NEW ENGLAND WATER ENVIRONMENT ASSOCIATION
NEWEA
WORKING FOR WATER QUALITY

Correlating Operational Conditions to Activated Sludge Microbial Community in One Year of An A2O Process

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1- Upper Blackstone Clean Water
2- Environmental Operating Solutions (EOS)

UPPER BLACKSTONE CLEAN WATER

January 2022

Outline

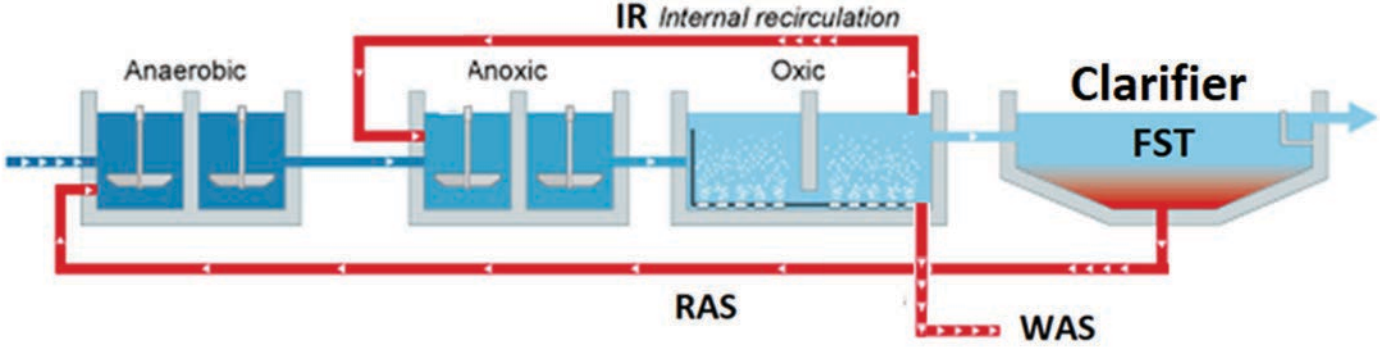
- Upper Blackstone in a glance
- Molecular analysis Study
- Historical Challenges & Case Studies
- Correlating operational conditions to microbial community

Upper Blackstone at a Glance

- Plant Information:
  - Influent characterization:
    - Avg Flow: 30 MGD
    - Avg CBOD: 154 mg/L
    - Avg TN: 28 mg-N/L
  - Process configuration
    - A2O
    - 4 trains
  - Regulation/Permit
    - Seasonal permit
    - TN: 5 mg-N/L

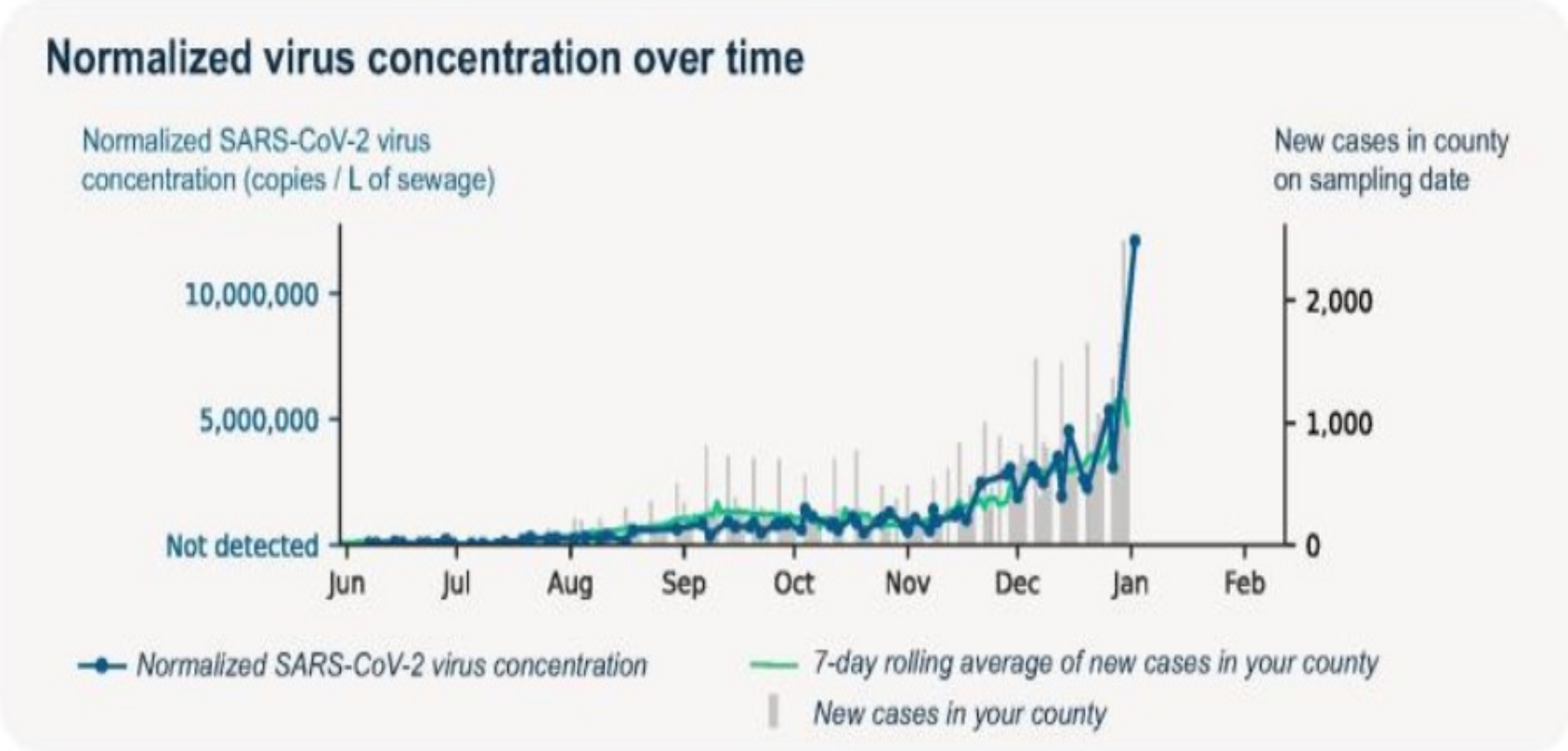
      Interim permit 6 mg-N/L
    - TP: 0.1 mg-P/L

      Interim permit 0.45 mg-P/L 60 days rolling average



Molecular Analysis Study- 16S RNA Amplicon Sequencing

- Molecular analysis Study, is the measurement of bacteria type and levels in wastewater through the real-time polymerase chain reaction, qPCR, technique.
- This is a well-known method that recently has been applied in the wastewater field to evaluate community-level infection trends like Covid-19.
- Correlating operational conditions to activated sludge microbial community will help us to predict and troubleshoot the process in advance.

