

Condensate Processing Facility East Arm, Darwin

NOTICE OF INTENT

- Final for issue
- 7 February 2006



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1. Introduction

1.1 This Document

This Notice of Intent (NOI) is submitted to the Northern Territory Government by Sinclair Knight Merz Pty Ltd on behalf of the proponent, Darwin Clean Fuels Pty Ltd, as the initial notification of a proposal to construct and operate a facility at East Arm to process petroleum condensate, and produce petroleum products principally for export and also for sale to the local Darwin market

This NOI is submitted in accordance with the NT *Environmental Assessment Act 1982* and the *Environmental Assessment Administrative Procedures 1984* (including subsequent amendments).

1.2 Project Summary

The proposed project involves the establishment and operation of a Condensate Processing Facility (CPF) at a site in the Darwin Business Park at East Arm (see **Figure 1**), to process approximately 40,000 to 60,000 barrels per day (bpd), or approximately 1.6 to 2.4 million tonnes per annum (tpa), of condensate. The CPF will produce a range of products, principally unleaded petrol, diesel and kerosene/jet fuel, as well as off-gas that will be used to power a 25 to 40MW power station on-site, with 21MW to 32MW surplus to be sold to other industries or the Power and Water Corporation. Much of the unleaded petrol produced will be transferred to tankers and exported to markets in the West Coast of the USA, Asia and Australian East Coast, while all of the diesel, kerosene, jetfuel and residual oil, together with some unleaded petrol, are intended for local markets.

It is anticipated that the condensate would be sourced principally from the Bayu Undan field in the Timor Sea and North West Shelf off Western Australia, however alternative feedstock may include condensate from the Middle East or other areas. Minor inputs of low sulphur light crude, sourced from various locations, may be required for blending in order to meet product specifications. The feedstocks would be transported to East Arm via tankers, unloaded at the existing bulk liquids wharf and discharged through pipelines leading to the Vopak fuel terminal. The condensate would then be directed to bulk storage facilities located at the CPF site.

1.3 Proponent Details

The proponent for the project is Darwin Clean Fuels Pty Ltd. Contact details are as follows:

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Sinclair Knight Merz Pty Ltd (SKM) was engaged by Darwin Clean Fuels to prepare this Notice of Intent. Contact details are as follows:

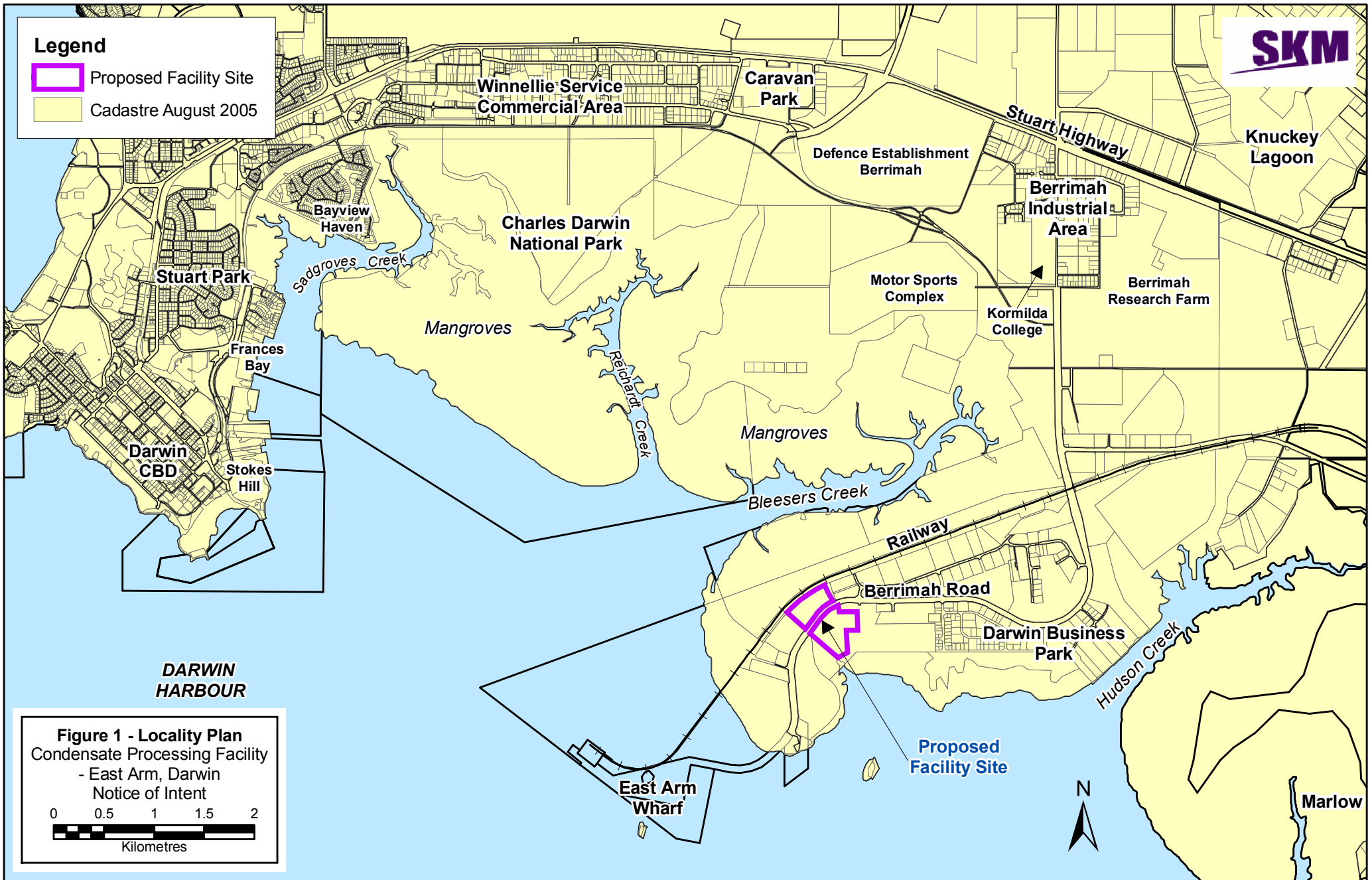
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1.4 Background to the Project

The proponent initiated contact within the Northern Territory Government in May 2004 to express interest in developing a condensate processing facility in Darwin. Upon a review of the available and planned industrial land in the Darwin region, it was determined that the Darwin Business Park in East Arm was the most suitable site, as the area had the necessary port facilities and key infrastructure in place, and is zoned for strategic, transport logistics, industrial fuel, gas-based and import and export-related industries.

In order to fully scope the potential environmental issues that could be faced by establishing the facility at East Arm, the proponent engaged Sinclair Knight Merz Pty Ltd to undertake an Environmental Scoping Study. The study (SKM, 2004) considered a wide range of environmental issues, including air emissions, marine spills, liquid and solid waste, storm water, noise, visual amenity and aviation safety, and concluded that there would be no environmental issues that would prevent construction and operation of the CPF at the East Arm site, and that any identified environmental impacts should be able to be managed to an acceptable level.

Following further consultation with the NT Government, the proponent has commenced the process for gaining legislative consents, which includes an approval under the NT *Environmental Assessment Act 1982*, for which this Notice of Intent has been prepared as a formal notification. The proponent will also be seeking a Development Permit under the NT *Planning Act 1999* (and subsequent amendments), and other approvals as required under legislation.





