Appendix H

Air Quality

Technical Appendix H

The Kurnell Port and Berthing Facility Upgrade

Air Quality Assessment

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Prepared for

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Introduction

URS Australia Pty Ltd (URS) were commissioned by Caltex Australia Pty Ltd (Caltex) to conduct an air quality assessment associated with the proposed upgrade of the Kurnell port and berthing facility (the proposed works). This Technical Appendix presents the air quality assessment conducted for the purposes of outlining potential air quality impacts associated with the proposed works.

1.1 Scope of the Assessment

The Director General's Requirements (DGRs) requested that the following aspects be considered in the assessment:

- air quality impacts associated with the dredging, handling, stockpiling and disposal of dredged material (as relevant), including potential odour impacts; and
- impacts relating to air quality as a result of operational changes (as relevant).

A number of additional aspects have been considered in the chapter, reflecting issues raised by statutory agencies, which follow:

- risks relating to environmental harm, human health and amenity;
- all processes that could result in air quality emissions; and
- consideration of the risks associated with fugitive and point source emissions.

1.2 Approach to Assessment

The assessment has adopted the following methodology:

- Conduct qualitative review of key emission sources and associated air quality issues with each associated area of the proposed works, which are:
  - Dredging works;
  - Fixed berth upgrades; and
  - Sub berth upgrades
- Undertake quantitative assessment, using dispersion modelling, of the key air quality issues highlighted in the qualitative review ; and
- Consider suitable mitigation measures for the key air quality issues assessed.

2

Existing Environment

2.1 General

The Site is located on the Kurnell Peninsula, in the Sutherland Shire on the southern coastal border of the Sydney Metropolitan Area. Kurnell Peninsula is bounded by Botany Bay to the north, the Tasman Sea in the east, the Princes Highway to the west, and the Royal National Park to the south.

The ambient air quality of Botany Bay is influenced by both local and regional pollutant sources, including road traffic, domestic sources, aircraft, shipping and industrial sources. The two key sub-regional influences relate to the bulk and container ship movements in and out of Port Botany (totalling 1,760 per annum[1]) and the airport's emissions.

The project site remains relatively isolated from the major industry and traffic of the Bay located along the north shoreline. Local to the project site, the primary influence are the emissions generated from the Refinery, which are controlled under the terms and conditions set by the site's Environmental Protection Licence (EPL) (reference number 837). These emissions primarily include combustion products and volatile organic compounds (VOCs) arising from both fugitive process emissions and combustion processes. The EPL requirements include a number of pollution studies and reduction programs aimed at reducing odour and air quality emissions associated with refinery operations.

Other local industrial developments include the Cronulla Sewerage Treatment Plant, the Sydney Desalination Plant and other smaller scale industrial facilities, however, in respect to this assessment, emissions from these industries are considered minor.

The nearest sensitive receptors to the project site are the residents located in the village of Kurnell. The nearest receptor locations are located along Prince Charles Parade approximately 800 – 850 m south of the limit of the proposed dredging of the fixed berths.

There are also a number of public spaces close to the proposed works including Silver Beach and Kamay Botany Bay National Park.

2.2 Ambient Air Data

The Office of Environment and Heritage (OEH), formerly NSW Environmental Protection Authority (EPA), operates a series of air monitoring stations within the Sydney and greater Sydney regions. Air quality monitoring stations in Sydney's east measures a range of pollutants and parameters, as follows:

- Ozone (O_3);
- Oxides of nitrogen (NO, NO_2, and NO_x);
- Sulphur dioxide (SO_2);
- Fine particles; and
- Weather parameters including wind speed, wind direction, sigma theta, ambient temperature and relative humidity.

Measurements of air pollutants are compared to National Environment Protection Measures (NEPM) guidelines values, designed to be protective of human health. Exceedances of the NEPM guidelines have occurred in the last five years in Sydney's east, however, exceedances are generally confined to particulate matter associated with natural events, such as bushfires and dust storms and infrequent ozone exceedances.

[1] Sydney ports Corporation Trade Report 2010/11

2.3 Climate and Meteorology

The climate in the local area can be described as warm and temperate, and is typified by warm to hot summers and cool to mild winters. The coastal nature of the refinery site means that it experiences stronger sea breeze effects and smaller seasonal and daily temperature ranges than more inland areas of Sydney.

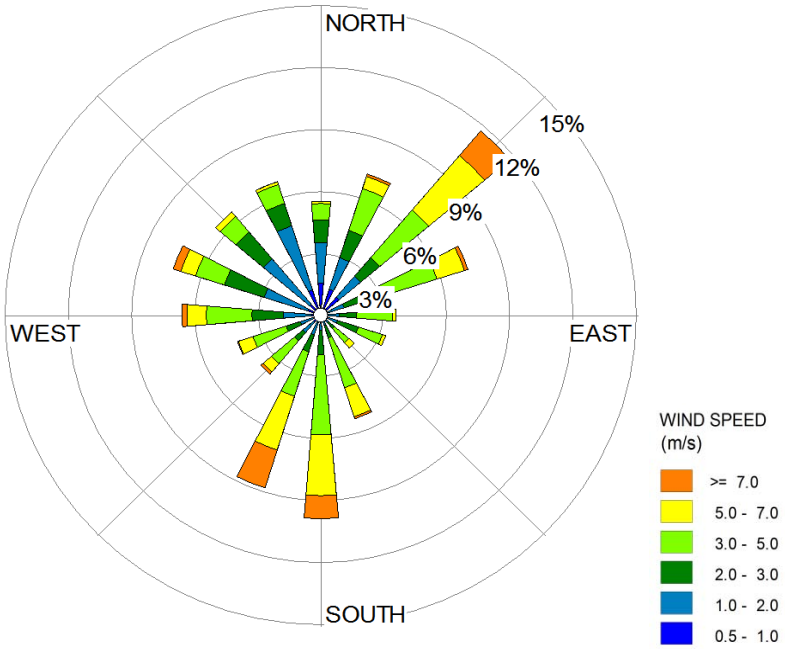
Average climate data for the area was obtained from the Bureau of Meteorology (BoM) operated weather station at Sydney Airport as shown in **Table 2-1**. A brief discussion of the climatic data presented is provided below.

The annual mean maximum and minimum temperatures are 22.1 °C and 13.4 °C respectively. January and February are generally the warmest months with temperatures of approximately 22 °C at 9 am and 24 °C at 3 pm. The mean relative humidity recorded is 69 % at 9 am and 57 % at 3 pm.

The area experiences a mild seasonal variation in rainfall, with most of the rain falling in the late summer and autumn months. The average annual rainfall is 1,085 mm, with an average of 129 rain days per year. Highest monthly rain falls occur in March and June, each recording a mean of 116 mm and 121 mm (per month) respectively. Lowest monthly rain falls occur in September with a mean of 61 mm. The mean daily evaporation peaks in December at 7.4 mm.

Typical meteorological conditions found within the Botany Bay & Kurnell region are provided as a wind rose diagram, refer to **Figure 2-1**, The figures shows the wind direction and wind speed for a typical year, in this case 1995. The wind rose diagram is based on a NSW EPA prepared Ausplume (a dispersion modelling software package) file. Dominant wind directions occur from the north east, south and south west.

Figure 2-1 Wind rose for Botany Bay



2 Existing Environment

Table 2-1 Climate statistics for Sydney Airport (BoM, 2012)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Years
Temperature														
Mean maximum temperature (deg C)	26.5	26.4	25.2	22.9	20	17.6	17	18.3	20.5	22.5	24	25.7	22.2	73
Highest temperature (deg C)	45.2	42.6	41.2	35.7	30	26.8	26.7	31.1	35.6	39.1	43.4	43.2	45.2	73
Mean minimum temperature (deg C)	18.8	19	17.5	14.2	10.9	8.6	7.2	8.1	10.4	13.2	15.4	17.5	13.4	73
Lowest temperature (deg C)	9.7	11.2	7.4	6.1	3	1	-0.1	1.2	2.3	4.8	5.9	8.2	-0.1	73
Rainfall														
Mean rainfall (mm)	94	112.9	116.3	106.3	100.1	120.7	71	75.5	60.8	71.3	81.7	74.3	1085.1	83
Highest rainfall (mm)	400.4	596.9	393	476.2	421.7	465.9	253.7	396.6	249.4	271.3	396.1	359.2	2025.2	83
Lowest rainfall (mm)	5.4	2.5	6.4	8	2.9	2.5	0	0.2	1.6	0	5.7	4.8	522.9	83
Mean daily evaporation (mm)	7.2	6.4	5.4	4.2	2.9	2.5	2.7	3.7	4.9	5.8	6.5	7.4	5	39
Mean number of days of rain	11.2	11.5	12.4	11	11	11.2	9.3	9.1	9.3	10.7	11.5	10.6	128.8	83
9 am Conditions														
Mean 9 am temperature (deg C)	22.4	22.3	21.1	18.2	14.6	11.9	10.8	12.5	15.7	18.4	19.9	21.6	17.4	71
Mean 9 am relative humidity (%)	70	73	73	71	73	74	71	65	62	61	64	66	69	60
Mean 9 am wind speed (km/h)	14.4	13.8	12.9	12.9	12.6	13.4	13.3	14.4	15.5	16.3	16	14.8	14.2	70
3 pm Conditions														
Mean 3 pm temperature (deg C)	24.8	24.8	23.9	21.7	19	16.6	16.1	17.2	19	20.7	22.1	23.9	20.8	71
Mean 3 pm relative humidity (%)	60	63	61	59	58	57	52	49	51	54	56	58	57	60
Mean 3 pm wind speed (km/h)	24.1	23	21	19.3	17.1	17.8	18.2	20.8	23.1	24.6	25.3	25.2	21.6	70

3

Legislative Context

There are three main types of regulatory criteria relevant to air emissions. These are:

- **Emission Standards** – which specific maximum allowable in stack pollutant concentrations specified for particular industrial activities and plant types;
- **Air Impact Assessment Criteria** – ambient criteria designed for use in air dispersion modelling and air quality impact assessments for new or modified emission sources; and
- **Ambient Air Quality Standards** – regional standards against which ambient air quality monitoring results may be assessed.

3.1 Emission Standards

The *Protection of the Environment Operations (Clean Air) Regulation 2010* (POEO Regulation) sets emission limits for air impurities from stationary plant and equipment. Limits are typically based on levels that are achievable through the application of reasonably available technology and environmental practices. As the proposed works don't involve stationary plant equipment, no emission standard limits apply.

3.2 Air Impact Assessment Criteria

In August 2005, NSW EPA released the Approved Methods and Guidance for the *Modelling and Assessment of Air Pollutants in NSW.* This document specifies impact assessment criteria for a range of air pollutants. The impact assessment criteria relevant to the proposed works have been outlined within the quantitative assessment of the air quality review (**Section 5**).

3.3 Ambient Air Quality Criteria

Ambient air quality criteria are provided in the National Environmental Protection Measure (Ambient Air Quality) NEPC (1998). The guidelines contained in NEPC (1998) are designed for use in assessing regional air quality and are not intended for use as project site boundary or atmospheric dispersion modelling criteria; hence emissions from the proposed works have not been assessed directly against these guidelines.

4

Qualitative Assessment

4.1 Review of Construction Activities

Table 4-1 provides a summary of the works proposed, approximate duration and proximity to sensitive receptors. This table summarises the relevant information to establish the key air quality issues associated with the proposed works. These relate to the proposed works as described in **Chapter 4 (Volume 1), Proposed Works Description.**

Table 4-1 Consideration of Key Air Quality Issues

Parameter	Air Emission Sources		
	Dredging	Infrastructure Upgrade	
		Fixed Berth Upgrade	Sub Berth Upgrade
Proposed Works	Mechanical dredging using backhoe dredge (BHD) and split hopper barges	Delivery of materials. Diesel generator use. Welding and cutting, including oxy-acetylene cutting. Tugboat and crew boat support vehicle	Delivery of materials. Diesel generator use. Welding and cutting. Tugboat and crew boat support vehicle use.
Pollutants of Interest	Odorous compounds or Volatile Organic Compounds (VOCs)	Particulate Matter (PM_{10}) and combustion products[2]	PM_{10} and combustion products
Emissions potential	Moderate	Low	Low
Duration of works	23 weeks	24 months	4-6 month
Distance from site works to residential receptors.	Approximately 900 m from fixed berth dredging areas	Approximately 900 m from fixed berth dredging areas	Greater than 1 km
Potential for adverse air quality impacts	Moderate	Low	Low

Infrastructure Upgrade

The infrastructure upgrade component of the proposed works would involve small scale emission sources, such as diesel generators and welding/oxy-acetylene cutting rigs. Combustion products and particulate matter would be associated with these types of sources. Given the small size of the emission sources and the distance from receptors, these emissions would present a negligible impact to air quality. Subsequently, no quantitative assessment of these sources is considered warranted.

Combustion pollutants would also be associated with the tug and crew support marine vessels. While these would be considered a larger source than previously mentioned sources, they should be viewed within context of the existing environment. Emissions from these sources would be considered low when compared against existing sources within the Botany Bay shipping channels and industrial developments within the area. The emissions from these sources would present a short term and minor impact to air quality. Subsequently no quantitative assessment of these sources is considered warranted.

[2] e.g. oxides of nitrogen (NOx), oxides of sulphur (SOx), carbon monoxide (CO)

4 Qualitative Assessment

Dredging

The dredging component of the proposed works would involve a mechanical dredging operation to remove harbour sediments for off shore disposal (sea dumping). Harbour sediments can present air quality issues with respects to releases of contaminants or odours when the sediments are exposed to ambient air. Given the potential adverse air quality impacts, a review of the dredging operations is provided below.

4.1.1 Review of Dredging Operations

The proposed works involve 'spot-dredging' at select location to leave a broadly flat, uniform area across the base of the footprint. The proposed dredging works would be undertaken using a mechanical dredging technique. This would involve using a backhoe dredge (BHD), which is comparable to a land based excavator. It would be used to load the dredged materials onto split hopper barges. Following loading, the material would be transported to the disposal/reuse areas where they would be unloaded from the bottom of the split hopper barge. The key pollutant of interest associated with dredging would be odour.

Odours may be released from dredged sediment, via two pathways. If the sediment contains residual contamination of VOCs or other odorous compounds, these may be volatised (evaporated) during the extraction, de-watering and exposure to the ambient air environment. The extent of the odour depends on the degree of contamination, the chemical properties of the compounds and other environmental factors. If the sediment contains a high portion of organic matter, the decomposition of the organic matter may result in reduced sulphur compounds, such as hydrogen sulphide (H_2S). The release of these reduced sulphur compounds, which are odorous, may occur when exposed to the ambient air environment.

Victoria's EPA (2001, pg 29-30) notes that "…*odour from anaerobic sediments containing hydrogen sulphide from dredging is rarely more than a temporary problem. Typically, during beach renourishment and when dredging channels at the entrance to rivers, discharged sand is initially anaerobic. When first discharged it is grey in colour and may smell, but the smell is lost and the colour of the sand changes to yellow within a few days of its exposure to air*". This is noted with a strong odour that can be perceived when sediment is exposed, but degrades quickly as the odorous compounds readily oxidise to form less odorous compounds.

A number of sediment investigations for the proposed dredging areas have been undertaken and reported within WorleyParsons (2012). Peat-like material was apparent in the sediment samples, indicating the presence of decomposing organic matter which may result in odours. Further to this, acid sufate soil testing indicates some presence of sulphurous compounds and field log of sample locations indicate that odours (in some instances reported as hydrogen sulphide odour) were noted in some areas within close proximity to the fixed berths. Analytical results from the sediment investigations were shown to be below both reporting and screening levels indicating limited contamination within the sampled sediments. It is noted that tributyltin (TBT) was detected within the sediments sampled.

With regards to TBT contamination, the author notes a study conducted by Vella *et al.* (2002) titled "*Emission to air of volatile organotins from tributyltin contaminated harbour sediments"*. Key points noted from the article are as follows:

- the outcome of a study conducted by Kuballa *et al.* which failed to detect organotins in an ambient air environment is referenced;
- only one of the six experiments conducted within the study detected organotins at a low recovery. In all other experiments, no organotins were detected in the headspace air above the sea water;
- emission of any organotins from the sediments tested were below detection limit during the first 2-3 days of the experiment when the sediments were still visibly wet; and
- "…*the preliminary results presented here suggest that the air pollution from such sediments is probably minor…(page 244)"*

Based on the information presented, the presence of TBT contamination would not present an air quality issue.

However odour has the potential to present short term adverse air quality issues, consequently a quantitative assessment of odour from the dredging operations is provided in **Section5**.

4.2 Review of Operational Activities

On the whole it is anticipated that there would be limited operational changes to the Kurnell port and berthing facility as a result of the proposed works. The only notable change would be the impact brought about through the improved shipping economics, and the proposed need not to export finished product. The changes to the design would introduce flexibility to the shipping schedule and therefore the size of ships that could berth at the Kurnell facility. Whilst there would be an economic impetus to berth larger ships where possible, this would be offset by a significant predicted reduction in overall shipping numbers, which would fall by approximately 24% in 2014 and approximately 41% in 2020 (as compared to 2011 annual figures). However, until these numbers are finalised and any further impact on operation of the port and berthing facility due to the proposed Refinery's conversion are understood it is not possible to validate the beneficial or adverse impacts on air quality.

5

Quantitative Assessment

As described within the qualitative review, odour releases from dredged sediment has the potential or adverse air quality impacts, thus requires a quantitative investigation, as follows.

5.1 Assessment Criteria

The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC, 2005) (the Approved Methods) contain criteria to quantitatively assess the impact of air pollutants on public health and amenity values. With regards to odour the Approved Methods provides assessment criteria as concentrations (mass per unit volume) of individual odorous compounds and concentrations (as odour units) for complex mixtures of odorous compounds. **Table 5-1** provides the assessment criteria for odour as complex mixtures, considered relevant to the proposed works.

Table 5-1 Odour Assessment Criteria (DEC, 2005)

Population of affected community	Impact assessment criteria for complex mixture of odorous air pollutants (OU)[1]
Urban (>= ~ 2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (<= 2)	7.0
Notes: [1] Nose response time average, 99th percentile	

5.2 Odour Emission Assessment

5.2.1 Odour Emission Inventory

A generic emission inventory has been prepared based on the anticipated method discussed in Section 4.1.1. It is anticipated that four hopper barge may be used on a rotational basis, ideally with a capacity to hold 500 m^3. It would be expected that one barge would be loaded at a time, with a second being moored alongside the BHD. The remaining two would be either in transit to, or from, the disposal ground. Odour emissions maybe present at the barge being loaded and would depend on the presence of odorous compounds and the quantity currently loaded. Other barges would be either empty or in transit to the disposal grounds i.e. some distance from sensitive receptors.

Based on this information, a generic odour emission inventory has been prepared. The inventory has been based on a single barge at full capacity (i.e. 500 m^3) containing odorous sediment. A sediment exposure area of 171 m^2 (19 m by 9 m)[3] has been assumed for the full barge. The source was considered at a nominal location at the fixed berth. The surface odour emission rate of the exposed area has been adopted from publically available literature taken from the odours generated from sediments in Newcastle (UNSW, 2003). A Surface Odour Emission Rate (SOER) of 3.357 OU/s/m^2 has been adopted for this assessment. This value is representative of an open area on an excavation barge. It should be noted that Newcastle Harbour sediments were known to contain a high level of

[3] Assumed exposed sediment area of 171 m^2 at a depth of 3 m when loaded onto a full barge. This equates to 513 m^3 of material

odour generating sediments due to the associated contaminants. This may attribute to the surface odour emission rate developed for the Newcastle study. As such this provides a good representation of potential impacts associated with dredging the fixed berths for the proposed works. The odour emission inventory is provided as **Table 5-2**.

