SOUTH BURNETT INDUSTRIAL CIRCULAR ECONOMY PLANNING AND DESIGN

Prepared for South Burnett Regional Council

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Figure 1. 3D Perspectives of the proposed South Burnett Circular Economy Technology Site (Source. Better Cities Group)

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V1	01/04/26	BH	DB
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Anaerobic Digestion

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Summary

South Burnett is experiencing mounting landfill pressures driven by rising waste volumes, limited remaining airspace and high disposal costs across the region and neighbouring LGAs. This pressure threatens local service affordability and constrains future industrial and agricultural growth unless alternative waste management pathways are established.

Project analysis confirms that the South Burnett Circular Economy Industrial Precinct (SBCEIP) will deliver multiple strategic benefits. These include:

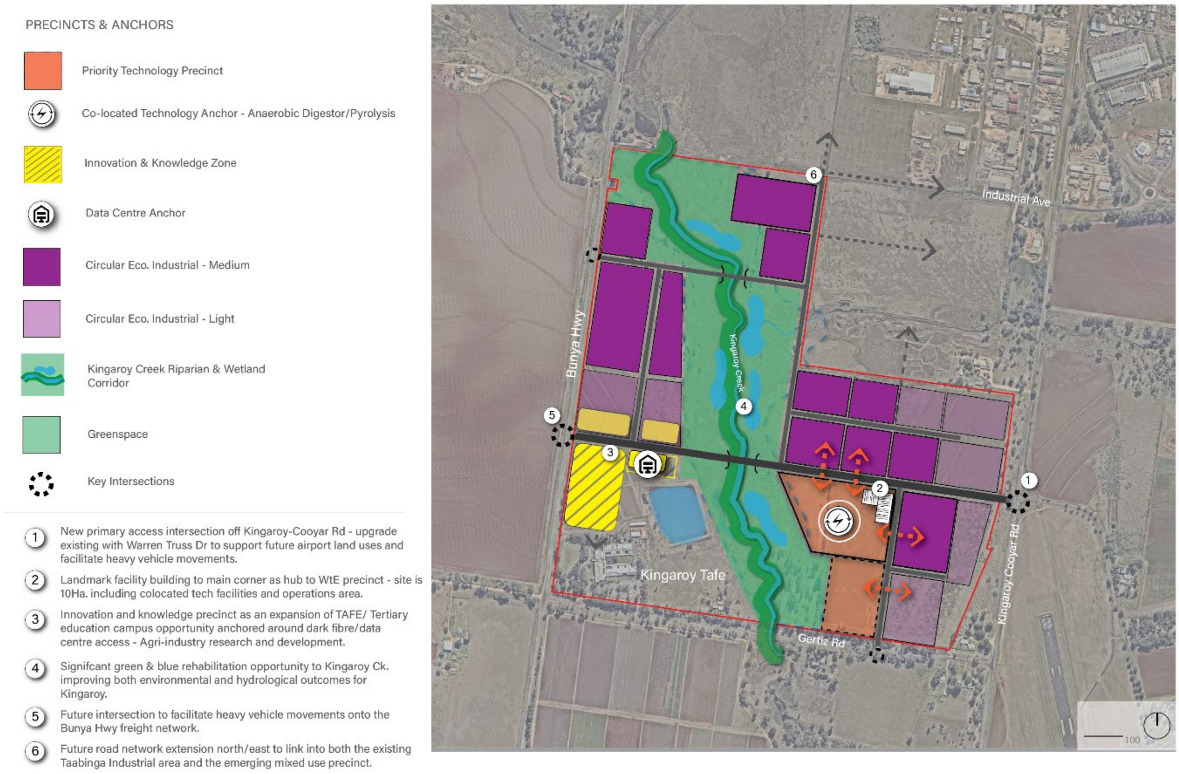
- reduced landfill volume;
- long-term industrial land supply;
- lower operating costs for co-located industrial operators through shared energy and services;
- a sovereign supply of BioCNG for transport;
- value-added outputs for agriculture (biochar, digestate, heat); and
- a replicable model for similar regional communities seeking circular economy solutions.

A comprehensive supply chain assessment confirms South Burnett has reliable feedstock for the proposed technologies. Priority inputs include livestock manures, food-processing residues, crop residues, green waste, biosolids and timber residues. Projected outputs comprise BioCNG (upgraded biogas), electricity and heat, liquid and solid digestate, biochar, bio-oil and syngas, plus environmental credits.

The report identifies two complementary anchor technologies - anaerobic digestion (AD) and pyrolysis (biochar production). AD is best suited to wet, nutrient-rich organics and produces biogas (upgradable to BioCNG), electricity, heat and nutrient-rich digestate. Pyrolysis converts dry, woody and carbon-rich residues into biochar, bio-oil and syngas, delivering soil health benefits and long-term carbon sequestration potential. Together these technologies enable on-site energy self-sufficiency and circular resource flows.

Regulatory and compliance requirements are clearly mapped for the precinct. The project aligns with Queensland planning and environmental frameworks and must satisfy Environmental Authority (ERA) classifications, planning scheme requirements, odour and emissions controls, water and stormwater management, and end-of-waste validation for outputs. The report sets out approval pathways, likely licence thresholds, and mitigation measures to manage environmental, biosecurity and amenity risks.

A coordinated masterplan positions the SBCEIP as a staged industrial hub that integrates processing anchors, serviced industrial lots, innovation and education precincts, and environmental buffers.



The precinct includes a 10-hectare South Burnett Circular Economy Technology Site (SBCETS) as the technology core and organises access, heavy vehicle circulation, feedstock receipt, product handling and environmental management to support safe, efficient operations.

The detailed site plan for the SBCETS clusters feedstock sheds, digesters, pyrolysis units, biochar handling, energy distribution and administrative facilities to maximise operational efficiency and industrial symbiosis. Heavy vehicle access, weighbridge, wash-down bays, bio-retention basins and buffer zones are incorporated to manage traffic, odour, stormwater and community amenity while enabling staged expansion and co-location benefits for tenants.

Whole-of-life cost modelling and financial analysis indicate the precinct is economically viable under multiple scenarios. Capital expenditure covers site works, buildings, roads, and servicing. Operating costs include feedstock handling, maintenance, compliance and workforce. Revenue streams from gate fees, BioCNG and energy sales, biochar and digestate markets, and environmental credits materially offset costs and deliver net economic benefits to Council and regional stakeholders.

The cost–benefit outcomes show strong regional returns including avoided landfill disposal costs, reduced waste transport, lower energy costs for precinct tenants, new local employment, improved soil productivity for agriculture and greenhouse gas reductions. Shared infrastructure and circular resource flows reduce operating costs for industrial operators and strengthen supply-chain resilience, creating compounding economic and environmental value over time.

Delivery is recommended as a staged, mixed public-private model to de-risk early investment and scale capacity with demand. Stage 1 prioritises pyrolysis to capture dry biomass value and establish biochar markets. Stage 2 phases AD development (2A partial capacity, 2B full capacity) to secure wet feedstocks and BioCNG production. Early actions include securing feedstock contracts, establishing off-take agreements, implementing contamination controls, progressing regulatory approvals and initiating community engagement.

By demonstrating a commercially viable precinct that co-locates AD and pyrolysis, the South Burnett project can set a new benchmark for rural industrial development. It would demonstrate to investors and industry how circular infrastructure can materially lower operating overheads through on-site renewable energy and fuel production (BioCNG, electricity and heat), reduce exposure to volatile fossil fuel markets, and convert a recurring cost (waste disposal) into predictable revenue streams.

The precinct's model of shared energy networks, centralised feedstock handling, and coordinated off-take agreements reduces entry barriers for smaller manufacturers and agri-processors by offering lower energy tariffs, access to low-cost fuel for fleets and machinery, and the option to avoid or reduce gate fees.

By packaging staged delivery (early pyrolysis to establish markets, followed by scaled AD) with clear infrastructure and land-use planning, the precinct becomes a replicable template for other rural regions showing how waste streams can underpin industrial land activation, generate local jobs, and strengthen supply-chain resilience while delivering measurable environmental benefits that increasingly matter to corporate buyers and government funders.

1.0 Introduction

South Burnett Regional Council is progressing the next phase of its Industrial Circular Economy Precinct initiative following completion of the SBRC Circular Economy Industrial Precincts Report (Business Case)[1]. Council's ambition is clear - to transition from a conceptually validated opportunity to a technically robust, investment-ready precinct plan that supports waste transformation, agricultural value-adding, and regional economic resilience. This study seeks to undertake the planning and design work required to advance the precinct from business case to concept design, regulatory analysis, and implementation readiness.

The Business Case confirmed that South Burnett and neighbouring LGAs face significant landfill pressures, high operational costs, and limited diversion pathways. As stated in the Business Case, "South Burnett Regional Council and neighbouring Councils have significant landfill challenges that could be alleviated through the development of an agricultural circular economy industrial precinct." This project responds directly to those challenges by enabling the co-location of complementary industries, valorisation of organic and construction waste streams, and deployment of technologies such as anaerobic digestion and biochar production.

Council's objective is to create a scalable, future-focused industrial ecosystem that supports the Queensland Government's Primary Industries Prosper 2050[2] goals, including AgTech adoption, innovation, and regional value-adding. The precinct is also intended to catalyse new employment pathways, strengthen supply chain resilience, and provide long-term industrial land certainty for the region.

This planning and design phase is therefore a critical step in transforming the strategic intent into a deliverable, staged, and investment-ready precinct model. The study builds on the Business Case findings, refines the preferred technology mix, assesses regulatory pathways, and provides a 2D master plan and 3D virtual model that can be used to attract private sector partners and secure government support.

[1] SBRC Circular Economy Industrial Precincts Report, Better Cities Group 2025
[2] Primary Industries Prosper 2050, Department of Primary Industries 2025

1.1 Scope

The scope of the South Burnett Industrial Circular Economy Planning and Design project builds directly on the Business Case recommendations. This study provides a coordinated package of technical, spatial, regulatory, and strategic outputs that will enable the precinct to progress toward implementation.

Concept Design and Master Planning

Preparation of:

- A 2D master plan illustrating land uses, infrastructure layouts, buffers, access arrangements, staging, and integration with surrounding land uses.
- A 3D virtual model of the precinct to support stakeholder engagement, investment attraction, and public communication.
- These outputs reflect the preferred technology mix (anaerobic digestion and biochar), industrial subdivision layout, and opportunities for education, AgTech, and value-adding industries.

Technology and Waste Stream Analysis

- Building on the Business Case, this study undertakes deeper analysis of:
  - Feedstock availability, quality, and logistics
  - Technology sizing, configuration, and co-location opportunities
  - Synergies between anaerobic digestion, biochar production, and other circular processes
  - Regional waste flows from South Burnett, North Burnett, Cherbourg, and Gympie

Regulatory Requirements and Risk Assessment

- Provision of a comprehensive regulatory assessment covering:
  - Planning scheme requirements
  - Environmental approvals (ERA thresholds, emissions, odour, noise, water)
  - Waste, energy, and biosecurity regulations
  - Infrastructure servicing requirements
  - Land tenure and subdivision considerations
  - The output outlines regulatory pathways, risks, mitigation strategies, and approval sequencing.

Regional Context and Cross-Council Benefits

- The study articulates how the precinct can serve as a regional waste solution, including:

  - Cross-boundary waste supply opportunities
  - Shared infrastructure benefits
  - Regional economic uplift
  - Opportunities for collaborative delivery models

Delivery and Investment Readiness

Advice on:

- Staging and implementation pathways
- Infrastructure servicing strategies
- Delivery models (public, private, PPP, hybrid)
- Investment attraction and industry targeting
- Integration with State Government land and partnerships

These elements ensure the precinct is positioned for funding, approvals, and market engagement.

2.0 Supply Chain

2.1 Feedstock Review of South Burnett Region

The feedstock review evaluates the suitability of waste streams for processing by assessing their potential for beneficial reuse, identifying waste as a resource. For the proposed precinct, the review has been undertaken with consideration of the two identified priority technologies being Pyrolysis and Anaerobic Digestion.

2.1.1 Pyrolysis

The pyrolysis process heats organic material without oxygen to break it down into biochar, gas and sometimes oil (depending on feedstock). For Biochar Pyrolysis, it is best suited to dry, woody, carbon-rich biomass such as green waste, agricultural residues, forestry waste and biosolids, reducing waste volumes and allowing energy recovery.

Feedstock

The South Burnett region predominantly consists of extensive agricultural activities, which provide a reasonable and consistent supply of feedstock suitable for a pyrolysis facility, particularly in the form of dry organic waste.

Additional contributions arise from various food processing facilities operating within the region. The area also supports significant forestry resources, including soft wood plantations, native forests, and active sawmilling operations, all of which generate substantial quantities of woody residues.

In addition, biosolids generated from surrounding wastewater treatment plants represent another viable input to the overall feedstock supply. Biomass mapping data for the South Burnett region is presented in Figure 2[3].

[3] Queensland biomass-mapping and data - South Burnett Region

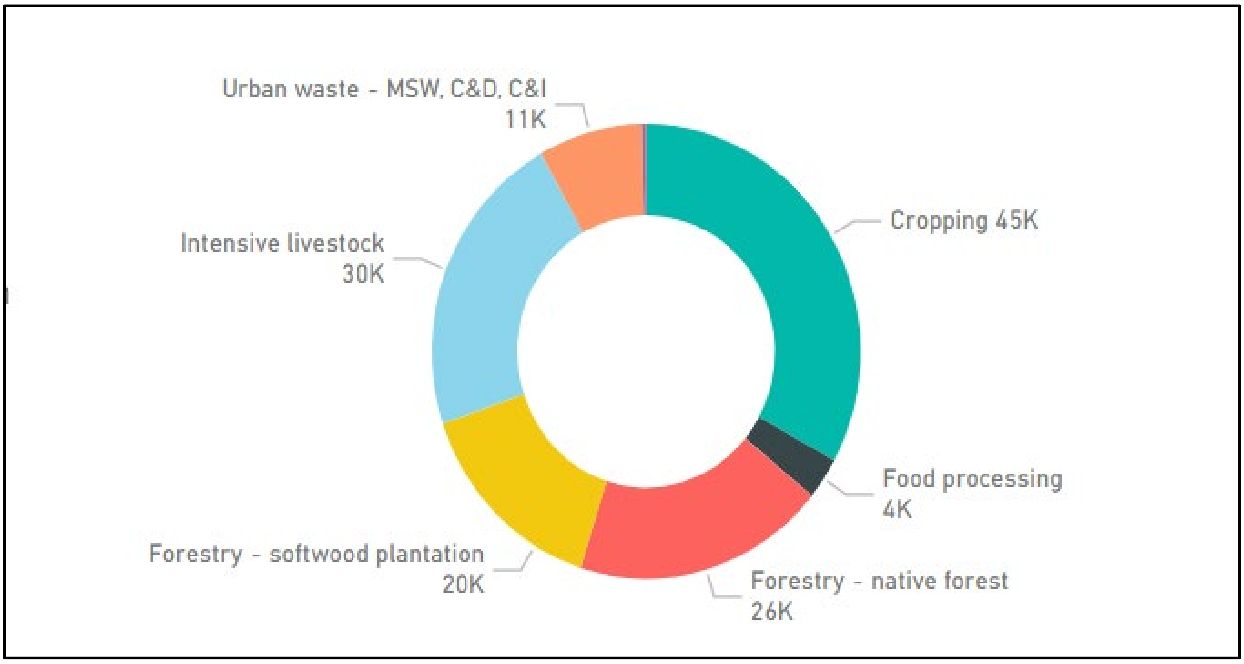


Figure 2. South Burnett Biomass (Source. Queensland biomass-mapping and data - South Burnett Region

The major feedstock material for Pyrolysis facility in South Burnett region are as follows:

- Agricultural residues
    - Crop residues
        - As a major peanut production hub, the region generates significant crop residues, including peanut shells, peanut hay, and vine residue.
        - Broadacre farming also produces crop residues such as stubble, straw and husks from grains such as sorghum, wheat, lucerne, maize, and barley and pulses such as soybeans, navy beans, and mungbeans.
- Horticultural and orchard residues
    - Macadamia shells and husks, vineyard residues, avocado and citrus pruning.

- Food/meat Processing Residues
    - The meat processing industry (pork and beef) produces dry by products suitable for pyrolysis feedstock.
    - Nut processing (peanuts and macadamias) generates waste materials.
    - Beverage manufacturing produces organic processing residues that can be utilised as feedstock.
    - Commercial operations generate paper and cardboard waste suitable for pyrolysis.

- Forestry Residues-Hardwood and softwood
    - Harvest Residues

        - Wood barks, branches and timber wastes.

- Wood processing residues
    - Sawdust, timber shavings and offcuts

- Pulp residues
    - Lignin-rich residues, barks and wood fines, rejected fibres and screening wastes from pulping.

- Municipal and urban waste
    - Dry solid wastes which include paper and carboard,
    - Timber wastes,
    - Dry green waste such as leaves, branches and grass clippings,
    - Other organic municipal solid wastes.

- Emerging Biomass
    - The Burnett Mary Regional Group is establishing Australia's first commercial Pongamia plantation, with seed production targeted for the development of high-grade biofuels.
    - Trials are assessing the suitability of native species such as mallee, acacia, and casuarina for short-rotation biomass production on marginal land, with the potential to supply high-yield fibre and energy feedstock.
    - Industrial hemp is also considered as an emerging biomass resource within Queensland.

- Biosolids
    - Murgon Wastewater Treatment Plant.
    - Wondai Wastewater Treatment Plant.
    - Nanango Wastewater Treatment Plant.
    - Blackbutt Wastewater Treatment Plant.
    - Kingaroy Wastewater Treatment Plant.
    - Proston Wastewater Treatment Plant.

2.1.2 Anaerobic Digestion

The anaerobic digestion process involves microbial decomposition of organic waste in the absence of oxygen. Anaerobic digestion prefers wet, nutrient-rich organics as the feedstock materials.

Feedstock

The South Burnett region is a key agricultural hub with a substantial livestock industry that generates a consistent supply of organic feedstock. This is further supplemented by outputs from local food processing facilities, as well as a range of agricultural residues and processing wastes. In addition, municipal and urban waste streams, including household waste, contribute to the overall feedstock availability within the region.

The major feedstock materials for Anaerobic Digestion Facility in South Burnett Region are as follows:

- Livestock and animal manures
    - Manure from feedlot cattle,
    - Piggery manure,
    - Poultry litter and
    - Dairy manure and effluent.

- Agricultural residues
    - Crop residues
        - As a major peanut production hub, the region generates significant crop residues, including peanut shells, peanut hay, and vine residue.
        - Broadacre farming also produces crop residues such as stubble, straw, and husks from grains such as sorghum, wheat, lucerne, maize, and barley and pulses such as soybeans, navy beans, and mungbeans.

    - Horticultural and orchard residues
        - Residues from crops such as blueberries, grapes, stone fruits, pecans, and mangoes.

- Food Processing Residues
    - Nut processing (peanuts and macadamias) generates waste materials.
    - Beverage manufacturing produces organic processing residues that can be utilised as feedstock.
    - Fruits or vegetable processing waste including blueberries, grapes, stone fruits, pecans, and mangoes

- Meat processing waste
    - Paunch solids removed during slaughter.
    - Unused small pieces of meat or trimmings.
    - Sludge from washing, cleaning, and processing operations.
    - Fatty residues separated during processing, including tallow or grease.

- Municipal and urban waste
    - Food and Organic Garden Waste.

2.2 Waste Profile Review

2.2.1 Inflows

Based on the *South Burnett Regional Council Waste Strategy 2023–2029(2024)*[4], annual waste inflows to the South Burnett regional waste management system are estimated at approximately 63,000 tonnes (2022-2023), predominantly comprising municipal solid waste. The inflow profile reflects the region's dispersed rural population, with a substantial proportion of waste delivered via self-haul disposal pathways, in addition to kerbside collection services.

The inflow composition of south Burnett Region based on the data is presented in the graph below in Figure 3 and can be categorised as follows:

- Municipal Solid Waste (MSW): Dominant fraction, comprising kerbside (30%) and self-hauled household waste streams (45%).
- Commercial and Industrial (C&I): Secondary contribution associated with local businesses, agricultural operations, and service industries which comprise 23%.
- Construction and Demolition (C&D) and Regulated Waste: Minor contribution (<5%), including inert materials and asbestos.

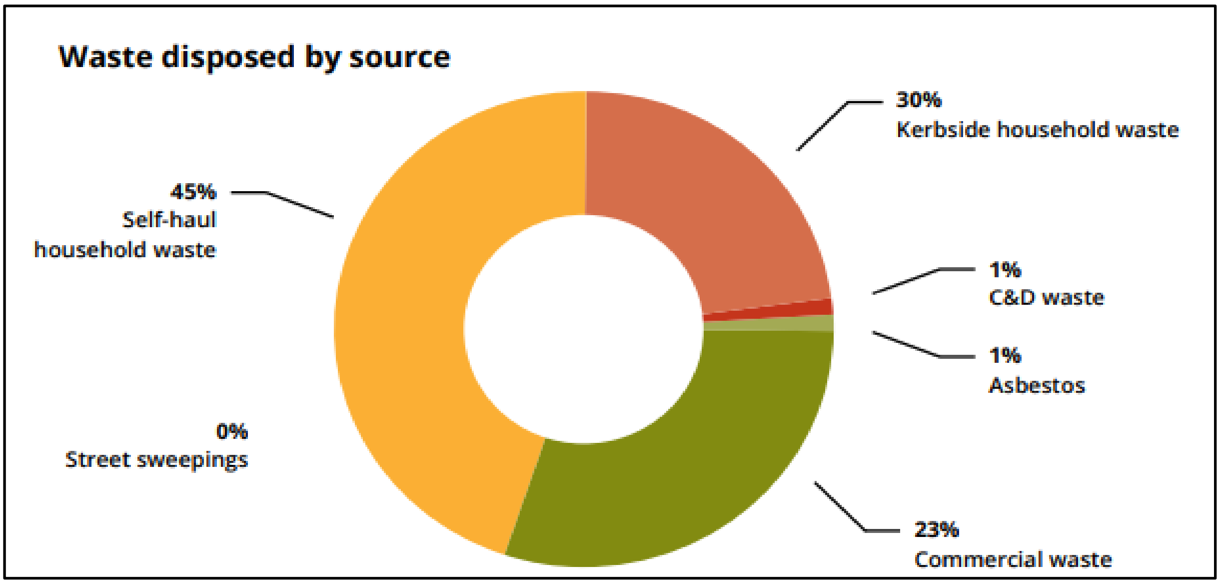


Figure 3. Waste disposed by source (Source. South Burnett Regional Council Waste Strategy 2023-2029 Report

[4] https://www.southburnett.qld.gov.au/files/assets/public/v/1/your-council/documents/sbrc_waste_strategy___final.pdf

Based on the South Burnett Regional Council waste stream outlined above, it is evident that the Council has a high proportion of self-haul and kerbside household waste, with no current Food Organics and Garden Organics (FOGO) recovery system in place. If a FOGO collection service were to be introduced, a reduction in both self-haul and kerbside household waste volumes would likely occur.

