

What We Learned from our Operational Evaluation Report (OER)



- By: Tim Nennig (Village of Grafton), Jon Butt & Anne Hunter (Symbiont)

Agenda

1. Background
2. WPDES Permit Requirements
3. Permit Compliance Schedule
4. OER Approach
5. OER Findings

Background – Village of Grafton

- Established: 1896
- Location: Ozaukee County, 20 miles north of Milwaukee
- Population: 11,459 (2010)
- Early Industries:
 - Furniture
 - Brewery
 - Cheese
 - Lumber
- Geography:
 - Milwaukee River

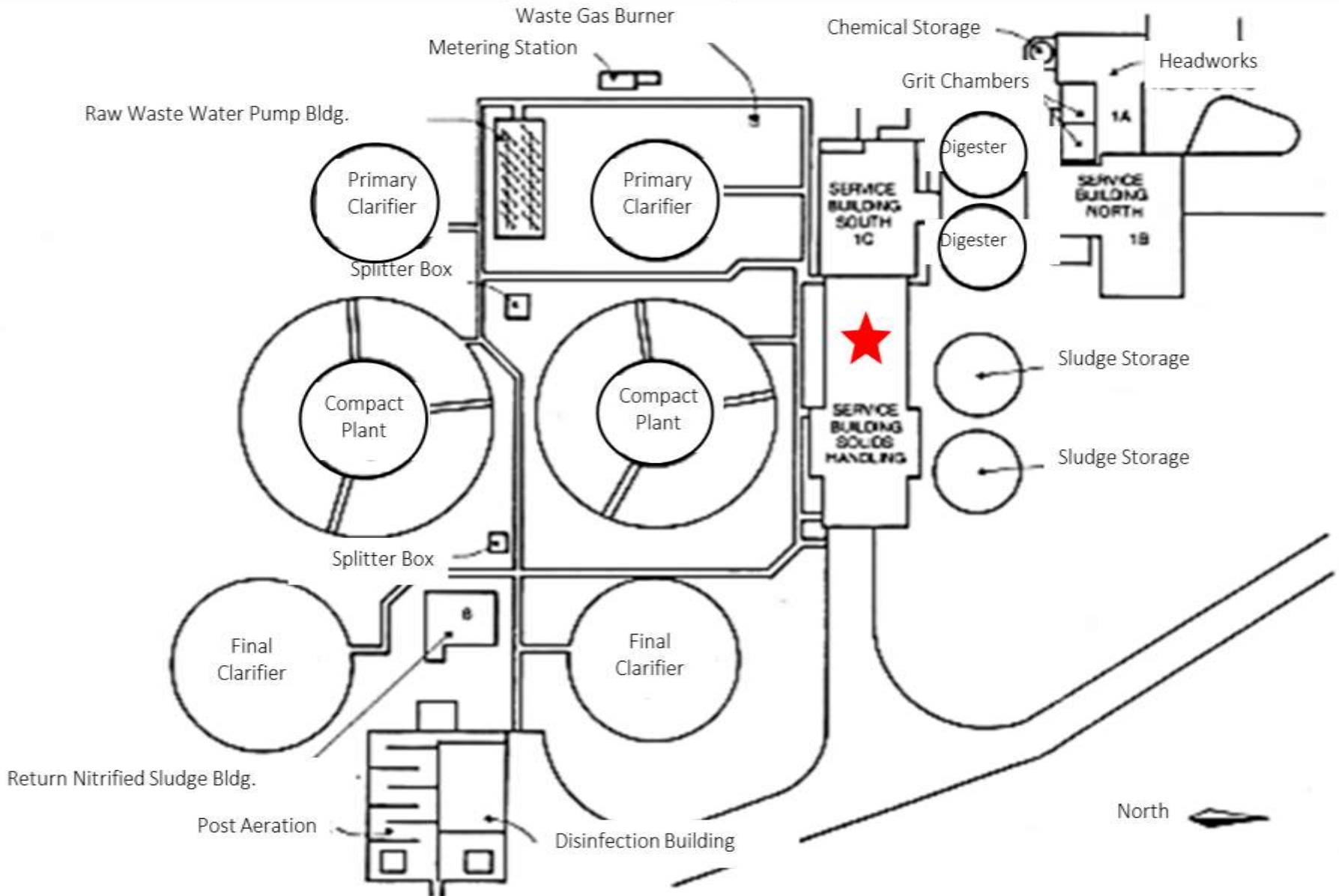


Background – Grafton WWTP

- Built: 1958
- Last Upgrade: 2005
- Average Flow: 1.50 gpd
- Design Flow: 2.50 gpd
- Type: Activated Sludge
- Twelve (12) sewage lift stations
- 54 miles sanitary sewers

