

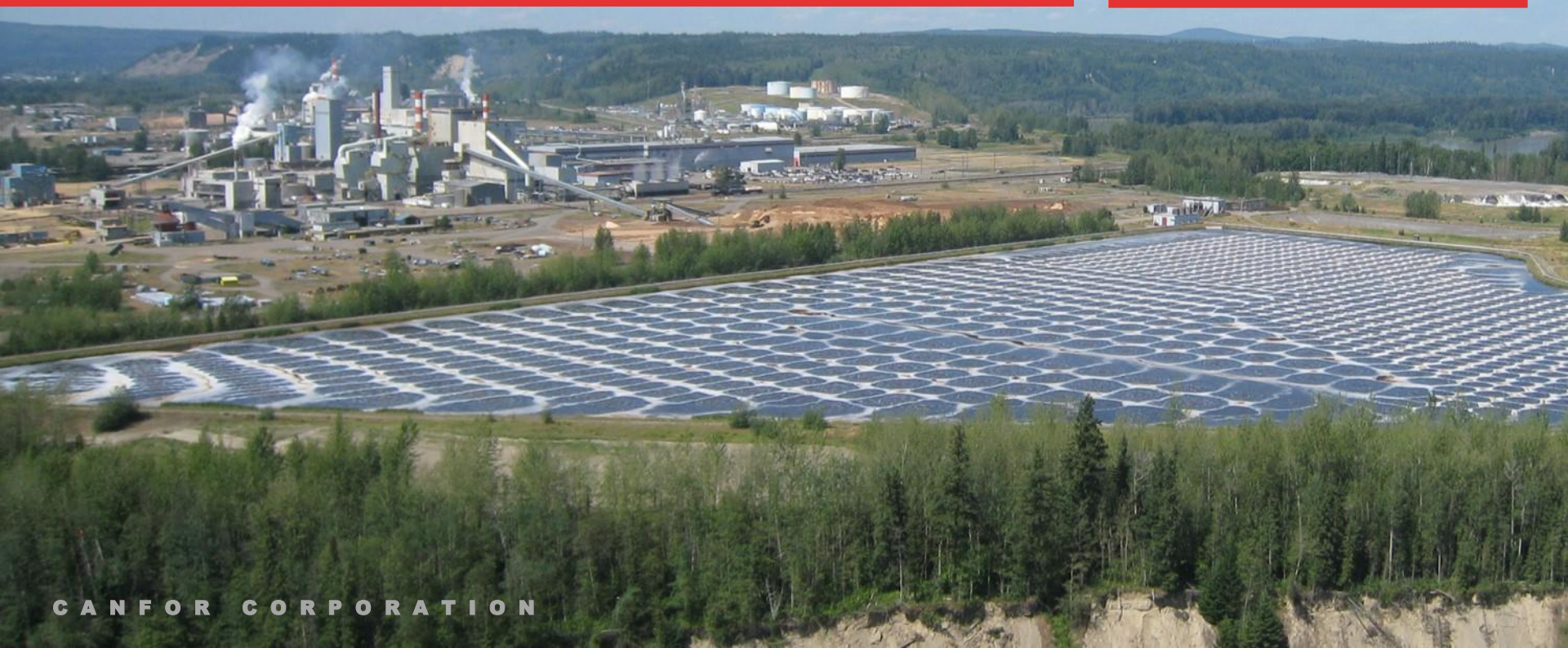
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MANTECH

**Western Canadian Pulp Mill Employs Fast
COD analyzer for Improved Effluent
Process Control and Savings**



- Reliance on 5 day test (BOD₅) for effluent quality control
- BOD₅ is a permitted effluent quality parameter but hard to predict
- Nutrient application and aeration is typically either “set & forget” or managed reactively
- Direction of effluent flows in upset conditions needs quick data

What Would Really Help?



- NEAR-REAL TIME BOD₅ RESULTS!
 - Would give warning of severity of process upsets and data could be used to direct flows
 - Would give near instant estimate of effluent quality across the treatment system
 - Would allow for day-to-day nutrient application or aeration changes.
- Need to find a strong correlation between BOD₅ and other effluent parameters.
 - Chemical Oxygen Demand typically correlates well.

