Preliminary Hazard Analysis

MidCoast Regional Organics Processing Solution

MidCoast Council
Document No. RCE-25375_MRA_PHA_Final_27Jan26_Rev(1)
Date 27/01/2026

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Quality Management

Rev	Date	Remarks	Prepared By	Reviewed By
A	6 August 2025	Draft issue for comment	Ezra Bagaskara	Renton Parker
0	27 October 2025	Final issued		
1	27 January 2026	Updated per bushfire report		

Executive Summary

Background

The MidCoast Council (MCC) has sought an operator of a Food Organics and Garden Organics (FOGO) processing facility in proximity to its waste processing facility at Darawank. The FOGO processing will produce methane from a biodigester. Where Dangerous Goods (DGs) are present, the site is subject to the State Environmental Planning Policy (Resilience and Hazards) (Ref. [1]) which aims to assess the risk posed by the site upon the adjacent land uses. The proposed quantities to be stored would exceed the thresholds within “Applying SEPP 33”; hence, it is necessary to assess the risks posed in the form of a Preliminary Hazard Analysis (PHA) in accordance with the Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 and No. 6 (Ref. [2] & [3]) for submission with the Development Application (DA).

MRA Consulting Pty Ltd (MRA), on behalf of NALG ENVIROTECH PTY LTD, has commissioned Riskcon Engineering Pty Ltd (Riskcon) to prepare the PHA for the facility. This document represents the PHA study for the proposed MidCoast Regional Organics Processing Solution (MC ROPS).

Conclusions

A hazard identification table was developed for the site to identify potential hazards that may be present at the site as a result of operations or storage of materials. Based on the identified hazards, scenarios were postulated that may result in an incident with a potential for offsite impacts. Postulated scenarios were discussed qualitatively and any scenarios that would not impact offsite were eliminated from further assessment. No scenarios were found to likely impact offsite.

Based on the analysis conducted, it is concluded that the risks at the site boundary are not considered to exceed the acceptable risk criteria; hence, the facility would only be classified as potentially hazardous and would be permitted within the current land zoning for the site.

Recommendations

- Notwithstanding the conclusions following the analysis of the facility, the following recommendations have been made:
- Bio-gas operations shall be subject to hazardous area classification in accordance with AS/NZS 60079.10.1:2022 and electrical equipment will be installed in accordance with AS/NZS 60079.14:2022.
- Any hot work on site shall be performed under a safe work permit.
- Appropriate first attack firefighting equipment and staff training shall be implemented to minimise the likelihood of poisonous gas evolution in the event of a fire.
- Gas leak detection systems shall be implemented and regularly maintained.
- Hydrogen sulfide detectors shall be either installed at potential release points or be worn on personnel conducting maintenance.
- Staff training shall be implemented to limit exposure to hydrogen sulfide below standards set by Safe Work Australia.

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Abbreviations

Abbreviation	Description
ADG	Australian Dangerous Goods Code
AS	Australian Standard
CCPS	Centre for Chemical Process Safety
DA	Development Application
DGs	Dangerous Goods
DGS	Dangerous Goods Store
DPHI	Department of Planning, Housing and Infrastructure
FRNSW	Fire and Rescue New South Wales
HIPAP	Hazardous Industry Planning Advisory Paper
HSE	Health and Safety Executive
MCC	MidCoast Council
MC ROPS	MidCoast Regional Organics Processing Solution
PFD	Probability of Failure on Demand
PHA	Preliminary Hazard Analysis
Pmpy	Per million per year
SEP	Surface Emissive Power
SEPP	State Environmental Planning Policy

1.0 Introduction

1.1 Background

The MidCoast Council (MCC) has sought an operator of a Food Organics and Garden Organics (FOGO) processing facility in proximity to its waste processing facility at Darawank. The FOGO processing will produce methane from a biodigester. Where Dangerous Goods (DGs) are present, the site is subject to the State Environmental Planning Policy (Resilience and Hazards) (Ref. [1]) which aims to assess the risk posed by the site upon the adjacent land uses. The proposed quantities to be stored would exceed the thresholds within “Applying SEPP 33”; hence, it is necessary to assess the risks posed in the form of a Preliminary Hazard Analysis (PHA) in accordance with the Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 and No. 6 (Ref. [2] & [3]) for submission with the Development Application (DA).

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1.2 Objectives

The objectives of the PHA project include:

- Complete the PHA according to the Hazardous Industry Planning Advisory Paper (HIPAP) No. 6 – Hazard Analysis (Ref. [3]),
- Assess the PHA results using the criteria in HIPAP No. 4 – Risk Criteria for Land Use Planning (Ref. [2]), and
- Demonstrate compliance of the site with the relevant codes, standards and regulations (i.e. NSW Planning and Assessment Regulation 1979, WHS Regulation, 2017 Ref. [5]).

1.3 Scope of Services

The scope of work is to complete a PHA study for the proposed MC ROPS as required by the Planning Regulations. The scope does not include any other assessments at the site nor any other MCC facilities.

2.0 Methodology

2.1 Multi-Level Risk Assessment

The Multi-Level Risk Assessment approach (Ref. [6]) published by the NSW Department of Planning and Environment, has been used as the basis for the study to determine the level of risk assessment required. The approach considered the development in context of its location, the quantity and type (i.e. hazardous nature) Dangerous Goods stored and used, and the facility's technical and safety management control. The Multi-Level Risk Assessment Guidelines are intended to assist industry, consultants and the consent authorities to carry out and evaluate risk assessments at an appropriate level for the facility being studied.

There are three levels of risk assessment set out in Multi-Level Risk Assessment which may be appropriate for a PHA, as detailed in **Table 2-1**.

Table 2-1: Level of Assessment PHA

Level	Type of Analysis	Appropriate If:
1	Qualitative	No major off-site consequences and societal risk is negligible
2	Partially Quantitative	Off-site consequences but with low frequency of occurrence
3	Quantitative	Where 1 and 2 are exceeded

The Multi-Level Risk Assessment approach is schematically presented in **Figure 2-1**.

