APPENDIX 8

Preliminary Hazard Assessment

Manildra Park Pty Ltd

Preliminary Hazard Analysis for Marine Fuel Storage/Distribution and Biodiesel Production Facility, Kooragang Island

October 2007

Umwelt
Environmental Consultants

Preliminary Hazard Assessment for Marine Fuel Storage/Distribution and Biodiesel Production Facility, Kooragang Island

Prepared by

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on behalf of

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Executive Summary

Manildra Park Pty Limited (Manildra Park) proposes to construct and operate a marine fuel and diesel distribution terminal and biodiesel production facility on Greenleaf Road, Kooragang Island. In support of the Environmental Assessment (EA) for the Manildra Park facility Umwelt (Australia) Pty Limited has prepared a Preliminary Hazard Analysis (PHA) to address the requirements of the NSW Department of Planning (DoP).

The PHA for the proposed Manildra Park facility was undertaken in response to the Director-General's Requirements (DGRs) issued by the DoP on 22 May 2007. The PHA has been prepared generally in accordance with DoP's *Hazardous Industry Planning Advisory Paper (HIPAP) No 6 - Guidelines for Hazard Analysis* (DUAP, 1992). It includes a preliminary screening assessment as described in *State Environmental Planning Policy No 33 – Hazardous and Offensive Development* (SEPP 33), which indicates that the proposed development is potentially hazardous with respect to the storage of class 3 PG II substances, the number of deliveries of class 8 substances and the size of the deliveries of class 3 and class 8 substances. The development will also require an Environmental Protection Licence from the Department of Environment and Climate Change (DECC).

The risk classification and prioritisation process, as described in DoP's *Multi-Level Risk Assessment* (DUAP, 1992), indicates the use of a Level 2 risk assessment is appropriate for the proposed development. The results of the Level 2 assessment indicate that the consequences of the most significant hazardous event, methanol bund fire, are contained within 30 metres the base of the flame, approximately 4 metres within the site and from the boundary with the nearest neighbour. The thermal radiation at the site's boundary with the Hunter River was found to be 9.2 kW/m^2. It is considered that the resulting impact of a confined bund fire on an unoccupied area is not significant. Additionally the 2.1 metre high bund wall will provide a degree of shielding reducing the thermal radiation from a fire on this location.

The PHA found that the low risks associated with the facility meets the risk criteria from *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992) for tolerable fatality, injury and societal risk. It was also found that transport, propagation and cumulative risks and risks to the biophysical environment are negligible. The absence of any credible off-site effects also means that there will be no impact from the proposed development on the existing cumulative risk levels in the Kooragang Island Industrial area.

It is recommended that a Hazard and Operability Study (HAZOP) should be conducted on the proposed facility prior to construction so as to review the hazards, controls and associated risks in greater detail.

It is also recommended that a Safety Management System be implemented to ensure that hazards associated with the site are identified and managed, so that all activities are undertaken in a safe manner. This management system should include a spill management program, driver training program and monitoring and maintenance programs associated with all essential infrastructure and equipment. Further management recommendations include:

- undertaking commissioning checks on the adequacy of the control system;
- design of instrumentation and electrical systems to AS 2430 for hazardous areas;
- provision of suitable electrically rated equipment for hazardous areas;

- development of a site emergency response plan; and
- design of retention system for control of fire water.

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1.0 Introduction

Manildra Park Pty Limited forms a company within the Manildra Group. The Manildra Group is a privately owned Australian company based in Auburn, NSW. The company was established in 1952 with the purchase of a flour mill in Manildra, western NSW. Over the past 50 years, the Manildra Group has diversified with its current product range including flour, pre mixes and products derived from flour such as modified starches, glucose syrups, maltodextrine, gluten, specialty protein products and methanol.

Manildra Park employs 80 staff through its direct operations. The Manildra Group employs over 600 people in New South Wales and approximately 900 people nationally and internationally.

Manildra Park (operating as Port Kembla Marine Fuels (PKMF)) is the owner/operator of the Marine Fuel Terminal at Port Kembla. The company imports marine fuels into the Port Kembla Terminal and resells these fuels to the Australian bunker fuel market. Bunkering is the refuelling of ships. A pipeline network and road tankers are used to distribute fuel to ships within Port Kembla. Road tankers are also used to distribute fuel to ships in the Port of Newcastle and other land based bulk fuel users in the Illawarra, Sydney and Hunter regions.

Manildra Park has secured an option for a long term lease over a site on Greenleaf Road, Kooragang Island from the Regional Land Management Corporation (RLMC). Manildra Park proposes to construct and operate a marine fuel and diesel distribution terminal and biodiesel production facility on the site.

The facility is located within the Kooragang Island Industrial Area, located at the southern end of Kooragang Island (refer **Figure 1.1**). Associated with the terminal's operation are, berth receival and distribution facilities, a pipeline connecting the terminal with the berth facilities, truck loading facilities, a biodiesel plant, and administration and amenities buildings.

In overview, the operations can be described as the following activities:

- **Receival**: the receival of marine fuel and diesel by ship and the primary raw materials (vegetable for biodiesel production) by ship and road;

- **Transfer**: the transfer of incoming marine fuel, diesel and the primary raw materials from the berth to the facility via a pipeline;

- **Storage**: the storage of marine fuel, diesel, biodiesel and the primary raw materials for biodiesel production;

- **Biodiesel Production**: the production of biodiesel from vegetable oils; and

- **Distribution**: the distribution of marine fuel, diesel and biodiesel via pipeline to a refuelling barge and then to ships within the Port of Newcastle and by road tanker to bulk diesel users within the region.

The Project is classed as a 'Major Project' under Part 3A of the Environmental Planning and Assessment Act 1979, requiring the preparation of an EA. This PHA forms part of the EA. The NSW Minister for Planning will be the consent authority for the project.

Source: Aerial Photo: Port Waratah Coal Services

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Legend

Greenleaf Road Terminal

FIGURE 1.1

Locality Plan

2.0 Site Description

2.1 Location

The project is located on Kooragang Island in the lower reaches of the Hunter River approximately two kilometres north of Newcastle (refer to **Figure 1.1**). The site is located within a designated industrial area on the north arm of the Hunter River, approximately 600 metres to the west of Stockton and approximately 1.6 kilometres to the north-east of Carrington (refer to **Figure 1.1**). Nearby developments include the former BHP Steelworks and the current OneSteel operations to the west across the river and the Orica and Incitec Pivot facilities adjacent to the site. Other businesses in the area include Port Waratah Coal Services, Cargill Australia, Air Liquide, Hifert and Boral.

The proposed facility is located on the eastern tip of Kooragang Island approximately one kilometre south of the Kooragang Nature Reserve. The Kooragang Wetland Rehabilitation Project was established in 1984 after parts of Kooragang Island were declared as internationally significant under the RAMSAR convention. The Kooragang Wetland Rehabilitation Project incorporates areas to the north, north-west and north-east of the facility.

The port facilities within the area are primarily used for the handling of raw materials, including coal, alumina, coke, wood chips, phosphate rock, and a number of agricultural products. There are also a number of transport and logistic companies located within the Kooragang Island industrial area, which are generally associated with the fertiliser manufacturing operations, and aluminium production.

2.2 Surrounding Land Uses

The surrounding land uses include:

- industrial development;
- residential development at Stockton; and
- port and recreational use of the Hunter River.

Industrial land uses dominate the immediate surrounding area. The industrial developments immediately adjacent to the project area include the OneSteel operations, Orica and Incitec Pivot facilities and Hifert Distribution Centre.

Industry and port facilities are located on the southern part of Kooragang Island. Some of the industrial activities in the area include coal handling, cement production, concrete batching and recycling, concrete building products, oilseed processing, fertiliser manufacturing and distribution, and ammonium manufacturing. Further industrial activities include hazardous waste management facility, LPG gas distribution facilities, a scrap metal reclamation facility, a licensed landfill and a number of engineering and fabrication operations.

The risk criteria for the surrounding land uses are summarised in **Table 2.1**.

Table 2.1 - Risk Criteria for Surrounding Land Uses

Land Use	Location	Distance (m)	Risk Criteria
Recreational	North Arm of the Hunter River	5	10×10^{-6}
Residential	Stockton	600	1×10^{-6}
Industrial	Orica	35	50×10^{-6}
Industrial	Incitec Pivot	35	50×10^{-6}

Source: HIPAP No. 4 – Risk Criteria for Land Use Safety Planning (DUAP 1992)

There are no land uses that require special precautions or further hazard mitigation measures over and above those required by *Hazardous Industry Planning Advisory Paper (HIPAP) No 4 – Risk Criteria for Land Use Safety Planning* (Department of Urban Affairs and Planning NSW (DUAP), 1992).

2.3 Project Description

Manildra Park proposes to undertake the development in three discrete phases, as outlined below:

Phase 1: involves refurbishing the two existing storage tanks, constructing the pipeline and operating fuel receival and distribution facilities at the berth, constructing a road tanker loading bay, constructing amenities and service buildings, and the purchase of a barge to distribute products around the port. Under this phase the storage capacity will be approximately 51 ML.

Phase 2: involves constructing three additional fuel storage tanks. Associated with the increased storage capacity, it is proposed to increase the distribution volumes to service local land based bulk diesel users and increased demand from the rise in ship numbers using the port. Under this phase, the storage capacity is proposed to be increased by approximately 21 ML, taking the total storage capacity to approximately 72 ML.

Phase 3: involves constructing a biodiesel production facility with a production capacity of approximately 60 ML per year. The distribution of biodiesel will utilise the marine and road distribution infrastructure constructed as part of **Phase 1**. Under this phase, the construction of a 5 ML tank and 0.5 ML tanks increases the total storage capacity to approximately 77 ML.

The annual marine fuel, diesel and biodiesel distribution volumes are shown in **Table 2.2**. Product will predominantly be transported to the facility via ship. The subsequent distribution of marine fuel will be predominantly undertaken via barge, while diesel and biodiesel will be mainly distributed by road tankers.

Table 2.2 - Indicative Annual Marine Fuel, Diesel and Biodiesel Distribution Volumes

		Years		
Product		1 – 3	4-6	7-10+
Marine Fuel	**ML/Yr**	190	280	280
Diesel	**ML/Yr**	110	245	245
Biodiesel	**ML/Yr**	19	44	60

A detailed description of the individual components associated with each phase can be found in **Sections 2.3.1** to **2.3.3**.

2.3.1 Phase 1

The general arrangement of the terminal can be seen in **Figure 2.1** and the main components are described below.

Under Phase 1 marine fuel and diesel will be received and distributed from the terminal. The marine fuel will be predominantly distributed via barge to ships within the Port of Newcastle, while road tankers will distribute diesel to other users within the port and local bulk fuel users.

Greenleaf Road Terminal

<u>Marine Fuel and Diesel Storage</u>

During the 1970's and early 1980's the site was used to store naphtha. The two existing steel tanks (T1 and T2), each with a capacity of approximately 25.5 ML and an earthen bund which surrounds these tanks, are evidence of this previous operation.

These tanks will be refurbished to allow for the storage of marine fuel and diesel.

The existing internal floating roofs in each tank will be removed and replaced with new floating roofs. Repairs to the floor and walls of the tanks will be completed where required. The southern bund wall will be relocated to the north. The site (including the bund walls) will be lined with an impervious membrane. A leak detection system will also be installed beneath the existing tanks.

<u>Road Tanker Loading Bay</u>

The loading bay will be roofed, bunded and drained to an oil separator. Truck loading operations will be semi automated to prevent overfilling. Spills during the coupling and uncoupling of hoses are minimised via the use of a 'dry break' coupling, which cannot be opened unless fitted to the vehicle. The trucks are also fitted with brake interlocks, which prevent the truck from driving off while connected to the loading bay hoses.

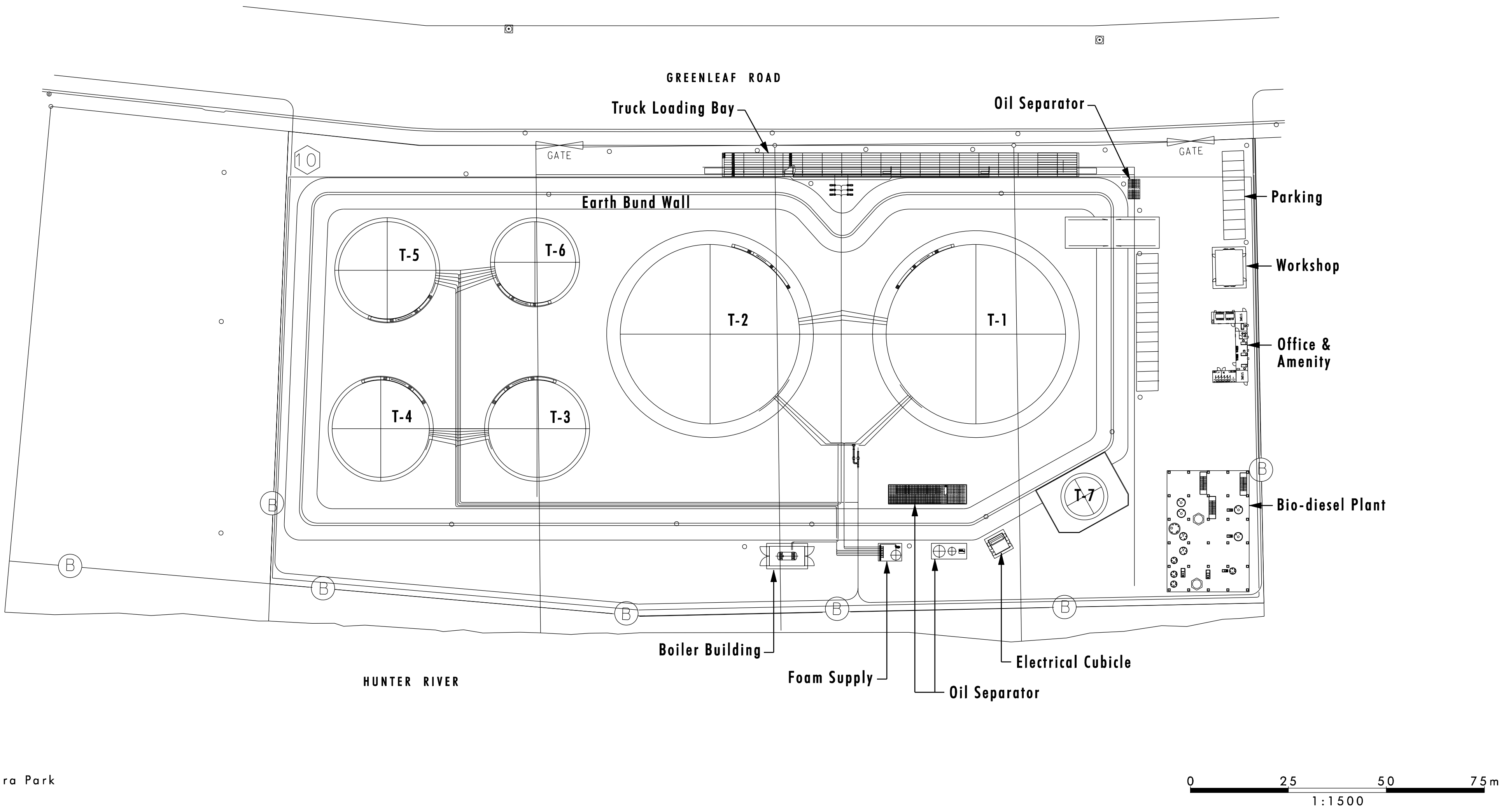
Discharges from the separator will be licensed under an Environment Protection Licence for the site.

<u>Amenities and Services</u>

Office and amenity buildings, together with car and truck parking areas, will be provided to accommodate staff at the terminal. A storage compound will also be constructed to store plant, equipment and emergency response equipment.

The site is unsewered and therefore an onsite sewage treatment facility will be designed and installed to treat wastewater from the office and amenity buildings.