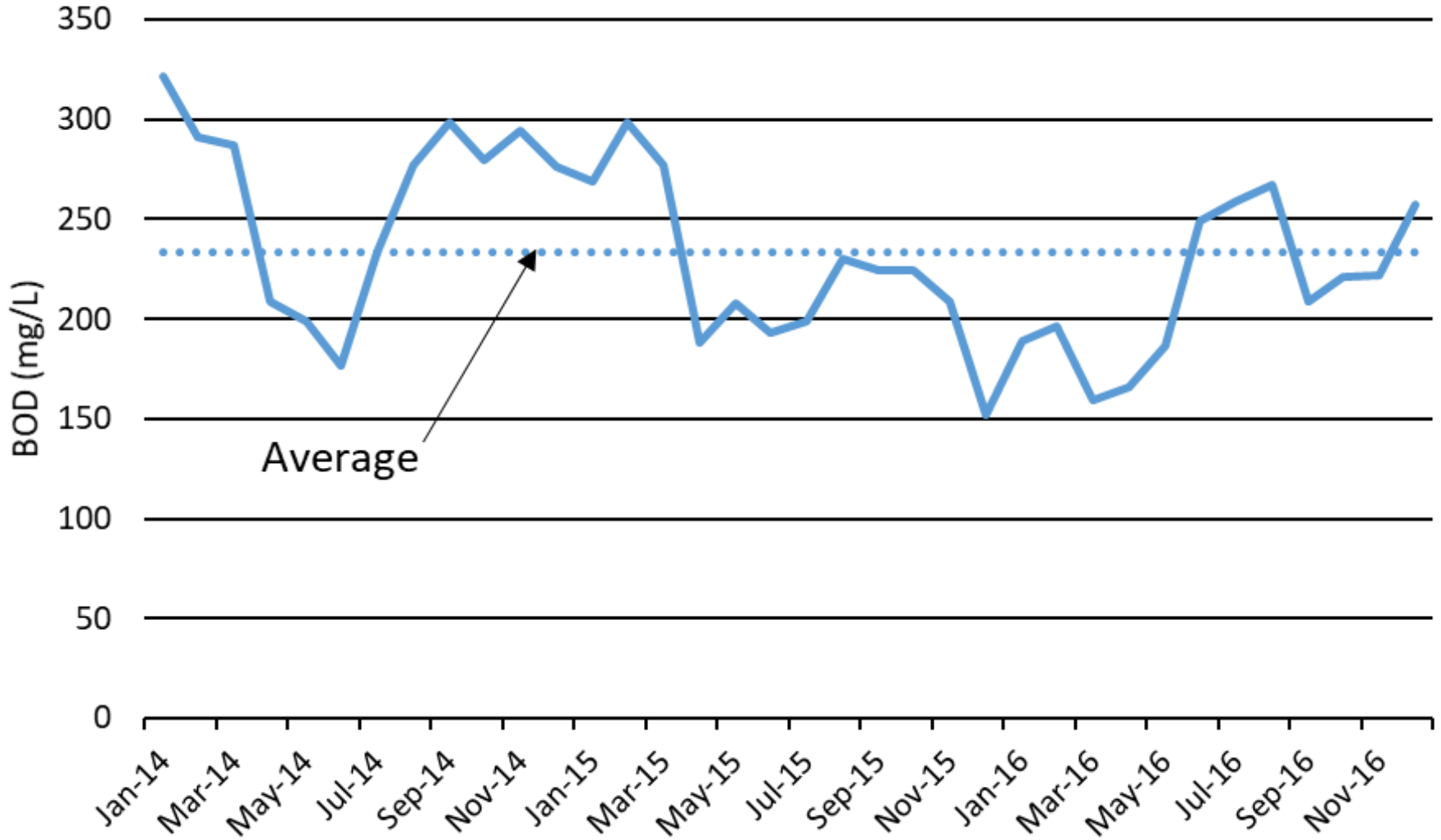


Background – Grafton WWTP



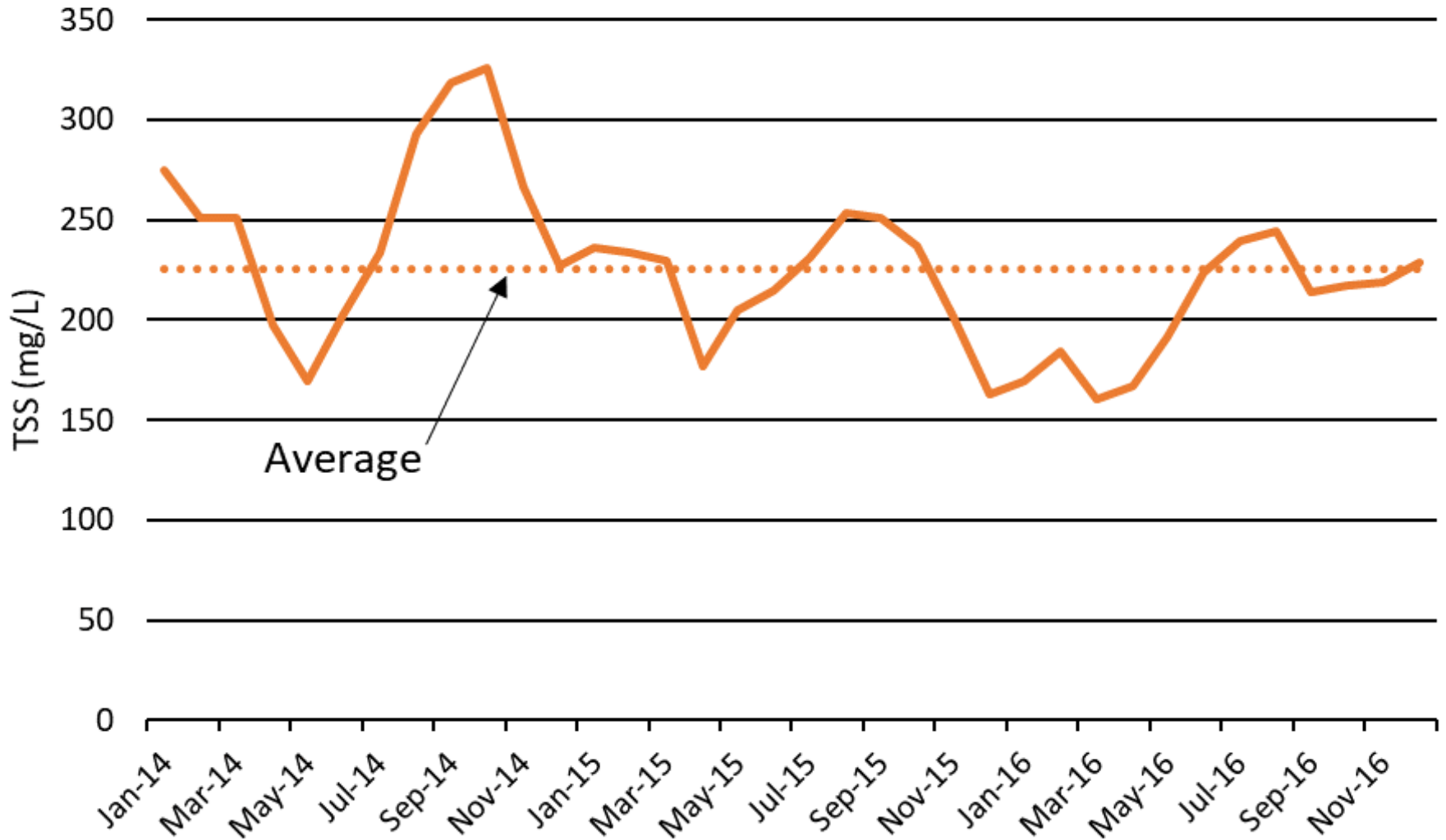
Background – Wastewater Influent

Figure 1: Influent BOD Monthly Average



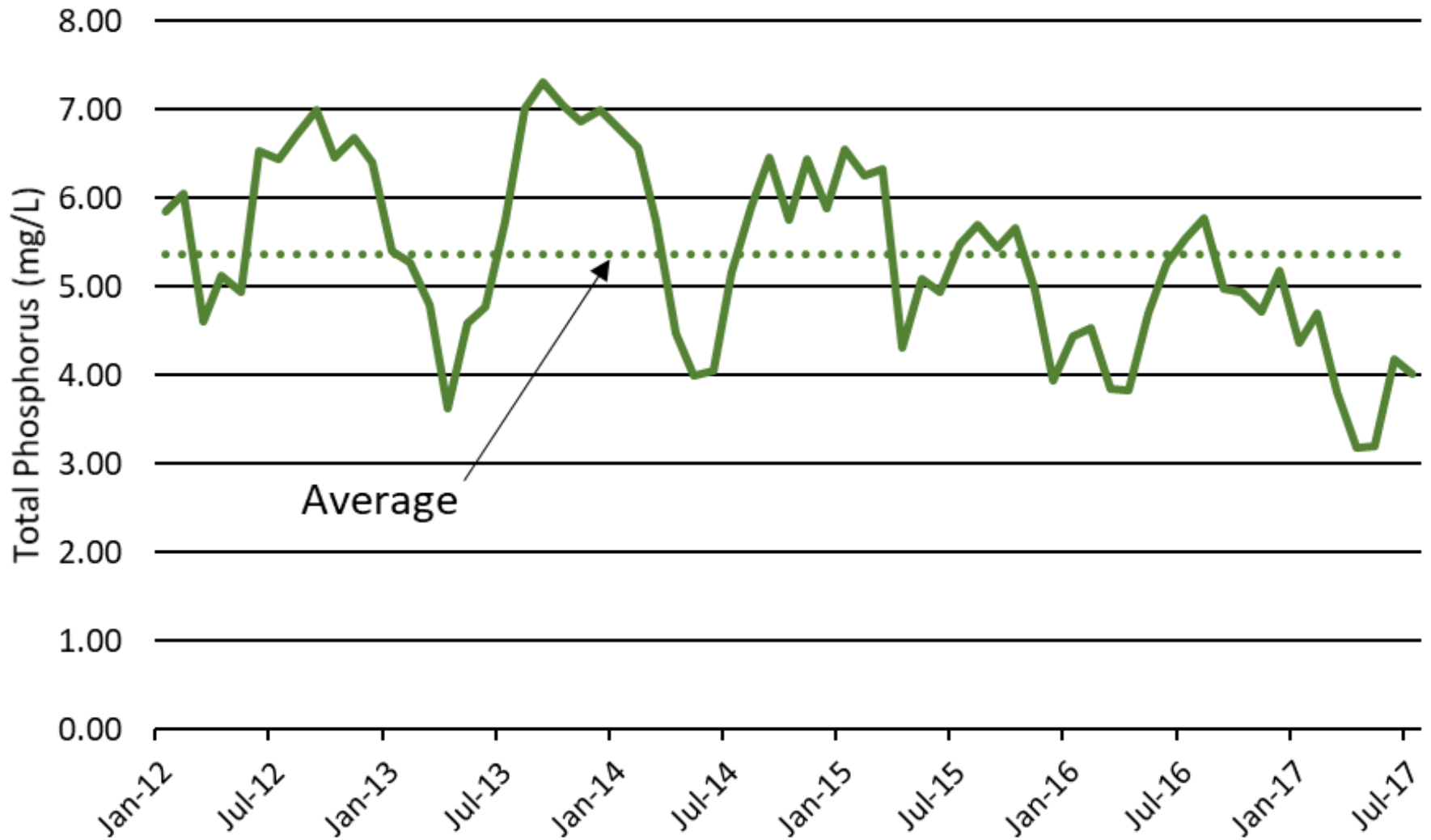
Background – Wastewater Influent

Figure 2: Influent TSS Monthly Average



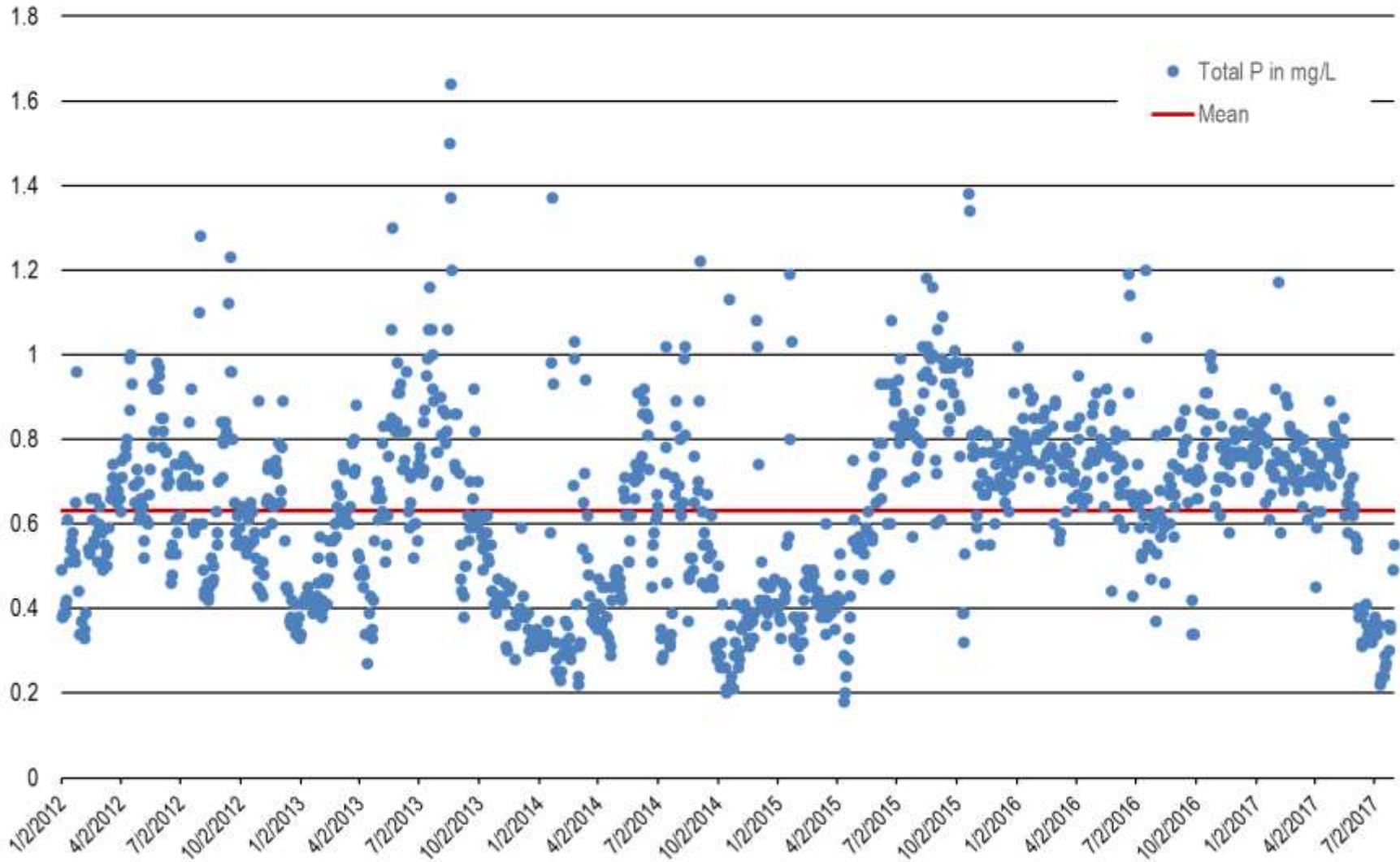
Background – Wastewater Influent

Figure 3: Influent Total Phosphorus Monthly Average



Background – Wastewater Effluent

Figure 4: Daily Total Phosphorus Effluent Concentration
Village of Grafton - Jan 2012 through July 2017