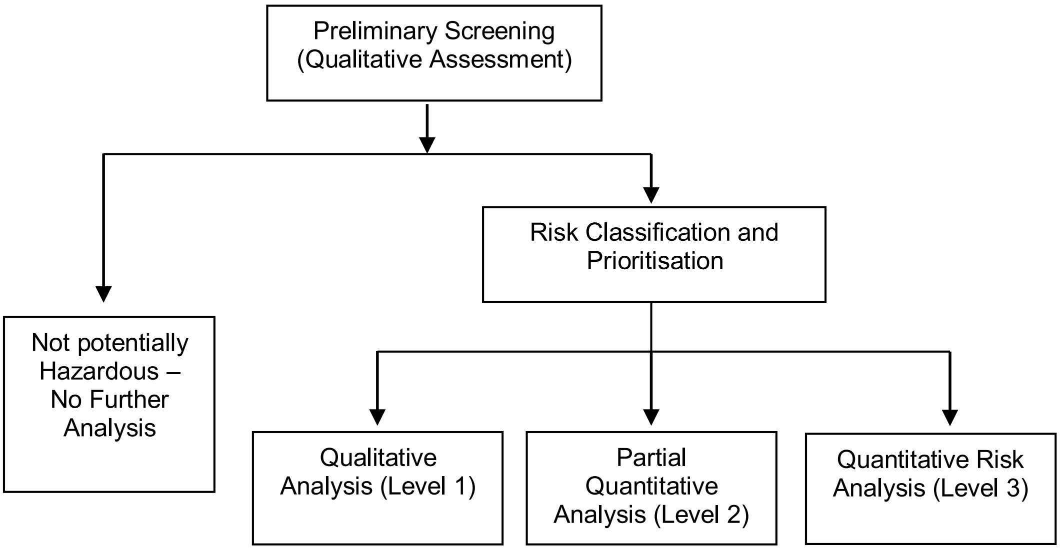

Figure 2-1: The Multi-Level Risk Assessment Approach

Based on the type of DGs to be used and handled at the proposed facility, a **Level 2 Assessment** was selected for the Site. This approach provides a qualitative assessment of those DGs of lesser quantities and hazard, and a quantitative approach for the more hazardous materials to be used on-site. This approach is commensurate with the methodologies recommended in "Applying SEPP 33's" Multi Level Risk Assessment approach (DPE, 2011).

2.2 Risk Assessment Study Approach

The methodology used for the PHA is as follows:

Hazard Analysis – A detailed hazard identification was conducted for the site facilities and operations. Where an incident was identified to have a potential off-site impact, it was included in the recorded hazard identification word diagram (**Appendix A**). The hazard identification word diagram lists incident type, causes, consequences and safeguards. This was performed using the word diagram format recommended in HIPAP No. 6 (Ref. [3]).

Each postulated hazardous incident was assessed qualitatively in light of proposed safeguards (technical and management controls). Where a potential offsite impact was identified, the incident was carried into the main report for further analysis. Where the qualitative review in the main report determined that the safeguards were adequate to control the hazard, or that the consequence would obviously have no offsite impact, no further analysis was performed. **Section 3.1** of this report provides details of values used to assist in selecting incidents required to be carried forward for further analysis.

Consequence Analysis – For those incidents qualitatively identified in the hazard analysis to have a potential offsite impact, a detailed consequence analysis was conducted. The analysis modelled the various postulated hazardous incidents and determined impact distances from the incident source. The results were compared to the consequence criteria listed in HIPAP No. 4 (Ref. [2]). The criteria selected for screening incidents is discussed in **Section 3.1**.

Where an incident was identified to result in an offsite impact, it was carried forward for frequency analysis. Where an incident was identified to not have an offsite impact, and a simple solution was evident (i.e. move the proposed equipment further away from the boundary), the solution was recommended, and no further analysis was performed.

Frequency Analysis – In the event a simple solution for managing consequence impacts was not evident, each incident identified to have potential offsite impact was subjected to a frequency analysis. The analysis considered the initiating event and probability of failure of the safeguards (both hardware and software). The results of the frequency analysis were then carried forward to the risk assessment and reduction stage for combination with the consequence analysis results.

Risk Assessment and Reduction – Where incidents were identified to impact offsite and where a consequence and frequency analysis was conducted, the consequence and frequency analysis for each incident were combined to determine the risk and then compared to the risk criteria published in HIPAP No. 4 (Ref. [2]). Where the criteria were exceeded, a review of the major risk contributors was performed, and the risks reassessed incorporating the recommended risk reduction measures. Recommendations were then made regarding risk reduction measures.

Reporting – on completion of the study, a draft report was developed for review and comment. A final report was then developed, incorporating the comments received for submission to the regulatory authority.

3.0 Site Description

3.1 Site Location and Layout

The proposed compost site is adjacent to the Tuncurry Waste Management Centre, and is formally described as Lot 5, DP 1089990. The proposed compost site, hereafter referred to as 'The Site', is approximately 5.82 ha. Access is via Midge Orchid Road.

The site is currently undeveloped land, characterised by temperate grassland vegetation. The site is shown in **Figure 3-1**.

Figure 3-1: Site Location

3.2 Adjacent Land Uses

The Site is approximately 3km north of the Tuncurry township. The surrounding area is characterised by conservation zones, scattered rural residential dwellings, and Nine Mile Beach. The Wallamba River is approximately 1km west.

Midge Orchid Rd is used as the access for the Tuncurry Waste Management Centre and Hallidays Point Sewerage Treatment Works. Although there is a residence immediately west of the proposed facility, it is owned by Council and has been vacated.

The proposed development would be separate to the services offered by the Tuncurry Waste Management Centre, located on the opposite side of the road, to the east.

The centre includes:

- A Community Recycling Centre for problem waste
- Reviva – 'Tip Shop'
- Materials Recovery Facility

- Men’s Shed
- Bicycle repair workshop – Green Bikes
- The Green – community garden
- Education centre

Being proximate to The Lakes Way, there is provision of road infrastructure for vehicles accessing the Site. The Lakes Way serves as the connection to Tuncurry from The Pacific Highway, either directly or via Failford Rd.

Distances to residential receivers have been summarised in **Table 3-1**. Furthermore, a map featuring the locations of the referred sensitive receivers have been provided in **Figure 3-2**.