The current fire ring main located on-site will be refurbished and reconnected to mains water and additional fire fighting equipment including foam, foam applicators and hoses will be installed around the terminal as required by legislation. A comprehensive Fire Safety Study will be carried out during the detailed design phase to identify the specific requirements of the site.



Source: Manildra Park

FIGURE 2.1

General Arrangement
Greenleaf Road Terminal

Berth Facilities – Receival

Marine fuel, diesel and vegetable oil will be shipped to Kooragang Island. The unloading of bulk fuels and oils will occur at either Kooragang Island Berth No 3 (K3) or Kooragang Island Berth No 2 (K2). The location of these berths is shown in **Figure 2.2**. The mechanics of unloading remains the same regardless of the unloading berth location, that is, fuel will be transferred from the ship to the terminal via a 400 mm steel pipeline. Flexible hoses will run between the ship and the point of connection with the steel pipeline.

The general alignment of the pipeline will follow the eastern side of Greenleaf Road and the western side of Heron Road and terminate at the K2 and K3 berths (refer to **Figure 2.2**). The pipeline will be located below ground within the road reserve.

From Heron Road the pipe to turn to the west and continue underground through the backup land which adjoins the berth and terminate in a bunded area at the eastern edge of the berths. An underground position avoids operational conflicts associated with the existing plant and equipment which use the berths. A manifold will be constructed within the bunded area, which provides a connection point for flexible hoses, which can be connected to a ship for the importation of fuels. Pig launching and receiving chambers will also be constructed within the bunded area (refer to **Plate 1**). Pigs are flexible rubber or urethane plugs used to clear a pipeline after it has been used to transfer a liquid product. The pig is loaded into the launcher prior to pumping and when fuel loading or unloading has been completed it is pushed back to the terminal using compressed air to ensure there is no product left in the line. A steel spill tray will also be used in the bunded area.

Berth Facilities - Distribution

The distribution of fuel to ships within the port will be undertaken using a refuelling barge. The refuelling barge will moor at the refuelling berth (the Wallarah Berth) and will receive fuel from the terminal via a pipeline, as described below. The location of this berth is shown in **Figure 2.2**. The Wallarah berth is located to the north of K3 and east of Kooragang Island Berth No 4 (K4). Fuel will be delivered to the Wallarah berth by an extension to the steel receival pipeline located on the K3 berth. A diverter will be placed at the point where the steel receival pipeline comes onto the K3 wharf. The pipeline will run from this point north underground, where the pipeline will then turn west 90 degrees once it enters Port Waratah Coal Service (PWCS) land. Once on PWCS property, the pipeline will be located on the surface and will run parallel to the Wallarah berth before extending onto the berth. The pipeline will terminate within a bunded area on land behind the berth. This bunded area will contain the pig launcher and will be housed in a small metal shed (refer to **Figure 2.2**). The loading of the refuelling barge will be accomplished by connecting flexible hoses between the manifold at the end of the pipeline and the refuelling barge.

The barge will also have the capability to undertake ship providoring if required. No additional infrastructure is required for these activities.

The barge will be self propelled and have a crew of three. When not in use the refuelling barge will be moored at the refuelling berth.

The need for any infrastructure, services upgrades and/or structural improvements such as berthing dolphins, fenders, walkways, anchoring points, power and water will be determined following a survey of the Wallarah berth. These works may be undertaken from land and/or water.

Source: Aerial Photo: Port Waratah Coal Services

0 100 200 500m
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Legend

- Greenleaf Road Terminal
- Receival and Distribution Pipeline
- Barge Refuelling Pipeline

FIGURE 2.2

Location of Receival / Distribution Berths and Pipeline Alignments

PLATE 1
Pipeline Manifold

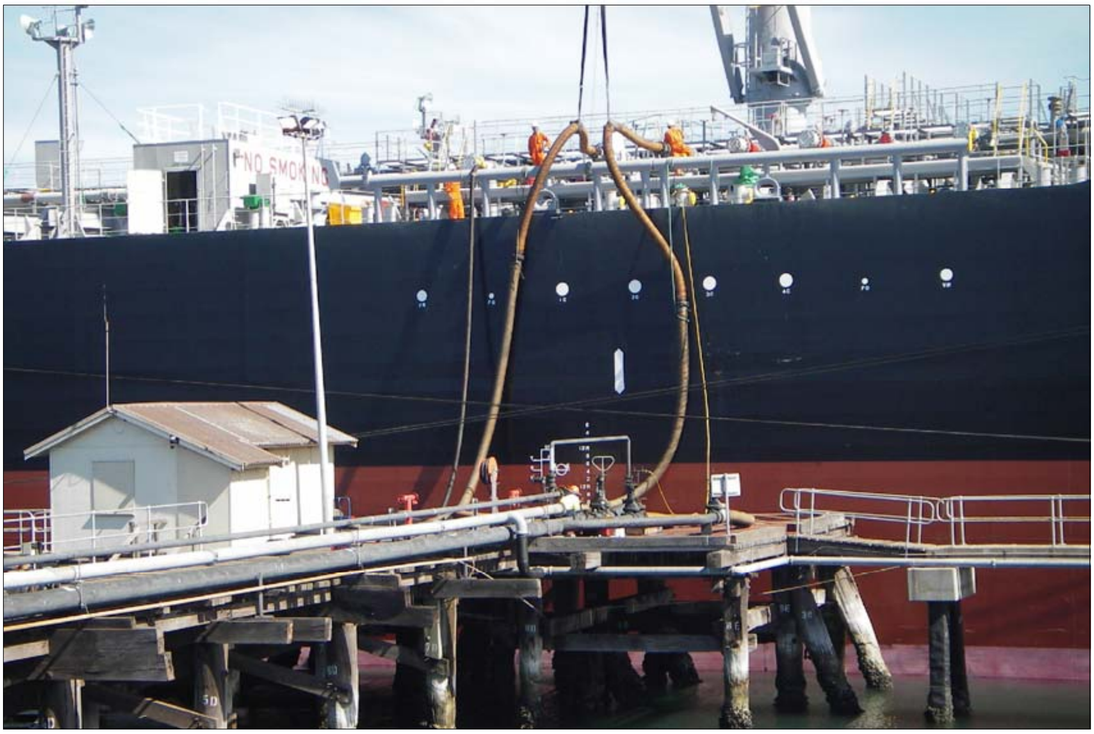


PLATE 2
Ship Transfers

The need for any fire fighting or safety equipment at the berth will be assessed in a comprehensive Fire Safety Study, to be completed in the detailed design phase of the proposal.

Pipelines

The design, construction, operation and maintenance of all pipelines will be undertaken in accordance with AS 2885 Pipelines – Gas and liquid petroleum. The pipeline will be cathodically protected for enhanced anti-corrosion properties. Any underground or inaccessible sections will be sheathed in polymer coating or wrapped in anti-corrosion impregnated tape. The pipeline will be hydrostatically tested every 12 months to ensure its integrity and visually inspected during pipeline transfers.

An emergency stop system will run the length of the pipeline, which will activate a visual and audible alarm at the terminal, K2, K3 berths and barge refuelling point. In barge refuelling situations, the emergency stop system will also stop pumps and shut valves at the terminal pipeline manifold. Pressure switches will be installed on pumps to ensure maximum operating pressures are not exceeded and check valves will be installed on the pipeline to ensure there is no backflow from receivers in the event of failure or power loss.

The berth receival pipeline will be cleared of product following the transfer of product by running a rubber plug, known as a ‘pig’ through the line propelled by compressed air. Flexible hoses used in the transfer of product between the berth receival/discharge points and ships or the refuelling barge, will also be cleared of remaining product by using compressed air. To avoid accidental opening, receival/discharge points will be fenced and secured by turning off, locking and isolating valves using bolted blind flanges (refer to **Plate 2**).

2.3.2 Phase 2

Phase 2 involves the construction of three 7 ML diesel storage tanks within the terminal as illustrated within **Figure 2.1**. Associated with the additional tanks will be the installation of additional pipe network infrastructure within the terminal.

2.3.3 Phase 3

Phase 3 involves the establishment and operation of a biodiesel production and distribution facility with an annual production capacity of approximately 60 ML. Construction of the biodiesel facility consists of assembling prefabricated components. The location of the biodiesel facility is shown in **Figure 2.1**.

A 5 ML and 0.5 ML tank will also be constructed under this phase.

The biodiesel facility will convert vegetable oil into biodiesel. The chemistry of the biodiesel process is based on transesterification, where fats or oils are mixed with methanol or ethanol and a catalyst (potassium hydroxide (KOH) or sodium hydroxide (NaOH)) and heated. The chemical reaction that occurs through this process breaks down the oil molecules and replaces the glycerin portion of the molecule with an alcohol molecule. The glycerin settles to the bottom of the mixing vessel where it is drained from the biodiesel.

3.0 Multi Level Risk Assessment Methodology

Under *SEPP 33 – Hazardous and Offensive Development* (NSW Government, 1997), a preliminary risk screening of the proposed development is required to determine the need for a PHA. The preliminary screening involves identification and assessment of the storage of specific dangerous goods classes that have the potential for significant off-site effects.

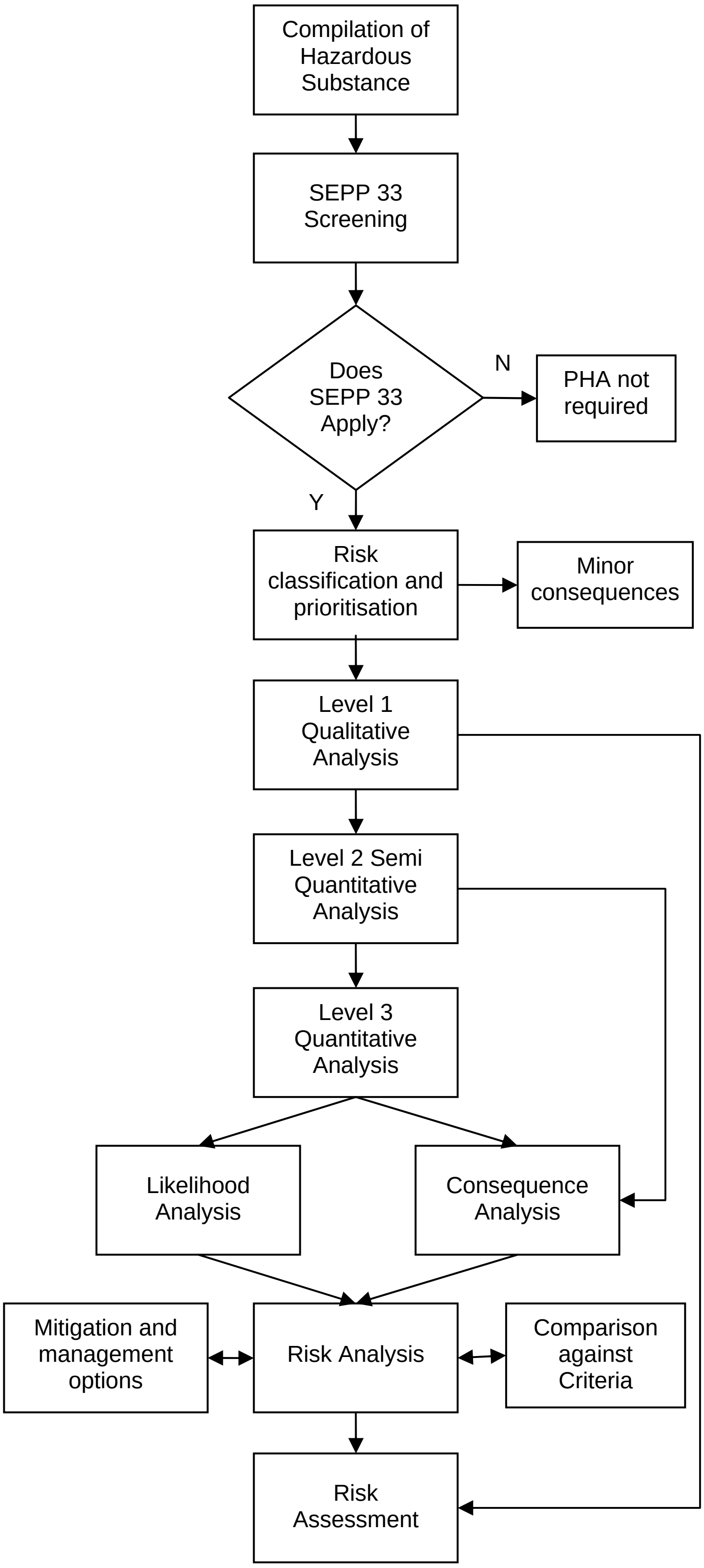
HIPAP No. 6 – Guidelines for Hazard Analysis (DUAP, 1992) and *Multi-level Risk Assessment* (DUAP, 1999) note that a PHA should identify and assess all hazards that have the potential for off-site impact. The expectation is that the hazards would be analysed to determine the consequence to people, property and the environment and their potential to occur.

The methodology used to identify and assess the hazards and respective failure scenarios that have the potential for off-site impact is outlined in **Figure 3.1**. The details of how this methodology is implemented are discussed in the respective sections of this report.

In summary, the risk assessment involves the following processes:

- identifying the risks to be managed, including:
  - a preliminary risk screening (refer to **Section 4.0**); and
  - classification and prioritisation of risks (refer to **Section 5.0**);
- analysis of the risks involved with the project, including sources, consequences, and likelihood of consequences (refer to **Sections 6.0** and **7.0**);
- assessment of risk by evaluating the results of the hazard analysis. This involves comparison of analysed risks with risk criteria as identified in *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP 1992) (refer to **Section 8.0**); and
- treatment of risks, including identification and assessment of safeguards and treatment plans (refer to **Section 9.0**).

Figure 3.1 - Overview of PHA Methodology



SEPP 33 Screening involves compiling information on the quantity of hazardous materials used, the mode of storage and location with respect to the site boundary and the number and size of annual and weekly road movements of the hazardous material.

A proposed development should be considered potentially hazardous if the storage or transport of hazardous substances exceeds the respective screening thresholds.

Risk classification and prioritisation involves ranking of the facility using techniques to make broad estimates of the consequence and likelihood of accidents. The output is expressed in terms of individual and societal risk and is compared against respective criteria.

A Level 1 analysis is a qualitative assessment based on detailed hazard identification. The objective is to demonstrate that the activity does not pose a significant risk. Where the qualitative analysis cannot satisfactorily demonstrate there will be no significant risk, further analysis is required.

A Level 2 analysis supplements the Level 1 analysis by quantifying the main risk contributors to show that their consequences are acceptable.

A Level 3 quantitative analysis is required when the screening and hazard identification process and/or risk classification and prioritisation process has identified risk contributors with consequences beyond the site boundaries. The analysis requires a comprehensive quantification of significant consequences and their likelihood.

The Risk Assessment compares the results of the risk analysis with the respective risk criteria. Where the level of risk is not acceptable, risk minimisation, mitigation and management options need to be investigated.

4.0 SEPP 33 Preliminary Risk Screening

4.1 Introduction

A preliminary risk screening of the proposed development is required under *SEPP 33 – Hazardous and Offensive Development* (NSW Government, 1997), to determine the need for a PHA. The preliminary screening methodology concentrates on the storage of specific dangerous goods classes that have the potential for significant off-site effects. A complete description of the methodology is provided in DUAP's *Applying SEPP 33 - Hazardous and Offensive Development Application Guidelines (Applying SEPP 33)* (DUAP 1994).

4.2 Methodology

The objective of the risk screening process is to assist consent authorities to determine if a proposed development is potentially hazardous and therefore subject to the requirements of SEPP 33.

To determine if a proposed facility is potentially hazardous the following information is collated:

- the quantity of hazardous materials used in the proposed development;
- the dangerous goods classification for each material;
- the mode of storage;
- the distance of the stored material from the site boundary. For underground tanks, the distance is measured from the above ground filling/dispensing point. The capacity of an underground tank should be divided by five prior to assessing it against the screening threshold; and
- the average number and size of annual and weekly road movements of hazardous material to and from the facility.