New WPDES Permit Requirements

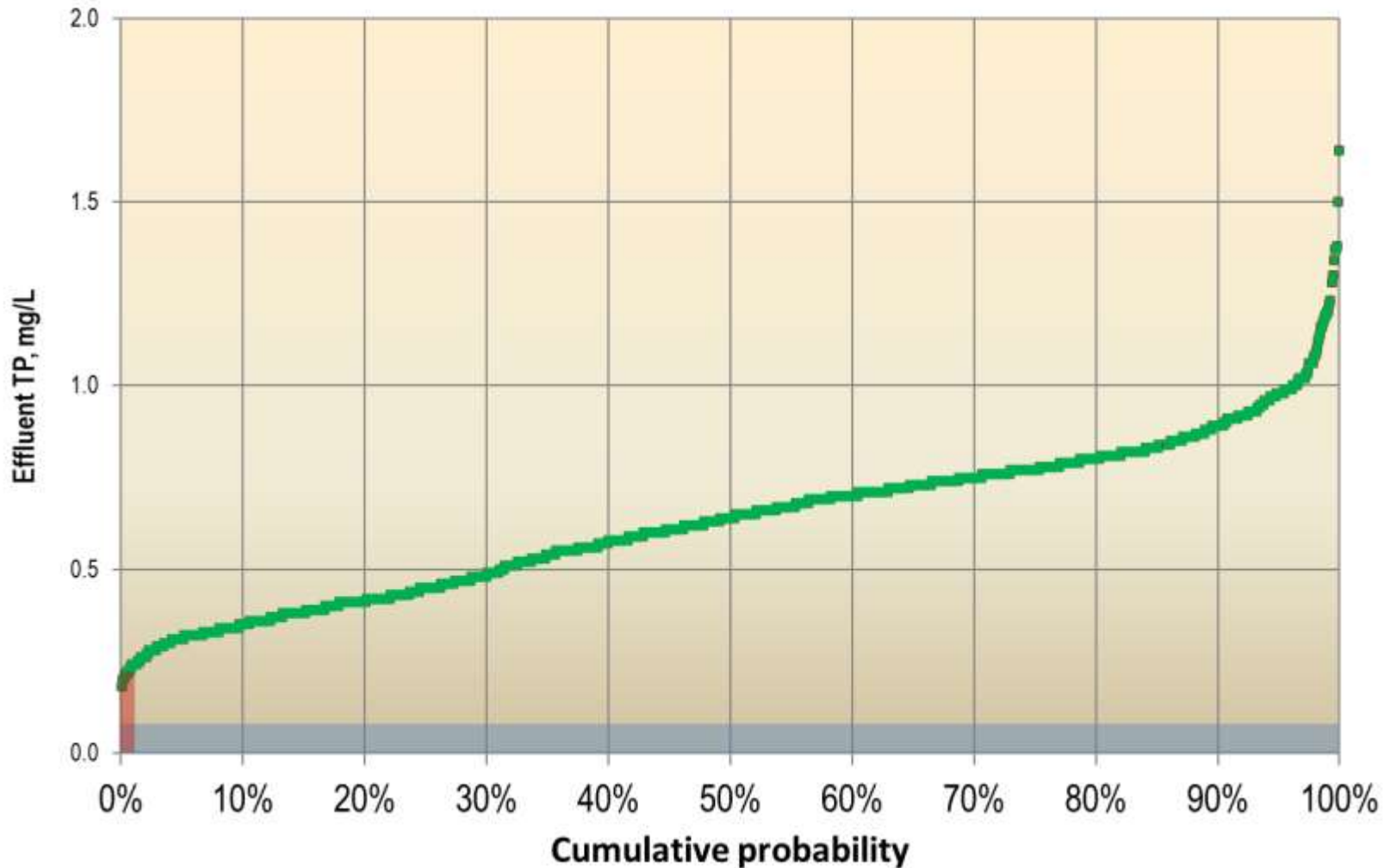
- Permit issued: July 2015
- 6-month TP average: 0.075 mg/L
- Max. monthly TP average: 0.225 mg/L
- 9-year compliance schedule
- Milwaukee River TMDL Draft TP Allocations:
 - October has lowest (72.2 lbs TP/ month)
 - June has highest allocation (96.5 lbs TP/month)
 - ~0.11 – 0.15 mg/L TP at 2.5 MGD

Permit Compliance Schedule

Required Action	Due Date
Operational Evaluation Report	6-30-2016 (complete)
Status Report: Compliance Alternatives, Source Reduction, Improvements & Modifications	6-30-2017 (complete)
Preliminary Compliance Alternatives Plan	6-30-2018
Final Compliance Alternatives Plan	6-30-2019
Progress Report on Plans & Specifications	6-30-2020
Final Plans & Specifications	6-30-2021
Initiation of Treatment Plan Upgrades	9-30-2021
Construction Progress Report #1	9-30-2022
Construction Progress Report #2	6-30-2023
Complete Construction	5-31-2024
Achieve Compliance	7-1-2024

Existing Conditions

Figure 5: Cumulative Distribution of Total Phosphorus Effluent Concentration for Village of Grafton
Jan 2012 through July 2017 - Daily



OER Investigation Approach & Results

1. Source Reduction Measures

- a. Industry Discharges
- b. Drinking Water Chemical Addition

2. Phosphorus Species Composition

3. Operation Improvements and Other Minor Facility Modifications

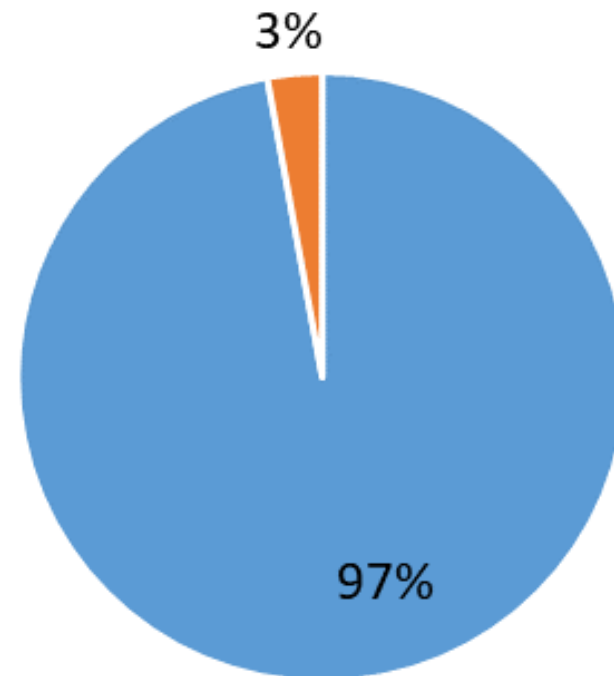
- a. Coagulant Addition to Mixed Liquor
- b. Coagulant Addition to Side Stream
- c. Potential for BioP
- d. Pilot Plant Testing

Industrial Phosphorus Discharge

- 3% (~0.16 mg/L) of Influent Phosphorus comes from Eleven (11) industrial sources
- Not worthwhile to reduce industrial sources

**Figure 6: Influent Phosphorus Mass Loading
Village of Grafton
3rd Quarter, 2016**

■ Non-Industry Sources ■ Industry Sources



Drinking Water Chemical Addition

- Drinking water additive contains 30% polyphosphate
- Potable water usages = 1.0 MGD
- Contributes 165 lbs P/yr (~ 0.7% total influent P, ~0.04 mg/L)

