PRELIMINARY HAZARD ANALYSIS,

MODIFICATION TO APPROVED PACKING PLANT AND OTHER WORKS,

SHOALHAVEN STARCHES,

BOMADERRY, NSW

CONSENT NUMBER: MP 06_0228 MOD 21

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Preliminary Hazard Analysis, Shoalhaven Starches, Modification to Approved Packing Plant and Other Works

Disclaimer

Rev	Date	Description	Reviewed By
A	9/9/15	Draft for Comment	Shoalhaven Starches
B	11/11/15	Vent Calculations Included	Shoalhaven Starches
C	23/11/15	Final Revision	Shoalhaven Starches
D	15/5/21	2021 Modifications Included	Shoalhaven Starches
E	30/5/21	Final Revision	Shoalhaven Starches

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EXECUTIVE SUMMARY

The Shoalhaven Starches factory located on Bolong Road, Bomaderry, produces a range of products for the food, beverage, confectionary, paper and motor transport industries including starch, gluten, glucose and ethanol.

Shoalhaven Starches have identified that as a result of the increase in range of different specialised products that will now be able to be produced due to the Mod 16 changes, modifications will be required to the approved Packing Plant on the northern side of Bolong Road to accommodate this increased range of specialised products.

As part of the project requirements, a revised Preliminary Hazard Analysis (PHA) is therefore required. Include in this revised report are “Other Works”, i.e. an additional raw waste water tank, a nitrogen generator, an additional starch cooking plant and equipment, and two additional fermenters.

The risks associated with the proposed modifications to the Packing Plant and Other Works at the Shoalhaven Starches Bomaderry site have been assessed and compared against the Department of Planning risk criteria.

The results presented in this report show compliance with all risk criteria.

Societal risk, area cumulative risk and environmental risk are also concluded to be acceptable.

The primary reason for the low risk levels from the modifications is the significant explosion overpressures from dust explosions remain on-site. The “Other Works” do not involve hazardous materials that can cause fires, explosions or toxic gas emissions with off-site impacts.

Based on the analysis in this revised PHA, there are no further recommendations to be made.

GLOSSARY

AS	Australian Standard
ATEX	Explosive Atmospheres (European Directive)
CIP	Clean-in-Place
DoP	NSW Department of Planning
HAZOP	Hazard and Operability Study
HIPAP	Hazardous Industry Planning Advisory Paper
LEL	Lower Explosion Limit
NFPA	National Fire Protection Association (USA)
PHA	Preliminary Hazard Analysis
QRA	Quantitative Risk Assessment
TNO	Dutch Based Research Organisation
TWA	Time Weighted Average

REPORT

1 INTRODUCTION

1.1 BACKGROUND

Shoalhaven Starches is a member of the Manildra Group of companies. The Manildra Group is a wholly Australian owned business and the largest processor of wheat in Australia. It manufactures a wide range of wheat-based products for food and industrial markets both locally and internationally.

The Shoalhaven Starches factory located on Bolong Road, Bomaderry, produces a range of products for the food, beverage, confectionary, paper and motor transport industries including starch, gluten, glucose and ethanol.

Under Project Approval MP 06_0228 Shoalhaven Starches obtained approval to establish a new Packing Plant, container loading area and a rail spur line on the northern side of Bolong Road. These works also required the provision of an overhead bridge structure to allow product to be transferred and safe pedestrian movement across Bolong Road.

In 2019 the Independent Planning Commission approved Mod 16 which included the construction of a Specialty Product Facility and additional Gluten Dryer. The Specialty Products Building would enable the production of an increased range of specialised products as an extension to Shoalhaven Starches existing product line. The specialty products will comprise a range of modified gluten products for the food industry and modified starches for both paper manufacturing as well as food production.

Shoalhaven Starches have now identified that as a result of the increase in range of different specialised products that will now be able to be produced as a result of Mod 16, modifications will be required to the approved Packing Plant on the northern side of Bolong Road to accommodate this increased range of specialised products.

Other process modifications include the following:

- Install an additional raw waste water tank within proximity of the existing raw waste water tank adjacent to the oxidisation pond within the Environmental Farm;
- Install a nitrogen generator and storage tanks that will supply nitrogen to the existing and proposed ethanol storage tanks to lower the tank explosion risk;
- Provide increased indirect starch cooking capacity that will be located adjacent to the existing Glucose Plant; and

- The installation of fermenters 18 and 19.

The Approved Packing Plant was assessed via a Preliminary Hazard Analysis (PHA) (Ref 1). This report is an update of this PHA.

Shoalhaven Starches requested that Pinnacle Risk Management revise the PHA for the proposed modifications. This PHA has been prepared in accordance with the guidelines published by the Department of Planning (DoP) Hazardous Industry Planning Advisory Paper (HIPAP) No 6 (Ref 2).

1.2 OBJECTIVES

The main aims of this PHA study are to:

- Identify the credible, potential hazardous events associated with the proposed modifications, i.e. the Packing Plant and the other new plant and equipment;
- Evaluate the level of risk associated with the identified potential hazardous events to surrounding land users and compare the calculated risk levels with the risk criteria published by the DoP in HIPAP No 4 (Ref 3);
- Evaluate the potential for propagation events;
- Review the adequacy of the proposed safeguards to prevent and mitigate the potential hazardous events; and
- Where necessary, submit recommendations to Shoalhaven Starches to ensure that the proposed modifications are operated and maintained at acceptable levels of safety and effective safety management systems are used.

1.3 SCOPE

This PHA assesses the credible, potential hazardous events and corresponding risks associated with the Shoalhaven Starches proposed modifications to the Packing Plant and other works.

There are no changes to the transport of Dangerous Goods to or from the site as part of this project. Therefore, transport is not assessed.

1.4 METHODOLOGY

In accordance with the approach recommended by the DoP in HIPAP 6 (Ref 2) the underlying methodology of the PHA is <u>risk-based</u>, that is, the risk of a particular potentially hazardous event is assessed as the outcome of its consequences and likelihood.

The PHA has been conducted as follows:

- Initially, the proposed modifications and their locations were reviewed to identify credible, potential hazardous events, their causes and consequences. Proposed safeguards were also included in this review;
- As the potential hazardous events are located at a significant distance from other sensitive land users, the consequences of each potential hazardous event were estimated to determine if there are any possible unacceptable off-site impacts;
- Included in the analysis is the risk of propagation between the proposed equipment and the adjacent processes; and
- If adverse off-site impacts could occur, assess the risk levels to check if they are within the criteria in HIPAP 4 (Ref 3).

2 SITE DESCRIPTION

The Shoalhaven Starches factory site is situated on various allotments of land on Bolong Road, Bomaderry, within the City of Shoalhaven (see Figure 1). The factory site, which is located on the south side of Bolong Road on the northern bank of the Shoalhaven River, has an area of approximately 12.5 hectares.

The town of Bomaderry is located approximately 0.5 km to the west of the factory site and the Nowra urban area is situated 2.0 km to the south west of the site. The “Riverview Road” area of the Nowra Township is situated approximately 600 metres immediately opposite the factory site across the Shoalhaven River.

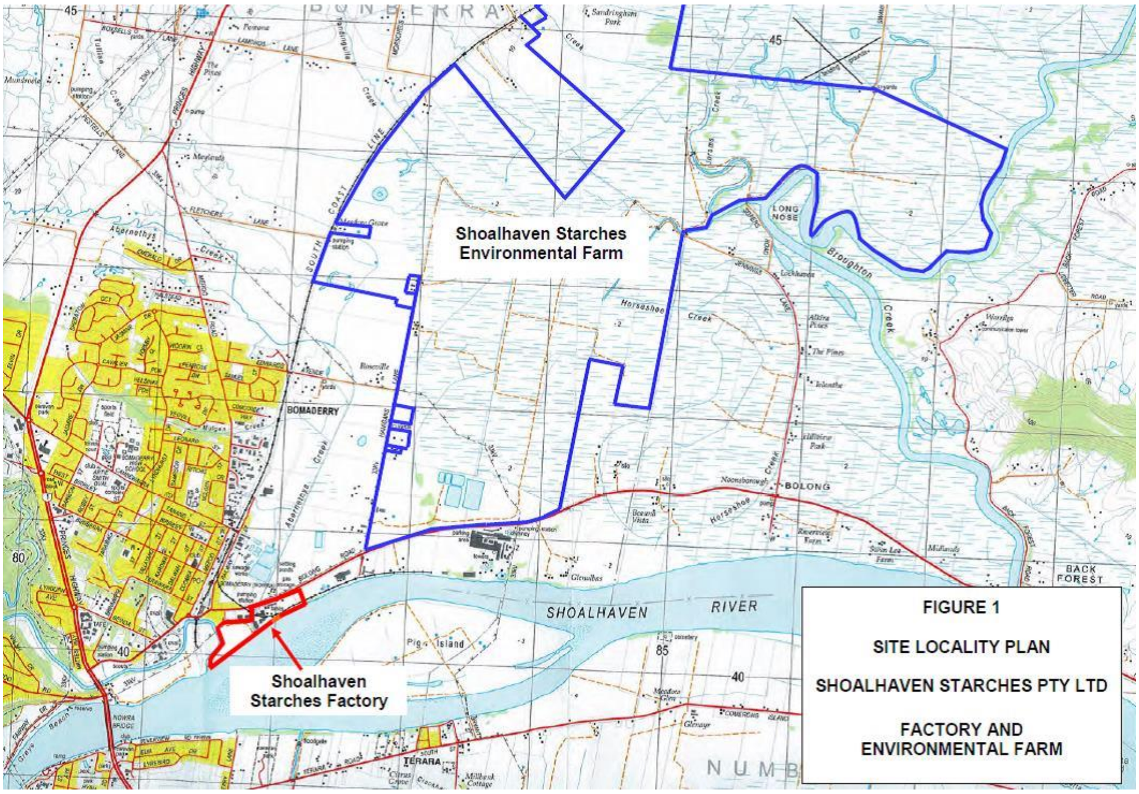
The village of Terara is situated approximately 1.5 kilometres to the south east of the site, across the Shoalhaven River. Pig Island is situated between the factory site and the village of Terara and is currently used for cattle grazing.

There are a number of industrial land uses, which have developed on the strip of land between Bolong Road and the Shoalhaven River. Industrial activities include a metal fabrication factory, the Shoalhaven Starches site, Shoalhaven Dairy Co-op (formerly Australian Co-operative Foods Ltd – now owned by the Manildra Group) and the Shoalhaven Paper Mill (also now owned by the Manildra Group). The industrial area is serviced by a privately-owned railway spur line that runs from just north of the Nowra-Bomaderry station via the starch plant and the former Dairy Co-op site to the Paper Mill.

The Company also has an Environmental Farm of approximately 1,000 hectares located on the northern side of Bolong Road. This area is cleared grazing land and contains spray irrigation lines and wet weather storage ponds (total capacity 925 Mega litres). There are at present six wet weather storage ponds on the farm that form part of the waste water management system for the factory. A seventh pond approved in 2002 was converted into the biological section of the new wastewater treatment plant has now been commissioned.

The Environmental Farm covers a broad area of the northern floodplain of the Shoalhaven River, stretching from Bolong Road in the south towards Jaspers Brush in the north. Apart from its use as the Environmental Farm, this broad floodplain area is mainly used for grazing (cattle). The area comprises mainly large rural properties with isolated dwellings although there is a clustering of rural residential development along Jennings Lane (approximately 1 kilometre from the site), Back Forest Road (approximately 500 metres to 1.2 kilometres to the west) and Jaspers Brush Road (approximately 1.2 kilometres to the north).