Other aspects to note when undertaking the screening process include:

- LPG is treated separately and not grouped with the other class 2.1 flammable gases;
- class C1 and/or class C2 combustible materials where stored in separate bunds from flammable liquids are not considered to be potentially hazardous;
- where several hazardous materials of the same class are kept on site in the same general location the assessment should be based on the total quantities by class and activity;
- underground and above ground storage are treated separately;
- where the proposed development is an extension to an existing site the quantity assessed should include any inventories on the existing site that are adjacent to the proposed development;
- where more than one subsidiary class is stored in the same general area, the total of that class present should be assessed as the most hazardous subsidiary class present; and

- the distance to the nearest boundary is measured from the material in the group located closest to the boundary.

The screening thresholds for the storage of hazardous substances are presented in Table 3 and Figures 5 to 9 of the DoP's guidelines *Applying SEPP 33* (DUAP 1994). A proposed development should be considered potentially hazardous if the storage of hazardous substances exceeds the respective screening thresholds.

A proposed development may also be considered as potentially hazardous based on the number of traffic movements involving hazardous materials as a result of the proposed operation. The screening threshold for the transport of hazardous substances is presented in Table 2 of the DoP's guidelines *Applying SEPP 33* (DUAP 1994).

If a proposed development is considered potentially hazardous, SEPP 33 will apply and a PHA will need to be submitted with the development application. The PHA should be prepared in accordance with the DoP's guidelines *HIPAP No. 6 - Guidelines for Hazard Analysis* (DUAP 1992).

If a proposed development is found to be potentially hazardous with respect to transportation, a route evaluation study may also be required.

4.3 Proposed Inventory

The proposed inventories of feed stock and products that will be stored at the facility and their dangerous goods classification are listed in **Table 4.1**.

Table 4.1 - Inventory of Feed Stock and Products

Product	Class	Storage Capacity
Marine Fuel	C1	25.5 ML tank
Marine Diesel	C1	25.5 ML tank
Road Diesel	C1	3 x 7 ML tank
Biodiesel	C1	5 ML tank
Raw Oil (e.g. Canola, sunflower, tallow, Palm oil)	No Classification	2,700 m^3 tank
Methanol [1]	3 PG II	480 m^3 tank
Glycerine	No Classification	51 m^3 tank
Sulphuric Acid	8	4 m^3 tank
Potassium hydroxide (KOH)	8	8 m^3 total
Potassium sulphate (K_2SO_4)	No Classification	28 m^3 tank

Note: 1: Ethanol may be substituted for methanol in the biodiesel production process as it has similar properties

SEPP 33 states that for combustible materials:

> If class C1 and/or class C2 are present on site and are stored in a separate bund or within a storage area where they are the only flammable liquid present they are not considered to be potentially hazardous. If, however, they are stored with other flammable liquids, that is, class 3PGI, II or III, then they are to be treated as class 3 PGIII, because under these circumstances they may contribute fuel to a fire.

A C1 combustible liquid is a liquid within the meaning of *AS 1940-2004: The storage and handling of flammable and combustible liquids* that has a flashpoint of greater than 60.5 °C but not greater than 150 °C. A C2 combustible liquid has a flashpoint of greater than 150 °C.

The flashpoints of the class 3 flammable liquids and C1 combustible liquids that will be stored at the facility are listed in **Table 4.2**.

Table 4.2 - Classification of Class 3 Flammable and C1 Combustible Liquids

Material	Flash Point	Classification	MSDS Source
Biodiesel	100 °C	C1	Biodiesel Industries
Diesel	> 61.5 °C	C1	Caltex
Marine Diesel D15	> 61.5 °C	C1	BPAust
BP Fuel Oil F180	>61.5 °C	C1	BPAust
BP Fuel Oil F380	>61.5 °C	C1	BPAust
Marine Bunker Fuel IF180	>61.5 °C	C1	BPAust
Ethanol	13 °C	Class 3 II	Veggiepower
Methanol	12 °C	Class 3 II	Veggiepower
Canola Oil	> 200 °C	Non-hazardous	Canola-USA

The proposed inventories of feed stock and products that will be transported to and from the facility are listed in **Table 4.3**.

Table 4.3 - Estimated Transport and Throughputs of Feed Stock and Products

Product	Transport Volumes	Transport Frequency
Imports		
Marine Fuel	280 ML/yr	14 ships/yr
Marine Diesel	25ML/yr	1 ship/yr
Road Diesel	220 ML/yr	11 ships/yr
Canola Oil	32 ML/yr	840 trucks/yr
Vegetable Oil	20 ML/yr	1 ship/yr
Methanol	6100 tonnes/yr	200 trucks/yr
Sulphuric Acid	750 tonnes/yr	170 trucks/yr
Potassium hydroxide	1070 tonnes/yr	360 trucks/yr
Exports		
Marine Fuel	280 ML/yr	180 barges/yr
Marine Diesel	18 ML/yr	11 barges/yr
Marine Diesel	7 ML/yr	190 trucks/yr
Road Diesel	220 ML/yr	6100 trucks/yr
Biodiesel	60 ML/yr	1560 trucks/yr
Glycerine	7200 tonnes/yr	260 trucks/yr
Potassium sulphate	1900 tonnes/yr	70 trucks/yr

The transport rates in **Table 4.3** are based on the following assumptions:

- all fuel products that are delivered by water to ships will use a 1600 kL capacity barge;
- 60 per cent of fuel products will be dispatched by road using 34 kL tri-axle fuel tankers and 40 per cent by 48 kL tri-axle B-double fuel tankers;
- raw fuel products (methanol) will be delivered by road using 34 kL tandem axle fuel tankers;
- raw fuel oil products (canola oil) will be delivered by road using 34 kL tri-axle fuel tankers;
- other vegetable oil products will be delivered by ship depending on market availability;
- chemical supplies delivered or dispatched by road;
- a minimum of one day's storage volume of chemicals will be held on site;
- marine diesel will be delivered by barge and road tankers; and
- chemicals dispatched by road will use 28 kL dual-axle road tanker.

4.4 Threshold Screening

The marine fuel, diesel, raw vegetable oil and biodiesel will be stored separately from the class 3 substances. The risk screening for the storage of hazardous substances therefore applies to the dangerous goods presented in **Table 4.4**. The shading in **Tables 4.4** to **4.6** indicates exceedances of the relevant risk screening thresholds.

Table 4.4 - Dangerous Goods Inventories for Risk Screening

Substance	Classification	Quantity	Distance to Boundary	Screening Threshold	Threshold Exceeded (Y/N)
Methanol	Class 3 PG II	480 m^3	19 m	> 30 m	Y
Sulphuric Acid and Potassium Hydroxide	Class 8 PG II	12 m^3	na	25 t / 25 m^3	N

Notes: na - not applicable

Table 4.5 summarises the number of vehicle movements for the various dangerous goods and **Table 4.6** provides the estimated delivery quantities per vehicle carrying dangerous goods.

Table 4.5 - Estimated Vehicle Movements of Dangerous Goods

Dangerous Goods Classification (DGC)	Deliveries Annual/Weekly	Delivery Screening Threshold	Delivery Threshold Exceeded (Y/N)
Class 3 PG II	200 / 4	>500 / >30	N
Class 8 PG II	530 / 11	>500 / >30	Y

Table 4.6 - Estimated Delivery Quantities of Vehicles Transporting Dangerous Goods

Dangerous Goods Classification (DGC)	Typical Deliveries Quantity	Quantity Screening Threshold	Quantity Threshold Exceeded (Y/N)
Class 3 PG II	24 t	1 t bulk	Y
Class 8 PG II	7 to 14 t	2 t bulk	Y

4.5 Results of Preliminary Screening

According to **Table 4.4**, the proposed development is potentially hazardous with respect to the storage of class 3 PG II substances. According to **Tables 4.5** and **4.6** the proposed development is potentially hazardous with respect to the number of deliveries of class 8 substances and also potentially hazardous with respect to the size of the deliveries of class 3 and class 8 substances. As a result SEPP 33 applies and a PHA is required. A transportation route evaluation study should also be included as a part of the environmental assessment.

The development will require an Environmental Protection Licence from the DECC as the development falls under the definition of a chemical storage facility and potentially a chemical works due to the production of biodiesel. Therefore the development is considered to also be potentially offensive and SEPP 33 applies.

5.0 Risk Classification and Prioritisation

5.1 Introduction

DUAP's *Multi Level Risk Assessment* (MLRA) (DUAP, 1997) suggests the use of a preliminary analysis of the risks related to a proposed development to enable the selection of the most appropriate level of risk analysis in the PHA. This preliminary analysis includes risk classification and prioritisation using a technique adapted from the *Manual for Classification of Risk due to Major Accidents in Process and Related Industries (Manual for Classification of Risk)* (International Atomic Energy Agency – IAEA – 1993). A complete description of the technique is presented in the MLRA (DUAP, 1997). The technique is based on a general assessment of the consequences and likelihoods of accidents and their risks to individuals and society, and the comparison of these risks to relevant criteria to determine the level of assessment required, be it qualitative or quantitative.

5.2 Methodology

The objective of the risk classification and prioritisation process is to identify whether the risks identified as part of the SEPP 33 preliminary screening pose acceptable risks or whether further assessment is required. The assessment involves the following steps:

- classification of type of activities and inventories;
- estimation of consequences;
- estimation of probabilities of major accidents for fixed installations;
- estimation of societal risk;
- estimation of individual risk;
- evaluation of alternatives; and
- assessment using criteria to determine required level of risk assessment.

For each potentially hazardous activity information is required regarding the location, type, production and storage condition of the activity, as well as name, physical state and amount of hazardous substances involved. Table II of the *Manual for Classification of Risk* (IAEA, 1993) provides a guideline of required information. Considering the site layout and location of hazardous activities or substances, the maximum amount of hazardous substances that could be released in an accident for each activity are conservatively estimated (refer to **Appendix A**).

DUAP (1997) suggests that for underground storage of flammable liquids, the quantity be divided by 5 and the substance treated as 'other'.

If a facility has effective physical isolation and separation between the storage vessels with the same dangerous goods classification, then the content of the largest storage vessel would typically be used to estimate the effect of an incident.

When selecting the activities likely to have the potential to cause risk/damage, the following should be considered:

- if more than one substance in the same activity can cause damage independently from the other substances, analyse them separately;
- if a group of substances may act together, consider them as a single (equivalent) substance; and
- if a flammable substance is also toxic, both effects have to be accounted for. After following the procedures it will be clear whether flammable properties are important or not, compared with toxic properties.

5.3 Estimation of Consequences

Consequences of an accident depend on the type of substance, activity and the quantity involved, as well as the population exposed to its effect.

The external consequences ($C_{a,s}$) of major accidents to humans are calculated using equation (1) of IAEA (1993):

$$C_{a,s} = A \times d \times f_a \times f_d \times f_m$$

where:

$C_{a,s}$ = external consequences (fatalities per accident) where the subscript ‘a’ represents an activity and subscript ‘s’ represents a hazardous substance
A = affected area - Tables IV and V (hectares; 1 ha = 10^4 m^2)
d = population density in defined populated areas (persons/ha)
f_a = correction factor for populated area (part of circle)
f_d = correction factor for populated area (distances)
f_m = correction factor for mitigation effects.

In accordance with the *Manual for Classification of Risk* (IAEA 1993) this calculation was undertaken for all hazardous substances and activities.

The external consequences relating to each of the substances during flammable or explosive events or toxic releases is summarised in **Appendix A**.

In the event of any hazardous event, the extent of the affectation area into adjacent sites will be limited. The calculations have assumed a population density for surrounding industrial development of thirty people per hectare. This value provides a conservative estimate of the number of people on adjacent sites likely to be present within the affectation area at any one time.

5.4 Estimation of Probabilities of Major Accidents for Fixed Installations

The probability number ($N_{\mathbf{i,s}}$) of major accidents to humans is calculated using equation (2) of *Manual for Classification of Risk* (IAEA, 1993):

$$N_{\mathbf{i,s}} = N^*_{\mathbf{i,s}} + n, + n_f + n_0 + n_p$$

where:

$N^*_{\mathbf{i,s}}$ = the average probability number for the installation and the substance;
n, = probability number correction parameter for the frequency of loading/unloading operations;
n_f = probability number correction parameter for the safety systems associated with flammable substances;
n_0 = probability number correction parameter for the organisational and management safety;
n_p = probability number correction parameter for wind direction towards the populated area.

In accordance with the *Manual for Classification of Risk* (IAEA 1993) this calculation was undertaken for all hazardous substances and activities.

This probability number was then converted into a probability $P_{i,s}$ by means of Table XIV of *Manual for Classification of Risk* (IAEA 1993) or directly, using the relationship between N and P which is defined as:

$$N = \log_{10}(P)$$

$P_{i,s}$ defines the frequency (number of accidents per year) of accidents involving a hazardous substance (subscript ‘s’) for each hazardous fixed installation (subscript ‘i’), which causes the consequences that have been estimated previously.

The probabilities of major accidents at the facility relating to each of the substances during flammable or explosive events are summarised in **Appendix A**.

The correction parameter n_0 accounts for factors including the development’s safety management, age of the plant, maintenance, documentation and procedures, safety culture, training and emergency planning. This factor was given a value of zero to represent average industry practice to provide a conservative estimate of the impact of the site's safety and management procedures on any major accidents.

5.5 Criteria for Multi Level Risk Assessment

The method of determining the assessment criteria recommended by DoP is outlined in Figure 5 of the MLRA (DUAP, 1997). This figure shows the three criteria regions. Below the lower criterion line the risk would be considered negligible. Above the upper criterion line the risk would be considered intolerable. The region between these criteria lines is considered to be tolerable depending on the results of an evaluation of other risk criteria.

These criteria are used to determine the level of assessment required by the PHA as follows:

- Level 1 assessment – can be justified if the analysis of the facility demonstrates the societal risk is negligible and there are no potential accidents with significant off-site consequences;

- Level 2 assessment – can be justified if the societal risk estimates fall within the middle region i.e. between the upper and lower criteria lines and the frequency of risk contributors having off-site consequences is relatively low. The assessment must demonstrate that the facility will comply, at least in principle, with the Department's risk criteria, based on broad quantification of the risk; and

- Level 3 assessment – is required if the societal risk estimates are in the intolerable zone, or where there are significant off-site risk contributors and a level 2 assessment fails to demonstrate that risk criteria will be met.

According to Section 3.1 of MLRA (DUAP, 1997), quantification of the risk must be undertaken on any component identified in the risk classification and prioritisation process which has off-site consequences of greater than or equal to 1 at a frequency greater than 1×10^{-7} per year.

5.6 Estimation of Societal Risk

The risk to the public from each potentially hazardous activity is estimated by combining the estimated consequences to humans and the probabilities of major accidents.

Using the results of the assessments undertaken in **Section 5.4**, the activities are classified and grouped according to *Manual for Classification of Risk* (IAEA, 1993). The details of the scenarios modelled are outlined in **Table 5.1**.

Table 5.1 - Dangerous Goods Scenarios Modelled for Societal Risk

Descriptor	Substance	Classification	Activity	Hazardous Event	Description
S1	Methanol	Class 3 PG II	Storage	Fire	Liquid
S2	Methanol	Class 3 PG II	Storage	Explosion	Tank vapour
P1	Methanol	Class 3 PG II	Plant	Fire	Plant volume
P2	Methanol	Class 3 PG II	Plant	Explosion	Vapour
T1	Methanol	Class 3 PG II	Transport	Fire	Liquid in truck
S4	Sulphuric Acid	Class 8	Storage	Toxic	Liquid
T2	Sulphuric Acid	Class 8	Transport	Fire	Liquid
S6	Potassium hydroxide	Class 8	Storage	Toxic	Liquid

Scenarios S2, P1 and P2 are representative of the hazardous events of fire and explosion associated with the storage of methanol and its use in the biodiesel plant. These scenarios assumed a conservative amount (i.e. 10 tonnes) of vapour is produced and stored in the methanol storage tank and biodiesel plant.