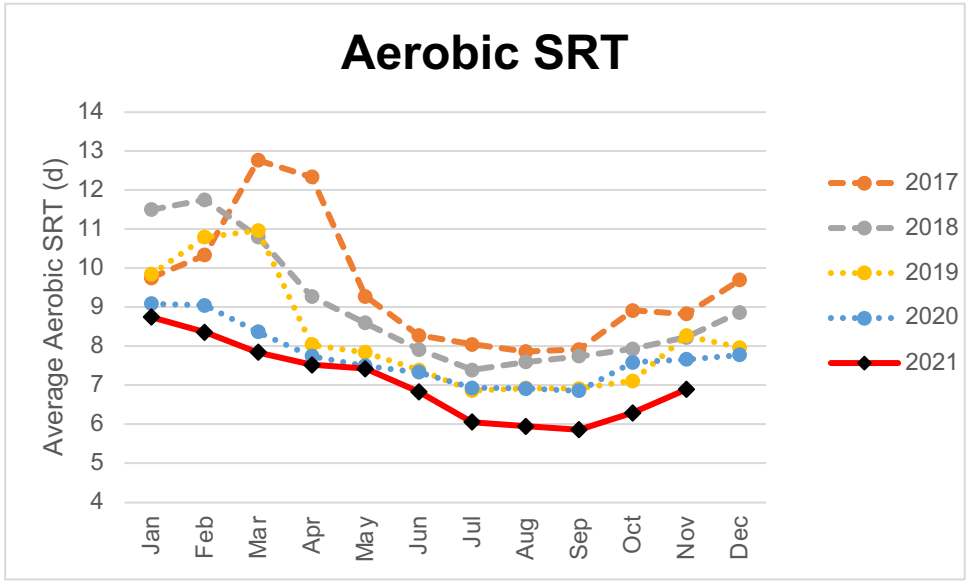


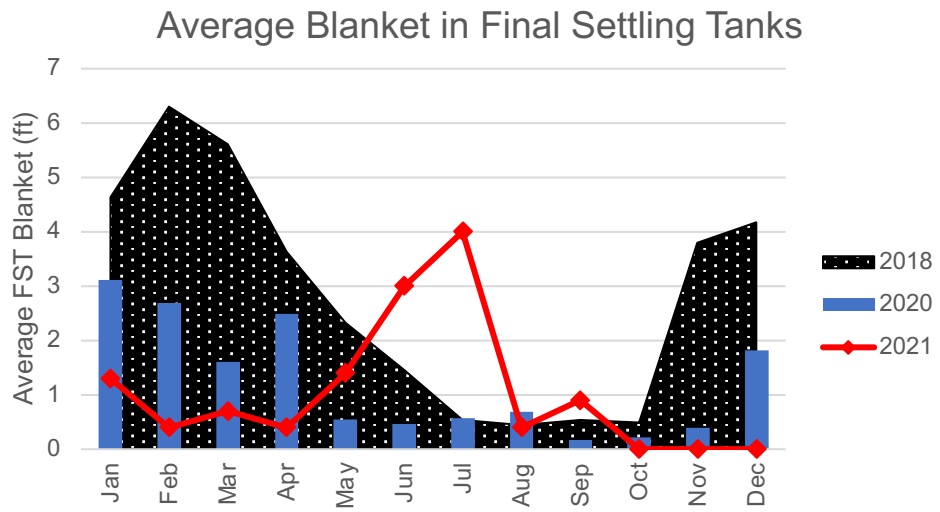
Historical Challenges

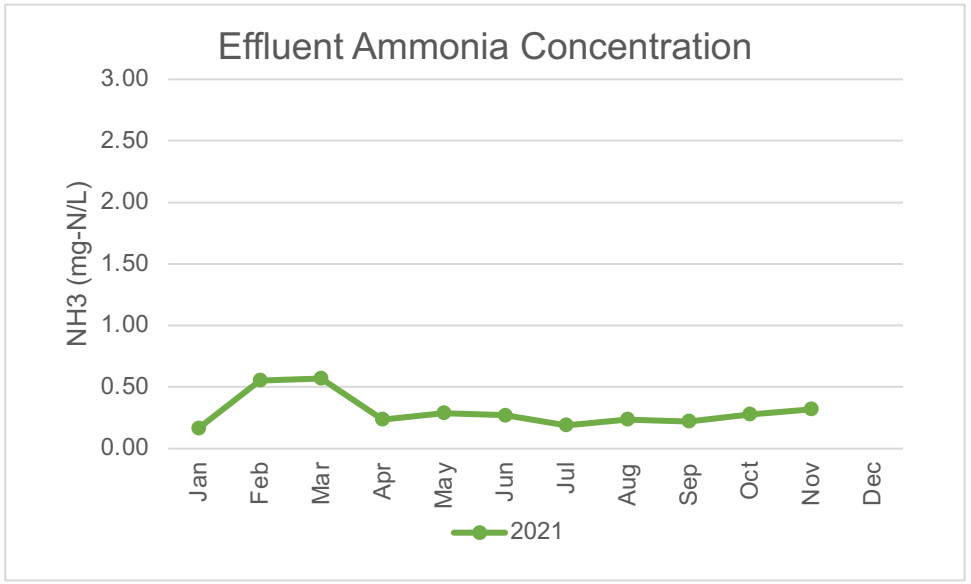
- High Blanket in Winter
- Occasional High Effluent Phosphorus in Summer
- Foaming in Spring

I. High Blanket in Winter

- Due to:
  - Higher SVI, Higher influent flow, Conservative SRT to maintain nitrification
- Solution:
  - Developed a 5-step adjustment strategy to control the solids inventory (presented in NEWEA 2020)
  - Reduced Aerobic SRT from 13 to 8.7d



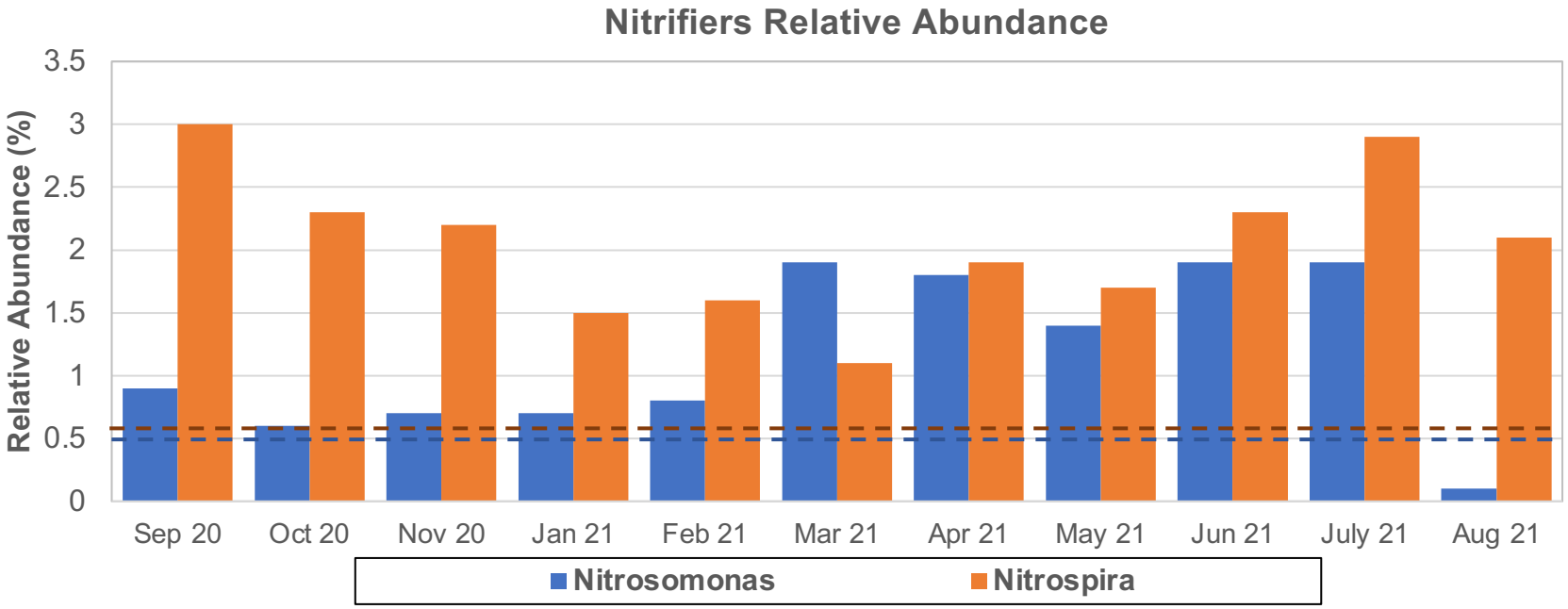




The Most Abundant Nitrifiers

- The population of Nitrosomonas-AOB did not change in winter 2021 compared to September 2020.

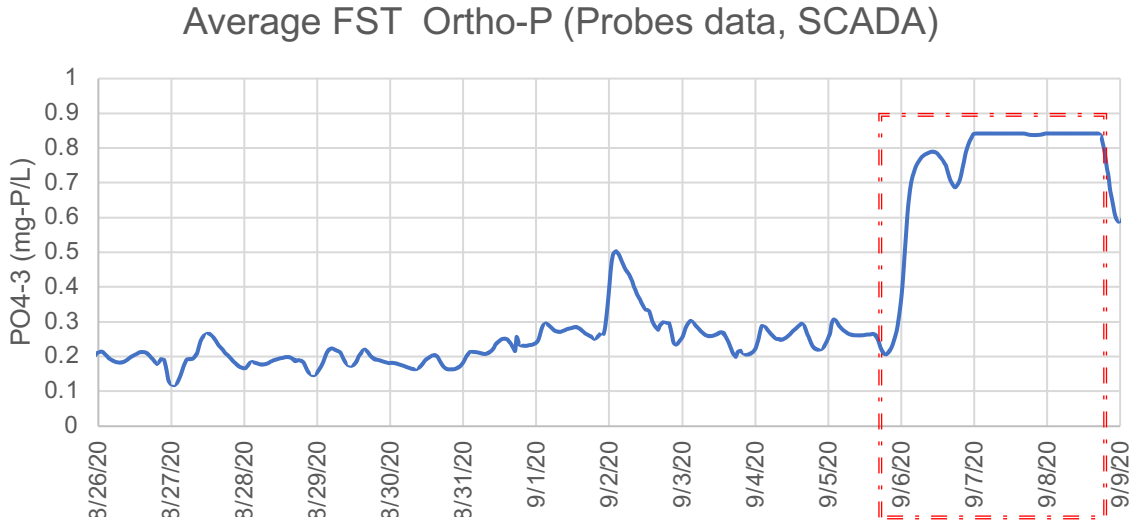
- AOB and NOB populations remained in the typical range reported by MiDAS database.