Figure 1 - Site Locality Plan



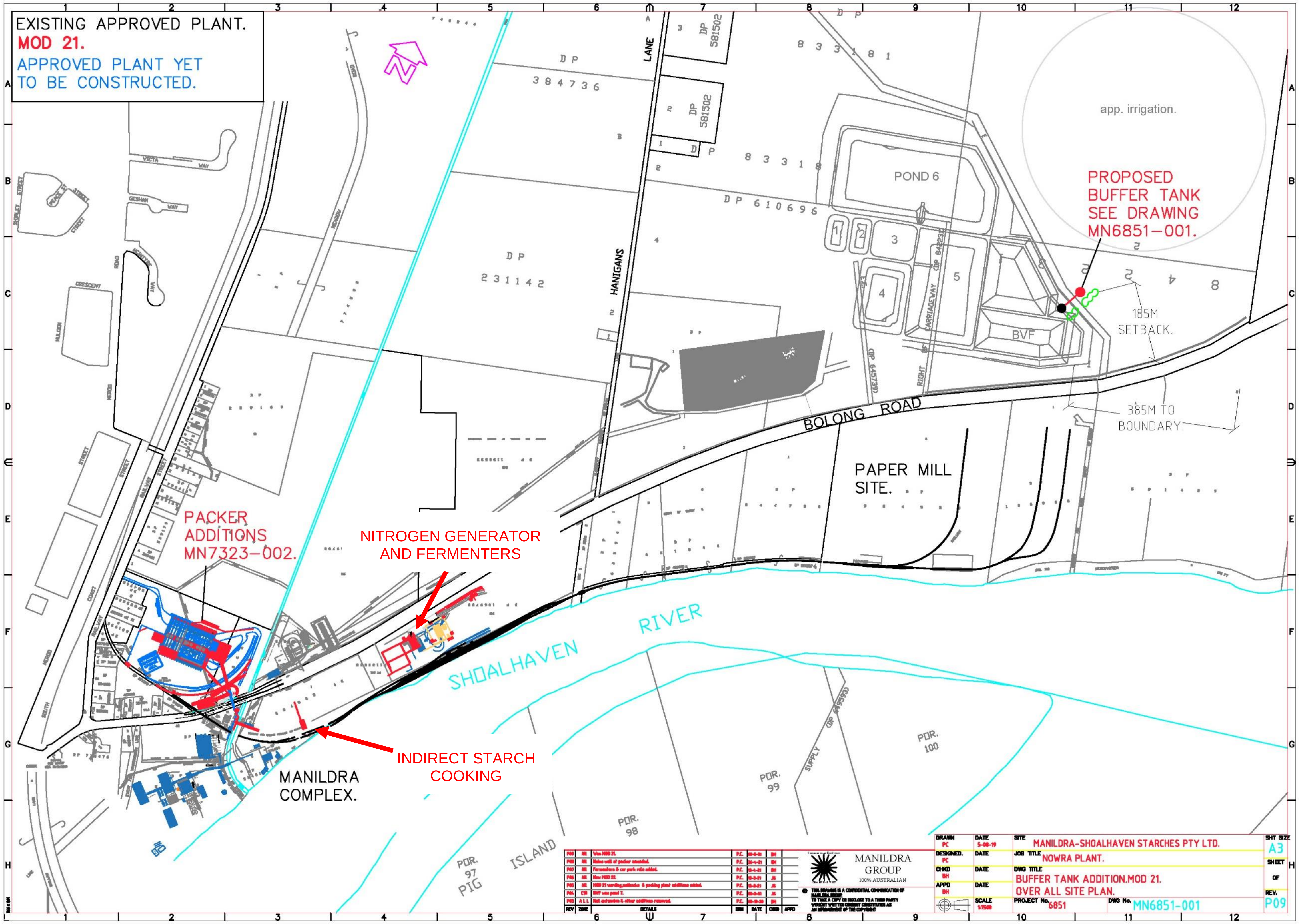
Security of the site is achieved by a number of means. This includes site personnel and security patrols by an external security company (this includes weekends and night patrols). The site operates 7 days per week (24 hours per day). Also, the site is fully fenced and non-operating gates are locked. Security cameras are installed for staff to view visitors and site activities.

There are approximately 126 people on site during Monday to Fridays 8 am to 5 pm and 88 people on site at other times.

The main natural hazard for the site is flooding. No other significant external events are considered high risk for this site.

A layout drawing showing the proposed locations of the modifications is shown in Figure 2.

Figure 2 - Site Layout



3 PROCESS DESCRIPTION

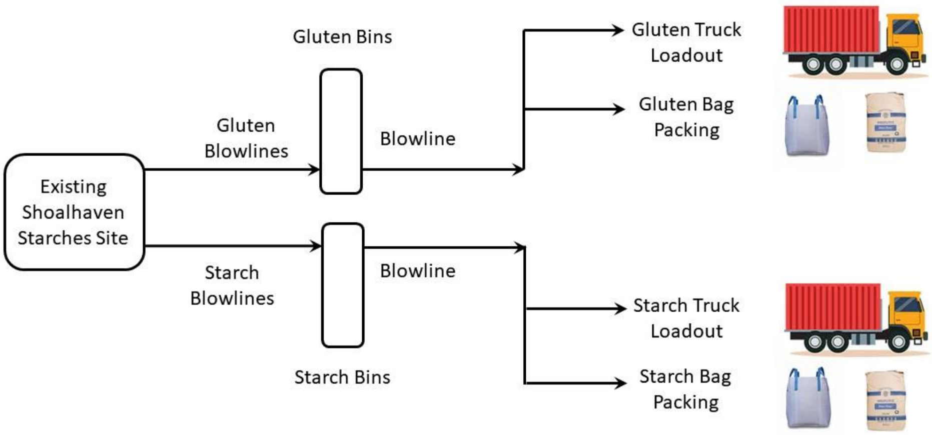
Drawings showing the layout of the following processes are provided in Appendix A. A process schematic for the Packing Plant operations is provided in Figure 3.

3.1 NORTH PACKER PLANT

The following modifications will be required to the approved Packing Plant on the northern side of Bolong Road to accommodate the different products from the Shoalhaven Starches facility:

- The approved Packing Plant made provision for 5 silos to store product awaiting packaging. To accommodate the different types of gluten and starch products that will now be able to be produced from the Specialty Product Building (Mod 16), greater flexibility will be required for the storage of the increased range of gluten and starch products on the Packing Plant site. It is therefore proposed to construct 16 smaller silos instead of the original 5 approved silos. The proposed 16 silos will either have:
    - A square footprint with dimensions of 5 metres by 5 metres, height of 30 metres and volume of 300 tonnes each; or
    - A square footprint with dimensions, e.g. 3.3 metres by 3.3 metres, height of 22 metres and volume of 150 tonnes each;
- Additional packer feed bins will also need to be installed within the Packing Plant building to accommodate the need for improved flexibility to enable a greater range of gluten and starch products to be packed;
- Additional product transfer lines and services will also need to extend from the Specialty Product Buildings approved under Mod 16 and extend across Bolong Road to the Packing Plant via the approved underground services crossing. It is also proposed to relocate the transfer lines and gantry to accommodate the amended product silos;
- To accommodate the change in equipment used within the Packing Plant such as the additional packer feed bins, the overall footprint of the Packing Plant building will need to be reconfigured from that which was originally approved; and
- The change in the footprint of the Packing Plant building will also necessitate a change in the layout of the approved car parking spaces associated with the Packing Plant building.

Figure 3 – Packing Plant Process Schematic



In addition to the above modifications it is also proposed to carry out the following modifications to the approved Packing Plant site:

- To enable storage of additional rail wagons and enable wagons to be taken off line for maintenance purposes, a third rail siding is proposed;
- It is also proposed to increase the height of the gantry containing the product transfer lines to the product silos to provide additional clearance above the container reach stacker. The current approved gantry has a height above ground level of 14.5 metres. It is proposed to lift the gantry to a minimum height above ground level of 19.6 metres, with the top of the gantry to 22.7 metres;
- It is also proposed to provide a train tunnel where the noise mitigation walls surrounding the container storage area terminate at the rail line. This is to provide additional noise attenuation; and
- It is also proposed to provide a loader maintenance and cleaning area within the container storage area.

The following process description is from Rev C of this report with the main abovementioned process changes to the Packing Plant included.

It is proposed to build a new Packing Plant and its associated container loading facilities on an undeveloped property owned by the Manildra Group of Companies on the northern side of Bolong Road. The property comprises two allotments: Lot 5 DP 825808 and Lot 2 DP 538289.

The new facility will include:

- Transfer blowlines (x5) from the existing site on the southern side of Bolong Road;
- New pipes under Bolong Road;
- The packing plant facilities for filling bags and trucks;
- A warehouse for bag storage; and
- A rail extension for loading containers onto trains (250 m long).

The proposal will seek to construct a purpose designed and built factory building with dimensions of approximately 108 metres by 60 metres, and having a height of approximately 34 metres above ground level.

There will also be 16 product storage silos (300 and 150 tonnes) located to the east of the Packing Plant building.

In addition to the above, it is proposed to construct a container / truck loading facility between the Packing Plant and the silos. Three new railway spur lines are also proposed to be extended from the existing railway to service this container loading area. The containers are to be stored to the south of the Packing Plant building.

The dried product will be pneumatically conveyed from the existing site to the proposed new silos via an underground pipe crossing for Bolong Road and once on the North Packing site, an overhead gantry system to the silos / building. The silos will feed the proposed new Packing Plant and container loading facility.

The packaged product will be filled into 1 tonne or 25 kg bags at dedicated bag filling stations (including feed bins). The 1 tonne bag filling stations will be designed for approximately 40 tonnes per hour filling rate. The bags will then be loaded into containers for distribution to the market.

The new Packing Plant will be built to avoid dust emissions as product will not be blown into bags but rather mechanically packed.

The packing building will be designed to meet good practice for food safety and housekeeping / cleanliness. The steel work has been designed to prevent ledges for product to settle on (i.e. reducing the risk of dust explosions).

The bags are to be stored in a new warehouse (concrete and steel construction). Starch and gluten can be delivered to the market via road or rail, e.g. using bulk trucks, or bags in containers or on trucks. At this point on the rail system the train is moving at walking pace, i.e. process safety incidents involving the train are unlikely. The Packing Plant will be designed for 1,600 ton per day of product. All equipment in contact with the product is to be constructed from 304L or equivalent stainless steel. All equipment handling potentially explosive dust is to be designed to ATEX and/or NFPA (US National Fire Protection Association) standards. This will include rotary valves for seals, explosion vents, equipment earthing and hazardous area zoning with the electrics and instruments to suit the requirements.

3.2 OTHER MODIFICATIONS

In addition to the modifications associated with the approved Packing Plant, it is also proposed to undertake the following modifications to the Approved Project.

3.2.1 Raw Waste Water Tank

It is proposed to install an additional raw waste water tank within proximity of the existing raw waste water tank adjacent to the oxidisation pond within the Environmental Farm and located to the north of Bolong Road (and opposite the former Paper Mill site). It is proposed that this tank will provide additional storage and act as a buffer in the case that the existing tank is required to be taken off line. This tank will have an effective volume of 3,000 kL with dimensions of approximately 20 metres diameter and 12 metres height above ground level. The raw waste water does not contain any flammable or toxic gases.

3.2.2 Nitrogen Generator

It is also proposed to install a nitrogen generator and storage tanks that will supply nitrogen to the existing and proposed ethanol storage tanks to eliminate the explosion risk. Ambient air will be drawn into the process and separated using pressure swing absorption to produce the nitrogen gas. The waste stream containing oxygen will be vented to atmosphere. This facility will be located between the existing ethanol loading bay and the Bolong Road frontage of the site. It will comprise two nitrogen generator trains housed within a container type building. Four storage vessels comprising compressed air and mixing tanks will be sited between the nitrogen generator and Bolong Road. The nitrogen that is produced will be stored in six vessels with a height above ground level of 7 metres adjacent and to the west of the nitrogen generator.

3.2.3 Indirect Starch Cooking

In order to produce ethanol, starch is essentially heated to convert it (with enzymes) into sugars which are then fermented to produce ethanol. This starch heating process is undertaken in an indirect cooking facility. Shoalhaven Starches have identified that there is inadequate capacity in their current indirect cooking process to accommodate both the existing ethanol production as well as that associated with the movement from lower to higher grade ethanol production under Mods 18 and 19. To provide increased indirect cooking capacity, it is proposed to establish an additional indirect cooking facility to be located adjacent to the existing Glucose Plant, to the north of the internal railway and to the south of the Ethanol Distillery.

The additional indirect cooking facility will comprise a series of vessels housed within a structure that will have a footprint of 184.5 m^2 (20.5 m x 9 m) and height of 16.6 metres above ground level. The structure will include a range of processing vessels situated over three floors; and a single product feed tank.