However, FOGO collected from the residential sector typically exhibits higher contamination rates, which can present challenges during processing and adversely affect the quality of outputs from technologies such as Pyrolysis and Anaerobic digestion. As such, until contamination levels can be reduced to negligible levels, it is not recommended to utilise FOGO materials from Council collection services as a feedstock for these technologies.

2.2.2 Outflows

Based on the South Burnett Regional Council Waste Strategy 2023-2029 waste from the region are primarily directed to landfill, representing approximately 48% of total waste streams and indicating ongoing reliance on landfill as the principal waste management pathway. The system achieves an overall recovery rate of around 52% of incoming materials, with over 65% of recovered materials being utilised on-site at landfill facilities for operational purposes. Clean fill constitutes the largest component of reusable material.

The municipal solid waste (MSW) stream contains a high proportion of putrescible organics and recoverable recyclables. Kerbside audit data indicates that approximately 64% of the waste stream is comprised of these combined organic and recyclable fractions. However, the absence of a source-separated organics system results in these materials being co-mingled within the residual waste stream, reducing recovery efficiency and increasing contamination levels. The data is presented in Figure 4.

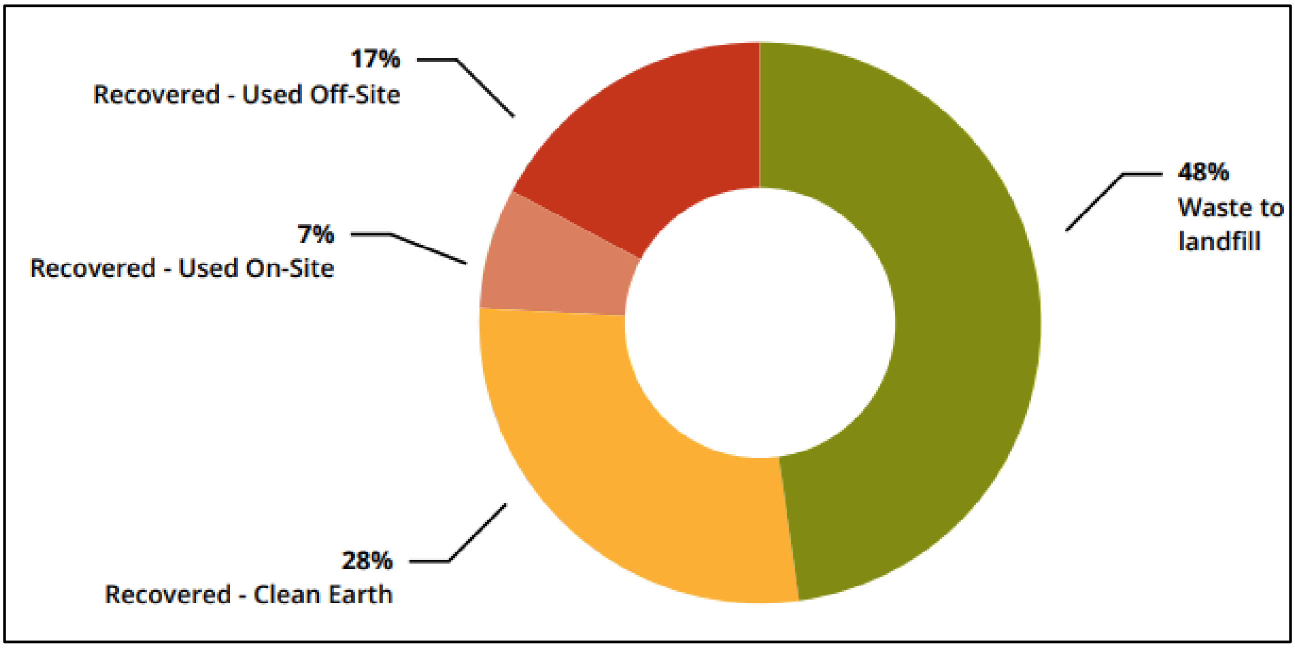


Figure 4. South Burnett Waste Outflows (Source. South Burnett Regional Council Waste Strategy 2023-2029 Report

The potential outputs of the two priority technologies are described below:

Anaerobic Digestion

The typical output from Anaerobic Digester includes:

- Biogas forms the major energy component of AD and typically comprises:
  - Methane (50-75 %)
  - Carbon dioxide-25-50%
  - Trace amount of other gases

The raw biogas can be utilised in combined heat and power (CHP) units to generate renewable electricity and heat for on-site/nearby buildings use. It can also be fed into the grid connection for off-site distribution.

- Digestates
  - Solid digestate retains unconverted organic carbon, which could be used for any onsite crop fertilisation or can be validated against quality limits to be used offsite or composted /incinerated.
  - Liquid digestate is a nutrient-rich slurry which is often lined and covered and stored in a storage fertiliser dam and undergo validation of digestate liquid fertiliser against release criteria and used for any onsite/offsite crop fertilisation.

- Heat
    - There is also recovered heat from biogas combustion in CHP units which can be reused within the facility.

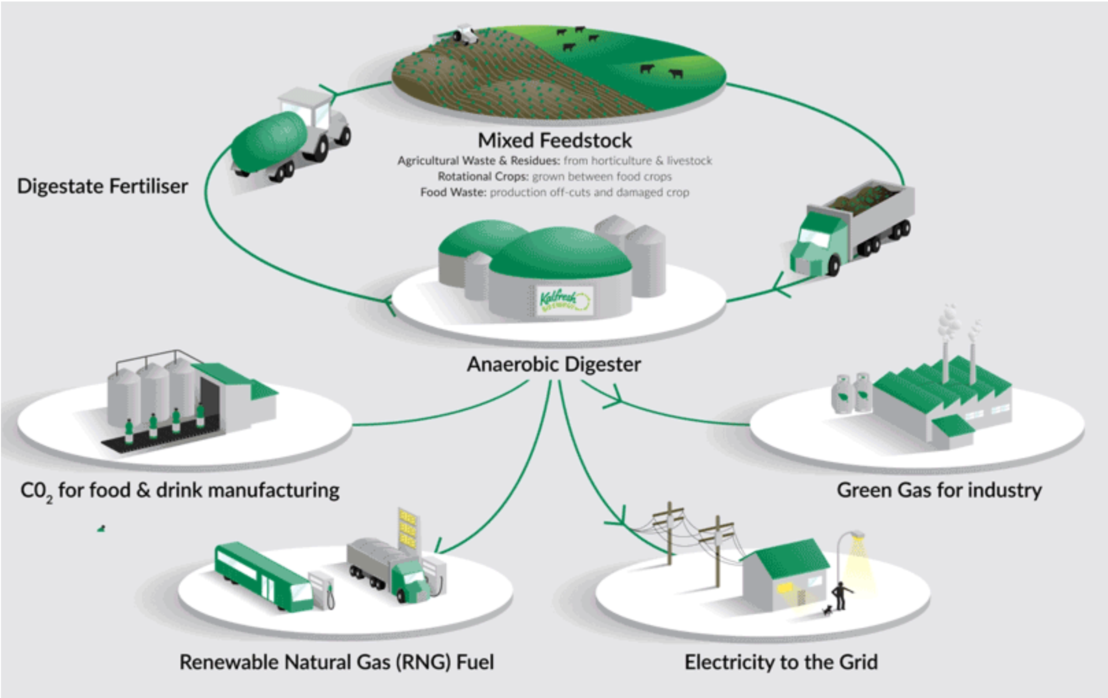


Figure 5. Anaerobic Digestion Cycle (Source. Kalfresh)

[5]

Pyrolysis

The major outflow materials from Pyrolysis are as follows:

- Biochar
    - Biochar is predominantly used in the agriculture industry for soil amendment as the carbon-rich residue improves soil structure and fertility as well as improve water-holding capacity thereby, increased crop yields.
- Bio-oil
    - Bio-oil is generally used as a renewable fuel for heat and power generation.
- Syngas (gas)
    - Syngas a mixture of CO, H_2, CH_4, CO_2.
    - It is generally recovered and used to generate power for the facility energy demands, using a Syngas Capture and Reuse System.
    - Syngas may also be used as a supplementary fuel for industrial applications, including use in turbines and internal combustion engines.

The recovery and use of Syngas is heavily dependent on controlling the feed stock quality.

[5] https://www.kalfresh.com.au/bioenergy/

2.2.3 Risks Associated with Priority Technologies

Anaerobic Digestion

- Environmental and Health Risks
  - The primary environmental risk associated with feedstock is the generation of biogas, which comprises potentially hazardous gases released during the decomposition of organic waste. This risk is increased if waste is stored for extended periods or if there is failure of an effective gas capture and control system, allowing uncontrolled gas release.
  - Inadequate containment and prolonged storage or processing of feedstock can result in uncontrolled decomposition, leading to excess odour generation and increased attraction of pests and vermin to the facility.
  - Failure or leakage of tanks, pipelines, or containment infrastructure may result in spills of feedstock or digestate, posing risks to soil, surface water, and groundwater quality.
  - Failure to comply with noise management requirements during anaerobic digestion operations presents a potential environmental risk to surrounding sensitive receptors, including nearby residential and ecological areas.
  - Contaminated stormwater or process water runoff may affect surface water or groundwater if the feedstock is not properly contained and treated.
  - A further health risk is associated with the potential presence and proliferation of pathogens in both untreated feedstock and digestate. Insufficient treatment or poor process control may result in increased pathogen risks.

- Feedstock and Supply Risks
  - Failure to adhere to the agreed feedstock quantities is a major risk, which includes delays in processing of waste, during periods of intermittent high-volume deliveries and reduced plant performance during periods of low supply, thereby affecting overall processing capacity.
  - Non-compliance with feedstock quality specifications presents a significant operational risk, as contaminated or unsuitable materials from suppliers can adversely impact anaerobic digestion process performance and it's a violation of Environmental Authority conditions.
  - Feedstock contamination may necessitate improved pre-treatment processes. This is a major issue when using Council FOGO materials, which typically have higher contamination rates.
  - Co-digestion is generally preferred to maintain process stability as it can disrupt microbial activity and optimise efficiency within anaerobic digestion systems. Inadequate blending or imbalance in feedstock composition can reduce operational efficiency and may affect the quality of the resulting digestate.

- Operational Risks
  - Anaerobic digestion plant requires regular maintenance, as equipment failure can disrupt overall plant operations and reduce process efficiency.

- The key operational risks are associated with variability in feedstock composition and uncertainties in supply, which can impact system stability and consistent performance of the anaerobic digestion process.

- Stakeholder Engagement Risks
  - Public opposition to facility operations due to odour, air quality impacts, or failures in land and water management, as well as concerns about pathogens, bioaerosols, and biogas safety despite low actual risk.
  - Potential disputes between suppliers and facility stakeholders regarding waste stream acceptance, over feedstock contamination concerns due to limited consultation, or misinformation.
  - Potential disputes between suppliers and the facility due to variability in feedstock quality and quantity.
  - Given the proximity of Kingaroy Airport (within 3 km), the development may increase wildlife hazard risks, particularly from birds and bats impacting operational airspace. Wind conditions should also be considered to manage potential stockpile material dispersion and ensure appropriate storage controls.
  - Risk of regulatory scrutiny or legal challenges from environmental authorities in response to non-compliance with Environmental Authority conditions for an Anaerobic Digestion Plant.
  - Risk of uncertainty regarding the market for the demand of the outflow materials such as biogas and digestate which affects the total economical viability of the facility.
  - Sensitive receptors potentially bearing environmental or amenity impacts while broader markets capture the benefits.

Pyrolysis

- Environmental and Health Risks
  - Pyrolysis can potentially generate hazardous emissions, including VOCs, methane, and other organic pollutants such as PAHs, requiring effective monitoring and control systems. It is noted that this is heavily dependent on the feedstock.
  - The technology can produce potentially contaminated residues containing heavy metals, which require appropriate handling, storage, and containment to prevent leaching into soil and water.
  - Failure or leakage of tanks, pipelines, or containment infrastructure may result in spills of feedstock or digestate, posing risks to soil, surface water, and groundwater quality.
  - Failure to comply with noise management requirements during anaerobic digestion operations presents a potential environmental risk to surrounding sensitive receptors, including nearby residential and ecological areas.
  - Contaminated stormwater or process water runoff may affect surface water or groundwater if the feedstock is not properly contained and treated

- Feedstock and Supply Risks

  - High moisture content in feedstock increases energy demand and reduces process efficiency and product quality.
  - Pyrolysis requires feedstock-specific temperature control to optimise biochar yield. Variability in feedstock quantity and composition can disrupt operations and reduce process efficiency and product yield.
  - Co-pyrolysis (processing biomass with other organic materials) is used to improve operational efficiency and product yield, inappropriate feedstock combinations may reduce product quality and process performance.
  - Contaminated or low-quality feedstock may compromise compliance with Environmental Authority conditions, particularly in relation to emissions and product quality.
  - Variability in feedstock quality may require additional or enhanced pre-treatment processes to avoid any contamination and thereby increasing operational efficiencies
  - Inconsistent feedstock supply lead to prolonged material storage and pose fire risk in dry materials.

- Operational Risks
  - Pyrolysis plant requires regular maintenance, as equipment failure can disrupt overall plant operations and reduce process efficiency.
  - Reactor design and operating mechanism may influence product consistency and heat transfer efficiency, potentially affecting overall process performance.
  - The key operational risks are associated with variability in feedstock composition and uncertainties in supply, which can impact system stability and consistent performance of the Pyrolysis process.

- Stakeholder Engagement Risks
  - Public opposition to facility operations due to odour, air quality impacts, or failures in land and water management.
  - Potential disputes between suppliers and facility stakeholders regarding waste stream acceptance, over feedstock contamination concerns due to limited consultation, or misinformation.
  - Potential disputes between suppliers and the facility due to variability in feedstock quality and quantity.
  - Risk of regulatory scrutiny or legal challenges from environmental authorities in response to non-compliance with Environmental Authority conditions for Pyrolysis plant.
  - Local stakeholders potentially bearing environmental or amenity impacts while broader markets capture the benefits.
  - Uncertainty in market demand for outputs such as biochar and syngas may affect the overall economic viability of the facility.
  - Given the proximity of Kingaroy Airport (within 3 km), the development may increase wildlife hazard risks, particularly from birds and bats impacting operational airspace. Wind conditions should also be considered to manage potential stockpile material dispersion and ensure appropriate storage controls.

2.2.4 Transportation, Storage and Contamination

Feedstock logistics for priority technologies, Anaerobic Digestion (AD) and Pyrolysis form a critical interface between raw resources (feedstock) and energy generation. Accordingly, a controlled supply chain is required to maintain feedstock quality and process performance, incorporating appropriate handling, transportation, and storage measures to minimise degradation, prevent contamination, and mitigate risks for the protection of environmental and community receptors.

Transportation requirements for Feedstock

The feedstocks for AD within the region are typically heterogeneous, high in moisture, bulky, biologically active, and sensitive to environmental conditions (manure and cereal crop straw) whereas the Pyrolysis feedstock are dry-woody agricultural residues or biosolids. Material transport depends on the physical form, as solids are moved using conveyor belts, forklifts, trucks, pneumatic conveyors, load shovels, cranes, and walking floor systems whereas liquids and semi-liquids are transported via pumps, pipelines, and tankers.

Queensland's waste tracking framework regulates the transport of environmentally significant waste to ensure its safe and responsible management by:

- ensuring waste is stored, transported, and treated appropriately
- ensuring waste is delivered only to suitably licensed facilities.

The priority technologies, Anaerobic Digestion (AD) and Pyrolysis, utilise environmentally significant waste streams as primary feedstock inputs. These include animal effluent and sewage sludge, which are classified as trackable wastes in accordance with Schedule 11 of the *Environmental Protection Regulation (2019)*. The relevant waste codes are presented in Table 1 below.

Table 1. Trackable Waste and Waste Codes

Type of Waste	Waste Code
Animal effluent and residues, including abattoir effluent and poultry and fish processing waste	K100
sewage sludge and associated residues including nightsoil and septic tank sludge, classified under waste code	K130

Under the Environmental Protection Regulation 2019 (Qld), waste generators, transporters, and receivers have defined obligations for the management of regulated or trackable waste, including animal effluent and residues from industrial treatment processes(biosolids), which represent key feedstock for the priority technologies. As this feedstock primarily consists of liquid organic waste, specific vehicle design, maintenance, and operational requirements also apply, as outlined in the following sections.

In addition, an Environmental Authority (EA) may be required under the Environmental Protection Act 1994 (Qld) for:

- Commercial regulated waste transporters, or
- The transport of 250 kg or more of trackable regulated waste.

Regulated /Trackable Waste Tracking Obligations

- Waste Generators are required to provide prescribed waste information to the transporter, submit the same information to the Department of Environment, Tourism, Science and Innovation, and retain records for a minimum of five (5) years.
- Waste Transporters must carry prescribed waste information during transport, provide it to the receiving facility upon delivery, report any discrepancies to the Department, and retain records for at least five (5) years.
- Waste Receivers are required to obtain prescribed waste information from the transporter, submit it to the Department (or ensure submission via an authorised agent agreement), report any discrepancies, and retain records for a minimum of five (5) years.

Waste must not be removed from a licensed regulated waste transporter's vehicle except at a facility that holds a valid Environmental Authority to receive that waste.

Vehicle Requirements for Transporting Regulated Waste

Vehicles used to transport regulated and trackable waste in Queensland must be designed, maintained, and operated to prevent environmental issues. Vacuum Tankers & Liquid Tankers can be used for organic liquid waste like wastewater sludge, animal effluent, and food processing residues. Tipper Trucks with Sealed Tailgates are also used for transporting "wet" solid food waste or manure to prevent liquid leakage on roads. Walking Floor (Live Bottom) Trailers are highly preferred for woody biomass and shredded waste, which allow for controlled unloading without tipping. High-Volume B-Doubles and Hook lift trucks can also be used for low density feedstock materials as well as agricultural residues.

The key requirements are as follows

- Vehicles, tanks, and containers must be maintained in a clean, serviceable condition to prevent leaks, spills, and contamination, and must be free of waste residues when not in use.
- Waste not in weatherproof packaging must be covered to prevent exposure to wind and rain ingress.
- All waste containers must be securely mounted and contained within the vehicle tray.
- Packaged waste must not protrude more than 30% above the height of the vehicle sides or gates.

- Road tankers for liquid regulated waste must be designed to minimise instability and rollover risks.

Potential Transportation Risks within the Region

Cost

- Anaerobic digestion (AD) processes typically utilise high-moisture organic feedstocks, which contain a high proportion of water relative to usable material, increasing transport weight, haulage frequency, and overall logistics costs. In contrast, pyrolysis feedstocks are generally dry, carbon-rich, and low-density, resulting in larger transport volumes and a higher number of truck movements, which similarly increases transport costs.
- Accordingly, appropriate pre-treatment strategies and optimised logistics planning are required to minimise transport inefficiencies and reduce overall feedstock delivery costs to processing facilities.

Sensitive Receptor Issues

- Transport and handling of feedstock can give rise to impacts on sensitive receptors, including residential areas, and other community uses, primarily through odour emissions, potential visual and amenity impacts, noise impacts, the risk of spillage and leakage necessitates increasing operational controls and compliance requirements.

Traffic Constrains

- Transport of feedstock for Anaerobic Digestion (AD) and Pyrolysis can increase heavy vehicle movements across regional and local road networks, particularly where sources are geographically dispersed. This may contribute to an increased interaction between heavy vehicles and general road users. Additional considerations include heightened safety risks at intersections, access points, and through townships or sensitive areas as well as reduced network efficiency during peak operating periods.

The above risks can be mitigated through the use of appropriately designed and fit-for-purpose transport vehicles that address the specific characteristics of the feedstock and associated handling and containment requirements. In addition to this the regulator will likely impose conditions around operating times for the facility to limit these to daylight hours.

Storage Requirements for Feedstock

Management and optimisation of waste input must be developed to minimise environmental and operational risks. Key risk factors include feedstock type or composition and biological activity, moisture variability, formation of dry pockets, excessive pile sizes, poor mixing, restricted airflow, and delayed temperature stabilisation or any risks associated with release of substance from the waste. In general, storage and handling of feedstock should be conducted within controlled areas, including a designated inspection zone for incoming loads, to minimise spills and prevent environmental release. These risks will be mitigated through timely processing of incoming materials, and use of appropriate operational and infrastructural controls as described below.

Storage Capacity and Processing Regime

Storage capacity is aligned with process capacity and managed to prevent waste accumulation. This includes waste acceptance planning, clearly defined maximum storage limits based on waste characteristics and treatment capacity, and regular monitoring of stored quantities. A first-in, first-out approach should be adopted, supported by defined maximum storage durations established, with waste treated or removed as soon as practicable preferably within one month and no later than six months of receipt, to prevent material degradation (AD) and self-heating ((Pyrolysis). Regular inspections will be undertaken to identify issues such as odour, leaks, or drainage failures, with maintenance activities documented accordingly.