Table 3-1: Location and Distance of Sensitive Receivers

ID	Direction from facility	Distance to Residence (m)	Distance to Boundary (m)
R1	North-west	530	510
R2	West	591	500
R3	West	570	415
R4	West	680	610
R5	South	430	85

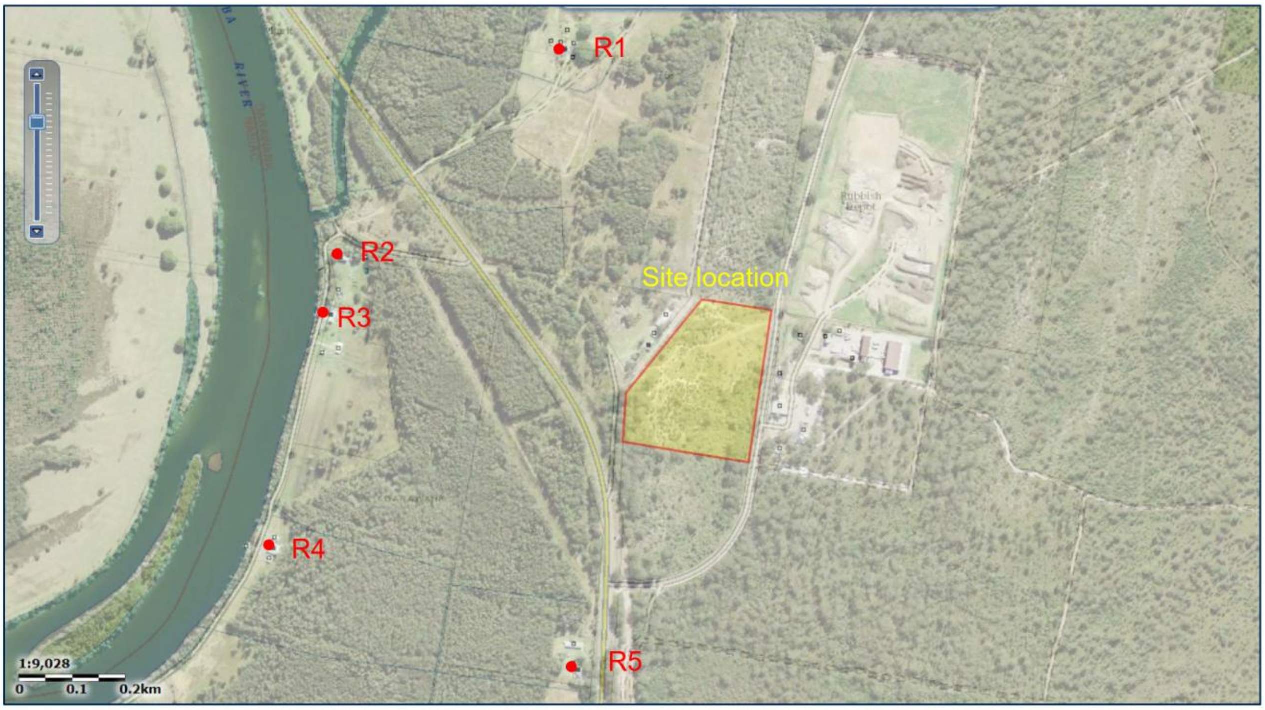

Figure 3-2: Location of Sensitive Receivers

3.3 Project Description

3.3.1 Introduction

MC ROPS will be a fully enclosed facility utilising NALG in-vessel composting (IVC) tunnels, Kanadevia Inova’s Kompogas dry anaerobic digestion (AD) system, an enclosed maturation area, and an air handling system comprising of extraction, multistage scrubbing and biofiltration to manage odours. Utilising IVC and AD technology, the facility will process organic waste and produce high-quality compost end products and green energy.

Inputs would be sourced from:

- Councils – Food & garden organics
- Commercial & Industrial – Paunch, dissolved air flotation residue, offal
- Agriculture – Poultry manure, layer hen, shed cleanout
- Commercial Restaurants – Grease trap, expired drinks
- Supermarkets – Commercial food waste, expired food

Outputs are in form of compost and biogas. Compost would be screened, refined and distributed in bulk for use, or for packaging and resale.

Site Works in the Proposal include:

- Site preparation
- Earthworks
- Road pavements
- Landscaping and screening
- Weighbridge installation
- Stormwater and drainage services
- Sewer works
- Potable water supply
- Waste water system
- Electrical and communication
- Provision of fire services
- Construction and fit out of receival building
- Construction and fit out of in vessel compost (IVC) tunnels
- Construction and fit out of semi-enclosed aerated maturation area
- Construction and fit out of air handling system, including odour control
- Provision of a leachate management system
- Provision of compost process control system.

3.3.2 Uses and activities

3.3.2.1 Arrival

Incoming vehicles utilise two weighbridges for entering and exiting to record incoming and outgoing loads in accordance with EPA record-keeping requirements. The use of two weighbridges facilitates efficient operations during periods of high-volume truck movements to and from the Site, with all operations being managed by an attended weighbridge office.

3.3.3 Receival

Trucks delivering waste will reverse onto a ramp leading to automated fast-acting doors, through which they will unload their material into designated reception bunkers. The finished floor level (FFL) of the bunkers will be approximately 4 meters lower than the ramps, allowing the organic waste to accumulate before being handled by the overhead crane.

3.3.4 Sorting and shredding

An overhead waste crane will service the reception bunkers, loading the organic waste from the bunkers into a feed hopper. The waste will be visually inspected for large contaminants which will be removed and set aside for subsequent inspection and disposal. The hopper directs the material to a slow speed shredder, then an overhead belt magnet and screen which separates it into two fractions: undersize (≤50mm) and oversize (>50mm). The undersized fraction, primarily consisting of food and grass clippings, is fed into the AD system via automatic gantry crane.

The oversized fraction, consisting of large woody organics, is loaded into the IVC tunnels.

3.3.5 Processing

a. Anaerobic Digestion System

The undersize and food organics are processed through the AD system. Pasteurised digestate from the AD system is dewatered, and the solid digestate is sent to the mixing bunker.

Liquid digestate is sent to a liquid digestate storage tank, which is used for moistening the oversized garden organics in the IVC tunnel systems.

The AD process generates biogas, which can be upgraded to separate biomethane from biogenic CO_2. A Combined Heat and Power (CHP) unit will be used to generate green electricity from the biogas. The waste heat from the CHP could be used for the composting process and the maturation process.

b. Composting – IVC Tunnels

Oversize materials are transferred to the composting area. During pasteurisation, microbes progressively break down organic material, creating heat and releasing nutrients. Organic matter naturally heats to over 55°C for at least 3 days. Pasteurisation of material induces pathogen and weed seed destruction. Recycled water and liquid digestate may be used during pasteurisation via collection from the leachate system.