The following is a description of a typical starch cooking process.

A waste wet starch stream (i.e. a water and starch solution) is pumped via collection tanks to buffer tanks. It is then transferred to the cooking process via preheaters where the wet starch is heated to approximately 40 to 55°C. The wet starch then passes through a steam heater where it is heated to approximately 83°C. This is where the starch is cooked, i.e. the starch is hydrolysed to form dextrins (low molecular weight carbohydrates). Enzymes such as liquid Alpha Amylase aid the starch hydrolysis process. These are typically pumped into the wet starch stream prior to the steam heater.

The cooked (modified) starch will then be held in a tank and then pumped to retention tanks. The hot cooked starch is then pumped through the heat recovery exchangers to preheat the incoming waste stream, as described above.

The cooled dextrins (cooked starch), at about 70°C, are pumped to an MVR (mechanical vapour recompression) transfer tank and then to the evaporators for water removal prior to fermentation to produce ethanol.

There are typically two trains, i.e. one on line; the other on CIP (clean-in-place, e.g. a low-strength caustic solution) or standby.

3.2.4 Fermenters 18 and 19

The waste products from the starch, gluten and syrup production processes are combined to feed the fermentation and subsequently distillation stage of ethanol production. The proposed fermenters (18 and 19) will operate identically to the existing fermenters at the site.

The carbohydrates in the slurry feed to the fermentation area are converted to ethanol. The fermentation process consists of the following steps:

- Enzyme (alpha amylase) is added to the aqueous slurry to achieve an initial conversion;
- The pH is adjusted by the addition of aqueous ammonia;
- The slurry is heated to 90°C to break down the starch into dextrin (a soluble gummy substance obtained by hydrolysis of starch);
- The slurry is cooled to 60°C and a second enzyme (glucomylase) converts the dextrin to glucose; and
- Yeast is added to convert glucose to ethanol at a temperature of 35°C with the evolution of carbon dioxide.

The fermentation process results in an approximate 10% solution of ethanol in water. The flash point of a 10% (vol) ethanol-water solution is 49°C, i.e. it is not a flammable liquid at typical ambient conditions.

The original nine fermentation tanks are located in the “Fermentation Area” immediately to the south of the original ethanol distillery. Fermentation tanks 10 to 17 are located to the east of the original fermentation tanks. Fermenters 18 and 19 will be located to the east of fermenters 10 to 17.

Carbon dioxide is produced within the fermenters. It is vented to atmosphere at the fermenters and/or sent to the nearby BOC and Supagas purification plants.

Each fermenter is 15.9 m diameter and 15 m high (tangent line to tangent line). The capacity of each fermenter is 3,000 m^3, i.e. the tanks sizes are Identical to existing fermenter tanks.

Given the abovementioned four “Other Works”, there are no credible fire, explosion or toxic gas emissions potential hazardous events that could affect off-site personnel. Therefore, no further analysis of these processes is required in this updated PHA.

4 HAZARD IDENTIFICATION

4.1 HAZARDOUS MATERIALS

The hazardous materials involved with the Packing Plant modifications are:

- Starch; and
- Gluten.

Starch:

Starch or amylum is a carbohydrate consisting of a large number of glucose units joined together. The chemical formula for starch is $(C_6H_{10}O_5)n$. It is not defined as a hazardous material or a Dangerous Good.

Starch is produced by most green plants as an energy store. It is the most common carbohydrate in human diets and is contained in large amounts in such staple foods as potatoes, wheat, corn, rice, and cassava.

Papermaking is the largest non-food application for starches globally. In a typical sheet of copy paper, the starch content may be as high as 8%.

Starch is a fine, white, odourless powder. The respiratory TWA is 5 mg/m^3. It is insoluble in water. Starch is not defined as a combustible solid (it will not support combustion) but may form explosive mixtures with air. It is a potentially explosive dust when critical parameters exist, e.g. particle size less than 500 micron and moisture content less than 30% (Ref 4).

Potential ignition sources include (Ref 5):

- Smouldering, self-heating or burning dust;
- Open flames, e.g. welding, hot work, cutting and matches;
- Hot surfaces, e.g. hot bearings, dryers, incandescent materials and heaters;
- Lightning;
- Heat from mechanical impact or friction; and
- Electrical discharges and arcs.

K_{st} is a measure of a dust's explosibility classification and is a measure of the maximum rate of pressure rise, i.e. the higher the K_{st} value, the greater the explosive energy. For starch, the K_{st} value is 199 bar.m/s. These are deemed potentially weak explosions although it is noted that previous incidents involving starch dust explosions have led to fatalities (Refs 4 and 5).

Starch is non-toxic to people and has a low environmental impact potential. It is mildly irritating to eyes and lungs.

Gluten:

Gluten is a protein composite found in wheat and related grains, including barley and rye. Gluten gives elasticity to dough, helping it rise and keep its shape, and often gives the final product a chewy texture (Ref 6).

Gluten is the composite of two storage proteins, gliadin and a glutenin, and is conjoined with starch in the endosperm of various grass-related grains, e.g. wheat. Worldwide, gluten is a source of protein, both in foods prepared directly from sources containing it, and as an additive to foods otherwise low in protein.

Gluten is a fine, pale yellow powder. It is insoluble in cold water. Gluten is ignitable above 460 C and may form explosive mixtures with air. It is a potentially explosive dust when critical parameters exist, e.g. particle size less than 500 micron. For gluten, the K_{st} value is 100 bar.m/s. As for starch, these are deemed potentially weak explosions. The lower explosion limit is 60 g/m^3 and the bulk density is 0.4 to 0.5 g/cm^3.

Gluten is slightly hazardous in case of inhalation, skin or eye contact and ingestion.

4.2 POTENTIAL HAZARDOUS INCIDENTS REVIEW

In accordance with the requirements of *Guidelines for Hazard Analysis*, (Ref 2), it is necessary to identify hazardous events associated with the facility's operations. As recommended in HIPAP 6, the PHA focuses on "atypical and abnormal events and conditions. It is not intended to apply to continuous or normal operating emissions to air or water".

In keeping with the principles of risk assessments, credible, hazardous events with the potential for off-site effects have been identified. That is, "slips, trips and falls" type events are not included nor are non-credible situations such as an aircraft crash occurring at the same time as an earthquake.

The identified credible, significant incidents with the potential for off-site impacts for the proposed facility are summarised in the Hazard Identification Word Diagram following (Table 1). These potential events are based known incidents and dust process safety (Refs 4 and 5) and were derived via a Hazardous Event Identification workshop conducted at the Manildra site. Only the potential hazardous events that could cause significant consequences are shown in Table 1.

This diagram presents the causes and consequences of the events, together with major preventative and protective features that are included as part of the design.

Table 1 – Hazard Identification Word Diagram

Event Number	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation
1	Dust explosions within the new equipment, e.g. the rotary seal valves and silos	Ignition of combustible dust, e.g. due to smouldering, open flames, hot surfaces, lightning, heat from mechanical impact or friction, and electrical discharges and arcs	Damage to the processing equipment and injury to personnel. Potential propagation to the combustible material processed and stored at the facility. Products of combustion emitted with the potential to impact people and the environment. The explosion can also travel throughout equipment with the potential for pressure piling and hence more significant explosive energy. Projectiles are possible with the risk of injury to people and damage to equipment	All equipment containing dust is to be designed to ATEX standards including explosion vents and airlocks to separate transfer systems. Housekeeping to keep the area dust-free. The equipment is to be rated for hazardous zones including electrics and instruments are to be suitably rated and all equipment is to be bonded and earthed. Permit to work system requiring adequate cleaning and control of ignition sources. Condition monitoring of equipment and preventative maintenance to limit the probability of hot surfaces from friction occurring. High level detection on the silos. Use of fire hoses to extinguish smouldering fires. As the minimum ignition temperature for starch is approximately 380 C and higher and gluten is 460 C, maintenance of equipment and possibly detection by operators may prevent hot surfaces initiating a dust explosion

Event Number	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation
2	Explosion in a dust collector	Propagation of fire event from elsewhere in the process, e.g. burning embers drawn into the dust collector	Explosion with the potential for injury and equipment damage	Inducted draft which keeps the concentration below the LEL (lower explosive limit). All filters are to be pulsed with air for cleaning. All filters are to be checked routinely by maintenance for high differential pressure (DP). If issues arise then the socks are changed
3	Blockage of the blowline to the silos	Material buildup, blower failure, baghouse failure on the silo	Material build-up with potential for heating and hence fire and explosion	Process tripped on loss of a blower and other essential drives. Pressure monitoring on the blowline
4	Release of product from the transfer blowline	Erosion, explosion vent opening, gasket failure, impact from a vehicle	Loss of containment of product to atmosphere potential for environmental impact and possible ignition. If the release is near Bolong Road then there is the potential to affect traffic, e.g. causing an accident	Schedule 40 stainless steel pipe for extra thickness, long radius elbows used to minimise the risk of erosion, minimum joints to be installed, pipe bridge to be installed under Bolong Road, impact protection for the pipe bridge supports including being located away from Bolong Road
5	Overfilling a silo	Failure of the level instrument monitoring the product level within the silos	The product level can overflow the silo via the aspiration system. This can lead to explosions	Independent high level trip on the silos to stop the filling system, the area is to be rated for hazardous zones including electrics and instruments are to be suitably rated and all equipment is to be bonded and earthed

Event Number	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation
6	Dust explosion within the warehouse / bagging area	Loss of containment of dust within the building, e.g. dust emissions from bags and the filling machine	Dust explosion within the building, loss of life, equipment damage, production downtime, potential for both a primary and secondary explosion	Aspirated system, instruments and electrics to hazardous zones' requirements, housekeeping. Equipment is to be designed for containment. The open building doors will provide explosion venting to minimise the developed overpressures. No purlins on the inside of the building where dust can accumulate. The bags are mechanically filled (air blowing is not to be used)
7	Static charge on the truck during loading	Free-falling product	Potential source of ignition for explosive / combustible dust	All loading equipment will be bonded to earth
8	Overfilling a container or truck	Failure of the loading systems	Loss of containment of the starch. Most credible consequence is environmental impact	Area is paved with liquid effluent to flow to the existing environmental farm. Batching systems to include overfill prevention
9	Release of product	Failed sock in a dust collector	Product release and environmental impact	Visual detection of an emission and response, reporting from outside sources, LEL levels not reached, i.e. not considered to be an ignition risk. Maintenance of the socks to check the integrity

Event Number	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation
10	Fire in warehouse	Arson, faulty electrics, hot work	Damage to warehouse and loss of product and contaminated fire water	For starch, this is a low risk given the starch is not deemed to be a solid capable of supporting combustion. The product is to be stored within 1 te and 25 kg bags on wooden pallets. The warehouse is to be a concrete and steel construction. Therefore, the fire load is very low and any fires occurring will be of limited radiant heat consequence. Fire protection to comply with Australian Standards as appropriate. Contaminated fire water flows to the Manildra waste water treatment plant. Permit to work system. The new facility is to be located within a new boundary fence and hence only authorised personnel have access. Security patrols, the area is to have adequate lighting
11	Flooding	Natural event involving significant rain fall	Potential for off-site environmental impact from material being swept away in the flood	The structural characteristics of the new facility will be certified by an engineer as capable of withstanding flooding and will not become unsafe during floods or as a result of moving debris that would potentially threaten the safety of people or the integrity of the structures

5 RISK ANALYSIS

The assessment of risks to both the public as well as to operating personnel around the new Packing Plant requires the application of the basic steps outlined in Section 1. As per HIPAP 6 (Ref 2), the chosen analysis technique should be commensurate with the nature of the risks involved. Risk analysis could be qualitative, semi-quantitative or quantitative.

The typical risk analysis methodology attempts to take account of all credible hazardous situations that may arise from the operation of processing plants etc.

Having identified all credible, significant incidents, risk analysis requires the following general approach for individual incidents:

Risk = Likelihood x Consequence

The risks from all individual potential events are then summated to get cumulative risk.

For QRA (quantitative risk analysis) and hazard analysis, the consequences of an incident are calculated using standard correlations and probit-type methods which assess the effect of fire radiation, explosion overpressure and toxicity to an individual, depending on the type of hazard.

