Appendix C

Human Health & Ecological Risk Assessment

URS

Statement of Environmental Effects

Appendix C HHRA and ERA

AUSTRALIA

Appendix C - Human Health and Ecological Qualitative Risk Assessment ('HHRA' and 'ERA')

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Prepared for:
Caltex Refineries (NSW) Pty Ltd

Prepared by URS Australia Pty Ltd

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Prepared by	Róisín Smit		20.10.14	Senior Human Health Risk Assesssor
Approved by	Victoria Lazenby		20.10.14	Senior Human Health Risk Assesssor

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Client Contact Details:
Dr Jos Kusters
Caltex Refineries (NSW) Pty Ltd
2 Solander Street
Kurnell

Issued by:
URS Australia Pty Ltd
Level 4, 407 Pacific Highway
Artarmon NSW 2064
Australia

T: +61 2 8925 5500
F: +61 2 8925 5555

URS

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EXECUTIVE SUMMARY

This assessment provides a qualitative assessment of the potential risks posed to human health and the environment from the demolition works associated with the conversion of the Kurnell Refinery (the 'Site') to a finished product terminal. The Site is located on the Kurnell Peninsula, on the southern side of Botany Bay, Sydney, Australia. This report has been prepared in response to the New South Wales (NSW) Department of Planning & Environment Secretary's Environmental Assessment Requirements (SEARs).

The demolition works, are the next phase in the process of establishing a viable, safe, reliable and sustainable finished product import terminal at the Site.

The demolition works would involve the demolition, dismantling or removal of refinery process units, redundant tanks, redundant pipelines, redundant services and redundant buildings as well as associated minor civil works and waste management activities. These works are planned to commence in mid-2015 and be completed by the end of 2017.

As described within **Chapter 4 Proposed Modification Description**, the demolition works would include the following ground disturbing works:

- demolition, dismantling or removal of:
  - refinery process units and associated infrastructure;
  - redundant tanks and associated infrastructure;
  - redundant pipeways and underground pipelines (within the Eastern and Western Rights of Way (ROW), the cooling water outlet from under Silver Beach, the cooling water inlets from the Kurnell Wharf and the Continental Carbon Pipeline); and
  - redundant buildings and services.

An estimated 150,000 tonnes of soil would likely require excavation for the demolition works from within the areas of potential disturbance shown in **Figure 9-4** of **Chapter 9 Soils, Groundwater and Contamination** of the SEE. The depth of excavation required across the Site varies from 1 m to 2 m.

The Site is adjacent to various sensitive receptors (refer to **Figure 1-1**) including residential areas and sensitive environmental sites including:

- the Kamay Botany Bay National Park which falls on the eastern boundary of the Site;
- Towra Point Nature Reserve, a designated Ramsar wetland (603.7 hectares) located approximately 1.5 km to the west of the Site;
- Towra Point Aquatic Reserve which is adjacent to the Towra Point Nature Reserve and covers the majority of Quibray Bay; and
- areas prioritised for Aquaculture (oysters) in Quibray Bay and Botany Bay.

The Site is not considered to provide any significant habitat for threatened or endangered organisms.

A qualitative Human Health Risk Assessment (HHRA) and a qualitative Ecological Risk Assessment (ERA) was prepared for the conversion works (URS, 2013).

To address the potential changes to impacts from the demolition works, URS undertook a qualitative HHRA and a qualitative ERA to address the SEARs for the demolition works which included the requirement for the consideration of contamination; specifically "*how ecological and human health risks posed by contaminants on the site would be mitigated and managed*". The SEARs also specify that potential impacts on the surrounding Kamay Botany Bay National Park, Towra Point Nature Reserve, Towra Point Aquatic Reserve watercourses, riparian land, wetlands and groundwater dependant ecosystems be considered.

In carrying out the assessment, URS identified sources, pathways and sensitive receptors which may be impacted by the demolition works. A number of site specific factors were considered as part of the assessment such as:

- the extent of excavation, both lateral and vertical;
- the extent of impacts noted in soil and groundwater at and surrounding the demolition works area; and
- the presence or absence of endangered and threatened species within the study area.