Infrastructure and Operational Controls

A site plan identifying all tanks, vessels, storage areas, bunds, and drainage systems and is kept up to date. All containers are labelled in accordance with acceptance requirements, with labels kept visible and legible during handling and storage. All tanks, vessels, storage areas, pipework, hoses, and transfer systems should be fit for purposes and chemically compatible with stored waste and are clearly identified using a standardised coding system. Containers, tanks and vessels are not used beyond their specified design life or used in a manner or for substances for which they were not designed. The layout also ensures continuous vehicular and pedestrian access to all storage areas, enabling container transfer without relocating other materials.

Anaerobic Digestion

- Feedstock storage areas handling putrescible, non-woody materials are designed to support thorough removal of residual material and routine washdown, with drainage systems incorporated as needed. Liquids generated during storage and cleaning, including leachate and wash water, are contained and transferred via a sump to appropriate management systems, allowing for process reuse, approved discharge to sewer, off-site treatment at a wastewater treatment facility, or disposal through authorised methods such as regulated land application.
- Specific feedstock materials (e.g. straw) are stored in designated areas for controlled blending with incoming bio-wastes and sludges. Storage and handling practices are implemented to minimise fugitive emissions (odour and dust) and reduce fire risk, including segregation, moisture control, appropriate stockpile management, and firefighting contingencies (i.e. tanks, extinguishers)

- Feedstock storage areas, particularly those handling putrescible materials, should have an impermeable lined surface with a sealed drainage system, to prevent any spillage entering the storage systems or escaping off site, should be roofed or enclosed to minimise exposure to rainfall and environmental conditions. A leak detection system may also be required if regulated waste materials will be used in the process.
- If left exposed, organic feedstock materials may attract birds and other pests, resulting in noise, litter generation, and the potential spread of waste beyond the site boundary. To mitigate these risks, such materials should be stored in sealed, moisture-resistant, and pest-proof containers. Additional controls should include the implementation of pest and vector management measures, installation of physical barriers (e.g. fencing or movable litter screens), and routine site housekeeping to maintain cleanliness. Storage facility design will also prevent stormwater ingress and include wind protection measures to minimise odour and litter dispersion.
- Risks such as hotspots, smoke, and odour emissions during storage of feedstock will be controlled and monitored as described below:
    - Routine temperature monitoring using probes deep within the degradable feedstock materials.
    - Maintaining adequate aeration through appropriate turning regimes
    - Managing moisture content to support heat dissipation
    - Avoiding oversized or compacted stockpiles
    - Adequate spacing between stockpiles will be maintained to reduce fire risk and allow access for management activities.
- An 'odour management plan' must be developed on site to identify the appropriate measures to mitigate odours at the site. Feedstock classified as having a high odour rating in accordance with the ERA 53(b) Schedule 1 – Odour Table 1 should be received, stored, and initially mixed within an enclosed system operating under negative pressure. The feedstock should be blended with a bulking agent or high-carbon material and transferred to a vessel or enclosed system as soon as practicable, and in any case within six hours of receipt. Processing must then occur within the in-vessel or enclosed system for a minimum period of 21 days or until pasteurisation has been achieved.
- All in-vessel or enclosed systems should be equipped with an air filtration system capable of achieving at least a 90% reduction in odour emissions and dust releases. The air filtration system should be designed, installed, operated, monitored, and maintained by a suitably qualified person to ensure ongoing performance and compliance and where relevant, explosion venting should be incorporated.
- Prior to or during storage, feedstock may be subjected to size reduction processes to produce homogeneous material, thereby improving handling and downstream processing efficiency. This may involve grinding, milling, shredding, drumming, or pulping. In addition, feedstock is often pre-treated or dried using hot air to reduce moisture content and minimise energy demand within the reactor.

Pyrolysis

- The storage of wastes in areas lined with sealed and resistant surfaces and controlled/segregated drainage prevents the release of substances either directly from the waste or by leaching from the waste.
- Odorous feedstock should be stored within enclosed areas equipped with controlled air systems, with extracted air directed for use as combustion air.
- Designated loading and unloading zones should incorporate controlled drainage, with clearly marked systems to manage runoff from areas with potential contamination, including storage, handling, and transport zones.
- Certain feedstock materials (dry woody waste) may be baled or otherwise contained for temporary storage, subject to site-specific risk considerations.
- Fire protection measures, such as fire-resistant separation between storage bunkers and furnace areas, should also be implemented, as well as have suitable fire suppression infrastructure in place.
- Solid municipal and other non-hazardous wastes should be stored in sealed floor bunkers or level storage areas within covered and enclosed buildings, although some low-risk bulky materials may be stored without special controls. Solid pre-treated municipal solid waste (MSW) should be handled in enclosed hoppers or sealed storage areas within covered and walled facilities. Waste water treatment plant biosolids and sludges should be stored in corrosion-resistant, bunded tanks with all flanges and valves contained within bunded areas, and tank vapors ducted to the pyrolysis plant where volatile compounds are present, along with appropriate explosion control systems.
- The facility should also consider having groundwater monitoring to measure if there is any breaches of lines pads / bunkers.

Potential Transportation Risks within the Region

Feedstock Degradation and Process Inefficiency

To maintain consistent feedstock quality and quantity, extended or improper storage conditions may occasionally arise due to seasonal variability in supply, particularly for agricultural residues. These improper or prolonged storage conditions can lead to:

- Loss of calorific value (for pyrolysis)
- Reduced biogas yield (for AD)
- Changes in moisture content and composition which affects the process efficiency.

Therefore, it is critical to have a feedstock management plan to control this process.

Contamination Risks

- Poor storage controls can result in cross-contamination and thus the plant processing efficiency along with the regulatory non-compliances.
- Storing feedstock output for extended period may increase the risk of regulated waste contaminating the environment if stored on unlined pads or storage areas.

Contamination Prevention Requirements for Feedstock

Potential adverse environmental impacts associated with activities within the facility, including transportation, storage, and processing, are minimised through compliance with regulatory requirements at all stages, supported by a planned and regular monitoring and sampling programme. Monitoring also includes impacts on environmental receptors and ecosystems, as well as on-site accidents and near misses, staff injuries, transport incidents, and community complaints.

Anaerobic Digestion

The key parameters to be considered include potential sources of contamination associated with the Anaerobic Digestion, such as fugitive emissions to air, water, and sewer; waste streams; contamination of land, water, and air; and releases of thermal energy, noise, odour, and dust. Potential emissions from the anaerobic digestion facility are summarised in Table 2 below.

Table 2. Potential Emission Sources from AD Process

Stage	Activity	Emissions
Waste Reception	• Transport of waste to site • Movement of waste within the site • Removal of Bulky items	• Dust • Odour • Bio-aerosols
Mechanical processing	• Size reduction • Pretreatment • Sorting	• VOC's • Dust • Odour • Bioaerosols
Biological Processing	• Anaerobic Digestion	• VOC's • Dust • Odour • Bioaerosols • Ammonia • Leachate • Methane and other gases
Process Output	• Storage or transport of output from site	• Dust • Odour • Bio-aerosols

The Regulator will likely impose regular monitoring of AD process above, likely in the form of regular air quality monitoring to be undertaken by a suitable qualified person.

Emissions to Air

Fugitive emissions of biogas can arise from pressure relief valves, poorly sealed water traps or condensate handling and from methane slip from storage of biogas. The Hydrogen Sulphide (H2S), nitrogen compounds and mercaptans present in biogas can be extremely odorous as well. This can result in a range of hazards, including the risk of fire or explosion, as well as toxicity from contaminant gases such as H2S.The most commonly measured parameters are ammonia, odour, dust, hydrogen sulphide and organic compounds. Preventive measures to reduce emissions to air are as follows:

- The AD system should be fitted with a scrubber and biofilter for gas treatment.
- Dust emissions are controlled using bag filters.
- Odour generation can be reduced by minimising residence time of odorous wastes in storage and handling systems (e.g. pipes, tanks, and containers).
- Feedstock with the potential to generate diffuse emissions are handled and stored in enclosed buildings or equipment, maintained under appropriate negative pressure, with emissions captured at source via extraction or suction systems and directed to suitable abatement systems.
- Chemical dosing may be applied to suppress or destroy odorous compounds, including oxidation or precipitation of hydrogen sulphide.
- A risk-based leak detection and repair program should be implemented to manage potential organic emissions, considering plant design and compound characteristics.
- Dust sources (e.g. storage areas, traffic routes) are controlled using water spraying or misting systems, utilising seal roads and regular street sweeping
- Facility layout includes buffer distances to sensitive receptors, with vegetation buffers used where practicable to provide screening and further reduce dust and odour impacts.
- Existing design of the facility is above flood levels and is adequately graded to shed surface water.
- A weather station must be installed, operated, calibrated and maintained on site which continuously and electronically records rainfall, wind speed, wind direction, air temperature and relative humidity responding to complaints and planning site operations to minimise odour impacts and protect surrounding communities

Emissions to Land and Water

Although anaerobic digestion (AD) systems can be operated in stages to reduce overall Chemical Oxygen Demand (COD) in the effluent, they are primarily optimised for methane production, resulting in a more concentrated liquid effluent. While the AD process itself generates less water, significant water streams may arise during storage, pre- and post-treatment, and other activities such as cleaning or biogas condensation. Key monitoring parameters typically include pH, COD, BOD_5, NH_3, and selected metals such as Cd, Pb, Cr, Ni, and Zn.

The emissions to land and water can be minimised by the following methods:

- Optimising water uses through efficiency planning or segregating water streams so that clean and contaminated waters are collected and treated separately.
- Providing drainage infrastructure to capture stormwater, wash water, and spillages for recirculation or treatment depending on quality.
- Constructing impermeable surfaces in waste treatment areas to prevent soil and groundwater contamination.
- Managing tank and vessel risks using overflow detection, controlled overflow to contained drainage, secondary containment, and isolation systems (e.g. shut-off valves).
- Applying leak detection and repair systems through risk-based monitoring, limiting underground components, and using secondary containment where necessary.
- Ensuring adequate buffer storage for wastewater during abnormal operations, with discharge only after appropriate monitoring, treatment, or reuse.

Noise and vibration emission

Noise impacts are mitigated through strategic siting of equipment and buildings, operational controls, and engineered measures. This includes:

- Maximizing distance to receptors, using buildings as noise barriers, and applying good operational practices such as maintenance, trained operation, and limiting noisy activities where possible.
- Low-noise equipment is utilised where feasible, supported by noise and vibration controls such as silencers, insulation, and enclosures.
- Additional noise attenuation may be achieved through physical barriers (e.g. walls or embankments)

Pyrolysis

The main environmental issues for Pyrolysis containment and storage are emissions to air and recovery of energy. Emissions to water are a less prominent issue, as long as the plant is put on a sealed surface.

Emissions to Air

- Emissions to air in Pyrolysis operations (Biochar) and are closely linked with odour generation. These emissions are primarily influenced by feedstock composition, reactor design, operating conditions (including temperature and residence time), and the efficiency of downstream gas treatment systems.

- Key air pollutants for Biochar pyrolysis include particulate matter (PM), carbon monoxide (CO), volatile organic compounds (VOCs), and condensable organic compounds. These emissions arise mainly from incomplete thermal conversion processes and the handling of solid residues such as biochar and fine particulates.
- When untreated biomass feedstock is used, emissions of acid gases (e.g. HCl, HF, SO_2) and trace metals are generally low and primarily dependent on feedstock composition
- Odorous emissions are primarily associated with feedstock handling, storage, transfer operations, and leakage of process gases or condensates, particularly those containing volatile organic compounds of CO and VOCs, which are also key contributors to odour, are governed by combustion efficiency and process stability.
- Dust emissions are largely dependent on the performance of particulate abatement systems, including cyclones and fabric filters, as well as the effectiveness of material handling controls.
- Pyrolysis systems operating under oxygen-limited conditions typically produce lower flue gas volumes per tonne of feedstock processed compared with conventional incineration processes

Emissions to Water

- Emissions to water are of secondary significance for biomass Pyrolysis facilities. Where present, they are primarily associated with wet gas cleaning systems, process condensates, and surface runoff from operational areas.
- Wet flue-gas treatment systems may generate effluents containing dissolved organic and inorganic compounds. These are typically managed through recirculation, treatment, or evaporation systems, where technically feasible.
- Surface water and runoff are managed through segregation of clean and contaminated streams, impermeable surfaces, and controlled drainage systems, with collection and treatment prior to discharge or reuse.

Noise Emissions

Noise emissions arise from mechanical equipment (e.g. fans, compressors, pumps, conveyors), material handling activities, and vehicle movements. Noise impacts can be mitigated through BAT (Best Available Techniques) for waste treatment facilities including:

- Appropriate siting and layout of equipment to maximise separation from sensitive receptors
- Use of enclosures, acoustic insulation, and vibration damping systems
- Implementation of low-noise equipment where practicable

- Operational controls including maintenance, restricted night-time operations, and trained personnel
- Use of noise barriers (e.g. buildings, walls, embankments) where required
- Noise control measures are applied in accordance with site-specific constraints, particularly in existing facilities where spatial limitations may apply.

2.3 Supply Chain Assessment

Previous analyses have identified the opportunity for implementing an Anaerobic Digester (AD) facility of approximately 4.4 MW capacity, receiving around 50,000 tonnes of untreated organic waste per annum, alongside a Pyrolysis Facility (biochar) comprising Pyrocal's CCT20 and CCT12 (Continuous Carbonisation Technology) units, receiving approximately 25,000 tonnes of untreated biomass per annum.

These facility scales are broadly aligned with industry benchmarks and comparable case studies, where such capacities represent commercially viable thresholds for waste-to-energy and biochar production systems. The proposed facilities are intended to operate as complementary technologies within a circular economy framework, processing different fractions of the regional waste stream and maximising overall resource recovery.

2.3.1 Priority Waste Streams

It is noted that different waste streams are preferred for each technology, with some waste types potentially suitable for both depending on pre-processing and moisture content.

The Anaerobic Digester (AD) is best suited to wet, biodegradable organic residues such as manure, food waste, biosolids, and organic sludges. Meanwhile, the pyrolysis process is best suited to dry, woody, carbon-rich biomass such as timber waste, crop residues (e.g. straw), forestry residues, and dry green waste.

This assessment identifies key priority waste streams to secure reliable and sufficient feedstock for both AD and biochar facilities. While the ultimate processing capacities are assumed to be 50,000 tonnes per annum for AD and 25,000 tonnes per annum for pyrolysis, it is important to note that these volumes are unlike to be required at commencement, with the project likely adopting a staged development approach.

Option 1 - Key regional businesses and waste producers

Anaerobic Digestion

- <u>Manure</u>: The South Burnett region comprises a well-established livestock sector, including feedlots, piggeries, and meat processing facilities, which represent some of the most reliable and consistent sources of AD feedstock. Key businesses and waste producers include:

  - Pakaderinga Feedlot: through consultation, the feedlot indicated it could supply approximately 10,000 tonnes of manure per annum to the AD facility.
  - The region also comprises other large cattle feedlots, including Smithfield Cattle Co. Feedlot (18,500 capacity), Wink's Feedlot (9,000 capacity), and Saxby Feedlot (4,800 capacity), which have the potential to supply significant volumes of manure.
  - In addition, piggeries represent a significant and consistent feedstock source. Large producers in the region include Wilson Pork (extension approved in 2026 to 57,000 capacity), Sunny Nook Pig Farm (28,000 capacity), and Bellgrove Pork (18,754 capacity).

Queensland Biomass Mapping data indicates that the South Burnett region produces approximately 20,000 tonnes of pig manure per annum. It is noted, however, that this dataset was last updated in 2018 and may not fully reflect current production levels or recent expansions within the region. As illustrated in Figure 7, there are numerous existing cattle feedlots and piggeries located within a 50 km radius of the precinct.

On this basis, it is estimated that additional cattle feedlots within the catchment could collectively provide approximately 10,000 to 20,000 tonnes of manure per annum. Similarly, piggeries across the region are estimated to contribute approximately 10,000 tonnes per annum of manure that could be diverted to the AD facility. These estimates are considered conservative and reflect only a portion of the total available resource, allowing for competing uses, logistical constraints, and partial participation by producers.

- <u>Cereal crop straw and crop residues:</u> The South Burnett region supports a strong agricultural industry comprising both primary production and food processing.
  - Queensland biomass data indicates that the region generates approximately 45,000 tonnes per annum of sorghum and wheat straw. Assuming a conservative basis and the additional waste from crop residues, it is estimated that approximately 20,000 tonnes per annum could be directed to AD feedstock.
  - Key regional companies associated with this sector include Crumptons and Sons and Bean Growers Australia, which may also act as aggregation points for broader agricultural waste streams. In addition, an Expression of Interest (EOI) campaign (discussed in the following section) is also expected to contribute to this feedstock supply by engaging a wider network of farmers and aggregators across the region.

Pyrolysis (Biochar)

- <u>Biosolids</u>: Biosolids are generated from wastewater treatment plants across the LGA, including facilities in Kingaroy, Wondai, Nanango, and Blackbutt. Through engagement with Council, it is estimated that approximately 10,000 tonnes per annum of biosolids could be directed to the pyrolysis facility.

- Green waste: Council has indicated that it can provide approximately 10,000 tonnes of green waste per annum. This waste stream primarily comprises garden waste, tree pruning, and other vegetative material collected through municipal services.

- Wood processing and hardwood harvest residues: Queensland biomass data indicates that the South Burnett region generates approximately 40,000 tonnes per annum of wood processing residues and hardwood harvest residues. On a conservative basis, approximately 5,000 tonnes per annum of this waste stream could be directed to the biochar facility.

Option 2 - Expression of Interest (EOI) campaign

In addition to sourcing waste streams and feedstock from major regional businesses, farmers and aggregators represent a significant source of biomass, particularly in the form of cereal straw, crop residues, and other agricultural by-products.

A structured Expression of Interest (EOI) campaign can be implemented to engage landholders, farming enterprises, and aggregation networks within a defined catchment area. This approach enables operators to identify available feedstock volumes, establish preliminary supply commitments, and better understand logistical considerations such as transport distances, seasonal variability, and storage requirements.

Similar approaches have been successfully implemented in other regions. One example is the Ararat Bioenergy project in Western Victoria[6], which secured cereal straw supply agreements from farmers within an approximate 100km radius. This model demonstrates how distributed agricultural biomass can be aggregated into a reliable feedstock stream through early engagement and contractual arrangements.

An additional advantage of this approach is the ability to store feedstock such as baled straw for use throughout the year, helping to manage seasonal variability in supply. It also provides an opportunity to secure feedstock at a lower cost during peak harvest periods, when supply is abundant, and utilise stored material during off-peak periods. This contributes to greater operational flexibility and cost stability for the facility.

Key considerations for implementing an EOI campaign include:

- Defining an economically viable collection radius (typically 50–100km depending on transport costs)

[6] https://valorify.com.au/2718-2/

- Establishing indicative pricing or gate fees to incentivise participation
- Understanding seasonal production cycles and storage requirements
- Identifying opportunities for on-farm pre-processing (e.g. baling, chipping, drying)

This approach provides flexibility and scalability, allowing the precinct to progressively expand its feedstock base over time while reducing reliance on a small number of large suppliers. It also supports broader regional participation in the circular economy by creating new revenue streams for farmers and landholders.

Option 3 - Cropping contracts

As an alternative or supplementary feedstock source, cropping contracts have been successfully employed in comparable projects to provide a dedicated and controlled supply of biomass. Under this model, specific crops are cultivated with the primary purpose of supplying feedstock to AD and pyrolysis facilities.

In this case, crops such as maize (corn), sorghum, or other high-yield biomass crops can be grown either as primary crops or as part of crop rotation systems. These crops can be utilised in different ways depending on the processing technology.

Pros	Cons
Reliable and predictable feedstock supply volumes	Land use implications and potential competition with food production
Greater control over feedstock quality and composition	Exposure to seasonal and climatic variability (e.g. drought conditions)
Reduced exposure to fluctuations in waste availability	Input costs associated with planting, harvesting, and transport
Ability to optimise crops specifically for energy or carbon outcomes	Need for long-term contractual arrangements with landholders

In the South Burnett context, where agriculture is a dominant land use, cropping contracts could provide a strategic opportunity to supplement waste-derived feedstock, particularly during periods of supply shortfall or where additional capacity is required.

This model is particularly relevant for scaling the AD facility, where consistent and high-energy feedstock is required, and may also support integration with local farming systems by providing an additional revenue stream and potential soil benefits through the return of digestate and biochar.

2.3.2 Regional Feedstock and Transport Considerations

In addition to feedstock sources within the South Burnett LGA, there is a significant opportunity to supplement supply through adjacent local government areas if necessary. Neighbouring LGAs include North Burnett, Gympie, Somerset, Toowoomba, and Western Downs.

There are several established agricultural and processing hubs within an approximate 100–140km road distance of the Kingaroy precinct. The most relevant opportunities include:

- North Toowoomba region: Oakey (approximately 120km) is a major centre for feedlots and meat processing
- Western part of the Western Downs: Dalby (approximately 100km) supports intensive agriculture, grain production, and feedlots
- Gympie region: Gympie (approximately 140km) has a mix of agriculture, forestry, and food processing activities
- Somerset region: Kilcoy (approximately 110km) is a key location for meat processing and intensive livestock industries

As illustrated in Figure 6, the Queensland Biomass Mapping data indicates that neighbouring LGAs generate significantly higher volumes of biomass compared to South Burnett. In particular, the Toowoomba region produces approximately five times the biomass of South Burnett, while Western Downs and Gympie produce approximately three times and two times more, respectively. This highlights the potential to draw on a broader regional supply base to improve feedstock security.

