Irving Paper

Improved Effluent Treatment System

IRVING PAPER LIMITED

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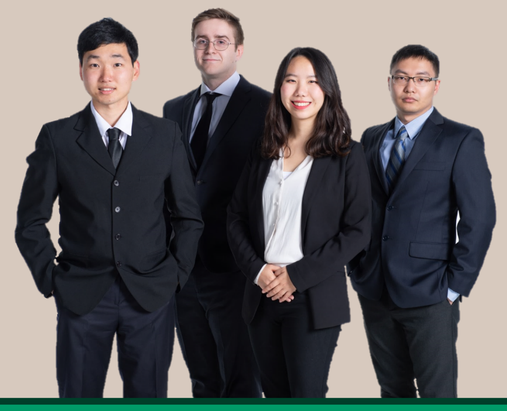
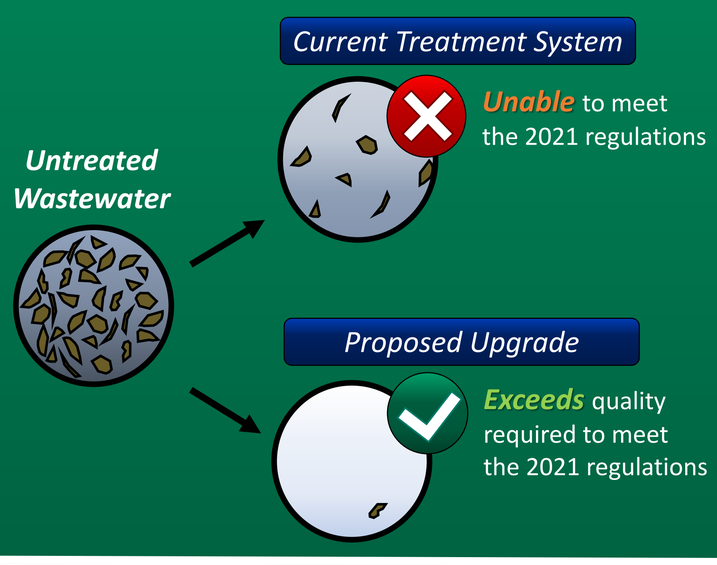


Project Summary

Objective

The objective of this project is to ***upgrade the wastewater treatment system at the Irving Paper mill*** such that it exceeds newly proposed effluent regulations by Environment Canada.

Problem Definition



Irving Paper Mill

The ***Irving Paper mill*** is in the city of Saint John, New Brunswick, where a Thermo-mechanical Pulping process is used to produce supercalendered paper and newsprint. The yearly production of the facility's two paper machines amounts to 420,000 tonnes.