In this PHA, however, the approach adopted to assess the risk of the identified hazardous events is scenario-based risk assessment. The reasons for this approach are:

1. The distance from the new equipment to residential and other sensitive land users is large and hence it is unlikely that any significant consequential impacts, e.g. due to radiant heat from fires, from the facility will have any significant contribution to off-site risk;

2. The new equipment is to be protected from explosions using explosion vents and hence these will limit the impact distance; and

3. There are a limited number of process safety events and therefore cumulative and societal risk is not significant. The main events of interest are dust explosions. Therefore, these are analysed in the remaining sections of this report.

The risk criteria applying to developments in NSW are summarised in Table 2 on the following page (from Ref 3).

Table 2 - Risk Criteria, New Plants

Description	Risk Criteria
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year
Fatality risk to residential and hotels	1×10^{-6} per year
Fatality risk to commercial areas, including offices, retail centres, warehouses	5×10^{-6} per year
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year
Fatality risk to be contained within the boundary of an industrial site	50×10^{-6} per year
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50×10^{-6} per year
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50×10^{-6} per year

As discussed above, the consequences of the potential hazardous events are initially analysed to determine if any events have the potential to contribute to the above-listed criteria and hence worthy of further analysis.

5.1 Dust Explosions

A summary of historical dust explosions is given in Ref 5. Two of the reported studies detail dust explosions in Germany from 1965 to 1985 and in the USA from 1900 to 1988. The following tables show some of the analysis results. It is noted that analysts suggest that not all dust explosions are reported. One analysis (Ref 5) reports that only 15% of the actual dust explosions that occur are reported, i.e. many more may have occurred.

Table 3 – Grain Dust Explosions in the USA

Loss Category	1900 - 1956		1957 - 1975		1979 - 1988	
	Total	Per Year	Total	Per Year	Total	Per Year
Number of Explosions	490	8.6	192	10.1	202	20.2
Fatalities	381	6.8	68	3.6	54	5.4
Injuries	991	17.4	346	18.2	267	26.7
Estimated Damage to Facility ($US millions), not inflated	70	1.3	55	2.9	169	16.9

Table 4 – Source Locations of Dust Explosions in Germany (1965-1985)

Type of Plant Item	Percentage of Total Dust Explosions in the Food and Feed Industry
Silos and Bunkers	22.9
Dust Collecting Systems	9.5
Milling and Crushing Plants	18.1
Conveying Systems	26.7
Dryers	7.6
Furnaces	2.0
Mixing Plants	2.0
Grinding and Polishing Plants	0
Sieves and Classifiers	2.8
Unknown and Others	8.4
Total	100.0

That is, dust explosions are credible events and can cause significant impacts.

From Ref 7, the damage radius of a dust explosion is usually limited to the building (or equipment item) in which it occurs and to a very short range outside. This is supported by the historical incidents involving dust explosions where the majority of fatalities involve on-site personnel.

The majority of dust explosion incidents detailed in Ref 5 resulted in no fatalities. For the incidents where fatalities occurred, these were to on-site personnel. Ref 5 quotes statistics from the USA where, on average, dust explosions result in approximately 5 deaths per year. Historically, about one in six fatalities occur in the food and grain industry. Again, the greater risk for fatality or injury for dust explosions is to on-site personnel as claimed in Ref 7.

To support the above findings, see the following calculations for maximum explosive overpressures and flame length from a dust explosion in one of the 300 te silos, i.e. the largest process vessel associated with the packing plant.

The maximum explosion overpressures at a distance D (m) from a vent or point of release is given by (Ref 5):

$$P_{blast} = (P_{max} \text{ x } C1 \text{ x } C2) / D$$

Where:

P_{blast} is the overpressure (or peak blast pressure) at a distance D from the vent, kPag

P_{max} is the pressure within the vessel when the vent opens or the rupture pressure of the vessel (if no vent installed), kPag

C1 = 10^((-0.26/A) + 0.49)

A = vent area, m^2

C2 = 1 m

D = distance away from the vent, m

The rupture pressure of weak structures such as grain handling equipment is typically less than 90 kPag (Ref 5). This reference quotes one experiment where a 500 m^3 silo ruptured at 60 kPag with a hole size of 50 m^2.

If a dust explosion were to occur in a 300 te silo with an estimated reduced pressure within the silo of 0.6 barg and a combined vent size of 25 m^2 (i.e. the area of the roof assuming it is blown off in the explosion) then the overpressures at various distances away from the top of the silo are estimated as shown in Table 5.

Table 5 – Overpressures from Dust Explosions

Distance, m	Overpressure, kPag
	1,000 te Silo
5	36
10	18
20	9
30	6
40	5
50	4

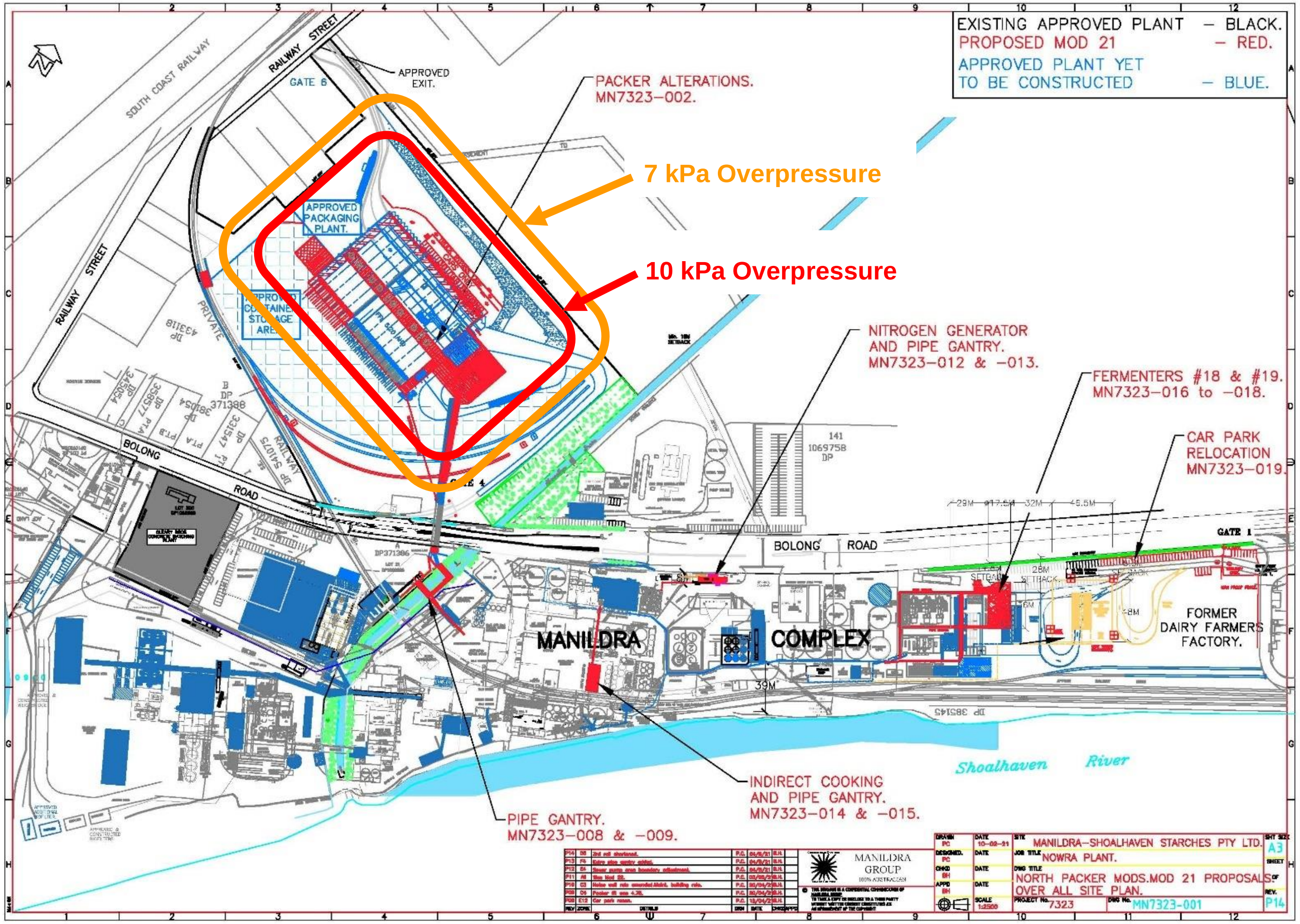
Pinnacle Risk Management has developed a methodology for approximating the overpressures from a confined explosion in a low-strength structure such as a building, i.e. the Packing Plant building (Ref 8).

The required input parameters are as follows:

- Building volume. The volume of the packing area within the building is approximated as 108 m long, 34 m wide and 35 m high, i.e. a total volume of 129,000 m^3. Allow 10% for bins and equipment, i.e. the volume is 116,000 m^3;
- Vent area. As the building has one long side then the end wall area is taken to be the vent area, i.e. 34 x 35 = 1,190 m^2;
- P_{max}. The rupture pressure for the metal sheeted walls is taken to be 15 kPa. Add 2 kPa for P_{max}, i.e. P_{max} = 17 kPa; and
- Angle of the overpressures from the vent (0 degrees for hazard analysis work).

Using the methodology, the distances to 10 and 7 kPa are estimated to be 60 and 80 m, respectively. These contours are plotted in Figure 4.

Figure 4 – Packing Plant Building Dust Explosion Modelling Results



The effects of explosion overpressures are summarised in the following table (Ref 3).

Table 6 – Effects of Explosion Overpressures

OVERPRESSURE, kPa	PHYSICAL EFFECT
3.5	90% glass breakage No fatality, very low probability of injury
7	Damage to internal partitions & Joinery 10% probability of injury, no fatality
14	Houses uninhabitable and badly cracked
21	Reinforced structures distort, storage tanks fail 20% chance of fatality to person in building
35	Houses uninhabitable, rail wagons & plant items overturned. Threshold of eardrum damage, 50% chance of fatality for a person in a building, 15% in the open
70	Complete demolition of houses Threshold of lung damage, 100% chance of fatality for a person in a building or in the open

As the 14 kPa overpressure contours stay on site for both the silo and building explosion scenarios then off-site fatality from overpressures is not expected. Also, as the 7 kPa overpressure does not encroach onto residential areas then off-site injury in residential areas is not expected. The nearest residential and shopping areas are over 200 m away.

To estimate the possible maximum horizontal flame length from a vented dust explosion, the following equation can be used (Ref 9):

$$\text{Flame Length} = 10 \times V^{1/3} \text{ (m)}$$

Where:

V is the volume of the vessel, m^3

However, no flame length has ever been measured greater than 37 m (even for large volumes) so this should be taken as the upper limit (Ref 9). Other studies in Ref 10 also show that effects of thermal radiation from the fireball is limited to close to the fireball's surface given the short duration.

Typically, the flames from a ruptured or vented vessel travel horizontally and vertically. For a 37 m flame length, the flames are therefore unlikely to impact people off-site as the silos are at least 67 m from the site's closest boundary.

Hence, given the above consequence assessment, adverse impact from the potential dust explosions is unlikely for off-site personnel and therefore the risk of fatality, injury or property damage is expected to comply with risk criteria in Table 2.

5.2 DUST EXPLOSION SAFEGUARDING

For equipment processing a potentially explosive dust, it is generally not possible to always ensure the concentration of the dust is below the lower explosive limit. Rather, safeguarding is required to prevent and/or control the potential explosions as discussed below.

There are no mandatory standards or regulations that dictate the design criteria and features for equipment where dust explosions can occur. However, the main means for safeguarding against dust explosions are as follows.

A discussion of the proposed safeguards for the new equipment is included at the end of this Section.

5.2.1 Dust Free Process

Inherently safer options include operating with the materials being wet rather than dry, i.e. preventing dust formation. Not all processes are suited to this option though, e.g. wheat grains, as self-heating can occur and degradation of the grain can occur.

