IRVING PAPER

WASTEWATER TREATMENT UPGRADE

Rachel Kierstead, Emily Morgan, Matthew Phillips, Jacob Wall

PROJECT SUMMARY

OBJECTIVE: To modify the existing wastewater treatment system at Irving Paper Limited (IPL) to reduce biochemical oxygen demand (BOD) and total suspended solids (TSS) in order to meet the proposed 2021 Pulp & Paper Effluent (Wastewater) Regulations (PPER)

Irving Paper is located in Saint John, New Brunswick

IPL uses thermo-mechanical pulp and Kaolin clay to produce 1,150 t/day of high-quality printing papers and newsprint

Must process 35,000 m^3/day of wastewater

The wastewater entering the treatment system has higher levels of BOD in the winter months

New PPER expected to come into effect in 2021

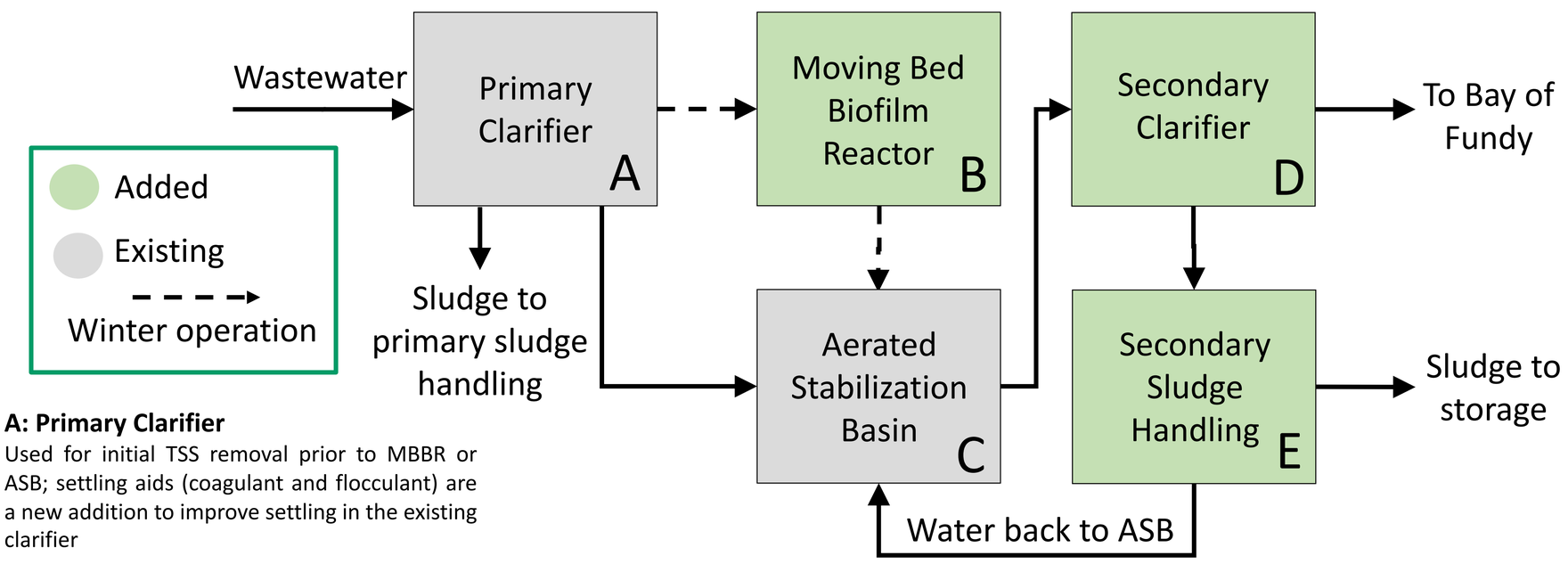
Maximum Allowable Limits		
Factor	TSS (t/day)	BOD (t/day)
PPER (1992)	12.7	8.5
PPER (2021)	1.7	0.8
Reduction	87%	90%

The current system uses a primary clarifier to remove TSS and an aerated stabilization basin to remove soluble BOD.

To meet the 2021 PPER, the chosen design uses a moving bed biofilm reactor seasonally to accommodate the higher BOD levels in the winter. A secondary clarifier and sludge handling system are used to remove TSS and dewater the sludge, year-round.

This process has an added annual operating cost of $1.45 M/year and a total capital investment of $12.35 M. The treatment system is not profitable by itself, but it will allow IPL to continue operating.