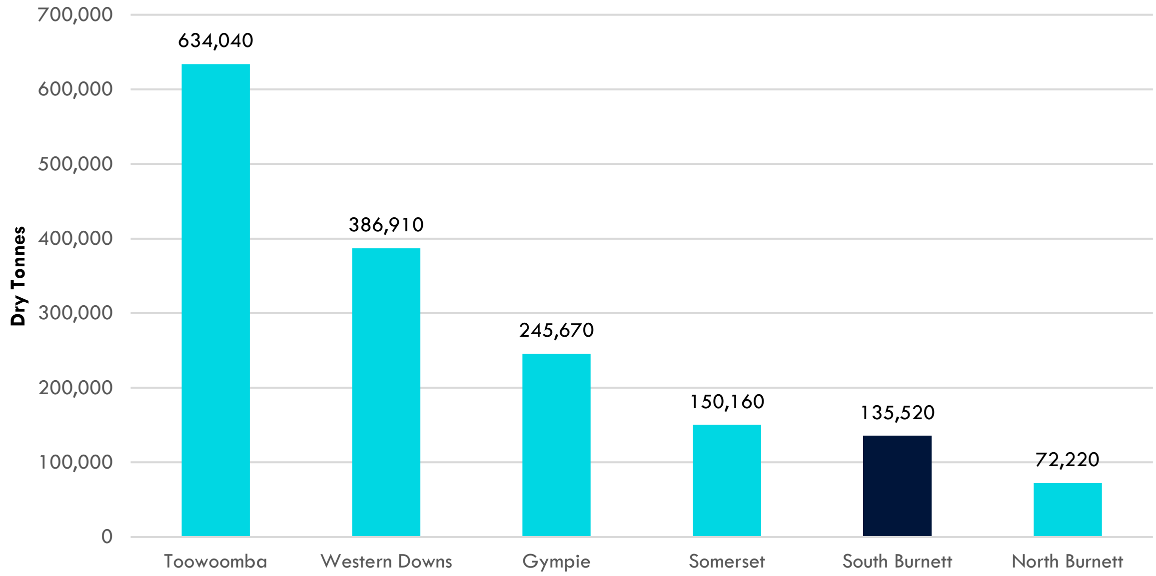


Figure 6. Biomass Production by LGA (Source. Queensland Biomass Mapping Data

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Notwithstanding this opportunity, transport and logistics represent a critical consideration in determining the economic viability of sourcing feedstock from outside the LGA. Transport costs can significantly influence the delivered price of biomass, particularly for low-value or high-moisture materials.

There are also opportunities to improve logistical efficiency through integrated supply chain approaches. For example, transport movements can be optimised by backloading, where vehicles delivering outputs such as digestate or biochar to agricultural users return with feedstock from the same locations. This type of circular logistics model can reduce transport costs and improve overall system efficiency. In addition, aggregation points within neighbouring LGAs may be established to consolidate feedstock prior to transport to the precinct.

It is also noted that certain waste streams, particularly biosolids and municipal green waste, may currently incur disposal costs for councils. In these cases, there may be an opportunity for such materials to be supplied to the precinct at low or zero cost, or potentially with a gate fee, thereby improving the overall economics of the project while providing an alternative waste management solution for neighbouring councils.

The exact transport implications and feasibility of sourcing feedstock from neighbouring LGAs will depend on a range of factors, including contractual arrangements, partnerships with councils and industry, transport distances, and the ability to achieve economies of scale and logistical efficiencies. Further detailed assessment of transport costs and supply chain optimisation would be required as part of the next stage of project development.

Table 2.3 Summary of Priority Waste Streams

Residue Type	Source	Tonnes
Anaerobic Digester (AD)		
Manure - feedlot cattle	Pakaderinga Feedlot	10,000
Manure - feedlot cattle	Other feedlots - For example, Smithfield Cattle Co., Wink's Feedlot, and Saxby Feedlot	10,000
Manure - pigs	QLD biomass data estimates 20,000 t/yr. For example, Wilson Pork and Bellgrove Pork	10,000
Cereal crop straw	Sorghum and wheat straw. QLD biomass data estimates 45,000 t/yr - EOI campaign farmers/aggregators	20,000
TOTAL		**50,000**
Pyrolysis Facility (Biochar)		
Biosolids	Murgon, Wondai, Nanango, Blackbutt, Kingaroy, and Proston Wastewater Treatment Plants	10,000
Green waste	Green waste indicated by Council	10,000
Wood processing residues	Mix wood residues. QLD biomass data estimates 20,000 t/yr. For example, Parkside Timber	5,000
TOTAL		**25,000**

Note: Feedstocks and associated volumes can vary subject to a number of factors, including seasonal and climatic conditions, industry activity and positioning, competing uses, and logistical considerations. As such, the estimated feedstock inputs presented in this assessment should be considered indicative and subject to further refinement through detailed feedstock supply studies and contractual arrangements.

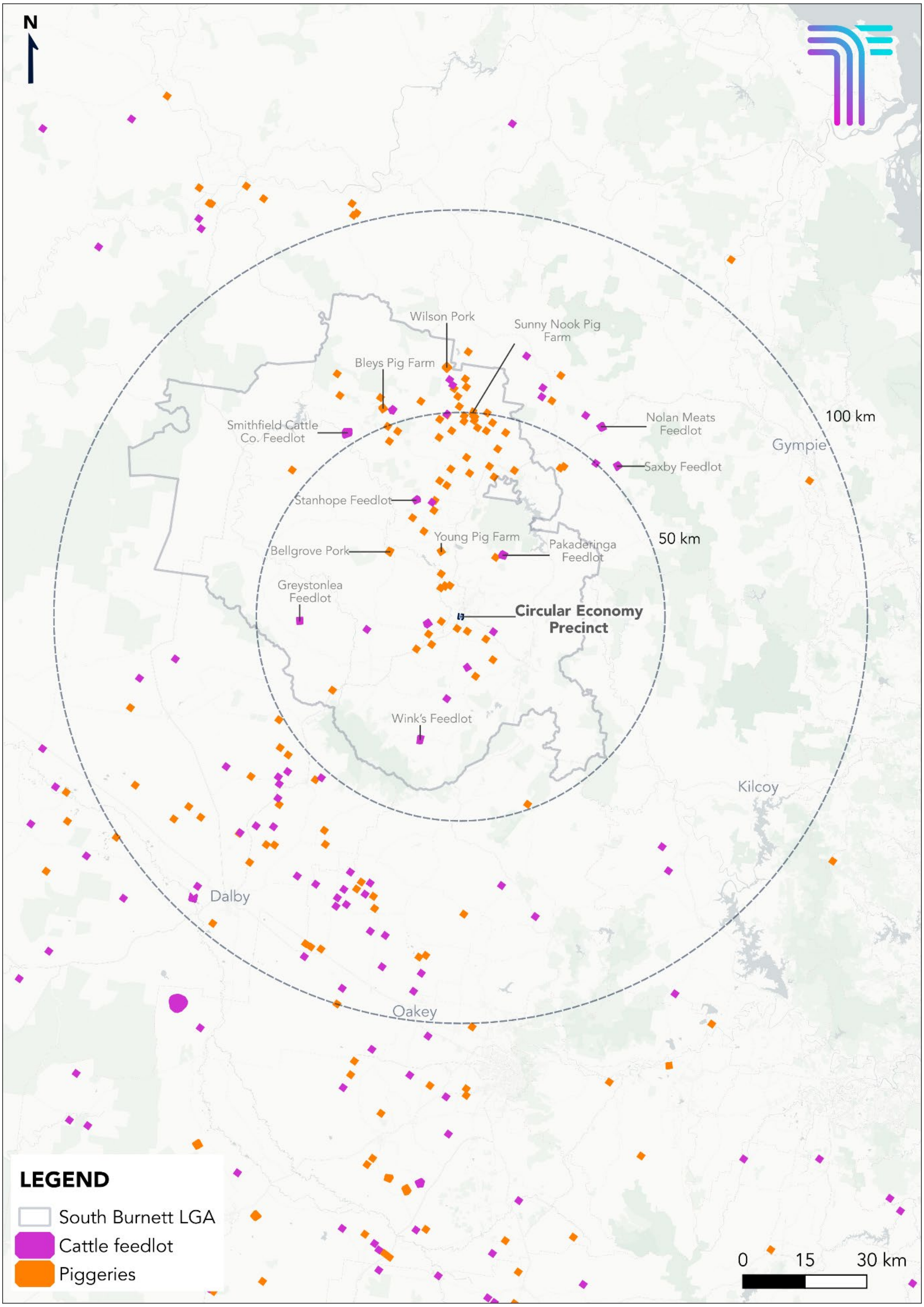


Figure 7. Cattle feedlots and piggeries (Source. Think Economics)

2.3.3 Onsite Circular Economy Functions

Overall precinct development

Revenue generated from the South Burnett Circular Economy Industrial Precinct subdivision is estimated to total approximately $87.5 million in land sales over a 24-year period. This estimate assumes an average land take-up rate of approximately 3 hectares per annum across the developable area of the precinct.

This staged release of industrial land aligns with the broader development strategy for the precinct, allowing infrastructure delivery to be coordinated with demand. It also reflects a realistic absorption rate for industrial land in a regional context, supporting sustainable long-term growth.

It is noted that stamp duty associated with land sales will provide additional revenue to the State (as the assumed land developer). However, broader tax implications in general have not been considered as part of this analysis.

In addition to direct land sales revenue, the precinct is expected to generate wider economic benefits, including job creation, increased industrial activity, and the attraction of complementary businesses that can utilise energy, heat, and by-products generated onsite.

Anaerobic Digester (AD)

Revenue generated from the AD facility is estimated at approximately $5.028 million per annum once operating at full capacity.

This reflects a diversified revenue model, with income generated across multiple product streams and environmental markets, including solid digestate, liquid digestate, BioCNG (Biomethane Compressed Natural Gas), Australian Carbon Credit Units (ACCUs), Green Certificates (renewable energy certificates), and electricity exported to the precinct or grid.

The revenue from each AD stream is summarised in the table below.

Table 2.4 Anaerobic Digestion Revenue Streams

Revenue Streams	Quantity	$/year
Solid digestate	10,000 t/pa	100,000
Liquid digestate	37,500 t/pa	375,000
BioCNG	128,700 GJ/pa	1,747,746
Australian Carbon Credit Units	37,187 tonnes CO2 ACCUs/pa	1,115,600
Green Certificates	138,333 GJ/pa	415,000
Electricity to Grid	12,500,000 kWh/pa	1,275,000
Total		**5,028,346**

Pyrolysis Facility (Biochar)

Revenue generated from the Biochar (pyrolysis) facility is estimated at approximately $2.769 million per annum at full capacity.

This revenue is primarily derived from the sale of biochar as a soil amendment and agricultural input and the generation of CO_2 removal credits through long-term carbon sequestration.

Biochar provides a range of benefits, including improved soil health, increased water retention, and reduced fertiliser requirements, which support its market demand within the agricultural sector. In addition, the generation of carbon removal credits represents a high-value and growing revenue stream, particularly within voluntary carbon markets.

Table 2.5 Biochar Facility Revenue Streams

Revenue Streams	Quantity	$/year
Biochar	3,413 t/pa	1,835,925
CO2 Removal Credits	4,129 tonnes CO2 Removal Credits/pa	933,510
Total		**2,769,435**

It is noted that there is a potential additional monetizable benefit associated with the generation of Combined Heat and Power (CHP) energy from both the AD and pyrolysis facilities. However, due to uncertainty regarding final plant configuration, heat recovery systems, and the availability of nearby heat users, this benefit has not been quantified within this assessment.

Further, if the South Burnett Regional Council were to own and/or operate one or both facilities, there is potential for significant cost savings associated with reduced waste disposal requirements. This includes the diversion of green waste, biosolids, and other organic materials from landfill or alternative treatment pathways. These avoided costs represent an additional indirect financial benefit that has not been explicitly quantified but would further strengthen the overall business case.

Note: Outputs can vary depending on both the type and quantity of feedstock processed. The composition of the feedstock mix will influence the volume and characteristics of outputs. Accordingly, the estimated outputs presented in this assessment are indicative and may vary under different operating scenarios.

2.3.4 Supply Chain Outputs

Energy

The Circular Economy precinct is expected to generate significant renewable energy outputs, with primary energy products including BioCNG (biomethane) and electricity, both of which can be utilised within the precinct and exported to external markets.

BioCNG represents a high-value renewable fuel derived from the upgrading of biogas produced through anaerobic digestion. This fuel can directly displace fossil fuels in a range of applications, particularly within transport and industrial sectors. Potential uses include:

- Freight and logistics vehicles
- Council waste collection fleets
- Agricultural machinery
- Industrial heating and boiler systems
- Potential regional biofuel supply networks

The adoption of BioCNG provides both economic and environmental benefits, including reduced fuel costs, improved energy security, and significant reductions in greenhouse gas emissions. It also presents an opportunity for local government and industry to transition fleet operations toward low-emission alternatives.

Electricity generated from the AD facility further supports the precinct's energy needs. This renewable electricity can be utilised to:

- Supply energy to precinct tenants
- Power onsite waste processing operations
- Export surplus electricity to the grid

This contributes to lower operating costs for businesses within the precinct while enhancing overall energy resilience. In combination, BioCNG and electricity outputs support the development of a decentralised and low-carbon energy system, reinforcing the precinct's role as a regional hub for renewable energy generation.

Agriculture

A key strength of the Circular Economy precinct is its ability to return valuable nutrients and carbon-rich products back to the agricultural sector, supporting improved productivity and long-term soil health. The primary agricultural outputs include solid digestate, liquid digestate, and biochar.

Solid digestate, produced through the AD process, is a nutrient-rich soil conditioner that can be applied to agricultural land to improve soil structure and fertility. Its potential applications include:

- Soil conditioning for cropping and pasture systems
- Land rehabilitation and soil improvement
- Soil stabilisation and landscaping
- Environmental restoration projects

Liquid digestate provides an additional nutrient stream in the form of a fertiliser substitute. It can be used for fertigation and irrigation, delivering essential nutrients such as nitrogen and phosphorus directly to crops. This reduces reliance on synthetic fertilisers, resulting in cost savings for farmers and improved nutrient cycling within the region.

Biochar, produced through the pyrolysis process, represents a high-value agricultural input with multiple benefits. When applied to soils, biochar can:

- Improve soil structure and water retention
- Enhance nutrient availability and reduce leaching
- Increase crop productivity and resilience
- Support long-term carbon storage in soils

Together, these products create a closed-loop system where organic waste is converted into valuable agricultural inputs. This not only reduces waste disposal requirements but also supports more sustainable and regenerative farming practices across the South Burnett region.

Environment

In addition to physical products, the Circular Economy precinct generates a range of environmental credits that provide both economic value and measurable environmental benefits. These include Australian Carbon Credit Units (ACCUs), Green Certificates, and CO_2 Removal Credits.

ACCUs are generated through the avoidance of methane emissions and the displacement of fossil fuels via renewable energy production. By diverting organic waste from landfill and processing it through the AD facility, significant greenhouse gas emissions are avoided. These credits can be:

- Sold to companies seeking to offset emissions
- Purchased by government or corporate net-zero programs

Green Certificates (renewable energy certificates) are generated through the production of renewable electricity. These certificates are typically purchased by energy retailers to meet regulatory obligations or by corporations seeking to source renewable energy. They provide an additional revenue stream while supporting the broader transition to a low-carbon energy system.

CO_2 Removal Credits are generated through the pyrolysis process, where carbon is captured and stored in biochar for long periods. Unlike traditional carbon credits, which focus on emissions avoidance, these credits represent the permanent removal of carbon dioxide from the atmosphere. They are increasingly sought after in voluntary carbon markets and are typically purchased by corporations pursuing net-zero or carbon-negative targets.

Collectively, these environmental outputs position the precinct as a significant contributor to regional and national emissions reduction goals. They also diversify revenue streams and enhance the financial viability of the project, while reinforcing its role in delivering tangible environmental outcomes.

Table 2.6 Supply Chain Outputs Overview

Technology	Output	Return to economy	Economic impact	Potential Uses
Physical Products				
Anaerobic Digester	BioCNG (Biomethane)	Transport & Industry	Reduced fuel costs and emissions	Freight and logistics vehicles, Council waste collection fleets, agricultural machinery, industrial heating and boilers, potential regional biofuel supply
Anaerobic Digester	Electricity	Agriculture / Industry	Lower energy costs	Energy supply to precinct tenants, electricity export to the grid, power for waste processing operations within the precinct
Anaerobic Digester	Solid Digestate	Agriculture / Land management / Construction	Reduced fertiliser expenditure	Soil conditioner for agriculture, land rehabilitation and soil improvement, soil stabilisation and landscaping, environmental restoration projects (a)
Anaerobic Digester	Liquid Digestate	Agriculture	Reduced fertiliser expenditure	Fertiliser substitute, nutrient-rich irrigation (fertigation), soil nutrient supplementation for cropping systems
Pyrolysis Facility	Biochar	Agriculture / Land management	Improved soil productivity	Improve soil health and water retention, reduction in fertiliser requirements, increased crop productivity and resilience (b)
Environmental Credits				
Anaerobic Digester	Australian Carbon Credit Units	Carbon markets	Additional revenue stream	Sold to companies offsetting emissions, purchased by government or corporate net-zero programs (c)
Anaerobic Digester	Green Certificates	Renewable energy markets	Additional revenue stream	Purchased by energy retailers to meet renewable energy target obligations, purchased by companies seeking renewable electricity sourcing
Pyrolysis Facility	CO_2 Removal Credits	Carbon markets	Additional revenue stream	Sold as carbon removal credits in voluntary carbon markets, purchased by corporations pursuing net-zero commitments (d)

(a) Primary use will almost always be agriculture rather than construction, but construction can be a secondary market.; (b) Agriculture is by far the main market; construction uses are still emerging.; (c) Revenue stream generated from avoided methane emissions and renewable energy displacement.; (d) Credits generated through long-term carbon sequestration in biochar.

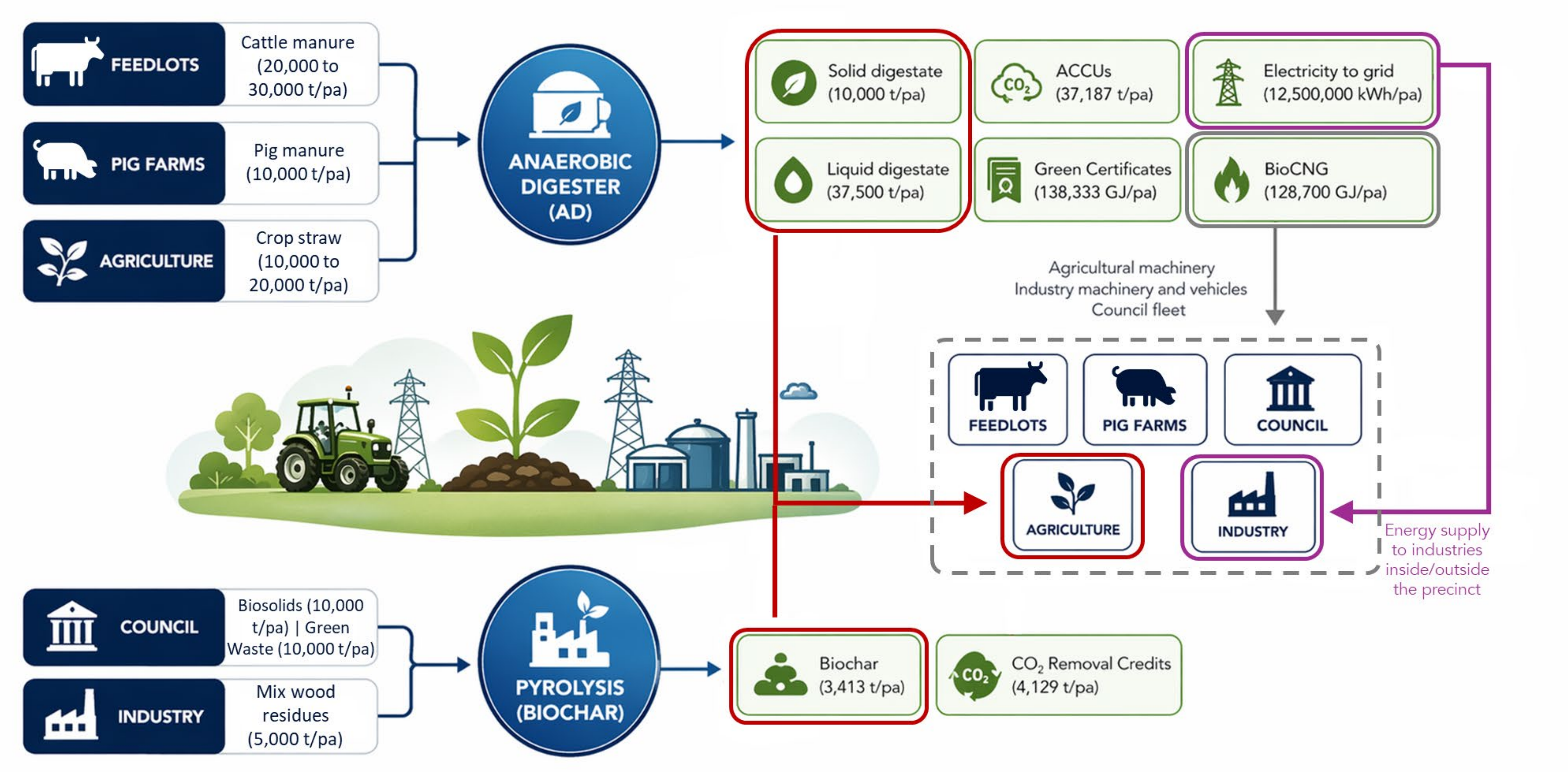


Figure 8. SBCEIP supply chain

3.0 Planning Regulatory and Risk Investigations

3.1 Stakeholder Engagement

To support the development of this report key stakeholders were engaged to confirm regulatory approval requirements and operational considerations. Table 1 below details the stakeholders engaged, key discussion points and implications for this study.