2. Description of the Proposal

2.1 Introduction

The proposed project involves the following elements:

- construction and operation of a Condensate Processing Facility at Darwin Business Park to produce transport fuels and petrochemical feedstocks;
- transport of feedstock and products;
- loading and unloading operations at the East Arm wharf; and
- possible local distribution of products via road tankers.

These elements are described in detail in the following subsections.

2.2 Condensate Processing Facility

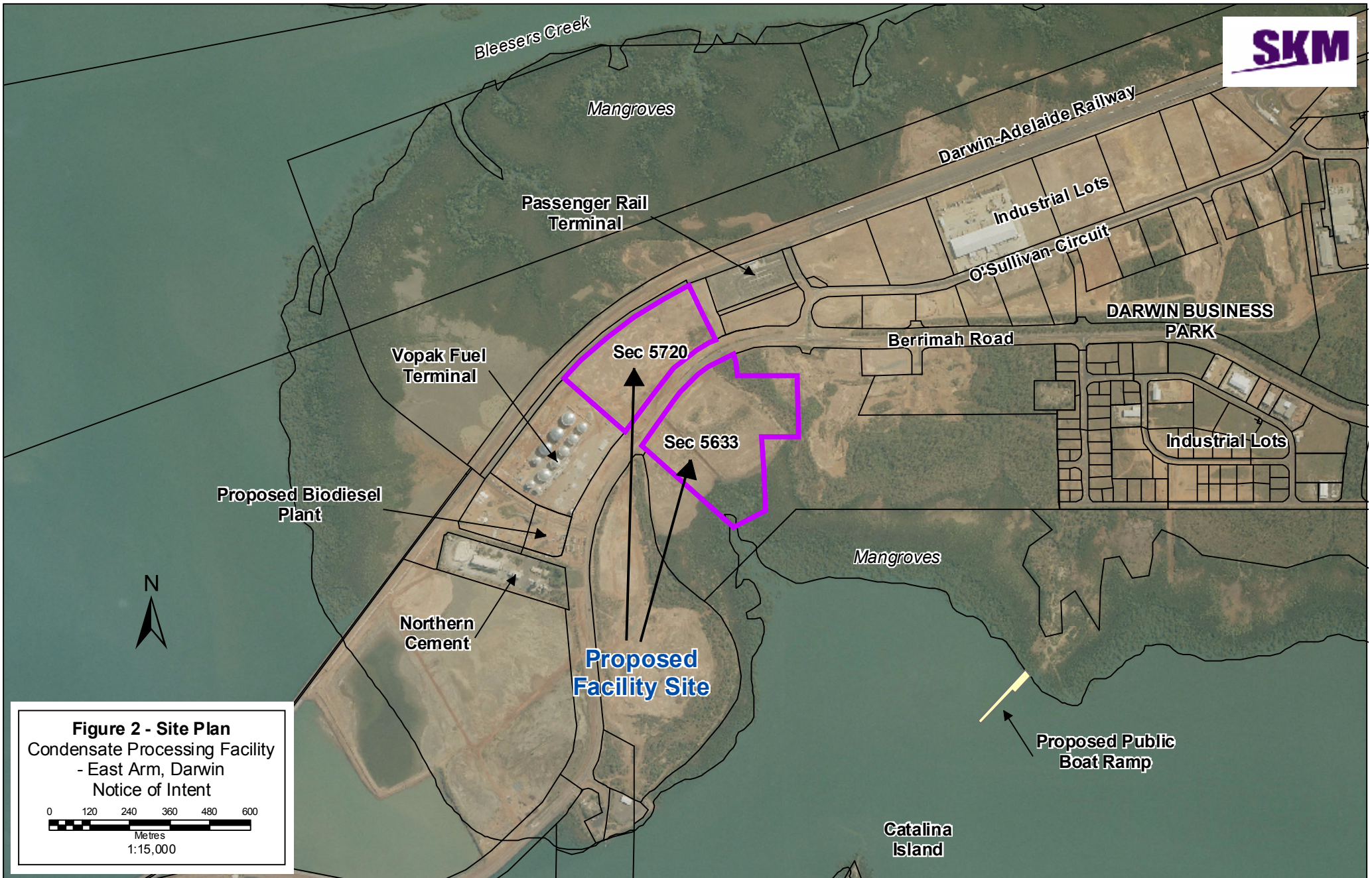
2.2.1 Facility Location

The CPF is proposed to be established upon Section 5720 (8.8ha) and part Section 5633 (13.7ha) along Berrimah Road in East Arm (**Figure 2**). Both land parcels have been cleared and reclaimed in anticipation of industrial development, however some further development may be required for part Section 5633 depending on the ultimate lot configuration.

It is anticipated that the processing facilities would require an area of approximately 5 hectares and the bulk storage facilities approximately 17 hectares, including feedstock, intermediate and finished product storage. It is proposed that Section 5720 would be used for bulk storage, with part Section 5633 used for processing facilities and additional storage. Pipelines would be constructed beneath Berrimah Road to convey condensate and product between the two land parcels.

The site and its vicinity are surrounded by mangroves, Darwin Harbour waters, the East Arm wharf and the Darwin Business Park industrial area. The Northern Cement milling and distribution facility, Vopak fuel terminal and proposed biodiesel plant all lie immediately west of the proposed site. The passenger terminal for the Darwin-Adelaide Railway is temporarily located within the Darwin Business Park, a few hundred metres to the north-east of the site.

The nearest residential premises are the residential quarters of Kormilda College, a private secondary school located along Berrimah Road, roughly 4.5km north-east of the site (**Figure 2**). The Shady Glen Caravan Park is located along Stuart Highway near the Coonawarra Naval Base, approximately 5km north of the site. The nearest residential suburbs are Bayview Haven, Frances Bay and Stokes Hill, located approximately 5.5km north-west to west of the site, whereas the nearest Palmerston suburbs (eg Marlow) are over 7km to the east.





The proposed location will therefore offer a buffer distance of between 4km and 5km from residential and commercial areas in the region.

2.2.2 Facility Description

The CPF will include the following facilities:

- Processing facility comprising
 - Condensate Distillation Unit
 - Recycling Isomerisation Units
 - Naphtha Continuous Catalytic Reformer
 - Heavy Naphtha Hydrotreater
 - Diesel Hydrotreater
 - Gas Treatment Plant, including Claus Sulphur Recovery Unit
- Process unit furnaces and relief flare
- Feedstock storage tanks
- Intermediate product storage tanks
- Product storage tanks
- 25 to 40MW gas power station
- Stormwater, process wastewater and sewage treatment systems (including storage facilities)
- Tanker/road train loading facilities for distribution of products to the local market
- Pipelines, pumps, valves, meters, electrical and mechanical components
- Buildings and associated infrastructure (sewer, water, electrical, telecommunications)

The CPF would comprise a number of large structures, the tallest of which would be the process vessels and furnace stacks, which could be between 20m and 40m in height. The bulk storage facilities would include feedstock storage tanks up to 20m high and 55m in diameter and product tanks as large as 15m high and 35m in diameter, as well as smaller tanks for minor and intermediate products.

2.3 Process Description

A simplified flow diagram of the condensate processing is shown in **Figure 3**. A description of the process is provided below.