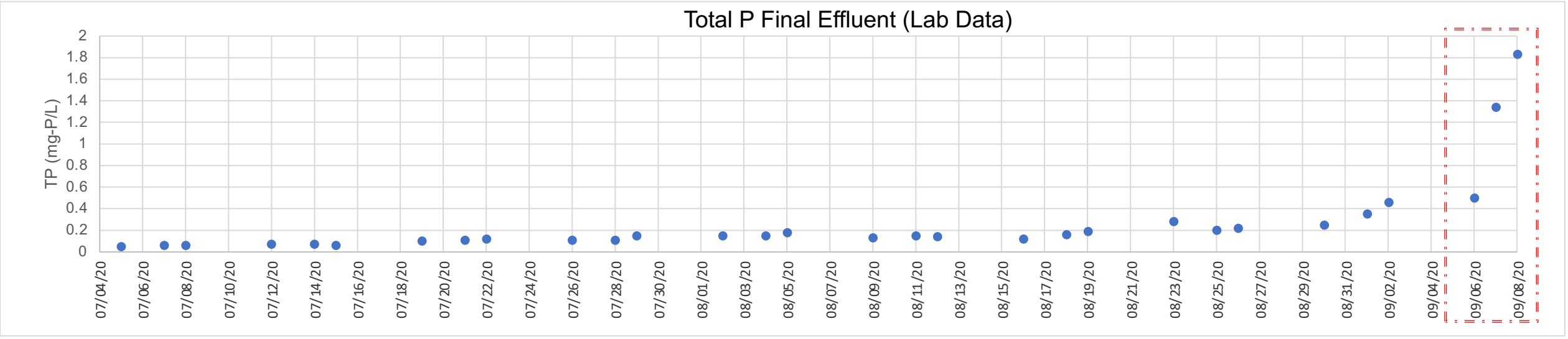


Dashed Lines: Median MiDAS :The median value based on long-term 16S rRNA amplicon sequencing surveys of >20 Danish full-scale BNR plants for activated sludge

II. Occasional High Effluent Phosphorus in Summer

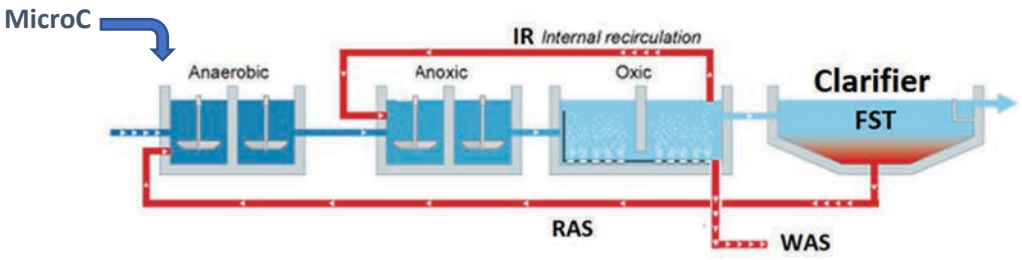
- On Monday September 6th, Effluent Ortho-P increased significantly.
- TP Seasonal Permit: 0.45 mg-P/L
  (60-d rolling average)