Table 5-2 Odour Emissions Inventory for a Barge

Source	Area (m2)	Adopted SOER (Ou/s/m2)	Peak to Mean Ratio	Calculated ER (OU/s)
Exposed sediment on full barge	171	3.357	2.5	1435

Notes: A peak to mean ratio of 2.5 has been adopted for all meteorological conditions as a conservative approach

5.2.2 Dispersion modelling

Emissions dispersion modelling has been undertaken using the Ausplume model. This model is approved by NSW EPA for use in most simple applications. This model is considered capable of representing the key dispersion mechanism in a manner appropriate to this assessment.

Odour emissions have been represented in Ausplume as a single area source representing a full barge containing odorous sediment. Emissions were assumed to take place continuously for each hour of the meteorological dataset, in order to estimate potential impacts over 12 months of meteorological conditions. **Table 14.4** provides a summary of emission parameters that were used in the dispersion modelling.

Table 5-3 Emission Parameters Used in Dispersion Modelling

Emission Parameters	Value	Units
Source height	2	m
Source length	19	m
Source width	9	m
Initial vertical spread	1	m

The Ausplume model was run using a NSW EPA prepared Ausplume file for botany, *Botany.AUS* dating from 1995[4]. The Ausplume modelling scenario has been compiled with the following settings.

- A single modelling scenario considering a full barge located at the fixed berth area (MGA coordinates : 334743 mE, 6236227 mN), with continuous odour emissions as described within the odour emissions inventory;
- A modelling domain configured on a 1200 m long and 1200 m wide Cartesian grid at 50 m resolution;
- Terrain effects have been ignored (due to the activity taking place over open water);
- Pasquill Gifford (PG) dispersion coefficients have been used for both horizontal and vertical dispersion;
- Irwin Urban wind profile exponents have been used.
- The Adjust PG curves for roughness option have been selected.
- A roughness height representative water conditions (0.0001 m) has been used.

[4] This data set is considered representative of the meteorological conditions within the project area

5 Quantitative Assessment

5.2.2.1 Discrete Receptors

For the purposes of assessing the estimated quantitative impacts of odour from dredged sediment a series of discrete receptors were included within the modelling scenario. The receptors were nominated at select locations along the Silver Beach shoreline. These were deemed to represent receptors in this location (i.e. users of the beach) as well as providing a conservative assessment for the residents along Prince Charles Parade. Unlike the noise assessment, no consideration has been made at the Ranger's House in Kamay Botany Bay National Park as this is further away from the fixed berths that Silver Beach and the residents of Prince Charles Parade. **Table 5-4** provides the coordinates of each discrete receptor considered.

Table 5-4 Discrete receptors considered in dispersion modelling

Receptor Identifier	Easting (m)	Northing (m)
R1	335419	6235979
R2	335359	6235845
R3	335256	6235725
R4	335135	6235643
R5	335028	6235573
R6	334889	6235528
R7	334743	6235508
R8	334631	6235479
R9	334513	6235468
R10	334390	6235469
R11	334243	6235482
R12	334087	6235479

5.2.3 Dispersion Modelling Results

Predicted odour concentrations (1 hour averaging, 99th percentile) experienced at the receptor locations above are shown in **Table 5-5** below. The results indicate that odour concentrations are below the NSW EPA guideline value of 2 OU for urban areas. The maximum predicted concentration would be approximately half the above limit experienced at R4, immediately south of fixed berth #1.

Table 5-5 Odour concentrations estimated at discrete receptors

Receptor Identifier	Easting (m)	Northing (m)	99th Percentile odour impact (OU)
R1	335419	6235979	0.2
R2	335359	6235845	0.3
R3	335256	6235725	0.7
R4	335135	6235643	**0.9**
R5	335028	6235573	0.8
R6	334889	6235528	0.7
R7	334743	6235508	0.2
R8	334631	6235479	0.5
R9	334513	6235468	0.5
R10	334390	6235469	0.6
R11	334243	6235482	0.4

5 Quantitative Assessment

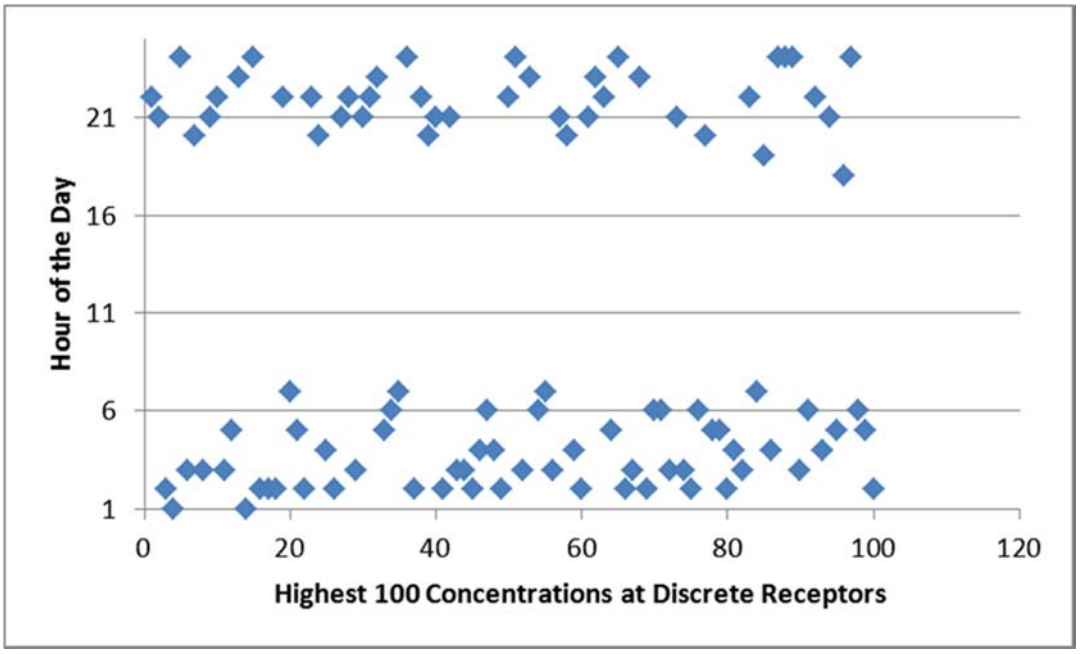
Receptor Identifier	Easting (m)	Northing (m)	99th Percentile odour impact (OU)
R12	334087	6235479	0.1

The predicted odour impacts are also shown on a contour (see **Figure 1** (attached)). The plot shows that the 2 OU contour extends for approximately 300 to 400 m from the source area.

It is noted that the South Australian EPA (2007) nominate a 300 m (with no correction for surface roughness or terrain weighting factors) separation distance for air emissions associated with dredging activities. The extent of the 2 OU contour generally reflects this separation distance providing an indication that the estimate of impacts are appropriate for this assessment.

Air quality and odour impacts are generally associated with emission releases during periods of poor dispersive conditions. Poor dispersive conditions generally occur during the early morning and late evening periods when wind speeds a low (i.e. during calm periods). As the dredging operations are proposed to be conducted during both day and evening periods it is important to understand the periods in which highest impacts are noted. **Table 5-1** provides an analysis of the one hundred highest odour concentrations at discrete receptors as a function of hour.

Figure 5-1 Highest concentrations at discrete receptors vs time of day



As would be expected the highest odour concentrations are associated with early morning, late evening periods.

6

Conclusion

Caltex commissioned URS to undertake an air quality assessment for the Kurnell port and berthing facility upgrade. The air quality assessment has been undertaken in accordance with the relevant air quality legislation, planning policy and guidance.

A qualitative review of the proposed works has considered both the proposed dredging operations and infrastructure upgrades. The qualitative review has concluded the following.

- The air emission sources associated with the infrastructure upgrades were considered minor within the context of the existing operations within Botany Bay, and segregated from sensitive receivers to an extent that would minimise their impact on air quality.
- With respect to emissions from dredged material, tri-butyl tin contamination within the sediment sampling completed to date would present a negligible impact to air quality. No other dredged contaminants were found to give rise to a potentially adverse air quality scenario.
- Odour from dredged sediment was considered a potentially significant source of air emissions and was considered for a quantitative assessment.

A quantitative assessment (conducted using dispersion modelling) has concluded that odour impacts would be confined to the project site, extending up to approximately 400 m from the source area. Consequently, it is unlikely that there would be impacts on the identified sensitive receptors. Additionally, odour would be unlikely to accumulate should immediate disposal not be possible as odour from dredged sediment is typically at its highest within the first couple of hours of being exposed to an ambient air environment, and this situation has been considered within the assessment.

However, it is recognised that there would be potential for recreational water-based users of the offshore areas around the fixed berths (outside of the imposed 100 m Marine Security Zone (see **Section 17.5.2 Volume** 1)) to be exposed to elevated odour concentrations. Under the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, they are not deemed sensitive receptors that require consideration and mitigation, as such impacts would be short term and localised.

6.1 Mitigation Measures

The modelling has confirmed that it is unlikely that there would be impacts to the identified sensitive receptors considered in this assessment. Whilst this suggests no specific mitigation would be required, a number of measures could be adopted by Caltex to limit odorous emissions, as follows:

- Limited de-watering when dredging known odorous, peat-like material. The surface water overlying the dredged material would limit the emissions of odours;
- Dredging during day time hours, outside of weather conditions conducive to odorous situations, shown to be in the early morning and early evening;
- Immediate removal of odorous sediments to disposal areas to limit the time frame for potential emissions.

Additionally the following procedural arrangements would be considered:

- The works' contractor would implement a process of odour screening to identify highly odorous material. When this is found, the works' contractor would notify Caltex, and an appropriate monitoring and management plan would be implemented.
- Continually observe for unanticipated odours during dredging and provision of log books described when odours were apparent and if any corrective action was taken;

6 Conclusion

- Preparation of procedures for handling complaints relating to odours and for responding to local residents.

7

References

DEC (2005) – *Approve Methods for the modelling and Assessment of Air Pollutants in New South Wales,* Department of Environment and Conservation NSW, December 2005

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8

Limitations

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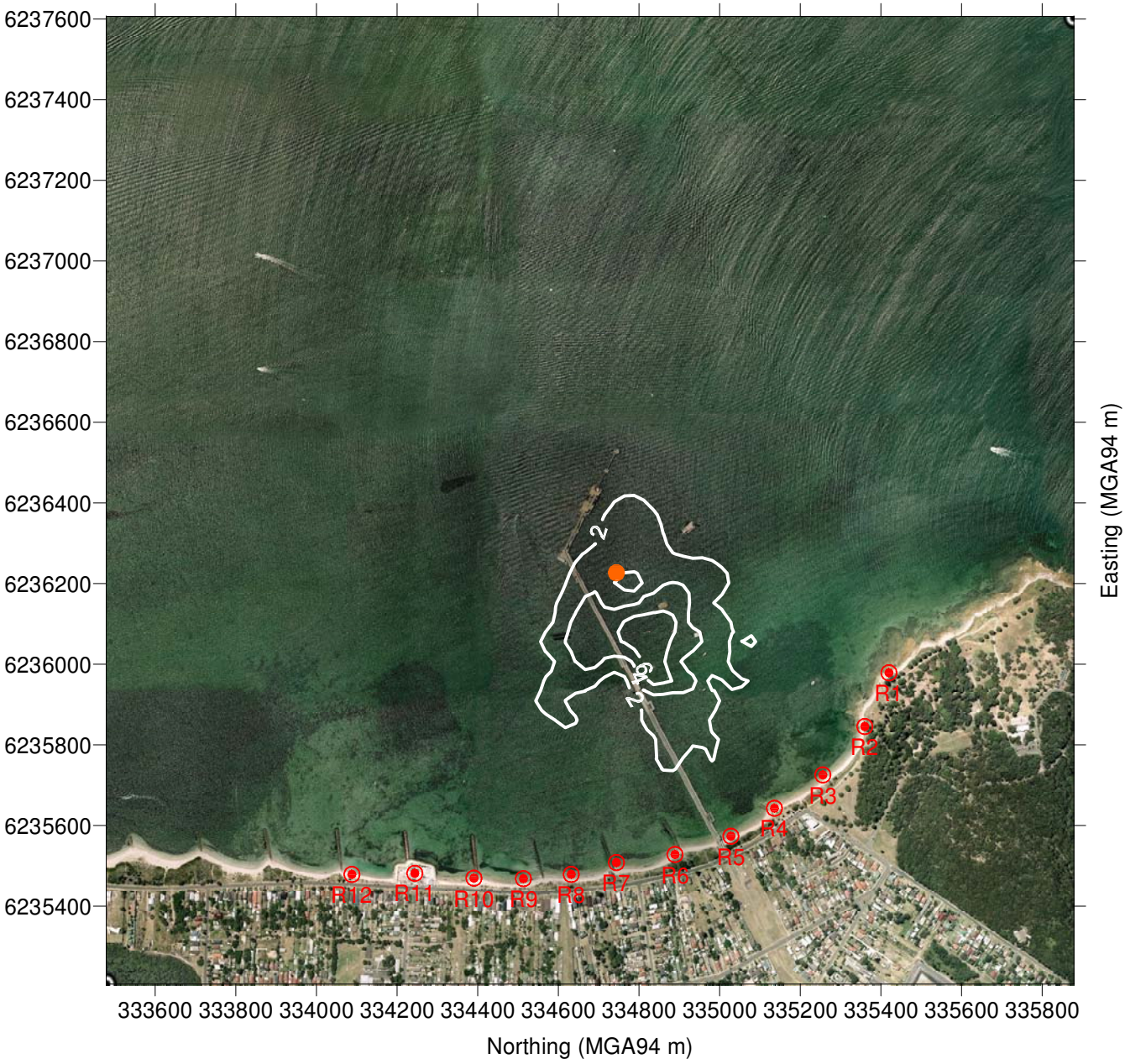
Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Figures



N

= Discrete receptors considered

= Source location considered

Aerial Imagery Sourced from Google Earth Pro

Client: **Caltex Australia Pty Ltd**	Project: **The Kurnell Port and Berthing Project Air Quality Assessment**		Title: Odour Concentation (1 hour averaging) (99th percentile nose response time)
URS	Drawn: RW	Approved: DRAFT	Date: 11 / 10 / 12
	Job No: 43177815	File: 43177815 - Odour Contour.srf	Figure: 1
			Rev: A
			A4

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Appendix I

Preliminary Hazard Analysis Report

PRELIMINARY HAZARD ANALYSIS OF THE PROPOSED KURNELL PORT AND BERTHING PROJECT, BOTANY BAY

Prepared for: URS Australia Limited

Document Number: URS\23-B336

Revision B

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Preliminary Hazard Analysis of the Proposed Kurnell Port and Berthing Project, Botany Bay

Acknowledgment

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Disclaimer

Rev	Date	Description	Prepared By	Reviewed By	Authorised By
A	01/10/2012	Draft for Comment	Karin Nilsson	Maarten Tentij	Karin Nilsson
B	25/10/2012	Draft for Comment	Karin Nilsson	Ros Bongiorno	Karin Nilsson
B v2	25/10/2012	Final report	Karin Nilsson	Ros Bongiorno	Karin Nilsson

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EXECUTIVE SUMMARY

E1 Introduction

Caltex are proposing to upgrade their port and berths at Kurnell Wharf.

A Preliminary Hazard Analysis (PHA) has been prepared by Planager Pty Ltd in accordance with the NSW Department of Planning and Infrastructure Director-General's Requirements for the Development. The PHA will be included in the Environment Impact Statement. The results are summarised in this report.

This analysis has been prepared with reference to the *State Environment Planning Policy No 33* (Hazardous and Offensive Development) and in accordance with the Hazardous Industry Planning Advisory Papers (HIPAPs) Numbers 4 (*Risk Criteria*) and 6 (*Hazard Analysis*).

The Kurnell Port and Berthing Project (the project) comprise the following principal components:

- dredging the seabed in the vicinity of the existing berths, turning circle and approaches;
- reuse of a proportion of the dredged material to cover two exposed sections of the submarine fuel pipelines behind the sub berth and a former anchor point at the approach to the sub berth;
- disposal of the remaining dredged material offshore;
- increase in size of both the fixed berth 'berthing boxes';
- upgrade of the Fixed Berth #1 infrastructure; and
- upgrade of the Sub Berth infrastructure.

E2 Results

The dredging, demolition, construction and operational phases of the proposed works will be subject to rigorous scrutiny by Caltex and by the designing company, safeguarding delivery and operation of the proposed works in a manner that minimises the risk to workers, contractors and the community.

The potential for incidents is well understood and the design of the upgraded port and berthing facility and equipment will minimise the probability of an incident happening and mitigating an incident if it did occur.

The preliminary hazard and risk assessment of the proposed works has found that the levels of risks to the biophysical environment and to the safety of the public, staff and contractors from project are reduced to As Low As Reasonably Practicable (ALARP) levels following the established processes for Caltex as part of their MHF Safety Case regime.

The present risk assessment has shown that the overall risk associated with the proposed works is low and does not introduce an excessive additional risk to the surrounding equipment and plant or to other users or Botany Bay.

E3 Recommendations

Where possible, risk reduction measures have been identified throughout the course of the study in the form of recommendations. These are as follows:

1. Measures would be put in place to control the presence and or spread of Caulerpa taxifolia.

2. A review of working procedures developed by the works' contractor for the berths would be undertaken ahead of the proposed dredging activities. This would be agreed with Caltex and relevant stakeholders. The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.

3. A procedure would be developed for the safe operations of the dredger and hopper barges. This procedure would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. It would be undertaken in conjunction with all stakeholders (including SPC). This procedure would form part of the Port Operating Procedure (POP) discussed in Chapter 17, Amenity, Land Use, Recreation and Navigation.

4. A Dredge and Spoil Management Plan (DSMP) would be prepared (see Chapter 10, Water and Sediment Quality). It would contain controls and measures to ensure no overflow dredging operations within parts of the turning circle and approaches along with the whole of the fixed berths. It would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.

5. Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works.

6. Materials would be available to provide spill containment if required in accordance with Caltex's Emergency Response Plan (STD 4.02.01.01) and Oil-spill Callout and Response Work Procedure (PROC 120.05.001).

7. Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.

8. A Port Operation Procedure (POP) would be developed (see Chapter 17, Amenity, Land Use, Recreation and Navigation). Part of this would include information on the prevailing weather conditions and when works are not permitted to take place within Botany Bay.

9. The dredging program would be audited to ensure the works' contractors are responding to incidences of high turbidity to ensure the effective prevention of sediment plumes being generated. Further controls would be included by way of the DSMP (see Chapter 10, Water and Sediment Quality).

10. A review of safeguards would be undertaken relating to the submerged equipment during detailed project development. This would likely involve considering the further isolation of submerged equipment and pipelines and removal of pollutant material contained in the equipment (e.g. through water flushing) prior to dredging operation.

11. Measures to ensure the dredged sediments would be monitored during transit would be put in place to ensure they would not dry out (see Chapter 9, Spoil and Contamination).

12. During detailed design there would be need to determine the requirement for additional remote operated emergency isolation valves at new loading arms.

13. A review of operational requirements for the berths would be undertaken during mooring activities. This would involve the visibility of pimple buoys at night.