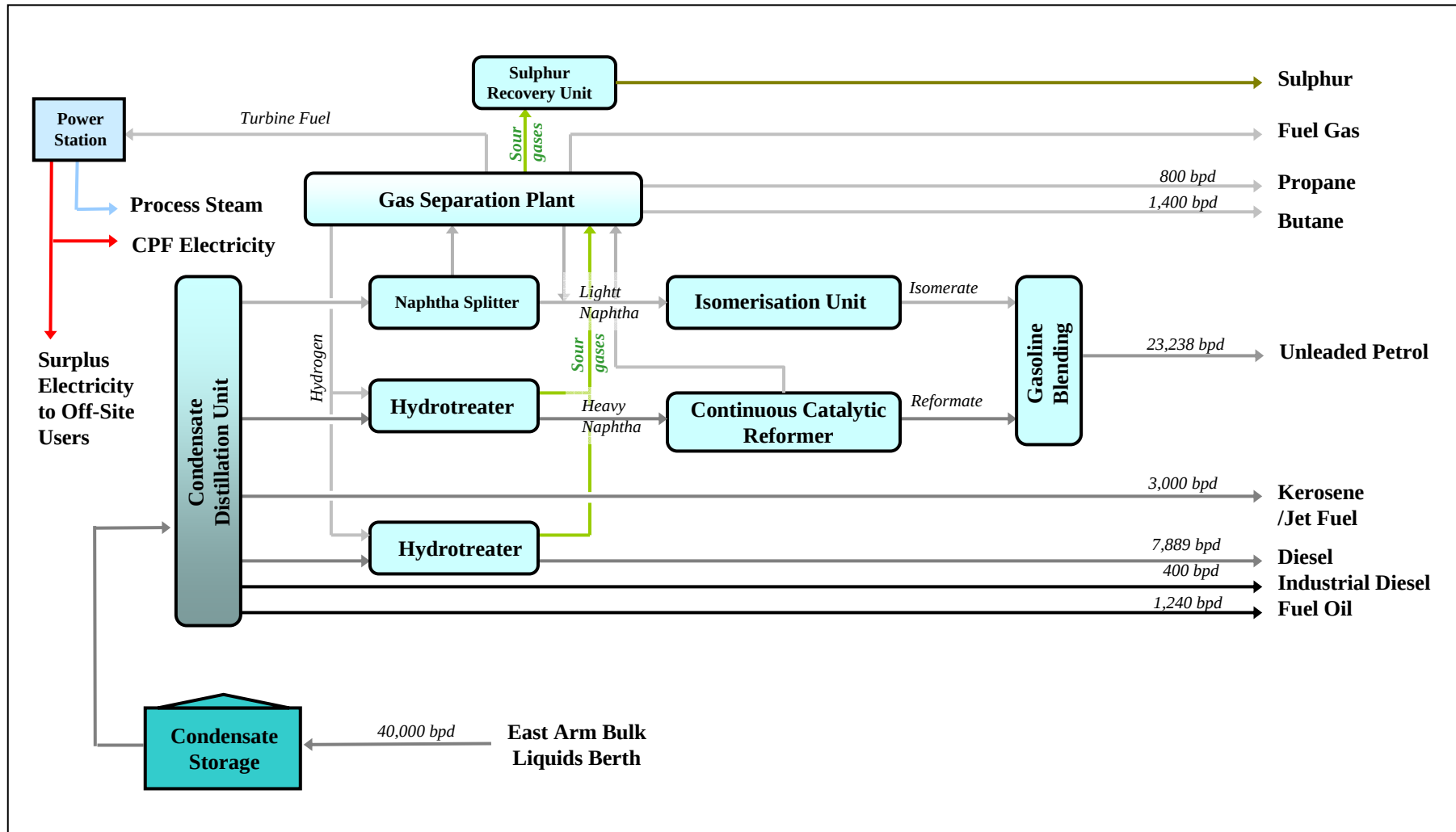


Figure 3 - Simplified Process Diagram

Condensate Processing Facility - East Arm, Darwin

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The incoming condensate feedstock will firstly be directed to a **Condensate Distillation Unit** (CDU), where the condensate will be heated to 400°C and the resulting vapour selectively condensed into different fractions, including light and heavy naphtha, kerosene, automotive diesel and atmospheric gas oil (industrial diesel). The little remaining liquid (residual oil) will accumulate at the bottom of the CDU tower.

The lighter overhead fractions will be directed to a **Naphtha Splitter** to separate the light naphtha and lighter gases from the heavier components. The lighter components from the Naphtha Splitter will be directed to a **Gas Plant** to separate out the lighter gases, such as propane and butane, with the remaining components directed back to the main light naphtha stream. The light naphtha stream will then be further processed at a **Recycling Isomerisation Unit** (RIU) to produce isomerate.

The heavier components from the Naphtha Splitter will be conveyed back to the main heavy naphtha stream, which will be directed to a **Heavy Naphtha Hydrotreater** (HNH) to remove sulphur prior to processing in a **Naphtha Continuous Catalytic Reformer** (NCCR). The NCCR will process the heavy naphtha to produce reformat. The HNH will also reduce the sulphur content of the naphtha in order to protect the NCCR catalyst from fouling.

Isomerate from the RIU and reformat from the NCCR will be directed to a **Gasoline Blending Unit**, which produces unleaded petrol, the principal product of the facility. Some of the butane will be used seasonally in the gasoline blending, as required to meet specifications for the unleaded petrol.

Minor quantities of low sulphur light crude may also be blended to ensure product specifications are met, however no processing of the heavier components (eg through catalytic cracking, visbreaking, coking or alkylation) will be undertaken.

The diesel produced through the CDU will be passed through a **Diesel Hydrotreater** to remove sulphur in order to meet Australian fuel specifications. The kerosene and residual oil streams will require minimal further treatment.

The CDU, NCCR, RIU and hydrotreaters will produce a significant amount of off-gas, which will be directed to the **Gas Plant**. The Gas Plant will separate out propane and butane, which will be liquefied for subsequent sale, with some of the butane used for gasoline blending. The balance of the gas, which is rich in hydrogen, will be used for heating and processing purposes at the CPF, as well as a fuel source for the on-site 25MW to 40MW power station.

The Gas Plant will also separate out hydrogen sulphide (H₂S) from the off-gas, particularly from the hydrotreaters. The H₂S will be processed in a Claus **Sulphur Recovery Unit** (SRU) to produce



elemental sulphur. The SRU will remove more than 90% of the H₂S, with the remaining to be burnt in order to minimise H₂S emissions to the atmosphere.

Approximately 4MW of capacity will be required for the CPF, with the remaining 21MW to 32MW surplus to be output to the local grid or nearby industries. The power station gas turbine exhaust heat will be used to produce steam for refinery processes and/or additional electricity generation, thereby increasing the efficiency of the fuel use.

Indicative quantities of products generated by the CPF operating at 40,000bpd are shown in **Table 1**. There will be a pro-rata increase in respective product yields with an increase in design capacity up to 60,000bpd. Additionally, there will be a degree of variation in relative quantities of product depending on the incoming feedstock and demands of the local market.

■ **Table 1 Estimated Product Quantities (40,000bpd Operation)**

Product	Quantity (barrels per day)
Unleaded Petrol	23,238
Kero/Jet Fuel	3,000
Automotive Diesel	7,899
Industrial Diesel	400
Fuel Oil (Residual)	1,240
Propane	800
Butane	1,400
Fuel Gas & Losses	2,023*

*Fuel gas expressed in bpd Fuel Oil Equivalent.