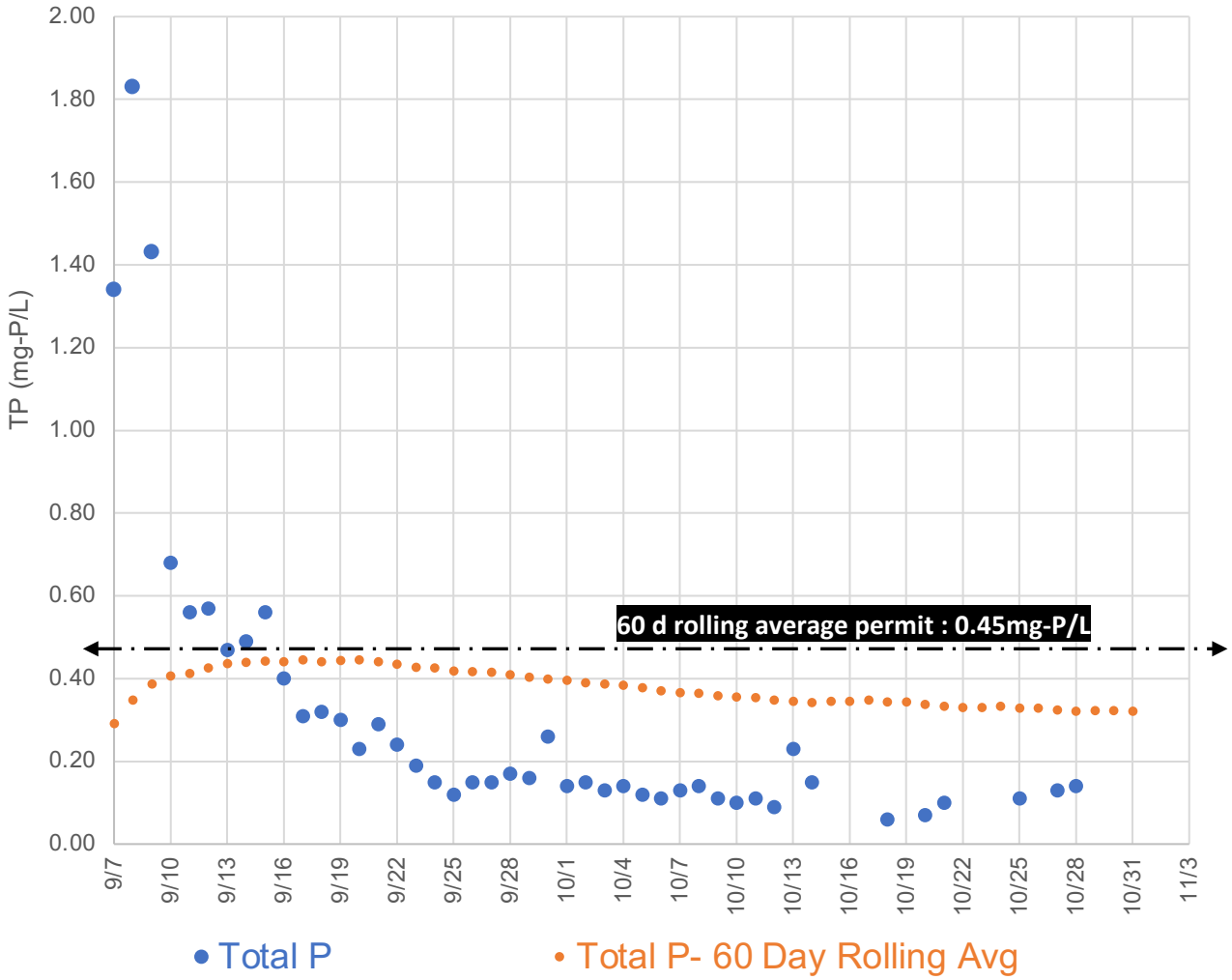




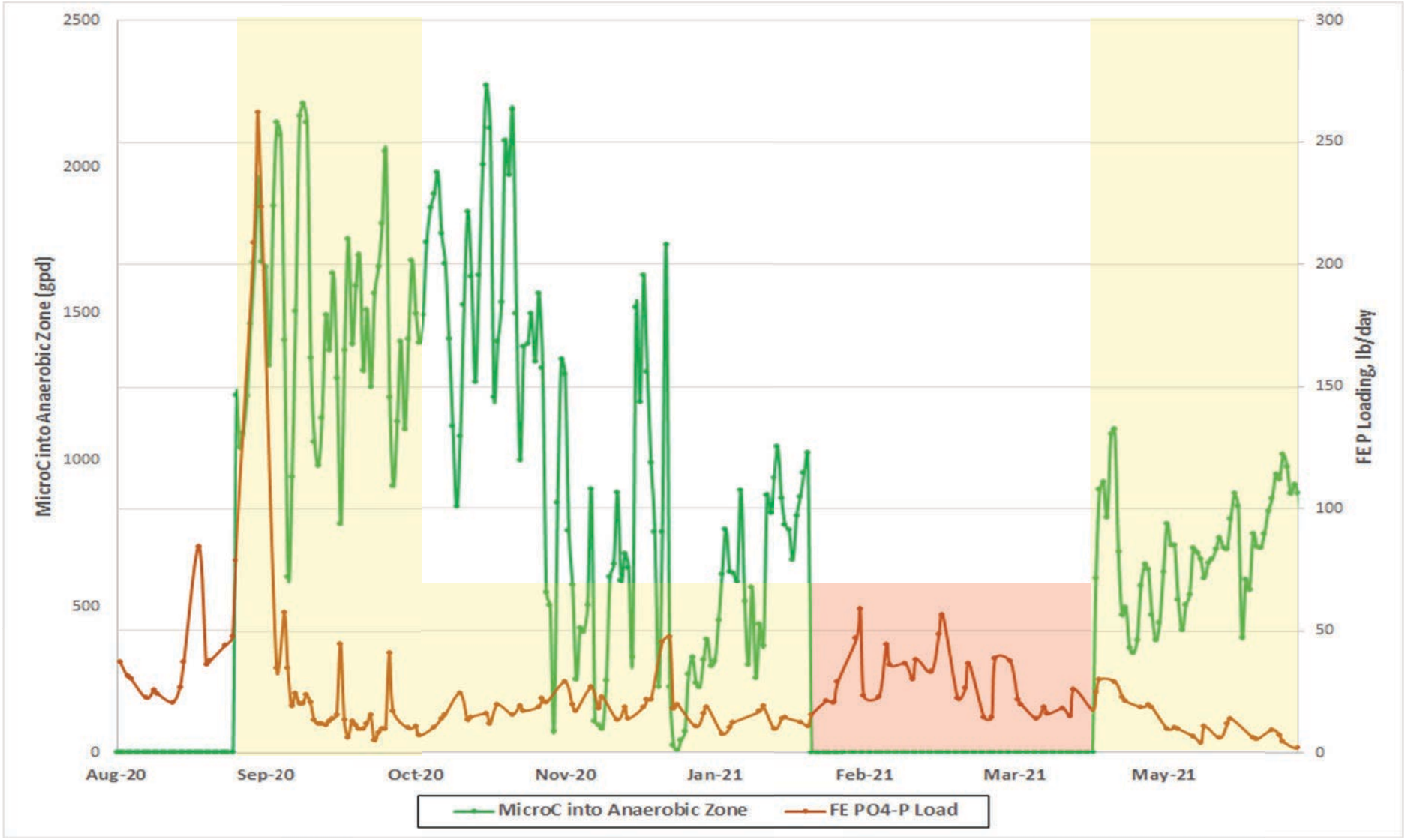
II. Troubleshooting Example: High Effluent Ortho P

- Approach:
  - Analyzing Historical data & identifying the cause
  - Dosing MicroC® 2000 as Supplemental Carbon to Anaerobic Zone
- Result:
  - Reduced the ortho-P
  - Maintain our permit – No Violation
  - Long term approach: Dosing MicroC® to anaerobic zone on holidays and long weekends