After pasteurisation and drying in the tunnels, the material is transferred to a second screen, which separates the fine (<30 mm) fraction which will be sold as soil conditioner/compost, from the overs (>30mm) which will be directed to a sort cabin windsifter for contaminant removal and to the shredder for size reduction. Material is then sold as mulch or directed to the mixing bunker to be mixed with the solid digestate.

c. Mixing

Pasteurised solid digestate from the AD is mixed with pasteurised and decontaminated overs from the IVC tunnels and then loaded on to the maturation floor for aerobisation and maturation. The mixing process allows the overs to absorb moisture from the digestate and provide structure to the sludge-like digestate to allow proper aeration.

d. Maturation

The mixture is piled into aerated bays for further aeration and maturation. After aerobisation and maturation, the material is directed to a screen for final processing.

e. Offtake

Compost is stockpiled within the building for bulk distribution.

3.4 Quantities of Dangerous Goods Stored and Handled

The quantities of DGs proposed to be stored at the site have been provided in **Table 3-1**. The site layout is presented in **Figure 3-2**.

Table 3-2: Classes and Quantities of DGs Stored and Handled

Class	Description	PG	Total Quantity[a]
Corrosive Substances in Tanks			
8	Sodium hypochlorite (10% – 30%)	III	13.5 m^3
8	Sodium hydroxide (5% – 51.5%)	II	13.5 m^3
8	Sulfuric acid (15% - 51%)	III	13.5 m^3
Biogas Storage Tanks			
2.1	Biogas	n/a	750 m^3
Biogas in Digester Freeboard			
2.1	Biogas	n/a	800 m^3
Rate of Biogas Production in AD			
2.1	Biogas	n/a	1,027 Nm^3/h

[a]55 v/v% of biogas is biomethane.

Figure 3-3: Site Layout

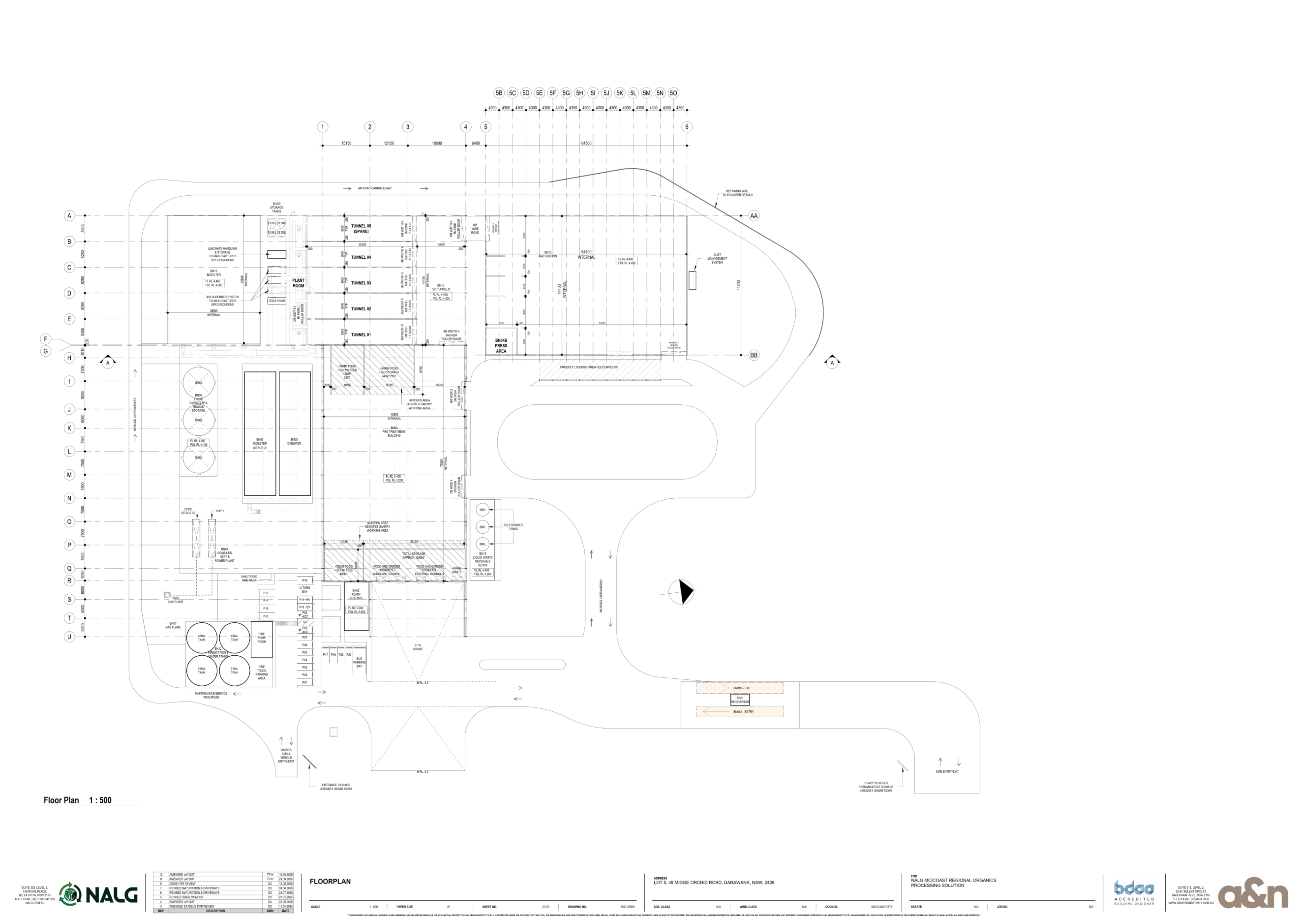

Figure 3-4: Facility Layout

4.0 Hazard Identification

4.1 Introduction

A hazard identification table has been developed and is presented at **Appendix A**. This table has been developed following the recommended approach in Hazardous Industry Planning Advisory Paper No .6, Hazard Analysis Guidelines (Ref. [3]). The Hazard Identification Table provides a summary of the potential hazards, consequences and safeguards at the site. The table has been used to identify the hazards for further assessment in this section of the study. Each hazard is identified in detail and no hazards have been eliminated from assessment by qualitative risk assessment prior to detailed hazard assessment in this section of the study.