GLOSSARY

ALARP	As Low As Reasonably Practicable
C	Consequence
CBD	Central Business District
DGRs	Director-General's Requirements
CD	Chart Datum
DP&I	Department of Planning and Infrastructure
EIV	Emergency Isolation Valve
EIS	Environment Impact Statement
GPS	Geographic Positioning System
HAZID	Hazard Identification
HIPAP	Hazardous Industry Planning Advisory Paper
JSA	Job Safety Analysis
L	Likelihood
MHF	Major Hazard Facility
OH&S	Occupational Health and Safety
PHA	Preliminary Hazard Analysis
PPE	Personal Protective Equipment
PTW	Permit to Work
SBU	Strategic Business Unit
SMS	Safe Method Statements
SPC	Sydney Ports Corporation

REPORT

1 INTRODUCTION

1.1 BACKGROUND

Caltex are proposing to upgrade their port and berths at Kurnell Wharf.

In accordance with the NSW Department of Planning and Infrastructure (DP&I) Director-General's Requirements (DGRs) for the Development, a Preliminary Hazard Analysis (PHA) has been prepared by Planager Pty Ltd for inclusion in the Environment Impact Statement (EIS). The results are summarised in this report.

This PHA has been prepared with reference to the *State Environment Planning Policy No 33 (Hazardous and Offensive Development),* and in accordance with the NSW DP&I's Hazardous Industry Planning Advisory Papers (HIPAPs) Numbers 4 (*Risk Criteria*) and 6 (*Hazard Analysis*), References 1, 2 and 3.

1.2 SCOPE AND AIM OF THE KURNELL PORT AND BERTHING PROJECT

1.2.1 Scope

The Kurnell Port and Berthing Project (the proposed works) comprise the following principal components:

- dredging the seabed in the vicinity of the existing berths, turning circle and approaches;
- reuse of a proportion of the dredged material to cover two exposed sections of the submarine fuel pipelines behind the sub berth and a former anchor point at the approach to the sub berth;
- disposal of the remaining dredged material offshore;
- increase in size of both the fixed berth 'berthing boxes';
- upgrade of the Fixed Berth #1 infrastructure; and
- upgrade of the Sub Berth infrastructure.

1.2.2 Aim

The proposed works would achieve a number of access improvements:

- increase overall navigability through removing sediment;
- extend the depth, length and width of the two fixed berths to allow larger capacity ships to access, berth and load/unload at the Kurnell Wharf;
- allow the existing turning circle to be relocated 47 m to the north east of its current location in order to achieve adequate separation between the expanded fixed berths and the turning circle; and improved access in and out of the sub berth allowing continued use whilst allowing smaller capacity ships to use the berth than at present.

The dredging would result in the turning circle and approaches being returned to the design depth of 12.8 m below Chart Datum (CD), whilst the sub berth would be returned to the design depth of 14 m below CD. The fixed berths would be dredged to increase the size of the berth boxes and their overall effective depth (12.8 m below CD).

1.3 SCOPE AND AIM OF THE PRELIMINARY HAZARD ANALYSIS

1.3.1 Scope

This PHA identifies and assesses hazards and risks associated with dredging, demolition and construction activities as well as those associated with operational activities, from the mooring of larger ships in berth #1.

It includes a review of hazards and risks associated with potential initiation of incidents during project activities onto the operating refinery (which is a Major Hazardous Facility, as defined in the NSW Regulation), and which operates under a Safety Case regime, This includes the potential for project activities to impact on the fuel supply pipelines and on the operations at the adjacent Fixed Berth # 2.It also includes a review of potential impacts on shipping lanes and queues within Port Botany operations.

The hazards and risks associated with unloading of the larger ships (including transfer of hazardous substances into pipelines and the refinery site) do not form part of the proposed works nor are they discussed in the present PHA.

The following risks are assessed as part of the PHA:

- risk from flammable material;
- environmental risk from spills; and
- safety risks to other users of Botany Bay, to staff and to contractors.

1.3.2 Aim

The aim of the PHA is to:

- provide an assessment of the hazards and risks associated with the proposed works;
- determine the incremental change (increase or decrease) in the risk levels associated with the port and berthing at Kurnell refinery;
- evaluate the resulting risk levels against As Low As Reasonably Practicable (ALARP) criteria.

The aim is in line with the requirements by the NSW DP&I for the proposed project as well as with the requirements for management of hazards and risk in the Caltex Safety Case. The risk associated with the proposed works is assessed qualitatively using the Caltex risk assessment process and risk matrix.

2 SITE AND PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The Kurnell Refinery is located on the Kurnell Peninsula within Sutherland Shire, approximately 30 km south of Sydney's CBD, as shown in

Figure 1 below.

The project site consists of the marine berths of the refinery and is located within the south-eastern portion of Botany Bay, north of the Kurnell Peninsula. It includes the existing marine berths (one sub berth and two fixed berths), a turning circle, the associated approaches and the Kurnell Wharf breasting island.

The project site is bounded to the north and east by the main Botany Bay shipping channel. To the south are Silver Beach, the suburb of Kurnell and the Kurnell Refinery. Towra Point and the inner waters of Botany Bay are located to the west of the Site.

2.2 DREDGING, DEMOLITION AND CONSTRUCTION ACTIVITIES

2.2.1 Dredging and Backfilling Work

Dredging of the Fixed Berth #1 and Sub Berth # 3, including approaches and turning circle would involve the following activities:

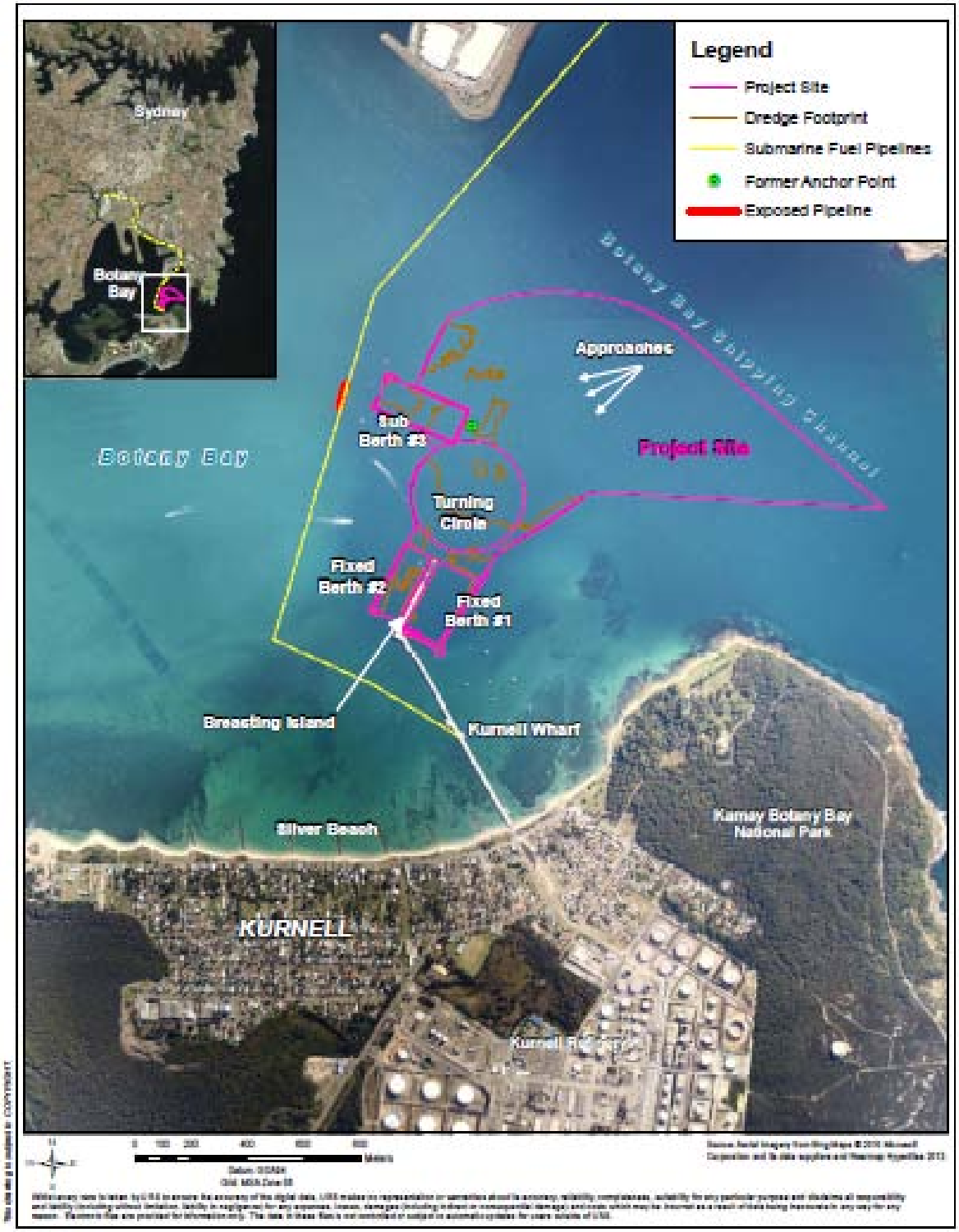
- dredge mobilisation and arrival, positioning, sinking of spuds to support the backhoe dredger, removal of spuds and moving of dredge to next location;
- barge operation including positioning, loading and unloading; and
- backfilling section of exposed submarine pipeline in Botany Bay.

The dredger would be fixed in place using spuds used to create a suspended platform on the seabed. The use of spuds removes the need for anchor lines. Barges and tugboats would moor in the area to the east of the fixed berths where a number of ships that support the maintenance of the wharf facilities currently moor. When in use the barges would moor against the dredge.

The submarine fuel pipelines have become exposed over the past three years resulting in damage to their outer casing (likely due to recreational ships dropping anchor over the pipelines). Consequently, exposed sections of the pipelines would be covered (100m long, 7m wide and 0.7 m deep). It is anticipated that the clean dredged materials would be placed over the submarine fuel pipelines and anchor point by positioning split hopper barges over the relevant locations and releasing the materials from the bottom of the barge.

Management of wastes created during these activities is discussed in Section 2.2.3.

Figure 1 – Project Location



CALTEX KURNELL PORT AND BERTHING PROJECT

PROJECT SITE AND CONTEXT

2.2.2 Construction and Demolition Activities

The existing fixed berths were constructed in the 1950s at the same time as the main wharf structure. Fixed berth #2 was subsequently upgraded in 2002.

The infrastructure used for fixed berth #1 has a number of design limitations, which restrict the size of ship that can be berthed, the peak flow pumping rate and ease of operation due to the use of a manual system. The infrastructure of fixed berth #2, having been upgraded comparatively recently, would not need altering to accommodate larger ships.

The table below shows the infrastructure on the existing berth #1 and compares this with infrastructure after upgrade proposal.

Table 1 – Berth # 1 Upgrade

Infrastructure	Berth #1	
	Existing	After Upgrade
Loading arms and manifold	Manually-operated loading arms and loading manifold	Replacement of the manual loading arms with hydraulic loading arms. No change to manifold.
Protection of wharf	Fenders	Replacement of fenders with a pair of 'breasting dolphins' to allow the berthing of larger ships. Installation of a 'bow mooring dolphin' approximately 40 m northwards of the existing turning dolphin.
Device used to moor the ships	Fixed bollards	Replacement of the bollards with quick release hooks (to allow the ships to berth and cast off more safely and quickly)
Sub berth	The present moorings and buoys are either poorly configured or have reached the end of their design life	Upgrade to comply with the latest industry standards, whilst improving the safety and efficiency with which ships can be moored. The proposal focuses on reconfiguring four of the mooring points around the sub berth
Wharf piles	Existing wharf piles located at the back of berth box	Removal of the existing wharf piles. Construction of a rock revetment

Infrastructure	Berth #1	
	Existing	After Upgrade
Launch jetty	Existing launch jetty attached to Kurnell Wharf	Removal of existing jetty and installation of a launch jetty between the rock revetment and the wharf.
Fire system	Basic fire system, covers scenario with only one berth occupied.	Upgrade of the existing fire safety system The current wharf firewater system would need upgrading to cover the scenario of having both berths occupied simultaneously.

Construction and demolition activities include:

- **Decommissioning of existing fuel lines and loading arms:** Isolation of the existing fuel lines, loading arms and manifold equipment at berth #1, and flushing with water and air to ensure no residual fuel or vapours were present. Cutting of existing fuel lines into 6 metre sections (cold-cut or hot work). Transport, using semi-trailers, of cut up pipe ends (sealed with plastic and taped) on to the main refinery site where they would be hydro-blasted in a dedicated area to remove any residual oil. The redundant loading arms and manifold equipment would be held in the metal yard at the refinery prior to being recycled offsite.

- **New manifold and loading lines,** including installation of the new berth #1 manifold connected to the existing supply lines that currently run from the wharf to the refinery; mounting of three loading arms and installation of three short piping spools to connect the loading arms to the new manifold.

- **Installation of quick release hooks** at various locations on berth #1 wharf to replace the existing bollards, anchored to the wharf top-deck concrete structure.

- **Installation of breasting and bow mooring dolphins,** including piling of foundations (up to 32 piles in total, sunk 10-15 m into the seabed, driven in to the ground using a drop hammer, and installation of a temporary platform to allow workers to install bracing to the pile group to then allow the precast breasting and bow mooring dolphin units to be installed.

- **Installation of rock revetment** comprising graded, interlocked, quarried armour stone, using the dredge.

- **Demolition of existing and replacement with new launch jetty:** on the south end of the Wharf, including piling foundations (as per method discussed above).

- **Decommissioning and removal of old and upgrade of sub berth mooring system** to comply with the latest industry standards, including removal of the existing preventer lines, installation of twin buoys, swamp lines and an anchor, installation of remotely operated quick-release hooks; and the replacement of various mooring chains.

- **Other:** Construction of equipment and construction laydown areas and site offices

Upgrading of Fire system: Upgrading current berth fire system, to cover the scenario of having both berths occupied simultaneously, by installation of a new fire water monitor which would sit atop a 15 m high pipe stack attached to the wharf with the capacity to reach and cover the entire tankage and deck of the larger ships. The monitor would connect directly in to the fire water header.

Electrical upgrade work: Installation of electrical cabling to supply a small hydraulic station for the loading arms, quick release hooks and valves. The cabling would be ducted, running from the existing motor control centre located on the wharf.

Management of wastes created during these activities is discussed in Section 2.2.3.

2.2.3 Waste Disposal

Excess dredge material: The remaining dredged material identified as not suitable for re-use (approximately 147,000 m^3) would be disposed of at the Sydney Offshore Disposal Ground. The disposal ground is located approximately 5 nautical miles (nm) (10 km) east-southeast off Sydney Heads in water depths approximately 100 to 130 m below CD. The offshore disposal grounds cover an area of approximately 23 km^2. The disposal of the materials would be subject to permit approval from the Commonwealth Government under the terms of the *Environment Protection (Sea Dumping) Act (1981),* and is hence outside the scope of this PHA.

Wastes created during dredging: The dredging and backfill operation would generate small quantities of waste diesels, oils and lubricants, hydraulic fluid, sewage, cooking oil, ablutions and detergents. Each ship would carry an approved spill kit and containment provisions (i.e. bunded areas), working under practices consistent with Caltex's procedures for managing waste so as to ensure appropriate storage, transfer, handling, management and disposal. Assessment of hazards and risks associated with waste disposal forms part of this PHA.

Wastes created during decommissioning of existing lines and equipment at berth #1: The displaced water flushed through the existing fuel lines to berth #1, and associated equipment, would be directed to specific 'slop drums'. The oily water would then be pumped to the dedicated 'slop line' using the existing 'slop pumps' installed on the wharf. The oily water would be treated in the

refinery at its dedicated waste water treatment plant prior to disposal under the terms of the site environmental protection licence. It is estimated that the flushing waters would total approximately 10,000 m^3. Any oily water generated during the cutting of gas free pipe into section and during hydro-blasting would be treated in the waste water treatment plan prior to its controlled discharge under licence

2.3 OPERATION OF UPGRADED PORT

Operation of the upgraded port and berth would involve the following activities:

- vessel arrival;
- vessel mooring;
- time spent in the berth;
- vessel unmooring; and
- sailing

Mooring in the berth would use the upgraded sub berth mooring design Wharf Fender & Turning Dolphin installation and operation.

3 STUDY METHODOLOGY

The methodology for the PHA is well established in Australia. The assessment has been carried as per the DP&I's HIPAP No 4 (*Risk Criteria for Land Use Planning*, Ref 2) and HIPAP No 6 (*Guidelines for Hazard Analysis*, Ref 3).

3.1 HAZARD IDENTIFICATION

The hazard identification includes a review of potential hazards associated with all dangerous and hazardous goods and activities associated with the proposed works. The hazard identification includes a comprehensive identification of possible causes of potential incidents and their consequences to public safety and the biophysical environment, as well as an outline of the proposed operational and organisational safety controls required to mitigate the likelihood of the hazardous events from occurring.

The tasks involved in the hazard identification of the proposed upgrade project included a review of all relevant data and information to highlight specific areas of potential concern and points of discussion, including drafting up of preliminary hazard identification (HAZID) word diagram, as summarised in Table 2 and detailed in Table 3.

A number of hazard identification and risk assessment studies had already been completed by a multidisciplinary team comprised of people with operational / engineering / risk assessment expertise (and summarised in the reports for the project, references 4, 5, 6, 7 and 8). The HAZID word diagram in the PHA was prepared based on the output from these studies and on Planager's knowledge of similar installations and facilities.

The review takes into account both random and systematic errors, and gives emphasis not only to technical requirements, but also to the management of the safety activities and the competence of people involved in them.

3.2 CONSEQUENCE, LIKELIHOOD AND RISK ANALYSIS

The risk associated with each incident scenario has been evaluated in turn for the situation before and after the upgrade project, using the Chevron Integrated Risk Prioritization Matrix, presented in Figure 2 below.

In performing the qualitative risk priority ranking, each cause-consequence scenario has been evaluated based on the severity of potential consequences and how probable it is that these consequences might fully develop (likelihood) with safeguards in place, according to:

$$Risk = Consequence \times Frequency$$

The consequence ranking (1 to 6) and likelihood ranking (1 to 6) are been combined the matrix to provide a risk priority ranking (1 to 10). Risk rankings are documented with "C" representing consequence, "L" representing likelihood, and "Risk" representing risk priority levels.

Figure 2 - Chevron Integrated Risk Prioritization Matrix

Chevron Integrated Risk Prioritization Matrix

For the Assessment of HES & Asset Risks from Event or Activity

Likelihood Descriptions & Index (with confirmed safeguards)

Likelihood Descriptions	Likelihood Indices		Legend	6	5	4	3	2	1
Consequences can reasonably be expected to occur in life of facility	1	Likely		6	5	4	3	2	1
Conditions may allow the consequences to occur at the facility during its lifetime, or the event has occurred within the Business Unit	2	Occasional		7	6	5	4	3	2
Exceptional conditions may allow consequences to occur within the facility lifetime, or has occurred within the OPCO	3	Seldom		8	7	6	5	4	3
Reasonable to expect that the consequences will not occur at this facility. Has occurred several times in the industry, but not in the OPCO	4	Unlikely		9	8	7	6	5	4
Has occurred once or twice within industry	5	Remote		10	9	8	7	6	5
Rare or unheard of	6	Rare		10	10	9	8	7	6

Decreasing Likelihood

Legend applies to identified HES risks (see guidance documents for additional explanations)

1, 2 , 3, 4 - Short-term, interim risk reduction required. Long term risk reduction plan must be developed and implemented.

5 - Additional long term risk reduction required. If no further action can be reasonably taken, SBU management approval must be sought to continue the activity.

6 - Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant requirements of the Risk Mitigation Closure Guidelines.

7, 8, 9, 10 - Manage risk. No further risk reduction required. Risk reduction at management / team discretion.