The assessment concluded that, while the demolition works are unlikely to increase the mobility of contaminants known to occur on the Site, the demolition works must be controlled so that the sources are managed appropriately to minimise and/or mitigate any potential impacts that may otherwise affect nearby receptors. Some specific recommendations are presented in the **Section 6** of this Report.

Providing the works are conducted in accord with the recommendations, which would be incorporated into the Demolition Environmental Management Plan (DEMP) for the demolition works, the nature of the intrusive works would not be expected to have any significant impact on the surrounding environment.

1 INTRODUCTION

1.1 General

Caltex Refineries (NSW) Ltd (Caltex) is currently converting Kurnell Refinery (the "Site") to a finished fuel terminal. These conversion works were granted development consent under SSD-5544. Caltex is subsequently seeking a modification to this consent to allow a number of related demolition works (SSD-5544 MOD 1) to be completed.

The demolition work involves: the demolition, dismantling and / or removal of redundant infrastructure; associated minor civil works; and returning the work areas to ground level.

The New South Wales (NSW) Department of Planning & Environment issued Secretary's Environmental Assessment Requirements (SEARs) for this modification dated 23 July 2014. These SEARs identify key aspects that must be addressed, including:

"***Contamination*** *– including:*

- *How ecological and human health risks posed by contaminants on the site would be mitigated and managed; and*
- *A description of the measures that would be used to identify, capture, treat, remediate and/or dispose of contaminated soil (including acid sulphate soil) and water that is encountered*."

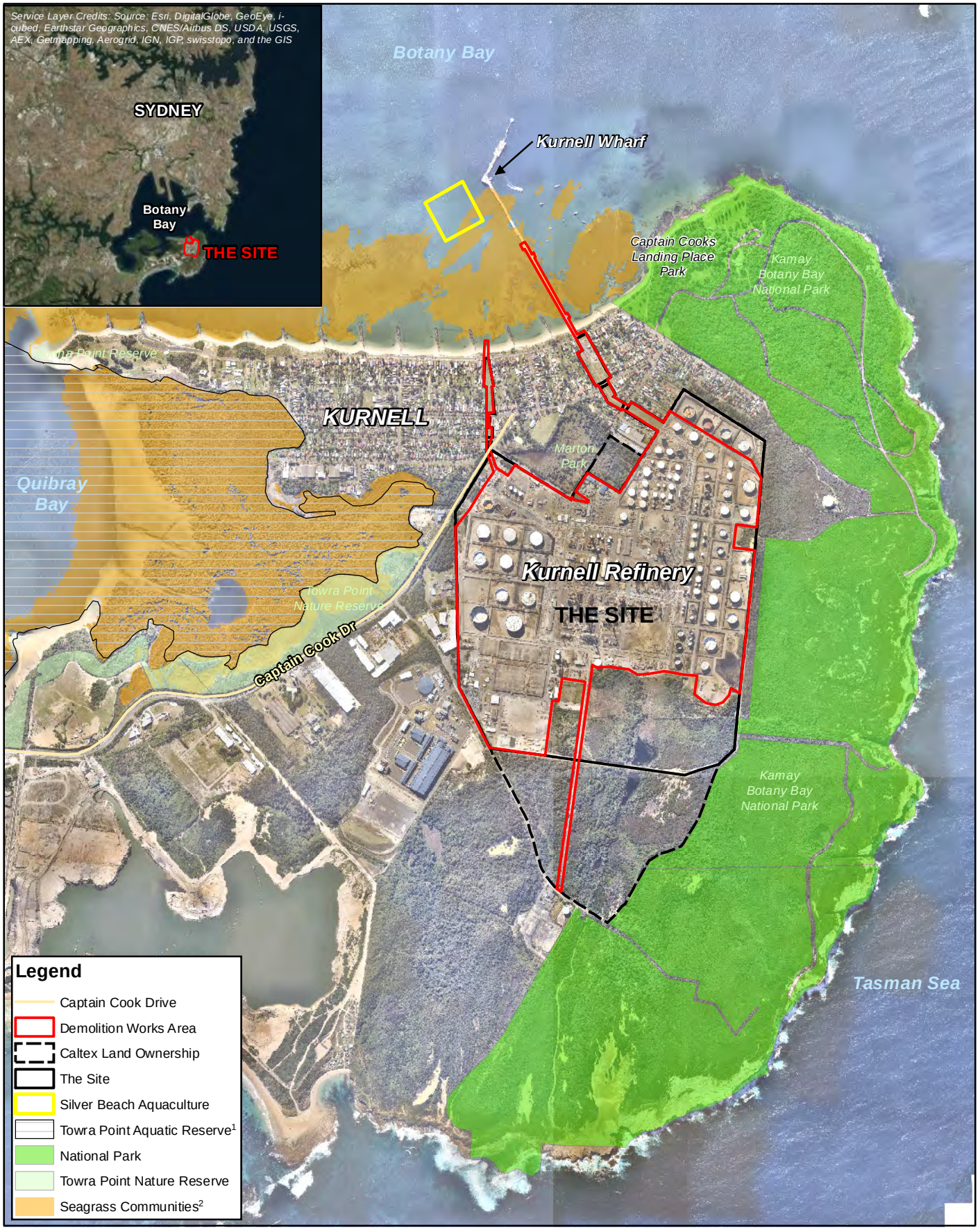
In response to these requirements, URS Australia Pty Ltd (URS) has been commissioned by Caltex to undertake a qualitative Human Health Risk Assessment and Ecological Risk Assessment (HHRA and ERA) for the areas on and surrounding the land which is the subject of demolition works, i.e. "the demolition works area". The demolition works area is shown on **Figure 1-1**.