As described in **Section 4.2** for the preliminary risk screening process, it has been assumed that as the class C1 combustible substances will be stored in separate bunds from the flammable liquids, these substances are not considered to be potentially hazardous and therefore do not require assessment under the classification and prioritization step.

The matrix of frequency and consequence for the facility is shown in **Figure 5.1**.

Figure 5.2 presents the cumulative societal risk curve associated with the facility compared to the indicative criteria shown in Figure 9 of *Manual for Classification of Risk* (IAEA 1993).

The results shown in **Figures 5.1** and **5.2** indicate that the risks from all activities are considered to be 'negligible' except for the transport of methanol. **Figure 5.1** indicates that the facility does not generate a significant societal risk due to flammable or explosive events associated with the storage or use of methanol in the biodiesel plant or the storage and transport of the class 3 substances.

The marine fuel, diesel, raw vegetable oil and biodiesel will be stored separately from the class 3 substances and are therefore not considered to be potentially hazardous and do not require assessment for societal risk (IAEA, 1993).

5.6.1 Rank and Prioritise the Results

With reference to Figure 9 of *Manual for Classification of Risk* (IAEA, 1993) the priority assessment risk categories correspond to the upper right hand side of the matrix of probability versus consequence, i.e. activities with relatively high probability and high consequences. However, it has to be taken into consideration that the concept of societal risk also implies that risk of higher consequences, with smaller frequency, are perceived as more important than those of smaller consequences with higher probabilities.

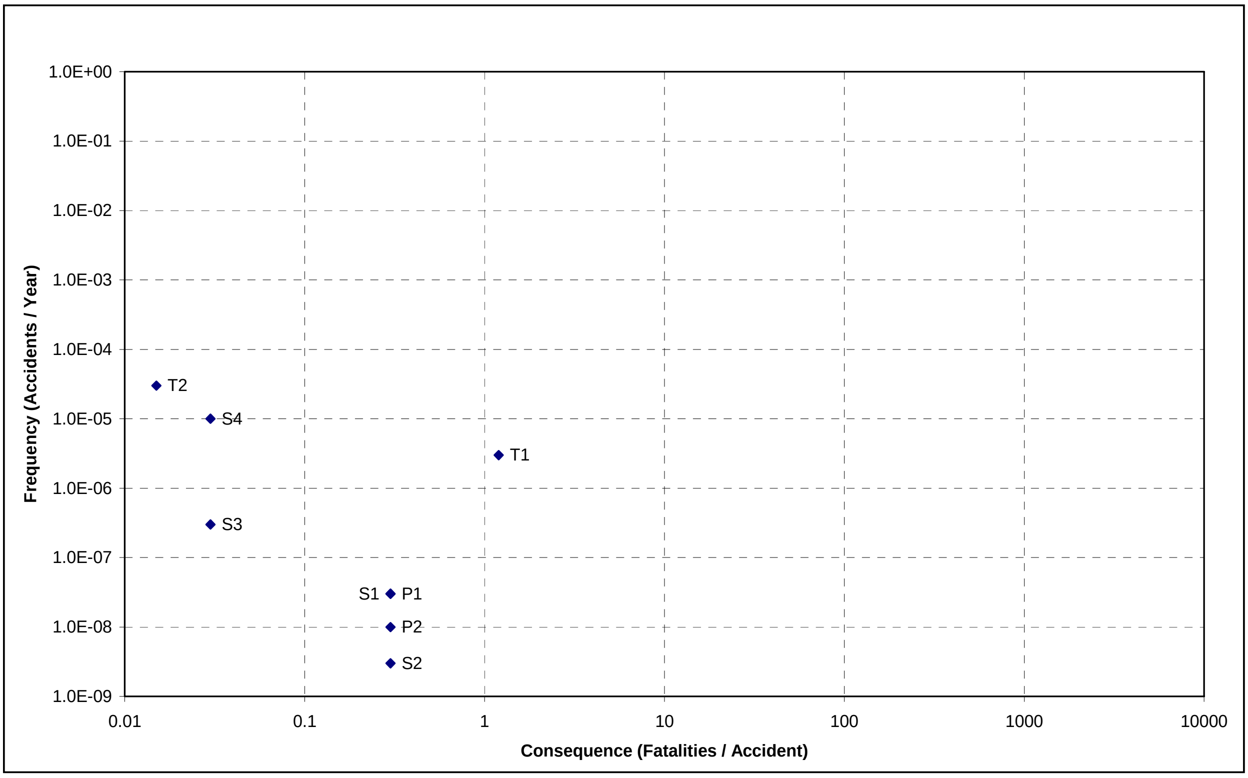
Based on the results of shown in **Figures 5.1** and **5.2** the highest risk activity is fire associated with the transport of a class 3 PG II substance (T1). The transport of this substance is seen to pose a greater risk than the other activities due to the combined consequence and frequency. The next highest risk activities are associated with the storage and use of a class 3 PG II substance (S1, S2, P1 and P2). The risks associated with sulphuric acid and potassium hydroxide (T2, S3 and S4) were considered to be negligible as the consequences were an order of magnitude below the consequences associated with the other substances.

In order for a Level 1 assessment to be sufficient, all points on the indicative societal risk curve produced in **Figure 5.2** should be below the negligible line. This criterion is not satisfied so a Level 2 assessment, incorporating the results of a Level 1 assessment, will be required.

5.7 Results of Risk Classification and Prioritisation Assessment

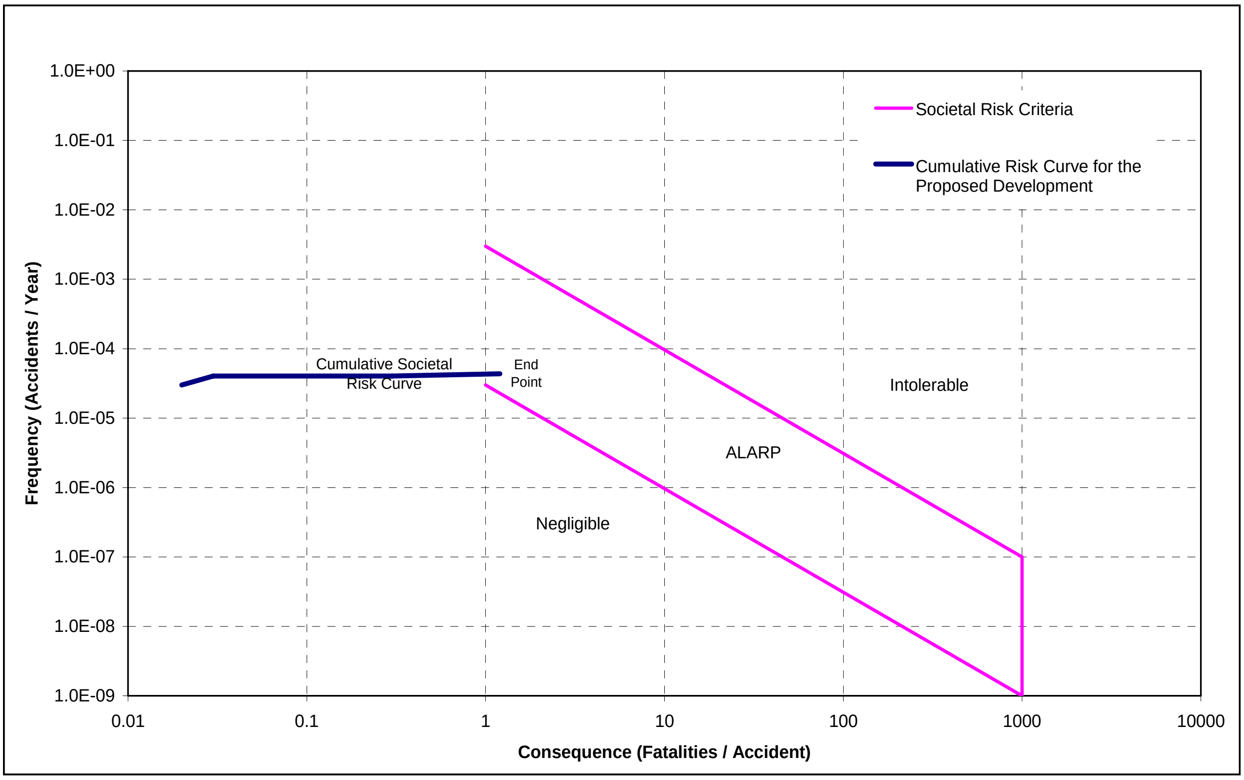
Based on the results of preliminary screening a Level 2 assessment is required to assess the likelihood and risk of potential hazardous events which may have off-site implications using appropriate qualitative and/or quantitative techniques. The results of a Level 1 assessment will be incorporated in a Level 2 assessment in accordance with MLRA (DUAP, 1997). The Level 1 assessment involves risk classification and prioritisation using word diagrams, simplified fault/ event trees and checklists.

The results of the classification and prioritisation assessment are based on the assumption that flammable substances will be stored separately to the combustible substances. In the event that flammable and combustible substances are to be stored in the same bunded area, the class C1 substances would be considered to be potentially hazardous and require



Risk Plot of Frequency against Concequence for Manildra Park Facility

FIGURE 5.1



Societal Risk Plot for Manildra Park Facility

FIGURE 5.2

assessment as part of the classification and prioritisation assessment. Preliminary investigations have indicated that in the event of this occurrence, the risks associated with the C1 liquids are likely to be intolerable and would necessitate the completion of a full quantitative risk assessment (i.e. a Level 3 assessment). A level 3 assessment is not required as combustible and flammable materials will note be stored in the same bund.

6.0 Level 1 Qualitative Assessment

6.1 Introduction

A Level 1 assessment is essentially a qualitative analysis that uses words and descriptive scales to determine the risk of each hazard identified in **Section 5.6**. This risk is then assessed against qualitative criteria to determine whether the facility could cause an accident of a magnitude significant in terms of risk to people or property, or harm to the biophysical environment.

Low and acceptable risks can be allowed with minimal further treatment, however, if the risks are significant a higher level of analysis will be required.

6.2 Methodology

A Level 1 assessment requires (as a minimum):

- hazard identification using word diagrams, simplified fault/ event trees and checklists;
- generalised consequence analysis of key risk contributors to demonstrate that their consequences are confined within the project boundaries. This analysis should incorporate the results of the preliminary screening and risk classification and prioritisation assessments;
- evaluation of the risks against the qualitative criteria in *HIPAP No. 4 Risk Criteria for Land Use Safety Planning* (DUAP 1992); and
- demonstration of adequacy of the proposed technical and management controls to ensure ongoing safety of the proposed development.

The assessment should be undertaken for all facilities which reported exceedances of initial screening thresholds.

DUAP (1997) provides guidance on choosing the level of assessment required based on dangerous goods classes. These are summarised below:

- Dangerous Goods Classes 1-3 and 6.1 (covering explosive, flammable and toxic materials) – if the risk classification and prioritisation process indicated a negligible level of societal risk a Quantitative Risk Analysis (QRA) may not be required. If these conditions are satisfied no further quantification is required:
  - all points on indicative societal risk curve are below the negligible line;
  - no events have consequences extending significantly (i.e. consequence < 1) beyond the site boundary at a frequency > 1 x 10-7;
  - process and operations are well understood and covered by recognised standards and codes of practice; and
  - any off-site consequences will not impact on sensitive adjoining land uses.

As discussed in **Section 5.6**, class 3 PG II substances are expected to have the highest potential for off-site consequences which exceed 1 fatality per year at a frequency exceeding

1×10^{-7}. A Level 2 partial quantification assessment which incorporates the Level 1 assessment is therefore required as part of the PHA.

6.3 Hazard Identification

6.3.1 Hazardous Materials

A brief summary of the properties of the hazardous materials associated with the project is provided below.

Marine Fuel

Marine fuel is a combustible liquid which means that it has the potential to produce flammable vapours, which are able to be ignited.

Diesel

Diesel is a combustible liquid which means that it has the potential to produce flammable vapours, which are able to be ignited.

Methanol

Methanol is a flammable liquid which is non-carcinogenic, biodegradable and water soluble. It is not a carrier of toxic particles though if consumed it is capable of causing personal injury. It will be stored at the facility at ambient temperature and so will be in liquid form.

Sulphuric Acid

Sulphuric acid is a corrosive liquid capable of causing personal injury and environmental damage. It will be stored at the facility as liquid at ambient temperature.

Potassium Hydroxide

Potassium hydroxide is a corrosive substance that can cause serious burns upon contact and irritation on inhalation.

Sodium Methoxide

Sodium methoxide is a corrosive highly flammable substance capable of causing personal injury and environmental damage.

6.3.2 Hazardous Event Identification

A hazard identification session was facilitated by Umwelt on 24 July 2007 and included representatives from Manildra Park and Solly Engineering. The participants have experience in fuel terminal and biodiesel facility design and operation. The purpose of the hazard identification session was to review the proposed new plant and equipment with the objective of identifying significant safety, occupational health and environment hazards both on-site and off-site.

The hazard identification session included:

- a review of the inventory of materials/chemicals stored and used on the site;

- a review of the plant process flow diagrams, equipment, physical environment, products/by-products, effluents, etc;
- consideration of the range of tasks, both routine and occasional, on the site;
- an overview of relevant legal standards; and
- a review of any occupational hygiene or health impacts.

A hazard study provides the opportunity for people to think creatively and examine ways in which hazards might arise in a meeting environment. To reduce the chance that something is missed, it is done in a systematic way using guide words to identify hazards. The study is carried out in accordance with *HIPAP No 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992) and comprises part of a Level 1 qualitative risk assessment.

The hazard study involved discussion of the scope of the project, followed by identification of hazards regarding safety, occupational health and environment. The hazard identification process is based on a brainstorming session using guidewords such as:

Hazardous event
Traffic accident
Injury
Explosion
Loss of containment
Hazardous substances
Process control
Material spillage
Release during loading/unloading
Fire
Acid/Alkali reaction
Dangerous goods
Maintenance

The hazards identified were discussed and safety or mitigation measures were decided upon. The outcomes of these discussions were recorded in minutes and the potential hazardous events are summarized as word diagrams in **Appendix B**. These word diagrams outline the causes, consequences and proposed preventative and mitigative control measures for the potential hazardous events identified in the meeting.

6.4 Level 1 Risk Criteria

The qualitative risk assessment criteria have been developed to identify key risks to the environment, society, heritage and business reputation. The criteria are based on a risk assessment matrix consistent with *Australian Standard AS4360 on Risk Management* (AS4360), and are shown in **Tables 6.1** to **6.3**. These values were used to help provide a general assessment of the hazards with off-site consequences, which are presented in **Appendix B**.

Additional criteria for acceptable risk have been adopted from *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992), which are summarised as:

a) all 'avoidable' risks should be avoided. This necessitates the investigation of alternative locations and alternative technologies, wherever applicable, to ensure that risks are not introduced in an area where feasible alternatives are possible and justifiable;

b) the risk from a major hazard should be reduced wherever practicable, irrespective of the numerical value of the cumulative risk from the whole installation. The assessment process should address the adequacy and relevancy of safeguards as they relate to each risk contributor;

c) the consequences of the more likely hazardous events should, wherever possible, be contained within the boundaries of the installation; and

d) where there is an existing high risk from a hazardous installation, additional hazardous installations should not be allowed if they add significantly to the risk.