It is anticipated that the CPF will operate 24 hours a day for 340 days a year, with an operational workforce in excess of 60 full time personnel.

2.4 Marine and Port Operations

The proposed CPF would process a total of 13.6 million to 20.4 million barrels per year or approximately 1.6 million to 2.4 million tpa of condensate, which would be transported from the Bayu Undan field, Northwest Shelf or Middle East to East Arm via tankers. Low sulphur light crude, if required as a blendstock, would comprise a minor fraction of this quantity and would be imported from the Northwest Shelf or elsewhere. In addition, most of the unleaded petrol produced by the CPF is targeted to be exported for sale to the East Coast of Australia, Asia or the West Coast of the USA. In order to transport these quantities it is proposed a total of 24 x 75,000 dead weight (dwt) condensate tanker loads and 12 product loads a year will be required.

Alternatively 40,000dwt tankers with a capacity of 300,000 barrels may be used to transport petrol and other products to export destinations



In summary, operating the CPF at 40,000bpd will require :

$24 \times 576,000 = 13.8$ million barrels/year of feedstock delivered to East Arm

$12 \times 576,000$ or $24 \times 288,000$ barrels = 6.9 million barrels/year of products delivered to US West Coast, Asia and East coast ports of Australia.

Operating at higher feedstock throughputs will require a prorata increase in frequency of shipments. For example, operating the CPF at 60,000bpd will require :

$36 \times 576,000 = 20.7$ million barrels/year of feedstock delivered to East Arm

$18 \times 576,000$ or $36 \times 288,000$ barrels = 10.4 million barrels/year of products delivered to US West Coast, Asia and East coast ports of Australia.

The bulk liquids berth at the East Arm wharf has been designed to accommodate vessels up to 80,000 dwt or Panamax class, and thus can accommodate the proposed tankers, subject to sufficient keel clearance. Given that the tankers will be constructed specifically for the project, Darwin Port Corporation dimensional requirements will be incorporated as necessary. The tankers would also be required to have double hull construction as a protective measure against marine spills.

The Darwin Port Corporation has commented that, in general, three to six additional tankers per month should not present a traffic issue for Darwin Harbour, as the harbour is of sufficient area to allow manoeuvring, even with the marine traffic levels projected for the Vopak fuel terminal, Wickham Point LNG plant, Biodiesel Plant and Bootu Creek Mine (Captain B. Wilson, Darwin Port Corporation, pers comm).

The incoming condensate feedstock and the outgoing products will be conveyed between the CPF and the bulk liquids berth via existing pipelines constructed between the Vopak fuel terminal and the berth. The Darwin Port Corporation has advised that there is sufficient capacity in the bulk liquids berth and pipelines to convey the expected loads of feedstock and products (Captain B. Wilson, Darwin Port Corporation, pers comm). Development of the CPF will therefore result in a greater use of existing infrastructure at East Arm while not compromising its capacity for existing and proposed users.

2.5 Local Distribution of Products

Products to be sold to local markets will be distributed via road tankers, either using loading facilities constructed at the CPF, or the facilities at the Vopak Fuel Terminal. The products to be sold include predominantly automotive diesel, unleaded petrol and kerosene/jet fuel depending on market arrangements. Proximity to Berrimah Road will provide excellent access to key transportation routes and will minimise transport of products through residential or other sensitive areas.



It is proposed that the relatively small amount of residual oil produced by the CPF will be sold as ultra low sulphur marine fuel oil, for use by marine tankers and other vessels using the East Arm Port. The fuel oil will be transported to the tankers or vessels while they are berthed at the East Arm Port, via the same pipelines used for conveying feedstock and export products to and from the CPF and the bulk liquids berth.



3. Proposed Site and Existing Environment

3.1 Site Location

It is proposed that the CPF be established over two land parcels (see **Figure 2**):

- 1) Section 5720 located immediately north of the Vopak fuel terminal; and
- 2) Part Section 5633 located opposite Section 5720, south- east of Berrimah Road.

The majority of the land parcels comprises reclaimed land that was formerly the mangroves and salt flats that lay between Quarantine Island and the mainland. The north-eastern extent of Part Section 5633 comprises the original terrestrial mainland, which is partly covered by woodland, whereas the south-eastern extent of Part Section 5633 comprises un-reclaimed mangroves.

3.2 Infrastructure

The location of the site is very suitable for the proposed CPF due to the proximity of established infrastructure, including the existing East Arm Wharf, bulk liquids berth and associated pipelines to the adjacent Vopak Fuel Terminal, as well as arterial road access, power and water supplies.

Road access to the CPF would be via an access road off Berrimah Road, with good connectivity to the Stuart Highway and the road network of Darwin. This will facilitate distribution of products (eg diesel) to the local Darwin market.

There is significant potable water infrastructure (DN600 main) and high voltage (11kV) aerial and underground distribution mains along Berrimah Road adjacent to the CPF. Negotiation will be undertaken with the Power and Water Corporation regarding connection to their water and power networks.

The nearest sewerage infrastructure is located along O’Sullivan Circuit to the north-east, with a pump station at the Passenger Rail Terminal (Section 5673). As such, all sewage and process wastewater would most likely be managed on site rather than discharged to sewer.

3.3 Climate

The climate of Darwin is characterised by a hot, humid, wet season (typically from November to March) and a hot, dry season (typically from May to September) separated by relatively short transitional periods (typically April and October).

The mean annual rainfall of approximately 1,700 mm is highly seasonal, varying from an average of 1 mm in July to approximately 400 mm in January. Rainfall was recorded on Quarantine Island between 1934 and 1985, with an annual mean value of 1,551 mm. Relative humidity at 9am varies from a low of 62% in June to a maximum of 84% in February, with respective monthly values of



30% to 71% at 3 pm. High precipitation rates are commonly experienced during storm events in the wet season.

Temperatures tend to remain within a relatively narrow range throughout the year, with mean daily minima varying from 19.2°C (July) to 25.2°C (November) and mean daily maxima for the same months varying from 30.3°C (July) to 33.1°C (November).

Synoptic winds during the dry season tend to be dominated by the southeast trade winds, while light west to north-westerlies predominate during the wet season. Sea breezes from the northwest occur on most afternoons throughout the year.

Tropical cyclones occur in the Darwin region on average about once per year. Australian Standard AS 1170 Part 2-1989 specifies likely maximum gusts during cyclonic events in Darwin for purposes of structural designs. The standard indicates likely maximum gusts of 180, 205 and 252 km/h for cyclones having mean return periods of 20, 100 and 1,000 years, respectively.

3.4 Terrestrial Environment

3.4.1 Hydrology

Sec 5720 is a fully earth-worked site and has been designed to drain via overland flow to a sediment basin located adjacent to Berrimah Road, which discharges to an open drain flowing south-east through Part Sec 5633 and discharging to the tidal creek adjacent to Sec 5633.

The existing topography of Part Sec 5633 is not known at present but from site inspection appears to be gently sloping and runoff is anticipated to flow either to the open drain discharging to the tidal creek, or else sheet flow into the adjacent mangroves.

Both Sec 5720 and Part Sec 5633 will be appropriately earth-worked and engineered to ensure that adequate stormwater drainage is provided and any erosion and sedimentation minimised.