1.2 Objective and Scope of Work

The overall objective of this technical appendix, in line with the SEARs, is to describe how human health and ecological risks posed by contaminants within the demolition works area would be mitigated and managed.

To achieve this overall objective, the HHRA and ERA comprise the following scope of work:

- identification of key Contaminants of Potential Concern (COPC) that may be exposed / released as a result of the demolition works;
- receptor identification;
- pathway identification, and assessment as to whether the pathways are complete;
- qualitative assessment of the risks posed; and
- measures recommended to mitigate identified unacceptable risks.



Source: Aerial Imagery from Nearmap 2014
[1]Office of Environment and Heritage (OEH)
[2]NSW DPI 2008

CALTEX REFINERIES (NSW) PTY LTD

KURNELL REFINERY CONVERSION MODIFICATION

SITE LOCATION

URS

File No: 43177915.014.mxd Drawn: SB Approved: RO Date: 16/10/2014

Figure: **1-1**

Rev. **A** A4

1.3 Site Description

The Site (**Figure 1-1**) is located on the Kurnell Peninsula, approximately 15 km south of Sydney's central business district (CBD). The Site covers approximately 187 ha and is zoned 'Special Industrial (Oil Refining)'. Caltex also owns two parcels of land adjacent to the Site shown as Caltex Land Ownership in **Figure 1-1**. The demolition works area mainly located within Caltex's land ownership, however works are required on parts of the road reserves in Kurnell (managed by Sutherland Shire Council) and under a small part of Silver Beach and Botany Bay (managed by NSW Roads and Maritime). The surrounding land uses include:

- North: Kurnell Village (zoned as 'Residential') and Botany Bay (zoned as 'Public Recreation (Existing)', 'Waterways' under the area covered by the *Kurnell Peninsula State Environmental Planning Policy 1989* (SEPP (Kurnell Peninsula));
- East: Kamay Botany Bay National Park (zoned as 'Public Recreation (Existing)' and 'National Parks and Reserves');
- South and south west: the decommissioned former Continental Carbon facility, the Sydney Desalination Plant and industrial developments (zoned as 'General Industrial', 'Special Industrial' and 'Special Development'); and
- West: Electricity Generation (zoned as 'Special Uses (Electricity)') and Quibray Bay (zoned as 'Regional Open Space', 'Public Recreation', and 'Waterways'). Quibray Bay includes the Towra Point Nature Reserve and Towra Point Aquatic Reserve. This area is a sensitive natural environment with mud flats, mangroves and a designated oyster growing industry.