Table 6.1 - Qualitative Measures of Environmental Consequence

Severity Level	Natural Environment	Legal/Government	Heritage	Community/ Reputation/Media
(1) Insignificant	Limited damage to minimal area of low significance.	Low-level legal issue. On the spot fine. Technical non-compliance prosecution unlikely. Ongoing scrutiny/attention from regulator.	Low-level repairable damage to commonplace structures.	Low level social impacts. Public concern restricted to local complaints. Could not cause injury or disease to people.
(2) Minor	Minor effects on biological or physical environment. Minor short-medium term damage to small area of limited significance.	Minor legal issues, non-compliances and breaches of regulation. Minor prosecution or litigation possible. Significant hardship from regulator.	Minor damage to items of low cultural or heritage significance. Mostly repairable. Minor infringement of cultural heritage values.	Minor medium-term social impacts on local population. Could cause first aid injury to people. Minor, adverse local public or media attention and complaints.
(3) Moderate	Moderate effects on biological or physical environment (air, water) but not affecting ecosystem function. Moderate short-medium term widespread impacts (e.g. significant spills).	Serious breach of regulation with investigation or report to authority with prosecution or moderate fine possible. Significant difficulties in gaining future approvals.	Substantial damage to items of moderate cultural or heritage significance. Infringement of cultural heritage/ scared locations.	Ongoing social issues. Could cause injury to people, which requires medical treatment. Attention from regional media and/or heightened concern by local community. Criticism by Non-Government Organisations (NGO). Environmental credentials moderately affected.
(4) Major	Serious environmental effects with some impairment of ecosystem function. Relatively widespread medium-long term impacts.	Major breach of regulation with potential major fine and/or investigation and prosecution by authority. Major litigation. Future project approval seriously affected.	Major permanent damage to items of high cultural or heritage significance. Significant infringement and disregard of cultural heritage values.	On-going serious social issues. Could cause serious injury or disease to people. Significant adverse national media/public or NGO attention. Environment/management credentials significantly tarnished.

Table 6.1 - Qualitative Measures of Environmental Consequence (cont)

Severity Level	Natural Environment	Legal/Government	Heritage	Community/ Reputation/Media
(5) Catastrophic	Very serious environmental effects with impairment of ecosystem function. Long term, widespread effects on significant environment (e.g. national park).	Investigation by authority with significant prosecution and fines. Very serious litigation, including class actions. Licence to operate threatened.	Total destruction of items of high cultural or heritage significance. Highly offensive infringements of cultural heritage.	Very serious widespread social impacts with potential to significantly affect the well being of the local community. Could kill or permanently disable people. Serious public or media outcry (international coverage). Damaging NGO campaign. Reputation severely tarnished. Share price may be affected.

Table 6.2 - Qualitative Measure of Likelihood

Level	Descriptor	Description	Guideline
A	Almost Certain	Consequence is expected to occur in most circumstances.	Occurs more than once per month.
B	Likely	Consequence will probably occur in most circumstances.	Occurs once every 1 month – 1 year.
C	Occasionally	Consequence should occur at some time.	Occurs once every 1 year - 10 years.
D	Unlikely	Consequence could occur at some time.	Occurs once every 10 years – 100 years.
E	Rare	Consequence may only occur in exceptional circumstances.	Occurs less than once every 100 years.

Source: AS/NZS 4360:2004 Risk Management

Table 6.3 - Qualitative Risk Matrix

Likelihood of the Consequence	Maximum Reasonable Consequence				
	(1) Insignificant	(2) Minor	(3) Moderate	(4) Major	(5) Catastrophic
(A) Almost certain	11 High	16 High	20 Extreme	23 Extreme	25 Extreme
(B) Likely	7 Moderate	12 High	17 High	21 Extreme	24 Extreme
(C) Occasionally	4 Low	8 Moderate	13 High	18 Extreme	22 Extreme
(D) Unlikely	2 Low	5 Low	9 Moderate	14 High	19 Extreme
(E) Rare	1 Low	3 Low	6 Moderate	10 High	15 High

Source: AS/NZS 4360:2004 Risk Management

6.5 Results of Level 1 Assessment

For the purposes of this assessment, significant risks have been defined in **Appendix B** as those with a risk rating of high or extreme, as defined by risk values exceeding 10 and 18 respectively in **Table 6.3**. None of the risks associated with the facility were found to constitute extreme risks.

The Level 1 qualitative analysis identified the following hazardous events with the potential to have off-site impacts which pose a risk to people (injury and/or fatality) and therefore require further assessment as part of a Level 2 assessment. These can be generally classified as:

- tank fire/bund fire associated with methanol storage; and
- release of methanol vapour leading to explosion.

The Level 1 qualitative analysis also identified a number of hazardous events which can be generally classified as off site discharges with impacts on the environment, for example, loss of containment leading to an oil spill. There are a number of possible events which may lead to an environment incident including:

- loss of containment of flammable and combustible materials ie breach or failure of a bund wall;
- mechanic failure of a pipeline;
- a fire and the loss containment of fire water;
- unloading/loading of ships;
- interactions with existing wharf activities; and
- exposure of contaminated soil/groundwater.

The management of these hazardous events are addressed within the Environmental Assessment for the project.

The activities with 'low' to 'moderate' risks are presented in **Appendix B** and will be mitigated and managed with the safeguards outlined in **Appendix B**. Aircraft crashes have been incorporated into **Appendix B** but it is considered highly unlikely that an aircraft crash will occur as the site is not located under an airport flight path.

As described in **Section 4.2** for the preliminary risk screening process, it has been assumed that class C1 combustible substances will be stored in separate bunds from the flammable liquids. The combustible substances are therefore not considered hazardous. The risks associated with storage of C1 combustibles will be managed by ensuring there is no mixing with flammables and through the provision of fire fighting detection and fire fighting systems.

The development can be shown to fulfil the following additional Level 1 assessment criteria:

a) all identified avoidable risks have been avoided. The qualitative risk analysis has sought to identify all avoidable risks and the design of the development has been modified to prevent all risks that could be addressed by feasible alternatives; and

b) remaining risks have been reduced to as low as practicable. **Appendix B** summarizes how the design and installation of the proposed facility mitigates the risks through appropriate safeguards and barriers.

On the basis of the risk classification and prioritisation process it is anticipated that a Level 2 (partial quantification) assessment will be required, as the risk classification and prioritisation identified a risk contributor with off-site impacts with a corresponding likelihood that is low.

7.0 Level 2 Semi-Quantitative Assessment

7.1 Introduction

A Level 2 assessment is required whenever a Level 1 assessment cannot demonstrate that the development will have no significant off-site risk. The risk screening and classification process and the Level 1 assessment have identified events with off-site consequences. It is noted however that these events have low corresponding likelihoods.

The criteria for Level 1 qualitative analysis applies to these assessments, however they must also demonstrate that the relevant numerical criteria will not be exceeded. This requires that the cumulative impacts of those risks with potential consequences outside the site boundary are quantified and shown to be below the appropriate criteria. This specifically means that:

- no individual event should have off-site consequences at a frequency greater than that appropriate for the land use (refer to **Table 3.1**); and
- at any point outside the site, there should be no combination of events which cumulatively will cause the individual risk criteria to be exceeded.

As part of the multi-level risk assessment, the facility could have potential off-site consequences relating to:

- tank fire/bund fire associated with methanol storage; and
- release of methanol vapour leading to explosion.

The off-site impacts of these hazards are expected to be low, as the societal risk determined in the risk screening and classification process was found to be generally low for hazards associated with methanol. The distance to residential and other sensitive land users is large for the terminal area and the risk screening and classification assessment indicated that the affectation area of any consequences is expected to be limited. Accordingly it is considered that any consequential impacts due to radiant heat from fires or overpressure from explosions will not have significant consequential impacts. The objective of the Level 2 assessment is to confirm the acceptability of the risks of the proposed development.

7.2 Methodology

The Level 2 assessment involves the following processes:

- using the results of the Level 1 assessment to evaluate the consequences of events with the potential for off-site impacts in accordance with the *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992); and
- assessing the likelihood and risk of potential hazardous events which may have off-site implications using appropriate qualitative and/or quantitative techniques (e.g. a risk matrix). This will determine whether existing off-site risk levels will be increased by the development. Assess these levels against *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992).

The Level 2 assessment should include the elements of Level 1 assessment, and:

- modelling of the consequences of events with off-site effects;
- estimation of the likelihood of each event which would have significant off-site consequences; and
- assessment of the above results to demonstrate compliance with relevant risk criteria.

7.3 Level 2 Risk Criteria

The risk criteria for off-site risk have been adopted from *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992). These criteria are summarised in **Tables 7.1** and **7.2**.

Table 7.1 - Quantitative Individual Fatality Risk Assessment Criteria

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	5×10^{-6} per year
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year
Fatality risk for industrial sites	50×10^{-6} per year

Source: HIPAP No. 4 – Risk Criteria for Land Use Safety Planning (DUAP 1992)

Table 7.2 - Quantitative Risk Assessment Criteria for Risk of Injury, Property Damage and Accident Propagation

Category	Criteria Description
Injury Risk	
Heat Radiation	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.
Explosion Overpressure	Incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year.
Toxic Exposure	Toxic concentrations in residential areas should not exceed a level which would be seriously injurious to sensitive members of the community following a relatively short period of exposure.
Toxic Exposure	Toxic concentrations in residential areas should not cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community.
Risk of Property Damage and Accident Propagation Category	
Heat Radiation	Incident heat flux radiation at neighbouring potentially hazardous installations should not exceed a risk of 50×10^{-6} per year for the 23 kW/m^2 heat flux level.
Explosion Overpressure	Incident explosion overpressure radiation at neighbouring potentially hazardous installations or at nearest public buildings should not exceed a risk of 50×10^{-6} per year for the 14 kPa explosion overpressure level.

Source: HIPAP No. 4 – Risk Criteria for Land Use Safety Planning (DUAP, 1992)

7.4 Consequence Analysis

Quantified consequence analysis has been undertaken for each of the credible hazard scenarios with potential off-site effects, listed in **Section 7.1**. The consequences of each incident are assessed using the generalised data from *HIPAP No. 4* (DUAP, 1992) to assess the effect of fire radiation, explosion overpressure and toxicity to an individual. If it can be shown that the identified events causing hazards off-site do not cause unacceptable impacts at the site boundary, the risk posed by these hazards is considered to be tolerable.

Consequence analysis has been undertaken separately for each selected incident scenario to estimate the effects of each outcome on people, property or biophysical environment. The most common types of hazardous incidents are fires, explosions and toxic releases.

7.4.1 Fires

The potential fire hazardous events associated with the proposed facility are associated with methanol. Fires could occur in the methanol storage tank or bunded area.

Marine fuel, diesel, vegetable oil, biodiesel, methanol and sulphuric acid/ potassium hydroxide will be stored on-site in bunded areas to contain any spills. As discussed in **Sections 4.3** and **4.4** the class 3 flammable substances will be stored separately from the combustible C1 and C2 substances. The combustible substances are not considered hazardous if they are not stored with class 3 flammable substances.

It is possible to have fires associated with biodiesel plant. The biodiesel plant will be manned and in the event of a loss of containment the process will be stopped. In the event of a fire the fire suppression system will be activated. This will mitigate the size of any potential fire and the potential damage.

It is possible to have fires associated with losses of containment from the wharf lines but significant fires can only occur during product transfer. During product transfer, both the wharf and terminal will be manned and in the event of a loss of containment the transfer process will be stopped. This will mitigate the size of any potential fire and the potential damage.

Fire Scenarios Associated with Methanol

The thermal radiation produced as a result of any potential fire in the methanol tank is expected to be substantially less than that produced by a bund fire, therefore only the bund fire scenario has been modelled.

Ethanol may be substituted for methanol in the biodiesel production process as it has similar properties (refer to **Table 7.3**). Ethanol has been modelled in the fire scenario as its heat of combustion is slightly higher than that of methanol, and the calculations will therefore provide a conservative estimate of the consequences associated with fires in the bund.

Fire consequence modelling was undertaken using the method outlined in the *Handbook of Fire Protection Engineering*, 3rd Edition (SFPE, 2002). The data used in this model is shown in **Table 7.3**.

Table 7.3 - Properties of Ethanol and Methanol for Fire Scenario Calculations

Material Contained in Storage Tank	Mass Burning Rate, kg/m^2s	Heat of Combustion, kJ/kg	Empirical Constant (kβ), m^{-1}	Liquid Density, kg/m^3
Ethanol	0.015	26,800	100	794
Methanol	0.017	20,000	100	796

The scenario modelled to represent the potential fire event associated with the methanol storage area is detailed in **Table 7.4**. The pool fire model is a conservative evaluation of a bund fire as it does not take into account the 2.1 metre high bund wall around the tank that would confine the fire, i.e. it models an unconstrained fire.

Table 7.4 - Distance to Specified Levels of Radiant Heat for Ethanol Bund Fire

Equivalent Pool Fire Diameter, m	Heat Release Rate, kW	Distance to Specified Radiant Heat Level *(from base of flame), m*			Distance to Nearest Neighbour's Boundary, m*
		23 kW/m^2	12.6 kW/m^2	4.7 kW/m^2	
16.5	8.6E+04	9.0	15.0	30.0	34.0

* Distance from base of the tank bund to the site boundary measured from site layout diagram provided by Manildra Park

The results shown in **Table 7.4** indicate that the critical thermal radiation levels do not enter the neighbouring site. The 12.6 kW/m^2 and 23 kW/m^2 radiation level represents the level at which unprotected steel on adjacent tanks or structures could suffer thermal stresses resulting in structural failure over different exposure periods. The results in **Table 7.4** indicate that these radiation levels are confined to within 9 metres and 15 metres respectively of the base of the flame. The 12.6 kW/m^2 thermal radiation load will encroach upon the adjacent biodiesel plant within the site and may cause structural damage, but fire protection systems will be in place on this structure to minimise impacts of any thermal radiation impacts.

The 4.7 kW/m^2 radiation level represents the level at which injury to people could occur. **Table 7.4** indicates that this radiation level is confined to within 30 metres the base of the flame. This is approximately 4 metres within the site and from the boundary with the nearest neighbour. These predictions of thermal load are conservative as a potential fire will be confined by a 2.1 metre high bund wall and a significant proportion of the thermal radiation from the pool fire will be shielded from the adjacent neighbouring property by the biodiesel plant.

The boundary fence along the north arm of the Hunter River is approximately 18.9 metres from the methanol storage area. The thermal radiation from an unconfined pool fire 18.9 metres from the base of the fire would be approximately 9.2 kW/m^2. The resulting impact of a confined bund fire on an unoccupied area is not considered to be significant.

The graph of heat radiation levels with respect to the distance from the centre of an unconfined ethanol pool fire is shown in **Figure 7.1**.