Chemical Oxygen Demand (COD)

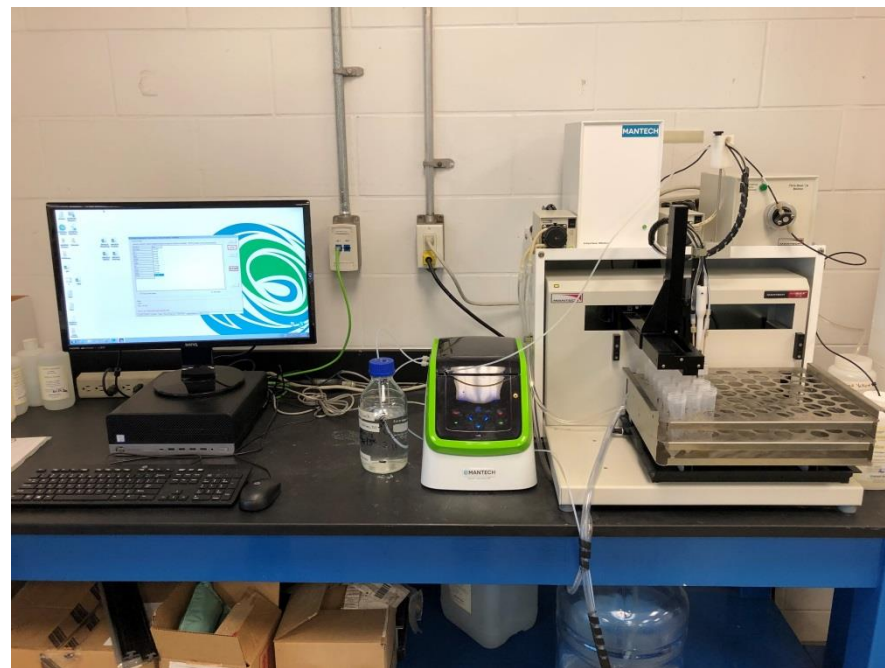
- Traditionally uses mercury dichromate vials
 - High health/environmental hazard
 - 3-4 hour turnaround time
 - Batch size limited by heat block capacity
 - Not efficient when managing upset effluent conditions across an entire ETS



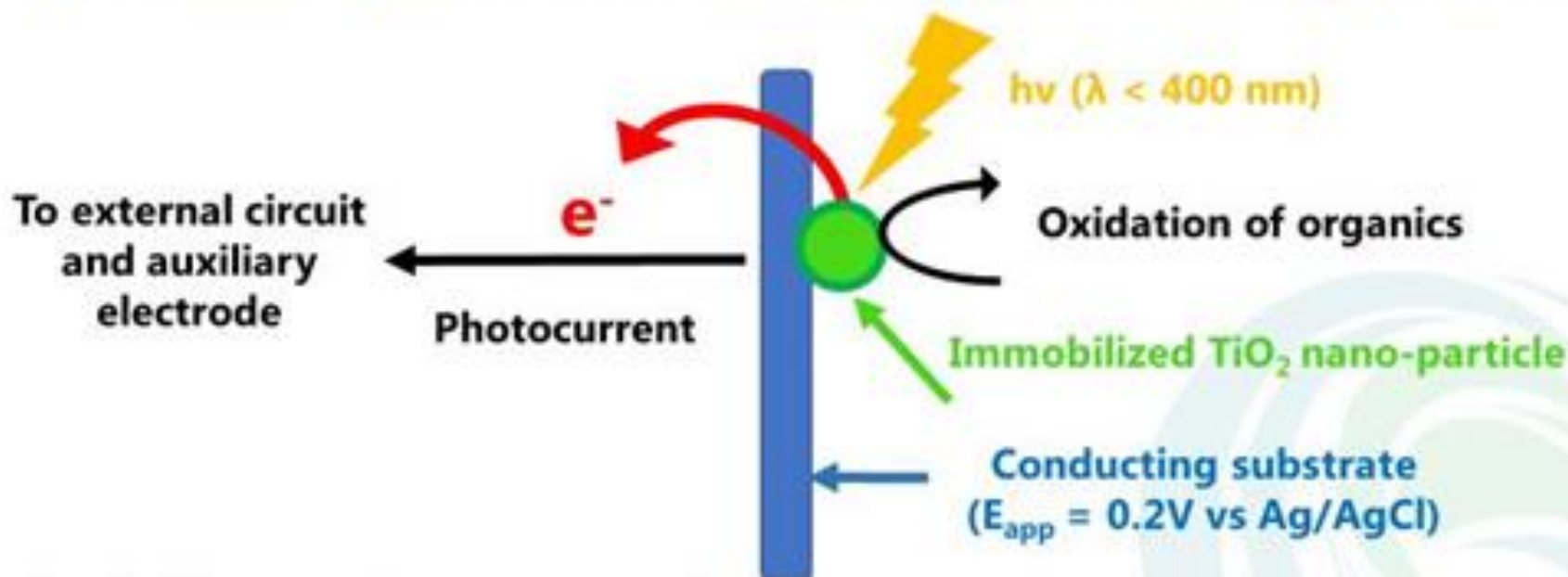
Photoelectric COD (PeCOD)