3.4.2 Landforms and Geology

The former Quarantine Island area comprised the Bustard and Littoral land systems, which were underlain by proterozoic rocks of the Burrell Creek formation, comprising fine grained siltstones and sandstones to coarser quartz conglomerates (Acer-Vaughan, 1993).

According to land unit mapping (DIPE, 2002), the north-eastern corners of Sec 5720 and Part Sec 5633 comprise gentle slopes (2 to 5%) with rapid drainage and shallow gravely soils, as well as low scarps and short steep slopes (10-15%) with shallow gravely lithosols.

The Littoral land system covers the remainder of the two land parcels, and previously formed a fringe of tidal mudflats around Quarantine Island (Acer Vaughan, 1993). The Littoral land system



has negligible relief and slope and is subject to tidal inundation, with mangroves and salt flats lying over muddy soils formed by sedimentary progradation (Acer Vaughan, 1993). The mangrove muds comprise clays and silts that would likely have a low bearing capacity and a possibly a high acid sulphate potential, which would have implications for construction of large structures.

Groundwater information is limited within the region and what is available indicates that groundwater is encountered within both the Quaternary and Proterozoic lithologies. Aquifers are low yielding, with flows reported at less than 0.5 litres/second. Higher yields with low storage may be available from sand lenses within the Quaternary sediments and fractures within sandstone. Groundwater depths are likely to be shallow, particularly given the proximity to the ocean.

The quality of groundwater within the shallow sediments is typically saline to hypersaline and not suitable for drinking or irrigation. The high salinity has likely resulted from landward salt-water intrusion and the dissolution of salts derived from marine sediments. The groundwater aquifers and marine environments are likely to be hydraulically connected.

Deeper groundwater resources may be available from fractured shales, siltstone and sandstones. Groundwater quality is variable within the deeper aquifers and typically brackish to saline. The hydraulic connectivity between the aquifers will depend upon the degree of structures such as fracturing within the shales.

No existing groundwater users are reported within the vicinity of the site.

Earthquake hazard maps produced by the Australian Geological Survey Organisation in Australian Standard 1170.4 1993 indicate that the Darwin area has an earthquake acceleration coefficient (10% probability of exceedence in 50 years) of 0.09. The higher the value of acceleration coefficient, the greater the severity of the expected earthquake.

3.4.3 Flora

Most of the land within Sec 5720 and Part Sec 5633 has been reclaimed and earth-worked in anticipation of industrial development, however recent aerial photography indicates that some remnant vegetation remains in Part Sec 5633 (see **Figure 2**). This vegetation includes:

- approximately 2.1 hectares of mangroves in the south-eastern extent of Section 5633; and
- approximately 1.9 hectares of terrestrial woodland in the north-eastern extent of Section 5633.

Based upon mapping undertaken for the East Arm Port EIS (Acer Vaughan, 1993), the mangrove vegetation in Part Sec 5633 appears to comprise a series of zones aligned roughly parallel to the shoreline. The zones are generally dominated by one or two mangrove tree species, in the following order (seaward to landward):



- *Sonneratia alba* (up to 12m tall) in the most seaward extent (-3.5m to 0m AHD);
- *Rhizophora stylosa* and *Avicenna marina* in the tidal creek;
- *Rhizophora stylosa* (up to 16m tall), lying between 0m and 1.5m AHD;
- *Bruguiera exaristata* and *Avicenna marina* lying between roughly 1.5m to 2.0m AHD;
- *Ceriops tagal* var. *australis* (up to 4m tall) lying between roughly 2m and 3m AHD; and
- *Avicenna marina* (up to 3m tall) merging into mixed mangrove at the most landward extent (roughly 3.5m AHD).

Much of the most landward mangrove zones within Part Sec 5633 are now covered by reclaimed land created through spoil from other developments within the Darwin Business Park.

Based upon mapping undertaken for the East Arm Port EIS (Acer Vaughan, 1993), the patches of terrestrial woodland within Part Sec 5633 would comprise mostly mixed woodland that has re-colonised disturbed and semi-cleared ground. Dominant species include *Melaleuca viridiflora*, *Pandanus spiralis*, *Zanthostemon paradoxus*, as well as *Calytrix*, *Grevillea* and *Acacia* species.

A search was undertaken of the threatened species database maintained by the Natural Systems Division of the Department of Natural Resources, Environment and the Arts. The search found no records of NT or Commonwealth listed threatened flora species within the CPF site or its immediate vicinity.

3.4.4 Fauna

The mangroves of Darwin Harbour have been shown to support a rich invertebrate fauna, with some 80 species of crustaceans recorded to date (Metcalf and Crawford, 2005), as well as molluscs and worms.

The patches of terrestrial woodland remaining within Part Sec 5633 would likely represent only limited habitat for terrestrial vertebrate fauna. Acer Vaughan (1993) recorded a total of 56 bird species at Quarantine Island the nearby Shell Islands, 90% of which were resident species and the remaining comprising nomads and migratory waders. A total of 8 mammal species were observed in the area, the obvious of which was the Agile Wallaby, as well as field indications of the presence of the Northern Brown Bandicoot, Northern Quoll and Northern Brushtail Possum (Acer Vaughan, 1993).

A search was undertaken of the threatened species database maintained by the Natural Systems Division of the Department of Natural Resources, Environment and the Arts. The search found no records of NT or Commonwealth listed threatened fauna species within the CPF site or its immediate vicinity.



3.4.5 Biting Insects

Although the Quarantine Island area has a high density of biting midges, which has been identified as a perennial problem at the nearby Northern Cement milling facility, there are no large mosquito breeding sites in the immediate vicinity of the site (Acer Vaughan, 1993). Minor mosquito breeding areas were previously identified near the Trade Development Zone and East Arm Leprosarium (Acer Vaughan, 1993).

3.5 Marine Environment

3.5.1 Darwin Harbour Values

Darwin Harbour is subject to a tidal range of 8 m and is bounded by extensive tidal flats. It has a relatively small catchment of 2,417 km² compared to its extensive estuary at 810 km² (DHAC, 2003). The harbour's tidal flats are estimated to support over 20,000 ha of mangroves in a relatively pristine condition (URS, 2002). Mangroves have been identified as a key component of the Darwin marine environment, providing primary production for the foodweb, as well as a nursery for vertebrate and invertebrate fauna (URS, 2002). In recognition of their status, the mangroves were recently rezoned for conservation under the NT Planning Scheme. The harbour is listed (Port Darwin NT029) in the Directory of Important Wetlands in Australia, with 25 species of migratory birds listed for protection under international treaties (JAMBA, CAMBA, Bonn).

Darwin Harbour also has significant cultural, social and economic values, with 45% of all NT fishing occurring in the harbour, most of which is by Darwin residents (DHAC, 2003). The harbour has been recently earmarked for waterfront development, including the Bayview Haven residential area and marina, and the proposed waterfront development near Stokes Hill Wharf. The harbour and its catchment contain 120 registered sacred sites and there are hundreds of archaeological sites scattered within the harbour mangroves (DHAC, 2003).

The area of mangroves to the north and north-west of East Arm comprises Charles Darwin National Park, which also covers a portion of terrestrial woodland. The Park features picnic facilities, a lookout, WWII historical buildings and walking trails. Although the National Park is relatively close to East Arm, due to the extensive woodland vegetation, the existing industrial structures at East Arm are barely visible from the picnic and lookout area.