CHOSEN DESIGN



A: Primary Clarifier
Used for initial TSS removal prior to MBBR or ASB; settling aids (coagulant and flocculant) are a new addition to improve settling in the existing clarifier

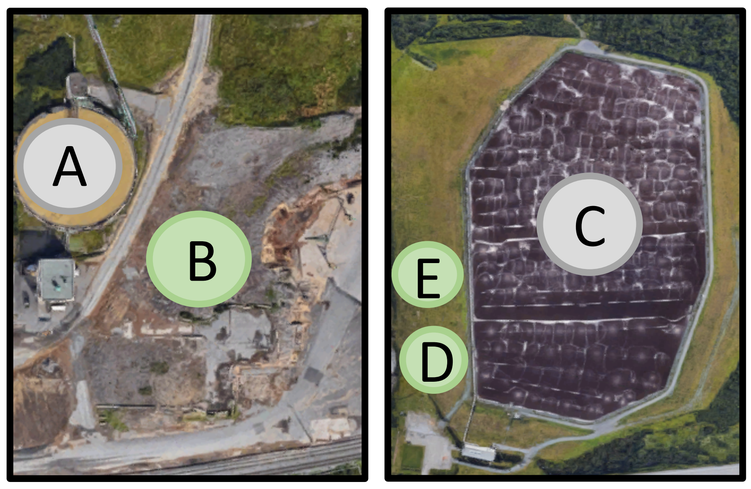
B: Moving Bed Biofilm Reactor (MBBR)
Removes soluble BOD during the winter months

C: Aerated Stabilization Basin (ASB)
Large pond used for soluble BOD removal; TSS is gained across the ASB

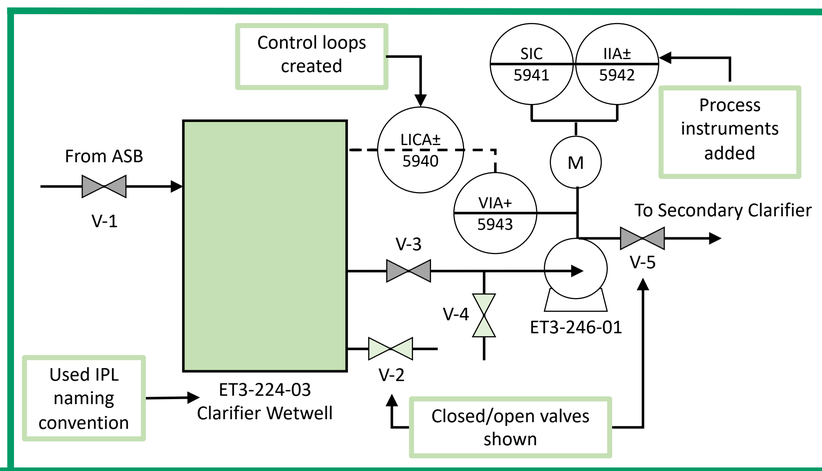
D: Secondary Clarifier
Removes TSS to prepare effluent for discharge to the Bay of Fundy; settling aids (coagulant are flocculant) are used to improve settling

E: Secondary Sludge Handling
Dewaters the sludge that is removed by the secondary clarifier

Design Layout

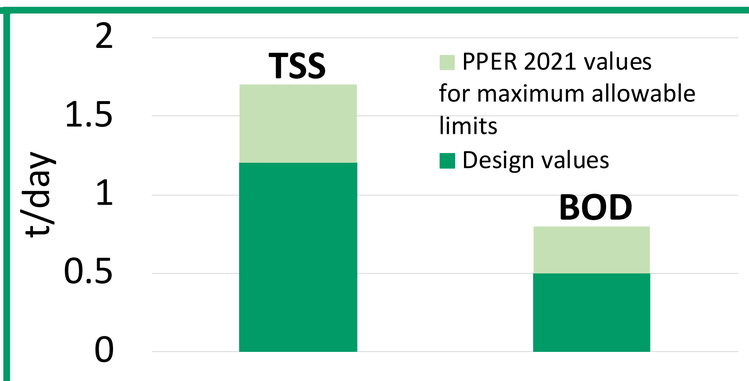


The MBBR is located near the existing primary clarifier; the secondary clarifier and secondary sludge handling system are located near the existing ASB



From this design, a detailed piping & instrumentation diagram (P&ID) was created to show the system's control scheme. An excerpt from the P&ID is shown to the left.

P&ID Features
- ✓ 100+ instruments
- ✓ 150+ valves
- ✓ 30+ pieces of new equipment
- ✓ Hazard and Operability Study (HAZOP) completed to analyze and mitigate risks for safety and the environment



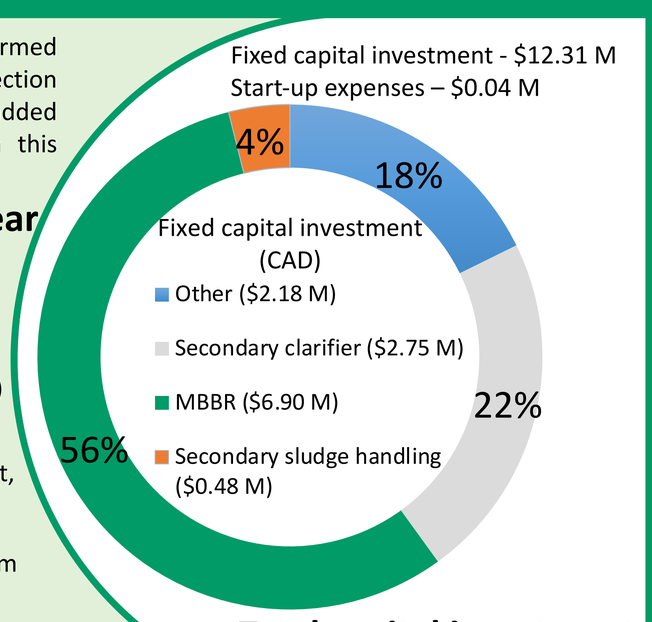
With this design, TSS falls 27% below the PPER 2021 values and BOD falls 36% below (in the worst-case scenario)