5.2.2 Dust Control

Measures to control dust and avoiding the explosive range include:

- Avoid large volumes as much as possible, e.g. to avoid equipment items running empty;
- Avoid dust formation by limiting the free-fall;
- Remove the dust at the point of production rather than convey it along ducts where it can accumulate;
- Buildings which contain plant handling flammable dusts should be designed to minimise the accumulation of dust deposits and to facilitate cleaning; and
- Regular housekeeping to avoid dust build-up.

5.2.3 Control of Ignition Sources

Measures used to control ignition sources which could give rise to dust explosions include:

- Avoid direct fired equipment;
- Bonding and earthing for static dissipation;

- Permits to work, training and auditing;
- Regular housekeeping to avoid dusts overheating, e.g. on hot surfaces;
- Hazardous area determination with compliant electrics and instruments;
- Preventative maintenance on equipment to minimise the probability of fault conditions;
- Use appropriate electrical equipment and wiring methods;
- Control smoking, open flames, and sparks;
- Avoid the possibility of a thermite reaction, e.g. aluminium reacting with iron oxide;
- Use separator devices to remove foreign materials capable of igniting combustibles from process materials; and
- Separate heated surfaces and heating systems from dusts.

5.2.4 Inerting

The suspension of a flammable dust in air may be rendered non-explosive by the addition of an inert gas. The main gases used for inerting of dust handling equipment are nitrogen, carbon dioxide, flue gas and inert gas from a generator, e.g. argon or helium.

Inerting by adding an inert dust is another means to prevent dust explosions. This is mainly done in mining, e.g. coal dust is mixed with ground stone to render the coal dust non-explosive.

5.2.5 Explosion Containment

One option for dealing with a dust explosion is total containment, i.e. design the equipment to withstand the maximum generated pressure. For dust explosions, the maximum generated pressures are quoted as 7 to 12 barg for atmospheric processes or up to 12 times the initial pressure in the equipment item. Hence, if the equipment has a design pressure equal to or exceeding these values then the explosion will be contained with no flames being emitted. Grinding mills are an example of such equipment items which may be made strong enough to withstand a dust explosion.

5.2.6 Explosion Isolation

The two basic methods for explosion isolation are:

- Automatic isolation, e.g. a pressure sensor will send a signal to a fast closing valve to shut and isolation the equipment item or pipe; and

- Material chokes such as rotary valves, screw conveyors with baffle plates and/or part of the helix removed to prevent the conveyor emptying on no feed flow, and self-actuating float valves.

5.2.7 Explosion Suppression

Typically an increase in operating pressure is detected (e.g. pressure rises to 5 kPag) which then results in a suppressant being injected into the equipment item to suppress the flame. By suppressing the flame early, the pressure rise is limited. Suppressants include dry powder and water.

5.2.8 Explosion Venting

Explosion venting is an effective and economic way to provide protection against dust explosions, however, it is only suitable if there is a safe discharge for the material being vented. For equipment within a building, ducting the vent to outside should be done provided it is short, e.g. less than 10 m (detonations can occur in pipes of 10 to 30 m in length).

5.2.9 Equipment Separation

It is possible that an explosion from one equipment item or building could propagate to another. This could be via secondary explosions due to dust lifting and forming a cloud or from projectiles embedding into thin-walled equipment and hence being a point of ignition due to heat. If layout considerations permit, adequately separating higher risk process items or buildings is an inherently safe option.

In practice (Ref 5), the assessment of dust explosion hazards is bound to be subjective because the problem is too complex for quantitative analytical methods to yield an indisputable answer. Therefore, the acceptable safeguards for any given design will vary from company to company. Ref 5 quotes work by Pinkwasser and Haberli who suggest most of the dust explosion hazards in the grain, feed and flour industry can be eliminated by soft means such as training, motivation, improving the organisation, good housekeeping and proper maintenance. All of these safeguards are in-place at Shoalhaven Starches.

When these are combined with the additional measures proposed for the new equipment and building then further risk reduction is achieved. These additional measures include all equipment handling potentially explosive dust is to be designed to ATEX standards including rotary valves for seals, explosion vents, equipment bonding and earthing, minimisation of horizontal surfaces in the buildings where dust can collect, screw feeders to contain plugs to prevent flame propagation, generous separation distances between the building, silos and site boundaries, mechanically filling bags (not pneumatic) and hazardous area zoning with the electrics and instruments to suit the requirements. Therefore, no further analysis of building dust explosions is warranted.

Compliance with the HIPA 4 risk criteria is therefore shown in Table 7.

Table 7 – HIPAP 4 Risk Criteria Compliance

Description	Risk Criteria	Comments	Risk Acceptable?
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year	No adverse levels of radiant heat or explosion overpressures to impact any of these land users. For example, the 14 kPa explosion overpressure is estimated to remain on-site for a confined dust explosion within the Packing Plant building	Yes
Fatality risk to residential and hotels	1×10^{-6} per year	No adverse levels of radiant heat or explosion overpressures to impact any of these land users. For example, the 14 kPa explosion overpressure is estimated to remain on-site for a confined dust explosion within the Packing Plant building	Yes
Fatality risk to commercial areas, including offices, retail centres, warehouses	5×10^{-6} per year	No adverse levels of radiant heat or explosion overpressures to impact any of these land users. For example, the 14 kPa explosion overpressure is estimated to remain on-site for a confined dust explosion within the Packing Plant building	Yes
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year	The are no sporting complexes or active open spaces where adverse levels of radiant heat or explosion overpressures are expected	Yes
Fatality risk to be contained within the boundary of an industrial site	50×10^{-6} per year	The 14 kPa explosion overpressure is estimated to remain on-site for a confined dust explosion within the Packing Plant building, therefore, no off-site fatality risk is estimated	Yes

Description	Risk Criteria	Comments	Risk Acceptable?
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50 x 10^{-6} per year	No adverse levels of radiant heat or explosion overpressures to impact any residential areas	Yes
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10 x 10^{-6} per year	No toxic gases associated with this modification	Yes
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50 x 10^{-6} per year	No toxic gases associated with this modification	Yes
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50 x 10^{-6} per year	As the 14 kPa explosion overpressure is estimated to remain on-site for a confined dust explosion within the Packing Plant building then this criterion is satisfied	Yes

5.3 PROPAGATION RISK

Propagation of events can occur, in particular, if radiant heat from fires and/or explosion overpressures are significant at nearby hazardous facilities (either on or off site). The propagation event could include initiating another fire, explosion or toxic gas releases.

Given the separation distance from the Packing Plant to the nearest site boundary (at least 54 m) and the 14 kPa overpressure remains on-site then the risk of propagation from potential dust explosions is considered acceptable. There are no credible fire events that could impose more than 23 kW/m^2 at the nearest site boundary.

Therefore, propagation risk is deemed acceptable.

5.4 EXTERNAL EVENTS

External events that may lead to propagation of incidents on any site include:

Subsidence	Landslide
Burst Dam	Vermin/insect infestation
Storm and high winds	Forest fire
Storm surge	Rising water courses
Earthquake	Storm water runoff
Breach of security	Lightning
Tidal waves	Aircraft crashes

These events were reviewed and none of them were found to pose any significant risk to the new facility given the proposed safeguards. Flooding can occur at this site, however, any potential propagation events are unlikely to be significant given that the new equipment and building are being designed for the expected flood conditions.

5.5 CUMULATIVE RISK

As shown in this PHA, the proposed changes to the Shoalhaven Starches site will have negligible impact on the cumulative risk results for the local area as the significant consequential effects such as explosion overpressures are local to the equipment and there are generous separation distances from the building and equipment to the site's boundary.

Therefore it is reasonable to conclude that the development does not make a significant contribution to the existing cumulative risk in the area.

5.6 SOCIETAL RISK

The abovementioned criteria in Table 2 for individual risk do not necessarily reflect the overall risk associated with any proposal. In some cases for instance, where the 1 pmpy contour approaches closely to residential areas or sensitive land uses, the potential may exist for multiple fatalities as the result of a single accident. One attempt to make comparative assessments of such cases involves the calculation of societal risk.

Societal risk results are usually presented as F-N curves, which show the frequency of events (F) resulting in N or more fatalities. To determine societal risk, it is necessary to quantify the population within each zone of risk surrounding a facility. By combining the results for different risk levels, a societal risk curve can be produced.

In this study of the new equipment and building, the risk of fatality does not extend significantly from the sources and is therefore well away from the off-site areas. The societal risk associated with the Packing Plant and new equipment is deemed acceptable.

5.7 RISK TO THE BIOPHYSICAL ENVIRONMENT

The main concern for risk to the biophysical environment is generally with effects on whole systems or populations.

As the Packing Plant is being designed to be above the expected flood levels then significant environmental impact is not expected. Importantly, any spilt material will be contained in the area or sent to the Manildra waste water treatment plant.

Whereas any adverse effect on the environment is obviously undesirable, the results of this study show that the risk of losses of containment impacting the environment is broadly acceptable.

From the analysis in this report, no incident scenarios were identified where the risk of whole systems or populations being affected by a release to the atmosphere, waterways or soil is intolerable.

6 CONCLUSION AND RECOMMENDATIONS

The risks associated with the proposed modifications to the Packing Plant and Other Works at the Shoalhaven Starches Bomaderry site have been assessed and compared against the DoP risk criteria.

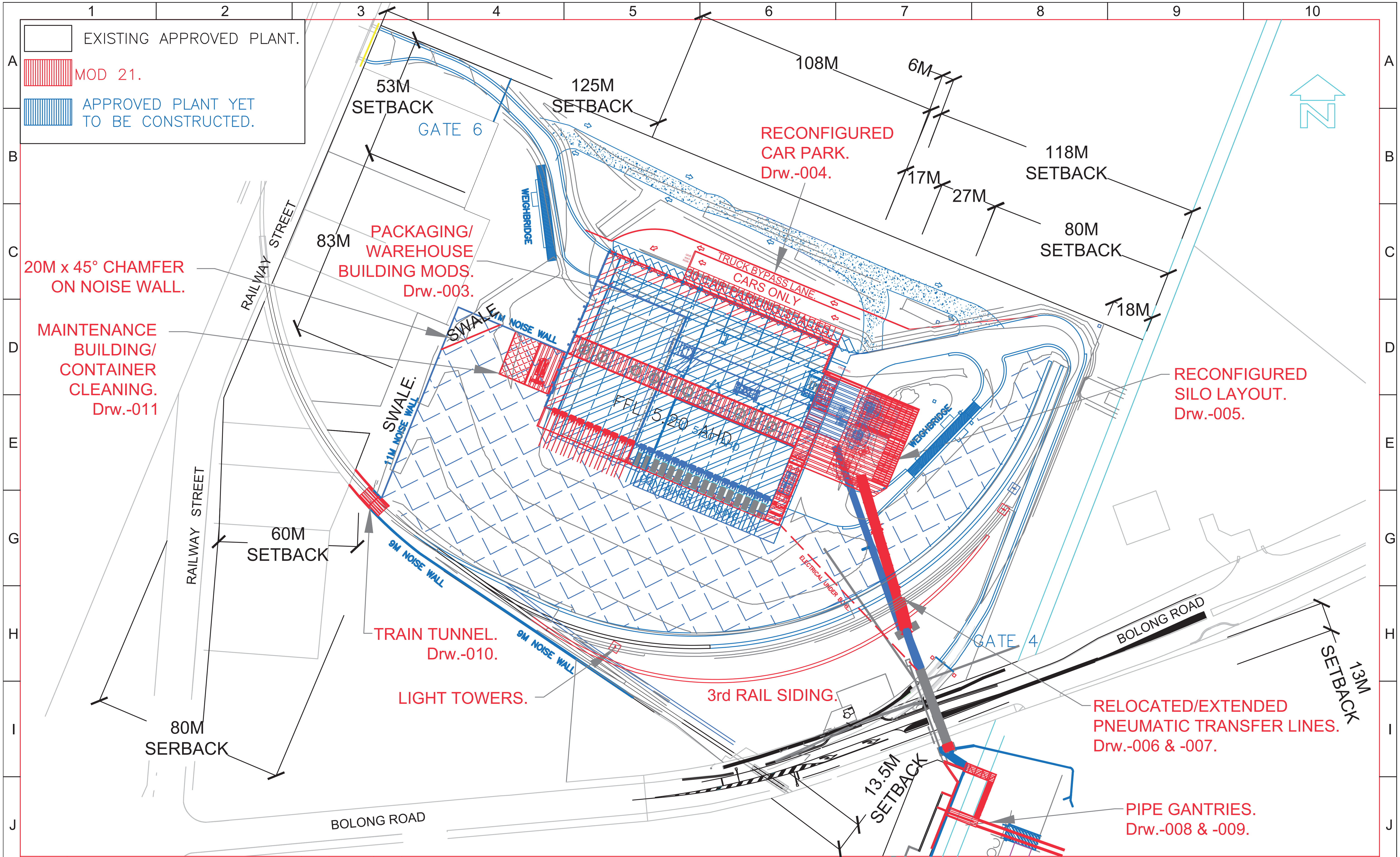
The results presented in this report show compliance with all risk criteria.