In order to determine acceptable impact criteria for incidents that would not be considered for further analysis, due to limited impact offsite, the following approach has been applied:

- *Fire Impacts* - It is noted in Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 (Ref. [2]) that a criterion is provided for the maximum permissible heat radiation at the site boundary (4.7 kW/m^2) above which the risk of injury may occur and therefore the risk must be assessed. Hence, to assist in screening those incidents that do not pose a significant risk, for this study, incidents that result in a heat radiation less that at 4.7 kW/m^2, at the site boundary, are screened from further assessment.

  Those incidents exceeding 4.7 kW/m^2 at the site boundary are carried forward for further assessment (i.e. frequency and risk). This is a conservative approach, as HIPAP No. 4 (Ref. [2]) indicates that values of heat radiation of 4.7 kW/m^2 should not exceed 50 chances per million per year at sensitive land uses (e.g. residential). It is noted that the closest residential area is more than several hundred meters from the site, hence, by selecting 4.7 kW/m^2 as the consequence impact criteria (at the adjacent industrial site boundary) the assessment is considered conservative.

- *Explosion* - It is noted in HIPAP No. 4 (Ref. [2]) that a criterion is provided for the maximum permissible explosion over pressure at the site boundary (7 kPa) above which the risk of injury may occur and therefore the risk must be assessed. Hence, to assist in screening those incidents that do not pose a significant risk, for this study, incidents that result in an explosion overpressure less than 7 kPa, at the site boundary, are screened from further assessment. Those incidents exceeding 7 kPa, at the site boundary, are carried forward for further assessment (i.e. frequency and risk). Similarly, to the heat radiation impact discussed above, this is conservative as the 7 kPa value listed in HIPAP No. 4 relates to residential areas, which are over more than several hundred meters from the site.

- *Toxicity* – Toxic substances may be a byproduct at the site; hence, toxicity has been assessed.

- *Property Damage and Accident Propagation* - It is noted in HIPAP No. 4 (Ref. [2]) that a criterion is provided for the maximum permissible heat radiation/explosion overpressure at the site boundary (23 kW/m^2/14 kPa) above which the risk of property damage and accident propagation to neighbouring sites must be assessed. Hence, to assist in screening those incidents that do not pose a significant risk to incident propagation, for this study, incidents that result in a heat radiation heat radiation less than 23 kW/m^2 and explosion over pressure less than 14 kPa, at the site boundary, are screened from further assessment. Those incidents exceeding 23 kW/m^2 at the site boundary are carried forward for further assessment with respect to incident propagation (i.e. frequency and risk).

- *Societal Risk* – HIPAP No. 4 (Ref. [2]) discusses the application of societal risk to populations surrounding the proposed potentially hazardous facility. It is noted that HIPAP No. 4 indicates that where a development proposal involves a significant intensification of population, in the vicinity of such a facility, the change in societal risk needs to be taken into account. In the case of the facility, there is currently no significant intensification of population around the proposed site; however, the adjacent land has been rezoned residential; hence, there will be housing located approximately more than several hundred meters from the site. Therefore, societal risk has been considered in the assessment.

4.2 Properties of Dangerous Goods

The type of DGs and quantities stored and used at the site has been described in **Section 3**. **Table 4-1** provides a description of the DGs stored and handled at the site, including the Class and the hazardous material properties of the DG Class.

Table 4-1: Properties* of the Dangerous Goods and Materials Stored at the Site

Class	Hazardous Properties
2.1 – Flammable Gas	Class 2.1 includes flammable gases which are ignitable when in a mixture of 13 per cent or less by volume with air or have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. Ignited gas may result in explosion or flash fire. Where gas released under pressure from a hole in a pressurised component is ignited, a jet fire may occur.
8 – Corrosive Substances	Class 8 substances (corrosive substances) are substances which, by chemical action, could cause damage when in contact with living tissue (i.e. necrosis), or, in case of leakage, may materially damage, or even destroy, other goods which come into contact with the leaked corrosive material. Releases to the environment may cause damage to sensitive receptors within the environment.

* The Australian Code for the Transport of Dangerous Goods by Road and Rail (Ref. [7]).

4.3 Hazard Identification

Based on the hazard identification table presented in **Appendix A**, the following hazardous scenarios have been developed:

- Bio-gas Release, Ignition and Jet Fire
- Bio-gas Release, Delayed Ignition and Flash Fire
- Bio-gas Release, Air Influx, Ignition and Explosion or Flash Fire in Vessels or Pipework
- Incomplete H_2S Conversion and Bio-gas Release
- Bushfire Impact on Digesters and Bio-gas Tanks, Bio-gas Release, Ignition and Fire
- Receival Hall
- Compost Ignition and Fire Propagation
- Class 8 Release in Presence of Incompatible Substances
- Class 8 Release and Environmental Incident
- Firewater Run-off and Environmental Incident

Each identified scenario is discussed in further detail in the following sections.

4.4 Bio-gas Release, Ignition and Jet Fire

In the event of a minor containment failure such as in the pipework or associated equipment, bio-gas would be released as the pressures within the digesters and associated pipework are above atmospheric. The bio-gas contains 55% methane which is above the Upper Explosive Limit, however upon release it would dilute with the oxygen in the atmospheric air, potentially creating an explosive atmosphere. If ignited, this may result in a jet fire. The jet fire would burn at the release point, preventing the influx of atmospheric air into the vessel or pipework.

The operating pressure is expected to be around 800 Pa; hence, in the event of release there would be insufficient pressure to result in flow that would form a jet. Ignition of the dispersing flammable atmosphere would not result in a jet fire and therefore would be unable to impact offsite.

As the underlying conditions for a jet fire to occur are not present, this incident has not been carried forward for further analysis.

4.5 Bio-gas Release, Delayed Ignition and Flash Fire

In a similar scenario to **Section 4.4**, a containment failure such as a hole in the biogas storage bladder, pipework or associated equipment would result in the release of bio-gas. In the absence of immediate ignition and sufficient ventilation, the gas would accumulate and may yield a large vapour cloud with a methane concentration within the flammability limits. As the digesters and plant equipment are outdoors, this cloud would not be confined hence it would be unlikely for ignition to yield a vapour cloud explosion. Instead, if ignited a flash fire may occur.

