84%	0.82%	0.80%	0.77%	0.75%	0.74%	0.72%	0.70%	0.68%	0.67%	0.65%

Design Challenges

- Pump design
  - Pump types, flow rates, ability to bypass
- Polymer addition
  - Testing ability to thicken

Questions?

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