Source Reduction Measures

Table 1: Annual Total Phosphorus

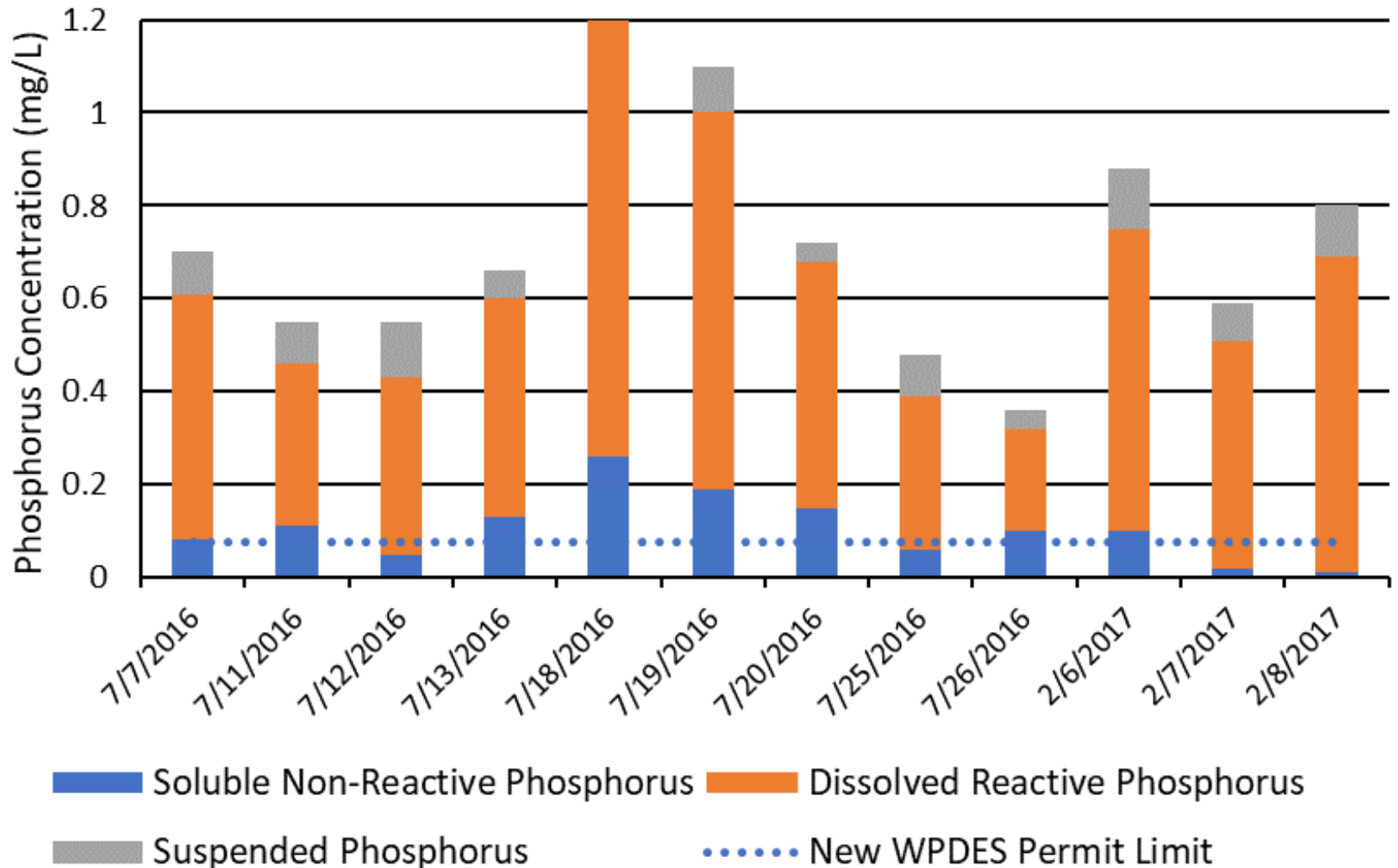
Year	Average Influent TP Conc. (mg/L)	Influent Daily Flow (MGD)	Daily TP (lbs)
2012	6.07	1.41	71.4
2013	5.79	1.57	75.5
2014	5.60	1.42	66.3
2015	5.39	1.38	62.0
2016	4.82	1.49	59.9



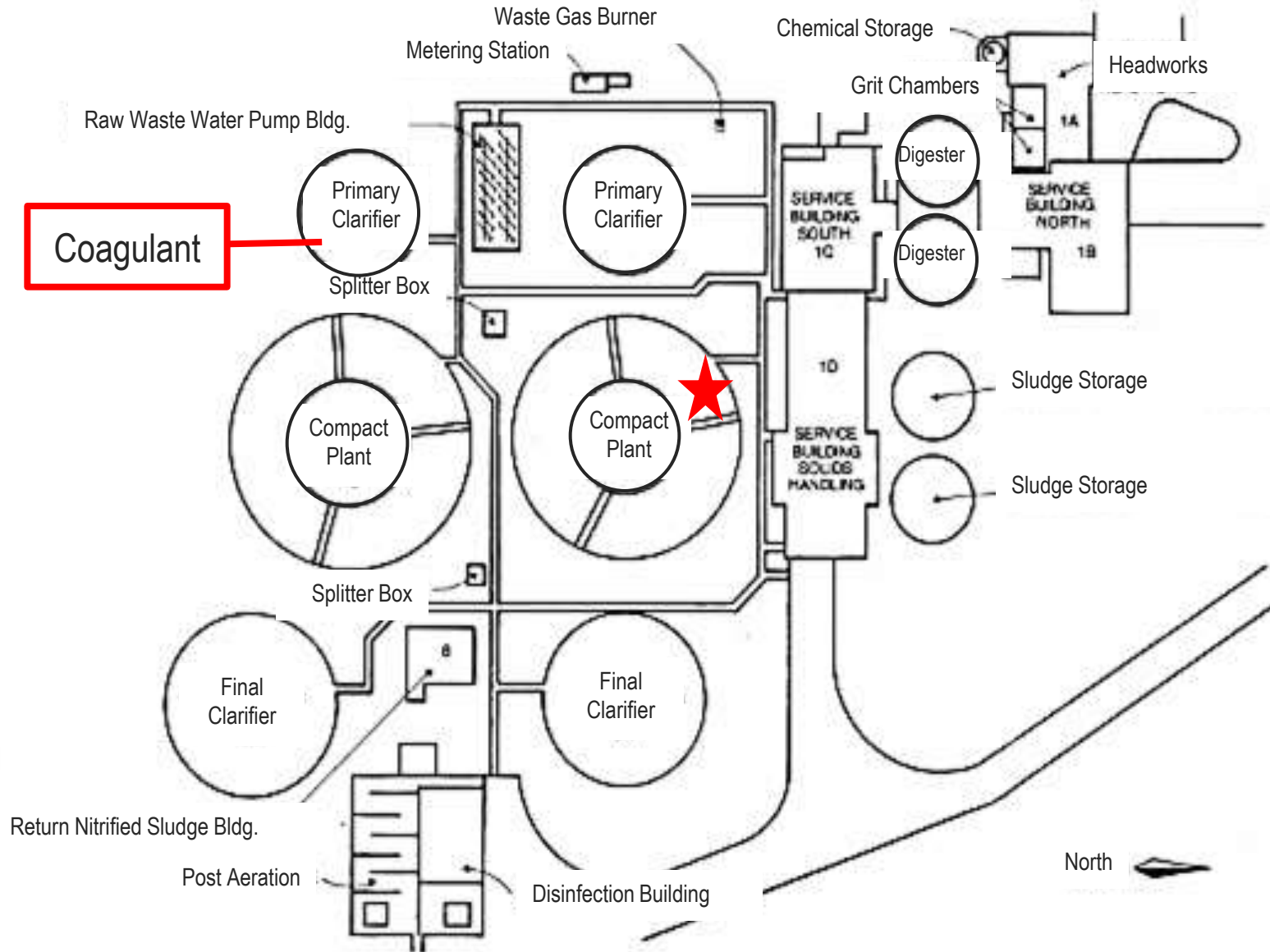
No reasonable source reduction opportunities exist within Grafton's water collection system

We Have SNRP!