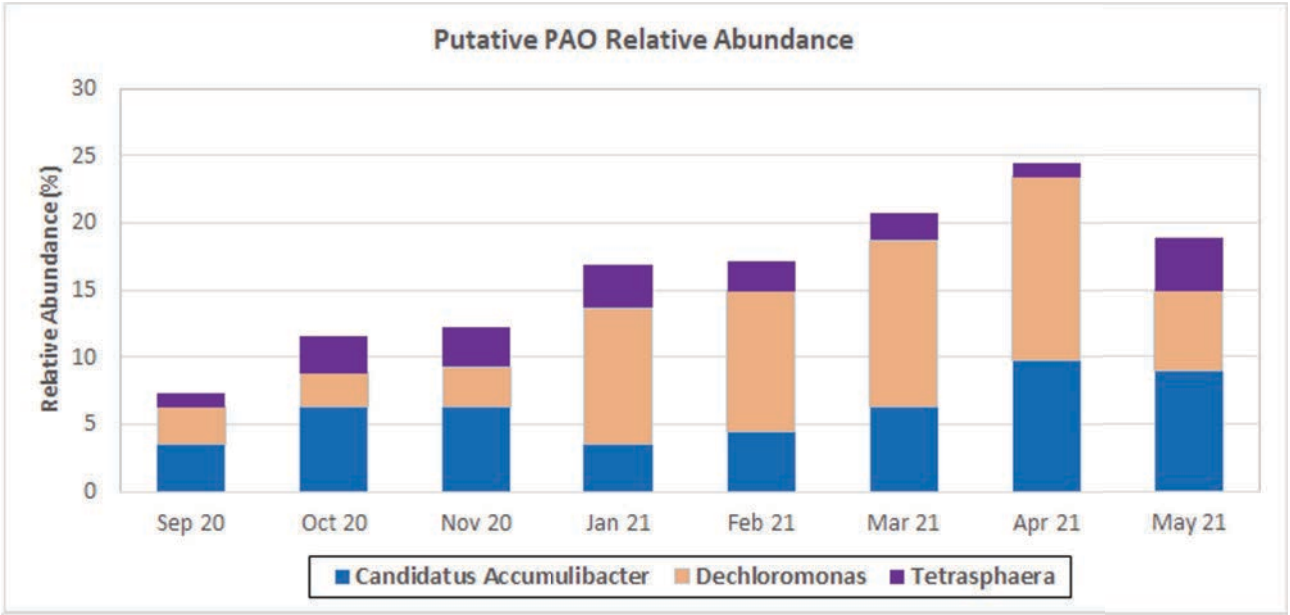


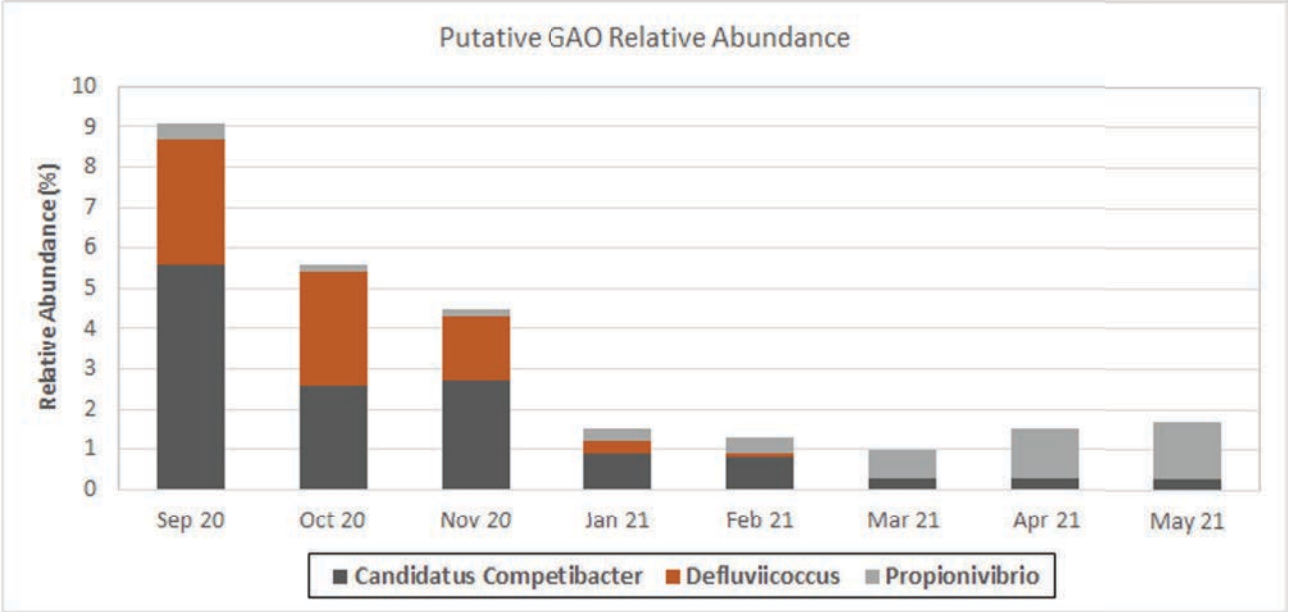


The Effect of MicroC® 2000 on EBPR Process



Putative PAOs and GAOs Population

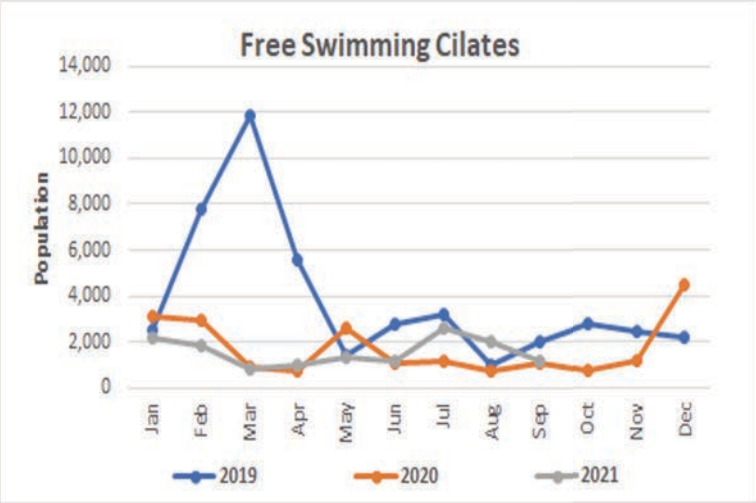


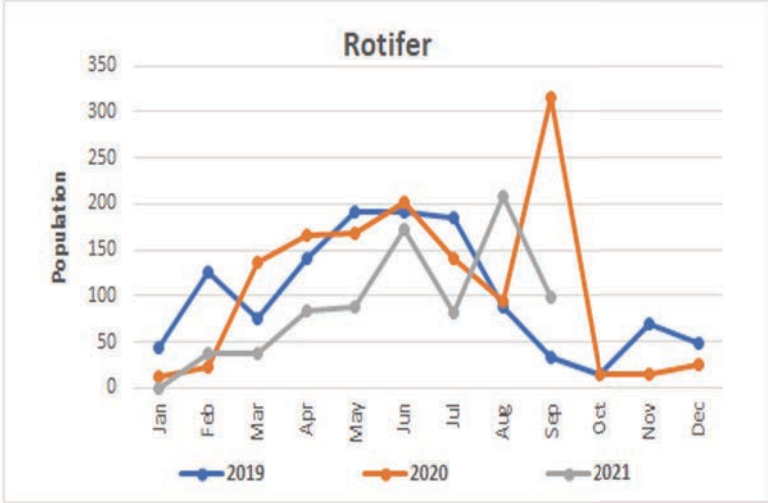


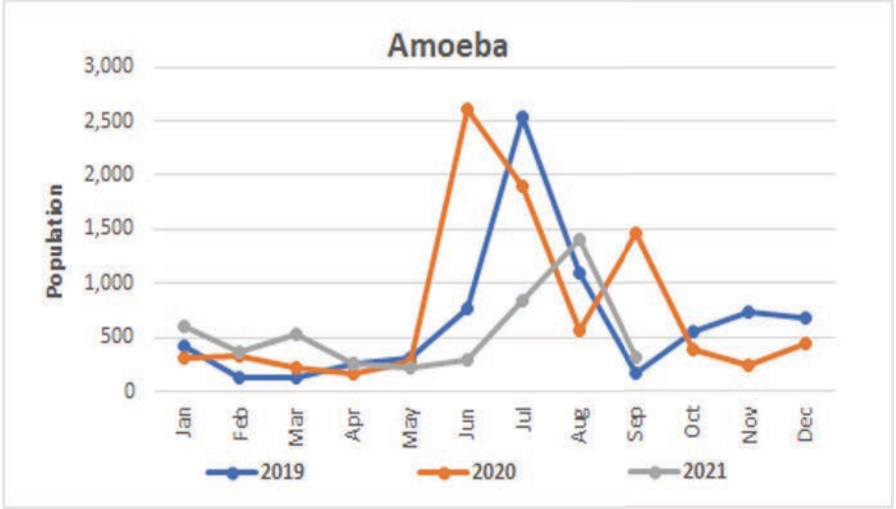
- Increase in overall putative PAOs (presumed PAOs) population after MicroC 2000 glycerol addition.

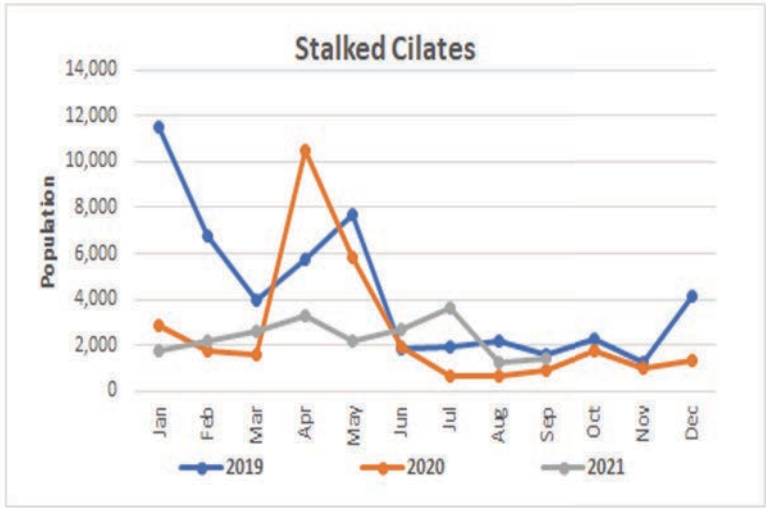
- Decreasing GAOs which could result in further increase in PAO population.