Regulation Changes

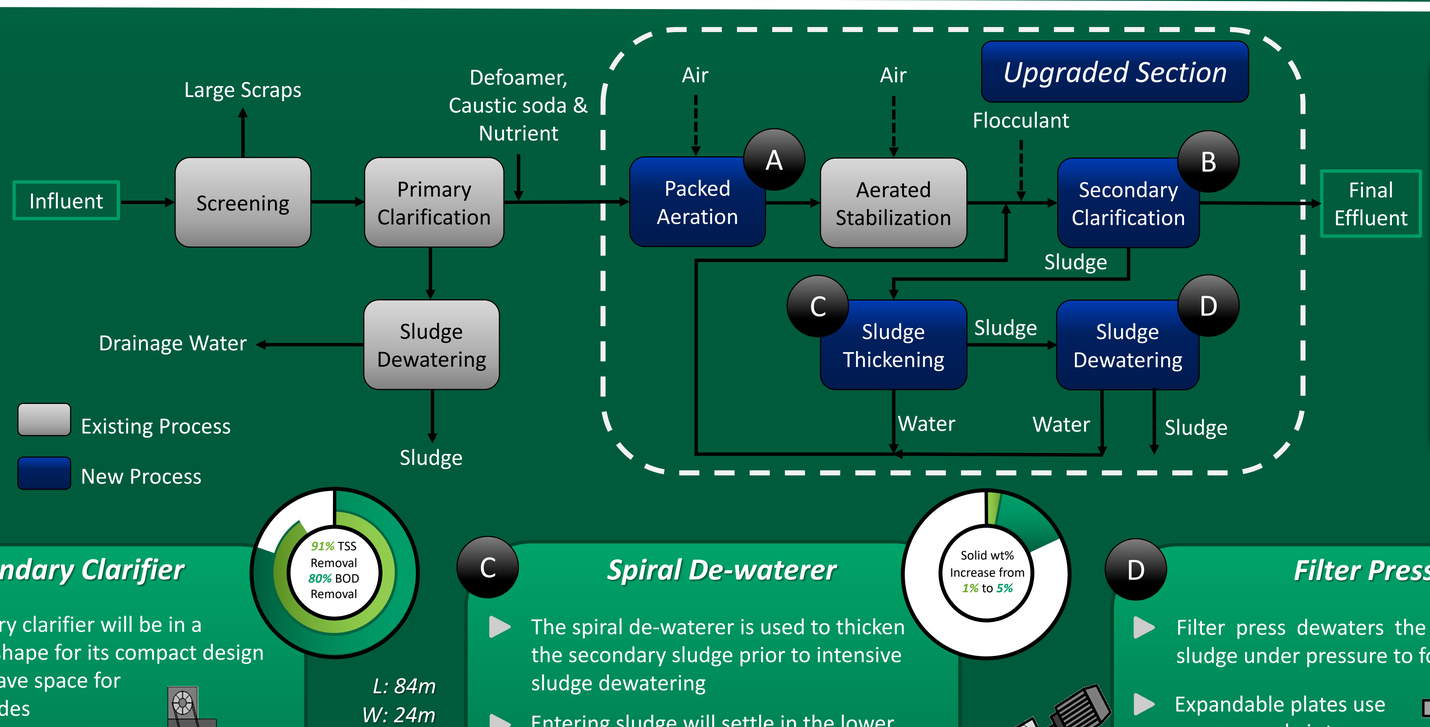
In 2021, the ***Pulp and Paper Effluent Regulations are being modernized*** from their 1992 implementation. The aquatic discharge limits for various pollutants have been significantly reduced. Irving Paper Limited's (IPL) main concern is reducing the discharge of ***Total Suspended Solids*** (TSS) and ***Biochemical Oxygen Demand*** (BOD), nevertheless meeting the limits of other constituents.

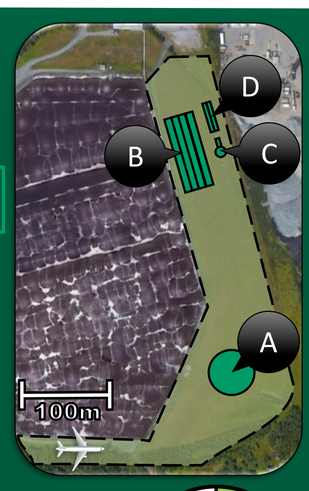
Estimated Costs

Total Capital Investment: ***$14.6M***
Annual Operating Costs: ***$3.0M***

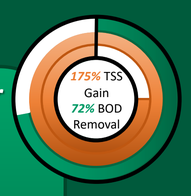
Proposed Design

- ***Packed Aeration*** is the process of adding air into wastewater inside a biofilm reactor to allow aerobic bio-degradation of the pollutants.
- ***Secondary Clarification*** is used to settle the generated biomass from the treated effluent stream prior to discharge.
- ***Sludge Thickening*** is a process that decreases the sludge volume to reduce the footprint and power requirements for sludge dewatering.
- ***Sludge Dewatering*** further separates the solid and liquid components so that it is easier and more cost-effective to handle the sludge for final disposal.