The digesters and plant equipment are located outdoors where natural ventilation is expected to dilute any releases. Notwithstanding this, there is the potential for an offsite impact to occur; hence, this incident has been carried forward for further analysis.

To determine whether there would be sufficient gas released in the event of a bio-digester failure a review of the release rate has been undertaken. The pressure difference between within the digester and the atmosphere is low such that the release rate of the gas will have a non-choked gas velocity, hence the release is subsonic. The release rate of a gas (G_L) with a non-choked gas velocity can be estimated using the **Equation 4-1** (Ref. [7]).

Equation 4-1

$$G_L = C_d S P_1 \left[\left(\frac{M}{ZRT}\right)\left(\frac{2\gamma}{\gamma - 1}\right)\left(1 - \left(\frac{P_a}{P_1}\right)^{\frac{\gamma-1}{\gamma}}\right)\right]^{0.5} \left(\frac{P_a}{P_1}\right)^{\frac{1}{\gamma}}$$

Where:

- G_L = gas release rate (kg/s)
- C_d = discharge co-efficient (0.6)
- S = cross sectional area of the hole ($2x10^{-3}$ m^2 based on a 50 mm hole)
- M = molecular weight of the gas (0.01604 kg/mol)
- P_1 = Upstream pressure of the leak (102,325 Pa)
- γ = ratio of specific heats at constant pressure and constant volume (assumed to be 1.3)
- Z = compressibility factor (approximated as 1.0 for low to medium pressures below 50 bar)
- R = universal gas constant (8.314 J/mol.k)

- T = temperature (310 K)

Substituting the above information in **Equation 4-1** results in a release rate of 0.042 kg/s. The mass flow rate of this magnitude would be dispersed by natural ventilation which for open air conditions for lighter than air gases can be assumed to be 0.5 m/s from Table C.1 from AS/NZS 60079.10.1:2022 (Ref. [8]). Therefore, the potential for a flammable atmosphere to extend over the site boundary would be considered negligible; hence, this incident has not been carried forward for further analysis.

4.6 Bio-gas Release, Air Influx, Ignition and Explosion or Flash Fire in Vessels or Pipework

During steady-state operation, the bio-gas in the digesters headspace and associated pipework and equipment is composed of 55% methane with the balance filled by carbon dioxide and a minute amount of hydrogen sulphide. This concentration of methane is above the Upper Explosive Limit (UEL) of 17%; hence, ignition of the gas within the digesters and associate pipework and equipment would not occur in normal operation.

However, if a hole forms in the containment vessel or pipework and methane is allowed to release and equilibrate to atmospheric pressure then oxygen may permeate into the vessel which could potentially lower the concentration to reside within the explosive limits. It is noted that in such a circumstance, it is expected that the majority of the ullage space would still be above the explosive limits; hence, an ignitable quantity would be limited, and an explosion would not be expected to occur. As the potential for an explosion to occur is considered negligible, this incident has not been carried forward for further analysis.

4.7 Incomplete H_2S Conversion and Bio-gas Release

H_2S is produced by the microorganisms involved in anaerobic digestion of the oragnic waste, and it is therefore present in the bio-gas in concentrations of up to approximately 500 ppm. This concentration can cause immediate loss of consciousness and death in humans. To reduce the concentration of H_2S in the biogas, a small volume (micro-dose) of air is injected into the headspace of each digester, enabling the conversion of H_2S gas to inert sulphate which precipitates out of solution.

Should the volume of H_2S generated be greater than expected, or the quantity of air added be too low, or any other unanticipated process variable result in the insufficient conversion of H_2S, the generated bio-gas may be contaminated. There is an additional H_2S scrubber for further reduction of the concentration. In the highly unlikely event that insufficient H_2S conversion occurred coinciding with failure of the scrubber and a bio-gas release scenario, ppm levels of H_2S could be released.

Since the bio-gas operations are outdoors, any release would be dispersed and diluted rapidly by natural ventilation. The concentrations are sufficiently miniscule to be unlikely to pose an offsite impact. Additionally, the bio-gas quality is measured in real time using gas chromatography, ensuring any off-spec gas is identified and sent for flaring as needed. Due to the low likelihood of an H_2S release occurring and the limited potential for offsite impacts, this incident has not been carried forward for further analysis. Nevertheless, the following recommendations are made:

- Hydrogen sulfide detectors be either installed at potential release points or be worn on personnel conducting maintenance.

- Staff training shall be implemented to limit exposure to hydrogen sulfide below standards set by Safe Work Australia.

4.8 Bushfire Impact on Digesters and Bio-gas Tanks, Bio-gas Release, Ignition and Fire

Nearby vegetation poses a potential bushfire risk to the site in terms of radiant heat and ember attack. A bushfire hazard assessment performed by MRA designated a Bushfire Attack Level of BAL-12.5 for the digesters and BAL-19 for the biogas tanks which corresponds to potential radiant heat exposure up to 12.5 kW/m^2 and 19 kW/m^2 respectively. For the digester, this level of radiant heat is below the typically accepted criteria for incident propagation of 23 kW/m^2 (Ref [3]) noting that the vessel walls are to be constructed of stainless steel. However, should embers land on the digester domes, there is potential for holes to be burned through the dome releasing flammable gas. Upon dilution with oxygen in the atmosphere, this released gas may ignite and further damage the dome, resulting in escalation of the release and fire which may impact offsite. The dome material is expected to be non-combustible, hence it is expected to prevent failure of the dome and release of significant volumes of gas.

MRA proposes various recommendations regarding maintenance of the surrounding vegetation, building construction measures, water supply and vegetation clearance to overhead powerlines. Riskcon recommends that the recommendations made by MRA are implemented so as to suitably manage the risk posed by bushfire to the site.

4.9 Receival Hall

The receival hall is where an initial pre-screening with a plant will take place to remove any heavily contaminated materials before the separation stage. The site will only receive materials as described in **Section 3.3.1**. However, the feed stream may contain combustible contamination, such as paper, cardboard, plastic, and other items that can add to the ignition and propagation of fire.