7.4.2 Combustion Product Impacts

When hydrocarbons burn, a mixture of water vapour, carbon dioxide and carbon monoxide is produced. Depending upon the nature of the combustion, ratios of carbon dioxide to carbon

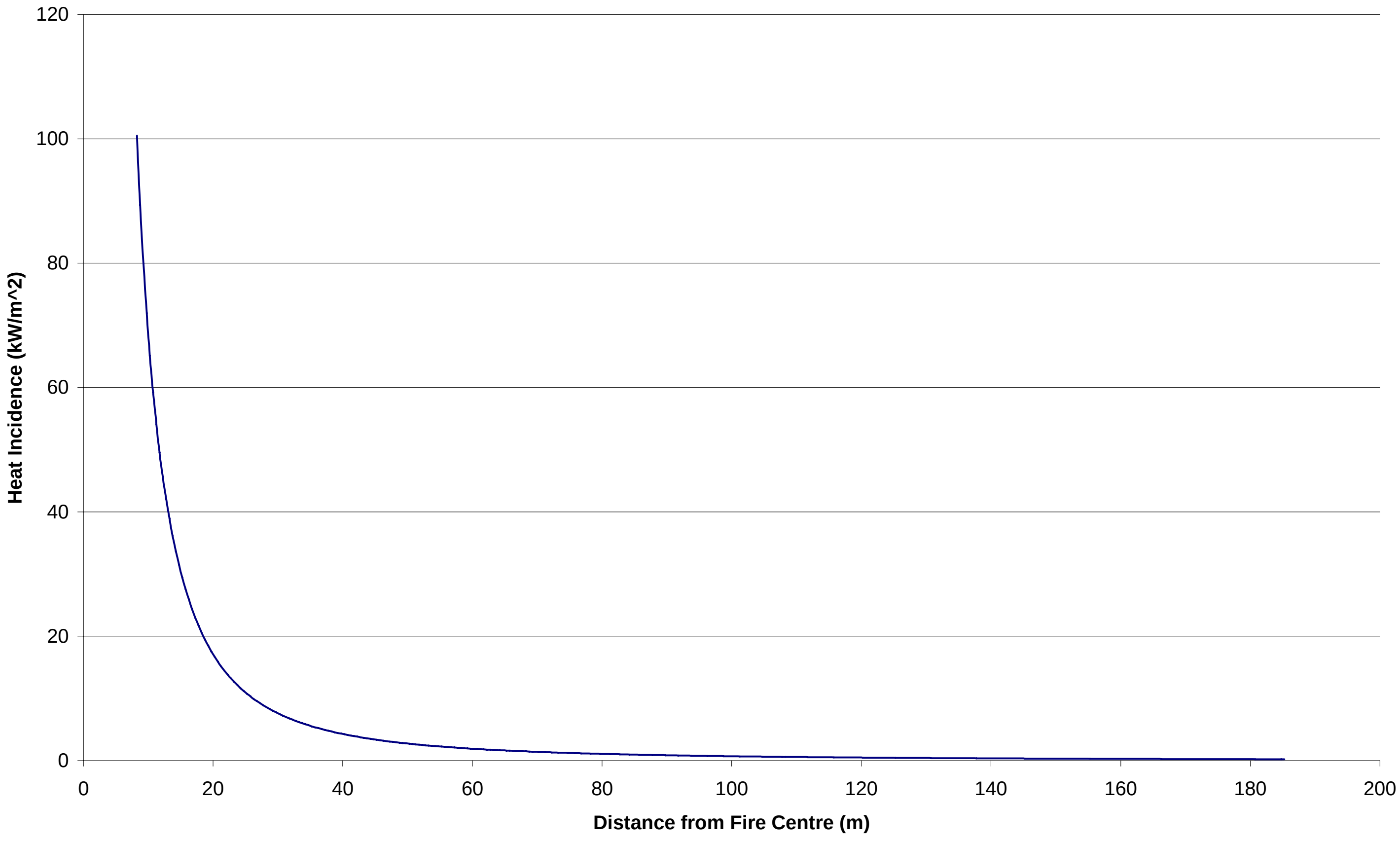


FIGURE 7.1

Heat Incidence at Distance from Centre of Pool Fire monoxide can vary between 10:1 and 200:1. In the situation where an adequate supply of oxygen is available then ratios in the range of 100:1 to 200:1 are expected, i.e. less than 1 per cent of carbon will be converted to carbon monoxide. It is also proposed that the methanol stored at the facility will be pure. On this basis there will be no scope for production of sulphur and nitrogen oxides that might be formed from combustion of flammable liquids such as petrol or diesel. Based upon the above discussion, and the buoyancy of the plume of combustion products, the toxicity effects from carbon monoxide are considered to be insignificant. Therefore this hazard has not been further addressed.

7.4.3 Explosions

The potential explosion hazardous events identified are associated with methanol and could occur as a result of a release of methanol vapour.

Explosion Scenarios Associated with Methanol

The credible, potential explosion hazardous event associated with the storage of methanol is the release of methanol vapour leading to an explosion.

For the proposed facility, the potential for an explosion involving methanol vapour producing significant off-site impacts is considered to be very low. Generally several tonnes of vapour must be present to obtain detonation of a vapour cloud and produce significant off-site impacts. While the inventory of methanol to be stored on site is large, the headspace within the tank is minimised by the use of an internal floating roof. Additionally the methanol is stored at temperatures below its boiling point, all of which ensures that significant quantities of vapours will not be generated. It is also considered that insufficient quantities of methanol could potentially escape from the biodiesel plant to cause a major unconfined vapour cloud explosion because of the low methanol vapour pressure.

Based on this assessment it is not anticipated that detonation of methanol vapours could occur and an explosion involving methanol is considered to be extremely unlikely.

Further safeguards to ensure that a vapour cloud explosion associated with methanol is prevented or mitigated are outlined in **Appendix B**. Generally, safeguards include:

- ensure methanol present is stored in a state that removes explosive potential of methanol;
- the design, inspection and maintenance of the facility to ensure that infrastructure is fully secure and operational; and
- access to fire fighting systems to control and mitigate any fire or explosions encountered.

These measures will prevent and mitigate the potential for a methanol vapour cloud explosion at the proposed facility.

Interactions with Existing Wharf Activities

The potential for an explosion involving ammonium nitrate and a fuel spillage on the wharf during the fuel unloading process is considered to be extremely low. For the scenario to be plausible ammonium nitrate would have to be present on the wharf where the unloading was taking place at the same time as a spillage occurred. For an explosion to occur the ammonium nitrate would have to be sensitised and then detonated.

Operationally diesel and ammonium nitrate ships can not occupy the same berth at the same time and thus there are no potential interactions due to the shipping operations. There are however two potential interactions associated with the materials handling operations in which diesel and ammonium nitrate could potentially come into contact, both of which are unlikely: These scenarios are described as follows:

1. if ammonium nitrate was consolidated/stockpiled at the berth while fuel was being unloaded. Our understanding is that ammonium nitrate is not consolidated/stockpiled at the berth; and

2. trucks transporting ammonium nitrate were to enter the berth from an entrance other than that designated for the berth where ammonium nitrate loading is taking place. While this is possible operationally this would require the trucks to gain entry via a more distance point of entry to the relevant berth.

It is noted that diesel and ammonium nitrate ships transfer operations can however be undertaken on adjoining berths i.e. K2 and K3 concurrently. Similarly concurrent operations on adjoining berths do not pose any hazard and thus there are no limitations imposed on the operation of the berth by the proposal, as a result of the physical separation of the adjoining berths and the truck transport arrangements as outlined above.

Based on this assessment it is believed a spillage of fuel on the wharf leading to an explosion involving ammonium nitrate would be extremely unlikely.

Further safeguards to ensure that a fuel spillage on the wharf does not come into contact with ammonium nitrate are outlined in **Appendix B**.

7.4.4 Results of Consequence Analysis

The consequence analysis undertaken as part of the Level 2 assessment found that the credible hazardous events at the facility are pool fires associated with the storage of methanol in the tank and bunded area.

The fire consequence modelling undertaken produced a graphical representation of the heat radiation levels in relation to the distance from the centre of the pool fire. **Figure 7.1** shows the graphical results for the bunded area to illustrate the impacts to be expected in the event of methanol fire. Comparison with the quantitative criteria outlined in **Section 7.3** shows that the heat radiation criterion of 23 kW/m^2 for surrounding industrial land uses is contained within the site boundary. A thermal radiation level of 12.6 kW/m^2 may extend to the adjacent biodiesel plant, however it is considered that the fire protection systems to be implemented will minimise the impacts on this structure. The results of the modelling (refer to **Table 7.4**) also indicate that in the event of fires associated with methanol storage tank, the thermal radiation criterion for residential land use of 4.7 kW/m^2 is expected to be retained within 30 metres the base of the flame, approximately 4 metres within the site and from the boundary with the nearest neighbour. This estimation does not account for the 2.1 metre high bund wall around the tank or the shielding effect provided on the adjacent property by the biodiesel plant. The thermal radiation at the site's boundary with the Hunter River was found to be approximately 9.2 kW/m^2. It is considered that the resulting impact of a confined bund fire on this unoccupied area is not significant. Additionally the nearest residential development is located approximately 600 metres away. Therefore the risk of injury or fatality in residential areas is considered to be negligible and the risk of fatality and injury are considered acceptable for radiant heat from fires (refer to **Table 7.2**).

7.5 Results of Level 2 Assessment

The Level 1 assessment identified hazardous events with the potential to have off-site impacts (i.e. fires associated with the storage of methanol and release of methanol vapour leading to explosion). The consequence analysis undertaken as part of the Level 2 assessment found that the potential for explosion associated with the methanol storage was considered to be very low and the safeguards outlined will ensure that explosions are prevented or mitigated. The hazards associated with methanol fires were assessed and the consequences modelled. The resulting thermal radiation impacts associated with methanol fires were considered to be insignificant. Therefore there is negligible risk of injury or fatality in residential areas associated with the thermal impacts of methanol fires, and the risk of fatality and injury due to radiant heat are considered to be acceptable.

8.0 Risk Analysis

Risk analysis involves comparing the level of risk found during the qualitative and/or quantitative analyses with previously established risk criteria, and deciding whether or not that level of risk can be accepted. Such decisions take into account the wider context of the hazard and include consideration of the tolerability of the hazards borne by external parties.

Low and acceptable risks can be allowed with minimal further treatment, however, they should be monitored and periodically reviewed to ensure they remain at this level. Higher level risks should be treated using appropriate safeguards.

Risk analysis and assessment generally involves the following processes:

- assess the risk of potential hazardous events which may have off-site implications using appropriate qualitative and/or quantitative techniques (e.g. a risk matrix). This will determine whether existing off-site risk levels will be increased by the development;

- assess the impacts of the proposed development on individual and societal risk, off site, cumulative and biophysical risk;

- identify risks associated with propagation from existing hazardous events in nearby equipment/processes; and

- management of residual risks using safeguards.

8.1 Individual/Off-Site Risk and Societal Risk

The criteria for qualitative assessments are shown in **Tables 6.1** to **6.3**. The criteria for semi-quantitative assessments are shown in **Tables 7.1** and **7.2**.

8.1.1 Societal Risk

Societal risk was assessed as part of the risk classification and prioritization step. The cumulative risks to the public from potentially hazardous activities associated with the facility were found to be significant as a result of the consequences associated with the bulk storage of methanol (refer to **Figure 5.2**). The results of the Level 2 assessment indicated that these risks are acceptable, as safeguards will be implemented to ensure risks are as low as reasonably practicable. The societal risks associated with all other potentially hazardous activities were found to be negligible.

It has been assumed that combustible C1 substances will be stored in separate bunds from the flammable liquids. The combustible substances are not considered hazardous if they are not stored with the class 3 flammable substances.

8.1.2 Individual Risk Due to Methanol Pool Fire

The Level 1 and 2 assessments identified that there is the potential for off-site impacts associated with methanol pool fires (refer to **Sections 6.0** and **7.0**). A consequence analysis indicated that most of the critical levels of thermal radiation impacts for injury and fatality for industrial and residential land uses are contained on-site and that any off-site radiation will extend into an unoccupied area of the Hunter River adjacent to the site. Therefore it is anticipated that there will be negligible off-site injury risk associated with methanol bund fires (refer to **Table 7.4**). Therefore the risks associated with the development were found to be acceptable.

8.1.3 Individual Risk Due to Explosion

The Level 2 assessment found that the quantities and conditions in which methanol is stored on-site should ensure that risk of an explosion is highly unlikely. Therefore it is predicted that there will be negligible risk of injury or fatality associated with explosions.

8.1.4 Individual Risk Due to Combustion Products

The Level 2 assessment found that the conditions in which methanol is stored on-site results in toxicity effects from combustion products which are considered to be insignificant. Therefore it is predicted that there will be negligible risk of injury or fatality associated with combustion products.

8.2 Propagation Analysis

A potentially hazardous event within a plant can cause further hazardous events in the same plant or other plants. The Level 2 assessment indicated that the major risk contributor at the facility is fire.

8.2.1 Propagation Due to Fire

Based on the results of the Level 2 assessment, it is not anticipated that heat radiation impacts from a pool fire in the methanol storage bund will propagate to storage tanks off-site. The assessment has indicated that there is a low risk of fire occurring on-site, and the heat radiation levels associated with structural damage may extend to the adjacent biodiesel plant, however structural damage will be minimised by the implementation of fire protection systems on the structure (refer to **Table 7.4**). The consequence modelling was also conservative, in that it did not account for the 2.1 metre high bund wall around the methanol tank which will confine the fire. Fire fighting services will also be provided to keep adjacent tanks cool in the event of a fire.

Propagation off-site to other industrial facilities in adjacent occupied developments is considered to be negligible as the critical thermal radiation levels for structural damage will be restricted to within site boundaries, and the distance between the bunded area and adjacent facilities is significant compared to the extent of thermal radiation impacts.

8.2.2 Propagation Due to Explosion

As discussed in **Section 8.2.3**, the likelihood of explosion at the proposed development is considered to be highly unlikely. Therefore it is predicted that the risk of propagation due to explosion overpressure will be negligible and is considered to comply with the criteria outlined in **Table 7.2**.

8.2.3 Combustion Product Impacts

As discussed in **Sections 7.4.2** and **8.2.4**, the likelihood of combustion product impacts at the proposed development is considered to be highly unlikely. Therefore it is predicted that there will be negligible risk of propagation associated with combustion product impacts.

8.3 Aircraft Impact

As discussed in **Section 6.5**, risks associated with aircraft crashes are highly unlikely as the proposed development is not located under any flight paths. Prevention and mitigation measures will be put in place at the facility as per aviation standards to minimise the impact of any aircraft impacts on the site.

8.4 Cumulative Risk

The cumulative off-site risk from the facility is expected to be negligible due to the low risks associated with the off-site propagation of the potential hazardous events (refer to **Section 8.3**). The risks associated with these hazardous events will be mitigated by the implementation of the risk treatment techniques outlined in **Section 9.0**.

8.4.1 Kooragang Island Area Risk Assessment Study

The Kooragang Island industrial area was the subject of a comprehensive risk study by DUAP in 1992, which included a cumulative risk assessment of the industrial area. The study concluded that Kooragang Island offers substantial capacity to safely accommodate new industries involving significant quantities of hazardous materials. The area offers good isolation from residential areas and good transport safety and infrastructure.

Figure 24 of the DUAP Study (DUAP, 1992) depicts the cumulative risk contour of 1×10^{-6} per annum associated with Kooragang Island and surrounding industry. Since there are no significant off-site effects from the proposed facility, it is anticipated that there will be no increase in the cumulative impact associated with the development.

8.5 Risk to Biophysical Environment

The main concern for risk to the biophysical environment is generally with effects on whole systems or species populations. For the facility, the storage areas and plant are located within the site boundary and away from the off-site biophysical environment. The impacts of the hazardous events which have the potential to occur at the site are predicted to be relatively low and to be generally restricted to within the site boundary except for risks associated with an unoccupied section of the Hunter River adjacent to the site. The risks associated with storage of combustible C1 substances will be managed by ensuring segregation of C1 substances from flammables. There are not expected to be any toxicological or combustion product impacts associated with the potential hazardous events for the facility. The PHA has indicated that there are no hazardous events associated with the facility that would threaten a whole system or species population.

The facility, tanks and storage areas will be bunded to contain potential spills and site water runoff. The facility will be subject to regular maintenance and inspection procedures.

The site is part of a highly modified landscape associated with the existing and previous industrial land uses in the area. The facility is situated in close proximity to a sensitive natural environment, however the risks associated with this development are considered to be very low. The site does not support any threatened or endangered species or endangered ecological communities and there are many habitat areas for migratory waders located in the surrounding areas of Kooragang Island (refer to main text of the EA). Therefore it is considered that the consequences associated with the facility will not threaten the long-term viability of the ecosystem or any species within it and the likelihood of these consequences is not significantly greater than background risk levels.

Therefore it is considered that the risk to the biophysical environment will be acceptable.

8.6 Transport Risk Analysis

A traffic assessment was undertaken by Christopher Stapleton Consulting Pty Ltd (Christopher Stapleton Consulting) to provide an assessment of the traffic and transportation issues associated with the construction and operational phases of the facility. This involved an assessment of the existing and future operation of the local traffic network (Christopher Stapleton Consulting Pty Ltd, 2007) and is included in the EA.

8.6.1 Potential Road Transport Hazardous Events

The hazardous materials to be transported to and from the facility are outlined in **Table 4.3**. The properties of these hazardous materials are described in **Section 6.3.1**.

The potential hazardous events that could occur whilst transporting hazardous materials are outlined in **Appendix B**. Also outlined in **Appendix B** are the safeguards to be implemented to prevent and mitigate any hazards associated with the transport of these materials.

Of the identified incidents in **Appendix B**, the prevention and protection measures proposed are typical for this type of hazardous material transport and no further safeguarding is deemed necessary for the proposed facility. Therefore there are no identified unacceptable risks associated with the transport of materials to or from the facility.

The full details of the transport assessment are provided in the EA.