Figure 7: Phosphorus Species Composition

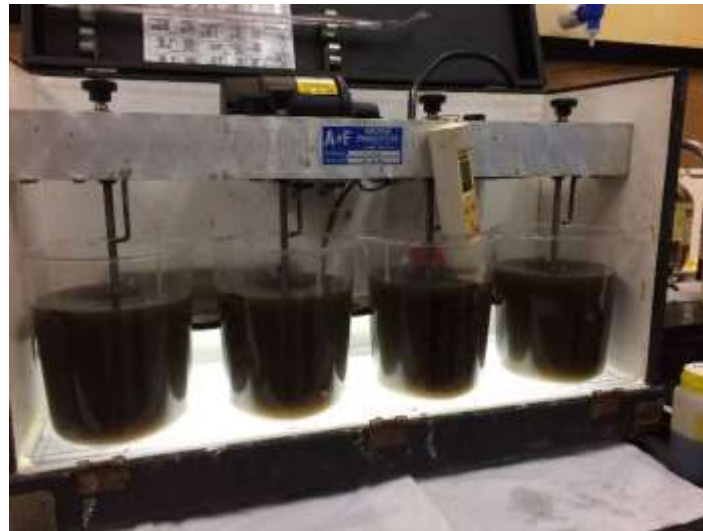


Coagulant Addition to Mixed Liquor



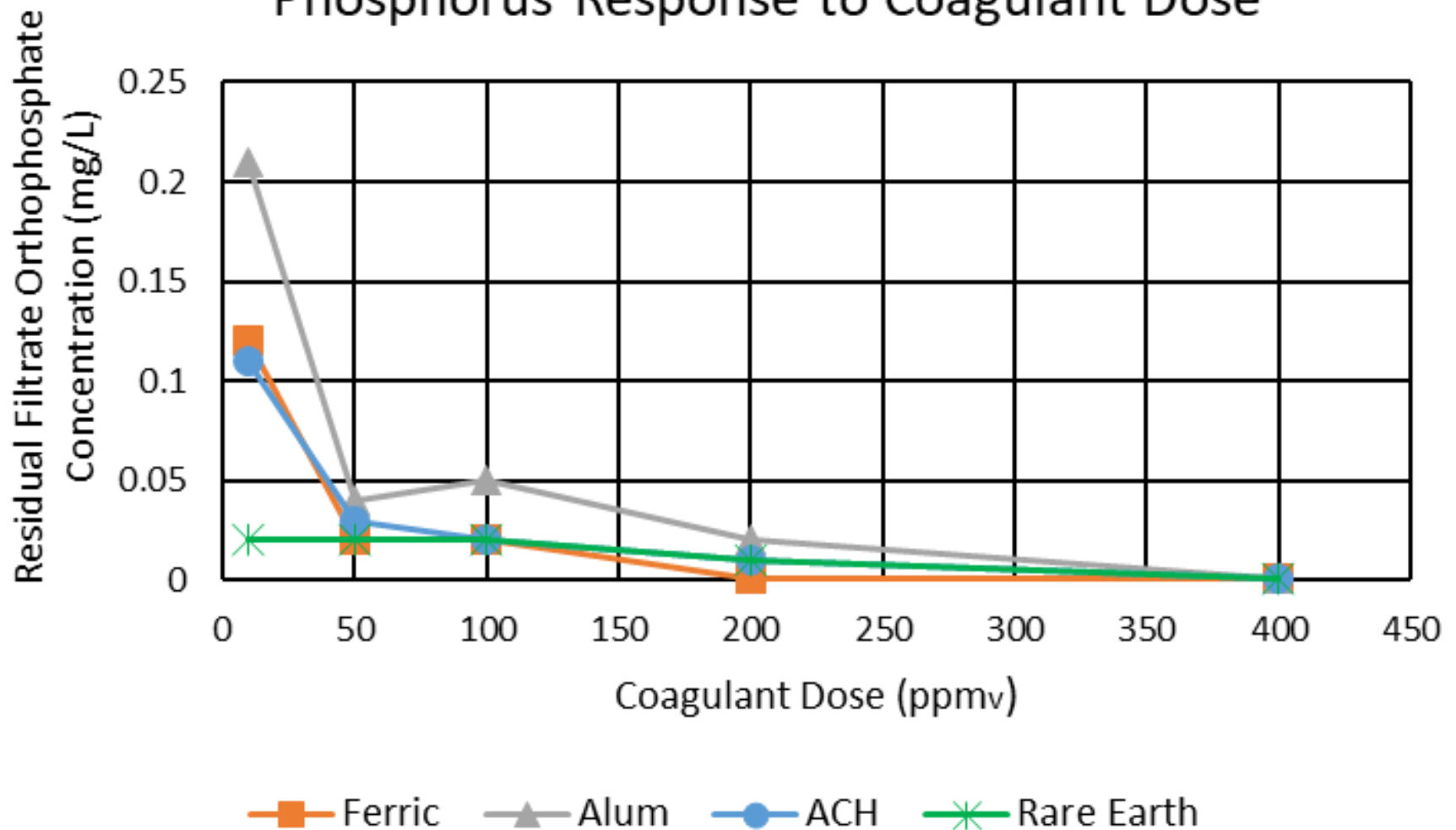
Coagulant Addition to Mixed Liquor

- Four coagulants tested in a bench-scale study:
 1. Iron salt
 2. Two aluminum salts
 3. Rare earth salt



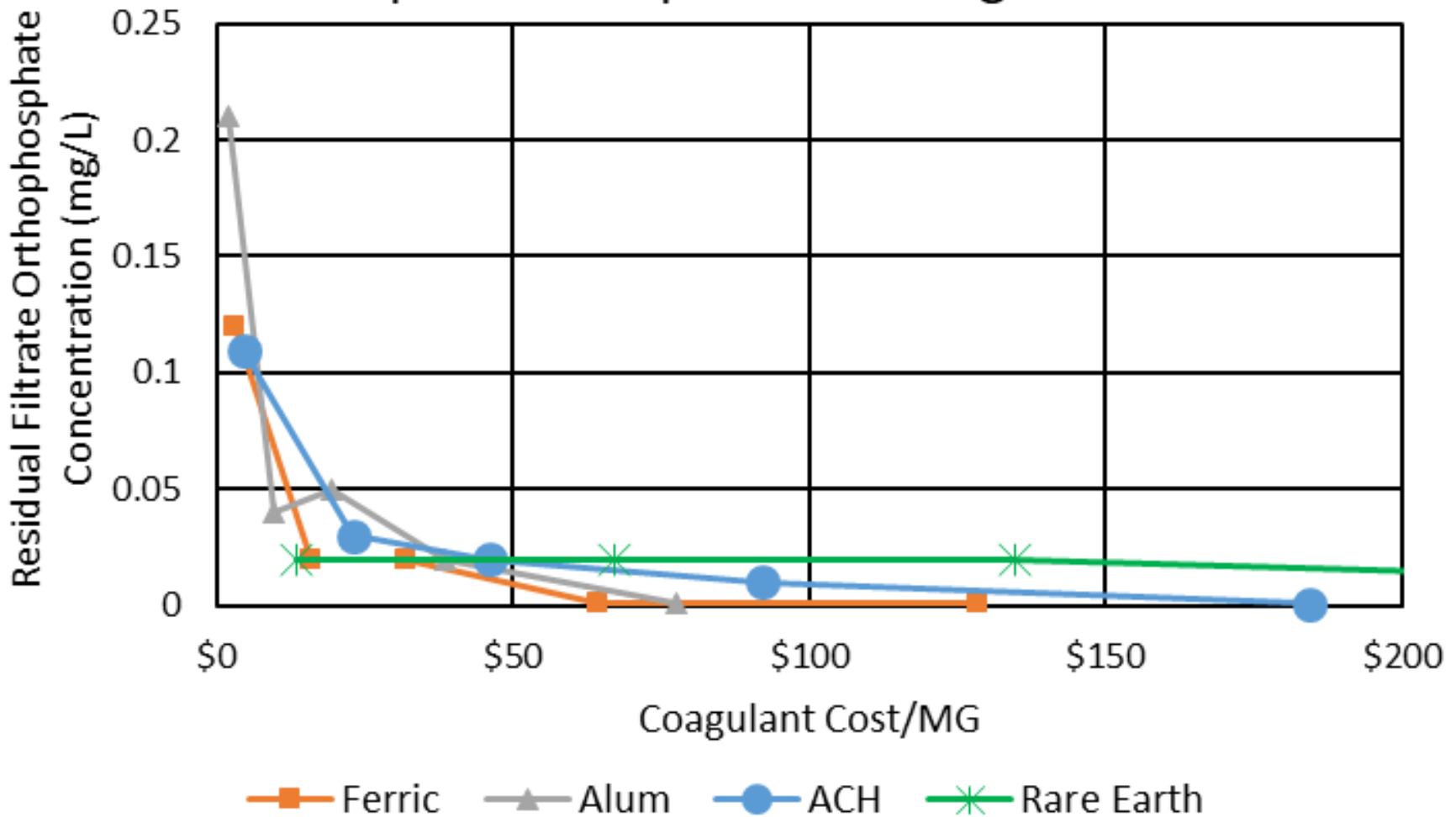
Coagulant Addition to Mixed Liquor

Figure 8: Village of Grafton Jar Test Results
Phosphorus Response to Coagulant Dose

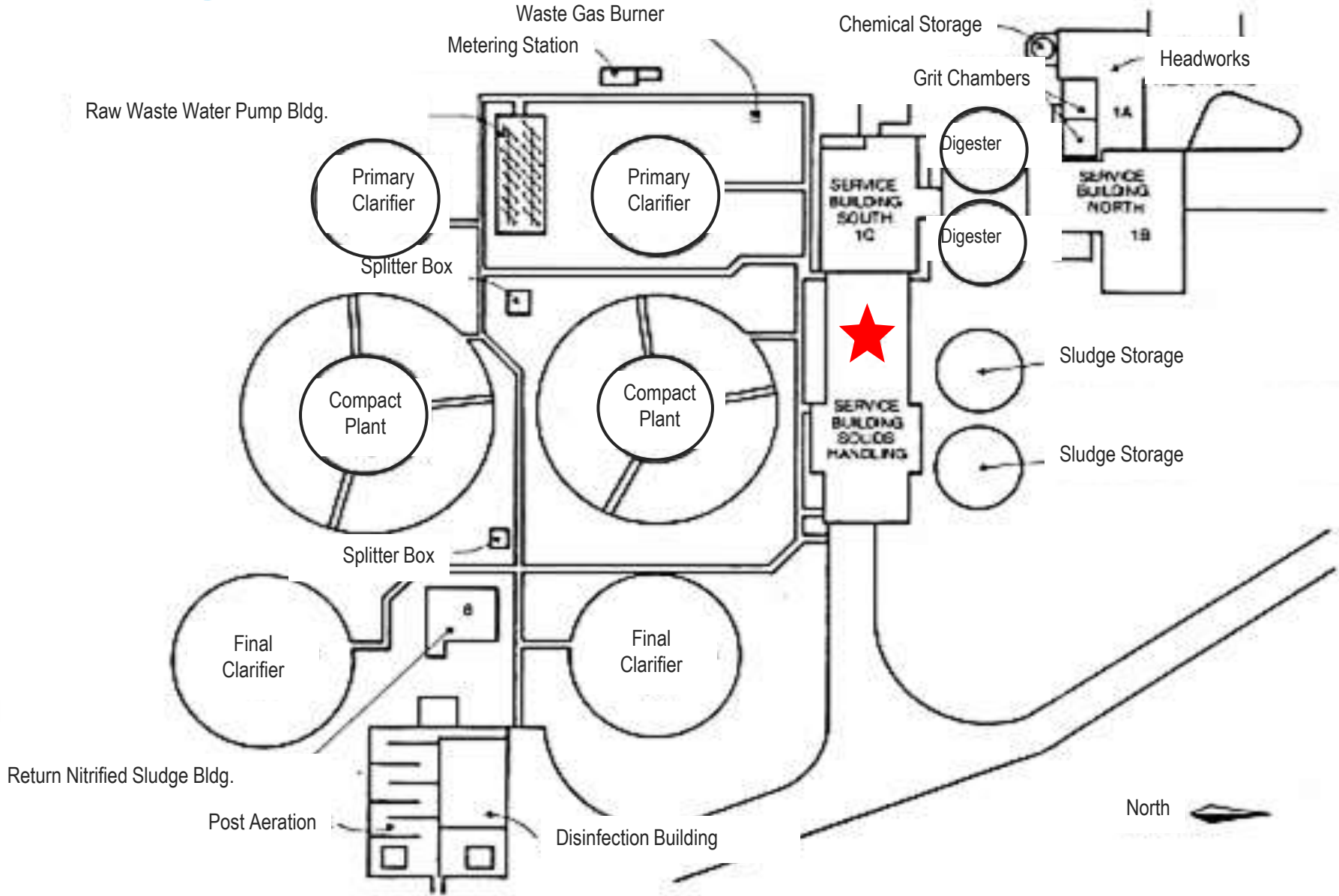


Coagulant Addition to Mixed Liquor

Figure 9: Village of Grafton Jar Test Results
Phosphorus Response to Coagulant Cost