The demolition works area also falls within the:

- Sydney Basin Bioregion;
- Hawkesbury-Nepean Catchment Management Authority (CMA); and
- The Sutherland Shire Council Local Government Area.

1.4 Demolition Works

As presented within **Chapter 4 Proposed Modification** of the SEE, the proposed demolition works would broadly comprise the following:

- demolition, dismantling or removal of:
  - refinery process units and associated infrastructure;
  - redundant tanks and associated infrastructure;
  - redundant pipeways and underground pipelines; and
  - redundant buildings and services.
- associated civil works;
- waste management activities including concrete crushing; and
- returning the works areas to ground level.

Figure 9-4 of **Chapter 9 Soil, Groundwater and Contamination** of the SEE shows where ground disturbance may occur during the demolition works, along with the anticipated maximum depth of excavation and the approach to the management and / or disposal of this soil during excavation.

1.5 Geological and Hydrogeological Setting

The Kurnell Peninsula is located on a plateau of Hawkesbury Sandstone (medium- to coarse-grained), and overlain by Quaternary medium- to fine-grained marine quartz sand. The demolition works area was originally a low lying sandy / swampy area that was levelled and filled prior to the refinery construction by excavating and spreading local sand dunes across the Site and supplementing this material with a significant quantity of sediment from Botany Bay.

Coffey (2007) reports that the depth to bedrock beneath the demolition works area varies between 2 m to 20 m. An unconfined aquifer of variable yield is located within the quaternary sands beneath the Site, with the depth to groundwater generally reported as being approximately 2 – 2.5 m below ground level (mbgl). Although the groundwater is generally found at this depth, groundwater monitoring (Coffey 2011, Caltex 2013a) indicates there is variable depth to groundwater across the Site, ranging from approximately 1 mbgl in the north-western area of the Site, to 15 mbgl in the south eastern area of the Site. Within the demolition works area, the groundwater depth ranges from approximately 1 – 4 mbgl, but is generally encountered within 2 to 2.5 mbgl.

The interpreted groundwater flow is generally in a northwest and west and is influenced by the underlying bedrock. Groundwater divides will generally be found where the bedrock is close to the ground surface and the quaternary deposits are thin. A groundwater divide is known to exist immediately north of the CLOR area (in the south-western corner of the Site), trending approximately east to west. To the north of the divide, the inferred groundwater direction is towards Botany Bay, while to the south, groundwater is expected to flow towards a stormwater drain located about 20 m south west of the Site boundary, which ultimately flows into Botany Bay (Caltex, 2013b). **Figure 9-1** in **Chapter 9 Soils, Groundwater and Contamination** of the SEE illustrates the groundwater flow direction beneath the Site.

There are several surface water bodies and swampy areas in the southern area of the Site. There is also a shallow surface water body present to the north of Solander Street (Caltex, 2013a).It is noted that there is a stormwater management plan (SMP) prepared for the Site under a previous EPL PRP condition (PRP U24.1).

2 APPROACH TO HHRA AND ERA

2.1 Risk Assessment Methodology

The fundamental concept underpinning the risk assessment methodology for both HHRA and ERA is the Conceptual Site Model (CSM), based on the source-pathway-receptor linkage concept. The CSM includes:

- source of COPC – impacted soil and groundwater resulting from recent or historic leaks or spills;
- transport media – migration of COPC in soil, surface water, groundwater, sediments, soil vapour or air. Groundwater transport includes dissolved phase and free phase liquids (also known as light non-aqueous phase liquids or LNAPL) such as gasoline and other liquid hydrocarbon fuels;
- exposure point/s – human and ecological receptors such as flora and fauna that may be adversely affected by impacts; and
- exposure route –pathway of contact with impacts (e.g. dermal contact, ingestion, inhalation and bioaccumulation).