Societal risk, area cumulative risk and environmental risk are also concluded to be acceptable.

The primary reason for the low risk levels from the modifications is the significant explosion overpressures remain on-site. The “Other Works” do not involve hazardous materials that can cause fires, explosions or toxic gas emissions with off-site impacts.

Based on the analysis in this revised PHA, there are no further recommendations to be made.

7 APPENDIX A – DRAWINGS



REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P16	G8	3rd rail shortened.	P.C.	04/5/21	G.M.	
P15	J8	Extra pipe gantry added.	P.C.	04/5/21	B.H.	
P14	I7	Sewer pump area boundary adjustment.	P.C.	04/5/21	B.H.	
P13	ALL	Was Mod 22.	P.C.	03/5/21	B.H.	
P12	ALL	Proposed wall relo deleted,wall chamfer added.Maint. build relo.	P.C.	22/4/21	B.H.	
P11	ALL	Finished floor level was 4.75 AHD.	P.C.	20/4/21	B.H.	
P10	ALL	Car park reconfigured.Now Mod 22.	P.C.	17/3/21	B.H.	

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PC Drafting 0439 436508

P.C.

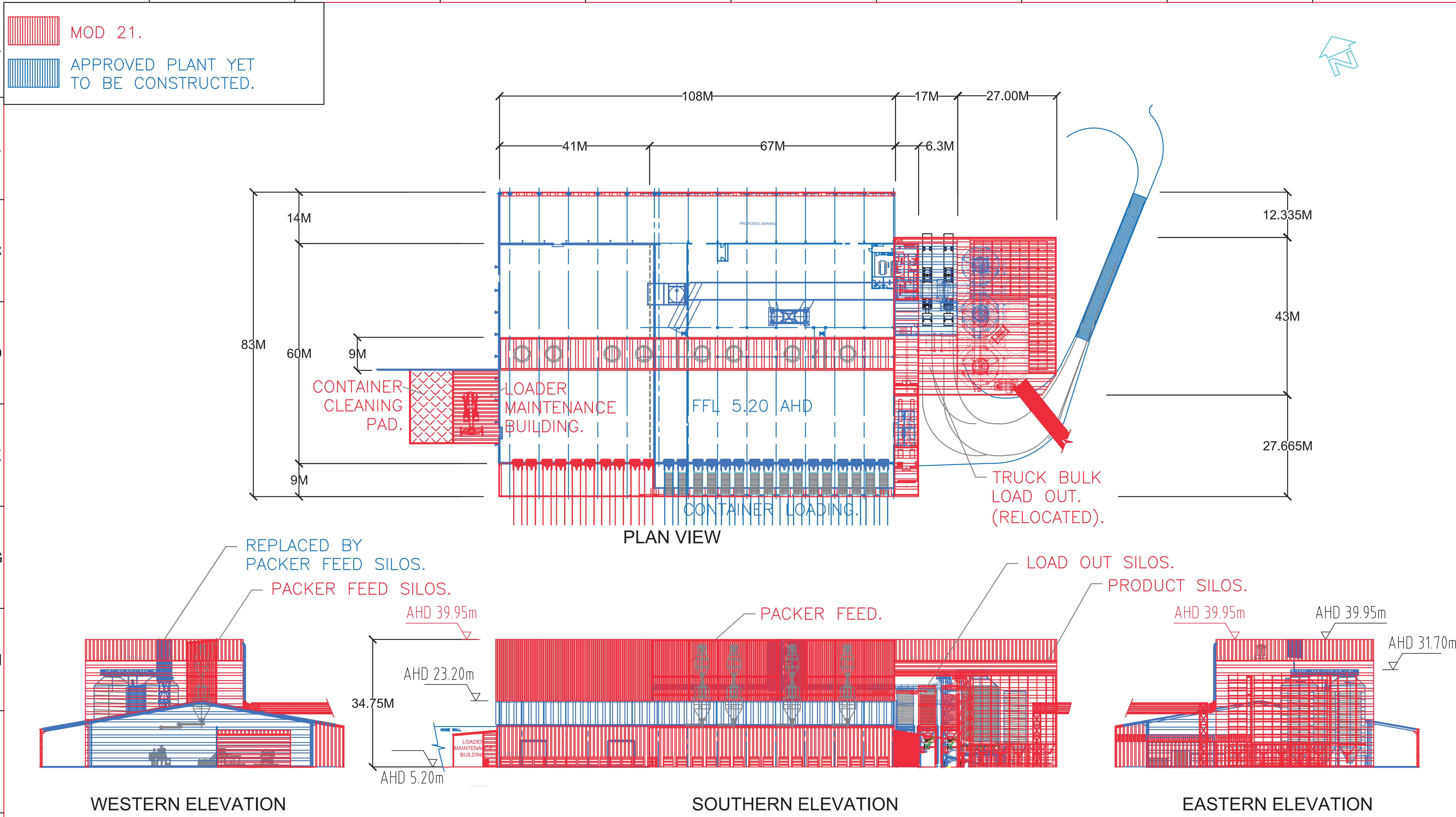
CHKD GM | DATE 10/02/21
APPD | DATE
SCALE 1:1500

SHOALHAVEN STARCHES.

DWG TITLE
NORTH PACKER MOD 21.
SITE PLAN .

PROJECT No. 7117WAE
DWG No. MN7323-002

SHT SIZE A3
REV. P16



REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P12	ALL	Was Mod 22.	P.C.	03/5/21	B.H.	
P11	ALL	Maintenance building added to this drawing.	P.C.	26/4/21	B.H.	
P10	ALL	Finished floor level was 4.75 AHD.	P.C.	20/4/21	B.H.	
PO9	ALL	Was Mod 21.	P.C.	17/3/21	B.H.	
PO8	ALL	FFL 4.75 AHD added.	P.C.	19/2/21	B.H.	
PO7	ALL	Silos shown.	P.C.	16/2/21	B.H.	
PO6	ALL	Now Mod 21.	P.C.	10/2/21	B.H.	

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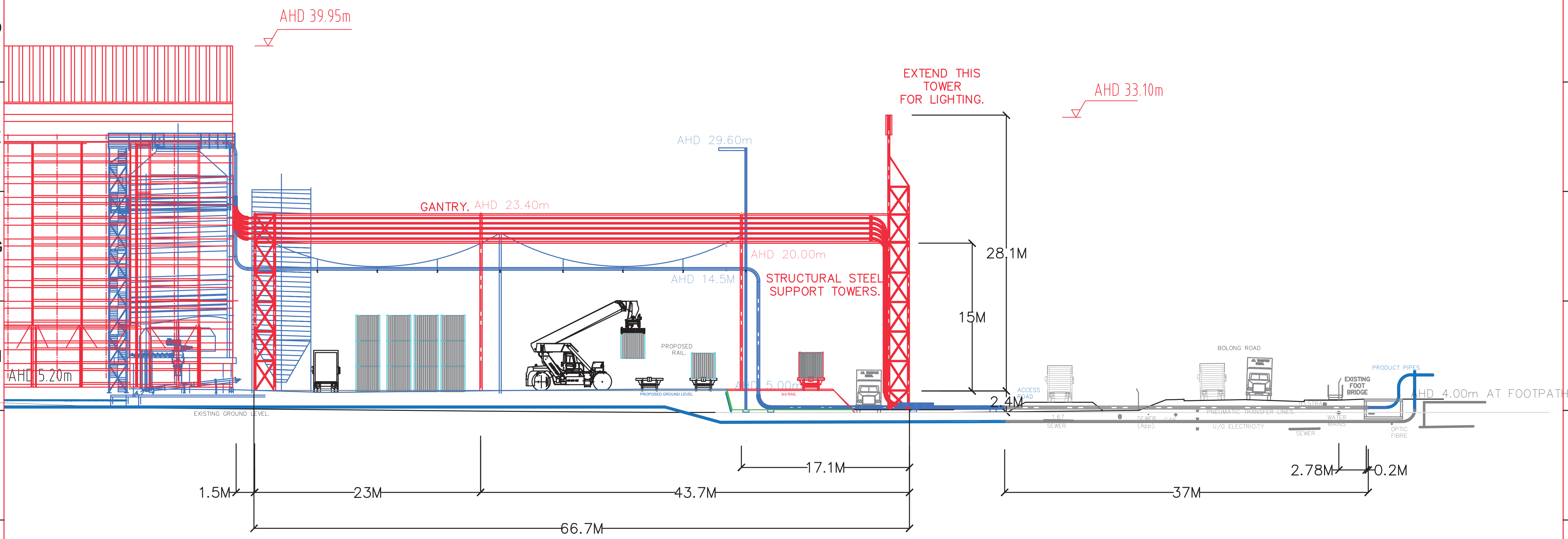
P.C.		SHOALHAVEN STARCHES.	SHT SIZE A3
CHKD GM	DATE 25/08/20	DWG TITLE NORTH PACKER MOD 21. PACKAGING/WAREHOUSE BUILDING.	
APPD	DATE		REV.
	SCALE 1:1000	PROJECT No. 7117WAE — DWG No. MN7323-003	P12

EXISTING APPROVED PLANT.

MOD 21.

APPROVED PLANT YET TO BE CONSTRUCTED.



GA ELEVATION

REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P10	ALL	Was Mod 22.	P.C.	03/5/21	B.H.	
P09	ALL	Levels adjusted.	P.C.	28/4/21	B.H.	
P08	ALL	Packer FFL was 4.75.Reset out.	P.C.	20/4/21	B.H.	
P07	ALL	Now Mod 22.	P.C.	17/3/21	B.H.	
P06	ALL	Now Mod 21.	P.C.	10/2/21	B.H.	
P05	ALL	Replaced app were green.	P.C.	9/2/21	B.H.	
PO4	ALL	Levels raised 200mm.	P.C.	18/12/20	B.H.	