3.5.2 Marine Biota

URS (2002) reported that the seabed of Darwin Harbour is dominated by gravel, with a scour zone in the centre of the harbour, where the hard pavement substrate is covered by only a thin veneer of sediment. Such areas can support a highly diverse fauna comprising sponges, soft corals and gorgonian whips and fans, often with attendant crinoids (feather stars), which rely on water currents to provide their food source and favour high-current areas (URS, 2002).



Survey undertaken for the East Arm Port EIS (Acer Vaughan, 1993) indicated relatively rich and diverse coral communities with associated marine fauna in the vicinity of the port where the seabed was hard and shallow. Hard corals were limited to depths of less than 6m below mean sea level, with gorgonian corals and sponges becoming increasingly sparse at depths beyond 10m below mean sea level (Acer Vaughan, 1993).

URS (2002) reported that Corals in Darwin Harbour are scattered as individual coral heads or colonies, and do not form reefs. The coral species found in Darwin Harbour are tolerant of conditions that exclude most corals, such as variable salinity, high turbidity and sedimentation, and it is likely that corals living well within the harbour are in suboptimal habitats and are naturally stressed URS (2002).

URS (2002) reported a total of 415 fish species in the Darwin Harbour waters, as well as 48 species from 21 families found within the mangrove creeks of the harbour, the greatest number being found in the Charles Darwin National Park. Darwin Harbour also supports marine reptiles such as the Flatback, Green and Hawksbill Turtles, as well as estuarine/saltwater crocodiles and sea snakes, and marine mammals such as the Indo-Pacific Hump-backed and Irrawaddy River Dolphins and also Dugongs (URS, 2002).

URS (2002) reported that Darwin Harbour supports seagrasses, for example off Mandorah and between Channel Island and the mainland, however there are no significant seagrass beds known to occur in the harbour.

3.6 Historic and Archaeological Heritage

Much of the proposed CPF site has been reclaimed and earthworked and hence does not have heritage sites present, however the north-eastern and north-western portions of Part Sec 5633 that remain undeveloped may contain historic or archaeological heritage sites or objects.

A search was conducted of the Archaeological Resource Database and NT Heritage Register maintained by Heritage Conservation Services. The search indicated that there are no recorded sites within the proposed CPF site. However, there is an archaeological site located approximately 400m west of Part Sec 5633, and there are historic remains located nearby within Sec 5163, 5420 and 5421 (D. Steinberg, Heritage Conservation Services, pers. comm.). The historic sites include the remains of a Catalina flying boat base and a Z force lugger maintenance section.

Overall the potential for historic or archaeological heritage sites or objects to be found within the CPF site is low, however a heritage survey will be conducted for the area to ensure that no undiscovered sites are present, and if any site are present that they are managed appropriately.



3.7 Sacred Sites

A search of the register maintained by the Aboriginal Areas Protection Authority indicated no recorded or registered sacred sites within the proposed CPF site or its immediate vicinity.

An application will be made for a clearance certificate under the *Northern Territory Aboriginal Sacred Sites Act 1989* and development of the CPF will be undertaken in accordance with the conditions specified in the clearance certificate.

3.8 Land Uses in the Vicinity

The site and its vicinity are surrounded by mangroves, Darwin Harbour waters, the East Arm wharf and the Darwin Business Park industrial area.

The Northern Cement milling and distribution facility, Vopak fuel terminal and proposed Biodiesel plant all lie immediately west of the proposed site.

The passenger terminal for the Darwin-Adelaide Railway is located within the Darwin Business Park, a few hundred metres to the north-east of the site. There is generally a single passenger train service per week, doubling to two train services during the peak tourist season, with the terminal being essentially empty for the remaining period. Although the terminal has been established as a temporary facility, it may be some time before funds are available for its relocation and hence it could remain at the location for some years into the CPF's operations.

The nearest residential premises are the residential quarters of Kormilda College, a private secondary school located along Berrimah Road, roughly 4.5km north-east of the site (see **Figure 1**). The Shady Glen Caravan Park is located along Stuart Highway near the Coonawarra Naval Base, approximately 5km north of the site. The nearest residential suburbs are Bayview Haven, Frances Bay and Stokes Hill, located approximately 5.5km north-west to west of the site, whereas the nearest Palmerston suburbs (eg Marlow) are over 7km to the east (see **Figure 1**).

The proposed CPF location will thus offer a buffer distance of between 4km and 5km from residential and commercial areas in the Darwin region.



4. Environmental Issues

4.1 Air Emissions

The CPF will generate air emissions from both point sources and fugitive sources. The point sources will include stack emissions from the following:

- Furnaces providing heat for the process units;
- NCCR catalyst regeneration;
- Hydrotreater catalyst regeneration;
- Sulphur recovery unit;
- 25MW to 40MW power station; and
- Flaring.

A process design has not been undertaken as yet and so the air emissions generated by the CPF cannot be estimated in detail, however based upon reasonable assumptions, the scale of the air emissions has been estimated and this is shown in **Table 2**.

▪ **Table 2 Estimated Scale of Air Emissions from 40,000bpd Condensate Processing Facility**

Pollutant	Scale of Total CPF Emissions (Tonnes per Annum)	Scale of Emissions from Surplus Power Supply* (Tonnes per Annum)	Total Emissions for Darwin Airshed** (Tonnes per Annum)	Key Sources of Darwin Airshed Emissions
Carbon Dioxide (CO ₂)	150,000	70,000	N/A	N/A
Sulphur Dioxide (SO ₂)	50	15	530	Commercial shipping, bushfires & automobiles
Hydrogen Sulphide (H ₂ S)	< 0.1	Negligible	0.3	Municipal waste disposal
Oxides of Nitrogen (NO _x)	Several hundred	Few hundred	10,000	Automobiles
Carbon Monoxide (CO)	Several hundred	Few hundred	62,000	Bushfires, automobiles
Particulate Matter below 10 microns (PM ₁₀)	< 100	< 50	6,000	Bushfires

* This represents the emissions from the 25 MW power station attributable to the surplus power supplied to off-site users.

** Source – National Pollutant Inventory, 2004. These emissions do not include the Wickham Pt LNG Plant.

The emission of sulphur dioxide would vary depending on the sulphur content of the feedstock. If Bayu Undan or North West Shelf condensate and low sulphur light crude were used, then the sulphur dioxide emissions would be in the order of 50 tonnes per annum. However, if condensate was sourced from the Middle East, and this was used as the sole feedstock, then the sulphur dioxide emissions could rise to a few hundred tonnes per annum. It should be noted that any processing of middle east condensate or use of low sulphur light crude as blendstock would be using the same



process as for the condensate, and not involve any heavy processing such as catalytic cracking, coking, visbreaking or alkylation.

The above estimates indicate that with the possible exception of H₂S and SO₂, the CPF emissions will be relatively insignificant compared to other emission sources in the Darwin region. It should be noted that the 10 million tpa Wickham Pt LNG Plant is estimated to generate approximately 4.5 million tpa of CO₂, 6,000 tpa of NO_x, 1,900tpa of CO and 130 tpa of SO₂ (URS, 2002), which would be in addition to the airshed emissions presented above.

It should also be noted that the emissions of the CPF will include those of the 25MW to 40MW power station, which would provide 21MW to 32MW of power to either local industries or the Darwin power grid that would otherwise have been generated by another power station with its associated air emissions. As shown on **Table 2**, the surplus power supplied to off-site users would contribute a significant portion of the air emissions from the CPF.