Consequence Descriptions & Index (without safeguards)

Decreasing Consequence/Impact

Consequence Descriptions	Consequence Indices	6	5	4	3	2	1
		Incidental	Minor	Moderate	Major	Severe	Catastrophic
Safety		**Workforce:** Minor injury such as a first-aid. *AND* **Public:** No impact	**Workforce:** One or more injuries, not severe. *OR* **Public:** One or more minor injuries such as a first-aid.	**Workforce:** One or more severe injuries including permanently disabling injuries. *OR* **Public:** One or more injuries, not severe.	**Workforce:** (1-4) Fatalities *OR* **Public:** One or more severe injuries including permanently disabling injuries.	**Workforce:** Multiple fatalities (5-50) *OR* **Public:** multiple fatalities (1-10)	**Workforce:** Multiple fatalities (>50) *OR* **Public:** multiple fatalities (>10)
Health (Adverse effects resulting from chronic chemical or physical exposures or exposure to biological agents)		**Workforce:** Minor illness or effect with limited or no impacts on ability to function and treatment is very limited or not necessary *AND* **Public:** No impact	**Workforce:** Mild to moderate illness or effect with some treatment and/or functional impairment but is medically manageable *OR* **Public:** Illness or adverse effect with limited or no impacts on ability to function and medical treatment is limited or not necessary.	**Workforce:** Serious illness or severe adverse health effect requiring a high level of medical treatment or management *OR* **Public:** Illness or adverse effects with mild to moderate functional impairment requiring medical treatment.	**Workforce** (1-4): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public:** Serious illness or severe adverse health effect requiring a high level of medical treatment or management.	**Workforce** (5-50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** (1-10): Serious illness or chronic exposure resulting in fatality or significant life shortening effects.	**Workforce** (>50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** (>10): Serious illness or chronic exposure resulting in fatality or significant life shortening effects.
Environment		Impacts such as localized or short term effects on habitat, species or environmental media.	Impacts such as localized, long term degradation of sensitive habitat or widespread, short-term impacts to habitat, species or environmental media	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media	Impacts such as significant, widespread and persistent changes in habitat, species or environmental media (e.g. widespread habitat degradation) .	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.	Loss of a significant portion of a valued species or loss of effective ecosystem function on a landscape scale.

The above legend applies only to HES risks, where risk levels 1-6 are actionable and mandatory.
For risks that may result in facility damage, business interruption, loss of product, the "Assets" category below should be used.
Asset risk reduction is at the discretion of management. Under no circumstances may a direct or indirect translation of Asset loss to HES consequences, or between any discrete categories of HES consequences be inferred.

Consequence Descriptions & Index (without safeguards)

Consequence Descriptions	Consequence Indices	6	5	4	3	2	1
		Incidental	Minor	Moderate	Major	Severe	Catastrophic
Assets (Facility Damage, Business Interruption, Loss of Product)		Minimal damage. Negligible down time or asset loss. Costs < $100,000.	Some asset loss, damage and/or downtime. Costs $100,000 to $1 Million.	Serious asset loss, damage to facility and/or downtime. Costs of $1-10Million.	Major asset loss, damage to facility and/or downtime. Cost >$10 Million but <$100 Million.	Severe asset loss or damage to facility. Significant downtime, with appreciable economic impact. Cost >$100MM but <$1billion.	Total destruction or damage. Potential for permanent loss of production. Costs >$1billion

This matrix is endorsed for use across the Company.
It is not a substitute for, and does not override any relevant legal obligations.
Under no circumstances should any part of this matrix be changed or modified, adapted or customized.
This matrix identifies health, safety, environmental and asset risks and is to be used only by qualified and competent personnel.
Where applicable it is to be used within the Riskman2 structure and governance of an OE Risk Management Process. If applied outside of these Processes, it is also mandatory to manage identified intolerable risks and comply with the Risk Mitigation Closure Guidelines.

3.3 RISK REDUCTION AND COMPARING WITH RISK TOLERABILITY CRITERIA

The Integrated Risk Prioritization Matrix rankings are numbered and aligned with associated required actions for health, environment and safety risks, these include:

- Risk levels 1, 2, 3, 4 – Short-term, interim risk reduction required. Long term risk reduction plan must be developed and implemented. No scenarios with risk levels 1, 2, 3, 4 were identified for this project.

- Risk level 5 – Additional long term risk reduction required. If no further action can be practicably taken, Strategic Business Unit (SBU) management approval must be sought to continue the activity. Two scenarios were identified having a risk level of 5, one during dredging activities and one during operational activities.

- Risk level 6 – Risk is tolerable if reasonable safeguards / managements systems are confirmed to be in place and consistent with relevant Risk Reduction Procedure and Closure Guidelines.

- Risk level 7, 8, 9, 10 – No further risk reduction required if risk level is As Low As Reasonably Practicable (ALARP).

As per the Caltex Safety Case regime, recommendations are provided for risk priority rankings 5 and above, as well as for events or conditions with low likelihood and high consequence that may require further risk evaluation.

Further, recommendations are also provided for risks where they would eliminate or mitigate the potential causes and / or consequences predicted for the scenario.

The Integrated Risk Prioritization Matrix and associated required actions are used consistently by Caltex when developing the Safety Case of the refinery and associated facilities, as part of the requirements under the Major Hazard Facility Regulations.

3.4 SAFETY MANAGEMENT SYSTEMS

Caltex have a commitment to Occupational Health and Safety (OH&S) and have numerous policies and procedures to achieve a safe workplace. Procedures specific to the upgraded plant and its environment will be developed and incorporated into the safety management system.

The upgraded berth and wharf equipment will comply with all current, relevant codes and statutory requirements with respect to work conditions. There will be no changes to existing precautions observed at the berth and wharf, in particular, standards and requirements for the handling of flammable liquids. All personnel

required to work with these substances are trained in their safe use and handling, and are provided with all the relevant safety equipment.

Emergency procedures have been developed and will be reviewed in the light of the proposed changes. The emergency procedures include responses to emergency evacuation, injury, major asset damage or failure, critical failures, spillages, major fire, and threats.

The refinery has a manager with overall responsibility for safety, who is supported by experienced personnel trained in the operation and support of the plant and associate facilities, including for the wharf and berths.

A Permit to Work (PTW) system, including Hot Work Permit, and a Management of Change system are in use.

Injury and incident management is proceduralised and people are trained in how to report incidents. An established incident reporting and response mechanism has been established, providing 24 hour coverage.

Protective systems will be tested to ensure they are in a good state of repair and function reliably when required to do so. This will include scheduled testing of trips, alarms, detectors, relief devices and other protection systems.

All persons involved in project activities are provided with appropriate personal protective equipment suitable for use with the specific hazard.

At least one person is trained in first aid; and a list of persons trained in, and designated as being responsible for the administering of, first aid is shown on the noticeboards on the premises.

4 HAZARD IDENTIFICATION

4.1 VOLUMES OF DANGEROUS GOODS AND NUMBERS OF MARINE VESSELS THROUGH BOTANY BAY

4.1.1 During Dredging, Construction and Demolition Activities

The following marine vessels would be used to support the dredging, construction and demolition activities.

With the exception of the diesel used for fuel of the marine vessels, no Dangerous Goods would be moved through Botany Bay as part of the dredging, construction and demolition activities.

During peak dredging: one backhoe dredger, four barges and up to 5 tugboats. One or two additional service ships would also be periodically required.

Construction / demolition activities: One dredger, two hoppers and supporting tugboats during construction of the rock revetment.

One barge, supporting tugboat, crew ship and a dive team during construction of the breasting dolphin, bow mooring dolphin, sub berth upgrade and launch jetty, and for delivery of the dolphins and launch jetty prefabricated buoys, anchors, moorings for the berths and the stone for the revetment.

4.1.2 During Operational Activities

The number of ships that will travel through Botany Bay after completion of the proposed works project will decrease from an annual 198 in 2011 to 160 marine vessels in 2014 and approximately 140 marine vessels in 2020.

4.2 HAZARDOUS INCIDENT SCENARIOS

The Hazard Identification Word Diagram has been prepared for this project and presented in Table 3. It includes initiating causes, consequences and proposed / existing safeguards to minimise consequences of likelihood of an incident.

Further discussions and evaluation of safeguards is provided in Section 5.

This table draws from the potential incident scenarios identified during the hazard identification exercises that were undertaken (and summarised in the reports for the project, references 9, 10, 11, 12 and 13), as well as based on Planager experience.

A total of 17 hazards were identified, 14 of these are associated with dredging, construction and demolition activities and three (3) are associated with the operational activities of the upgraded wharf and #1 berth.

Those hazards that are associated with dredging, construction and demolition activities have a limited life and will be eliminated at the completion of this stage of the project.

Those hazards that are associated with operational activities are ongoing throughout the life of the Terminal.

A summary listing of the hazards associated with the project is listed in Table 2 below.

Table 2 - Summary Listing of Identified Hazards

No.	Hazard
Dredging and Facility Upgrade	
1	Spreading of noxious weeds in Botany Bay
2	Hazardous interaction between marine ships and commercial/recreational ships
3	Extreme weather
4	Disturbing sediments containing tributyltin (TBT)
5	Loss of containment of environmental polluting material (diesel, oil etc.)
6	Injury during facility upgrade activities
7	Electrical hazards
8	Generation of sediment plumes
9	Hazardous interaction with ongoing operations at the Kurnell Wharf
10	Generation of acid sulphate soils (ASS)
11	Failure to remove flammable gas and liquid at fuel lines at fixed berth #1 prior to the proposed facility upgrade
12	Failure to isolate flammable material from existing operational supply lines
13	Loss of containment of displaced water flushed through the fuel lines at fixed berth #1
14	Generation of excessive noise levels
Continuing Operation of the Port and Berthing Facility	
15	Hazardous interaction between the marine ship and operations at the wharf
16	Extreme weather
17	Hazardous interaction between moored ships/ships transferring through Botany Bay and commercial / recreational ships in the area

Table 3 – Hazard Identification Word Diagram

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
Dredging, Construction and Demolition Activities					
1	The spread of noxious weeds within the marine environment during dredging and as a result of the reuse of sediments within the Bay, with potential for long-term or persistent environmental harm.	• Ballast water discharge is not permitted. • A regular inspection of any berthing ships is required to ensure no introduction of pest species. **Recommendation 1:** Measures would be put in place to control the presence and or spread of *Caulerpa taxifolia*.	N/A	C: Major L: Seldom Risk: 5	Introduced by the project Conservative risk ranking.
2	Hazardous interactions between ships involved in the proposed dredging and upgrade works and the current commercial and recreational ships that use the area, with the potential for personnel injury or the loss of personnel overboard.	• The Sydney Ports Corporation Control Tower issues warnings for maritime activities. • A speed limit of < 4 knots is set in place when within 200 m of maritime activities at the port and berthing facility. • Ships are lit at night. **Recommendation 2:** A review of working procedures developed by the works' contractor for the berths would be undertaken ahead of the proposed dredging activities. This would be agreed with Caltex and relevant stakeholders. The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.	N/A	C: Major L: Unlikely Risk: 6	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
3	Extreme weather resulting in damage to ships involved in the proposed dredging and upgrade works with the potential for personnel injury or the loss of personnel overboard.	• The weather forecast communicated to all ships. • There is the ability to relocate and moor safely in extreme weather conditions and at short notice. • The dredged, split hopper barges and all other ships would be fully manned. • A working procedure would be prepared for the operation of the barges and dredger in consultation with SPC. • Personal flotation devices are a requirement for all staff on ships mooring at the port and berthing facility. **Recommendation 3**: A procedure would be developed for the safe operations of the dredger and hopper barges. This procedure would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. It would be undertaken in conjunction with all stakeholders (including SPC). This procedure would form part of the *Port Operating Procedure* (POP) discussed in **Chapter 17, Amenity, Land Use, Recreation and Navigation**.	N/A	C: Major L: Unlikely Risk: 6	Introduced by the project
4	Disturbing sediments containing TBT, and loading and reuse of these sediments within Botany Bay potentially leading to contamination and long-term environmental harm.	• Dredging activities are managed through a process of development application approval. The loading, transport and dumping is permitted under the *Commonwealth Environment Protection (Sea Dumping) Act 1981* as supported by the *National Assessment Guidelines for Dredging 2009* **Recommendation 4:** A *Dredge and Spoil Management Plan* (DSMP) would be prepared (see **Chapter 10, Water and Sediment Quality**). It would contain controls and measures to ensure no overflow dredging operations within parts of the turning circle and approaches along with the whole of the fixed berths. It would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.	N/A	C: Major L: Unlikely Risk: 6	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
5	Loss of containment event (diesels, oils, lubricants and hydraulic fluids) from ships as a result of the proposed works.	**Recommendation 5:** Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works. **Recommendation 6:** Materials would be available to provide spill containment if required in accordance with Caltex's Emergency Response Plan (STD 4.02.01.01) and Oil-spill Callout and Response Work Procedure (PROC 120.05.001). **Recommendation 7:** Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.	N/A	C: Incidental L: Likely Risk: 6	Introduced by the project
6	Workplace injuries.	• A Work Method Statements (WMS) would be prepared. This would include Job Safety Analysis (JSA) (which would be undertaken consistent with current working practices). The WMS would also include that safe working loads are established that adequate support is provided for cranes and an assessment of the capacity and performance of marine equipment to account for working conditions (currents, movements over water, working on water) is undertaken. • A naval architect would be used to assess the lifting and performance of the equipment (cranes, hooks etc.). • Requirement to check the safety performance of the past performance of the works' contractor(s). • For all works, a pre-start meeting would be held to forewarn of any hazards and provide guidance and advice on safe working methods (i.e. tool-box talks). • Restricted areas would be established and set out. These would be highlighted during the pre-start (tool-box) talks.	N/A	C: Major L: Unlikely Risk: 6	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
		• The weather would be regularly monitored and no works would proceed during adverse and unsafe weather conditions. • Appropriate PPE would be provided to all personnel. This would include ensuring all works contractors provide a personal floatation device to staff.			
7	Electrical hazards during the proposed upgrade of the electrical system leading to injury and/or fire.	• Contractor selection process, experienced personnel. • Training and qualifications of workforce as per Caltex procedures for electrical work. • Permit to Work, including lock-out / tag-out. • Appropriate PPE.	N/A	C: Major L: Unlikely Risk: 6	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
8	Generation of sediment plumes leading to contamination, smothering, and degradation of seagrass habitat and impacts on other sensitive marine species and receptors.	• Safe operational limits would be confirmed through modelling. • A dredging method has been adopted that minimises sediment dispersion of possible alternatives (see **Chapter 2, Project Need and Alternatives**). • Global Positioning would be used to ensure accurate dredging and placement of the proposed reuse and dumping locations. • Barge unloading activities would be closely monitored. • Continuous turbidity monitoring would be carried out during (please see Chapter 10, Water and Sediment Quality within the EIS). **Recommendation 8:** A *Port Operation Procedure* (POP) would be developed (see **Chapter 17, Amenity, Land Use, Recreation and Navigation**). Part of this would include information on the prevailing weather conditions and when works are not permitted to take place within Botany Bay. **Recommendation 9:** The dredging program would be audited to ensure the works' contractors are responding to incidences of high turbidity to ensure the effective prevention of sediment plumes being generated. Further controls would be included by way of the DSMP (see **Chapter 10, Water and Sediment Quality**).	N/A	C: Moderate L: Unlikely Risk: 7	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
9	Hazardous interaction between ongoing port and berthing activities leading to impacts on submerged submarine fuel pipelines, hoses, risers etc., resulting in the loss of containment of crude oil and petroleum products.	• Type and design of the proposed dredger reduces risk of inaccurate dredge location during heavy seas. • There is the ability to isolate the underwater equipment from the wharf breasting island. • A working procedure would be prepared for the operation of the barges and dredger in consultation with SPC. • The existing hose locations in the sub berth would be identified. These are currently being avoided by the proposed works. **Recommendation 10**: A review of safeguards would be undertaken relating to the submerged equipment during detailed project development. This would likely involve considering the further isolation of submerged equipment and pipelines and removal of pollutant material contained in the equipment (e.g. through water flushing) prior to dredging operation.	N/A	C: Moderate L: Unlikely R: 7	Introduced by the project
10	Removal of ASS leading to short-term localised environmental harm and impacts on the marine environment.	• Short residence time is unlikely to cause sulphides contained in the sediments to oxidise. • Sediments covered by a layer of water. **Recommendation 11:** Measures to ensure the dredged sediments would be monitored during transit would be put in place to ensure they would not dry out (see **Chapter 9, Spoil and Contamination**).	N/A	C: Minor L: Seldom Risk: 7	Introduced by the project
11	Failure to remove flammable gas and liquid at fixed berth # 1 during the facility upgrade leading to a loss with the potential to pollute the marine environment and/or cause personnel injury.	• Caltex Permit to Work procedure, including lock-out tag-out requirements. • Positive isolation from all fuel sources and flushing of pipelines prior to any removal of pipes being allowed. • Flammable gas monitoring required as part of PTW procedure if hot work is used for cutting of pipes.	N/A	C: Major L: Remote Risk: 7	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
12	Failure to isolate the operational supply lines when connecting to the proposed upgraded manifold on the Kurnell Wharf leading to a loss a flammables.	• Caltex Permit to Work procedure, including lock-out tag-out requirements.	N/A	C: Major L: Remote Risk: 7	Introduced by the project
13	Loss of displaced water flushed through the existing fuel lines and pipework that would be removed through the proposed upgrade of fixed berth #1 resulting in the pollution of the marine environment.	• Caltex Permit to Work procedure, including lock-out tag-out requirements.	N/A	C: Major L: Remote Risk: 7	Introduced by the project
14	Excessive noise generation leading to excessive surface and underwater noise impacting sensitive receptors in Kurnell or underwater marine fauna.	• Dredge and barge operation not believed to be noisy in comparison to other activities around Botany Bay. • Activity is relatively short term and will not have the potential to affect more than one breeding season.	N/A	C: Moderate L: Remote Risk: 8	Introduced by the project

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
Operation of Upgraded Port					
15	Hazardous interaction between moored ships and the sub berth equipment (including manifolds), wharf equipment (including risers) and the hydraulic loading arm leading to an oil spill with consequential marine pollution and/or personnel injury.	• Marine ships are secured at fixed berths through the use of port anchor and tug. Bow, Stern and Quarter lines would be used to ensure that the ship remains secure. . • Ships are only berthed during the run-in tide requiring a clearance of about 700 mm at sub berth. • The provision of a sub berth warning system provides information to pilots of berthed ships when hazardous interactions with other water craft are likely. • Pilots provide an independent assessment of the berth safety. • A Spar buoy would be positioned relative to the crude riser and would allow pilots to be provided with an indirect indication of the location of the sub berth riser. • There is the presence of an existing wharf emergency shutdown system. This includes provisions for the isolation of underwater equipment from a safe location at wharf breasting island. • The wharf and ship both are both equipped with fire-fighting system. • A port and berthing facility oil spill emergency response plan is in place to manage current operations. • An emergency plan relating to the hazardous interaction between marine ship and commercial/ recreational ships is managed by the Master of the ship. **Recommendation 12:** During detailed design there would be need to determine the requirement for additional remote operated emergency isolation valves at new loading arms.	C: Major L: Seldom Risk: 5	C: Major L: Seldom Risk: 5	Slight increase in potential consequences due to the increased quantity of fuel available to fuel a fire with the new loading arms design. The new sub berth design should reduce the likelihood of the event. Result is a marginal decrease in risk levels.