If any one of these steps (source, transport media, exposure point or route) is absent, then the exposure pathway is incomplete and, hence, further assessment of risks is not required.

Where exposure pathways are complete, or have the potential to be complete, then the pathways can be considered as “significant”. The significance of the exposure pathway depends on the nature of the impact present, and the likely exposure concentrations that may be associated with the pathway.

The qualitative HHRA and ERA have been completed following the above approach in general accordance with the relevant legislation and guidance for risk assessment in Australia, as discussed below.

2.2 Regulatory Framework

The relevant guidelines for undertaking Human Health and Ecological Risk Assessments are discussed below. Where relevant, these have been applied to this assessment.

2.2.1 Commonwealth

Amended National Environment Protection (Assessment of Site Contamination) Measure (NEPM)

The primary national framework for assessing risk on potentially contaminated sites is provided in the amended National Environment Protection (Assessment of Site Contamination) Measure (Amended ASC NEPM) 1999 (NEPC 2013). The Measure has been adopted by all Australian jurisdictions and comprises two schedules; A and B with Schedule B containing a number of sub schedules; B1 to B7.

It contains guidelines on Investigation Levels (ILs) for soil and groundwater (Schedule B1), Health Risk Assessment Methodology (Schedule B4), Ecological Risk Assessment (Schedule B5) and derivation of the Health-Based ILs (Schedule B7). As applied within the Amended

ASC NEPM and also considered within this report, the assessment of risk consists of four main phases:

1 data collection and evaluation;
2 toxicity assessment;
3 exposure assessment; and
4 risk characterisation.

Phases 2 and 3 are often conducted concurrently.

The most common approach to risk assessment is a simple comparison of the site analytical data with the relevant ILs. In most cases, if the contaminants are below the adopted ILs, the site is considered to be low risk and acceptable for the intended use. If the contaminants exceed the adopted ILs, then further evaluation is usually required.

A range of ILs for Australia are assigned in the Amended ASC NEPM, including Health Investigation Levels (HILs), Health Screening Levels (HSLs) for petroleum hydrocarbons, Ecological Investigation Levels (EILs), Ecological Screening Levels (ESLs) for petroleum hydrocarbons, Management Limits (MLs) for petroleum hydrocarbons and Groundwater Investigation Levels (GILs).

2.2.2 NSW Legislation and Policy

The following environmental planning instruments are relevant to the demolition works.

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55)

State Environmental Planning Policy No. 55 - Remediation of Land (SEPP 55) provides a State wide planning approach to the remediation of contaminated land. SEPP 55 aims to promote the remediation of contaminated land with the objective of reducing the risk of harm to human health or other aspects of the environment. Section 7 of the SEPP specifies that:

'*A consent authority must not consent to the carrying out of any development on land unless:*

1. *it has considered whether the land is contaminated, and*
2. *if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and*
3. *if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.*'

Contaminated Land Management Act 1997 and Amendment Act 2008

The primary objective of the Contaminated Land Management Act 1997 (CLM Act) is to establish a process for investigating and remediating land where contamination presents a significant risk of harm to human health or another aspect of the environment.

2.2.3 Other Jurisdictions

Various State and local regulations, policies and guidelines have been applied within the HHRA and ERA. These guidelines are discussed under the separate risk assessments within **Section 4** and **Section 5** respectively.

Where no Australian Commonwealth, State or local guidelines exist for a particular contaminant and exposure scenario, international guidelines have been used where relevant.

3 SITE CHARACTERISATION

The Site has been the subject of numerous investigations over the past two decades. This section considers the key findings from these investigations and presents an summary of how the demolition works area has been characterised and delineated. This information provides the basis for the qualitative assessments for human health and ecological risk presented in **Section 4** and **Section 5** respectively.