The generation of greenhouse gas (GHG) emissions from the CPF will be minimised through use of the hydrogen-rich off gas as a fuel, which will produce less GHG emissions per joule than either natural gas or fuel oil, and through reuse of the power station heat for the CPF process units (ie cogeneration). The generation of 21MW to 32MW of power for the Darwin industries or other users would therefore result in a net GHG saving compared to its generation from a natural gas-fired power plant. As shown in **Table 2**, of the 150,000 tpa of CO₂ emitted from the CPF, roughly 70,000 tpa or 45% would be attributed to the surplus power supplied to off-site users.

The CPF will also generate emissions of volatile organic compounds (VOCs) due to the following:

- storage tank breathing and working losses;
- loading of tankers/road trains at the road gantry;
- volatilisation from process water and stormwater treatment plants; and
- fugitive emissions from pipelines, valves and equipment.

Shipping movements will result in comparatively lower emissions through auxiliary engines while berthing and main engines when entering or exiting the harbour. Using National Pollutant Inventory emission factors for commercial shipping (NPI, 1999), the emissions during berthing are expected to be in the order of 30 tpa of SO₂ and NO_x, and less for CO and PM₁₀. A similar scale of emissions are expected for shipping within the harbour, however this would be dispersed along the shipping route and any anchorages.

Air emissions will be calculated in detail, incorporated into atmospheric dispersion modelling and used to determine potential air quality impacts in the Darwin airshed, as part of the formal assessment of the project under the *NT Environmental Assessment Act 1982*. The modelling will be



cumulative, incorporating emissions from other major industries in the Darwin airshed such as the LNG Plant, Channel Island Power Station and East Arm Quarantine Waste Incinerator.

The generation of greenhouse gas emissions and options for emission offsets will be assessed in detail as part of the formal assessment of the project under the *NT Environmental Assessment Act 1982*.

4.2 Marine Spills

4.2.1 Marine Spill Risk

The operation of tankers in Darwin Harbour could result in spills through marine accidents such as grounding, hard contact with the berth or tug during manoeuvring, collisions or structural failure (SKM, 2003). Whilst a petroleum spill from a marine tanker is a possibility, it should be noted that there have been a relatively small number of significant marine spills in Australian waters. There are approximately 19,000 ships entering Australian ports each year (Australian Maritime Safety Authority, 2005a), whereas in the last 100 years there have been 17 significant oil spills (Australian Maritime Safety Authority, 2005b). By comparison, the CPF will result in 36 to 54 marine tankers entering Darwin Harbour each year and thus the likelihood of a marine spill from the CPF operations would be low.

The East Arm port will be exposed to tropical cyclones from December through April. In the event of a tropical cyclone warning, tankers would be ordered to put to sea (Captain B. Wilson, pers. comm). In cyclonic conditions there is always the risk of a ship leaving anchorage being driven ashore in high winds. Should a tanker strand on, or strike a rock outcrop on grounding, it is possible that shell plating may be fractured or the vessel's back could be broken, a situation that could potentially result in a significant release of fuel or oil. Whilst much of the sediments in the harbour comprise soft muds, isolated hard pavements and reefs do exist and hence the potential for grounding on these cannot be dismissed.

There is also the potential for spills to occur following a major collision with other vessels or with the wharf structures. Given the low traffic experienced in the harbour and the large size of the harbour, the Darwin Port Authority does not consider that traffic would be a major issue (Captain B. Wilson, pers. comm) and hence the risk of collisions would probably be low.

The Darwin Port Corporation is responsible for responding to all petroleum spills within Darwin Harbour, in accordance with the Australian Marine Oil Spill (AMOS) Plan to which Darwin Clean Fuels will be a participant and contributor.

4.2.2 Spills During Loading/Unloading or Bunkering Operations

The penetration or fracture of the shell plating of a tanker's bunker fuel tank during berthing due to a total power failure, a failure of bridge/engine room communication, or the failure of the tug engine control system could result in the immediate release of heavy fuel oil or diesel oil.



Unloading of condensate and loading of petroleum products will be continuously monitored, however hose, pipeline, valve or communication failure could result in a possible release of hydrocarbons. A spill could also occur during bunkering activities as a result of an overflow or communication failure.

Although the project will involve the moderate use of the East Arm bulk liquids berth which is purpose designed for such operations, there remains a risk of spills during loading of products and tanker fuel, and unloading of feedstock.

4.2.3 Potential Impact of Spills

The potential for hydrocarbon spills to affect marine and intertidal flora and fauna in Darwin Harbour would depend on the size of the spill, the type of hydrocarbons, weather conditions and the response time for emergency clean up actions (SKM, 2003).

The unleaded petrol and other products to be loaded at the bulk liquids berth for export would predominantly comprise lighter hydrocarbons with moderate to high evaporation rates, and low persistence (one to three days) in the sea. However, the lighter hydrocarbons would have an acute aquatic toxicity and a spill could have a serious impact on marine life, particularly in the intertidal zone (SKM, 2003). The condensate to be unloaded at the wharf would mostly comprise the lighter hydrocarbons described above, as well as a small proportion (less than 10% by volume) of heavier hydrocarbons with lower evaporation rates, higher persistence in the sea and more chronic toxicity. In the event that some low sulphur light crude is imported for use as a blendstock and is spilled, this material would have up to 20% heavier hydrocarbons by volume and thus result in a greater persistence and chronic toxicity than that of a condensate spill.

The fuel oils and engine oils used by marine tankers would also tend to have low evaporation rates, low solubility in water, high emulsion potential and relatively high persistence (approximately a week) in sediments (SKM, 2003). These heavier compounds would cause oiling of marine life such as water birds, which can affect their thermoregulation and cause drowning before toxicity sets in.

It should be noted that the marine impacts described above are potential and may not occur during the lifetime of the project. As noted previously, the likelihood of a major spill from the CPF operations would be low. The risk of marine spill impacts will be assessed in detail as part of the formal assessment of the project, which will assist in the development of management strategies to ensure that the risk is minimised as far as practicable.

4.3 Stormwater

The CPF will involve the storage and processing of significant quantities of petroleum compounds, which could potentially contaminate soil and water resources should any spills occur either through



gradual leaks or through sudden accidents. To mitigate the risk of these impacts, the CPF will have sufficient containment systems to retain petroleum spills as well as accumulated rainfall during peak storm events. The depth of rainfall to be contained will be determined through an assessment of spill risk, rainfall conditions and response timeframe.

The containment systems will be provided for all areas at risk of spills of petroleum or other hazardous materials, including all process areas, pipelines, any loading and unloading areas, and all storage tanks for feedstock, intermediate products, products, wastes and process chemicals (eg acids or caustics). These areas will be contained within bunded compounds with impervious pavements to prevent any spills infiltrating into underlying soils.

The generation and management of stormwater, including potential impacts to Darwin Harbour, will be assessed in detail as part of the formal assessment of the project under the *NT Environmental Assessment Act 1982*.

4.4 Liquid Waste

4.4.1 Sewage

Sewage from facility offices and ablutions would be disposed of either to an on-site sewage treatment plant or to the Power and Water Corporation's sewerage system. If an on-site system is used, the sewage will be treated prior to disposal/reuse on site via subsurface or drip irrigation, in accordance with the requirements of the Department of Health and Community Services.