Coagulant Addition to Side Stream



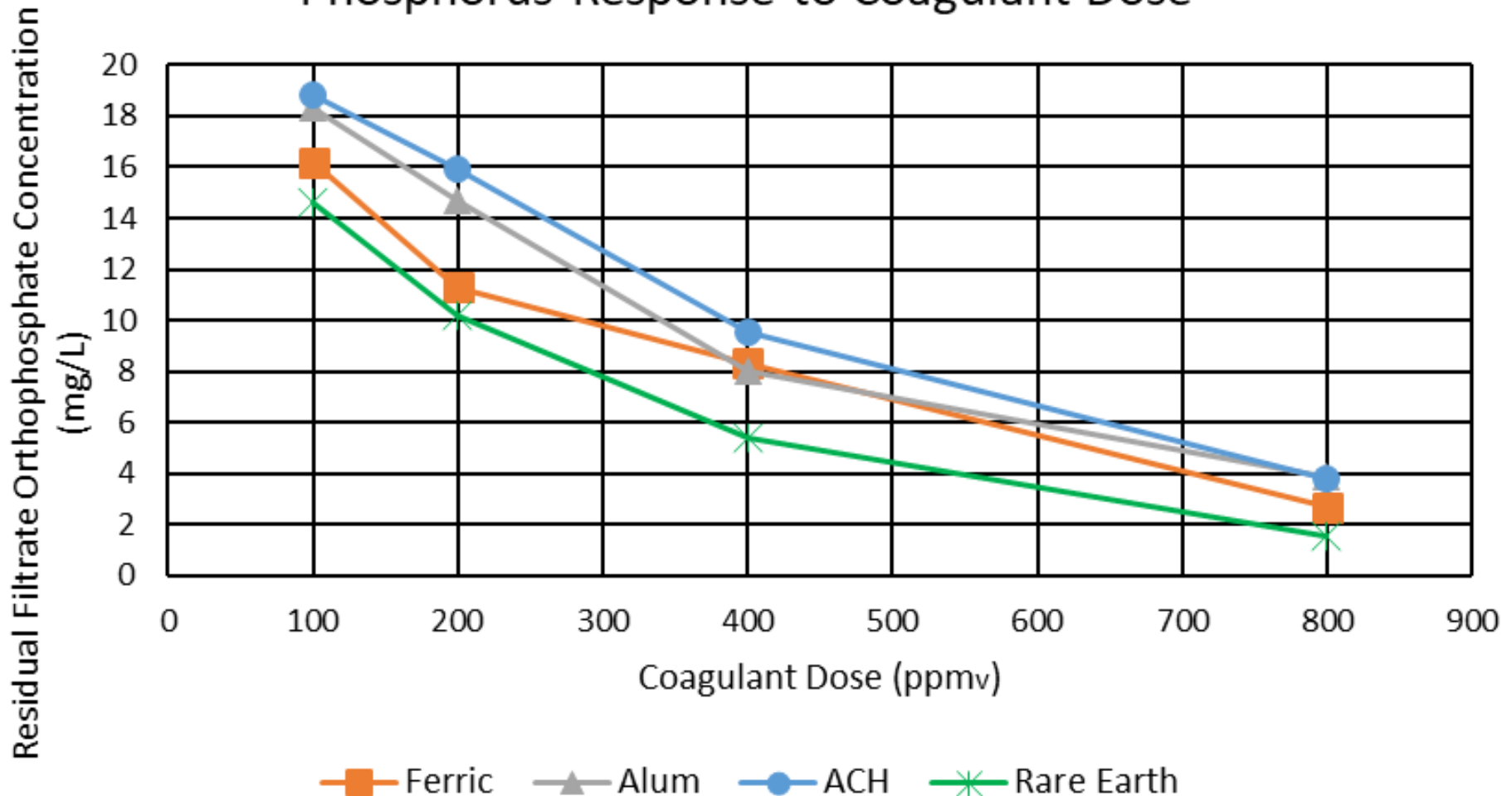
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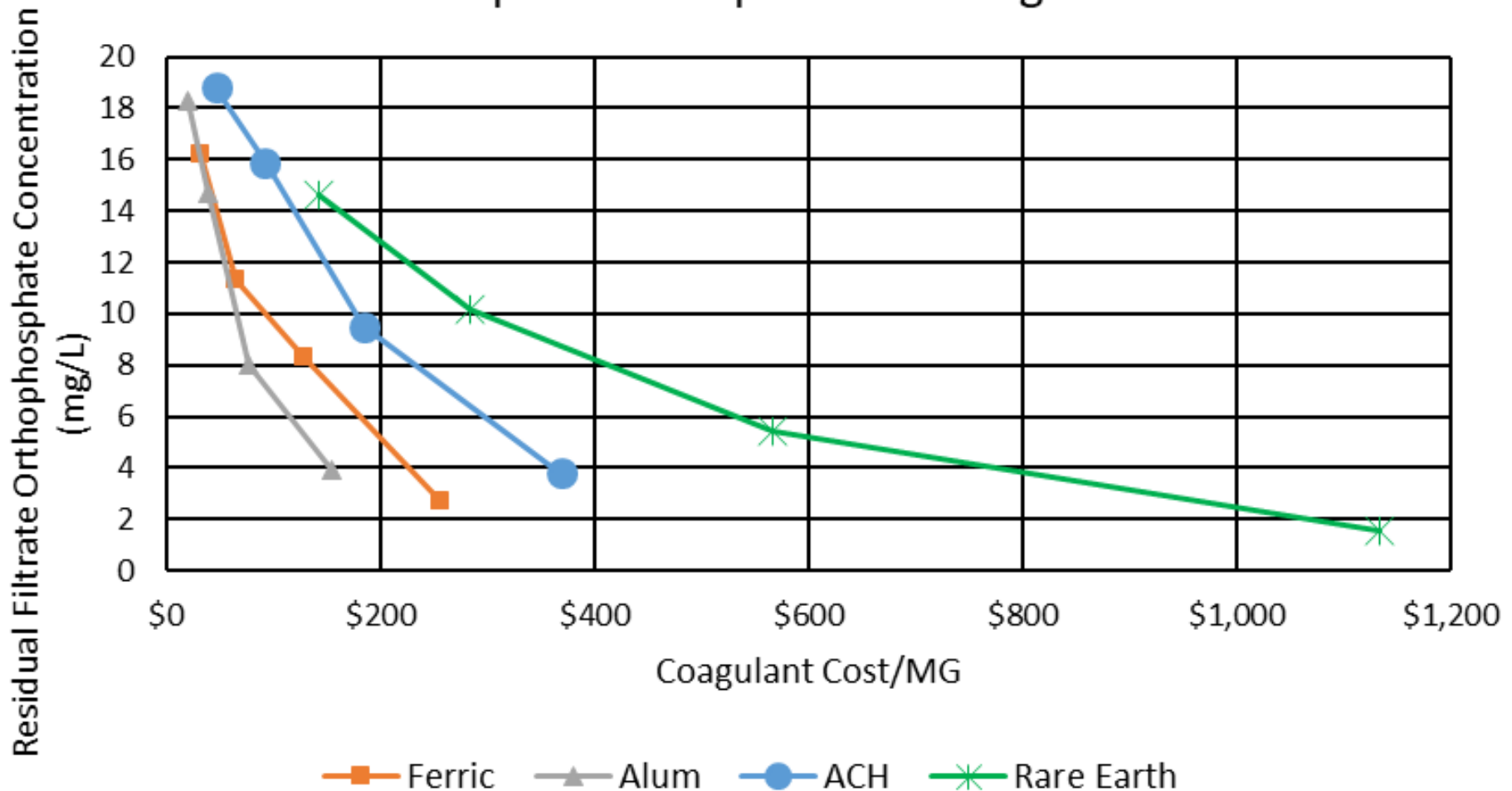
Coagulant Addition to Side Stream

Figure 10: Village of Grafton Side Stream Jar Test Results
Phosphorus Response to Coagulant Dose



Coagulant Addition to Side Stream

Figure 11: Village of Grafton Side Stream Jar Test Results
Phosphorus Response to Coagulant Cost