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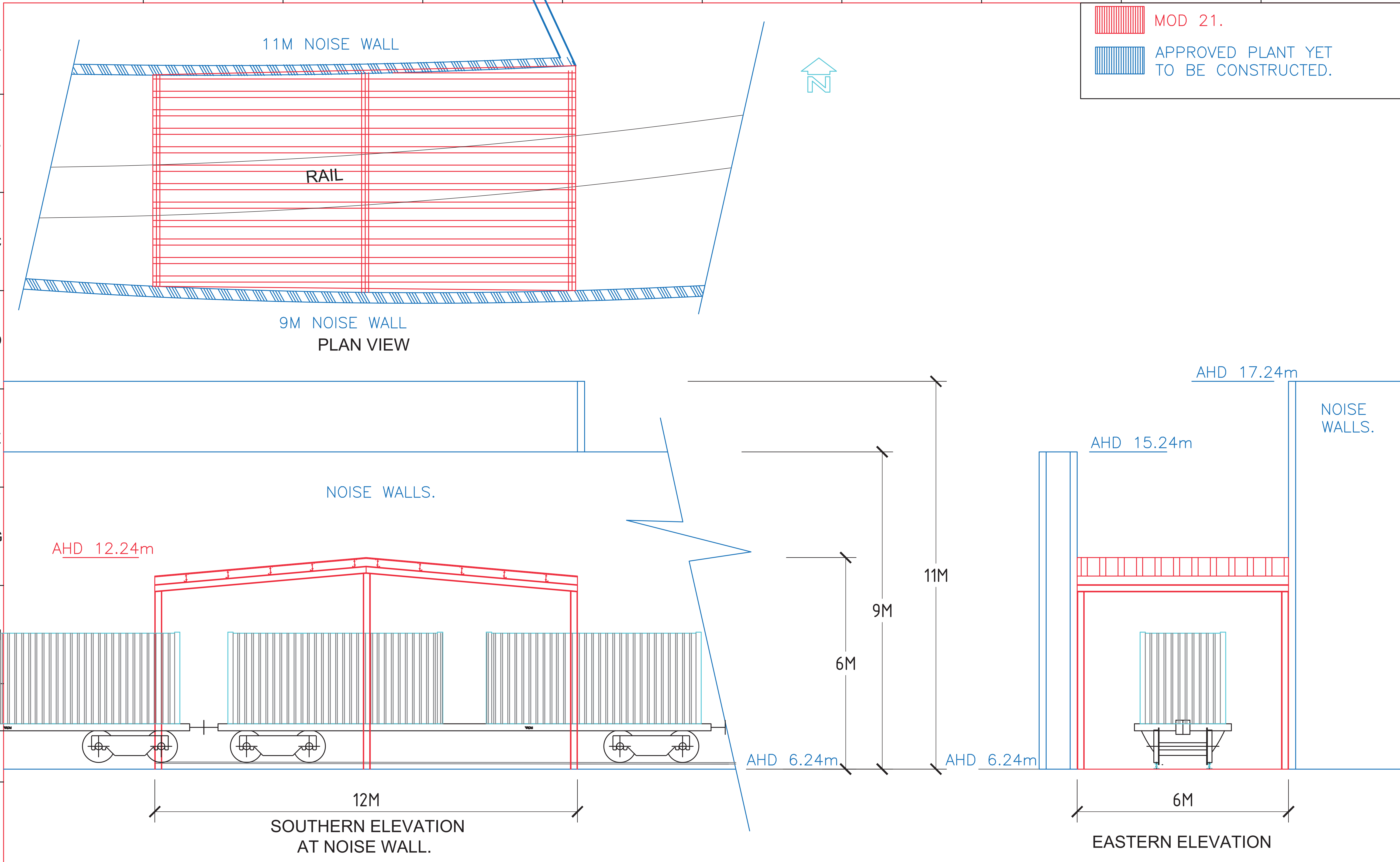
P.C.		SHOALHAVEN STARCHES.	SHT SIZE A3
CHKD GM	DATE 25/08/20	DWG TITLE NORTH PACKER MOD 21. PNEUMATIC TRANSFER LINES GANTRY.	
APPD	DATE		REV. P10
	SCALE 1:400	PROJECT No. 7117	DWG No. MN7323-006



REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P10	ALL	Was Mod 22.	P.C.	03/5/21	B.H.	
PO9	ALL	Levels adjusted.	P.C.	26/4/21	B.H.	
PO8	ALL	Now Mod 22.	P.C.	17/3/21	B.H.	
PO7	ALL	Dimensions added.AHD was RL.	P.C.	18/2/21	B.H.	
PO6	ALL	At noise wall wording added.	P.C.	12/2/21	B.H.	
PO5	ALL	Now Mod 21.	P.C.	10/2/21	B.H.	
PO4	ALL	Levels raised 400mm.	P.C.	18/12/20	B.H.	

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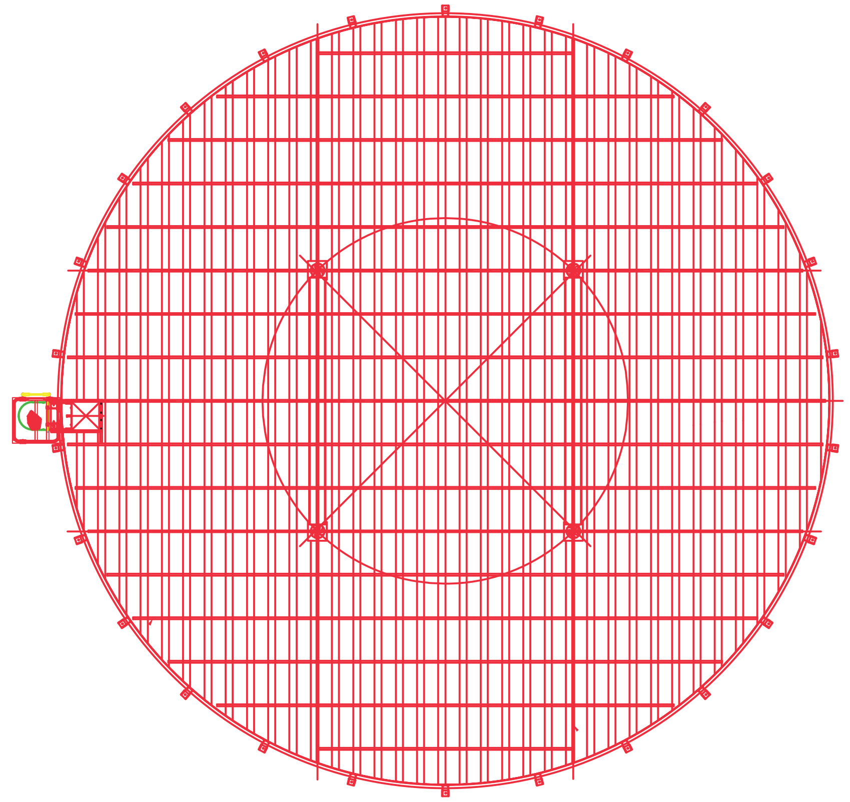
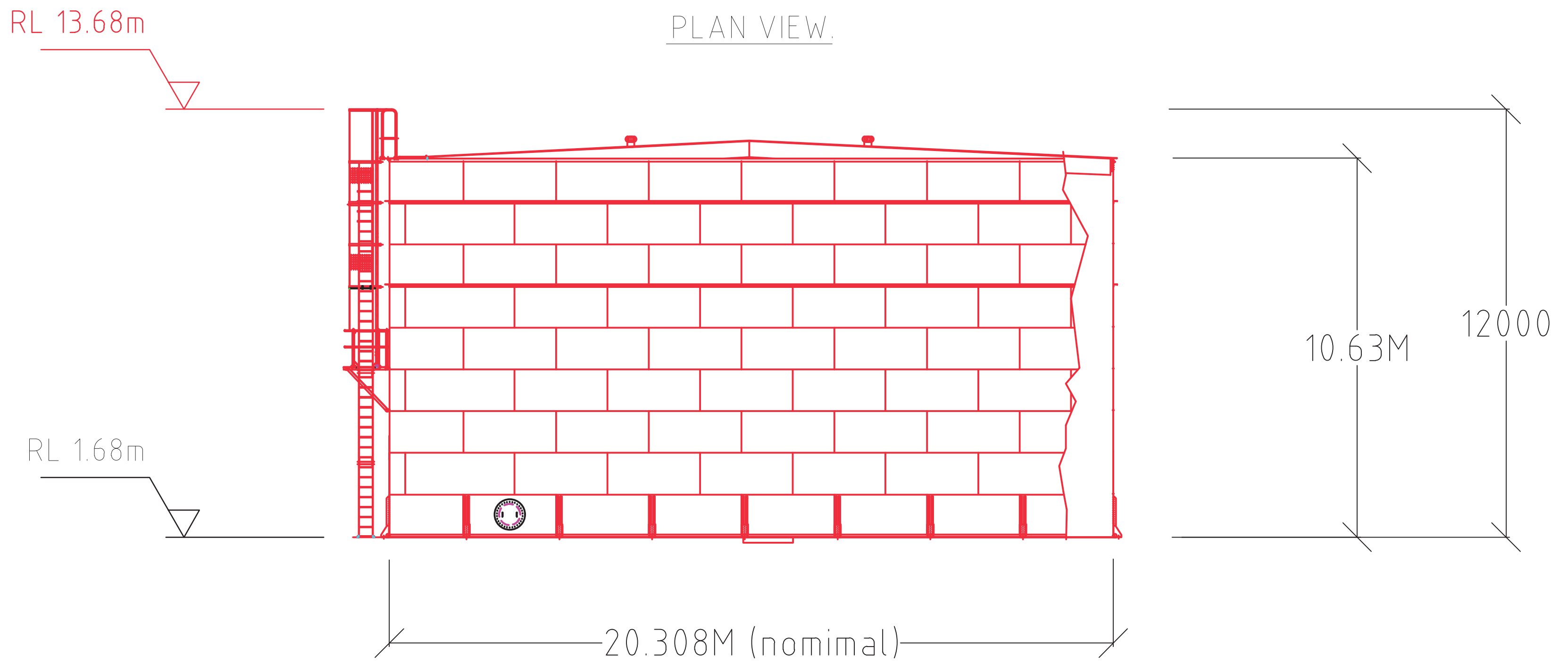
0439 436508
Est. 2001

P.C.		SHOALHAVEN STARCHES.	SHT SIZE A3
CHKD GM	DATE 25/08/20	DWG TITLE NORTH PACKER MOD 21. RAIL TUNNEL.	
APPD	DATE		REV.
	SCALE 1:100	PROJECT No. 7117 / DWG No. MN7323-010	P10



PLAN VIEW.



SECTIONAL ELEVATION.

AUSTRALIAN STANDARDS CONFORMANCE

AS 4100 – STEEL STRUCTURES
AS 4600 – COLD FORMED STEEL STRUCTURES
AS 1657 – LADDERS AND PLATFORMS
AS 1170.2 – WIND LOADINGS
AS 1170.4 – EARTHQUAKE LOADINGS
AS 4680 – HOT DIP GALVANISING
AS 3500 – PLUMBING CODE

3000 KL EFFECTIVE CAPACITY

1350 mm TOTAL VOID ALLOWANCE

3000 KL = 9.25 m WATER HEIGHT

REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P04	All	Was MOD 22.	P.C.	3-5-21	BH	
P03	All	Now MOD 22.	P.C.	18-3-21	JS	
P02	All	MOD 21 wording added.	P.C.	12-2-21	JS	
1	ALL	Draft	P.C.	30-7-19	M.H.	

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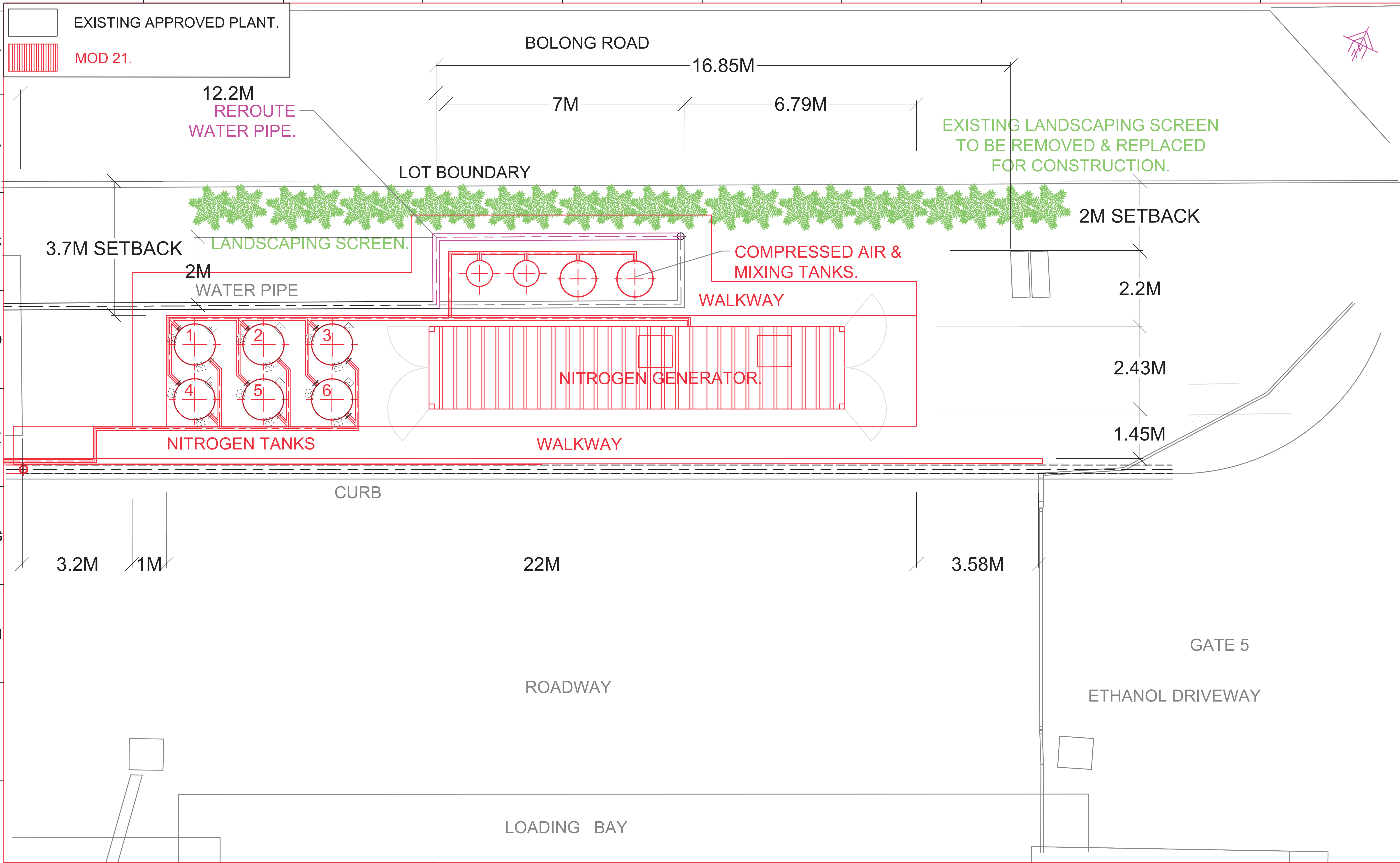
DRAWN PC	DATE 5-08-19	SITE MANILDRA-SHOALHAVEN STARCHES PTY LTD.	SHT SIZE A3
DESIGNED. PC	DATE	JOB TITLE NOWRA PLANT.	SHEET
CHKD BH	DATE	DWG TITLE BUFFER TANK ADDITION.MOD 21. BUFFER TANK DETAIL.	OF
APPD BH	DATE		REV.
	SCALE 1:200	PROJECT No. 6828 DWG No. MN6851-003	P04



REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P05	ALL	Was Mod 22.	P.C.	03/5/21	B.H.	
P04	ALL	Now Mod 22.	P.C.	17/3/21	B.H.	
P03	ALL	Small tanks relo.Landscaping note added.Was Drw -016	P.C.	16-02-21	BH	
P02	ALL	Now Mod 21.	P.C.	15-02-21	BH	
P01	ALL	Draft.	P.C.	28-01-21	Faris	

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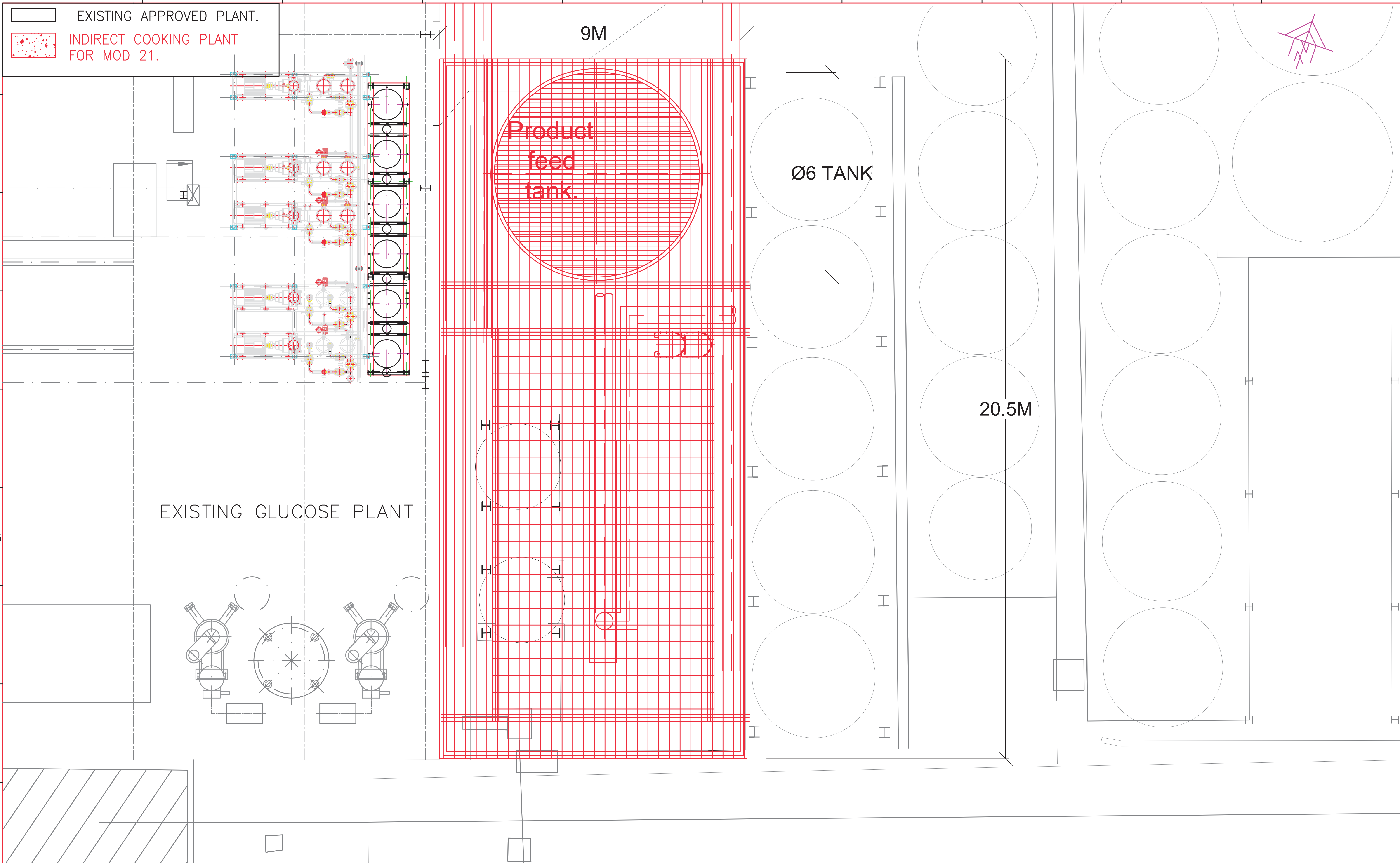
DRAWN P.C.	DATE 28/01/21	JOB TITLE	SHOALHAVEN STARCHES.BOMADERRY. NSW
CHKD FARIS	DATE	DWG TITLE	ETHANOL NITROGEN GENERATOR.MOD 21. SITE PLAN.
APPD	DATE		
	SCALE 1:100	PROJECT No. 7319	DWG No. MN7323-012

SHT SIZE A3

REV. P05



REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
PO8	ALL	Was Mod 22.	P.C.	3/5/21	B.H.	
PO7	ALL	Now Mod 22.	P.C.	17/3/21	B.H.	
P06	ALL	Notes added.	P.C.	12-02-21	K.L.	
P05	ALL	MOD 21.	P.C.	10-02-21	K.L.	
P04	ALL	Proposal finalised.	P.C.	05-02-21	K.L.	
P03	ALL	Original layout.	P.C.	04-02-21	K.L.	
P02	ALL	Footprint narrowed and heightened.	P.C.	04-02-21	K.L.	

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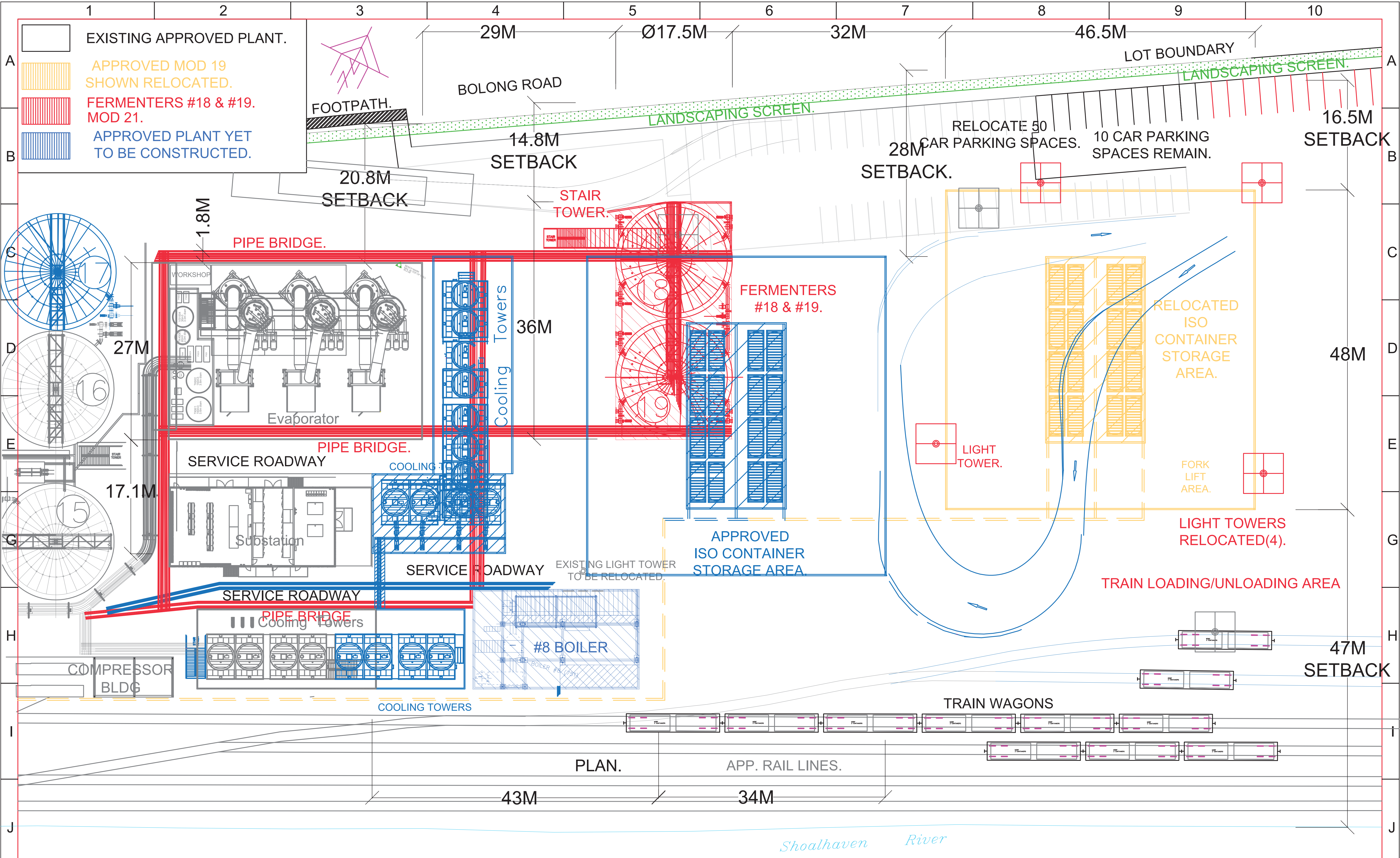
DRAWN P.C.	DATE 28/01/21	JOB TITLE	SHOALHAVEN STARCHES.BOMADERRY. NSW
CHKD AT	DATE	DWG TITLE	INDIRECT COOKING MOD 21. SITE PLAN.
APPD	DATE		
	SCALE 1:100	PROJECT No. 7320	DWG No. MN7323-015

SHT SIZE A3
REV. P08



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REV	ZONE	DETAILS	DRN	DATE	CHKD	APPD
P03	ALL	Was Mod 22.	P.C.	03/5/21	B.H.	
P02	K9	Drawing No updated.	P.C.	19-4-21	B.H.	
P01	ALL	Was mod 23.	P.C.	12-4-21	B.H.	

DRAWN	P.C.
DATE	25/06/19
CHKD	T.J.
DATE	
APPD	
DATE	
SCALE	1:500
JOB TITLE	SHOALHAVEN STARCHES.BOMADERRY. NSW
DWG TITLE	FERMENTERS #18 & #19.MOD 21. SITE PLAN.
PROJECT No.	7417
DWG No.	MN7323-016
SHT SIZE	A3
REV.	P03

8 References

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