Table 7. Stakeholder Engagement

Stakeholder	Key Discussion Points	Implications for this Study
Department of the Environment, Tourism, Science and Innovation	Prescribed Environmentally Relevant Activity (ERA) for the SBCEIP	The following ERA permits are likely to be required: • Anaerobic Digestion – ERA53(b) • Vermicomposting – ERA53(a) • Biosolids to gas & biochar product – ERA61 • Aerobic Flow through Composter – ERA53(a) • Energy-Saving Fast Biochar Expert System – ERA61 • Construction Material Resource Recovery Plant – ERA62(1a) and ERA54(1) • Waste to Energy (Waste-to-energy (WTE) – ERA61 and possibly 54.
Pyrocal	Feasibility and scale of pyrolysis for biochar production	Consideration of quality, transport and storage of feedstocks.
Valorify	Feasibility and scale of anaerobic digestion	Commercial approach to securing feedstock availability.
Plenty Foods	Review of feedstock availability	Feedstock made available for animal consumption.
Swickers	Review of feedstock availability	Feedstock (manure) availability depends on price point as manure currently used for fertiliser.

Pakaderinga Feedlot	Review of feedstock availability	Feedstock (manure) availability depends on price point as manure currently used for fertiliser.
South Burnett Agri-Industrial Proposal	Integration of land uses	Integration of roads, services and tenancies.
Gympie Regional Council	Waste management memorandum of understanding	Opportunity to collaborate on waste management and processing.

3.2 Regulatory Requirements

3.2.1 General Legislative Framework

The proposed circular economy precinct incorporating the primary applications of anaerobic digestion (AD) and pyrolysis technologies is subject to a legislative and regulatory frameworks that governs environmental protection, waste management, land use planning, and operational compliance. This framework establishes the statutory basis for development approvals, environmental licensing, and the ongoing operation of waste-to-resource facilities.

Environmental Protection Act 1994

Under the *Environmental Protection Act 1994* (EP Act), environmentally relevant activities (ERAs), including waste processing and resource recovery operations, are subject to regulatory requirements. Facilities such as pyrolysis and anaerobic digestion (AD) plants that process organic waste are typically classified as ERAs and must comply with the applicable environmental assessment, approval, and operational requirements prescribed under the Act. Operators must obtain an Environmental Authority (EA) before construction or operation and comply with conditions related to odour, air emissions, bioaerosols, noise limits, stormwater and leachate management, waste acceptance criteria, and monitoring and reporting.

Pyrolysis and anaerobic digestion (AD) facilities must comply with the General Environmental Duty (GED), requiring all reasonable and practicable measures to prevent or minimize environmental damage through a proactive and systematic risk management approach, beyond compliance with EA conditions.

This includes implementing operational controls for the storage and handling of feedstocks and outputs (e.g. digestate and biochar), such as covered receival areas, impermeable hardstands, effective stormwater segregation, appropriate buffer distances, and routine inspection and maintenance of tanks, pipework, and processing infrastructure to ensure environmental protection and system integrity.

Waste Reduction and Recycling Act 2011

The *Waste Reduction and Recycling Act 2011* (WRR Act) establishes the legislative framework for waste management, resource recovery, and circular economy practices in Queensland. The Act reinforces the waste hierarchy by prioritizing reuse, recycling, and recovery over disposal, and supports the conversion of waste materials into beneficial resources through regulated recovery processes.

In a waste-to-energy facility such as anerobic digestion and pyrolysis, the *Waste Reduction and Recycling Act 2011* (WRR Act) regulates the classification, handling, storage, transport, and processing of feedstocks such as organic waste, biosolids, and other biodegradable materials. It also governs the beneficial reuse of outputs, including digestate and biochar, under the End-of-Waste (EOW) framework. This is discussed further in Section 3.3.5**.**

DETSI

The primary environmental regulator for the proposed facilities is the Department of Environment, Tourism, Science and Innovation (DETSI), which administers environmental approvals and compliance under the EP Act and associated policies. DETSI is responsible for assessing Environmental Authority applications, setting license conditions, reviewing environmental management documentation, and undertaking compliance monitoring and enforcement.

DETSI *Energy from Waste Policy* (2021) outlines policy outcomes that guide assessment of environmental authority applications for Energy from Waste facilities. Table 2 below outlines policy outcomes applicable to Anaerobic Digestion and Pyrolysis plants.

Table 8. Applicable Waste Policy Outcomes for Anaerobic and Pyrolysis Facilities

Policy Outcomes	**Anaerobic Digestion Energy from Waste**	**Pyrolysis Energy from Waste**
1. Protect the waste hierarchy	x	x
2. Demonstrate operational performance	x	x
3. Engage with the community	x	x
4. Only residual waste as feedstock		x
5. Adapt to residual waste changes		x
6. Energy recovery requirements		x
7. Environmental protection requirements	x	x

The requirements of each policy outcome are outlined below.
1. Protect the waste hierarchy requires facilities to demonstrate waste processing at the highest possible order level of the waste hierarchy. For pyrolysis and Anerobic Digestion treatment plants, this means justifying that feedstock is residual waste and cannot be managed through higher order pathways.
2. Operational performance of proposed facilities must be demonstrated with providing data from a reference facility that:

- It is at a scale similar to the proposed facility
- Has feedstock similar in composition
- Data for at least two continuous years and no older than five years
- Is in Queensland or in a jurisdiction with comparable regulations

3. Engaging with the community requires operators of the facility to implement stakeholder engagement strategies including complaint management system and transparent communication of environmental performance.
4. Residual waste as feedstock requires pyrolysis and anaerobic digestion facilities to ensure only waste that cannot be recycled or recovered is used.
5. Adapt to residual waste changes requires pyrolysis facilities to demonstrate that readiness for potential reduction in residual waste that can be used as feedstock.
6. Energy recovery requirements must be demonstrated through the R1 Energy Efficiency formula and procedures set out in the European Union Waste Framework Directive by reaching the minimum R1 value of 0.65.
7. Environmental protection requirements must be met with guidance of Waste Incineration and Waste Treatment Best Available Techniques Reference Documents regulated by the Industrial Emissions Directive (2010).

For AD and pyrolysis operations, DETSI oversight will extend to emissions and environmental management, waste processing limits, environmental monitoring programs, and adherence to approval conditions throughout the operational life of the facility.

It is highly recommended to have a pre lodgement application meeting with DETSI to confirm the requirements for the facility prior to submission to reduce the number of requests for information's requests, get the right information to DETSI to reduce the overall assessment process timeframe.

3.2.2 Environmental Authority and ERA Classification

The proposed precinct concept includes an AD facility and a Biochar (Pyrolysis) facility. Both activities will require Environmental Authorities under the *Environmental Protection Act 1994* with conditions determined by their respective environmental risks.

The developer of an AD facility classified under ERA53(b), organic material processing by anaerobic digestion, should consider the impacts, monitoring, and management of:

- Odour emissions
- Biogas composition, including methane, carbon dioxide, and hydrogen sulphide

- Leachate collection and storage
- Segregation of clean and contaminated runoff
- Surface water and groundwater quality
- Feedstock characterisation, storage, and processing

The following impacts are discussed in detail in Section 3.3.3 below.

The developer of a Pyrolysis facility classified under ERA61, thermal waste reprocessing and treatment, should consider the impacts, monitoring, and management of:

- Air emissions including particulate matter, carbon monoxide, volatile organic compounds
- Energy recovery performance
- Fugitive emissions during handling and processing
- Reuse, storage, or disposal of residual solids
- Noise and dust impacts associated with processing activities

The following impacts are discussed in detail in Section 3.3.4 below

3.2.3 Anaerobic Digestion Requirements

Waste and Feedstock Management

The developer must produce, provide and implement a Feedstock Management Plan for the activity to ensure the appropriate acceptance, handling, storage, and processing of all incoming feedstock. DETSI is likely to require the plan to meet the following requirements:

- Methods for characterizing all feedstock and determining its odour rating in accordance with applicable criteria, including:
  - Schedule 1 Odour Table for composting feedstock; or
  - The Organic Feedstock Odour Rating Assessment available on the department's website where the feedstock is not listed.

- Storage and processing requirements based on the odour rating and physical composition of each feedstock type.
- Procedures for sampling and testing to determine the carbon to nitrogen ratio of composting material.
- Procedures to assess whether the feedstock is suitable for the processing techniques used at the site
- Procedures to verify feedstock acceptance complies with environmental authority conditions.
- Procedures for rejecting feedstock that is unsuitable or unlawful.
- Procedures for reporting unlawful waste deliveries to the administering authority.

Prior to acceptance, feedstock suitability should be assessed by the developer using certified reports or other adequate information provided by the supplier. This information should include representative sampling and analysis to characterize the chemical, physical, and biological properties of the material and to evaluate potential risks to human health and the environment.

Where necessary, a risk assessment should be undertaken to identify process controls, potential contaminants, and any factors that may inhibit the composting process, thereby confirming the appropriateness of the proposed treatment method.

Comprehensive records must be maintained by the operator for all feedstock received and any materials rejected under the Feedstock Management Plan, including the following:

- Generator or transporter details with contact information.
- Date and time of receipt.
- Feedstock description.
- Weight or volume.
- Assigned odour rating.
- Sampling details (sample ID, laboratory holding time, storage method and location).
- Measurements, observations, and characterization results.
- Name of the person responsible for measurements or observations.

All records should be created as soon as practicable after the feedstock is received on site operational compliance.

Land Management

Contaminants must not be released to land except as specifically authorised under ERA 53(b), ensuring the protection of land and preventing contamination.

To achieve compliance, the developer should implement measures to prevent direct or indirect releases, minimise on-site and off-site spills, and avoid irrigation of wastewater, leachate, or contaminated stormwater to land. Additional controls include maintaining adequate freeboard in contaminated water storages, covers for stored contaminants, treating contaminated stormwater before offsite release, storing contaminants on hard or lined surfaces only, and implementing leak detection, groundwater monitoring bores, alarm systems, regular maintenance, and emergency response procedures.

Areas of the site with liquid containing structures, or any other area of the site capable of releasing contaminants should be bunded to contain potentially harmful substances an mitigate damage to the environment. Typically, these risks are defined with there control measures in an Environmental Management Plan and design documentation with ongoing monitoring outlined in management plans (i.e. stormwater management plan, site based management plan).

DETSI will require an erosion and sediment control plan to be developed for the site, covering construction through to operation of the facility. The developer/operator will be responsible for implementing an approved erosion and sediment control plan which complies with regulatory standard, and is certified for the site. Erosion and sediment control measures must be in place to manage stormwater flow, minimise exposure of soils to wind and rain, reduce soil erosion and sedimentation, and prevent adverse impacts to downstream land, watercourses, and properties. Site-specific risk assessments should guide the selection and implementation of these measures. Areas used for receiving, mixing, and storing feedstock, processing composting material, and collecting or storing leachate or stormwater runoff must be impervious to protect subsoil, surface water, and groundwater from contamination. Operators must ensure that the design, construction, and use of impervious areas effectively prevent contaminant infiltration, taking into account site-specific soil and feedstock characteristics.

Water and Leachate Management

Contaminants must not be released to any waters except as specifically permitted under ERA 53(b), including surface waters, stormwater, groundwater, tidal waters, the bed and banks of waterways, and the ocean.

Any stormwater that passes through composting piles or stored feedstock must be managed as leachate, either by preventing contamination or by directing contaminated stormwater to appropriate treatment and retention systems. Stormwater treatment and retention systems must have sufficient capacity to contain runoff from disturbed areas generated by a 24-hour rainfall event with the specified Annual Exceedance Probability (AEP) typically 10% AEP. Stormwater may only be released where beneficial reuse on site is not viable, release is necessary to maintain the required retention capacity for the same design rainfall event, and no contaminants are present that could cause environmental harm. The developer will need to provide is information in design documentation as well as in a stormwater management plan which will also outline the long term monitoring requirements.

Leachate must be stored in lined and aerated ponds that maintain aerobic conditions or in enclosed leachate tanks, with all collection and storage systems designed, installed, operated, and maintained by a qualified person to ensure ponding occurs only in designated areas, leachate does not directly enter stormwater basins, it is drained away from composting material to a designated collection drain, and the structural integrity of impervious barriers is maintained. The operator may need to install leak detection, groundwater monitoring bores, alarm systems, regular maintenance, and emergency response procedures which would be outlined in the design documentation and site management plans.

Air Quality Management

Odours and airborne contaminants generated by the activity must not cause environmental nuisance at any sensitive or commercial receptor, except permitted under ERA 53(b). Environmental nuisance may occur where emissions unreasonably degrade air quality and result in conditions that are unhealthy, offensive, or detrimental to public amenities. Air contaminants may include odour, dust, smoke, fumes, aerosols, steam, or particulate matter, whether visible or not, with odour and dust being the most common sources of complaint. The operator is required to identify all potential emission sources and implement effective management measures to prevent impacts at and beyond the site boundary.

Control measures are to be commensurate with site-specific risks and may include minimising areas of exposed soil, stabilising disturbed surfaces, applying water sprays or dust suppressants, managing stockpiles to reduce wind exposure, covering materials during transport, enclosing dust- or emission-generating activities, scheduling works with regard to prevailing weather conditions, installing windbreaks, and prohibiting the burning of waste materials.

The operator must produce an Odour Management Plan prior to the commencement of operations to identify all actual and potential odour sources, provide for investigations by suitably qualified personnel where required, assess routine and non-routine operations that may generate odour, and outline measures to prevent or minimise off-site impacts. The plan must also include periodic reviews to ensure ongoing effectiveness.

Typical management practices may include maintaining sufficient bulking agents to cover odorous materials, promptly incorporating putrescible feedstock into the composting process, managing windrow turning to prevent anaerobic conditions, minimising turning during early composting stages, applying biofilter covers such as finished compost or mulch, maintaining stable biological conditions within processing systems, promptly cleaning spills, installing odour control equipment where necessary, and scheduling odour-generating activities to reduce the likelihood of offsite impacts. If the proximity to sensitive receptors is considered high risk odour modelling may need to be undertaken to confirm if the activities are low risk and not likely to cause nuisance to the local community.

In addition to the requirements of State Regulator it is also noted that due to the proximity of the development to the Kingaroy Airport the development may also see conditions put on the facility to reduce impacts to the airport. One of the key items is buffer distances which is outlined in the Overlay Map (om1-airport-environs-overlay-map-2023-02-22.pdf) which has a 3km buffer distance from the airport. It is noted that the whole circular economy precinct is within this buffer with the Pyrolysis and AD development some 500m from the airport boundary.

Noise Management

The developer should consider that an environmental authority provided by DETSI will stipulate requirements for the management of reasonable noise levels. Noise from the activity must not cause environmental nuisance at any sensitive or commercial receptor. It is recommended that a site-specific noise assessment be completed where there is a higher risk of noise generation, with appropriate limits applied to protect nearby receptors.

The operator must identify potential noise sources and implement suitable mitigation measures. These may include selecting low-noise equipment, installing acoustic barriers or enclosures, maintaining plant and vehicles, managing traffic movements and road conditions, orienting noise sources away from receptors, limiting operating hours (particularly at night, on weekends and public holidays), and ensuring equipment is not left running when not in use.

Site layout and operational planning should minimise noise transmission by locating noisy activities away from sensitive areas, reducing material drop heights, routing internal roads to maximise separation distances, and avoiding placement of staff or vehicle waiting areas near receptors. Monitoring should be undertaken as necessary to confirm that controls are effective and that the activity is not causing environmental harm. The operator remains responsible for implementing measures appropriate to the scale and risk of the activity. The developer should consider how they are able to address operational noise issues in the event of complaint or breach. If complaints are made by those in nearby sensitive receptor, the operator should be able to implement control measures and demonstrate to DETSI that compliance can be achieved.

Anerobic Digestion Summary

The following outlines the minimum requirements for the proposed Anerobic Digestion development. Additional assessments and investigations may be required depending on actual site factors during detailed design phase.

Table 9. Anaerobic Digestion Summary

Key Risks to be addressed	• Feedstock management • Odour management • Groundwater and surface water protection • Noise
Documentation Required	• Feedstock management plan • Design documentation/engineering assessment by suitably qualified persons • AD Technology with data relevant to proposed conditions • Odour modeling assessment • Odour/air quality management plan • Groundwater and surface water management plans • Noise impact assessment and management plan • Environmental management plan • Erosion and Sediment Control Plan • Site Based Management Plan
Ongoing Management Requirements	Groundwater and leak detection monitoring Surface water monitoring Odour monitoring Waste tracking of incoming waste materials and outgoing resources sold.

3.2.4 Pyrolysis Requirements

The proposed South Burnett Regional Council Circular Economy project is expected to include a Pyrolysis facility, and associated infrastructure. Pyrolysis is referred to by DETSI as thermal waste reprocessing and treatment, and the requirements and regulations of such facilities are classified ERA61. Although the developer should be aware that several regulatory requirements apply to both Anaerobic digestion and Pyrolysis, there are guidelines and requirements specific to Pyrolysis.

As part of the developer's application for a thermal treatment of waste (Pyrolysis) facility, the applicant should produce the site specific information relating to the thermal treatment of waste. These include a description of the activities to be carried out on the site, proposed Pyrolysis technology, Feedstock materials and predicted residual content material composition. In this case, it is understood that the residual material is to be Biochar.

Feedstock

DETSI will likely align an environmental authority condition with the requirements of feedstock material for pyrolysis. The developer should consider their process for intake of feedstock material, onsite material management including but not limited to general storage, protection against environmental contamination, health requirement associated with the material, potential noise and air pollution. The type of available feedstock material should also be considered for the life of the facility as the operator may be required to adapt to changing feedstock streams.

Feedstock management can pose risk to the developments surrounding environment through several methods. It is recommended that the developer produce a plan for containment of feedstock material prior to it undergoing the pyrolysis process. Should feedstock material come in contact with heavy rainfall events, leachate generation will occur and potentially leave the site. The developer should implement infrastructure and procedural controls for leachate management.

Dust & Odour

The developer should investigate the existing conditions of the proposed location and surrounding sensitive receptors to be able to provide a detailed description of the environment values relating to air and noise. DETSI will seek to understand how the facility operator will manage, minimise and suppress dust and odour produced at the facility. The operator should present a robust facility management plan, incorporating primary and backup controls for these items which outlines the specific pollution control equipment and techniques proposed, as well as backup infrastructure and procedural measures that will enact in if the primary systems fail to mitigate the likelihood of plant failure and environmental impact.

It is recommended that the developer seeks to understand the effect of the facility on the surrounding sensitive receptors and completes an outdoor odour impact assessment to quantify potential impact. It is likely that DETSI will expect to review a completed odour impact assessment of the proposed development.

In addition to the requirement of State Regulator it is also noted that due to the proximity of the development to the Kingaroy Airport the development may also see conditions put on the facility to reduce impacts to the airport. One of the key item is buffer distances which is outlined in the Overlay Map (om1-airport-environs-overlay-map-2023-02-22.pdf) which has a 3km buffer distance from the airport. It is noted that the whole circular economy precinct is within this buffer with the Pyrolysis and AD development some 500m from the airport boundary.

Noise

Both Pyrolysis and Anaerobic Digestion have the potential to produce noise pollution which can affect nearby sensitive receptors. High noise output areas should be strategically positioned in the facility to mitigate the risk of excessive noise reaching sensitive receptors. The site-specific noise assessment and management plan should incorporate both the Pyrolysis and Anaerobic Digestion activities.

Monitoring should be undertaken as necessary to confirm that controls are effective and that the activity is not causing environmental harm. The operator remains responsible for implementing measures appropriate to the scale and risk of the activity. The developer should consider how they are able to address operational noise issues in the event of complaint or breach. If complaints are made by those nearby, the operator should be able to implement control measures and demonstrate to DETSI that compliance can be achieved.

Water & Leachate

It is recommended that the Pyrolysis infrastructure be designed to mitigate the effect of rainfall, leaks and leachate production. Covering and bunding areas containing materials capable of producing leachate if contacted by water, can lower associated risks. Bunding should be considered as in important control measure in the event of leakage.

The developer should demonstrate that they can implement effect leachate management systems and infrastructure capable of diverting and treating leachate as necessary. Delineation of non-contaminated water, and leachate should be a key consideration for the site water management plan. In general the site water management plan should consider how rainfall will impact the site, how leachate generation and be minimised and treated, and how site water can be released in accordance with expected site water release conditions. Water modelling for the proposed site is recommended to further support the development application.

Air Quality

The Pyrolysis facility will require a release stack as a location for the release of potential airborne contaminants resulting from the pyrolysis process. DETSI will seek to understand characteristics of the release point, including the dimensions of the stack, release direction, prevailing winds and controls to prevent rainfall ingress.

The developer should seek to understand the potential emissions of their proposed facility at all sources including but not limited to point sources, volumes, areas both producing and affected as well as road sources. An estimate of emissions should be undertaken considering real measurements from similar facilities, published emission factors and data supplied by manufacturers of the process and control equipment proposed to be used in the facility. This estimation should be completed to estimate normal operating conditions, and 'upset' conditions. The estimation may be required to be backed by air quality modelling undertaken by a suitability qualified person.

As part of the site's specific Environmental Authority, DETSI will include conditions in relation to 'Air'. These conditions will likely stipulate requirements for contaminants that will be released through the release point, as well as maximum release limits, release height and velocity, and monitoring frequencies.

Contaminants released may include but are not limited to particulates (TSP, PM10, PM2.5), sulphur dioxide (SO2), nitrogen oxides (NOx) volatile organic compounds (VOC), carbon monoxide (CO), hydrogen chloride (HCl), hydrogen fluoride (HF), heavy/trace metals (e.g. cadmium, thalium, mercury, antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium), and toxic/hazardous substances such as polycyclic aromatic hydrocarbons (PAH) and dioxins and furans (PCDD/Fs). Similar facilities may be subject to requirements stating that the release of contaminants may only be through a single point, and only vertically upwards. This is likely to apply to the proposed facility.

The developer should prepare an emission inventory for all expected air pollutants based on items such as the proposed operations and expected feedstock. Monitoring of release contaminants will be required under a site's Environmental Authority, stipulating the minimum frequency of monitoring. The monitoring requirements will also be dependent on the feedstock materials. It is recommended that the developer produce a monitoring plan and methodology for the site.