9.0 Risk Management

The control of risks is a continuous process where strategies are put into place to eliminate risks wherever possible, mitigate the residual risks identified using appropriate control measures, safeguards and procedures, and, lastly, accept the residual risk and manage the impacts should the hazardous event occur. The risk control strategies and their effectiveness are broadly described as:

- engineering control to either completely eliminate the risk (100 per cent effectiveness) or to implement physical controls and safeguards (minimum 90 per cent effectiveness);
- administrative control based around procedures (maximum 50 per cent effectiveness); and
- personnel control using training and the control of work methods (maximum 30 per cent effectiveness).

The qualitative risk assessment identified a range of technical control measures and non-technical safeguards and procedures that will be put in place to eliminate or mitigate the level of risk associated with the operation of the facility (refer to **Appendix B**).

Technical safeguards are those controls that are incorporated into the process or control system hardware, software, or firmware. Non-technical controls are management and operational controls, such as security policies, operational procedures, maintenance procedures and training. Technical and non-technical safeguards can also be divided into preventive controls which inhibit or prevent hazardous events from occurring and detective controls such as control system alarms that warn of unacceptable process deviations, or security monitoring systems that initiate an alarm in the event of violations of security protocols.

The technical control measures identified in **Appendix B** include:

- design of tanks, plant, bunding and piping in accordance relevant standards and codes;
- design of surface drainage systems to prevent contamination of surrounding waterways;
- equipment selected for respective hazardous area classification to control ignition sources;
- provision of emergency isolation valves, shut down system and backflow prevention devices;
- reversion of valves, process equipment and control systems to fail safe positions;
- auto shutdown of plant on high temperatures or pressures;
- install tank level device(s) as appropriate and provision of high level alarms;
- physical barriers including bunding and bollards;
- ensuring biodiesel and methanol is stored at suitable conditions to prevent fires and explosions, including venting, internal floating roof on storage tanks and nitrogen blanketing of the methanol process tank in the biodiesel facility;

- control of ignition sources;
- storage of dangerous goods in dangerous goods compliant stores;
- inlet and outlet flow monitoring during ship transfers;
- implementation of leak detention system;
- provision of pump deadhead instrumented protection and recycle lines;
- provision of flame arrestors on vent systems;
- installation of oil/water separators to remove contamination prior to discharge;
- provision of fire detection system and fire suppression including fire water ring main, cooling water system and foam deluge fire fighting system; and
- use of internal floating roofs in the tanks to ensure minimal vapour build up.

The non-technical safeguards and procedures identified in **Appendix B** include:

- conducting HAZOPs of process designs, site layout and design changes;
- equipment and plant inspection and maintenance procedures;
- operating procedures, including manual tank transfers, and training;
- cessation of operations in adverse weather conditions;
- operator monitoring of control conditions such as inlet and outlet flow monitoring during ship transfers, leak detection systems and;
- Hot Work/Safe Work Procedure;
- implementation of site speed limit and driver training;
- provision of security measures include fencing, CCTV, intruder beams, security patrols, operator/driver vigilance.
- development of spill response procedures and management plan;
- provision of PPE and safety shower/eye wash;
- appropriate training a supervision of operations;
- provision of on-water pollution response equipment and plan;
- ensure no flammable class 3 liquids are stored in the same bund area as the combustible C1 substances;
- preparation of a Fire Safety Study in accordance with HIPAP 2;
- preparation of an Emergency Response Plan in accordance with HIPAP 1 that coordinates onsite activities and defers authority to the Local Emergency Operations Controller once external support is sort is response to the emergency. The Local

Emergency Operations Controller is the position as defined in the *Newcastle Disaster Plan Newcastle City Council 2005*;

- procedures are in place for the storage and handling of dangerous goods; and
- management procedure for contaminated soil in accordance with Orica's Management Plan.

The safeguards proposed for the hazardous events involving explosion are outlined in **Section 7.4.3**. The safeguards proposed for the hazards associated with potential methanol fires include:

- conducting a HAZOP of the process design to minimise the potential for the loss of containment of methanol on site;
- the design, inspection and maintenance of the facility to ensure that infrastructure is fully secure and operational;
- access to foam fire fighting systems to control and mitigate any fires encountered; and
- control of ignition sources.

10.0 Conclusion and Recommendations

The preparation of a PHA for the facility was undertaken in response to the DGRs issued by the DoP on 22 May 2007. This policy requires that the risks arising from a potentially hazardous development be identified and assessed against criteria presented in *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992).

It includes a preliminary screening assessment as described in *State Environmental Planning Policy No 33 – Hazardous and Offensive Development* (SEPP33). SEPP 33, which indicates that the proposed development is potentially hazardous with respect to the storage of class 3 PG II substances, the number of deliveries of class 8 substances and the size of the deliveries of class 3 and class 8 substances. The development will also require an Environmental Protection Licence from DECC as the development is considered to be potentially offensive.

The risk classification and prioritisation process, as described in DoP's MLRA (DUAP, 1992), indicates that there are potential off-site effects related to the storage of dangerous goods and the societal risk is considered to be significant to warrant further investigation. The use of a Level 2 (partial quantification) risk assessment is regarded as appropriate for the proposed facility.

A hazard identification session identified a number of credible hazard scenarios with potential off-site consequences involving flammable liquids and vapours. The significant scenarios identified by the hazard identification session and/or the risk classification and prioritisation technique have then been assessed in a Level 2 semi-quantitative analysis.

The most significant hazardous event scenario is a pool fire associated with methanol storage. The Level 2 assessment indicated that in the event of pool fire the critical thermal radiation levels will be retained on-site. Specifically, the assessment found that the thermal radiation criterion for residential land use of 4.7 kW/m^2 is expected to be retained within 30 metres the base of the flame, approximately 4 metres within the site and from the boundary with the nearest neighbour. The thermal radiation level at the site's boundary with the Hunter River was found to be approximately 9.2 kW/m^2. It is considered that the resulting impact of a confined bund fire on an unoccupied area is not significant as the fire will be confined by a 2.1 metre high bund wall. The other credible hazardous event scenarios of explosion associated with methanol storage was considered and determined to be negligible.

In both cases, the risk of any significant off-site impacts is considered to be low and therefore complies with the acceptable injury and fatality risk criteria from *HIPAP No. 4 – Risk Criteria for Land Use Safety Planning* (DUAP, 1992), for adjacent industrial and residential land uses. It is therefore considered that the proposed development is not hazardous with regard to surrounding land uses and the risk of propagation and cumulative impacts regarding surround land uses is considered to be low.

The Level 2 assessment assumed that combustible C1 substances will be stored in separate bunds from the flammable liquids. The combustible substances are not considered hazardous if they are not stored with class 3 substances.

The assessment also found that the proposal would not restrict any existing wharf activities i.e. the concurrent handling of diesel and ammonia nitrate at adjacent berths.

Recommendations

It is recommended that a HAZOP be conducted on the proposed facility prior to construction to review the hazards, controls and associated risks in greater detail.

It is also recommended that a Safety Management System be implemented to ensure that hazards associated with the site are identified and managed, so that all activities are undertaken in a safe manner. This management system should include a spill management program, driver training program and monitoring and maintenance programs associated with all essential infrastructure and equipment.

Further recommendations include:

- undertaking commissioning checks on the adequacy of the control system;
- design of instrumentation and electrical systems to AS 2430 for hazardous areas;
- provision of suitable electrically rated equipment for hazardous areas;
- development of a site Emergency Response Plan; and
- design of a retention system for the control of fire water.

11.0 Glossary and Abbreviations

Term	Meaning
ALARP	as low as reasonably practicable
AS	Australian Standard
Audit	the process used to confirm compliance with practices and procedures used for the control of risk. Audit is critical when potentially high risks are controlled by procedures
Bund	an impervious barrier used to ensure that any spillage is retained within the barrier
Class	the classification number assigned to a dangerous good to indicate its most significant type of risk
Consequence	the outcome of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with an event
DECC	Department of Environment and Climate Change
DG	Dangerous Goods
DIPNR	Department of Infrastructure, Planning and Natural Resources
DoP	Department of Planning
DUAP	Department of Urban Affairs and Planning (now DoP)
EA	Environmental Assessment
Emergency Plan	a detailed, documented plan that seeks to minimise the impact of the occurrence of a specific risk event
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
Hazard	the potential or possibility for harm to occur
Hazardous Materials	substances falling within the classification of the Australian Code for Transportation of Dangerous Goods by Road and Rail (Dangerous Goods Code)
HAZOP	hazard and operability study
HIPAP	Hazardous Industry Planning Advisory Paper
Intermediate	a partly processed substance formed during a manufacturing process which is neither unconverted raw material nor a finished product
ISO	International Standards Organisation
kL	kilo litres or thousands of litres, e.g. 3 kL is the same as 3,000 litres
LEL	lower explosion limit
Likelihood	a qualitative measure of probability or frequency

LPG	Liquefied Petroleum Gas as defined in Australian Standard AS1596
ML	megalitres or millions of litres, e.g. 5 ML is the same as 5 million litres
Monitor	to check, supervise, observe critically, or record the progress of an activity, action, or system on a regular basis in order to identify change
MSDS	Material Safety Data Sheet
PG	packing group
PHA	Preliminary Hazard Analysis
PPE	personnel protective equipment
ppm	parts per million
Residual Risk	the level of risk remaining after risk reduction measures have been applied
QRA	Quantitative Risk Analysis
Risk	the chance of something happening that will impact on objectives. It is measured in terms of consequence and likelihood
Risk Analysis	a systematic use of available information to determine how often specified events may occur and the magnitude of their consequences
Risk Assessment	the combination of risk identification, risk analysis and risk evaluation
Risk Evaluation	the process used to determine risk management priorities by comparing the level of risk against pre-determined standards, target risk levels or other criteria
Risk Identification	the process of determining what can happen, why and how
Risk Management	the culture, processes, and structures that are directed towards the effective management of potential opportunities and adverse effects
Risk Treatment	that part of risk management that involves the implementation of policies, standards, procedures and physical changes to eliminate or minimise adverse risks
SEPP	State Environmental Planning Policy
Subsidiary Risk	the classification number(s) indicating other significant types of risk(s) in addition to the primary classification of a substance

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APPENDIX A

Consequence and Probability Calculations

Appendix A – Consequence and Probability Calculations

Multi-level Risk Assessment Classification and Prioritisation

Estimation of Consequence of Major Accidents for Fixed Installations

Substance		Quantity		UN No.	Class	PG	Activity	Physical Harm	Ref. No.	Effect Category Table IV		Max. Dist. (m)	Effect area, A (ha)	Pop. Fraction (%)	Pop. Corr., fA	Mit. Factor, fM	External Consequences, Ca,s
S1	Methanol	380	tonnes	1170	3	II	Storage	Fire	1	A	I	25	0.2	5%	0.05	1	0
S2	Methanol	10	tonnes	1170	3	II	Storage	Explosion	3	A	I	25	0.2	5%	0.05	1	0
P1	Methanol	10	tonnes	1170	3	II	Plant	Fire	3	A	I	25	0.2	5%	0.05	1	0
P2	Methanol	10	tonnes	1170	3	II	Plant	Explosion	3	A	I	25	0.2	5%	0.05	1	0
T1	Methanol	24	tonnes	1170	3	II	Transport	Fire	6	B	II	50	0.4	5%	0.1	1	0
S3	Sulphuric Acid	7.4	tonnes	1830	8	II	Storage	Toxic	18	A	III	25	0.02	5%	1	0.05	0
T2	Sulphuric Acid	4	tonnes	1830	8	II	Transport	Toxic	19	A	II	25	0.1	5%	0.1	0.05	0
S4	Potassium hydroxide	16	tonnes	1813	8	II	Storage	Toxic	18	A	III	25	0.02	5%	1	0.05	0

Estimation of Probabilities of Major Accidents for Fixed Installations

Substance		Ref. No.	Activity	Average Probability Number N*i,S	Table XI Flammables Correction Factor, nf	Table XII Safety Correction Factor, no	Table X Loading Frequency / year		Corr. Factor, nl	Effect Area Cat.	Pop. Fraction (%)	Corr. Factor, np	Probability Number Ni,s	Frequency (P) (event / year)
S1	Methanol	1	Storage	8	0.5	0	c	50-200	-1	I	5%	0	7.5	3 x E-08
S2	Methanol	3	Storage	8	0	0.5	b	10-50	0	I	5%	0	8.5	3 x E-09
P1	Methanol	3	Plant	7	0.5	0	b	10-50	0	I	5%	0	7.5	3 x E-08
P2	Methanol	3	Plant	7	0	0.5	a	1-10	0.5	I	5%	0	8	1 x E-08
T1	Methanol	6	Transport	6	0	0	c	50-200	-1	II	5%	0.5	5.5	3 x E-06
S3	Sulphuric Acid	18	Storage	5	0	0	b	10-50	0	III	5%	1.5	6.5	3 x E-07
T2	Sulphuric Acid	19	Transport	4	0	0	b	10-50	0	II	5%	0.5	4.5	3 x E-05
S4	Potassium hydroxide	18	Storage	5	0	0	d	200-500	-1.5	III	5%	1.5	5	1 x E-05

Fixed Variables	Population Density, d (pp/ha)	30

Assumptions	Assume industry practice as average Assume worst flammables factor

Estimation of IAEA F-N Curve

	Substance	Ca,s	P	Ca,s	P	F
S1	Methanol	0.30	3E-08	1.20	3E-06	4E-05
S2	Methanol	0.30	3E-09	0.30	3E-08	4E-05
P1	Methanol	0.30	3E-08	0.30	3E-09	4E-05
P2	Methanol	0.30	1E-08	0.30	3E-08	4E-05
T1	Methanol	1.20	3E-06	0.30	1E-08	4E-05
S3	Sulphuric Acid	0.03	3E-07	0.03	3E-07	4E-05
T2	Sulphuric Acid	0.02	3E-05	0.03	1E-05	4E-05
S4	Potassium hydroxide	0.03	1E-05	0.02	3E-05	3E-05

Probabilities Calculations

Pool Fire Modelling Results - Ethanol Tank

Maximum Pool Fire Diameter (m)	16.5
Flux Q (kW)	8.6E+04
Closest Distance to Boundary (m)	34.0

Pool Fire Radius (m)	Extent of Pool Fire Diameter outside Bunded Area (m)	Heat Intensity (kW/m^2)	Criteria kW/m^2
17.25	9	22.99	23
23.25	15	12.65	12.6
27.25*	19	9.21	-
38.25	30	4.68	**4.7**
42.25**	34	3.83	-
56.75	48.5	2.12	**2.1**
75.25	67	1.21	**1.2**

*Distance to boundary adjacent to unoccupied Hunter River
** Distance to boundary adjacent to nearest industrial area

APPENDIX B

Hazard Identification Study

Appendix B – Hazard Identification Study

Plant: **Manildra Park – Kooragang Island Facility** **Date:** 09.07.2007

Drawing No: **Facility Layout**

Description: **Bulk Storage of C1 Combustible Liquids**

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Fire in storage tank	Construction or maintenance activities Hot work Lightning Electrical spark	Fire in combustible liquid storage tanks or bund	Tank spacing to AS 1940 Tanks fitted with internal floating roof Atmospheric venting to prevent build-up of flammable gas Tanks fitted with foam fire fighting systems Tanks fitted with cooling water system in the event of a fire Fire water ring main in accordance with the Building Code of Australia Equipment to suit respective hazardous area classification	4	E	10	Ensure procedure is in place for the control of Hot Work Ensure no flammable class 3 liquids are stored in the same bund area as the C1/C2 combustible liquids