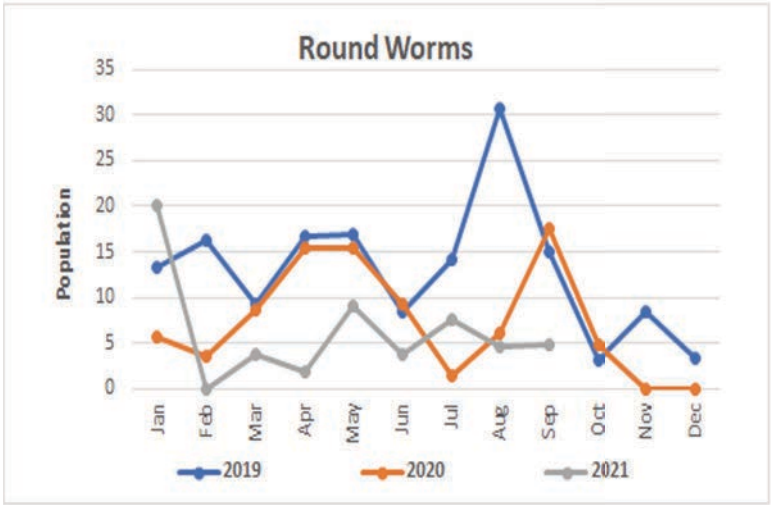
Higher Life Form Identification

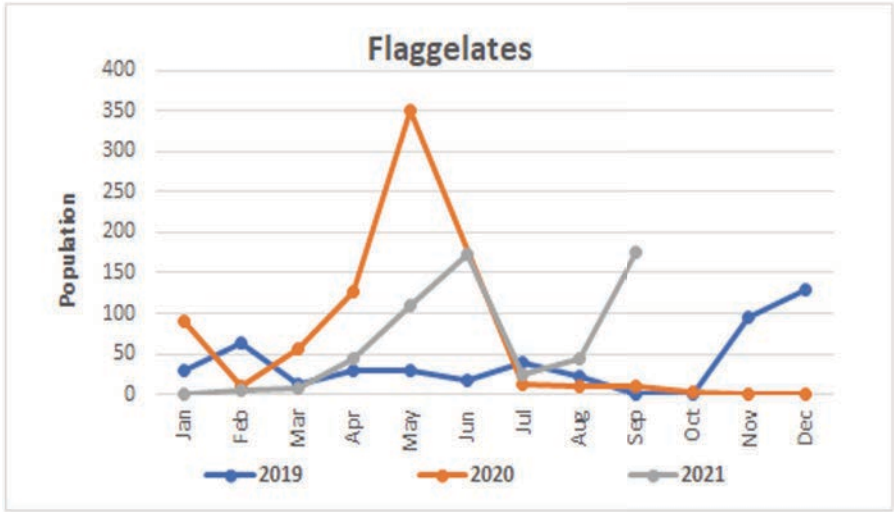




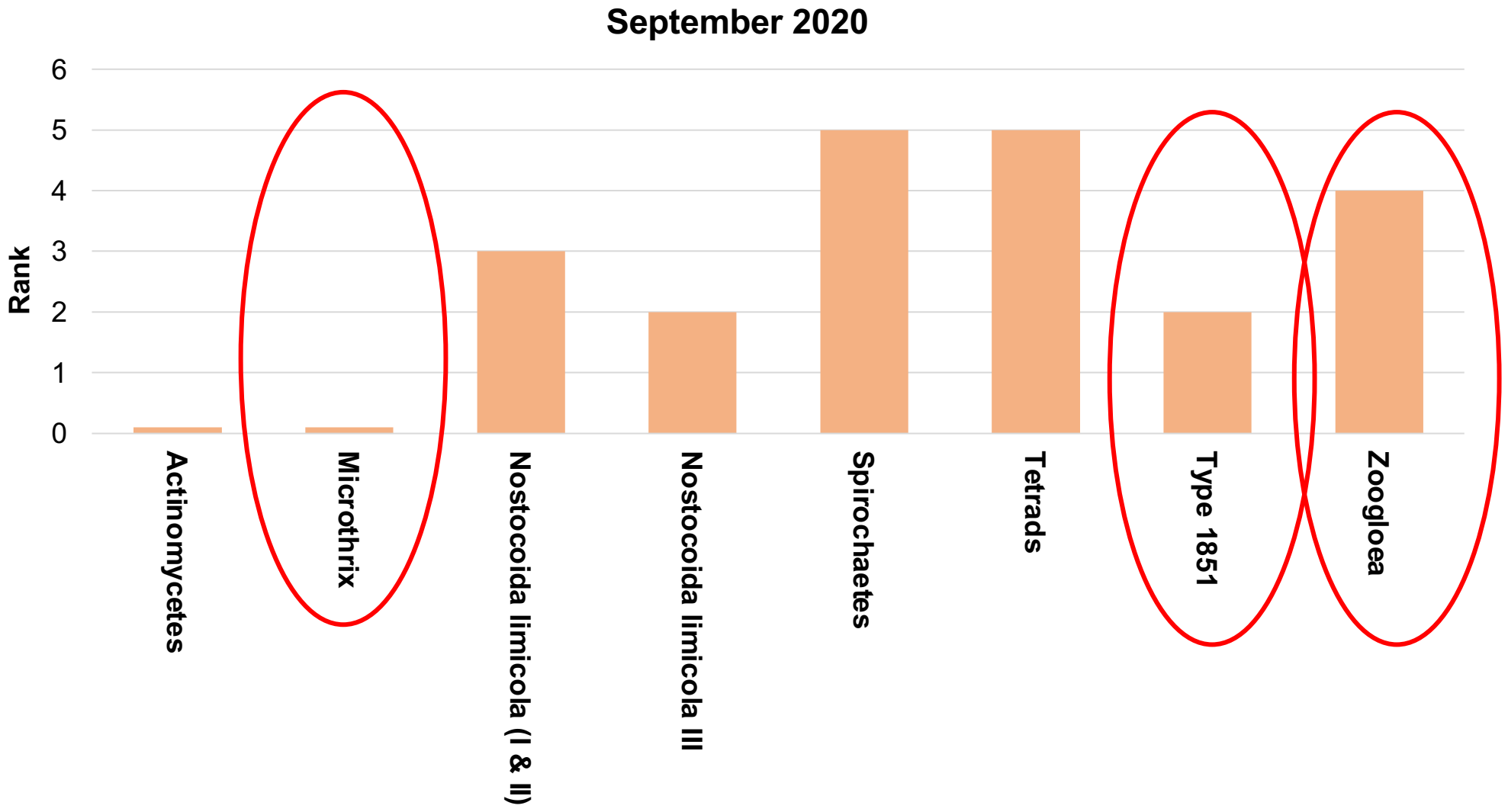




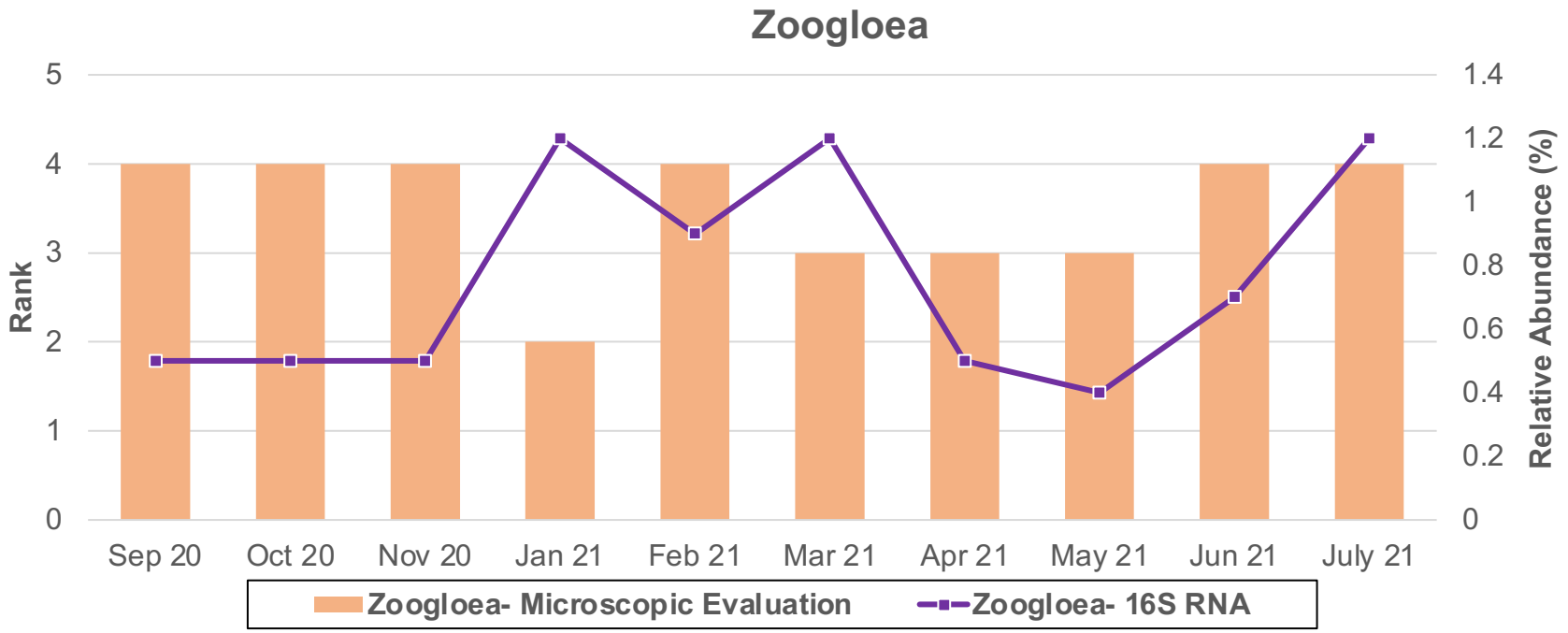




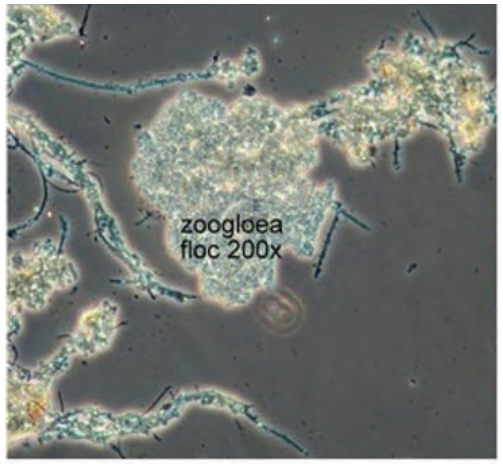
Morphology Analysis

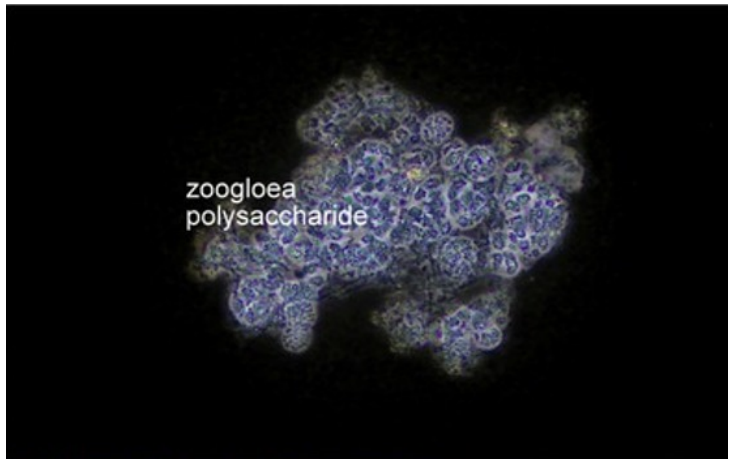


Zoogloea- Morphology Analysis vs 16S RNA Amplicon Sequencing

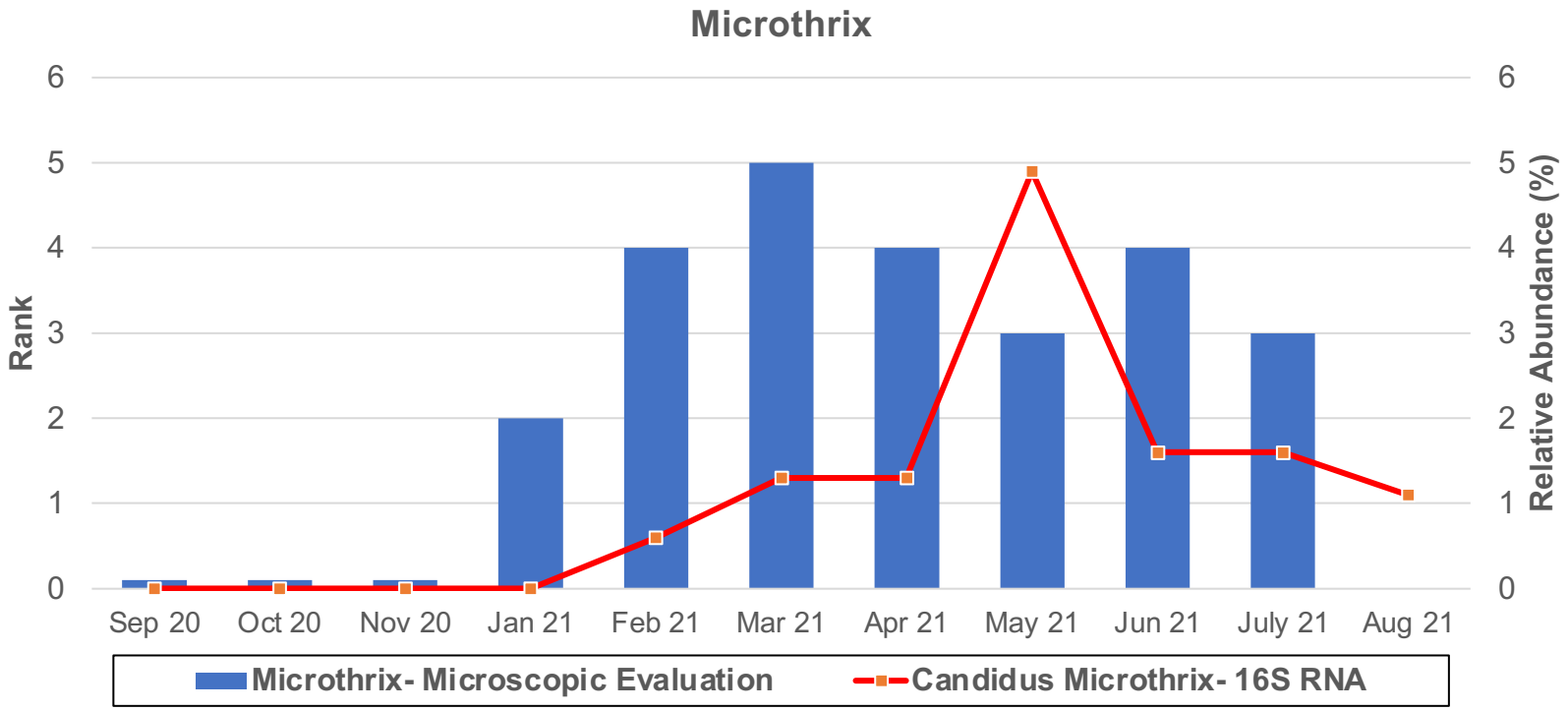


RANK	Abundance
4	Abundant
3	Common
2	Some
1	Few