- New green COD technology offered by MANTeCH
 - Uses a photoelectric effect across a Titanium dioxide catalyst to create powerful oxidation of soluble chemicals.
 - Reagents are soluble, environmentally benign salt solutions.
 - Minimum health risk.
 - Results in 15 min/sample.
 - Measures soluble COD only.
- Purchased in early 2017.



| PeCOD[®] | A Nanotechnology Based Approach



Roughly 2 times the oxidizing power vs. dichromate

- i.e. Benzene, 1.8 by COD_{Cr} and 2.6 by PeCOD[®]



- Mantech had worked with FPInnovation to test correlations with Dichromate COD in Pulp Mill Effluent

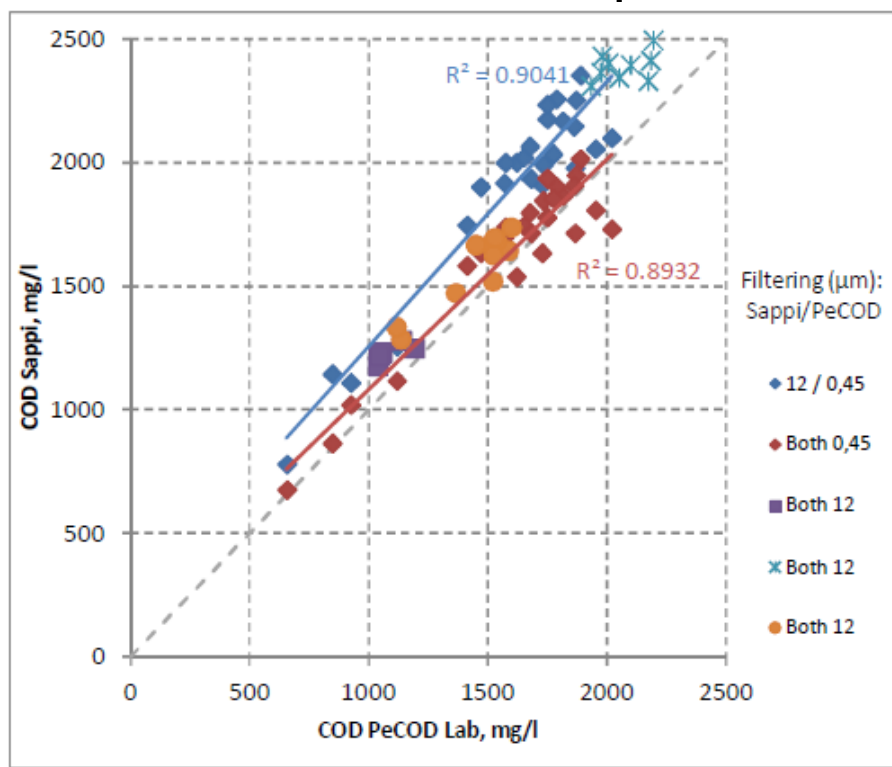


Figure 32. COD results measured with dichromate and peCOD technologies. Samples were filtered either with 12 μm or 0.45 μm filters before the analysis.