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Loss of containment of combustible or corrosive material	Spillage from pipework or pumps Rupture of pipeline or hose Failure of tank Tank overfilled during transfer Tank drain valve left open or tank sampling valve left open Loss of containment at pigging stations	Contamination of groundwater Spill into bund Bund fire if flammable or combustible material ignited Possible tank fire and boil over Impact to people (radiant heat and/or exposure to products), property and the environment (products of combustion and corrosive materials)	Bund lined with impervious material Leak detention under each tank Bund capacity in excess of AS 1940 Fire fighting as above Tank level device(s) installed as appropriate Emergency shutdown system Operating procedures for manual tank transfers PPE and safety shower/eyewash	3	D	9	Ensure procedures are in place to check condition of bund liner, tanks and leakage monitoring system
Flooding	High rainfall Blockage of stormwater system	Excess water in bunded area Contaminated stormwater	Bund capacity designed to handle excess water even if a major spill occurs at the same time (design as per AS 1940) Oil/water separator to remove any oil contamination prior to discharge off site	1	B	7	Individual oil/water separators for combustible and flammable bund areas

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Unauthorised access by person(s)	Tank farm unattended Unauthorised access by tanker drivers Unauthorised access by public	Injury to driver/person	Drivers not required to access tank farm Tank farm fenced separately from the truck loading/ unloading area Close-circuit TV coverage Security patrol Man-proof fencing Security lighting Access to truck loading areas via security card when terminal unmanned	3	D	9	Ensure clear signage is provided Ensure non-manned areas are secure
Power outage	Thunderstorm	Loss of control	All valves, process equipment and control systems will revert to fail safe positions	1	B	7	Conduct HAZOP of process design
Uncontrolled event	Activity not covered by standard procedures	Excavations damage the bund liner Hot work leading to fire	Hot Work/Safe Work Procedure Unlikely to coincide with spillage	4	E	10	Ensure procedure is in place

Plant: **Manildra Park – Kooragang Island Facility** **Date:** 09.07.2007

Drawing No: **Facility Layout**

Description: **DG Storage for Biodiesel Plant**

Hazardous Event	**Possible Cause**	**Potential Consequence**	**Prevention and Mitigation**	**S**	**P**	**R**	**Additional Measures**
Loss of containment of methanol	Spillage from pipework or pumps Rupture of pipeline or hose Faulty high level protection Tank overflow	Ground water contamination	Bunded in accordance with AS 1940 Tanks fitted with foam fire fighting systems High level alarms (visual and audible) Equipment to suit respective hazardous area classification	3	D	9	Location of tank to be within guidelines with respect to distance to boundary and accessibility
Fires from spills	Spillage from pipework or pumps Rupture of pipeline or hose Faulty high level protection Tank overflow	Fire Toxic products of combustion	Tanks are contained within the bunded areas Bunded in accordance with AS 1940 Tanks fitted with foam fire fighting systems Equipment inspection and maintenance procedures Operating procedures and training Fire water ring main in accordance with the Building Code of Australia Equipment to suit respective hazardous area classification to control ignition sources	4	D	14	Location of tank to be within guidelines with respect to distance to boundary and accessibility Ensure procedure is in place for the control of Hot Work Conduct HAZOP of process design

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Loss of containment of KOH	Damage to bag(s) Water ingress to store	Environmental spill Ground water contamination	Stored as solids in dangerous goods compliant store	3	E	6	Ensure procedures are in place for the storage and handling of dangerous goods
Loss of containment of Sulphuric Acid	Spillage from pipework or pumps Rupture of pipeline or hose Failure of container	Environmental spill Groundwater contamination	Stored in dangerous goods compliant store Delivered in 1000L containers	3	E	6	Ensure procedures are in place for the storage and handling of dangerous goods

Plant: **Manildra Park – Kooragang Island Facility** **Date:** 09.07.2007

Drawing No: **Facility Layout**

Description: **Biodiesel Plant**

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Major loss of containment of liquids	Loss of process control Over pressure of system component Rupture of tank, vessel or pipework	Spillage to ground escaping to the stormwater system and the river	Concrete slab fall and drainage directed away from the river. Surrounding ground graded to prevent stormwater from entering the ground floor of the plant Biodiesel plant fully supervised while operating All valves, process equipment and control systems will revert to fail safe positions	4	D	14	Conduct HAZOP of process design Regular maintenance and inspection procedures Storage capacity of ground floor bunded area reviewed during detailed design

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Major mechanical failure of tank	Metal fatigue Faulty fabrication Corrosion of tank base/weld Tank explosion due to lightning strike/breach of hazardous area ignition source controls Adjacent tank on fire Blocked vent	Large spillage of flammable, combustible or corrosive materials in bund. Fire if flammable or combustible materials ignited Explosion leading to destruction of the tank Impact to people (radiant heat and/or exposure to products), property and the environment	Tank and site fire protection facilities available Ensure that tank contents at steady state conditions so combustible materials tank ullage is below Lower Explosive Limit (LEL). Ensure design conforms to AS 1940 requirements Methanol tanks have internal floating roofs and methanol process tank to include nitrogen blanket Tanks bunded PPE and safety shower/eyewash	4	E	10	Regular maintenance and inspection procedures
Minor loss of containment of liquids	Minor damage/failure of system component Pump/flange leakage	Spillage to ground Fire if flammable or combustible materials ignited	Ground floor consists of a concrete slab with drainage to collection wells Collection wells pumped to an oil/water separator Oil/water separator sized to handle spillage rate Provision of fire fighting system	2	D	5	Ensure oil/water separator suitable for class 3 flammable liquids and that it does not return the oil component back to the combustible bulk storage tank farm

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Pipe failure	Corrosion	Major spillage of flammable, combustible or corrosive material	Provision of emergency isolation valves Provision of fire fighting system (including foam) The piping is designed relevant standards	3	D	9	Regular maintenance and inspection procedures
Fire in plant	Spillage of material flammable material Venting of flammable vapours Ignition source from hot work, electrical fault or over temperature	Fire	Routine inspection of plant Auto shutdown of plant on high temperature or pressure Nitrogen blanketing of process tanks and vessels to minimise generation of flammable vapours Plant fitted with foam deluge fire fighting system Plant built in accordance with the Building Code of Australia Equipment to suit respective hazardous area classification	4	D	14	Conduct HAZOP of process design Ensure emergency shutdown features are included in the process control system Ensure all operators are appropriately trained
Pump fire	Pumps being deadheaded or seal failures	Localised fire at pump	Pump deadhead instrumented protection and recycle lines Preventative maintenance for pumps Fire protection systems available on the site	3	D	9	Conduct HAZOP of process design Ensure emergency shutdown features are included in the process control system Ensure all operators are appropriately trained

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Contaminated fire water	Fire in plant initiating fire fighting system	Contaminated water draining to the river via the surrounding stormwater system	Concrete slab fall and drainage directed away from the river.	4	E	14	Review layout and sizing of ground floor drainage capacity and how excess water would interact with the stormwater system Storage capacity of ground floor bunded area reviewed during detailed design
Fire/explosion	Spillage of potassium methoxide (potassium methanolate) allowed to crystallize	As a solid the intermediate material in biodiesel manufacture, potassium methoxide, is a strong oxidizing agent and could self ignite under the right conditions	Spill response procedure Biodiesel plant fully supervised while operating Routine inspection of plant Containment of potassium methoxide within the process	3	D	9	Ensure all operators are appropriately trained and are aware of hazards associated with spills

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Failure of vapour recovery system	Contamination with feed stock with highly volatile material overloading vapour recovery system Control system failure Cooling water failure on condenser Over temperature of the process units Exhaust air washing column failure Low water flow or loss of water flow	Air emissions greater than predicted for the plant	Plant specifically designed for methanol recovery Nitrogen blanketing of process tanks and vessels to minimise vapour generation rate Batch process limits continued occurrence of hazardous event Biodiesel plant fully supervised while operating All valves, process equipment and control systems will revert to fail safe positions Flame arrestor on vent system Process control of steam generation and distribution Flow measurement, water pump running status	3	D	9	Conduct HAZOP of process design

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Overpressure in the process equipment and vent system	Vent line blocked High temperature	Piping system failure resulting in a loss of containment. Fire, if ignited	Ensure operating procedures for valves positions are in place High level protection in tanks High temperature protection Pressure protection Process area bunded Control of ignition sources Fire protection systems available on the site	3	D	9	Conduct HAZOP of process design Ensure spill response procedures in place
Operator exposure to potassium methoxide	Loss of containment of potassium methoxide	Exposure to potassium methoxide will cause nerve cell damage before pain is detected	Spill response procedure Biodiesel plant fully supervised while operating Routine inspection of plant Containment of potassium methoxide within the process	4	D	14	Ensure all operators are appropriately trained and are aware of hazards associated with spills Provision of personnel protective equipment (PPE)
Loss of containment of cooling tower or boiler dosing chemicals	Spills and leaks	Soil and ground water contamination	Chemicals in bunded building in accordance with AS 1940 Small inventory of chemicals	2	D	5	Regular maintenance and inspection procedures

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Contamination of oil tanks with methanol	Contamination from incorrect filling	Risk of ignition due to flammable layer on top of the oil Explosion / fire	Pipeline cleaning procedures in place Inspection and testing of tank contents Back flow prevention devices fitted	4	E	10	Operator training and procedures Review separation of systems

Plant: **Manildra Park – Kooragang Island Facility** **Date:** 09.07.2007

Drawing No: **Facility Layout**

Description: **Unloading Combustible Liquids from Ships**

Hazardous Event	**Possible Cause**	**Potential Consequence**	**Prevention and Mitigation**	**S**	**P**	**R**	**Additional Measures**
Pipeline failure external to the terminal, i.e. in the pipeline corridor	Corrosion Mechanical damage	Environmental spill Fire Soil and ground water contamination	Kooragang Island berths are under the control of Newcastle Ports Corporation procedures Regular maintenance and inspection procedures Emergency isolation valves Routine inspections during transfers Flow monitoring system at both ends of pipeline System 'pigged' out after use	4	D	14	Conduct HAZOP of process design Ensure spill response procedures in place Regular maintenance and inspection procedures Ensure all operators are appropriately trained and are aware of hazards associated with spills
Spillage during ship unloading	Spillage from 16 inch diameter pipe during ship unloading	Environmental spill Fire Water contamination	Transfer lines will be pigged prior to disconnection/ uncoupling All transfers will be supervised Pipes fitted with spill trays located under flanges on the wharf Double flow meter monitoring will be undertaken during transfers	4	D	14	Conduct HAZOP of process design Ensure spill response procedures in place Regular maintenance and inspection procedures Ensure all operators are appropriately trained and are aware of hazards associated with spills

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Spillage during ship unloading	Handling of ammonium nitrate on adjacent wharf Fuel spillage mixing with ammonium nitrate	Explosion	Ammonium nitrate not handled on the same berth at the same time as the fuel unloading process Physical separation of K2/K3 berths and access roads All transfers will be supervised	4	E	10	Ensure that the operational procedures recognise that the handling of other potentially hazardous materials in the vicinity of the fuel unloading process needs to be adequately managed to eliminate the opportunity for the cross contamination of materials Ensure spill response procedures in place Ensure all operators are appropriately trained and are aware of hazards associated with spills

Plant: **Manildra Park – Kooragang Island Facility** **Date:** 09.07.2007

Drawing No: **Facility Layout**

Description: **Transport - Road**

Hazardous Event	**Possible Cause**	**Potential Consequence**	**Prevention and Mitigation**	**S**	**P**	**R**	**Additional Measures**
Loss of containment (during road tanker transfer)	Accident event Failure of internal valves Open external valve and cap Failure of flexible connection/hose Leak from valves or fittings Road tanker overfill	Leak of material in road tanker bay Fire if flammable or combustible materials ignited	Loading area bunded Licenced operators Drivers have Dangerous Goods licences Trucks fitted with multiple level safety system Use of leak detection & shutdown systems Ignition sources controlled	2	C	8	Driver awareness and training Ensure procedures are in place to check condition of tanks, hoses, tank overflow and leakage monitoring system
Road tanker drive-away incident	Failure of procedures and hardware interlocks	Leak of material in road tanker bay Fire if flammable or combustible materials ignited	Driver training Loading area bunded Trucks fitted with multiple level safety system Site drains to the oil water separator PPE and safety shower/eyewash	2	C	8	Driver awareness and training Ensure procedures are in place to check hoses are disconnected and truck safety systems are operational
Road accident	Bad road or traffic conditions Driver error	Most likely outcome is no loss of load Leak of flammable or combustible material may occur, leading to fire or environment incident	Design of road tankers to survive accident without a loss of containment Driver training and choice of routes to reduce accident potential	2	C	8	Driver awareness and training Route selection

Plant: **Manildra Park – Kooragang Island Facility** **Date:** 09.07.2007

Drawing No: **Facility Layout**

Description: **Transport – Barge**

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Loss of containment of combustible liquids when filling the barge	Spillage from pipeline or hose to barge Rupture of pipeline or hose to barge	Spill to land/water Fire Water contamination	Only transferring C1 Combustible Liquids, as proved by NATA testing to ensure flash point is not above 61 degrees C On-board fire-fighting system Barge is double hulled/skinned with minor spillage going to a slops tank Multiple tanks on the barge to minimise potential loss of product Barge acts as a bund with the capacity designed to handle volume required	4	D	14	Ensure barge is seaworthy Operator awareness and training Ensure procedures are in place to check hoses conditions Ensure that there is an adequate loading procedure Spill response and containment equipment on standby
Minor spillage during ship refuelling	Spillage from 4 or 6 inch diameter pipe during ship refuelling	Spill to water Fire Water contamination	All transfers will be supervised Double flow metre monitoring will be undertaken during transfers Flow monitoring will also be undertaken by ship and barge while transfers are taking place	1	C	4	Operator awareness and training Spill response and containment equipment on standby

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Loss of containment while barge ship refuelling ship	Hose damage/ failure Failure of mooring lines Corrosion or mechanical failure Human error Terrorist event Weather event Passing ship collision	Loss of containment of combustible material. Spill to water Injury to personnel. Damage to berth and/or ship Fire Water contamination	All transfers will be supervised Spills would be captured within ship deck or barge scuppers will be blocked to contain spills to the deck Barge or ship would act as a bund with material being held on the deck Provision of on-water pollution response equipment and plan for operators held on the barge Hoses are inspected and routinely tested	4	D	14	Conduct HAZOP of process design Ensure spill response procedures in place Regular maintenance and inspection procedures Operator awareness and training Ensure procedures are in place to check all hose and pipe conditions

Plant: Manildra Park – Kooragang Island Facility **Date:** 09.07.2007

Drawing No: Facility Layout

Description: Manildra Park Site – All Plant Areas

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Accidents, vehicle damage resulting in spillage	Reckless driving, illegal driving, impact with other mobile equipment Inadequate training, inattention/distraction	Injuries to people, loss of containment of materials	Site speed limit Physical barriers, e.g. bunding and bollards Driver training Pedestrian walkways identified Drug and alcohol policy	3	D	9	
Breach of security/ sabotage	Disgruntled employee or intruder	Injuries to people, loss of containment of materials	Security measures include fencing, CCTV, intruder beams, security patrols, operator/driver vigilance Process SCADA computer alarms monitored Security access	3	D	9	
Aircraft crash	Pilot error Bad weather Plane fault	Fire propagation to tank/bund and/or process plant Environmental release	As per aviation standards	5	E	15	Unlikely event as plant is not locate near any flight paths

Hazardous Event	Possible Cause	Potential Consequence	Prevention and Mitigation	S	P	R	Additional Measures
Strong winds or earthquakes	Environmental conditions lead to plant or equipment failure	Loss of containment leading to a fire if ignited	Tanks and process equipment designed to relevant standards Structures designed to relevant codes for wind and earthquake Operations stopped in adverse weather conditions	4	E	10	Ensure all designs meet relevant codes of practice
Exposure of contaminated lands/ waters	Excavation of trench for pipeline	Contact with contaminated groundwater	Adopt recommendations as per Orica EMP for contaminated plume area	2	B	12	Management procedure for contaminated soil in accordance with Orica's Management Plan
Disturbance of contaminated soils	Site work disturbs underlying acid sulphate soils	Exposure of acid sulphate soils Contamination of surface water and groundwater	Investigation into the depth of construction for the C1 bund sump Excavation works restricted to above the groundwater table (where possible)	2	B	12	Management outcome plan Investigation into the depth of construction for the C1 bund sump