3.1 Environmental Information Sources

The background data used in the identification of potential contamination sources for the HHRA and ERA are based on a review of the following reports:

- Soil and Groundwater Contamination Assessment, Classification and Risk Ranking Report (Coffey 2007);
- Soil and Water Contamination Data Review – Caltex Refinery, Kurnell (Caltex 2013a);
- Contamination Data Gap Assessment – Caltex Refinery, Kurnell (Caltex 2013b); and
- Contamination Data Gap Investigation Plan – Caltex Refinery, Kurnell (Caltex 2014).

The Caltex 2013a, 2013b and 2014 reports were issued pursuant to Environmental Protection Licence 837 – Preliminary Investigation Order 20131001 issued by NSW Environmental Protection Agency (EPA).

The following assessments that form part of this SEE were also utilised:

- **Chapter 9 Soil, Groundwater and Contamination**;
- **Chapter 14 Air Quality and Odour**;
- **Appendix G1 Ecology Impact Assessment** (prepared by Biosis, 2014);
- **Appendix G2 Marine Ecology Impact Assessment** (prepared by Cardno, 2014); and
- **Appendix H Coastal Processes** (prepared by Cardno, 2014).

Coffey (2007) reports that various remedial works have been undertaken on the demolition works area, including bioventing and contaminant recovery from groundwater. Such works are expected to have improved the general contamination status of the demolition works area since the 2007 report. In addition, some of the organic contaminants may have undergone natural attenuation, especially in the near-surface layers. More specifically it is noted that remediation works are being undertaken in the following zones (Caltex, 2013b):

- Zone F – LNAPL extraction and bioventing;
- Zone I and T - LNAPL extraction and vertical barrier wall; and
- Zone O - encapsulation of Limestone Pits and phytoremediation.

This assessment is largely based on soil and groundwater data primarily collected between 1998 and 2013. It is also supplemented by the results of the quarterly groundwater monitoring program. As such the assessment should be considered in conjunction with the limitations presented in the documents noted above. Notwithstanding the limitations of relying on

existing data, the use of these documents is appropriate given the limited scope and duration of the demolition works and the purpose of this SEE.

3.2 Contaminants of Potential Concern

Based on the historical land use and reported activities carried out across the demolition works area, investigations have been conducted to determine primary COPC for the area (Coffey 2007, Coffey 2011, Caltex 2013a, Caltex 2013b and Caltex 2014). These studies have identified the following primary COPC:

- TPH – associated with diesel fuel, gasoline, heating oil, jet fuel, other petroleum-based products and wastes;
- Benzene, toluene, ethylbenzene, xylene (BTEX);
- Polycyclic aromatic hydrocarbons (PAH);
- Phenols;
- Lead; and
- Asbestos.

The COPC identified are generally related to fuels and related products stored or used within the demolition works area. The fuel-based COPC are composed of a range of mixtures of organic compounds, including a range of volatile and semi-volatile organic compounds (VOC and SVOC) that have potentially adverse impacts on human health and the environment.

In addition, Caltex has noted that ammonia concentrations are generally elevated across the Site and throughout the Kurnell area including residential areas to the north (Caltex 2013a). Numerous exceedances of ammonia, phosphate, phosphorous, copper and iron have been measured in both in-bound and boundary monitoring wells (Caltex, 2013a) and groundwater wells that are considered to be hydraulically up-gradient of the Site. The distribution of these compounds does not suggest a point source on the Site but rather that these analytes could be considered representative of wide-spread groundwater quality in Kurnell and are not related specifically to the refinery (Caltex 2013a). Therefore these compounds have not been considered as site-specific COPC.