Impact Assessment

The developer should complete impact assessment modelling for the proposed pyrolysis facility. This should be undertaken using an appropriate model which is supported by DETSI. An impact assessment is an essential item that DESTI will require as part of application for a development including thermal waste to energy activities such as Pyrolysis.

Pyrolysis Summary

The following outlines the potential minimum requirements for the proposed Pyrolysis development. Additional assessments and investigations may be required depending on actual site factors during detailed design phase.

Table 10. Pyrolysis Summary

Key Risks to be addressed	• Feedstock management • Air quality management • Groundwater and surface water protection • Noise

Documentation Required	• Feedstock management plan • Design documentation/engineering assessment by suitably qualified persons • Pyrolysis technology information with emissions data relevant to proposed conditions • Air quality and dispersion modeling assessment • Impact assessment • Health Risk Assessment • Odour/air quality management plan • Groundwater and surface water management plans • Noise impact assessment and management plan • Environmental management plan • Erosion and Sediment Control Plan during construction • Site Based Management Plan
Ongoing Management Requirements	Groundwater and leak detection monitoring Surface water monitoring Air quality/stack monitoring Waste tracking of incoming waste materials and outgoing resources sold.

3.2.5 End of Waste Code (EOW)

An End of Waste Code is a regulatory instrument that allows a material that would otherwise be classified as waste to cease being waste once it meets specified quality, contaminant, and management criteria.

The priority technologies proposed within the precinct are expected to produce digestate and biochar as end products. Under normal circumstances, these materials would be classified as waste. However, the End of Waste Codes EOWC010001054 for digestate and EOWC010002177 for biochar provide a regulatory pathway for these materials to cease being classified as waste when all relevant criteria are satisfied. Upon compliance with the requirements of the applicable codes, these materials may be lawfully supplied and used as approved resources, such as soil conditioners or fertilisers.

To apply these EOW Codes, the producer must be a registered resource producer/user and comply with all associated requirements applicable to registered resource producers under the relevant code.

- Criteria for Digestate as Resource Producer under EOWC010001054.
    - o The approved resource is digestate.
    - o The digestate must meet the maximum permissible concentration of impurities for fertiliser under the resource quality criteria.
    - o The digestate must be produced only from the following approved feedstocks:
        - Paunch

        - Organic material from agricultural and livestock production
        - Liquid digestates.
        - Green waste (municipal kerbside collection only).
        - Food waste and food processing waste (including pet food and beverage waste).
        - Cardboard and paper waste.
    - Undergo pasteurisation prior to land application or supply to resource users.
    - The approved resource is digestate which complies with requirements of this EOW code and is used for the following purposes:
        - as a feedstock in the manufacture of compost; and/or
        - as a soil conditioner and/or fertiliser on agricultural land.

The registered resource producer must not use, sell or give away the resource under this EOW code unless the resource complies with all the criteria and quality characteristics'

- Criteria for Biochar as Resource Producer under EOWC010002177 Code.
    - The approved resource is biochar
    - If produced from digestate, food waste, food processing waste and/or biosolids, must not exceed specified quality limits.
    - Biochar must be produced only from the following approved feedstocks:
        - Biosolids meeting classification requirements
        - Digestate
        - Organic material from agricultural and livestock production
        - Green waste
        - Food waste and food processing waste
        - Cardboard and paper waste
    - The approved resource is biochar which complies with requirements of this EOW code and is used for the following purposes:
        - As a fertiliser and/or soil conditioner on agricultural land; or
          As a fertiliser and/or soil conditioner for domestic lawns, gardens, and landscaping.
- Criteria for Paunch as Resource User under ENEW07597819.

Prior to operating under this EOW code, a person who intends to use the approved resource must notify the chief executive by giving a notice in the approved form 5 at least 10 days prior to the commencement of using the resource.

Use of the paunch solids as a feedstock in an anaerobic biogas plant must only be carried out in accordance with the Guideline for operating plant – Biogas.

Treating or processing waste to meet End of Waste (EOW) resource quality criteria may require an Environmental Authority (EA) under the *Environmental Protection Act 1994* if the activity triggers an Environmentally Relevant Activity (ERA).

4.0 Masterplan and 3D Virtual Model

The 2D masterplan has been developed as a spatial and functional blueprint for the Kingaroy South precinct, beginning with the prioritisation of land required for the priority technologies.

These Priority Technologies form the anchor around which all other land uses, infrastructure and circulation networks are arranged. The masterplan allocates sufficient footprint for current waste-processing volumes while reserving expansion capacity to accommodate future regional growth.

Supporting infrastructure including heavy-vehicle road geometry, set-down areas for inbound raw materials and outbound value-added products, water connections, parking, and precinct amenities has been designed to ensure operational efficiency and safety. The layout also intentionally positions complementary industries, agricultural value-adding enterprises, and a potential zero-waste demonstration or innovation hub to leverage the precinct's circular economy focus and attract research, education and industry partners.

The 3D virtual model has been developed using the 2D masterplan as the georeferenced foundation for building footprints, circulation networks, land-use zones and site boundaries.

4.1 Site Analysis

The Project Site outlined at the Kingaroy TAFE location comprises a large, predominantly cleared land parcel on the southern edge of Kingaroy, framed by major transport corridors including the D'Aguilar Highway and Bunya Highway. It sits immediately adjacent to the TAFE Queensland Kingaroy Campus and near the Kingaroy Aerodrome, placing it within an established education and light-industrial precinct.

The land itself is largely open, gently contoured, and currently used for agricultural or low-intensity purposes, offering substantial flexibility for redevelopment. Its strategic position, close to existing road networks, utilities, and workforce training facilities makes it well suited for a circular economy industrial precinct, particularly one integrating anaerobic digestion, biochar production, and complementary value-adding industries.

Context Analysis

The Project Site is surrounded by a variety of uses that may complement future proposed development. These include the following as shown in Figure 2.

a) Kingaroy TAFE
b) Kingaroy Airport
c) Joe Bjelke-Petersen Research Facility & Redvale Field Site
d) Proposed future "agri-park"
e) Kingaroy Water Treatment Plant.

Figures 2-6 provide further detail on the background of each site and the opportunities and constraints as they relate to the Project Site.

Figure 96. Precinct Scope

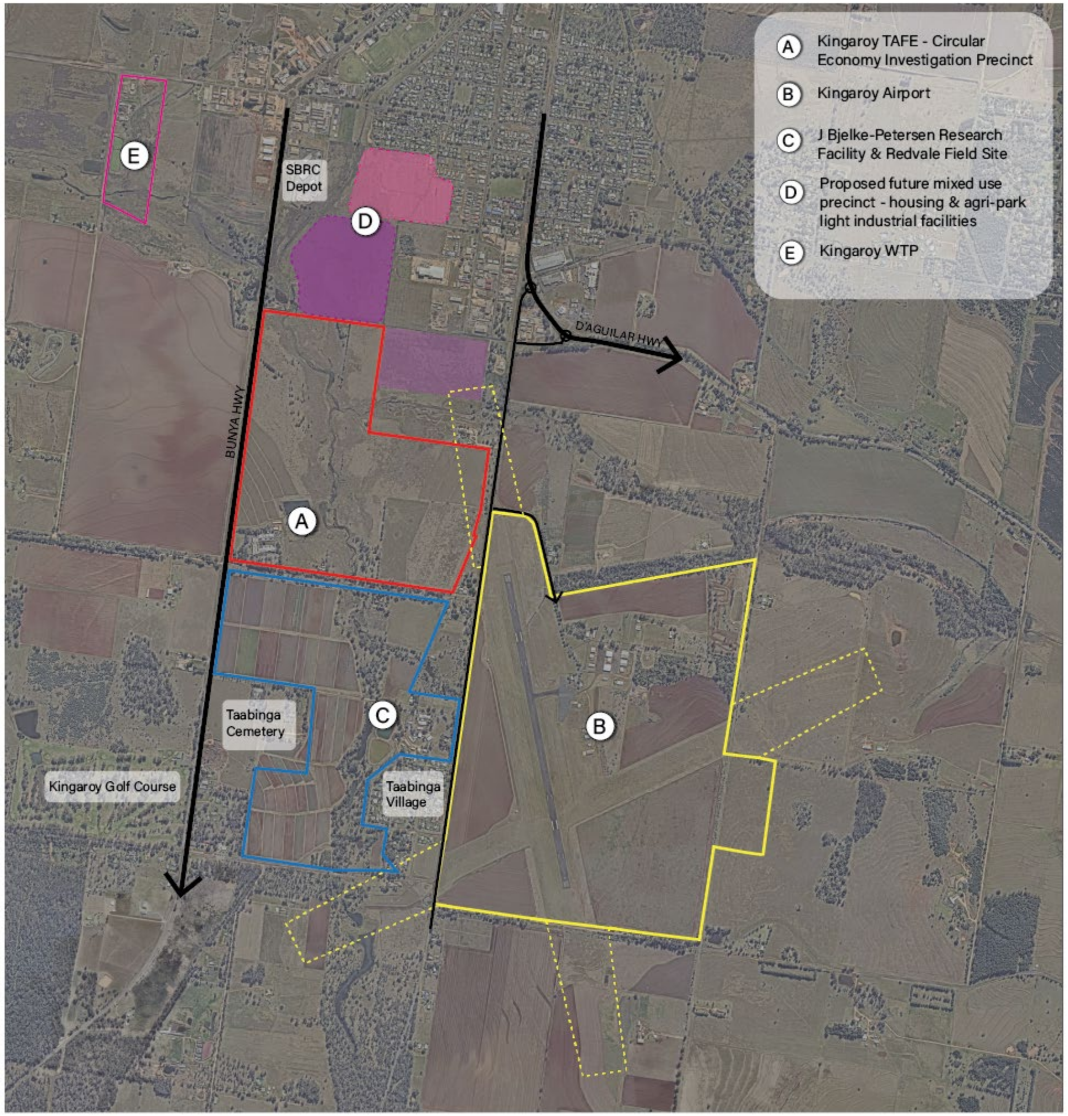
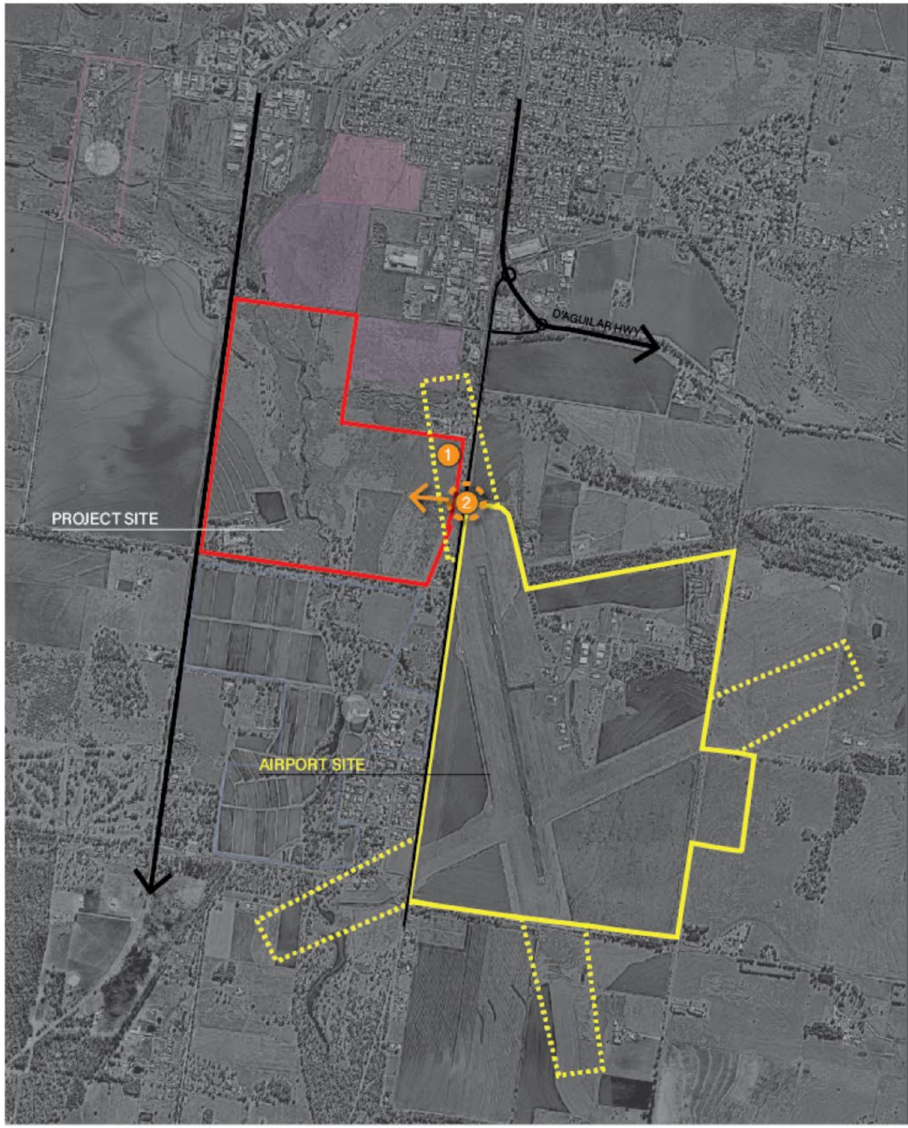


Figure 10. Strategic Land Use Analysis



Background Context

Sir Joh Bjelke-Petersen Airport (Codes: IATA: KGY, ICAO: YKRY)

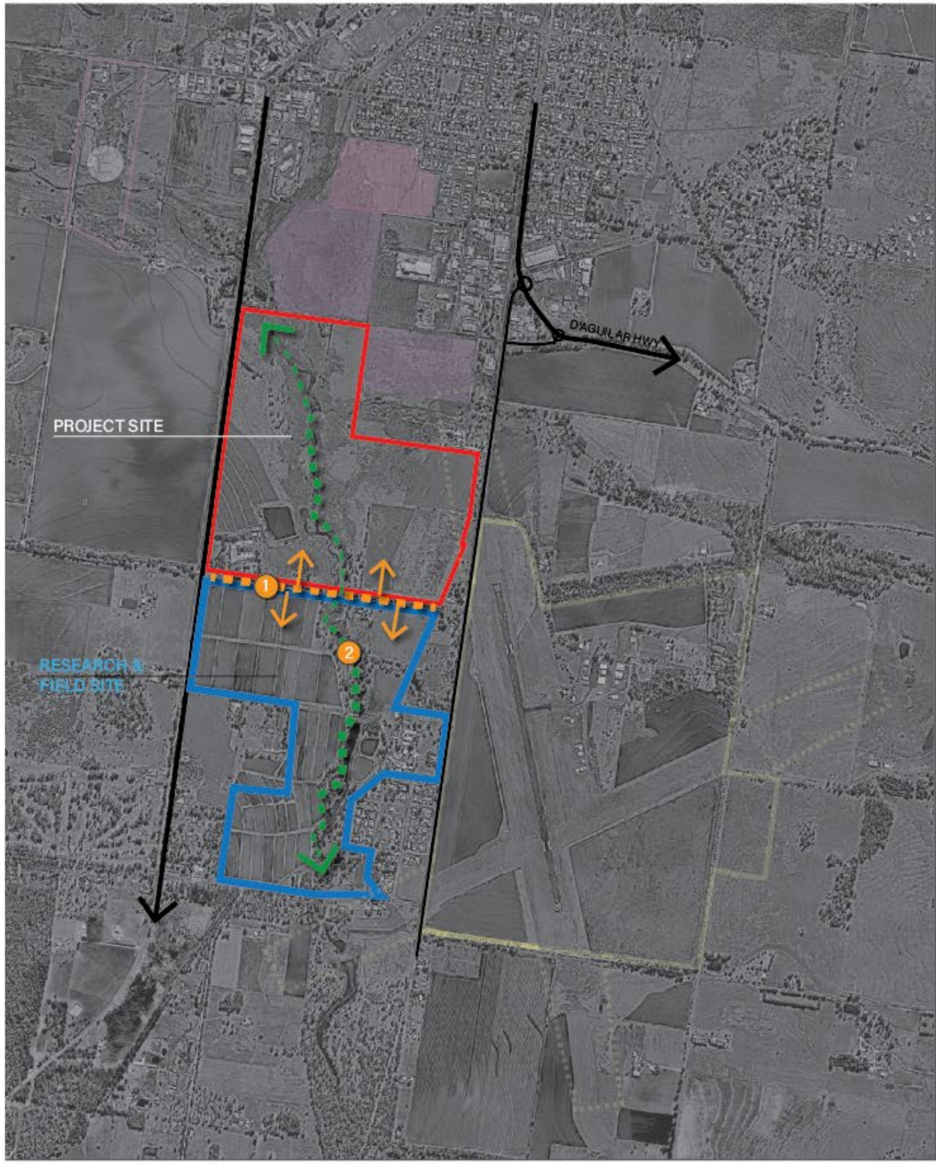
- Located 4.5 km south of Kingaroy on Warrent Truss Dr
- 258 ha (FH) site
- Zoned: Community Facilities, Rural
- 2 runways (with associated OHL & Safety Areas)
- Subject to future SBRC masterplanning

Strategic Opportunities & Contraints to Project Site

1. OHL & Safety constraints overlay the north east of the site

2. Warren Truss Dr intersection presents an opportunity for a new primary East-West access into the Project Site whilst improving (safety & capacity) vehicle access into the Airport.

Figure 11. Kingaroy Airport Analysis



Background Context

J Bjelke-Petersen Research Facility & Redvale Site

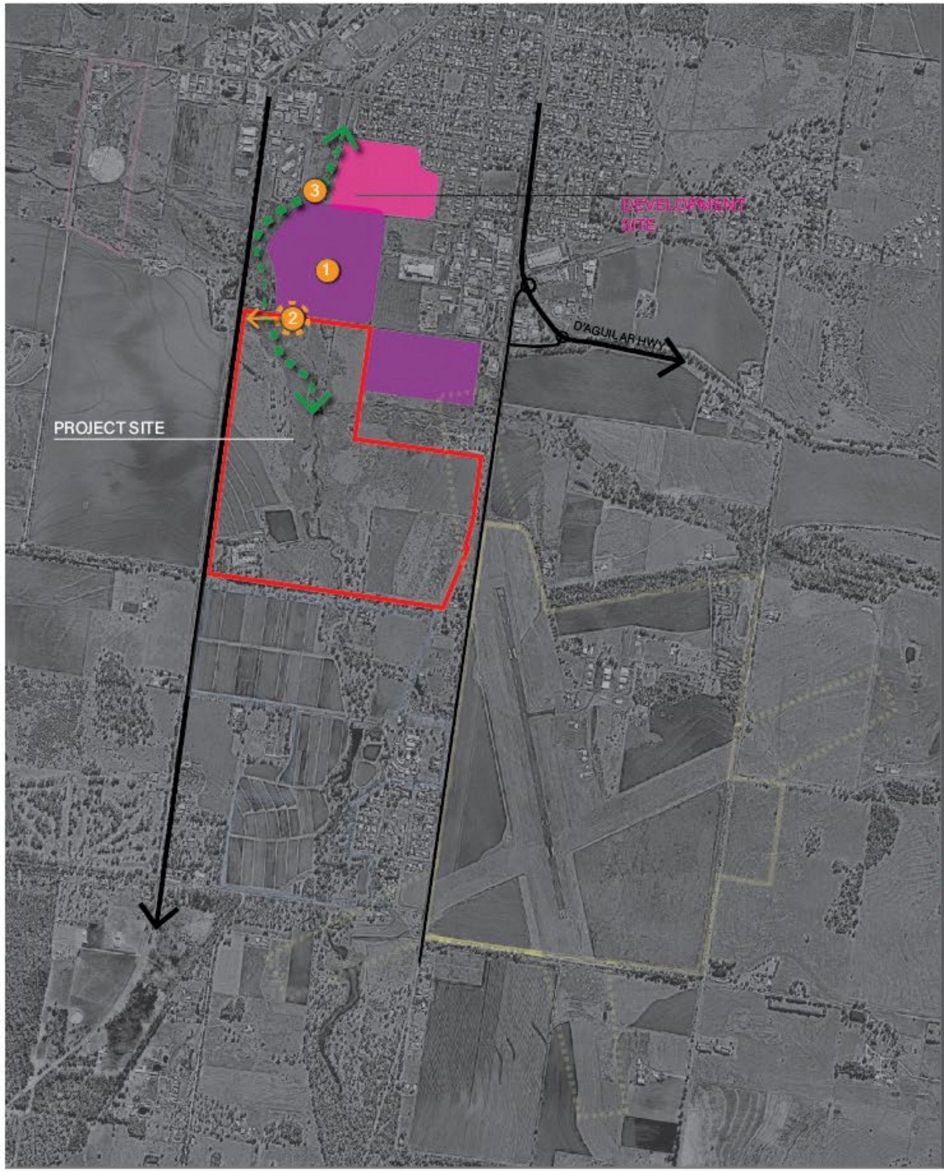
- Located 5km south of Kingaroy on Kingaroy Cooyar Rd
- 2 Lots combined for 140Ha, RE & FH - State Gov. owned
- Zoned: Rural
- Central facilities along with labs, workshops & storage
- Focus on dryland, irrigated and high rainfall inland farming systems

Strategic Opportunities & Contraints to Project Site

1. Long parallel boundaries across Geritz Rd present synergies for future land uses, infrastructure & access

2. Both sites contain over 1 km+ of Kingaroy Creek & associated flood plain - opportunity to improve both water quality, flood mitigation and environmental outcomes.