No	Hazard	Safeguards	Risk Prior to Upgrade	Risk After Upgrade	Increase / Decrease of Risk Level
16	Extreme weather resulting in damage to ships, with the potential for personnel injury or the loss of personnel overboard.	• Only double hulled ships would be allowed at the berth. Caltex approval is required for ships to be allowed to moor at the sub berth. • The warning system on the sub berth is used warn ships. • Pilots are provided with an independent assessment of the berth safety prior to mooring. • Ships are prevented from mooring and casting off during poor weather (high wind/low visibility) this would reduce the likelihood of incidents occurring due to poor visibility or high seas. A decision on the permissibility of travel would be made by the pilot in consultation with the Harbourmaster. • Ships are escorted by tugs during their approach to berths. Ability to place tugs on standby.	C: Severe L: Remote Risk: 6	C: Severe L: Remote Risk: 6	No change
17	Hazardous interaction between commercial and recreational ships and either moored ships or ships that are in transit to and from the port and berthing facility, with the potential for personnel injury or the loss of personnel overboard.	• A speed limit of < 4 knots is set in place when within 200 m of maritime activities at the port and berthing facility. • Ships are lit at night to increase the visibility and reduce the likelihood of a hazardous interaction between marine ship and commercial/ recreational ships. **Recommendation 13:** A review of operational requirements for the berths would be undertaken during mooring activities. This would involve the visibility of pimple buoys at night.	C: Severe L: Rare Risk: 7	C: Severe L: Rare Risk: 7	Increase in risk levels due to the increase in the number of marine vessels travelling through Botany Bay

5 DETAILED CONSIDERATION OF ALL HAZARDS AND ASSOCIATED CONTROLS

The Hazard Identification Word Diagram in Table 3 details the control mechanisms for each identified hazard associated with the proposed works. Further details on these controls are provided below.

5.1 DREDGING, DEMOLITION AND CONSTRUCTION ACTIVITIES

The following hazards and controls are identified for the activities associated with dredging, construction and demolition. Where the controls were not deemed as sufficient to reduce the risk level to ALARP, further safeguards have been recommended.

5.1.1 Spread of noxious weeds within the marine environment during dredging

The extent and credibility of this potential hazard is yet to be determined and has therefore been rated conservatively. Measures would be put in place to control the presence and or spread of Caulerpa taxifolia.

5.1.2 Hazardous interaction between marine vessel and commercial / recreational ships in the area

In case of inadvertent interaction between marine vessels involved in the dredging and construction/demolition activities, there is a potential for personnel injury or man overboard. A number of well-established controls apply to manage this hazard, including SPC's existing operating procedures and Control Tower issuing warnings for maritime activities and the speed limit of less than 4 knots when within 200 m of maritime activities, as per NSW regulations. Further, Port regulations require the marine vessels involved in this work to be lit, also when not operating. It is recommended that working procedures be developed by the works' contractor for the berths and agreed with Caltex and relevant stakeholders.

5.1.3 Extreme weather and swell leads to damage to ships

This scenario has the potential for personnel injury or man overboard. This potential is well understood by the operators of the marine vessels involved in the works. Mitigation measures include forecasting of weather conditions; preparation of working for the operation of the barges and dredger in consultation with SPC; the ability to relocate and moor safely in extreme weather conditions and at short notice and requirement of all staff to wear personal flotation devices. To further reduce the risk associated with this potential hazard it is recommended that a procedure be developed for the safe operations of the dredger and hopper barges, determining the need for a works-specific operation safety plan for extreme weather conditions.

5.1.4 Disturbing sediments containing tributyltin

Certain sediments in Botany Bay are known to contain TBT which is a toxic substance with a potential to lead to sea floor contamination and long term habitat degradation as well as flow on effect on humans.

Failure to manage the dredging and backfill operations have a potential of disturbing and spreading this material inside of Botany Bay, to previously uncontaminated areas.

The hazard associated with TBT is well known and understood by Caltex, measures have been put in place to ensure effective management of this risk during dredging and backfill activities.

The *National Assessment Guidelines for Dredging 2009* (Ref **Error! Bookmark not defined.**) sets up the framework for the environmental impact assessment and permitting of the ocean disposal of dredged material. The framework includes evaluating alternatives to ocean disposal, assessing loading and disposal sites, assessing potential impacts on the marine environment and other users, and determining management and monitoring requirements. The Guidelines refer to the *Sea Dumping Act (Ref 14)* and its Regulations (Ref 15), the *Environment Protection and Biodiversity Conservation Act 1999* (Ref 16), and Australia's international obligations outlined in the London Protocol as set in the Sea Dumping Act. Caltex is committed to follow all requirements under these Guidelines.

Caltex has undertaken a thorough identification of contaminated areas (Ref **Error! Bookmark not defined.**). Further steps in ensuring full compliance with the guideline's requirements are being implemented as part of the detailed design process.

It is recommended that a *Dredge and Spoil Management Plan* (DSMP) be prepared, detailing the controls and measures to ensure no overflow dredging operations within parts of the turning circle and approaches along with the whole of the fixed berths and the measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.

5.1.5 Loss of containment of environmentally pollutant material

The vessels involved in the dredging and construction/demolition work carry diesel, oils, lubricants and hydraulic fluids which would be pollutant to the environment if not managed appropriately.

To minimise the risk of a loss of containment, Materials would be available to provide spill containment if required in accordance with Caltex's Emergency Response Plan.

Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works.

Pre start checks would be included in the daily log book and would be completed prior to mobilisation. Drip trays would be provided under machinery containing hydraulic oil.

Any off ship incidents would be managed as per established procedures.

5.1.6 Workplace injuries

As for all demolition and construction activities there is a potential for personnel injury.

Safeguards include the selection of the contractor involved in the proposed works based on experience, preparation, issuing and communication of the contractor Safe Method Statements, including Job Safety Analysis. Safe working loads and adequate support for cranes will be determined.

Job pre-start meetings will be conducted prior to the start of each shift, and the area will be sealed off and restricted to non-authorised personnel. Restricted areas would be established and set out. These would be highlighted during the pre-start (tool-box) talks.

Weather forecasts and monitoring and appropriate PPE, including personal floatation device would also be appropriate to manage this risk.

5.1.7 Electrical hazards

The proposed works include upgrade of the electrical system to berth #1. Such work is inherently hazardous due to the hazardous nature of high voltage electricity. However, it is also well known and understood by the personnel involved in the project and specific safeguards include the selection process for the contractor and the experience of personnel, training and qualifications of workforce as per Caltex procedures for electrical work, and adherence to Permit to Work, including lock-out / tag-out procedures.

5.1.8 Generation of sediment plumes

Generation of sediment plumes, including from emergencies such as a pipe break or rupture, spillage or unplanned overflow dredging, may lead to leading to sedimental contamination and degradation of sea grass and to adversely affecting marine species (including benthonic).

Caltex has performed computer generated modelling of the dredging and spoil unloading work to determine safe operational limits. The results from the modelling are used to develop procedures and requirements for safe dredge, barge and backfill operation.

A dredging method has been adopted that minimises sediment dispersion of possible alternatives (see Chapter 2, Project Need and Alternatives). Further, the barges are fitted with GPS locating device and displacement indication to ensure a controlled unloading operation.

Continuous turbidity monitoring would be carried out during (please see Chapter 10, Water and Sediment Quality within the EIS).

The unloading of barge contents is also closely monitored by Caltex, the dredge operator and SPC and a survey will be performed afterwards to ensure that material is building up over the existing pipeline as required.

It is recommended that a Port Operation Procedure is developed, including information on the prevailing weather conditions and when works are not permitted to take place within Botany Bay.

It is also recommended that the dredging program are audited to ensure the works' contractors are responding to incidences of high turbidity to ensure the effective prevention of sediment plumes being generated.

5.1.9 Hazardous interaction with the ongoing port and berthing activities

Impact of submerged equipment, such as protruding pipelines, hoses, risers etc., operating at the Kurnell Wharf, during dredging and demolition/construction activities may lead to a loss of containment of oil and diesel and environmental pollution.

Safeguards include the choice (type and design) of the dredge used which reduces risk of inaccurate dredge location during heavy swell.

It is possible to isolate underwater equipment at the wharf breasting island and to pull vacuum on underwater equipment from the wharf, thus minimising the amount of pollutant material that could be released in case of impact and damage of equipment. The normal hose location is out of the area to be dredged.

A working procedure would be prepared for the operation of the barges and dredger in consultation with SPC. The existing hose locations in the sub berth would be identified. These are currently being avoided by the proposed works.

It is recommended that a review of safeguards is undertaken, relating to the submerged equipment, during detailed project development. This would likely involve considering the further isolation of submerged equipment and pipelines and removal of pollutant material contained in the equipment (e.g. through water flushing) prior to dredging operation.

5.1.10 Generation of acid sulphate soils

Generation of acid sulphate soils, through oxidisation of sediments if allowed to dry out, may lead to habitat degradation. Due to the processes involved, this degradation is likely to be short term and localised only.

The risk associated with this hazard is managed through the short residence time provided for sediments prior to these being dumped in the Bay or at sea, making it unlikely that sulphides contained in the sediments are converted to acid sulphates. During residence time, the sediments will be covered by a layer of water, which will further prevent oxidation of the sulphides.

It is recommended that dredged sediments are monitored during transit to ensure they would not dry out.

5.1.11 Failure to remove flammable gas and liquid at fuel lines at berth #1 prior to demolition

A failure to remove flammable gas and liquid at the existing fuel lines at berth #1 prior to it's demolition could lead to a loss of containment of flammable and pollutant material into the Bay.

Further, if hot work is used for cutting of the pipes, the flammable vapours may ignite and explode leading to injury of personnel.

Caltex's Permit to Work procedure apply, this includes lock-out tag-out requirements. The decommissioning and removal of existing fuel lines will require positive isolation from all fuel sources, and flushing of pipeline prior to any cutting being allowed. Flammable gas monitoring is required as part of PTW procedure if hot work is used for cutting of pipes.

5.1.12 Failure to isolate flammable material from existing, operational, supply lines

A failure to isolate flammable material from existing (operational) supply lines when connecting the new manifold to these pipelines may lead to a loss of containment of flammable and pollutant material into the Bay.

Caltex's Permit to Work procedure apply, this includes lock-out tag-out requirements. The decommissioning and removal of existing fuel lines will require positive isolation from all fuel sources, and flushing of pipeline prior to any cutting being allowed. Flammable gas monitoring required as part of PTW procedure if hot work is used for cutting of pipes.

5.1.13 Loss of displaced water flushed through existing fuel lines and pipework

A loss of containment of displaced water, flushed through the existing fuel lines at berth #1 prior to demolition, would lead to pollution of the Bay.

Caltex's Permit to Work procedure apply, this includes lock-out tag-out requirements. The decommissioning and removal of existing fuel lines will

require positive isolation from all fuel sources, and flushing of pipeline prior to any cutting being allowed.

5.1.14 Generation of excessive noise levels

Generation of excessive noise levels may lead to disturbing of fauna, including migratory birds, leading to interruption of their breeding cycle.

The dredge and barge operation is not believed to be noisy in comparison to other activities around Botany Bay. The activity is also relatively short term and will not have the potential to affect more than one breeding season

5.2 OPERATION OF UPGRADED PORT

The following hazards and controls are identified for operational activities associated with the upgraded port. Where the controls were not deemed as sufficient to reduce the risk level to As Low As Reasonably Practicable (ALARP), further safeguards have been recommended.

5.2.1 Hazardous interaction between moored vessel and operations at the wharf

Hazardous interaction between moored vessel and the operational equipment and pipelines at the wharf and berth could lead to oil spill and environmental pollution and to personal injury of crew and staff. The potentially sensitive equipment and pipelines, which may be subject to hazardous interaction, include:

- sub berth equipment (including riser),
- shore equipment (including manifold),
- ship manifold (e.g. from impact with loading arm)

Damage to wharf / berth equipment may result from loss of securing of the marine vessel during mooring or impact by the vessel during movement in and out of the berth.

Safeguards include a combination of hardware and software (procedural) measures, as follows:

The marine vessel is firmly secured during mooring at the berth through the following measures:

- port anchor,
- tug boat,
- bow, stern and quarter lines,
- vessels allowed to be berthed on run in tide only, providing sufficient clearance (~700 mm at sub berth) to prevent riser damage.

Further, pilots provide independent assessment of the berth safety prior to berthing vessels, and this includes an assessment of the prevailing wind and swell conditions, and the forecast.

A Spar buoy would be positioned relative to the crude riser and would allow pilots to be provided with an indirect indication of the location of the sub berth riser. Further, the marine vessel is escorted by tugs during approach to berth.

Emergency measures, should impact and damage occur, include:

- existing wharf Emergency Shut Down system to remotely isolate valves, including the ability to isolate underwater (sub berth) equipment from safe location at wharf breasting island,
- wharf and ship firefighting system (to be upgraded as part of the project),
- terminal and Port oil spill emergency response plan, and
- emergency plan relating to the hazardous interaction between marine ship and commercial/ recreational ships is managed by the Master of the ship.

During detailed design it is recommended that the need for additional remote operated EIVs at new loading arms is reviewed.

5.2.2 Extreme weather and swell leads to potential for damage to ship

Extreme weather and swell may lead to damage to marine vessel, resulting in oil spill and environmental pollution.

In order to safeguard against this risk, only double hulled vessels would be allowed to moor at the berth. Formal Caltex approval would be required for any vessel berthing at the sub berth.

Further, pilots would provide independent assessment of the berth safety prior to berthing vessels, and this would include an assessment of the prevailing wind and swell conditions. Ships are prevented from mooring and casting off during poor weather (high wind/low visibility) this would reduce the likelihood of incidents occurring due to poor visibility or high seas. A decision on the permissibility of travel would be made by the pilot in consultation with the Harbourmaster. Vessel is escorted by tugs during approach to berth (ability to place tugs on standby).

5.2.3 Hazardous interaction between moored vessel / vessel transferring through Botany Bay and commercial / recreational ships in the area

Hazardous interaction between marine vessel moored at berth or during ship transfer through Botany Bay and commercial / recreational ships in the area could cause personnel injury or man overboard.

Safeguards include the use of pimple buoys (visible during day time), SPC Control Tower warnings for maritime activities, NSW regulations requiring a speed limit of less than 4 knots when within 200 m of maritime activities, and port regulations requiring the marine vessel to be lit.

It is recommended that Caltex reviews the operational requirements for the #1 and #2 berths during mooring activities - this may involve improvement of visual indication of location of pimple buoys during night time.

6 QUALITATIVE RISK ANALYSIS

As discussed above, the qualitative risk assessment has been prepared on the basis of the risk matrix and associated consequence and likelihood scoring tables in Figure 2, and based on the hazardous incident identification exercise summarised in Table 3 above.

The risk profile is presented in Table 4 below. Note that, as per the risk matrix (refer Figure 2), a low number represents a high risk while a high number represents a low risk.

6.1 RISK LEVELS 1 TO 4

No scenarios with risk levels 1 to 4 were identified for the proposed works.

6.2 RISK LEVEL 5

The maximum risk level is 5, as identified for the following potential hazards:

- Scenario 1: The spread of noxious weeds within the marine environment
- Scenario 15: Hazardous interaction between moored vessel and operations at the wharf

It is believed that the risk ranking of scenario 1 is conservative until such time that more information is available as to how this hazard will be managed.

The likelihood of scenario 15 is reduced through the design of the new sub berth equipment. However, the quantity of material held in the loading arms would increase somewhat. The result is that the risk level is expected to remain as per existing risk levels.

6.3 RISK LEVEL 6

The majority of hazards identified for this project have been ranked at risk level 6, as follows:

- Scenario 2: Hazardous interactions between ships involved in the proposed dredging and upgrade works and the current commercial and recreational ships that use the area
- Scenario 3: Extreme weather resulting in damage to ships involved in the proposed dredging and upgrade works
- Scenario 4: Disturbing sediments containing TBT, and loading and reuse of these sediments within Botany Bay

- Scenario 5: Loss of containment event (diesels, oils, lubricants and hydraulic fluids) from ships
- Scenario 6: Workplace injuries
- Scenario 7: Electrical hazards
- Scenario 16: Extreme weather and swell leads to potential for damage to ships

6.4 RISK LEVEL 7

The following hazards were ranked as risk level 7, as follows:

- Scenario 8: Generation of sediment plumes
- Scenario 9: Hazardous interaction between ongoing port and berthing activities
- Scenario 10: Removal of ASS
- Scenario 11: Failure to remove flammable gas and liquid at fixed berth
- Scenario 12: Failure to isolate the operational supply lines when connecting to the proposed upgraded manifold
- Scenario 13: Loss of displaced water flushed through the existing fuel lines and pipework
- Scenario 17: Hazardous interaction between moored vessel / vessel transferring through Botany Bay and commercial / recreational ships in the area

6.5 RISK LEVEL 8

The following hazard was ranked as risk level 8, as follows:

- Scenario 14: Excessive noise generation

6.6 RISK LEVELS 9 AND 10

No scenarios with risk levels 9 to 10 were identified for this project.

Table 4 – Project Risk Profile

Likelihood			Consequences			
Likely	6 Scenario 5	5	4	3	2	1
Occasional	7	6	5	4	3	2
Seldom	8	7 Scenario 10	6	5 Scenario 1 Scenario 15	4	3
Unlikely	9	8	7 Scenario 8 Scenario 9	6 Scenario 2 Scenario 3 Scenario 4 Scenario 6 Scenario 7	5	4
Remote	10	9	8 Scenario 14	7 Scenario 11 Scenario 12 Scenario 13	6 Scenario 16	5
Rare	10	10	9	8	7 Scenario 17	6
	Incidental	Minor	Moderate	Major	Severe	Catastrophic

7 DISCUSSIONS AND CONCLUSION

7.1 DREDGING, DEMOLITION AND CONSTRUCTION ACTIVITIES

The main hazards associated with the proposed works are associated with the relatively short lived dredging, construction and demolition phases of this project (14 out of 17 hazards identified).

The majority of these hazards have a potential for environmental pollution with others relating to safety concerns involving staff and marine vessel crew as well as pleasure crafts and commercial vessels in the vicinity of the proposed works activities.

While these hazards are introduced by the proposed works (i.e. they are not applicable for the existing site), they are relatively short lived and would be eliminated following the conclusion phase of the proposed works.

These hazards are all well-known and understood by the staff and contractors involved in the project and the safeguards associated with controlling the hazards have been largely established.

Provided the recommendations listed in Section 8 are implemented, the risk associated with dredging, construction and demolition phases of this project is considered to be ALARP, in accordance with the definitions in the Caltex refinery Safety Case (Ref **Error! Bookmark not defined.**).

7.2 OPERATIONAL ACTIVITIES

The remaining three (3) hazards, out of a total of 17, are associated with the operational activities post completion of dredging, construction and demolition phases of the proposed works.

The majority (two out of three) of these hazards have a potential for environmental pollution with the remaining one (1) relating to safety concerns involving staff and marine vessel crew as well as people operating pleasure crafts and commercial vessels in the vicinity of the project activities.

These hazards are not new and are all also applicable for the existing port and berth at Kurnell.

All hazards are well-known and understood by Caltex, SPC and the marine vessel operators, and the safeguards associated with controlling the hazards have been largely established.

Provided the recommendations listed in Section 8 are implemented, the risk associated with the operational activities of this project is considered ALARP, in

accordance with the definitions in the Caltex refinery Safety Case (Ref **Error! Bookmark not defined.**).

7.3 OVERALL CONCLUSION

The dredging, demolition, construction and operational phases of the proposed works will be subject to rigorous scrutiny by Caltex and by the designing company, safeguarding delivery and operation of the project in a manner that minimises the risk to workers, contractors and the community.

The potential for incidents is well understood and the design of the upgraded port facility and equipment will minimise the probability of an incident happening and mitigating an incident if it did occur.

The preliminary hazard and risk assessment of the proposed works has found that the levels of risks to the biophysical environment and to the safety of the public, staff and contractors from project are reduced to ALARP levels following the established processes for Caltex as part of their MHF Safety Case regime (as submitted to NSW WorkCover).