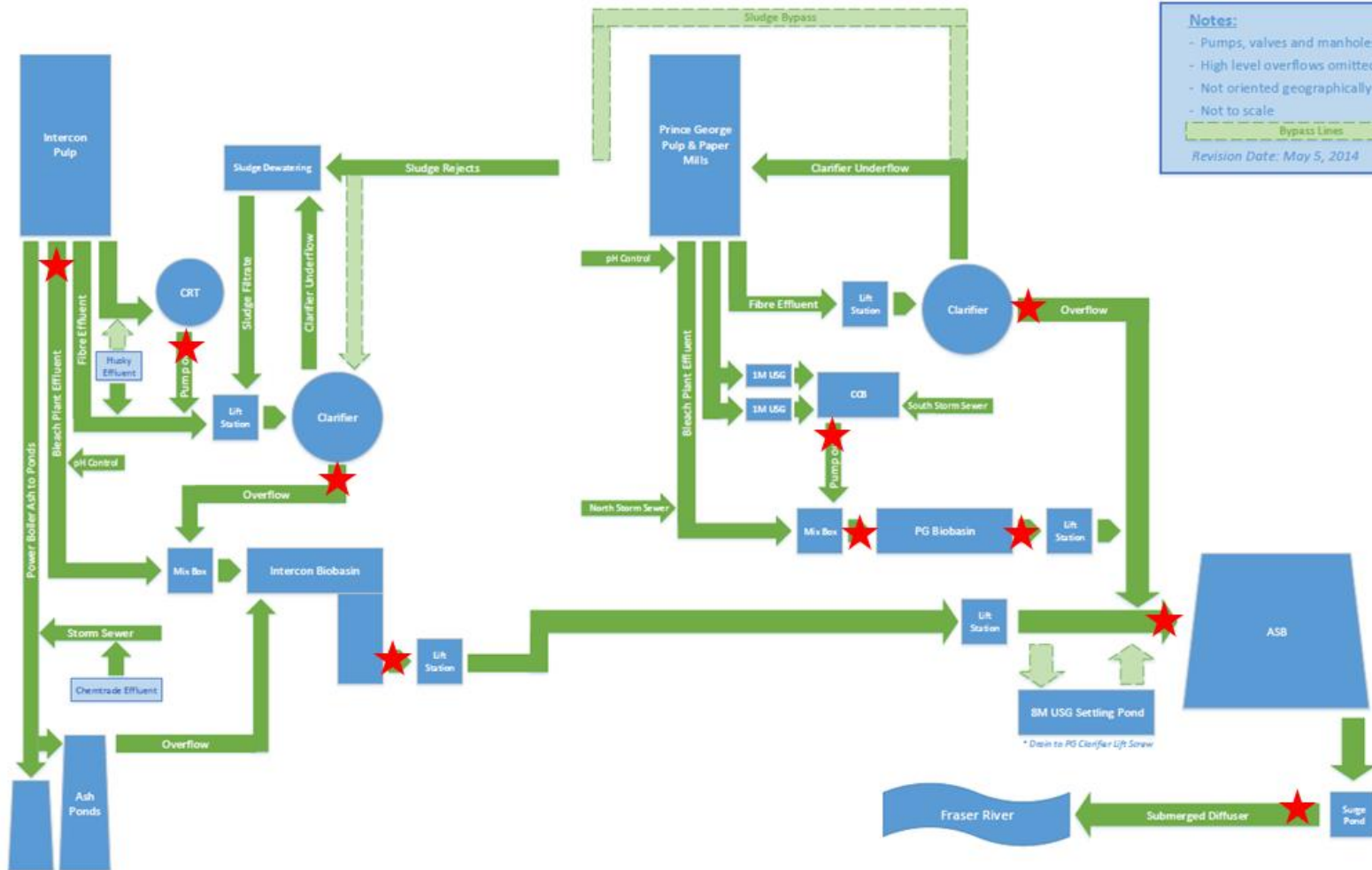
- Little previous testing for BOD:PeCOD correlations in Pulp Mill effluent
- Because PeCOD is a measure of Soluble COD, there should be a good correlation with BOD
- Selected sample locations across the spectrum of the ETS
- Samples were tested twice a week for both PeCOD and BOD



The PGI Effluent Treatment System



Intercon and PG Pulp Effluent Flow Chart



Notes:

- Pumps, valves and manholes omitted
- High level overflows omitted
- Not oriented geographically
- Not to scale

By-pass Lines

Revision Date: May 5, 2014

PeCOD Correlates With BOD₅



- *R values $X > 0.8$*
 - *CRT, Intercon Clarifier Overflow, PG Biobasin Inlet, PG BWW*

- *R values $0.6 < X < 0.8$*
 - *CCB, Intercon Bleach Plant Effluent, PG Clarifier Overflow, ASB Inlet*

- *R Values $X < 0.6$*
 - *Intercon Biobasin Midpoint and Outlet, PG Biobasin Outlet, River Outfall*

- *“In all instances the PeCOD slopes for the secondary treated effluents were greater than the slopes for the corresponding primary treated effluents. This could be due to the fact that the treated effluents contain higher levels of recalcitrant COD which the PeCOD measures more effectively than the dichromate method.” **FPInnovations Report (2016)***
 - *Could explain correlations weakening further through the effluent system.*

Challenges with PeCOD System



- Ran well initially.

- Mid 2017 – Results and strong correlations indicated imminent BOD₅ permit failure.
 - While BOD₅ had climbed significantly, it did not reach levels close to those predicted.
 - Result of a failed electrode block.

- March 2019 – Instrument started producing consistent errors pertaining to the auxiliary electrode in the electrode block.
 - Troubleshooting indicated the block failed again.
 - Working with Mantech to determine root cause.
 - Effluent chemistry?