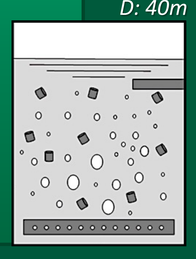




A — Moving Bed Biofilm Reactor

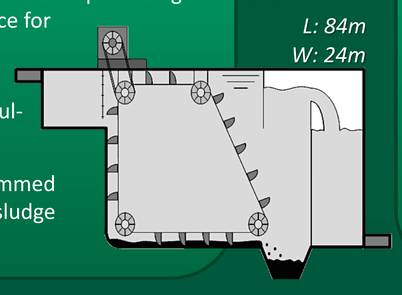


- The Moving Bed Biofilm Reactor (MBBR) is filled with polyethylene carrier media
- The carrier media increases the internal surface for optimal contact of water, air, and bacteria
- The additional contact will allow high amount of soluble BOD removal in a compact space



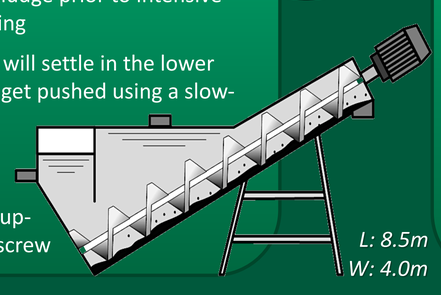
B — Secondary Clarifier

- The secondary clarifier will be in a rectangular shape for its compact design which will leave space for future upgrades
- Aluminum Sulfate will be used to flocculate the small solids
- Settled sludge is skimmed by the hopper to sludge handling

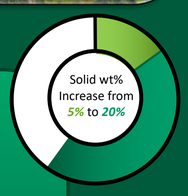


C — Spiral De-waterer

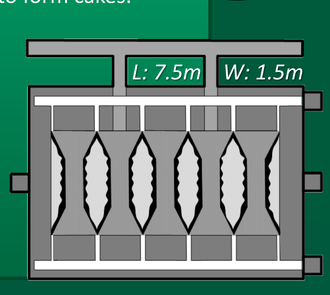
- The spiral de-waterer is used to thicken the secondary sludge prior to intensive sludge dewatering
- Entering sludge will settle in the lower pool area, then get pushed using a slow-moving screw
- Slurry will be thickened by drainage in the upper part of the screw



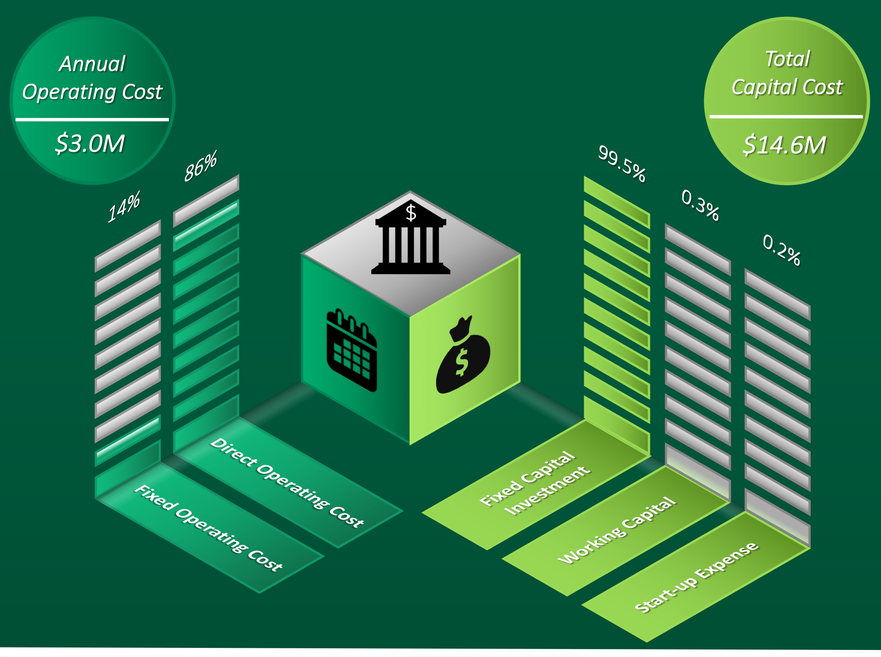
D — Filter Press



- Filter press dewaters the thickened sludge under pressure to form cakes.
- Expandable plates use compressed air to further remove water
- The sludge cakes will be trucked to farms to be used as a source of nutrients