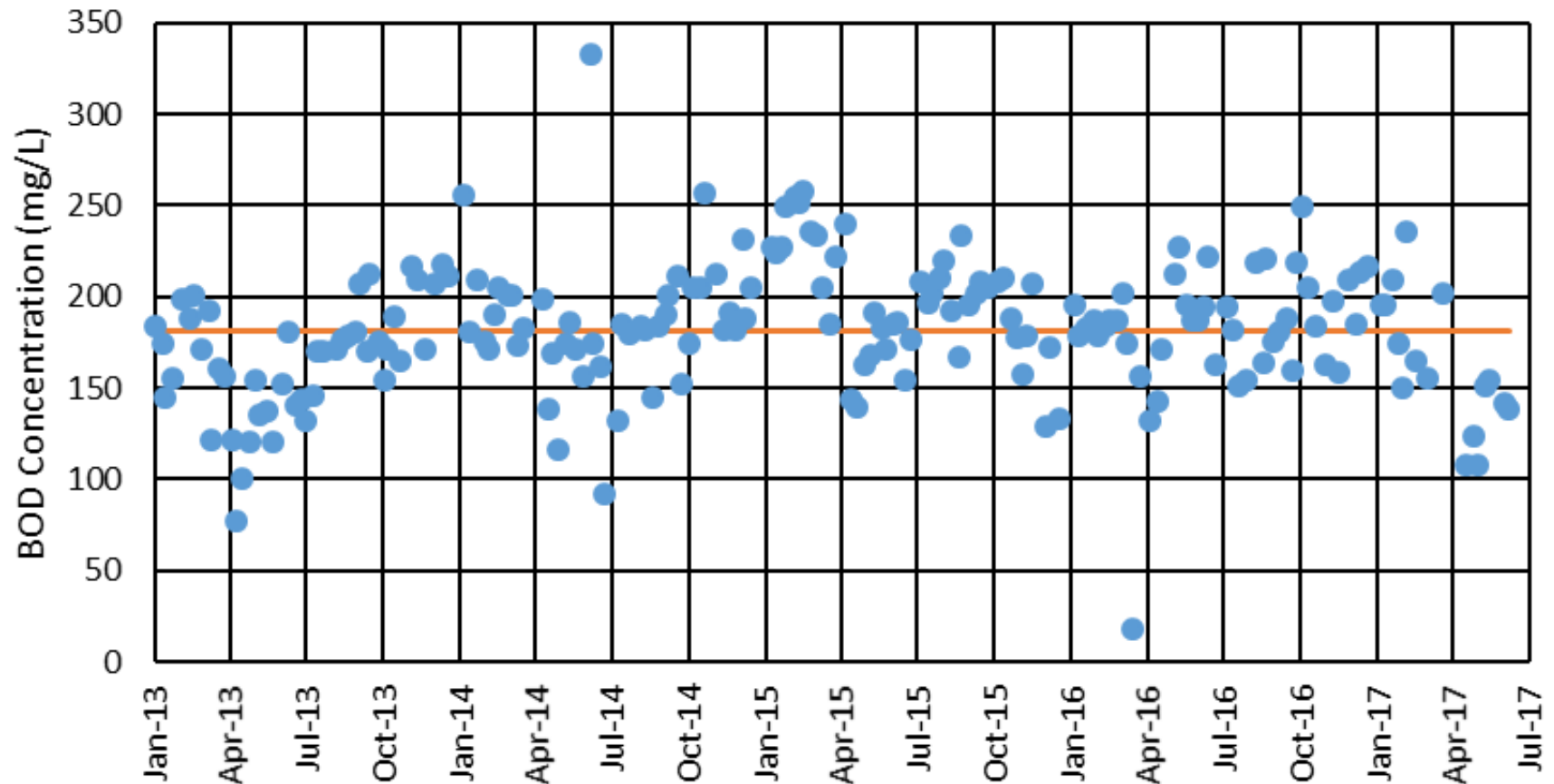


Potential for Biological Phosphorus Removal

- Influent BOD : Total Phosphorus (TP) ratio is 246:1
 1. Influent BOD approx. 170 mg/L
 2. Influent TP approx. 0.69 mg/L
- Measured Dissolved Oxygen (DO) at three locations:
 1. Primary clarifier effluent in the splitter box
 2. First stage (front) of the selector zone
 3. Last stage (back) of the selector zone

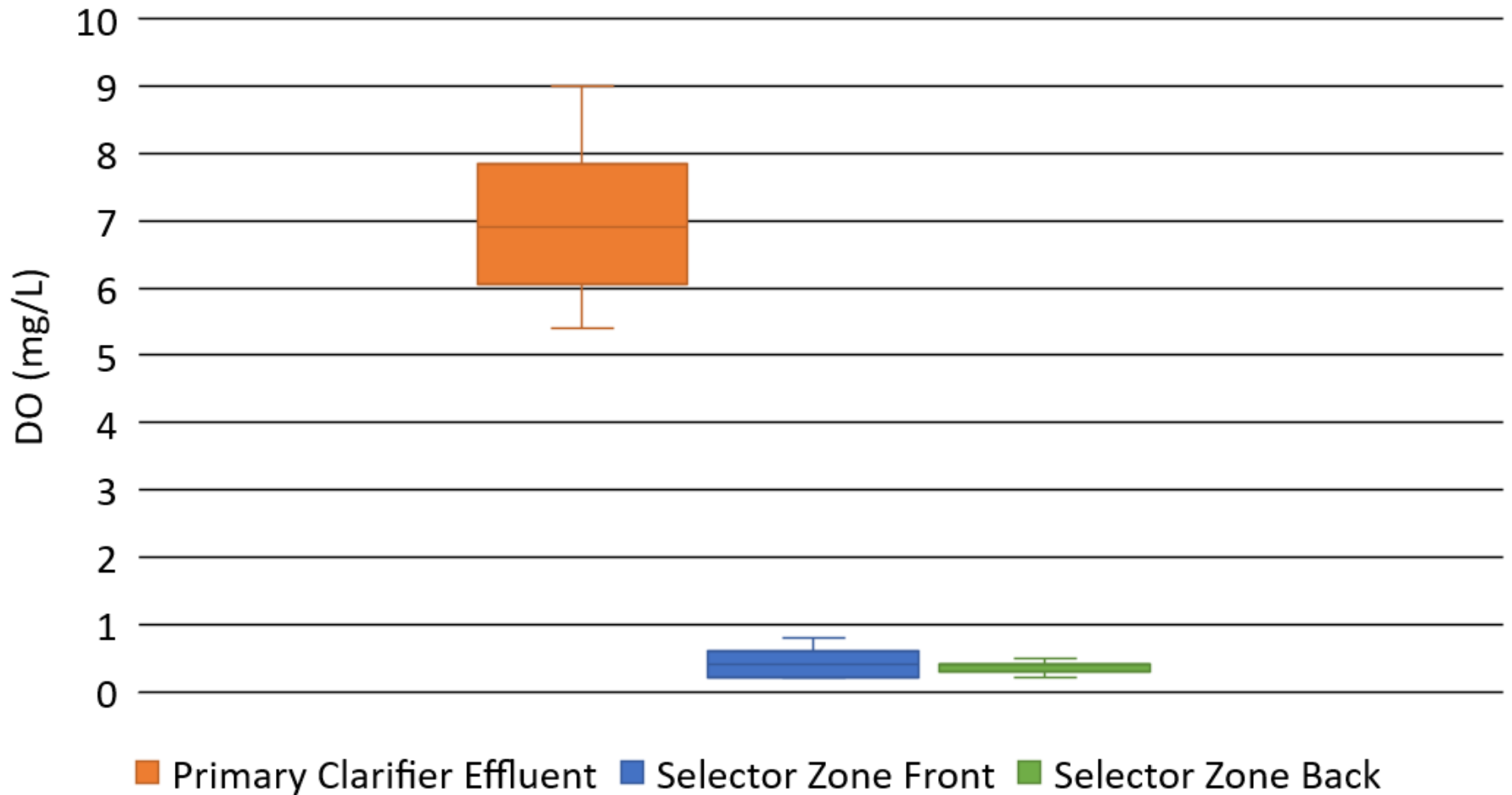
Potential for Biological Phosphorus Removal

Figure 12: Primary Clarifier Effluent BOD Concentration from Jan 2013 through June 2017