- Monitoring of Effluent System inlet BOD in near-real time.
 - One sample a day (at each location) under normal conditions
 - Shutdowns/upset conditions can run multiple samples per shift
- Can test u-drains as needed, results in 15 min
- Contaminated effluents can be directed to storage basins/tanks and an appropriate pump-back rate set based on data.
- Potential for pumping back liquors into the mill (Weak Black System) - has been used for liquor/soap spills

PeCOD for Aeration control



- ASB at PG contains the full flows from both PG and Intercon mills
 - Subsurface aeration grid runs off of 2 or 3 800HP blowers
 - 2 blowers run all the time
 - 3rd blower turned on if high loading is expected
- Prior to PeCOD, decisions were based on BOD results, Resin Acid loading and knowledge of operating conditions.
- After PeCOD, decisions still take multiple factors into account but now include daily data on inlet loading
- With a cost to run the 3rd blower at about \$660 per day, or \$240,000 per year, important to make the right decisions

PeCOD for Nutrient Management

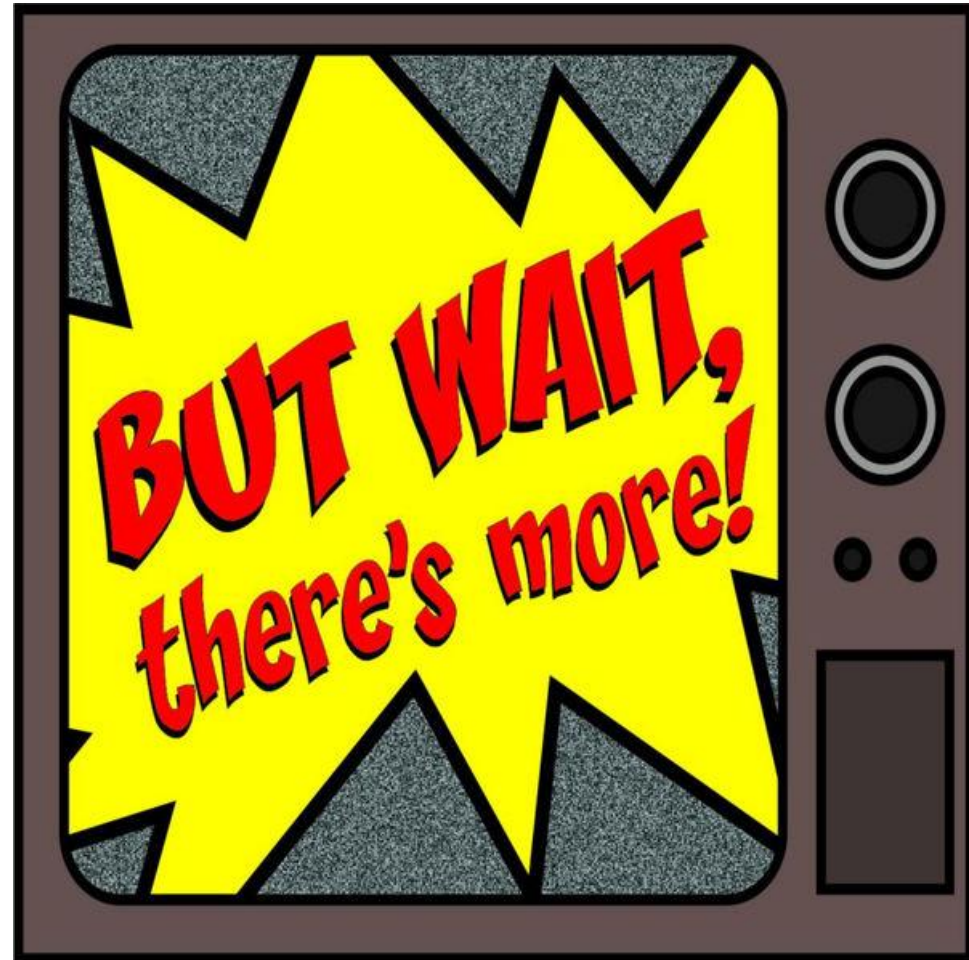


- PGPP and Intercon Bio Basin Nutrient Study
 - Initial results indicate large over application of nutrient in both basins.
 - Using PeCOD to predict appropriate BOD:N:P Ratio.
 - Adjusting application regularly (Targeting daily Mon-Thurs)
 - Reduced nutrient application to PGPP Bio Basin by ~40%.
 - Potential cost savings of ~\$350,000/year over 2018 after full implementation of nutrient management at PG Pulp and Intercon

Other Potential PeCOD Correlations



- Methanol in condensates
- Soda losses in effluent
- Other process stream management options
 - Washing
 - Bleaching



Acknowledgements



- Matthew Jensen – Environmental Specialist, Canfor Pulp
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Questions