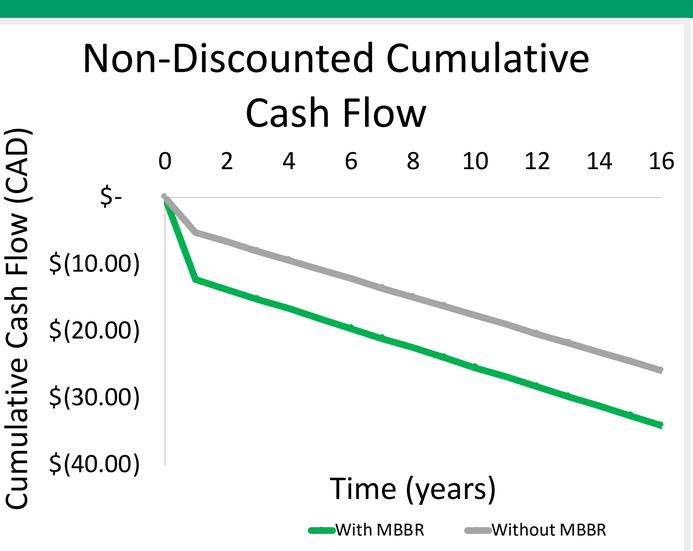
ECONOMICS

A Class V economic analysis was performed with an uncertainty of 20%. This section provides an estimate of the capital and added annual operating costs associated with this design.

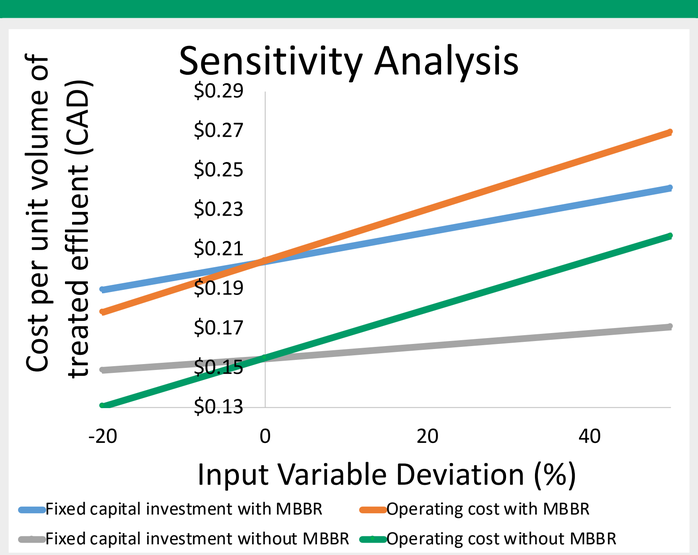
Operating costs: $1.45 M/year

- Maintenance and repairs of equipment ($0.25 M)
- 4 additional employees ($0.40 M)
- Raw materials - coagulant, flocculant, caustic, nutrient ($0.06 M)
- Trucking 18,000 m^3 of sludge from secondary clarifier ($0.32 M)
- 4.9 GWh of power ($0.42 M)





This project does not generate any profit over its lifetime. However, if IPL cannot meet the upcoming PPER, they will not be able to continue operating.



The project is more sensitive to changes in the operating costs than the fixed capital investment. Without the MBBR, the project becomes significantly more favorable economically.

CONCLUSIONS

Performance
The design will meet and be lower than 2021 PPER limits by more than 25%

Seasonal Operation
MBBR is required during the months when the ASB is less efficient

RECOMMENDATIONS

Reduce Process Variability
IPL is encouraged to investigate seasonal BOD variability in process which could eliminate the need for the MBBR

Detailed Design
If the seasonal variability cannot be reduced, it is recommended to proceed with a detailed design phase

Further Testing
More settling tests should be performed to better estimate the increased TSS removal for both clarifiers

Engineering Design Symposium

Acknowledgments

Ms. Gabriella Murphy, P.Eng, Mr. Nick Grandy, EIT; Dr. Zhongguo Dai, P.Eng; Dr. Yang Qu; Dr. Guida Bendrich, P.Eng; Dr. Michel Couturier, P.Eng; Ms. Sylvia Demerson Locke; Ms. Karen Annett

EST. 1785 UNIVERSITY OF NEW BRUNSWICK