Figure 12. Research Facility & Redvale Site Analysis



Background Context

- Proposed housing & agri-park light industrial precinct
- 2 Lots combined FH - privately owned.
- Zoned: Emerging communities
- Development currently under discussion with SBRC & proponent
- Agri-park style (light industrial) with potential for fish hatchling industry to southern precinct

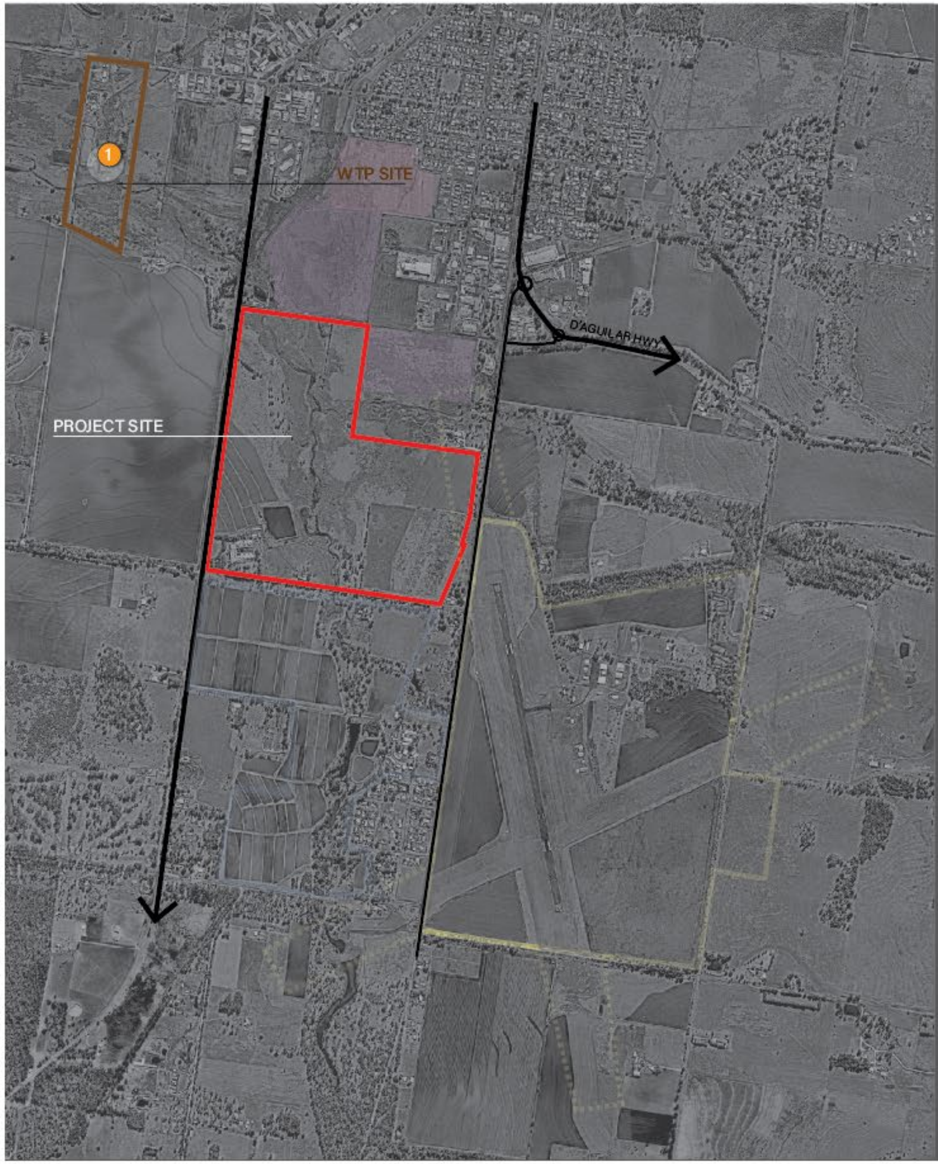
Strategic Opportunities & Contraints to Project Site

1 Southern precinct as housing (as currently zoned emerging communities) would constrain land uses to Project Site due to required buffers to sensitive receptors like residential housing - an Agri-park industrial use would be beneficial to the Circular Economy Precinct

2 Common northern boundary (500M+) to the Project Site presents opportunity for shared new access & infrastructure to Bunya Hwy

3 Both sites contain over a significant length Kingaroy Creek & associated flood plain corridor - opportunity to improve both water quality, flood mitigation and environmental outcomes.

Figure 13. Proposed Agri-Park & Housing Analysis



Background Context

- Existing Kingaroy Wastewater Treatment Plant
- Single Lot
- Zoned: Part medium impact industrial, part Rural
- Investigation underway for bio-digestor facility co-located with SBRC WTP facilities

Strategic Opportunities & Contraints to Project Site

1. Outcomes from a feasability study to co-locate bio-digestor with the WTP to be shared with the Circular Economoy Project and any opportunties to be explored.

Figure 14. Co-located Waste Water Treatment Plant Analysis

Facilities and Operations

Operated by Education Queensland, the Kingaroy TAFE facility is located in the south-western corner of the Project Site. The main facility buildings and operations are contained within an area of approximately 6Ha and are accessed via Geritz Road.

Just east of the main facility buildings are a small cluster of agricultural buildings and storage sheds, accessed internally from the main facility. These are currently under lease to Kingaroy High School.

Some seasonal cropping is also evident in the south-west and south east corners of the site, where good slope orientation and access to water allows.

Figure 15. Facilities and Operations

Access and Connections

The Project Site is ideally located close to two regional freight highways allowing high quality heavy vehicle (HV) access to the wider region in particular south and east towards Toowoomba, Dalby and Ipswich.

The Project Site has a 1.3 kilometre frontage to the Bunya Highway along its western boundary. To the north-east and within 400 metres via Kingaroy-Coolyar Road is the Saleyards Bypass Road intersection with the D'Aguilar Highway.

The southern edge of the site is bound by Geritz Road which connects the Bunya Highway with Kingaroy-Cooyar Road.

Of value to the development of the site is the existing intersection at Warren Truss Drive/Kingaroy-Cooyar Road, currently used toi service the airport which is also subject to future masterplanning.

Figure 16. Access and Connections

Existing Surface Water Analysis

The Project Site is split north-south by the Kingaroy Creek waterway. The waterway is defined by sections forming small chains of ponds and low flow channels interspersed with small areas of wetlands. The creek is part of a larger floodplain wrapping around Kingaroy.

A flood extent of approximately 200-300 metres wide, bounds the waterway and is mapped on Council's mapping of existing flood event extents. The Project Site also has a large dam and on-site farm bores for the purposes of agricultural activities.

Figure 17. Existing Surface Water Analysis

Existing Sensitive Receptor Analysis

The purpose of this analysis is to determine the type and location of adjacent receptors (and their related distances from the Project Site) to inform future spatial planning of the proposed new facilities.

Section 12.1.2 of the State Planning Policy (SPP) prepared by the Queensland Government is a guideline to assist local government in assessing buffer requirements between sensitive uses (e.g. residential, educational and community land uses) and proposed or existing industrial activities.

For the purposes of these spatial constraints analysis, a 250 metre buffer distance around receptor sites has been used that aligns with buffers to "medium impact industry" as outlined in the Part A – Emissions and Hazardous Activities SPP.

In general, the Project Site is surrounded by very few sensitive receptors, namely 5-6 rural farm houses on larger rural properties and the Kingaroy TAFE facility (educational) which is located within the south-western corner of the site. The north-eastern corner of the Project Site is also adjacent to an existing light industrial precinct off Industrial Avenue.

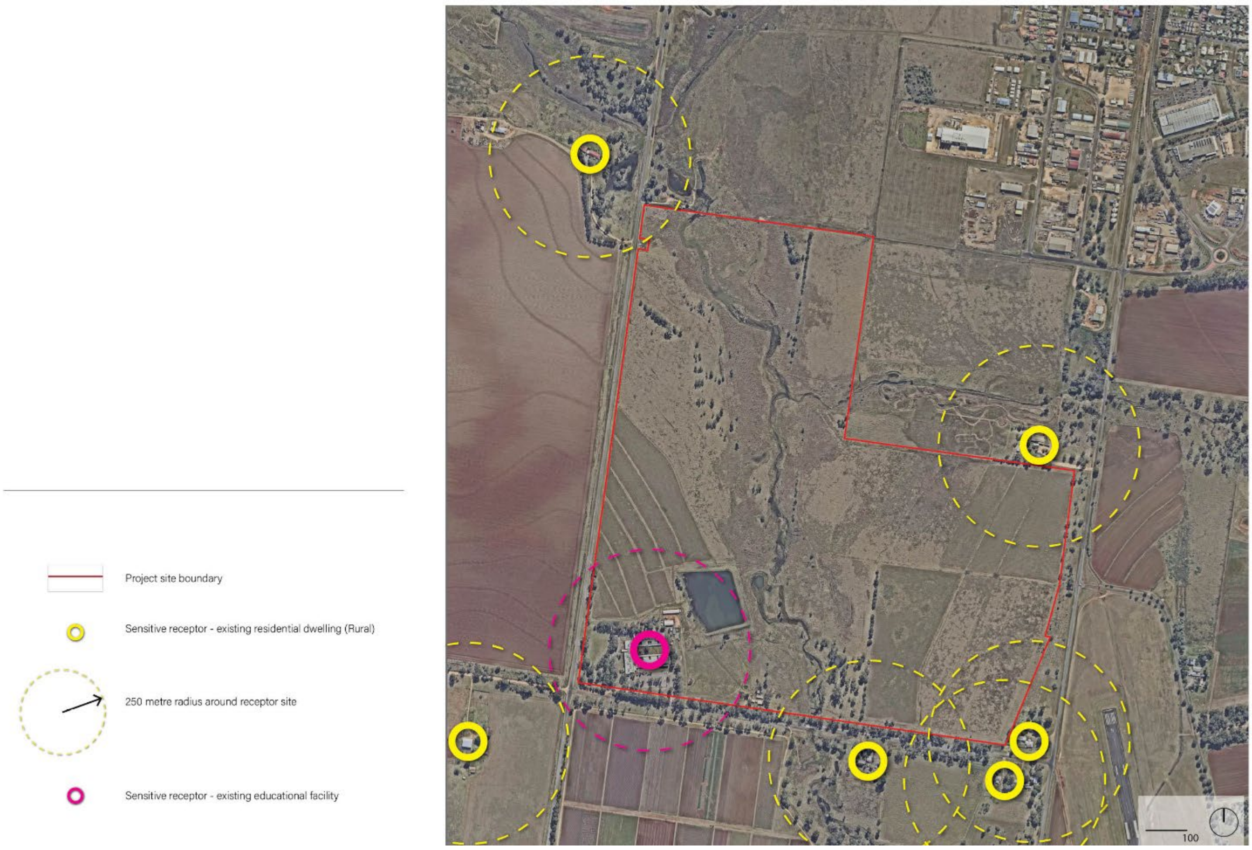


Figure 18. Existing Sensitive Receptor Analysis

Existing Land Use Zoning

The Project Site is currently zoned rural under the South Burnett Regional Council Planning Scheme. To the northeast of the site along common boundaries are existing zoned medium impact industrial lots and a single rural zoned residential property. Along the northern boundary are two large lots zoned emerging communities, allowing residential development to occur. It is noted however that SBRC have indicated that these lots may seek to create an "agri-park" style light industrial development to the adjacent southern lot, reducing conflict of land uses with any proposed industrial development for the Project Site.

Immediately east over Kingaroy-Cooyar Road is the Kingaroy Airport, which is zoned community facilities. Given the proximity there are also Airport Environment Overlays impacting the eastern side of the Project Site, namely OHL/Safety restrictions which are shown in figure 20 in the inset diagram.

To the south and west of the sites are rural zoned large lot properties, including the Redvale Research Site adjacent along Geitz Road.

The DAMS maps on Figure 11 detail the extent of Strategic Cropping Area (SCA) and the Priority Agriculture Area (PAA) in and around the Project Site.

INSET - Airport environment constraints

DAMS mapping of Priority Agricultural Areas

DAMS mapping of Strategic Cropping Areas

Figure 19. Existing Land Use Zoning

4.2 Precinct Design Principles

The masterplan is shaped by a set of interconnected design principles that position the precinct as a regionally significant circular-economy hub. Strategic connections ensure the precinct is embedded within South Burnett's broader movement network, with clear freight routes, regional linkages, and internal circulation patterns that support efficient heavy-vehicle access and safe separation of industrial and public interfaces.

Anchor technologies, particularly circular economy systems such as anaerobic digestion, and pyrolysis form the operational heart of the precinct, driving resource recovery and creating the industrial symbiosis loops that underpin the circular-economy model. These technologies are deliberately clustered to optimise feedstock flows, energy exchange, and co-location benefits, ensuring the precinct functions as a high-performance industrial ecosystem rather than a collection of standalone facilities.

At the same time, the masterplan elevates the precinct beyond pure industry by embedding precincts as places, innovation, sustainability, and education as core design drivers. This means creating identifiable precinct characters, public-facing elements, and opportunities for collaboration between industry, researchers, and training institutions such as TAFE.

Demonstration landscapes, interpretive elements, and innovation hubs help translate complex technologies into accessible community narratives. The principle of water resilience and environmental legacy ensures natural systems are treated as structuring elements rather than constraints, using wetlands, bio-retention, riparian restoration, and circular water-cycle thinking to manage stormwater, enhance biodiversity, and create a green-blue spine through the precinct.

Together, these principles produce a masterplan that is technically robust, environmentally regenerative, and socially connected, positioning South Burnett as a leader in regional circular-economy innovation.

STRATEGIC CONNECTIONS

Figure 20. Strategic Connections

ANCHOR TECHNOLOGY

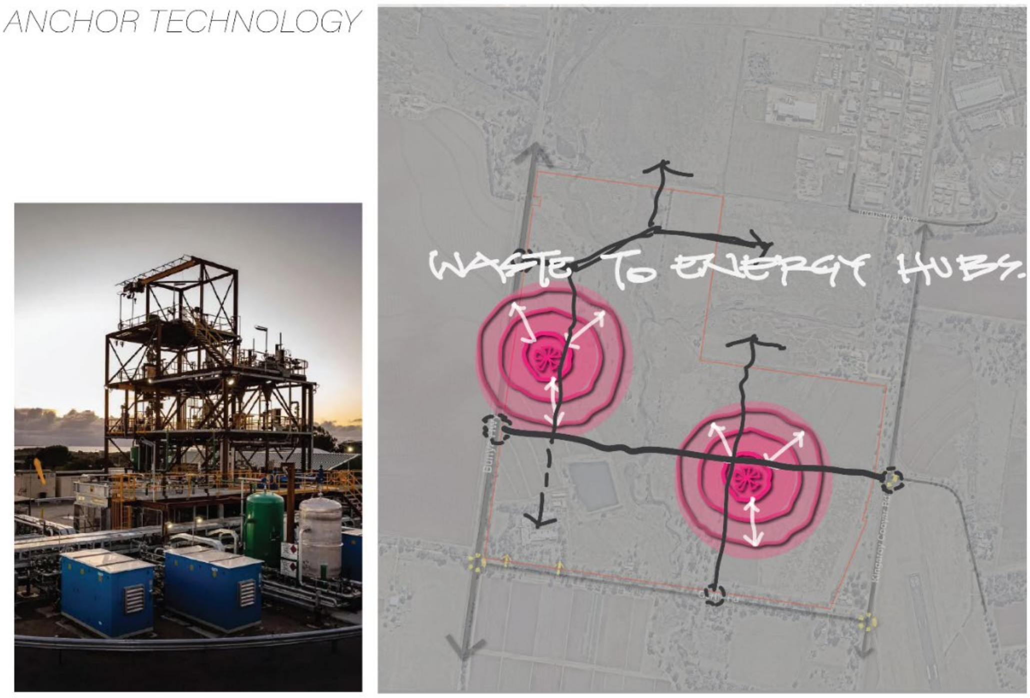


Figure 21. Anchor Technology

Figure 22. Precincts as Places

Figure 23. Innovation, Sustainability and Education

4.3 Masterplan

4.3.1 Precinct Masterplan

The masterplan sets out a structured vision for transforming the area around Kingaroy TAFE into a circular-economy industrial precinct anchored by advanced priority circular economy technologies. It establishes a hierarchy of precincts - technology, innovation, medium and light circular-economy industry arranged around a central cluster of anaerobic digestion and pyrolysis facilities.

These anchors are supported by a proposed landmark operations hub, upgraded access from Kingaroy–Cooyar Road, and a future heavy-vehicle intersection connecting the precinct to the Bunya Highway freight network. Together, these elements create a spine for industrial symbiosis, where energy, heat, materials, and data flows can be shared across co-located businesses.

The plan also integrates education, research, and environmental restoration as core components of the precinct's identity. An innovation and knowledge zone expands the TAFE campus and leverages dark-fibre connectivity to attract agri-industry R&D and data-driven enterprises.

Surrounding this, the masterplan proposes significant rehabilitation of the Kingaroy Creek corridor, creating a green-blue network that improves hydrology, biodiversity, and amenity. New road links to the Taabinga Industrial Area and emerging mixed-use precincts ensure the site is embedded within the broader regional economy, positioning the precinct as a catalyst for sustainable industry, skills development, and long-term economic diversification in South Burnett.

PRECINCTS & ANCHORS

- Priority Technology Precinct
- Co-located Technology Anchor - Anaerobic Digestor/Pyrolysis
- Innovation & Knowledge Zone
- Data Centre Anchor
- Circular Eco. Industrial - Medium
- Circular Eco. Industrial - Light
- Kingaroy Creek Riparian & Wetland Corridor
- Greenspace
- Key Intersections

1. New primary access intersection off Kingaroy-Cooyar Rd - upgrade existing with Warren Truss Dr to support future airport land uses and facilitate heavy vehicle movements.
2. Landmark facility building to main corner as hub to WtE precinct - site is 10Ha. including colocated tech facilities and operations area.
3. Innovation and knowledge precinct as an expansion of TAFE/ Tertiary education campus opportunity anchored around dark fibre/data centre access - Agri-industry research and development.
4. Signifcant green & blue rehabilitation opportunity to Kingaroy Ck. improving both environmental and hydrological outcomes for Kingaroy.
5. Future intersection to facilitate heavy vehicle movements onto the Bunya Hwy freight network.
6. Future road network extension north/east to link into both the existing Taabinga Industrial area and the emerging mixed use precinct.

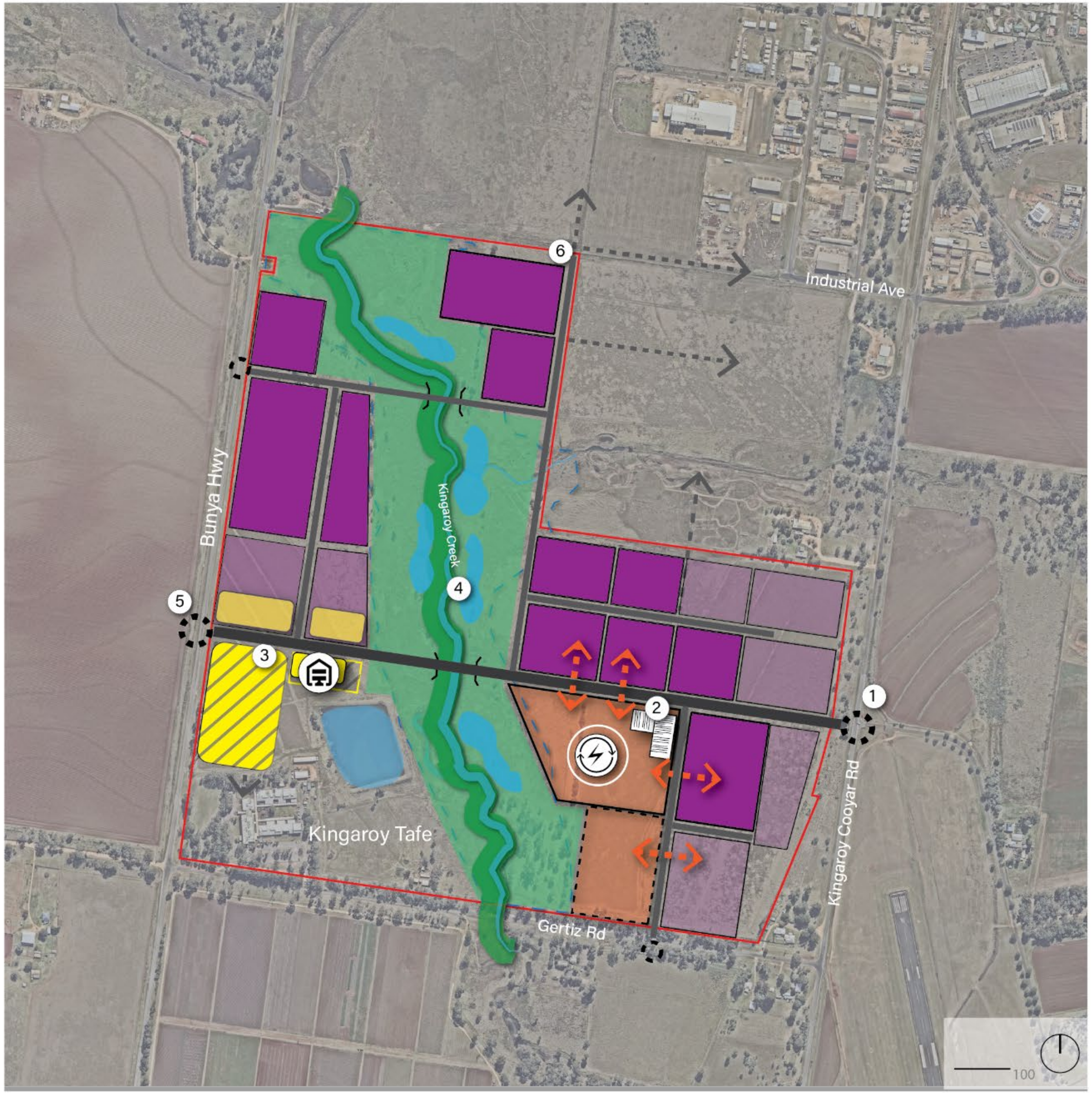


Figure 24. Precinct Masterplan

4.3.2 Site Plan

The site plan shows a fully integrated circular economy precinct combining anaerobic digestion (AD) and pyrolysis as the core processing priority technologies. The layout clusters key operational elements such as feedstock sheds, laydown areas, digesters, fermenter tanks, gas treatment systems, and storage tanks around a central operations building and main entrance.

Heavy-vehicle access is carefully managed through a B-double turnaround road, weighbridge, gatehouse, and internal service roads, ensuring efficient movement of materials into and out of the facility.