The present risk assessment has shown that the overall risk associated with the proposed project is low and does not introduce an excessive additional risk to the surrounding equipment and plant or to other users or Botany Bay.

8 RECOMMENDATIONS

Where possible, risk reduction measures have been identified throughout the course of the study in the form of recommendations. These are as follows:

1. Measures would be put in place to control the presence and or spread of Caulerpa taxifolia.

2. A review of working procedures developed by the works' contractor for the berths would be undertaken ahead of the proposed dredging activities. This would be agreed with Caltex and relevant stakeholders. The results of this may involve installing additional hardware (such as protective buoys) as well as the introduction of procedural safeguards.

3. A procedure would be developed for the safe operations of the dredger and hopper barges. This procedure would be undertaken to determine the need to develop a works-specific operation safety plan for extreme weather conditions. It would be undertaken in conjunction with all stakeholders (including SPC). This procedure would form part of the Port Operating Procedure (POP) discussed in Chapter 17, Amenity, Land Use, Recreation and Navigation.

4. A Dredge and Spoil Management Plan (DSMP) would be prepared (see Chapter 10, Water and Sediment Quality). It would contain controls and

measures to ensure no overflow dredging operations within parts of the turning circle and approaches along with the whole of the fixed berths. It would also include measures to ensure the sediments would be lifted and loaded so as to prevent any excessive disturbance and agitation, whilst preventing excessive spillage.

5. Biodegradable oil would be used within the pile rig. Pre start checks would be undertaken prior to commencing piling. Regular servicing and maintenance would be scheduled as part of the works.

6. Materials would be available to provide spill containment if required in accordance with Caltex's Emergency Response Plan (STD 4.02.01.01) and Oil-spill Callout and Response Work Procedure (PROC 120.05.001).

7. Any off ship incidents would be managed as per current established operating procedures in place for the existing port and berthing facility.

8. A Port Operation Procedure (POP) would be developed (see Chapter 17, Amenity, Land Use, Recreation and Navigation). Part of this would include information on the prevailing weather conditions and when works are not permitted to take place within Botany Bay.

9. The dredging program would be audited to ensure the works' contractors are responding to incidences of high turbidity to ensure the effective prevention of sediment plumes being generated. Further controls would be included by way of the DSMP (see Chapter 10, Water and Sediment Quality).

10. A review of safeguards would be undertaken relating to the submerged equipment during detailed project development. This would likely involve considering the further isolation of submerged equipment and pipelines and removal of pollutant material contained in the equipment (e.g. through water flushing) prior to dredging operation.

11. Measures to ensure the dredged sediments would be monitored during transit would be put in place to ensure they would not dry out (see Chapter 9, Spoil and Contamination).

12. During detailed design there would be need to determine the requirement for additional remote operated emergency isolation valves at new loading arms.

13. A review of operational requirements for the berths would be undertaken during mooring activities. This would involve the visibility of pimple buoys at night.

9 REFERENCES

1 State Environment Planning Policy No 33 - *Hazardous and Offensive Development*, NSW Department of Planning

2 Hazardous Industry Planning Advisory Paper No. 4 (HIPAP No. 4): *Risk Criteria for Landuse Planning*, NSW Department of Planning

3 Hazardous Industry Planning Advisory Paper No. 6 (HIPAP No. 6): *Guidelines for Hazard Analysis*, NSW Department of Planning

4 *Sub Berth Mooring Upgrade PHA*, Caltex Kurnell Refinery, 24/8/2012

5 Terminal Dredging PHA, Caltex Kurnell Refinery, 31/8/2012

6 Quick Release Marine Hooks PHA, Caltex Kurnell Refinery, 24/8/2012

7 Marine Loading Arms PHA, Caltex Kurnell Refinery, 29/8/2012

8 Fenders/ Dolphins/ Jetty/ Revetment/ Laser Docking PHA, Caltex Kurnell Refinery, 31/8/2012

9 *Sub Berth Mooring Upgrade PHA*, Project XA12.014, Caltex Kurnell Refinery, 24/8/2012

10 Terminal Dredging PHA, Caltex Kurnell Refinery, 31/8/2012

11 Quick Release Marine Hooks PHA, Caltex Kurnell Refinery, 24/8/2012

12 Marine Loading Arms PHA, Caltex Kurnell Refinery, 29/8/2012

13 Fenders/ Dolphins/ Jetty/ Revetment/ Laser Docking PHA, Caltex Kurnell Refinery, 31/8/2012

14 *Environment Protection (Sea Dumping) Act,* Commonwealth, 1981

15 Sea Dumping Regulations

16 Environment Protection and Biodiversity Conservation Act 1999

Appendix J

Capital Investment Value Report

QUANTO Pty Ltd

quantity surveyors

Capital Investment Value Report

For

Caltex Kurnell Jetty Upgrade

Located at

Kurnell NSW

13 September 2012

QUANTO Pty Ltd
quantity surveyors

Level 1, 92 Hill St Carrington NSW 2294
PO Box 1818, Newcastle 2300
P: 02 4961 4465
F: 02 4962 5260
E: info@quanto.com.au
W: www.quanto.com.au
ABN 35 123 795 095

Thursday, 13 September 2012

Attention: Greg King
Caltex Refineries (NSW) Pty Ltd
2 Solander Street
Kurnell NSW 2231

Re – Capital Investment Value Report
Caltex Kurnell Jetty Upgrade, Kurnell NSW

Dear Sir,

Please find attached our Capital Investment Value Report prepared following the information supplied by Worley Parsons.

The report has been prepared by Quanto Pty Ltd under instruction from Worley Parsons and not in any other capacity.

This provides the costs estimated to complete the Caltex Kurnell Jetty Upgrade in a broad sense at this stage of the design process to determine the Capital Investment Value as per the *Environmental Planning and Assessment Regulation 2000* and certain state Environmental Planning Policies.

Quanto Pty Ltd has been requested to prepare the Capital Investment Value Report.

1.0 General Project Overview

Quanto Pty Ltd note the general overview indicates the upgrade of the Caltex Kurnell Jetty.

Caltex has operated the refinery facility at Kurnell since 1956. The refinery consists of significant land based operations (approx 174 hectares), as well as a large jetty structure (approx 1.1km in length) accommodating two fixed berths and a third floating berth (sub berth).

In August 2011 Caltex began undertaking a review of its refining facilities in Australia. The findings of the review determined the status quo for the Kurnell refinery was not suitable. On the 26th July 2012 Caltex announced that it would convert the Kurnell refinery to a major import terminal.

Caltex are now in the process of designing upgrade works to allow for the conversion of the existing Kurnell refinery into an import terminal. The upgrade works include modifications to the existing jetty to allow for the berthing and unloading of vessels up to 100,000 DWT.

2.0 Capital Investment Value Cost Estimate

Quanto Pty Ltd has been provided with the total project estimate as prepared by Worley Parsons. We believe the independent estimated construction cost for the complete construction of the Caltex Kurnell Jetty Upgrade total $66,291,308 exclusive of GST.

We have based this cost estimate of works upon the definition of Capital Investment Value which includes 'all costs necessary to establish and operate the project, including the design and construction of the development including buildings, structures, associated infrastructure and fixed or mobile plant and equipment'.

We have excluded costs for land, costs for any separate approvals and Good and Services Tax (GST).

2.1 Basis of Estimate

We have based the estimate upon the capital cost estimate on the engineering details, including material take-offs and, budget quotes from subcontractors and man-hour estimates.

2.1.1 Qualifications

No detail mobile crane and rigging studies have been completed;
No geotechnical investigations have been completed;
No formal logistics studies have been completed;
An estimate for electrical instrumentation has been provided;
An estimate for the supply of marine loading arms has been provided;

Dredging works has been set at a depth of 12.8 metres (Chart Datum). The known location of an operational sub berth pipeline in the area is not accurately known.

2.1.2 Assumptions

- This estimate has been based upon an Engineering, Procurement, and Construction Management (EPCM) execution strategy;
- Australian Work Place Agreements are in place;
- Statutory Permits are in place prior to construction;
- Manual labour is to be sourced locally;
- Cost estimate makes provision for the establishment of a hardstand area for laydown, and temporary facilities for construction;
- Current provisions for site security are sufficient for construction activities;
- The current structures & equipment are suitable for the increased load required by the upgrade unless specifically noted.

2.1.3 Exclusions

- Foreign Exchange rate variations;
- No provision for delay costs with regard to permitting beyond what would be reasonably expected;
- No provision for delay costs associated with obtaining statutory approvals;
- Land acquisition costs;
- Environmental testing and remediation of contaminants;
- Influence of Market Forces such as concurrent projects and resource/commodity prices on labour and material costs;
- No allowance has been made for diving contractors;
- No allowance has been made for the following items which are outside the scope:
    - Slope System
    - Stormwater System
    - Firewater Treatment, containment etc
    - Foam Concentrate
    - EIS Approval

2.2 Quantity and Cost Basis

2.2.1 Quantities General

The majority of quantities used have been based upon material take-offs and drawings supplied.

2.2.2 Pricing General

All costs to complete are in Australian dollars.

2.2.3 Manual Labour Rates

The rate is based upon a nominal 56 hour work week and excludes escalation.
The direct labour hours have been based upon database of similar projects and assessed according to current construction techniques, methodology and productivity of trades.

2.2.4 Subcontractor Distributables

These rates cover construction equipment and other support required to support and deploy installation of labour.
Subcontractor's distributables were developed as a percentage of contract direct manual labour costs by major commodities and are supported by historical site data.

2.2.5 Productivity

Productivity Factors have been applied to direct man-hours to account for 'brownfield' installation, safety access issues and labour availability.

2.2.6 Design Growth

Design growth has been applied at a rate of 10% over the total direct costs.

2.2.7 EPCM Services

The Engineering, Procurement and Construction Management (EPCM) services have been estimated based on the project schedule and necessary deliverables to compete the Project.
A total of 21% to Total Installed Costs have been included.

2.2.8 EPCM Services

The Engineering, Procurement and Construction Management (EPCM) services included in the EPCM services estimate. Provision for the manual support to the same have been included in the overall cost estimate.

2.2.9 Freight

No formal logistics study has been completed. An allowance has been included for freight of bulk materials and other equipment.

2.2.10 Spares

Unless noted, no allowance has been made for capital or operating spares.

2.2.11 First Fills

No allowances have been made for first fills.

2.2.12 Escalation Assessment

No allowances have been made for escalation.

2.2.13 Contingency Assessment

Contingency has been allowed at 20% of the base cost.

Please refer to Appendix 3 the Estimated Cost for Capital Investment Value attached to this report.

3.0 Disclaimer

Quanto Pty Ltd have prepared this report in part on the basis of information supplied by Worley Parsons Services Pty Ltd.

Whilst all professional care and skill have been exercised to ensure the accuracy, Quanto Pty Ltd is unable to provide and guarantee in that regard, and will not be liable to any party for loss arising as a result of any such information subsequently being found to be inaccurate or lacking authenticity.

Quanto Pty Ltd have provided this report only on visible elements of the building and the Schedule of Information provided.

This report should be seen as a reasonable attempt to identify and provide cost of any significant items indicated.

4.0 Conclusion

Quanto Pty Ltd believe the costs indicated within this report have been based on the information supplied by Worley Parsons Services Pty Ltd, and believe the current level of documentation indicates these budget estimates to be fair and reasonable. We believe the independent cost estimate for Capital Investment Value total $66,291,308 exclusive of GST.

Yours Sincerely

Bob Macansh (AAIQS)
Director
Quanto Pty Ltd
Quantity Surveyors

Appendix 1

Schedule of Information

Schedule of Information

The following items are the information used in determining the Estimated Cost Plan for this report.

- Drawings as prepared by Worley Parsons Drawings: 301015-02989-ST-DRG-0066 Rev B, 301015-03067-MA-DSK-0001 Rev A, 301015-03067-MA-DSK-0002 Rev A, 301015-03067-MA-DSK-0001/A Rev A, 301015-03067-MA-DSK-0002/A Rev A;
- Regional and State Planning Definition of Capital Investment Value issued 10 May 2010; and
- Total Project Estimate as prepared by Worley Parsons dated 7 September 2012.

Appendix 2

Schedule of Exclusions

Schedule of Exclusions

The following items have been excluded in determining the Estimated Cost Plan for this report.

- Land and Legal costs;
- Goods and Services Tax (GST);
- Finance Costs;
- Development Contributions; and
- Any costs relating to separate development consent.

Appendix 3

Independent Cost Estimate of Capital Investment Value – Caltex Kurnell Jetty Upgrade

Full Estimate Summary

Job Name : 12251 KURNELL
Client's Name: Worley Parsons

Job Description
Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Trd No.	Trade Description	Trade %	Cost/m2	Sub Total	Mark Up %	Trade Total
	Dredging Works	33.48		22,193,750		22,193,750
	Marine Loading Arms & Manifold	2.41		1,597,739		1,597,739
	Jetty Upgrade - Marine Works	15.19		10,070,912		10,070,912
	Jetty Services, Utilities & Infrastructure	4.53		3,005,000		3,005,000
	Design Growth - calculated on Total Design Costs	5.56		3,686,740		3,686,740
	Testing Commissioning & Training	0.14		93,715		93,715
	Indirect Costs - Engineering Procurement and Construction Management	20.96		13,894,357		13,894,357
	Owners Costs	1.98		1,315,000		1,315,000
	Base Total - Excluding GST					*55,857,213*
	Contingency Costs	15.74		10,434,095		10,434,095
		100.00		**66,291,308**		**66,291,308**
					Final Total : $	**66,291,308**