Accumulation of these combustible goods, alongside the potential presence of flammable substances in the received waste, is a large concern for fire safety. However, it must be noted that FOGO contains a relatively high moisture content, which may act as a natural fire suppressant thus mitigating the risk of ignition. Furthermore, several fire protection systems are available for use in the receival and separation building, such as fire extinguishers and fire hose reels, for first-response firefighting. Due to the reduced fire risk and the protections present in the receival hall, it is not expected that the fire risk will escalate to a full building fire and compromise essential firefighting equipment. Therefore, this incident has not been carried for further analysis.

4.10 Compost Ignition and Fire

Maturation takes place in an indoor system and is not expected to pose a fire risk as the process control is meticulous (negligible likelihood of methane generation). Due to the extensive area available in this stage, it is concluded that the primary hazard posed by this facility is ignition within a bay and exacerbation of a fire scenario through propagation across adjacent bay or along the same bay.

Based on an extensive literature review, the following potential causes for ignition have been identified:

- Spontaneous combustion of windrows due to elevated internal temperatures.

- Anaerobic formation of flammable biogas as a result of insufficient oxygen availability.
- Equipment influence (i.e. conveyors/shredders/turners).
- Acts of nature (i.e. lightning and bushfire).
- Acts of arson/vandalism.

It must be noted that the maturation process will take place in an enclosed maturation building that contain multiple aerated bays for maturation, instead of being in a fully outdoor environment. The maturation building will significantly improve the process control of the composting process in comparison to the existing process, as the shelters will act as a barrier from potential rainwater and solar radiation; thus, the temperature and moisture content are consistently kept below 80ºC and 50%-65% respectively, of the compost can be kept within operating parameters more readily. In addition, the aerated bays are ventilated mechanically with dust control mechanism. The maturation pad will be fitted with fire protection as well to combat any small fire that may arise along with an automated fire detection system that operates 24/7. Note that the composting process itself plays a role in mitigating the risk of combustion by reducing the amount of available calorific value in the waste through the breaking down of organic matter into stable soil amendments, such as compost. This process decreases the concentration of flammable materials in the waste, thereby minimising the likelihood of fire hazards associated with high-energy organic residues.

It is highly unlikely that a fire within a bay has the potential to propagate across other stockpiles and to the other facilities on site. Hence, as the risk of fire hazard impinging on essential fire fighting equipment is expected to be low, this scenario has not been carried forward for further analysis.

4.11 Class 8 Release in Presence of Incompatible Substances

Corrosive substances such as sodium hypochlorite, sodium hydroxide and sulfuric acid are stored at the site for use in tanks. There is the potential for storage vessels to leak or for pipework to be damaged resulting in the loss of containment of the corrosive substances. Should a release of these substances result in contact with incompatible substances (such as sodium hypochlorite with sulfuric acid), it could result in an exothermic reaction and generation of toxic fumes of chlorine.

The tank stores are designed in accordance with AS 3780:2023 (Ref. [8]) which requires bunding around the storages and compliance with the crest locus limit preventing lateral sprays from vessels discharging outside the bund. Additionally, incompatible substances including sodium hypochlorite and sulfuric acid are to be segregated by at least 5 m in accordance with the standard. Furthermore, it is highly unlikely for a simultaneous release of both sodium hypochlorite and sulfuric acid. Based on the presence of bunding, compliant separation and low likelihood for a simultaneous release, it is considered suitably unlikely that these incompatible substances will come into contact and result in dangerous reactions. Therefore, this incident has not been carried forward for further analysis.

4.12 Class 8 Release and Environmental Incident

Corrosive substances such as sodium hypochlorite, sodium hydroxide and sulfuric acid are stored at the site for use as water treatment chemicals or cleaning. There is the potential for storage vessels to leak or for pipework to be damaged resulting in the loss of containment of the corrosive substances. If the spills are not contained, they could migrate into waterways which if discharged from the site may result in environmental damage.

The corrosive substances will be stored in accordance with AS 3780-2023 ((Ref. [8]) which requires bunding around the storages and compliance with the crest locus limit preventing lateral sprays from vessels discharging outside of the bund. Based on the presence of the bund, it is expected that any spills will be contained within the bund and prevented from being released into the stormwater system. Therefore, it is considered that the risk of an offsite release from the corrosive storage is low. Hence, this incident has not been carried forward for further analysis.

4.13 Firewater Run-off and Environmental Incident

Where fire occurs in the presence of hazardous materials or Dangerous Goods there is the potential for the water to become contaminated which may result in an environmental incident if released into the water ways. A risk assessment methodology was followed as outlined by the Department of Planning document "*Best Practice Guidelines for Potentially Contaminated Water Retention and Treatment Systems"* (Ref. [9]) (The Guideline). The guideline follows a risk-based approach based upon the identified hazards and the potential for contamination. To determine the volume which must be provided for the onsite containment, the worst-case credible fire scenario is considered.

It is anticipated that FRNSW will combat the fire using three hydrant hoses for 60 minutes. In summary, in a major fire scenario the following protection systems are likely to be discharging:

- 3 hydrant hoses, output at 1.8 m^3/min for 240 minutes.

The total water discharge over the fire combat period would be 432 m^3. The site's firewater containment will be largely driven by two proposed stormwater tanks that have a capacity of 415 m^3 each. The aggregate capacity will then therefore be 830 m^3 which does not consider the volume of any bunds nor surface ponding available. As the containment capacity exceeds the calculated firewater demand, it is considered that the risk of an offsite release from firewater run off is low. Hence, this incident has not been carried forward for further analysis.

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5.0 Conclusion and Recommendations

5.1 Conclusions

A hazard identification table was developed for the site to identify potential hazards that may be present at the site as a result of operations or storage of materials. Based on the identified hazards, scenarios were postulated that may result in an incident with a potential for offsite impacts. Postulated scenarios were discussed qualitatively and any scenarios that would not impact offsite were eliminated from further assessment. No scenarios were found to likely impact offsite.

Based on the analysis conducted, it is concluded that the risks at the site boundary are not considered to exceed the acceptable risk criteria; hence, the facility would only be classified as potentially hazardous and would be permitted within the current land zoning for the site.