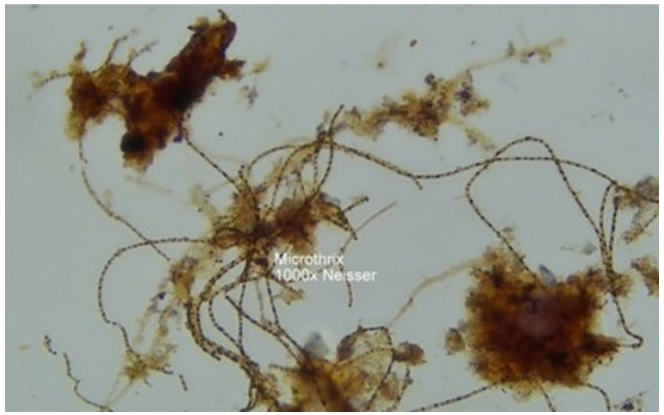




Microthrix- Morphology Analysis vs 16S RNA Amplicon Sequencing



RANK	Abundance
4	Abundant
3	Common
2	Some
1	Few

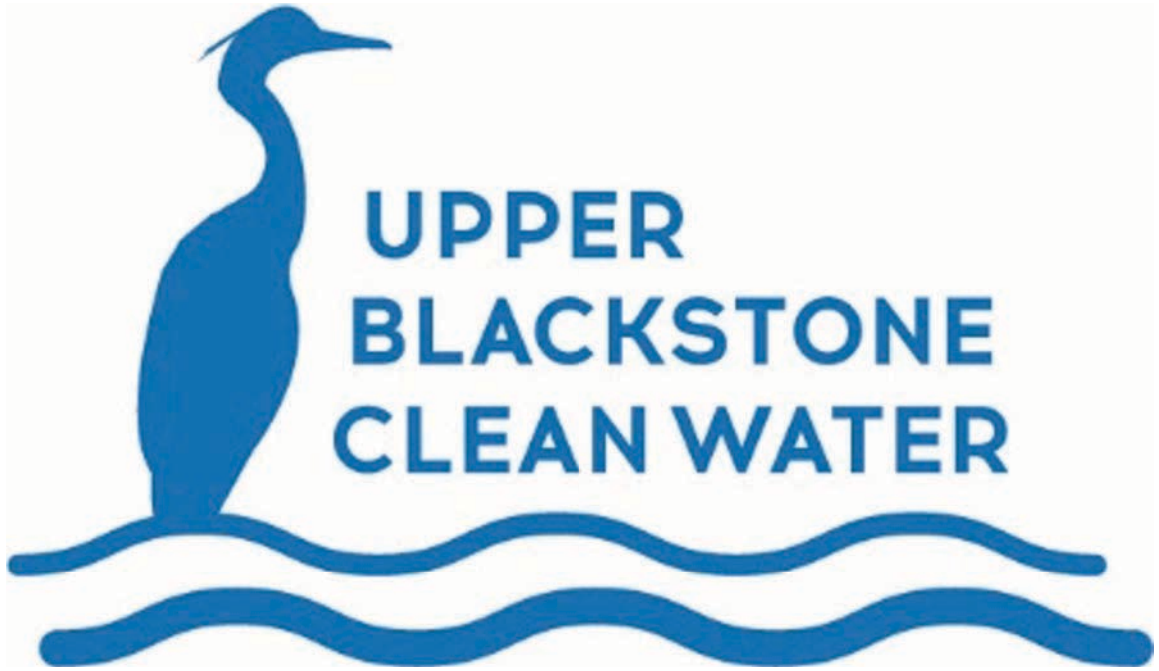
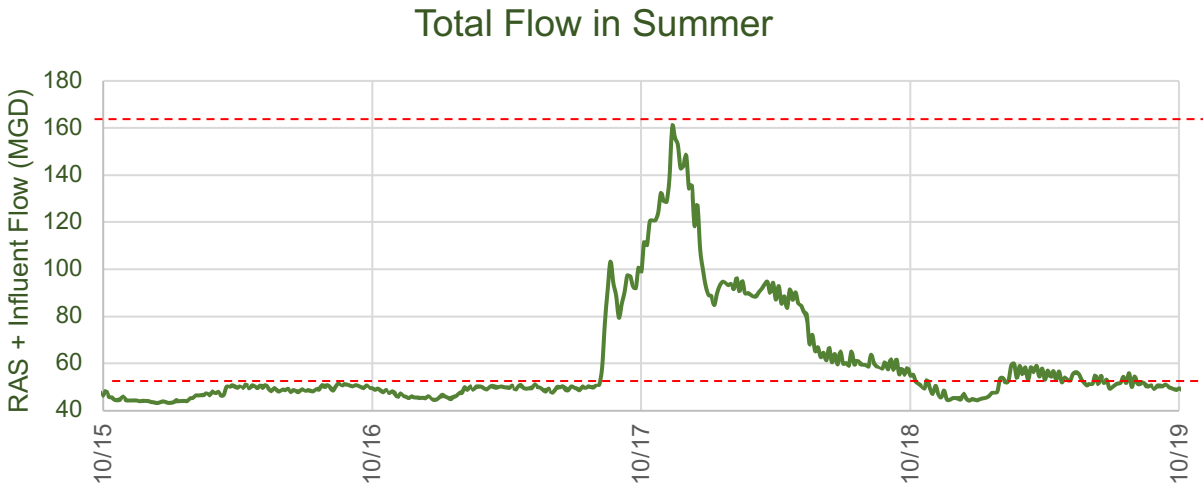
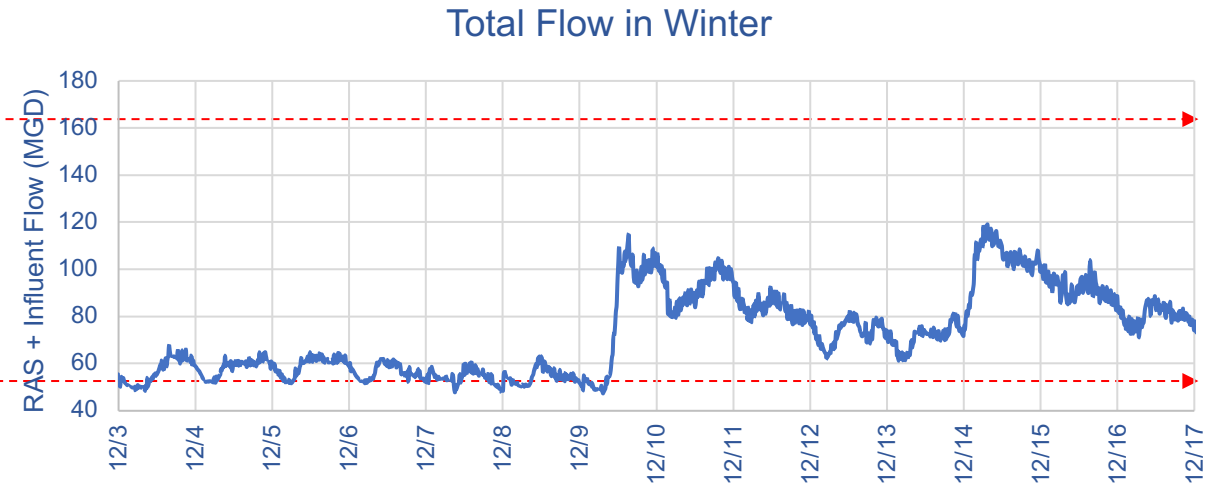
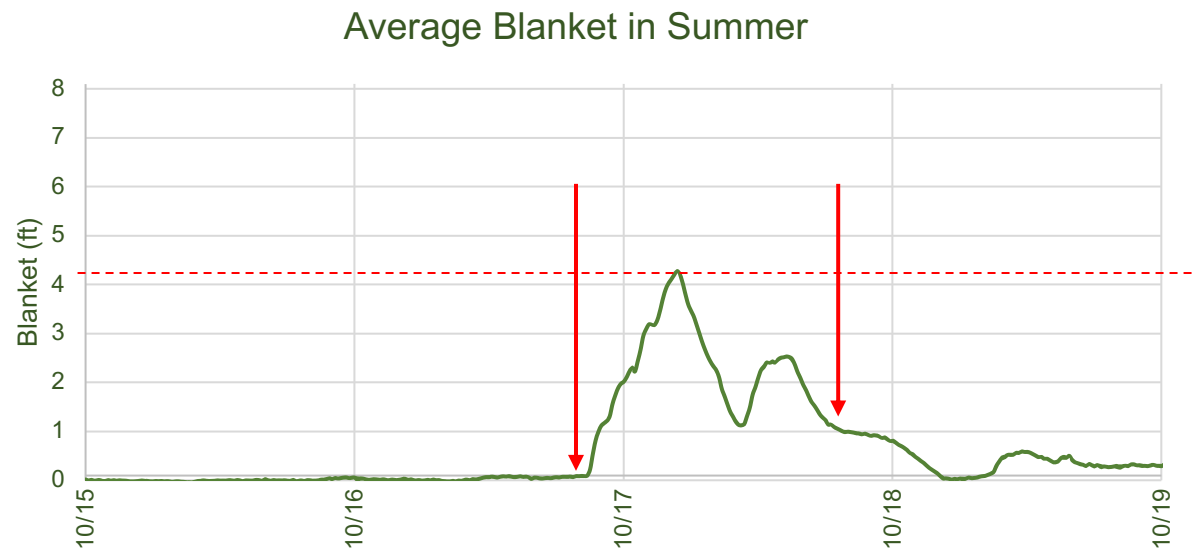
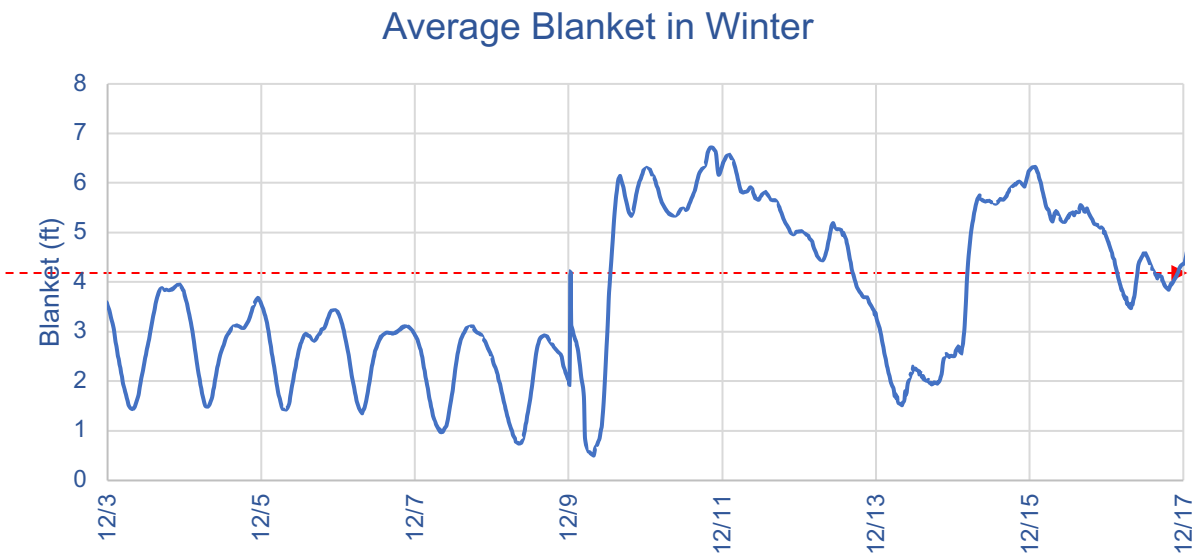


Conclusions

- Controlling SRT in the range of 8-9 days in winter resulted in a significant reduction in secondary clarifiers blanket while did not adversely affect the nitrification.

- MicroC® 2000 addition in anaerobic zone proved to be beneficial on long weekends and holidays when the influent BOD/TP ratio is low. As a result, an increase in PAO population was observed.

- Microscopic and molecular analysis of the sludge are powerful tools to predict possible process upsets which can be used to troubleshoot the process in advance.


UPPER
BLACKSTONE
CLEAN WATER

Blanket: Summer vs Winter