The priority technology processing locations are supported by dedicated feedstock storage, wash-down bays, and an output stockpile area, creating a clear flow from raw material intake to processed product handling.

The precinct also incorporates environmental management and site-support infrastructure to ensure safe, compliant, and resilient operations. Bio-retention basins are positioned near key hardstand and processing areas to manage stormwater and runoff, while proposed batters and security fencing define the operational footprint and protect sensitive equipment. Offices, operations buildings, and signage (including a billboard) provide the administrative and public-facing components of the site.

Overall, the plan illustrates a purpose-built industrial ecosystem where feedstock waste streams are transformed into energy, fuels, and reusable outputs through co-located technologies, supported by carefully designed logistics, water management, and operational facilities.

Review of the requirement for the two priority technologies has been conducted to inform the concept planning process.

Review of the requirement for the two priority technologies has been conducted to inform the concept planning process.

Table 11. Pyrolysis Requirements

Requirement	Concept Design Implication
Ability to receive packaged waste and transport processed products	Separate entry and exit driveways Car parking
Administration and staffing requirements	Office building
Feedstock storage	Dry Storage Facility Concrete bays
Layover	Hard stand area
Processing operations	Workshop Processing Area
Pyrolysis Line Layout	Hard stand area
Area	2.0Ha
Annual Feedstock Requirement	25,000 tonnes per annum

Table 12. Anaerobic Digestion Requirements

Requirement	Concept Design Implication
Ability to receive packaged waste and transport processed products	Separate entry and exit driveways Car parking
Administration and staffing requirements	Office building
Feedstock storage	Dry Storage Facility Concrete bays
Layover	Hard stand area
Processing operations	Stogag Tanks Storage Tanks Digester Tanks Biogas Plant
Area	6.0Ha
Annual Feedstock Requirement	50,000 tonnes per annum

Figure 25. Site Plan

4.3.3 Service Infrastructure

Water

The South Burnett Circular Economy Industrial Precinct has a clear opportunity to be serviced by town water, supported by the existing reticulated network shown in the attached SBRC mapping plan (Figure 26).

This plan identifies mains water infrastructure running along Kingaroy–Cooyar Road and Bunya Highway, with multiple water nodes and distribution lines in close proximity to the precinct boundary. This establishes a practical and cost-efficient first point of connection, enabling early stages of the precinct to access a reliable potable supply without requiring major trunk extensions. The presence of existing road easements and service corridors along these routes also simplifies construction, reducing both delivery risk and staging complexity.

From a staging perspective, the logical sequencing is to establish the initial connection at the Kingaroy–Cooyar Road / Warren Truss Drive intersection, then progressively extend internal reticulation as development areas come online.

Early stages such as the Priority Technology Site or initial industrial lots could be serviced via a single primary feed, with subsequent stages adding internal mains, hydrants, and potential booster infrastructure as demand increases. Over time, this staged approach supports a scalable, resilient water network that grows with the precinct while leveraging the existing SBRC system as its backbone.

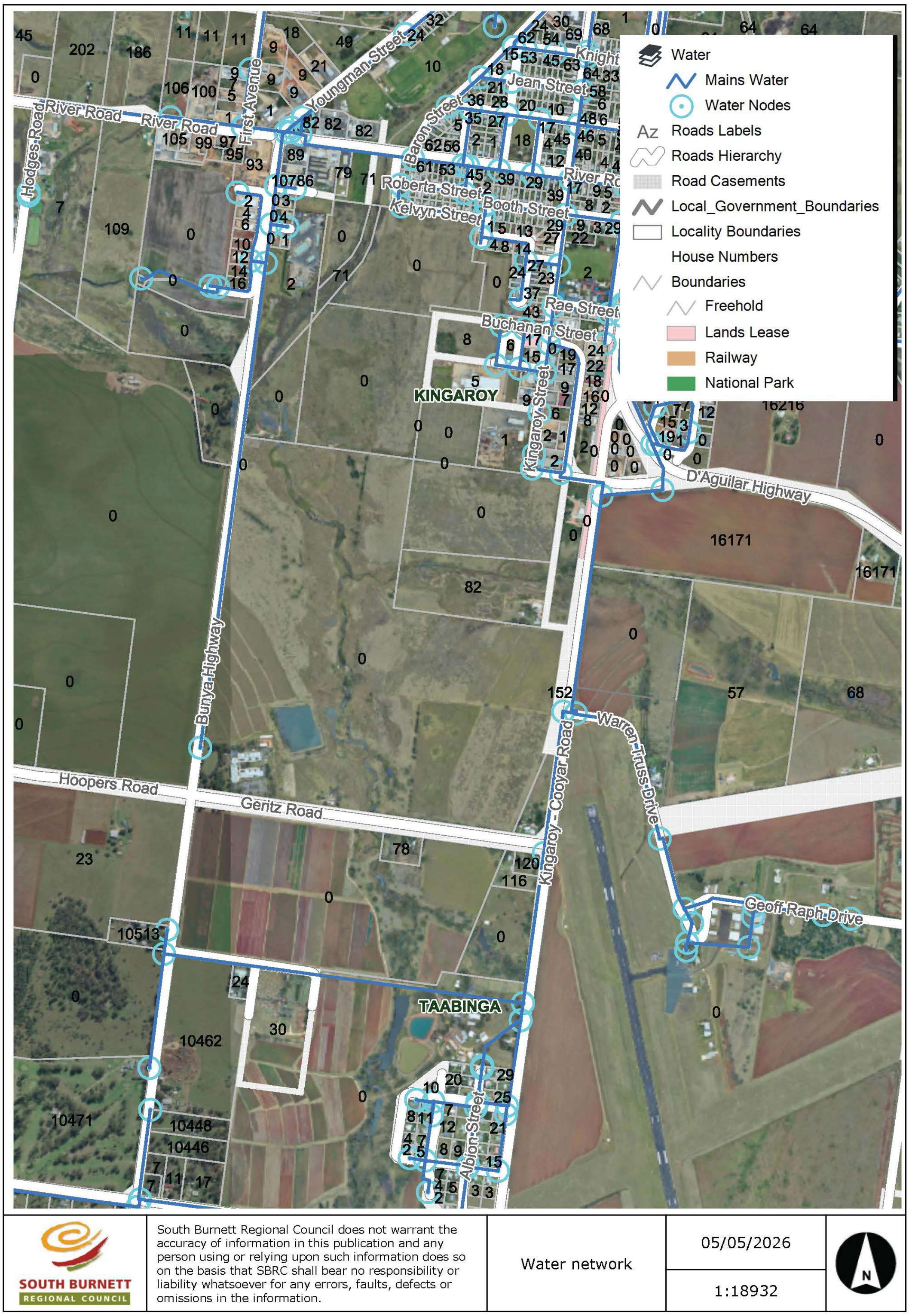


Figure 26. Existing trunk water network

Sewer

The South Burnett Circular Economy Precinct has a potential pathway to connect to the town sewer network, supported by the presence of nearby trunk sewer mains and rising mains shown in the attached SBRC interactive mapping plan (Figure 28).

The plan shows sewer infrastructure running along Kingaroy–Cooyar Road, River Road and the broader Kingaroy township interface, indicating that the precinct sits close to established wastewater corridors. However, the LGIP wastewater catchment map confirms that the site is outside the preferred sewer service area, meaning it is not currently planned for connection within Council's priority sequencing. This creates a situation where connection is technically feasible due to proximity but not immediately supported by existing planning or funding pathways.

Given this context, early stages of the precinct could benefit from using a package treatment plant, providing on-site wastewater treatment until a future trunk extension or sewer catchment expansion is justified. A modular package plant allows staged growth, aligns with the precinct's circular-economy ethos, and avoids the cost and timing constraints of extending sewer infrastructure prematurely.

As development intensifies and demand increases, the precinct could transition to a town sewer connection, leveraging the nearby mains and the proximity of the Kingaroy Sewage Treatment Plant once Council's servicing priorities or developer-led infrastructure agreements make connection viable.

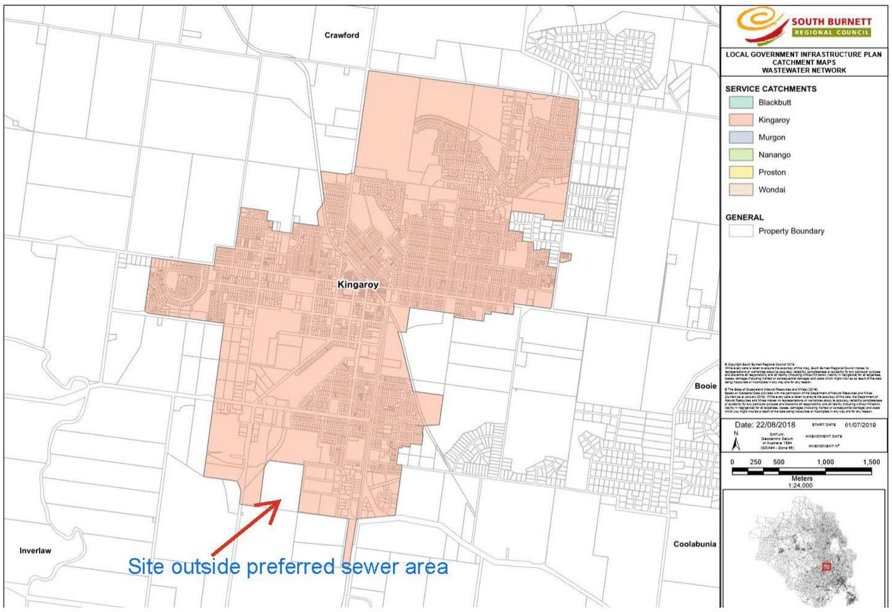


Figure 27. Priority sewer area

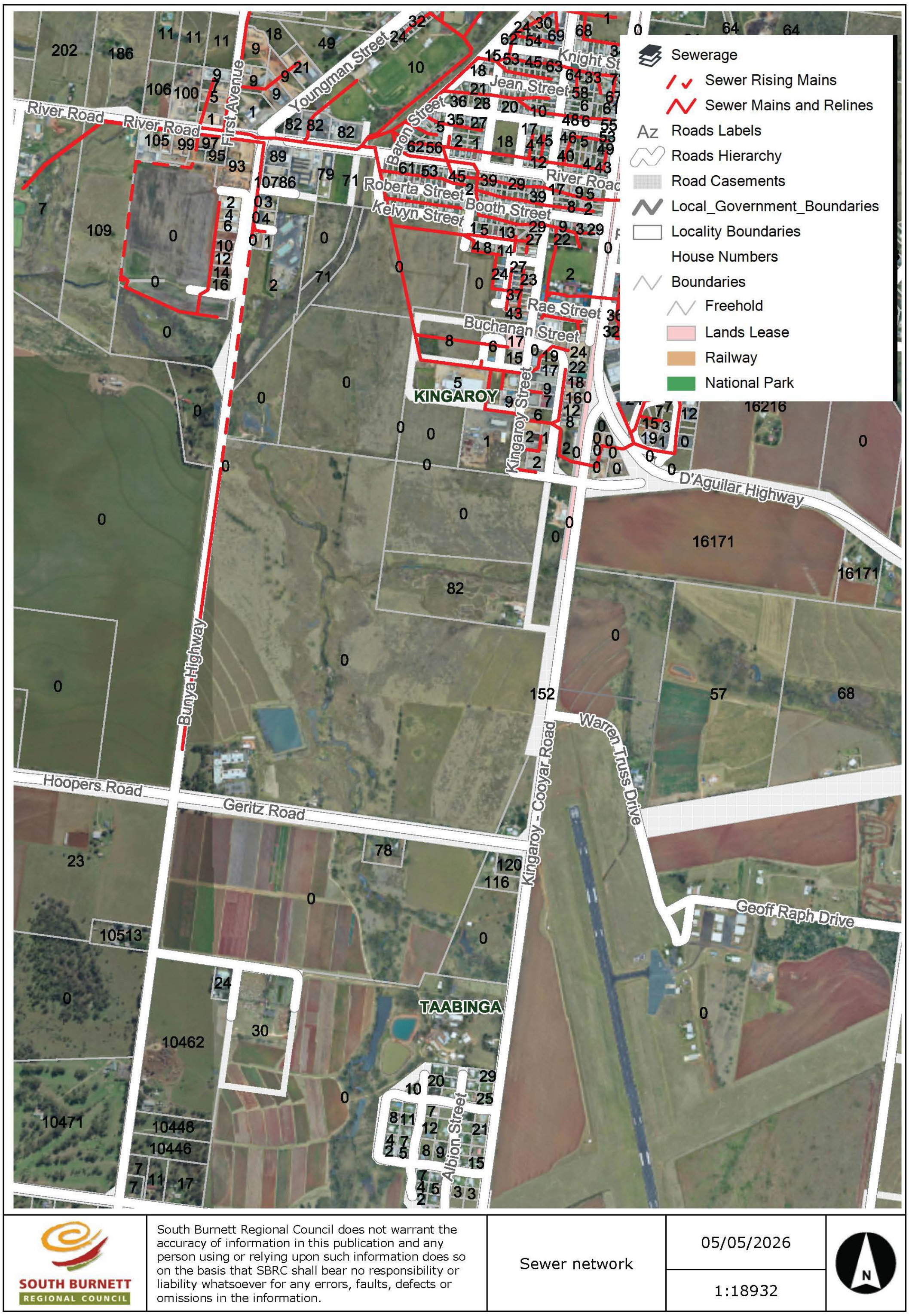


Figure 7. Existing trunk sewer network

4.4 3D Virtual Model

A 3D Visualisation of the precinct has been developed and is available here. Screenshots are shown below:

Figure 29. 3D Virtual Model Perspectives

4.5 Whole of Life Costing

Previous analysis conducted as part of the first stage of the SBRC Circular Economy investigation identified a preferred precinct opportunity at the South Kingaroy site, comprising a total land area of approximately 148 hectares, with around 75 hectares considered developable. The recommended development includes the implementation of a commercial-scale Anaerobic Digester (AD) facility and a commercial-scale biochar (pyrolysis) facility.

It is assumed that the Queensland Government, as the land developer, would contribute the required land at zero cost (via a lease agreement or similar arrangement) to provide incentivisation by improving the commerciality of these business options.

A summary of the costs associated with the overall development of the precinct, including land subdivision, enabling infrastructure, and the delivery of the AD and pyrolysis facilities, are summarised in the table below. It is noted that these costs estimates are preliminary in nature and will require confirmation based on future detailed project design and construction estimates.

Table 4.13 Project Costs Summary

<table>
<tr><th></th><th>Capex</th><th>Opex</th></tr>
<tr><td>South Kingaroy precinct subdivision and initial setup</td><td>$65 million (evenly distributed across five stages between Year 0 and Year 20 of the project)
(internal transport, waste and wastewater infrastructure, an intersection, a sewer pump station, project management, design and overall contingency)
*Note: It assumes that Qld Gov will contribute the land required at zero cost</td><td>$0
(rates revenue and associated Council services costs excluded from this assessment)</td></tr>
<tr><td>Anaerobic Digester (AD)*</td><td rowspan="2">$29.3 million - Pre-feasibility cost estimates provided by Greentec Consulting. Includes 30% contingency and GST.</td><td>$4.0 million/year</td></tr>
<tr><td>Pyrolysis Facility (Biochar)*</td><td>$1.3 million/year</td></tr>
</table>

**It is noted that pricing assumptions have been applied to specific feedstock inputs for each of the technology options. This pricing has been estimated based on available data, however, will need to be reviewed through negotiations of formal agreements and/or market rates.*

4.5.1 Capital Expenditure (Capex)

Capital expenditure associated with the subdivision and initial development of the South Kingaroy industrial precinct (the current South Burnett Circular Economy Industrial Precinct – the site which is the focus of this report) is estimated at approximately $65 million. These costs are assumed to be staged and distributed over a 20-year development horizon (Year 0 to Year 20), reflecting a progressive rollout of infrastructure in line with demand and tenant uptake.

This estimated cost includes internal roads, waste and wastewater infrastructure, an intersection and access works, a sewer pump station, project management, design, and overall contingency. It is also assumed that the Queensland Government, as the land developer, would provide the land at no cost (through a lease agreement or similar arrangement).

It is noted that the staging opportunity for infrastructure costs include the option for onsite servicing for the proposed technology components of the precinct (i.e. the Anaerobic Digester and Pyrolysis facilities), which could provide a more cost efficient outcome prior to trunk infrastructure servicing.

In addition to the South Kingaroy precinct infrastructure, the costs associated with the Circular Economy precinct (i.e. the Anaerobic Digester and Pyrolysis facilities) have been estimated at approximately $29.3 million, based on a pre-feasibility cost estimate prepared by Greentec Consulting.

This estimate includes precinct planning and design, earthworks, civil infrastructure, AD and pyrolysis plant and equipment, and associated buildings and operational structures. As with many large-scale infrastructure projects, the Circular Economy precinct is expected to be delivered through a staged development approach. This allows capital investment to be aligned with feedstock availability, market demand, and operational readiness.

Stage 1 is proposed to comprise the development of the pyrolysis (biochar) facility. This reflects the relatively lower feedstock requirements of pyrolysis and the availability of Council-controlled feedstocks such as green waste and biosolids, which provide a more secure and immediate supply base.

Stage 2 would involve the progressive development of the AD facility, with Stage 2A comprising the development of approximately 50% of the AD capacity and Stage 2B the expansion to full AD capacity.

This staged approach enables the project to progressively secure feedstock supply agreements (particularly for manure, food waste, and processing residues) while scaling operations in line with demand. Each stage is assumed to be implemented at approximately two-year intervals between Year 0 and Year 4.

4.5.2 Operational Costs

Operating expenditure is assumed to be nil for the South Kingaroy Industrial Land Subdivision, with any rates revenue and associated Council service costs excluded from this assessment.

Operating expenditure for the Circular Economy precinct is estimated at approximately $4.0 million per annum for the AD facility and $1.3 million per annum for the Biochar (pyrolysis) facility. The Opex accounts for costs associated with overall operation and required maintenance of the facilities, which is estimated as 8% of the Capex, consistent with comparable waste-to-energy and bioenergy projects [7].

Further, a significant component of operating expenditure is associated with feedstock input. Based on preliminary assumptions, feedstock costs are estimated at approximately $2.5 million per annum for the AD facility and $0.5 million per annum for the pyrolysis facility. These estimates reflect a blended feedstock cost incorporating a mix of low-cost or neutral-cost inputs (e.g. manure and agricultural residues) and higher-cost inputs (e.g. baled crop residues and timber). Actual costs will vary depending on final feedstock contracts, transport distances, and market conditions.

It is also noted that both facilities generate significant thermal energy as part of their processes, typically in the form of Combined Heat and Power (CHP). While the utilisation of this energy was considered, uncertainty regarding the final technology configuration, scale, and integration with surrounding industries has limited the ability to quantify this benefit at this stage.

However, there are several potential applications for recovered heat, including pre-treatment and drying of feedstock (particularly biosolids and green waste), process heat for on-site operations, and integration with greenhouse agriculture or food processing activities.

[7] Based on assumption detailed at the RACE for 2030 Biogas from agricultural waste report.

4.6 Delivery Model

A practical set of delivery models emerges when you combine the business case findings with the ownership context (Education Queensland as landowner) and the three assets to be delivered:
(1) the industrial subdivision,
(2) a pyrolysis/biochar facility, and
(3) an anaerobic digestion (AD) facility.

The previous business case noted that "it is appropriate for the government and the private sector to collaborate in the delivery of an agricultural circular economy industrial precinct" and that the preferred model involves "State Government land to be developed as industrial subdivision with lots being made available for investment in an anaerobic digester and a biochar facility". This creates a clear foundation for a range of delivery pathways that vary in terms of land control, capital responsibility, and operational risk allocation.

A State-led subdivision with private delivery of the two technology anchors is the model most aligned with the business case. The report states that the recommended approach assumes "State Government land development with sites made available to the private sector" and that this model delivers the strongest economic outcome at a precinct scale, with an overall BCR of 1.24.

Under this model, Education Queensland (as landowner) either transfers or leases land to the State (e.g., Economic Development Queensland) or SBRC, who then undertake subdivision and release serviced lots to private proponents for AD and pyrolysis. This model keeps government control over land use outcomes while leveraging private capital for technology deployment.

A second pathway is a public–private partnership (PPP) for one or more components. The business case highlights that the anaerobic digester and biochar facility both have strong standalone BCRs (1.21 and 1.28 respectively) and are attractive for private investment. A PPP could be structured as:
(a) design–build–operate for the AD and pyrolysis plants,
(b) a long-term lease of land with performance obligations, or
(c) a joint venture where the State or SBRC retains an equity share. This model suits situations where government wants long-term influence over pricing, feedstock access, or environmental performance.

A third option is a State-owned, privately operated (SOPO) model for the technology sites. The business case notes that these facilities generate regional public benefits such as landfill diversion, agricultural productivity uplift, and innovation capacity, which are not fully monetised in the BCR.

Government ownership of the AD and/or pyrolysis assets, paired with private operation can therefore be justified where strategic control is important (e.g., ensuring biosolids processing security or guaranteeing biochar availability for local farms).

A fourth pathway is a fully private delivery model for the AD and pyrolysis facilities, with government focusing solely on enabling infrastructure and planning. The business case shows that even without land contribution, the facilities remain economically viable (BCRs of 1.12 and 1.16). In this scenario, Education Queensland could lease land directly to private proponents, or the State could dispose of land through an expression-of-interest process. SBRC's role becomes regulatory, facilitative, and infrastructure-supporting rather than financial.

Finally, a multi-agency precinct governance model can be layered over any of the above. Because the site is owned by Education Queensland and the business case emphasises integration with TAFE, agri-tech, and research functions, a governance structure involving EQ, SBRC, EDQ, and private operators can coordinate land release, shared utilities, circular economy synergies, and workforce development. This model supports the report's emphasis on "education and agri startups" and the creation of a long-term curated industrial ecosystem rather than a simple land release.