5.2 Recommendations

Notwithstanding the conclusions following the analysis of the facility, the following recommendations have been made:

- Bio-gas operations shall be subject to hazardous area classification in accordance with AS/NZS 60079.10.1:2022 and electrical equipment will be installed in accordance with AS/NZS 60079.14:2022.
- Any hot work on site shall be performed under a safe work permit.
- Appropriate first attack firefighting equipment and staff training shall be implemented to minimise the likelihood of poisonous gas evolution in the event of a fire.
- Gas leak detection systems shall be implemented and regularly maintained.
- Hydrogen sulfide detectors shall be either installed at potential release points or be worn on personnel conducting maintenance.
- Staff training shall be implemented to limit exposure to hydrogen sulfide below standards set by Safe Work Australia.

6.0 References

[1] NSW Department of Planning and Environment, "Applying SEPP33 – Hazardous and Offensive Developments," NSW Department of Planning and Environment, Sydney, 2011.

[2] Department of Planning, "Hazardous Industry Planning Advisory Paper No. 4 - Risk Criteria for Land Use Safety Planning," Department of Planning, Sydney, 2011.

[3] Department of Planning, "Hazardous Industry Planning Advisory Paper No. 6 - Guidelines for Hazard Analysis," Department of Planning, Sydney, 2011.

[4] SafeWork NSW, "Work Health and Safety Regulation," SafeWork NSW, Lisarow, 2017.

[5] Department of Planning, Multi-Level Risk Assessment, Sydney: Department of Planning, 2011.

[6] Road Safety Council, The Australian Code for the Transport of Dangerous Goods by Road and Rail Edition 7.7, Canberra: Road Safety Council, 2020.

[7] Standards Australia, AS/NZS 60079.10.1:2022 - Explosive Atmospheres Part 10.1: Classification of Areas, Explosive Gas Atmospheres, Sydney: Standards Association of Australia, 2022.

[8] Standards Australia, "AS 3780:2023 - The storage and handling of corrosive substances," Standards Australia, Sydney, 2023.

[9] NSW Department of Planning, "Best Practice Guidelines for Contaminated Water Retention and Treatment Systems," NSW Department of Planning, Sydney, 1994.

Appendix A

Hazard Identification Table

Appendix A

A1. Hazard Identification Table

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards

1	Digester tanks/Bio-gas Generation and Processing	• Releases from pipework due to corrosion, flange leaks, hose/pump leaks, weld failure, operator error, maintenance error, mechanical damage (e.g. tanker impact on fill point) etc.
		• Overproduction of bio-gas and excessive pressure buildup leading to equipment failure
		• Improper operation of water wash process
		• Malfunction in process control system
			• Bio-gas controlled release from pressure safety valve
			• Bio-gas release from minor leak (5 mm hole) or major leak (50 mm hole)
			• If ignition then:
			  ○ Flash fire, jet fire, or possible explosion if confined, and potentially hazardous heat radiation, direct fire involvement, and/or overpressure.
			• Potential fire propagation to adjacent sites.
				• Tanks designed per the following standards:
				  ○ AS1210 – Unfired pressure vessels
				  ○ AS4041 – Pressure piping (on pad pipework, vaporiser)
				  ○ AS5601 – Gas installations (gas pipeline)
				  ○ AS1271 – Safety valves, other valves, liquid level gauges and other fittings for boilers and unfired pressure vessels
				  ○ AS1345 – Identification of the contents of pipes, conduits and ducts
				  ○ AS/NZS3000 – Electrical installations
				  ○ AS/NZS60079.10.1 – Classification of Areas – Explosive Gas Atmospheres
				  ○ AS/NZS60079.14 – Explosive atmospheres, electrical installations design, selection and erection
				  ○ AS1768 – Lightning Protection
				• Tank and associated pipework/fitting will be pressure tested in accordance with the requirements of the pressure vessels code
				• Ignition source control including earthing to prevent static sparks.
				• Regular inspection and maintenance
				• PLC redundancy system for managing faults in critical process control equipment
				• Leak detection systems

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards
				• Monitoring and control of bio-gas production and pressure • Use of pressure relief systems • Flare for bio-gas disposal reducing likelihood of bio-gas emissions • Appropriate first attack fire-fighting equipment (e.g. hose reels & extinguishers) • Fire detection systems • Methane from spent digestate piped back into the primary digester tanks' gas space
2	Gas Management and Power Utilities	• Incomplete conversion of H_2S to sulphate and equipment failure • Malfunction or failure to ignite flare	• Release of toxic and corrosive H_2S • If both CHP and flare malfunctions when needed, then controlled release of bio-gas	• Chromatographic monitoring of gas composition • Automatic shutoff and flaring for disposal of out-of-spec gas • Availability of appropriate PPE for workers • Mechanical ventilation • Regular inspection and maintenance of flare
3	Digesters	• Bushfire ember attack	• Failure of dome top, release of flammable gas and fire	• Flame resistant dome material (steel) • Establishment of Inner Protection Area against bushfire through vegetation management
4	Receival Hall	• Combustible / flammable material contaminants such as hazardous chemicals • Insufficient control of ignition sources (i.e., electrical equipment, smoking, etc)	• Waste fire in the receival building	• Fire extinguishers • Fire hose reels • Smoke detection • Thermal imaging cameras to detect hotspots • Separation of hazardous and inappropriate materials from the stream • Trained operators • Negative air pressure system with a min. of 3 air exchangers per hour.

ID	Area/Operation	Hazard Cause	Hazard Consequence	Safeguards
				• FOGO has high moisture content (difficult to ignite and produce dust)
5	Maturation pad	• Moisture content of compost not within operating parameters • Anaerobic conditions leading to methane generation • Hot equipment from vehicles • Exothermic reaction (heat generation) from composting	• Compost fire in one of the bays	• Bays are separated by a concrete barrier to prevent propagation of fire to other windrows • Roofed building that prevents rain and solar radiation from impacting stockpiles (better process control) • Mechanical ventilation with dust control mechanisms. • Fire extinguishers • Fire hydrants • Fire hose reels • Daily monitoring for incompatible waste or high temperatures • Trained operators • FOGO has high moisture content (difficult to ignite)
6	Sodium hypochlorite, Sodium hydroxide, Sulfuric acid tanks	• Mechanical damage (due to vehicle impact or equipment failure)	• Release to the environment • Damage to other goods and/or living tissues • Exothermic reaction resulting in heat production	• Storages are designed per AS 3780:2023 (i.e., tank construction/installation/containment) • Trained operators • Bunded tanks