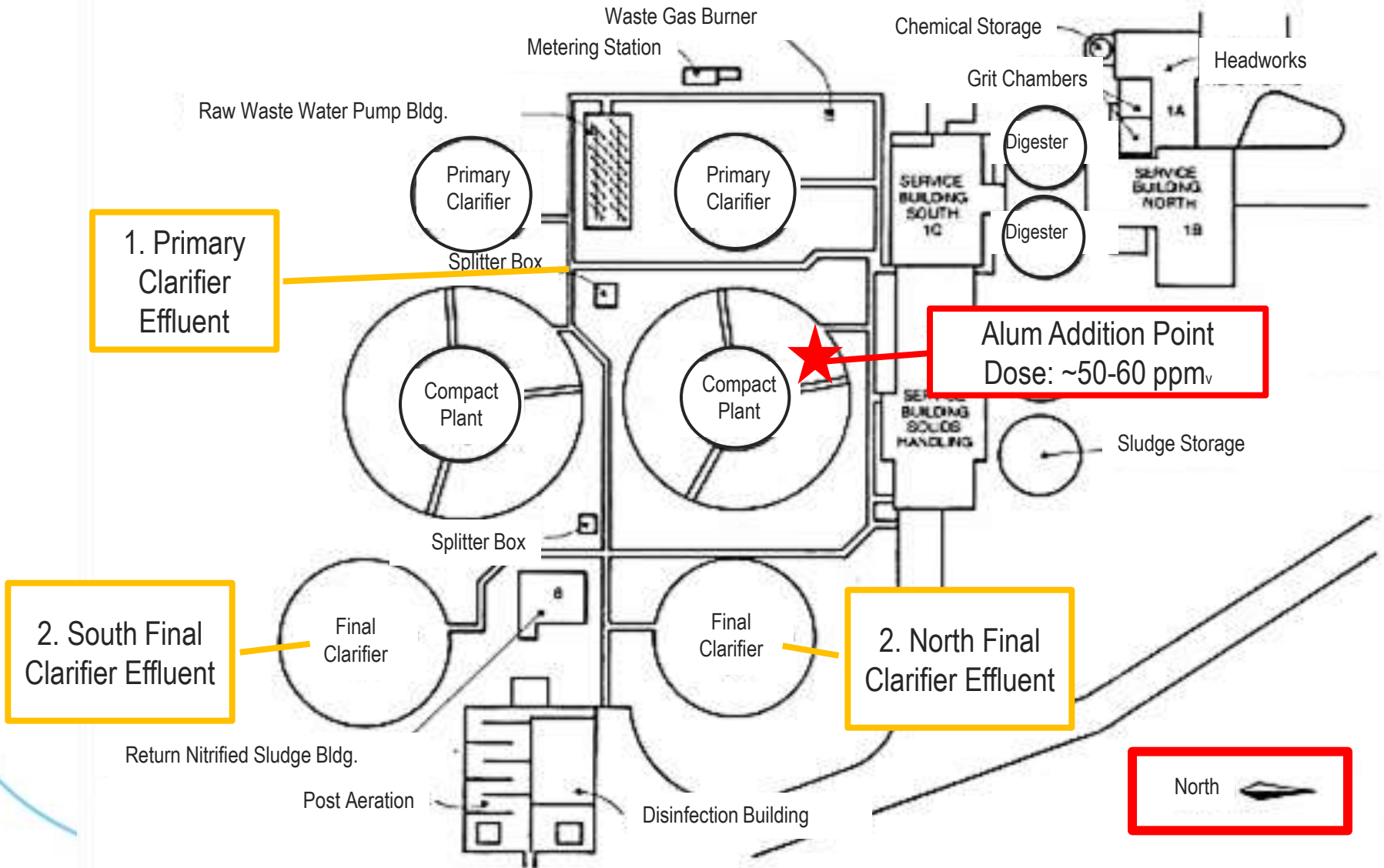


Potential for Biological Phosphorus Removal

Figure 13: DO vs. North Plant Sample Location

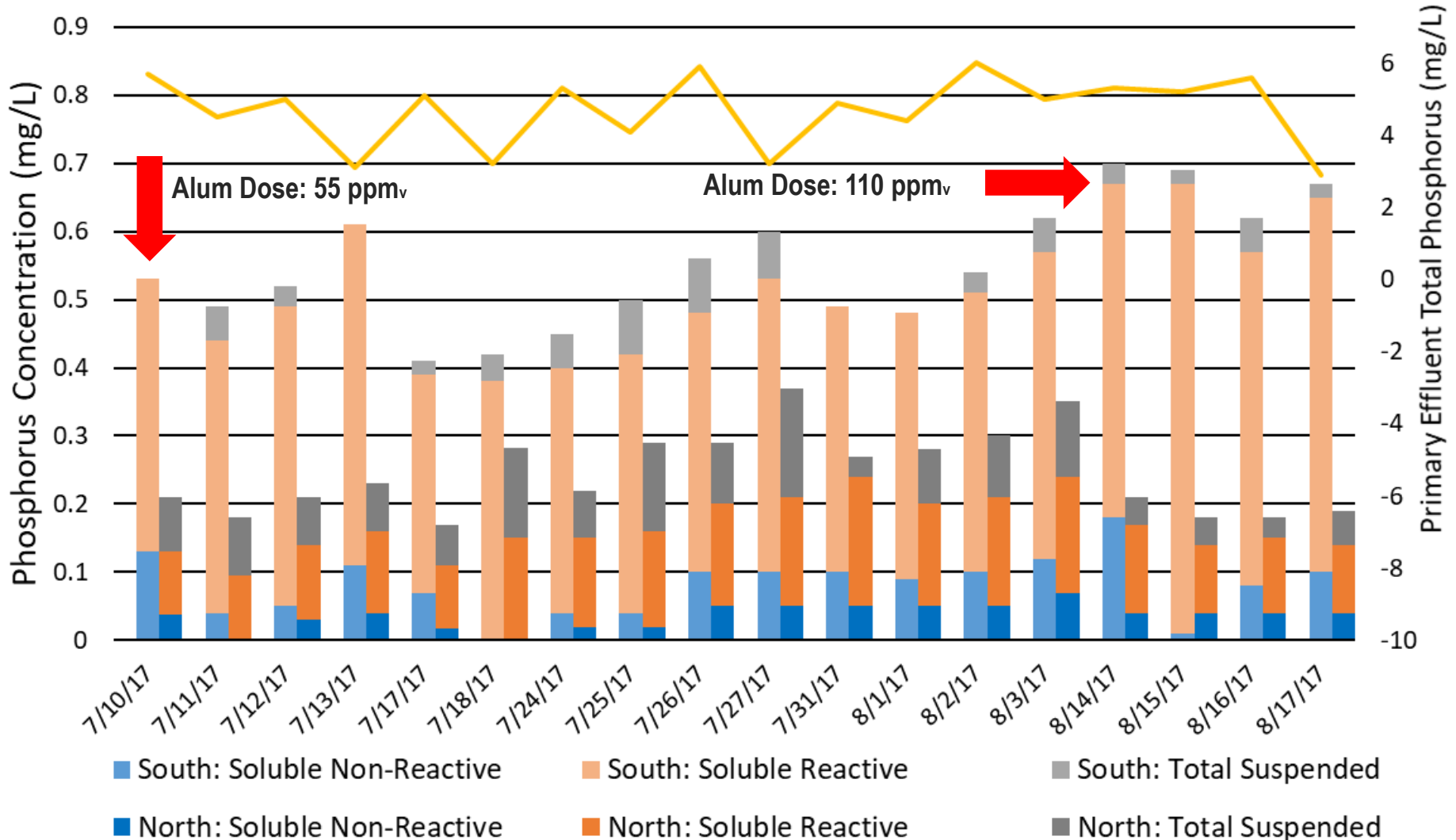


Pilot Plant Testing



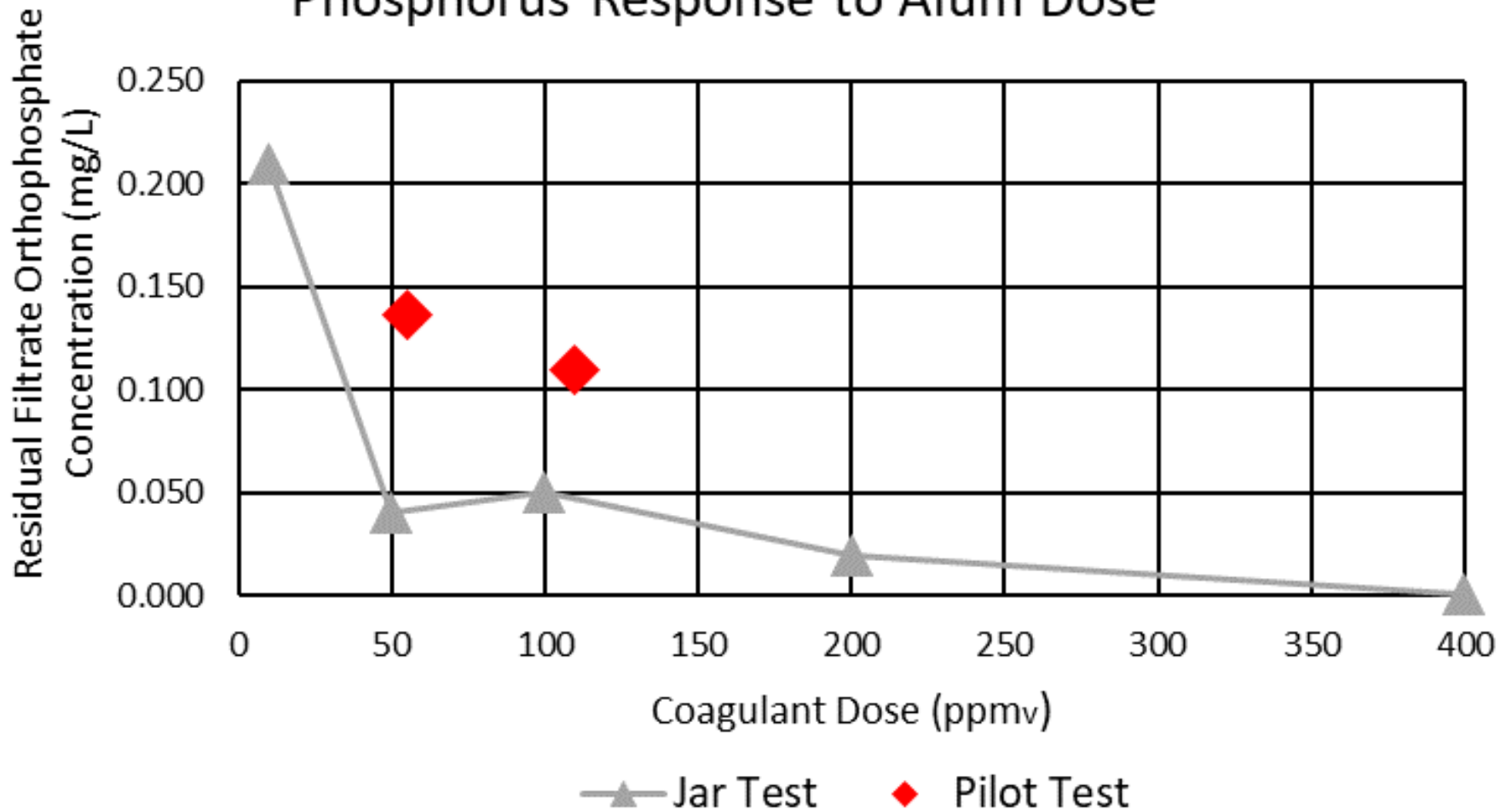
Pilot Plant Testing

Figure 14: Pilot Test Results



Pilot Plant Testing

Figure 15: Jar Test vs. Pilot Test Results
Phosphorus Response to Alum Dose



Conclusions

- The permit required the Village to complete an OER
- The Village found the process to be very informative
- The Village learned:
 - Source reduction may not be worthwhile
 - Industrial phosphorus sources are minor
 - Influent TP concentration low to begin with
 - Bio-P – not so easy
 - SNRP is present
 - Second Coagulant feed point helpful

What's next?

- Pilot testing adding coagulant to the GBT filtrate to begin this winter
- The Village plans to begin discussions with the County on identifying trading opportunities
- The Village will prepare a preliminary phosphorus plan that will evaluate:
 - Treatment plant improvements
 - Adaptive management
 - Nutrient Trading
 - MDV

Thank you!



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