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**1** ***Dredging Works***					
	Coastal Revetment					
1	Rock Revetment allowance supply and install	7,550.00	M/T	350.00		2,642,500.00
	Coastal Dredging					
	Mobilisation					
2	Allowance for large dredger	1.00	Item	700,000.00		700,000.00
3	Barges	1.00	Item	500,000.00		500,000.00
4	Sweep Barge & Tug	1.00	Item	100,000.00		100,000.00
5	G/E Survey	1.00	Item	75,000.00		75,000.00
6	Survey Establishment	1.00	Item	40,000.00		40,000.00
	Dredging & Disposal					
7	Dredging to areas where overflow not allowed	1.00	Item	8,500,000.00		8,500,000.00
8	Dredging to areas where overflow allowed	1.00	Item	4,760,000.00		4,760,000.00
9	Stand By rates	1.00	Item	998,750.00		998,750.00
10	Survey	1.00	Item	1,312,500.00		1,312,500.00
11	Supervision costs	1.00	Item	1,575,000.00		1,575,000.00
	Demobilisation					
12	Large dredger	1.00	Item	600,000.00		600,000.00
13	Barges	1.00	Item	300,000.00		300,000.00
14	Sweep Barge	1.00	Item	30,000.00		30,000.00
15	G/E Survey	1.00	Item	30,000.00		30,000.00
16	Survey Disestablishment	1.00	Item	30,000.00		30,000.00
	Dredging Works				**Total :**	**22,193,750.00**
Trade :	**2** ***Marine Loading Arms & Manifold***					
	Berth 1 - Marine Loading Arms					
1	Remove existing Loading Arms	1.00	Item	104,328.00		104,328.00
2	Piping	1.00	Item	108,736.00		108,736.00
3	Piping supports	1.00	Item	26,650.00		26,650.00
	Berth 1 - MLA platform structure					
4	400 WC 184	1.00	Item	144,646.00		144,646.00
5	200 UB 25	1.00	Item	4,323.00		4,323.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**2** ***Marine Loading Arms & Manifold***					*(Continued)*
6	200 PFC	1.00	Item	1,829.00		1,829.00
7	150 PFC	1.00	Item	2,494.00		2,494.00
8	125 PFC	1.00	Item	12,802.00		12,802.00
9	75 x 16 pl	1.00	Item	998.00		998.00
10	Webforge Grating	1.00	Item	57,040.00		57,040.00
11	20 Bar	1.00	Item	1,496.00		1,496.00
12	180 x 25 pl	1.00	Item	4,822.00		4,822.00
13	200 x 16 pl	1.00	Item	9,311.00		9,311.00
14	8.8s M20 Bolts	1.00	Item	3,591.00		3,591.00
15	M20 Nut and Washer	1.00	Item	1,554.00		1,554.00
	Marine Loading Arms					
16	Marine loading arms - Includes hydraulic controls & spares	1.00	Item	1,113,119.00		1,113,119.00
	Marine Loading Arms & Manifold				**Total :**	**1,597,739.00**
Trade :	**3** ***Jetty Upgrade - Marine Works***					
	Marine - Dolphin, Catwalks and associated works					
	Northern Mooring Dolphin					
	Piles					
1	12 off - 1200 x 20 vertical piles x 32m long - 0.582 M/T	1.00	Item	1,184,039.00		1,184,039.00
	Dolphin Superstructure					
2	Concrete super structure 10 x 7.5 x 3	1.00	Item	1,248,075.00		1,248,075.00
	Quick Release Hook					
3	100T Quad quick release hook with integral 1T capstan foot switch & remote release	1.00	Item	174,630.00		174,630.00
	Other					
4	Safety Barrier	1.00	Item	52,186.00		52,186.00
5	Handrail	1.00	Item	3,720.00		3,720.00
6	Life Bouys	1.00	Item	4,500.00		4,500.00
7	East side platform trelleborg ladder & fender	1.00	Item	10,000.00		10,000.00
8	Lighting poles 9 high x .3m diam x 16 thick	1.00	Item	6,000.00		6,000.00
9	Rope rails	1.00	Item	5,430.00		5,430.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**3** ***Jetty Upgrade - Marine Works***					*(Continued)*
10	Holding down bolts	1.00	Item	5,864.00		5,864.00
	Berthing Dolphins (2 off)					
	Piles					
11	2 x 6 off - 1200 x 20 vertical piles x 32m long - 0.582 M/T	1.00	Item	1,184,039.00		1,184,039.00
	Dolphin Superstructure					
12	2 off Concrete super structure 7.5 x 5 x 3	1.00	Item	1,248,075.00		1,248,075.00
	Quick Release Hook					
13	100T double quick release hook with integral 1T capstan foot switch & remote release	1.00	Item	137,154.00		137,154.00
	Fender					
14	Dolphin fender SCN 2000 E 1.3	1.00	Item	166,368.00		166,368.00
	Other					
15	Safety Barrier	1.00	Item	52,186.00		52,186.00
16	Handrail	1.00	Item	4,584.00		4,584.00
17	Life Bouys	1.00	Item	9,000.00		9,000.00
18	East side platform trelleborg ladder & fender	1.00	Item	20,000.00		20,000.00
19	Lighting poles 9 high x .3m diam x 16 thick	1.00	Item	12,000.00		12,000.00
20	Rope rails	1.00	Item	6,516.00		6,516.00
21	Holding down bolts	1.00	Item	5,864.00		5,864.00
	Berth 1 Miscellaneous					
22	Handrail	1.00	Item	20,405.00		20,405.00
23	Demolition	1.00	Item	28,980.00		28,980.00
24	Electrical Wiring - Additional 10m	1.00	Item	2,108.00		2,108.00
	Northern Turning Dolphin Upgrade					
25	100T double quick release hook with integral 1T capstan foot switch & remote release	1.00	Item	76,942.00		76,942.00
	Catwalks					
	Berth 1 - Steel Catwalk Truss					
	Type 1 Turning Dolphon to Northern Morring Dolphin					
26	Girders - 3 off - OD 323.9 x 10 CHS x 35m welded	1.00	Item	182,540.00		182,540.00
27	Bracing - 90 off - OD169.3 x 6 CHS x 2.1m welded	1.00	Item	102,015.00		102,015.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**3** ***Jetty Upgrade - Marine Works***					*(Continued)*
28	Grating support angle - 2 off - 150 x 100UA x 35m Bolted	1.00	Item	28,337.00		28,337.00
29	Cleats - 32 off - 180 x 150 x 10 w/stiffener 200 x 100 x 10 welded	1.00	Item	2,879.00		2,879.00
30	Webforge Grating - Galvanised steel - 35 x 1.5	1.00	Item	37,433.00		37,433.00
31	Handrail - 2 off - 35m Bolted	1.00	Item	20,055.00		20,055.00
32	Holding Down Bolts	1.00	Item	5,864.00		5,864.00
33	Nuts, Bolts & Washers, Cleats - 64, Handrails - 128	1.00	Item	9,322.00		9,322.00
	Type 2 Span between new Berthing Dolphins					
34	Girders - 3 off - OD 68.3 x 4.8 CHS x 20m welded	1.00	Item	10,121.00		10,121.00
35	Bracing - 36 off - OD60.3 x 4.5 CHS x 2.1m welded	1.00	Item	10,508.00		10,508.00
36	Grating support angle - 2 off - 150 x 100UA x 20m Bolted	1.00	Item	16,193.00		16,193.00
37	Cleats - 16 off - 180 x 150 x 10 w/stiffener 200 x 100 x 10 welded	1.00	Item	1,439.00		1,439.00
38	Webforge Grating - Galvanised steel - 20 x 1.5	1.00	Item	21,390.00		21,390.00
39	Handrail - 2 off - 20m Bolted	1.00	Item	11,460.00		11,460.00
40	Holding Down Bolts	1.00	Item	5,864.00		5,864.00
41	Nuts, Bolts & Washers, Cleats - 32, Handrails - 72	1.00	Item	5,049.00		5,049.00
	Type 3 Slops Platform to new Berthing Dolphin					
42	Girders - 2 off - 200 x 100 x 10 RHS x 9m welded	1.00	Item	17,792.00		17,792.00
43	Bracing - 7 off - 200 x 100 x 10 RHS x 1.3m welded	1.00	Item	8,995.00		8,995.00
44	Grating support angle - 2 off - 150 x 100UA x 9m Bolted	1.00	Item	7,287.00		7,287.00
45	Webforge Grating - Galvanised steel - 9 x 1.5	1.00	Item	9,626.00		9,626.00
46	Handrail - 2 off - 9m Bolted	1.00	Item	5,157.00		5,157.00
47	Holding Down Bolts	1.00	Item	5,864.00		5,864.00
48	Nuts, Bolts & Washers - Handrails - 24	1.00	Item	1,165.00		1,165.00
	Type 4 Strongpoint #6 to new Berthing Dolphin					
49	Girders - 2 off - 200 x 100 x 10 RHS x 4.5m welded	1.00	Item	8,896.00		8,896.00
50	Bracing - 3 off - 200 x 100 x 10 RHS x 1.3m welded	1.00	Item	3,855.00		3,855.00
51	Grating support angle - 2 off - 150 x 100UA x 3m Bolted	1.00	Item	2,429.00		2,429.00
52	Webforge Grating - Galvanised steel - 3 x 1.5	1.00	Item	3,209.00		3,209.00
53	Webforge Treads - Galvanised steel - 4 x 1.5	1.00	Item	2,852.00		2,852.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**3** ***Jetty Upgrade - Marine Works***					*(Continued)*
54	Handrail - 2 off - 4.5m Bolted	1.00	Item	2,579.00		2,579.00
55	Holding Down Bolts	1.00	Item	5,864.00		5,864.00
56	Nuts, Bolts & Washers - Handrails - 16	1.00	Item	777.00		777.00
	Marine Breasting Islands					
	Existing Structure Upgrade					
	Strengthening Works					
57	Provide concrete shear walls (2off) for strengthening existing structure = 25 x .6 x 2	1.00	Item	332,820.00		332,820.00
	Existing Fender Upgrade					
58	Concrete super structure 6 x 6 x 4.5m	1.00	Item	898,614.00		898,614.00
59	4 - 900 dia. x 22th steel piles - 20 long - 0.476 MT/m	1.00	Item	209,364.00		209,364.00
	Fenders					
60	Dolphin fender SCN 2000 E 1.3	1.00	Item	83,184.00		83,184.00
	Spill Boom Upgrade					
	Spill Containment Upgrade					
61	Spill containment stainless steel sumps - special	1.00	Item	11,698.00		11,698.00
62	DN 100 Pipe ANSI 150 slip on flange ASTM A269	1.00	Item	1,809.00		1,809.00
63	DN 100 Remote Automated Valve - knife gate/solenoid - SS (chemical resistant)	1.00	Item	9,091.00		9,091.00
64	Pump - EX rated, potable, 10L/s @20m head - SS (chemical resistant)	1.00	Item	27,728.00		27,728.00
	Miscellaneous Wharf Furniture/SOLAS Equipment					
65	Miscellaneous Wharf Furniture/SOLAS Equipment/ Line marking	1.00	Item	44,150.00		44,150.00
	Slops Platform					
	New Platform for slops tank					
66	762 x 22 pile (vertical pile option at 4 off 20m long) - .365MT/m	1.00	Item	160,542.00		160,542.00
67	Concrete deck 5 x 10 x .25	1.00	Item	70,800.00		70,800.00
68	Handrail	1.00	Item	5,730.00		5,730.00
	Berthing System Upgrade					
	Berth 1 - QRH					
69	Remove existing bollards	1.00	Item	46,572.00		46,572.00
70	100T double quick release hook with integral capstan	1.00	Item	274,308.00		274,308.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**3** ***Jetty Upgrade - Marine Works***					*(Continued)*
71	100T quad quick release hooks with integral capstan	1.00	Item	174,630.00		174,630.00
72	Electric remote control system - Total for all hooks	1.00	Item	171,035.00		171,035.00
73	Mooring load monitoring system - Total	1.00	Item	211,954.00		211,954.00
74	Spares - Total for all hooks	1.00	Item	10,000.00		10,000.00
	New Tug Facility					
	Building New Jetty Demolition					
75	Remove existing piles & structure	1.00	Item	25,200.00		25,200.00
	Buiulding New Jetty in New Location					
76	10no 508 x 16 CHS piles 25 long - 0194MT/m	1.00	Item	290,903.00		290,903.00
77	34m of 410 UB 60	1.00	Item	33,917.00		33,917.00
78	20m of 150 UB 37	1.00	Item	12,303.00		12,303.00
79	2.3m x 5 610 UB 125	1.00	Item	23,900.00		23,900.00
80	Concrete deck 6 x 2.3 x .25	1.00	Item	19,137.00		19,137.00
81	FRP grating 4.8 x 2.3	1.00	Item	10,852.00		10,852.00
82	11no 300 PFC x 3.2 long - 0.040 MT/m	1.00	Item	16,826.00		16,826.00
83	Handrail	1.00	Item	8,595.00		8,595.00
	Navigation Aids					
	Nav Aids					
84	6 - 600dia. x 18tk steel piles - 20 long - 0258MT/m	1.00	Item	365,204.00		365,204.00
85	Ladder	1.00	Item	120,000.00		120,000.00
86	Miscellaneous steelwork	1.00	Item	44,565.00		44,565.00
87	7 x beacon light	1.00	Item	70,000.00		70,000.00
88	1 x PEL light - $20-30K	1.00	Item	60,000.00		60,000.00
	Jetty Upgrade - Marine Works				**Total :**	**10,070,912.00**
Trade :	**4** ***Jetty Services, Utilities & Infrastructure***					
	Fire Fighting Systems Upgrade					
	Fire Water Sstem - Supply to Fire Water Monitors					
1	1 Lot distribution fire water headers - Fire water monitor supply and supports	1.00	Item	500,000.00		500,000.00
2	5 x Fire water monitor control valve assemblies	1.00	Item	50,000.00		50,000.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**4** ***Jetty Services, Utilities & Infrastructure***					*(Continued)*
3	Fire monitor towers - 18m high x 0.7 dia x 200mmtk epoxy coated, including cat ladders, platforms, top mount lifting hoist. Will require barge crane	1.00	Item	450,000.00		450,000.00
4	Fire water system deluge system replacement	1.00	Item	250,000.00		250,000.00
	Fire Monitor Upgrade					
	Remote Fire Control Monitors					
5	5 x new remote control fore monitors - 6000 lpm each - w/- CCTV	1.00	Item	205,000.00		205,000.00
6	Remote control - Unit - PC Based	1.00	Item	40,000.00		40,000.00
	Foam System Upgrade					
7	Foam system - 8000 litre foam tank pump and proportioning system - Excl concentrate - from Caltex stock	1.00	Item	500,000.00		500,000.00
8	Fire fighting equipment	1.00	Item	10,000.00		10,000.00
	Electrical Controls & Lighting					
9	Total order of magnitude estimate - by Caltex	1.00	Item	1,000,000.00		1,000,000.00
	Jetty Services, Utilities & Infrastructure				**Total :**	**3,005,000.00**
Trade :	**5** ***Design Growth - calculated on Total Design Costs***					
1	Design Growth allowance @10% of physical costs	1.00	Item	3,686,740.00		3,686,740.00
	Design Growth - calculated on Total Design Costs				**Total :**	**3,686,740.00**
Trade :	**6** ***Testing Commissioning & Training***					
	Testing Commissioning & Training					
1	MLA - Commissioning assistance by Emco Wheaton	1.00	Item	60,665.00		60,665.00
2	QRH	1.00	Item	20,000.00		20,000.00
3	Fire Monitors	1.00	Item	5,000.00		5,000.00
4	Miscellaneous	1.00	Item	8,050.00		8,050.00
	Testing Commissioning & Training				**Total :**	**93,715.00**
Trade :	**7** ***Indirect Costs - Engineering Procurement and Construction Management***					
	Engineering Procurement and Construction Management					
	EPCM Services					
1	Phase 1: Identify Engineering		Note			

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**7** ***Indirect Costs - Engineering Procurement and Construction Management***					*(Continued)*
2	Phase 2: Select Engineering	1.00	Item	300,000.00		300,000.00
3	Phase 3: Define Engineering	1.00	Item	1,400,000.00		1,400,000.00
4	Phase 4: Execute Engineering	1.00	Item	6,097,179.00		6,097,179.00
	Common Distributables					
5	Common Distributables	1.00	Item	6,097,178.00		6,097,178.00
	Indirect Costs - Engineering Procurement and Construction Management				**Total :**	**13,894,357.00**
Trade :	**8** ***Owners Costs***					
	Owners Costs					
	Studies and Approvals					
	Studies					
1	Sediment assessment, SAP, sea dumping permit	1.00	Item	250,000.00		250,000.00
2	Hydrodynamic, wave and plume modelling	1.00	Item	100,000.00		100,000.00
3	Ship simulation	1.00	Item	130,000.00		130,000.00
4	Geotech - by Caltex	1.00	Item	290,000.00		290,000.00
5	WQ monitoring pre and during dredging	1.00	Item	240,000.00		240,000.00
6	Mooring analysis		Note			
7	Hazops	1.00	Item	20,000.00		20,000.00
8	Safety in design workshops	1.00	Item	20,000.00		20,000.00
	Approvals					
9	REF - Dredging site only	1.00	Item	70,000.00		70,000.00
10	DECCW EPL - Dredging	1.00	Item	30,000.00		30,000.00
11	NSW Maritime licence	1.00	Item	30,000.00		30,000.00
12	Fisheries Permit	1.00	Item	10,000.00		10,000.00
13	SPC Harbour Master approval	1.00	Item	5,000.00		5,000.00
14	Sea dumping permit	1.00	Item	30,000.00		30,000.00
	Water Quality Monitoring					
15	Water quality monitoring - Dredge site - 3 Mths pre & post Derdging - 7Wk derdging campaign - icluded in abovc studics		Note			
16	Whale watch disposal site - Included in dredging rate		Note			
17	Bathymetric Surveys pre & post disposal	1.00	Item	90,000.00		90,000.00

Trade Breakup

Job Name : 12251 KURNELL

Client's Name: Worley Parsons

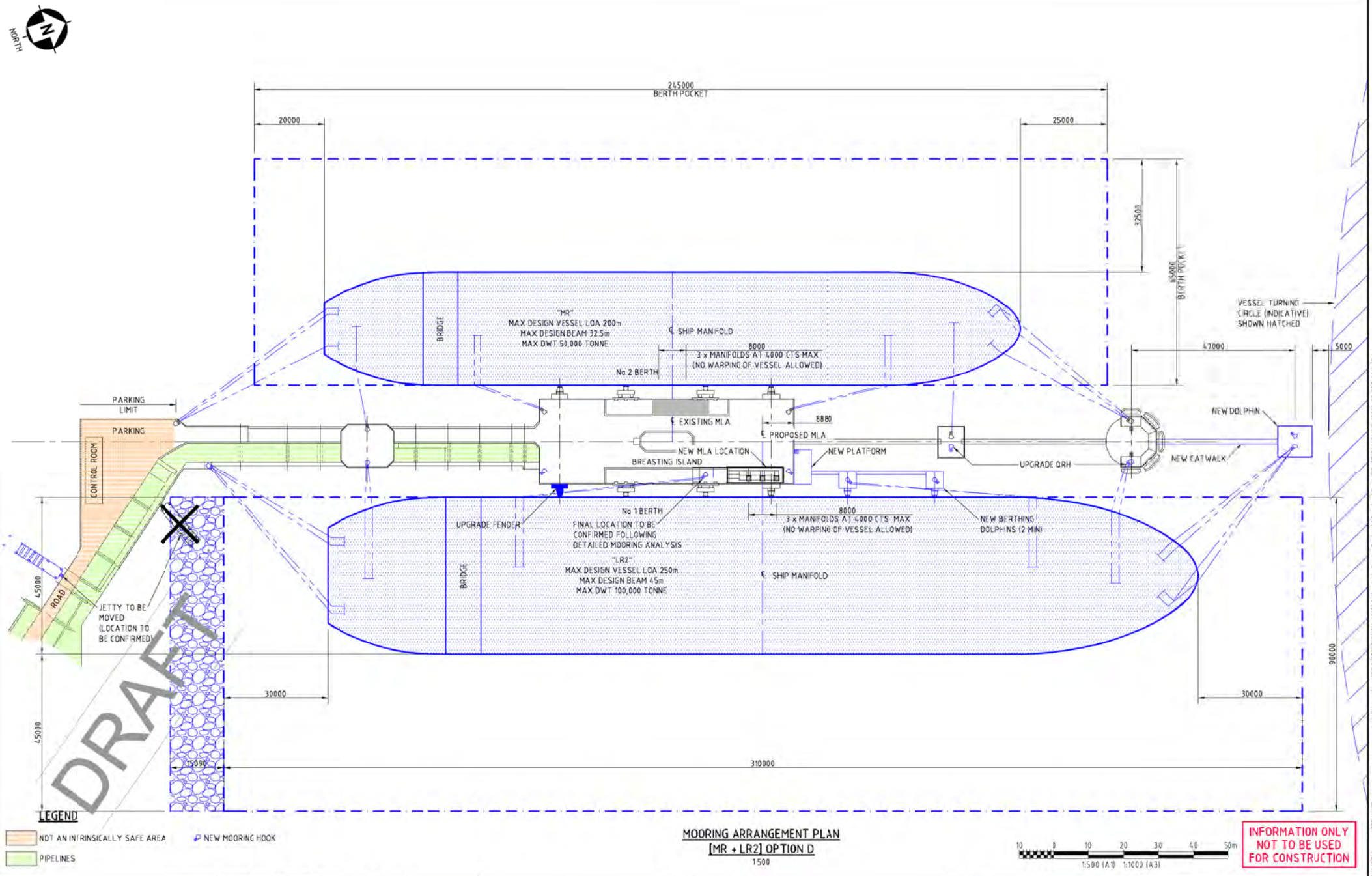
Job Description

Capital Investment Value of development of the Caltex Jetty Upgrade at Kurnell NSW

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
	Owners Costs				**Total :**	**1,315,000.00**
Trade :	**9** ***Base Total - Excluding GST***					
	Base Total - Excluding GST				**Total :**	
Trade :	**10** ***Contingency Costs***					
1	Contingency Applied @ 20% of costs	1.00	Item	10,434,095.00		10,434,095.00
	Contingency Costs				**Total :**	**10,434,095.00**

Appendix 4

Drawings for – Caltex Kurnell Jetty Upgrade



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A	05.01.12	ISSUED FOR CLIENT REVIEW	VIP	LJH	SOR	MJT	PMC			

A1 SHEET SCALE AS SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No. 301015-02989

WorleyParsons resources & energy

INFRASTRUCTURE & ENVIRONMENT
LEVEL 12, 141 WALKER STREET, NORTH SYDNEY, N.S.W. 2060
PH: +61 2 8456 7200 - FAX: +61 2 8923 6877 ABN 61 001 279 812

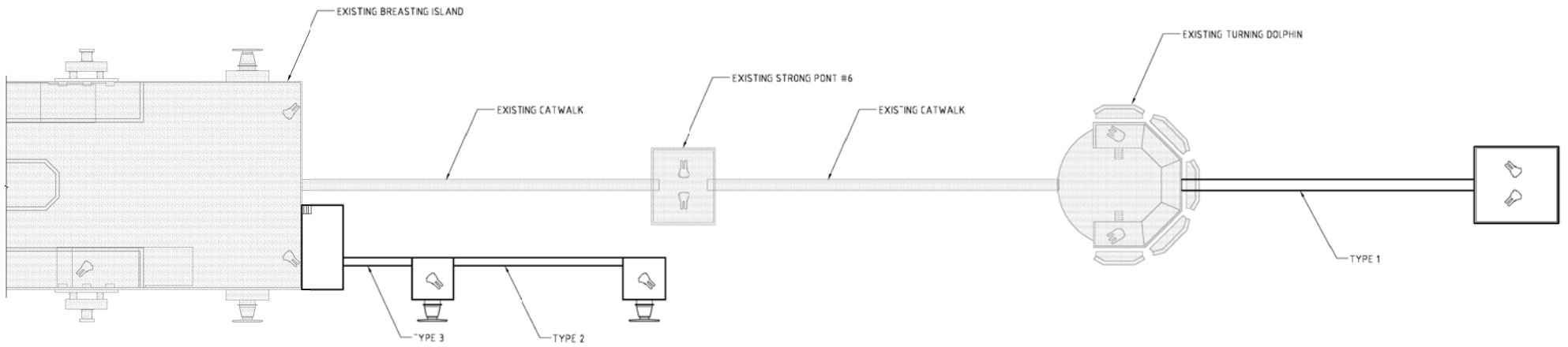
CUSTOMER

CALTEX we put more in

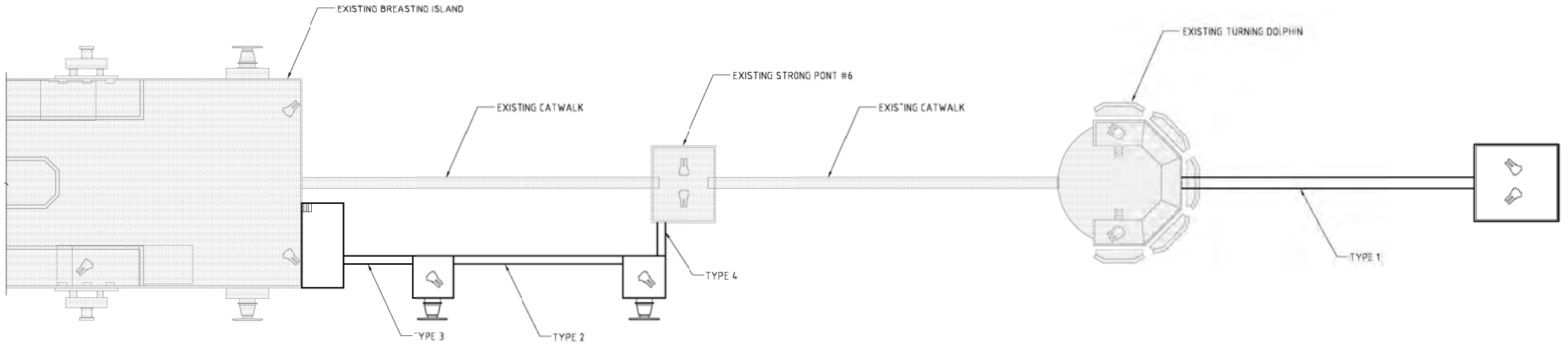
KURNELL REFINERY JETTY
MOORINGS UPGRADE AT No 1 BERTH
GENERAL ARRANGEMENT
[MR + LR2] OPTION D

DRG No 301015-02989-ST-DRG-0066 REV B

DATE & TIME 24/01/2012 04:12:17 PM USER NAME vaughan.patrick LOCATION K:_JOBS\CURRENT\301015-02989 Caltex Jetty Scoping Study\11 Drawings\Dgn\STRUCTURAL\301015-02989-ST-DRG-0066-01.dwg



OPTION 1
SCALE 1:250



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SCALE 1:250

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A	31.08.12	FOR INFORMATION	MN		DHP	PM			301015-03067-MA-DSK-0002	CATWALK DETAILS

A1 SHEET SCALE AS SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No.