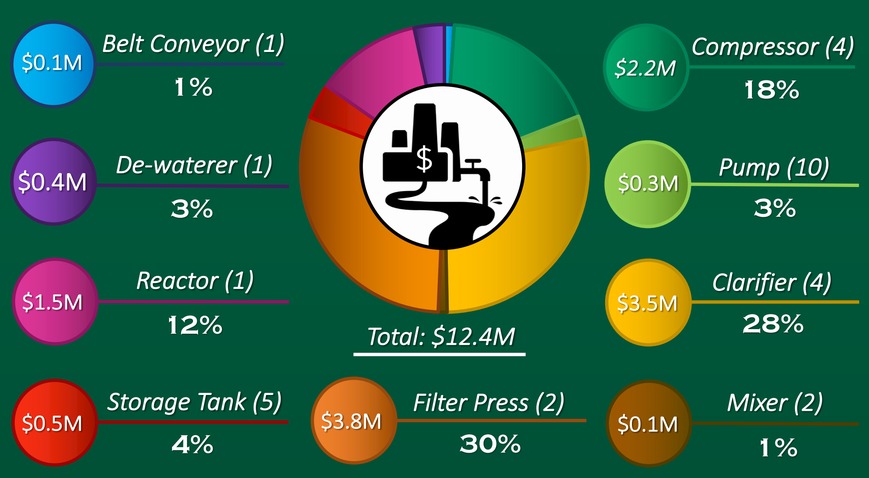


Economic Summary

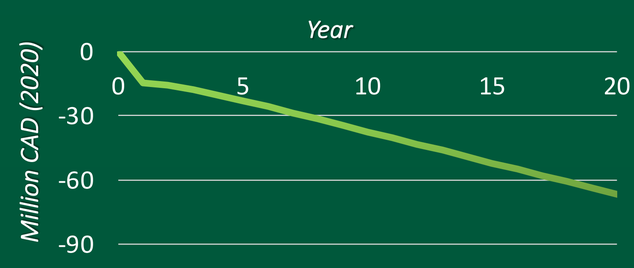


Bare Module Equipment Cost

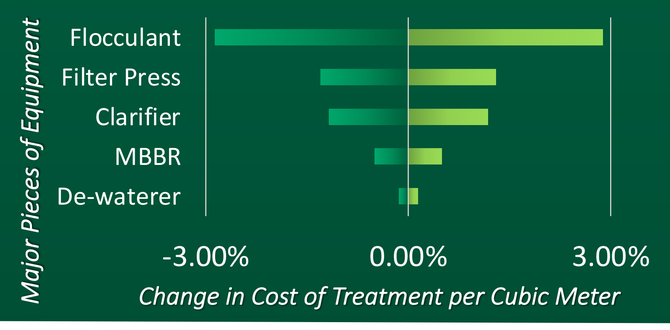
This feasibility study was completed as a ***Class 5 estimate.*** This means the accuracy of the costs within this analysis can vary between ***-20% to -50%, and +30% to +100%.***



Net Cash Flow



Sensitivity Analysis



Key Takeaways

- Exceeds required BOD and TSS reduction
- Integrative to the current treatment system
- Estimated Capital Investment: $14.6M
- Estimated Annual Operating Cost: $3.0M

Conclusions

The upgrade produces effluent that will beat the newly proposed discharge limits. Process technologies were chosen using decision matrices, where 20 technologies were investigated. Using this selection process, the MBBR was added to supplement the removal of the high-loading soluble BOD. The generation of TSS through biological treatment required the addition of a secondary clarifier, and sludge dewatering system. ***The process has minimized environmental impact by increasing removal of total BOD and TSS from 90% and 60% to 98% and 95% respectively.*** This upgrade enables Irving Paper mill to continue day-to-day operations while minimizing environmental loading by producing effluent that meets the proposed regulation for TSS discharge, while being 20% lower for BOD, all in the worst case.

Recommendations

- It is recommended that IPL move forward to a detailed design phase. This process can ***exceed the newly proposed Pulp and Paper Effluent Regulations*** and has ***feasible avenues for improvement and optimization.***
- Prepare an excess of carrier media as this design uses a MBBR carrier fill of 50% total volume, where it may be filled to 70%, ***providing more BOD removal for future stringent regulations.***
- Lab testing for the optimal addition of flocculant prior to the clarification system allows for ***increased solids removal, providing saving to solids handling fees.***

EST. 1785 UNB UNIVERSITY OF NEW BRUNSWICK

Engineering Design Symposium

Acknowledgements

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