

Wastewater Treatment Concept Design

Front End Engineering (FEED) – Integrated Bio-resource
Recovery Facility – Stage 1

Project Code
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Project Description

Bindaree Food Group is one of Australia's leading red meat processing companies, employing more than 1,000 staff. The Inverell Processing Facility, located in New South Wales, is operational 260 days per year and operates 24 hours during weekdays. Currently, the average heads of cattle processed per year are equivalent to 166,816. The expansion planned for 10 years aims to process up to 399,984 head of cattle, more than double the current production.

Bindaree Food Group (BFG) Inverell facility is looking to adopt an innovative way to their wastewater management. Aiming to improve the removal of nitrogen and phosphorus in the effluent to maintain an effective nutrient balance on irrigation of crops and use recycled water for further applications. In recent years, environmental regulation has become increasingly stricter, regarding the amount of water that can be disposed of via irrigation and the nutrients loading (nitrogen and phosphorus). Besides, using recycled water for specific irrigation applications limits recycled water use.

Unlocking the potential for recycling water for further applications represents the opportunity for BFG to increase production along with abiding by environmental regulations. Of particular interest, the raw water used in the BFG process is currently supplied by the local council. The existing water supply is limited by the current water supply network infrastructure to a flow rate of 26.6 L/s, which represents a total of 840 ML of water per year.

It is known that Bindaree's current wastewater treatment plant (WWTP) is designed for the removal of organic matter, but not nutrients. The innovative front-end engineering design (FEED) for an Integrated Bio-Resource Recovery Facility tailored specifically to BFG's processing plant considers the removal of nutrients (nitrogen and phosphorus) and other compounds from wastewater, ensuring compliance with permissible limits for irrigation and further applications such as cattle wash (other than final wash). Following a series of technical assessments, including sampling campaigns and Biowin modelling, the conclusion was that to achieve compliance with the regulation and water quality requirements for further applications other than irrigation, a new WWTP is required.

Bindaree's Integrated Bioresource Recovery Facility Stage 1 – WWTP encompasses the BFG effluent assessment, the new WWTP concept design (including layouts and process flow diagrams) and the detailed system implementation cost estimate with a list of preferred suppliers. In this concept, the treated water produced in the wastewater treatment plant aimed to remove oil & grease, solids and organic matter, nitrogen and phosphorus. The concept design technology selection was based on the requested applications for recycled water such as irrigation and cattle wash (other than the final wash). Thus, the wastewater treatment plant does not include tertiary treatment equipment apart from chlorination.

The total capital expenditure (CAPEX) based on a +/- 30% cost estimate for the first two modules (to cater for current treatment needs) of the proposed WWTP is \$6.6M. The further investment regarding the third module of the WWTP (to allow future expansion on production) is planned to occur in the long term. A modular treatment design was proposed due to process flexibility and equipment redundancy.

Project Content

This project aims to develop a front-end engineering design of a wastewater treatment plant. The concept to be used in the design considers engineered biological reactors for adequate management of wastewater originated from the abattoir processing plant.

This design is for a new optimised and modular wastewater treatment plant with medium level of automation, due to less stringent monitoring requirements. It was focused on attending to current wastewater disposal issues faced by the facility and expanding its application. Design upgrades of the existing infrastructure were not considered. The current infrastructure can remain operating until the full installation of the new WWTP. A pipeline connection can be placed to diverge the wastewater to the new WWTP. After that, the existing infrastructure can be decommissioned.

The new plant design is considering aspects such as nutrients (N, P) and other compounds removal from wastewater, with the possibility of irrigation and cattle wash (other the final wash). The result of this project, including the cost estimates for the plants, will then be used by Bindaree Food Group for the decision-making process for further stages of the plant implementation. These results will also support the Environmental Licensing application process.

The overarching objective of this project is to prepare a front-end engineering design for an integrated wastewater plant for better wastewater management in the facility. The result of this project can be used for the licensing application, decision making process, procurement related to this and further stages of the system implementation.

The objectives to be achieved include:

- ◆ Waste and wastewater audit and characterisation (quantities and quality).
- ◆ Development of a design of an integrated bio-resource wastewater recovery facility for the Bindaree Food Group (BFG) processing plant in Inverell, NSW.
- ◆ Preparation of an equipment list to be used in the procurement stages.
- ◆ Development of a cost estimate for the wastewater treatment plant implementation.

Project Outcome

Abattoir wastewater is a rich source of valuable nutrients, energy, and water. When well-managed, resource recovery can be achieved, along with robust environmental compliance. Implementing a state-of-the-art wastewater treatment facility at Bindaree Food Group Inverell production site will future proof the company's operation in terms of environmental compliance, aligned with the concepts of circular economy and resource recovery.

In this context, the concept design proposed for this project has taken into consideration the production of recycled water compliant with low exposure quality. The facility's wastewater stream is processed in a modular wastewater treatment plant, aiming for the removal of oil & grease, solids and organic matter, nitrogen and phosphorous. For the technology selection, specific applications of irrigation and cattle wash were considered to determine the recycled water quality requirements. Which is achieved through pre, primary, secondary, and tertiary water treatment stages.

To source information for the project, it was undertaken a site visit, desktop review of relevant documentation and communication via phone calls and emails with the BFG engineering team. The scope of the project comprises:

Wastewater Characterisation (liquid Stream): A sampling campaign of the BFG save-all stream, derived from the combined red and green streams, was required. The samples were sent to an accredited laboratory to select parameters to be analysed for the characterisation of the wastewater. The available data allowed the WWTP design calculations to achieve the treated wastewater quality required.

Concept Design: A series of process and hydraulics calculations were carried out in Microsoft Excel followed by BioWin modelling software. This resulted in a preliminary basis of design to be used for the equipment specification list. The BioWin model was used to validate the process design assumptions and process sensitivity. Its sensitivity analysis was carried out using a methodical step-by-step process. The initial BioWin inputs were based on the assumptions and outputs of the Excel process design calculations. One parameter was altered at a time, with the selection of the final chosen value being used as an input in the subsequent sensitivity analysis parameter, and so on. The resulting effluent quality was the output of both process calculations and Biowin modelling.

Cost Estimate: A meticulous methodology that encompassed issuing requests for quotations (RFQs) to selected suppliers to obtain the WWTP equipment cost. Cost estimation methods were employed to consider various factors such as contractors' preliminaries, project contingency and civil works. These were accurately assessed to into consideration the project's overall capital expenditure (CAPEX).

Benefit for Industry

- ◆ Further application for the Inverell recycled water.
- ◆ State-of-the-art wastewater treatment plant.
- ◆ Potential for valuable resources recovery (nitrogen and phosphorus as fertilisers).

- ◆ Potential for less carbon footprint (biogas production from the anaerobic digestion of the solid streams).
- ◆ Reduce dependence on an external supplier.

Useful resources

Not applicable.