The generation, treatment and disposal of sewage, including potential impacts to soil and water resources, will be assessed in detail as part of the formal environmental assessment of the project.

4.4.2 Process Wastewater

Process wastewater would be generated from the CPF process units as well as any washdown facilities. The wastewaters generated by the CPF process units and washdown area will vary in their characteristics, however as a combined stream they may contain a range of range of contaminants including hydrocarbons, suspended solids, metals, sulphide, ammonia, mercaptans and other organic compounds (European Commission, 2003). The wastewater would also be high in pH (caustic) and would result in an impact to water quality and ecosystems if directly discharged to Darwin Harbour.

The process wastewater will be treated prior to discharge into the harbour, or else reused on site (eg as process, washdown or cooling water). Reuse at the CPF would be desirable from an environmental perspective, however its feasibility will depend on several factors including risk to the CPF process units and pipelines, and the need for segregated treatment or reticulation systems for different wastewater streams. Any discharge of treated process wastewater into Darwin Harbour will be in accordance with a licence under the Northern Territory *Water Act 1992*.

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The generation, treatment and disposal of process wastewater, including potential impacts to Darwin Harbour, will be assessed in detail as part of the formal environmental assessment of the project. This will include quantitative estimates of the flows and characteristics of wastewater and treated effluent.

4.5 Solid Waste

The CPF will generate general rubbish from office and maintenance areas, inert wastes (eg rubble, construction materials), as well as potentially hazardous wastes including spent process materials (eg catalysts), sludges from tanks, process vessels and wastewater treatment facilities, and contaminated soils.

Rubbish and inert wastes would be collected by local waste contractors and disposed of at licensed landfill sites. Spent catalysts may be recycled due to their high value (eg platinum catalyst), otherwise they would be disposed of as a hazardous waste. At present there are no dedicated facilities in Darwin to treat or dispose of hazardous liquid or solid wastes (Mike Lawton, Office of Environment and Heritage, pers. comm., 2004). There are a number of possible options for disposal of hazardous wastes from the CPF:

- Disposal at the Shoal Bay Waste Facility owned by the Darwin City Council. The facility is not designed for hazardous wastes and hence additional protective measures (eg cement encapsulation in drums) may be required in order to prevent contamination of that site. Negotiation would be undertaken with the Darwin City Council to determine if it would accept hazardous wastes at the Shoal Bay Waste Facility.
- Transport of wastes for disposal at dedicated hazardous waste facilities elsewhere in Australia. Sludges may be dewatered in Darwin to reduce the transport costs.
- Land farming of contaminated soils, depending on the availability of land.
- Construction of a dedicated hazardous waste facility near Darwin.

The generation and management of solid wastes will be assessed in detail as part of the formal assessment of the project under the *NT Environmental Assessment Act 1982*.

4.6 Hazardous Materials

The CPF will require the use of caustic soda (NaOH) to treat or remove acid impurities in the naphtha stream, such as hydrogen sulphide (H₂S), mercaptans and organic acids. The spent caustic soda would either be recycled in the CPF or be treated along with process wastewater in the CPF's WWTP. There may also be a potential to sell the spent caustic to other industries, however given the lack of synergistic industries and the small volumes involved, this may not be economical.



Any storage areas for caustic soda would need to be provided with adequate spill containment measures.

The CPF will not have an alkylation unit and hence will not require acids such as hydrofluoric acid (HF) or sulfuric acid (H₂SO₄).

The inventory, risk and management of hazardous materials will be assessed in detail as part of the formal environmental assessment of the project.

4.7 Ballast Water

All marine tankers engaged for the project will abide by the Australian Ballast Water Management Requirements (2001) prior to discharging ballast water within 12 nautical miles of the Australian coast. This would generally require the flushing of ballast water tanks mid-ocean, or alternative measures, to ensure that ballast water from foreign ports is not discharged into Australian waters. The Australian Ballast Water Management Requirements are administered by the Australian Quarantine and Inspection Service (AQIS) and are consistent with International Maritime Organisation (IMO) guidelines for ballast water. The Requirements are legally enforceable under the *Commonwealth Quarantine Act 1908*.

The prohibition on discharging ballast waters from foreign ports will significantly minimise the risk of introducing exotic species to Darwin Harbour.

4.8 Acid Sulphate Soils

Sec 5720 and Part Sec 5633 both overly marine sediments that are likely to have a significant acid sulphate potential, which could pose an environmental issue should the sediments need to be excavated, dewatered or otherwise be exposed to air. The risk and management of acid sulphate soils will be assessed in further detail as part of the formal assessment of the project under the *NT Environmental Assessment Act 1982*.

4.9 Visual Amenity

The CPF would comprise a number of large processing and storage structures that have the potential to affect the visual amenity of the area. At present, the East Arm wharf, Northern Cement, Vopak terminal and Wickham Point LNG facilities have significantly large structures that are all clearly visible from populated areas near Darwin, including Bayview Haven, Frances Bay and Stokes Hill. It is therefore likely that the CPF structures on Section 5720 would be also visible from these areas, however most of the structures on Section 5633 would be hidden behind the Vopak terminal or CPF feedstock storage tanks, with the exception of the process vessels, furnace and flare stacks, as these could be considerably higher (in the range of 20m to 40m).



Given the presence of other industrial structures in the vicinity, the considerable distance (5km +) to residential and commercial areas, the movement of large marine vessels and the general industrial nature of the East Arm area, the risk of the CPF causing a significant impact to the visual amenity of Darwin would probably be low. However, the flare stack, at a height of 40m or more, could stand out should a flare event be occurring, particularly from the nearby rail passenger terminal.

The visual impression of the facility, including any visual impacts, will be assessed in detail as part of the formal environmental assessment of the project. This would include photo-montages to show how the facility would look from key locations within Darwin, such as the Darwin waterfront and CBD.



5. Project Development

It is anticipated that construction of the CPF will occur shortly after gaining a Development Permit and environmental approvals for the project.

Development of the CPF will take approximately 24 months, including detailed design, site development works, fabrication and erection of structures, and plant commissioning.

The construction of the CPF at East Arm would require several hundred workers.

Assuming that all legislative approvals were in place in early 2007, the CPF could commence operations by early to mid 2009.



6. Environmental Management

Detailed environmental management measures will be developed as part of the anticipated formal assessment of the project under the *NT Environmental Assessment Act 1982*. It is anticipated that construction of facilities will be subject to an Environmental Management Plan whereas operations will be subject to an Environmental Management System developed to the requirements of ISO14001.



7. Acronyms

AQIS	Australian Quarantine and Inspection Service
bpd	Barrels per day (1 barrel = 159 litres)
CDU	Condensate distillation unit
CO	Carbon monoxide
CPF	Condensate processing facility
dwt	Dead weight tonnes
GHG	Greenhouse gas
HNH	Heavy naphtha hydrotreater
H ₂ S	Hydrogen sulphide
IMO	International Maritime Organisation
NCCR	Naphtha continuous catalytic reformer
NO _x	Oxides of Nitrogen
PM ₁₀	Particulate matter less than 10 microns in diameter
RIU	Recycling isomerisation unit
SRU	Sulphur recovery unit
tpa	Tonnes per annum
ULP	Unleaded petrol
VOC	Volatile organic compounds
WWTP	Wastewater treatment plant



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