ENGINEERING AND PERMIT STAMPS (As Required)

FOR INFORMATION ONLY

CUSTOMER

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KURNELL REFINERY JETTY UPGRADE

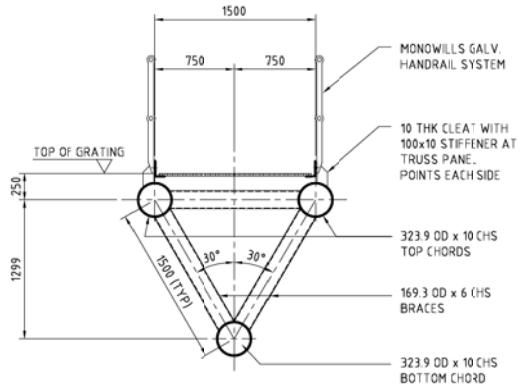
CATWALK LAYOUT OPTIONS

DWG No 301015-03067-MA-DSK-0001 REV A

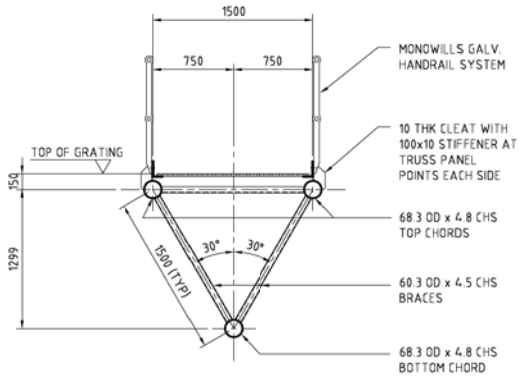
WORLEYPARSONS_A1_REV2

NOTES:

1. ALL STEELWORK TO BE PREPARED TO Sa2.5 THEN COATED WITH INTERZONE (DFT 400).



TYPE 1 CATWALK
TYPICAL CROSS SECTION
SCALE 1:25



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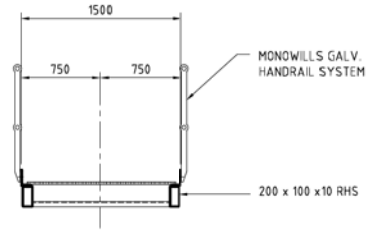
SCALE 1:25



TYPE 3/4 CATWALK
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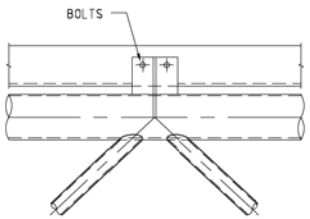
SCALE 1:25



DETAIL 1
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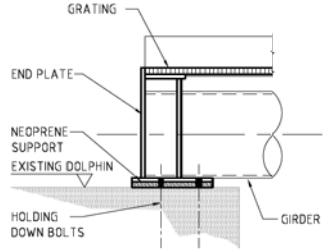

TYPICAL SUPPORT DETAIL
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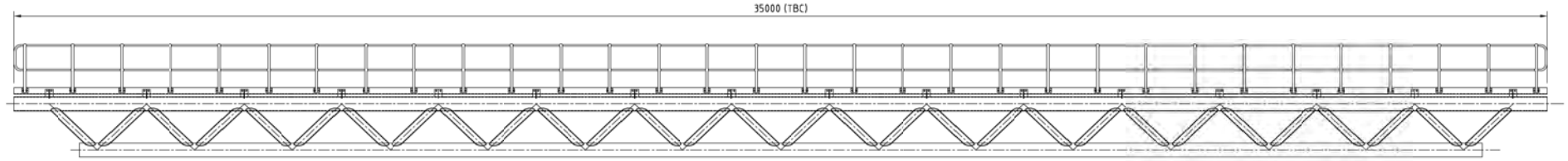
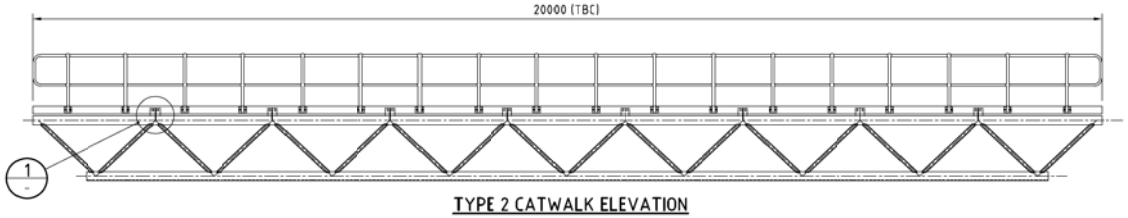
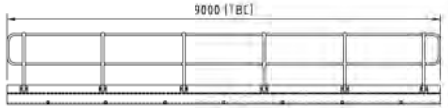


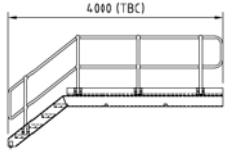
TYPE 1 CATWALK ELEVATION
SCALE 1:50



TYPE 2 CATWALK ELEVATION
SCALE 1:50



TYPE 3 CATWALK ELEVATION
SCALE 1:50



TYPE 4 CATWALK/STAIR ELEVATION
SCALE 1:50

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A	31.08.12	FOR INFORMATION	MN		DHP	PM				

A1 SHEET SCALE

OneWay to zero harm

WORLEYPARSONS PROJECT No.

ENGINEERING AND PERMIT STAMPS (As Required)

FOR INFORMATION ONLY

IVISTIMER

CALTEX we put more in

WorleyParsons resources & energy

KURNELL REFINERY JETTY UPGRADE

CATWALK DETAILS

DWG No 301015-03067-MA-DSK-0002 REV A

WORLEYPARSONS_A1_REV2

WorleyParsons
resources & energy

Proj No. 301015-03067

SKETCH Calc No. 301015-03067-MA-DSK-0001 /A

Customer CALTEX

Phase/CTR

Project title KURNELL REFINERY JETTY UPGRADE

Project file

Calculation title

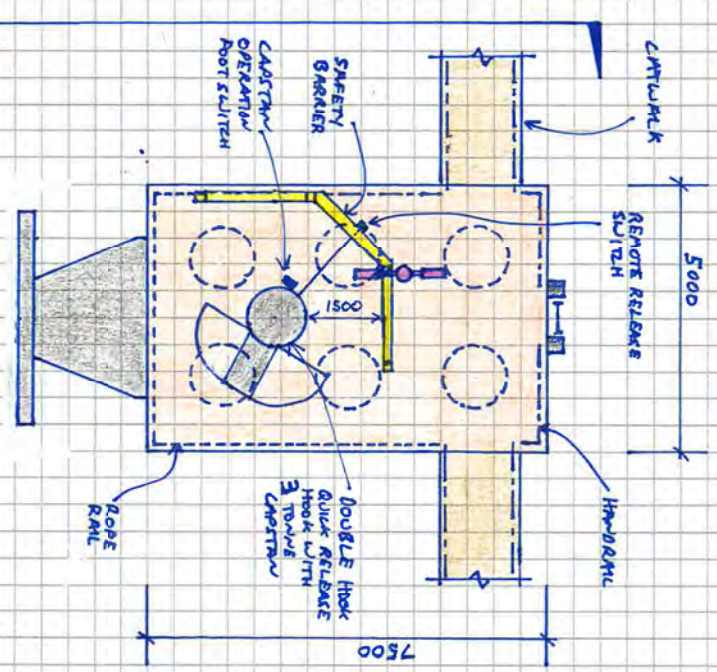
Page 1 of 1

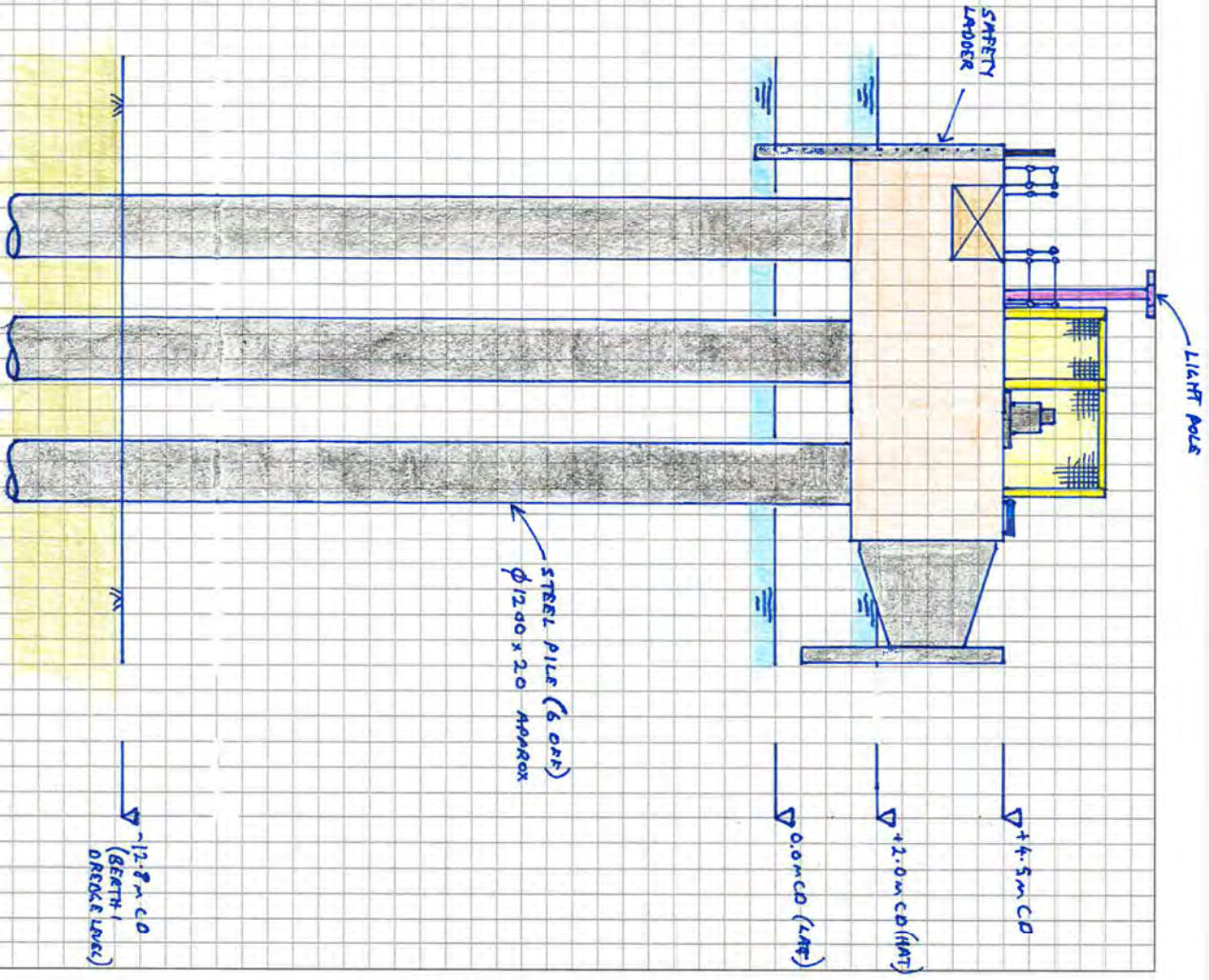
REVISION	DATE	BY	CHECKED	REVISION	DATE	BY	CHECKED	REVISION	DATE	BY	CHECKED	REVISION	DATE	BY	CHECKED
A	28/8/12	SJB													

NOTES:
1- ALL DIMENSIONS IN MILLIMETERS, UNO.

NEW BERTHING DOLPHIN CONCEPT LAYOUT
1:100 @ A3

ELEVATION (A)





WorleyParsons
resources & energy

Customer	CALTEX	Proj No.	301015-03067
Project title	KURNELL REFINERY JETTY UPGRADE	Calc No.	301015-03067-MA-0SK-0002 /A
Calculation title		Phase/CTR	
		Project file	
		Page	1 of 1

REVISION	DATE	BY	CHECKED	REVISION	DATE	BY	CHECKED	REVISION	DATE	BY	CHECKED	REVISION	DATE	BY	CHECKED
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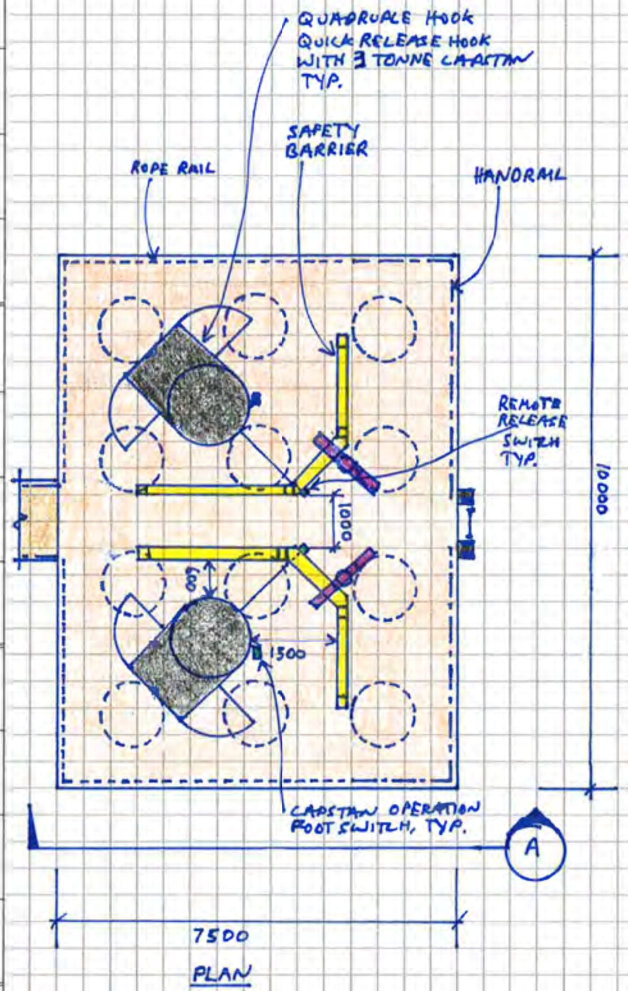
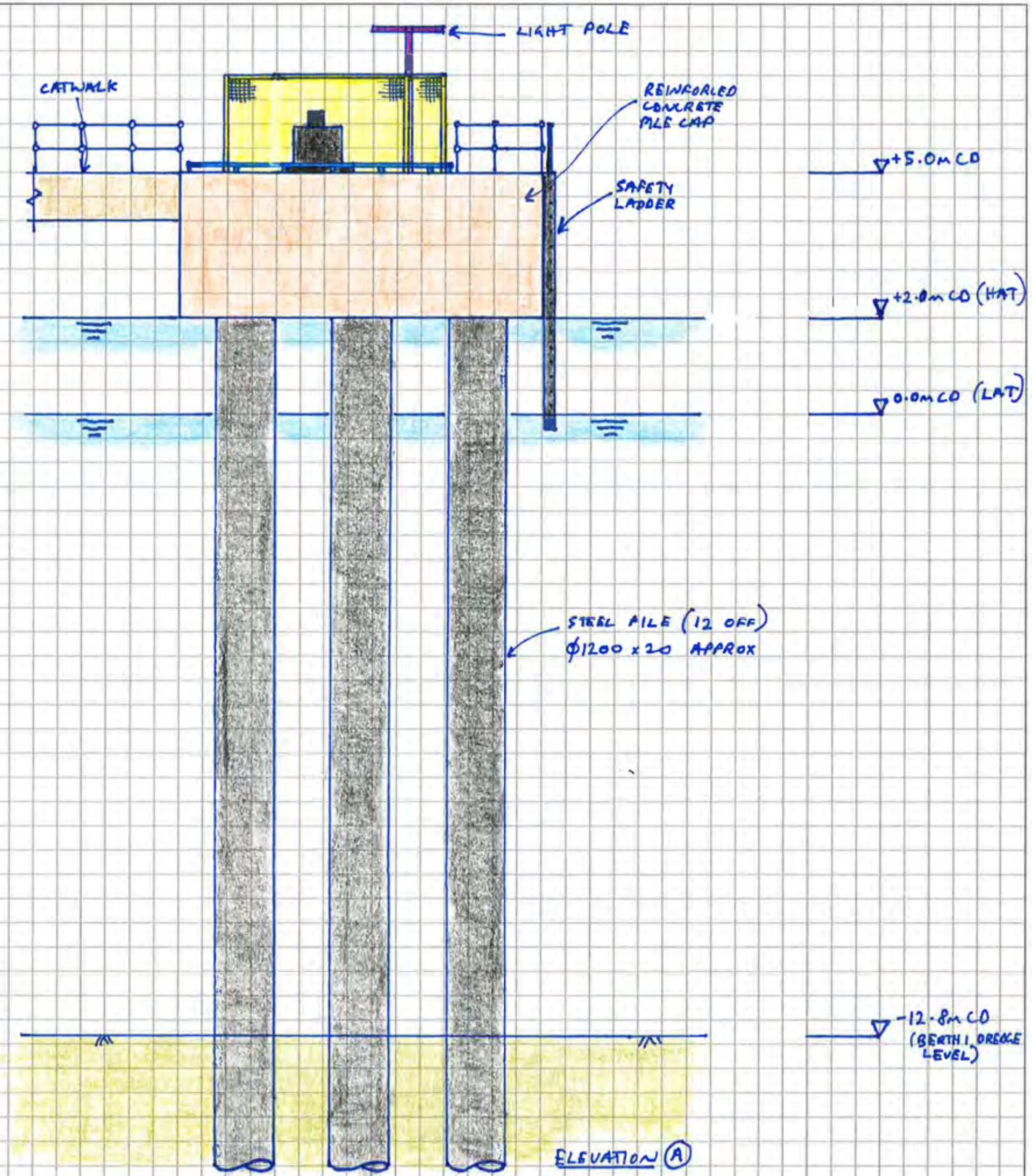


PLAN

Notes:

1- ALL DIMENSIONS IN MILLIMETRES, UNO.



ELEVATION (A)

NEW MOORING DOLPHIN CONCEPT LAYOUT
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