URS has considered additional COPC that may be potentially relevant to the demolition works area, based on knowledge of general refining processes and based on isolated detections across some portions of the Site (Caltex 2013b). These additional COPC include:

- metals (in addition to lead) such as chromium, mercury;
- cyanide;
- fluoride;
- furfural;
- monoethanolamine (MEA);
- Methyl ethyl ketone (MEK);
- mercaptan;

- polychlorinated biphenyls (PCBs);
- perchloroethene (PCE);
- various pesticides;
- phosphorous and phosphate;
- tetrachloroethylene;
- trimethylbenzene (TMB)
- Dimethyl disulphide (DMDS); and
- perfluorocarbons (PFCs).

There is little or limited site data available for many of these COPC since they do not appear to be widespread across the demolition works area. However, given that the potential exposure routes are common with the primary COPC, this assessment and the recommended management and mitigation measures also address the additional COPC listed above.

3.3 Screening Criteria

The demolition works includes soil excavation up to a depth of 2 mbgl. The proposed soil disturbance works (as outlined in **Figure 9-4**, **Chapter 9 Soils, Groundwater and Contamination** of the SEE) would occur in sections of the demolition works area as follows:

- Eastern and Western Tank Areas, excavation up to 1 mbgl; and
- Refinery Process Units, Western right of way (ROW), north of the Western ROW for the removal of the Cooling Water Outlet to 20 m beyond the low tide mark, Eastern ROW, and Continental Carbon Pipeline excavation up to 2 mbgl.

The depth to groundwater varies across the demolition works area varies but is generally encountered within 2 to 2.5 mbgl. Therefore deeper excavations may encounter groundwater (refer to **Section 1.5**).

To identify the COPC across the demolition works area the reports referenced in **Section 3-1** applied screening criteria from various sources. The relevant criteria, as applied during the intrusive investigations and sampling events, are summarised below.

Soil

Health Investigation Levels (HILs) for non-volatile and semi-volatile chemicals – based primarily on physical contact (soil and dust ingestion/dermal contact); selected for receptors on an industrial site (generally, workers on-site).

Health Screening Levels (HSLs) for volatile petroleum chemicals - based on vapour risk and the potential for a contaminant to volatilise and percolate upwards through the soil. HSLs are intended to protect receptors at the surface (above an impact) and were derived for exposure scenarios of people spending time in an enclosed space above a volatile contaminant.

For many of the petroleum-based COPC, the HSL is denoted as ‘NL’ or ‘Non-limiting’, which indicates that the physical properties of the chemical lead to the vapour reaching saturation point and unable to increase further to a level that would result in an unacceptable health risk.

NSW EPA Service Station Guidelines for petroleum compounds. Prior to the HSLs the values provided within these guidelines were used to assess the potential impacts associated with fuel distribution outlets.

This technical note outlines industry best practice in the assessment of service station sites in consideration of relevant legislation and policies. This technical note is relevant to the Site as is describes the assessment steps for sites where fuel storage systems are present that are similar to above ground tanks, fuel lines, and dispensers.

Ecological Investigation Levels (EILs) and **Ecological Screening Levels** (ESLs) for various settings / land uses. The Amended ASC NEPM EILs and ESLs have been developed for selected metals and organic substances and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties whereas ESLs do not. Both are relevant to land use scenarios and apply to the top two metres of soil. EILs take into account soil texture and age of the impacts, whereas ESLs account only for soil texture.

Management Limits. The Amended ASC NEPM also allows for Management Limits due to policy considerations which reflect the following potential properties of petroleum hydrocarbons:

- formation of observable light non-aqueous phase liquids (LNAPL);
- fire and explosive hazards; and
- effects on buried infrastructure, e.g. penetration of, or damage to, in-ground services by hydrocarbons.

The Amended ASC NEPM also notes that these limits are less relevant at operating industrial sites which have no or limited sensitive receptors in the area of impact. .

Groundwater

Groundwater Investigation Levels (various) – GILs are generally based on protection of the nearest receiving environment (usually surface water). It is not essential to meet the criteria in the aquifer; however the first step in assessing groundwater risk to surrounding ecosystems is to compare contaminant levels in groundwater with the GIL.

GILs are outlined in the Amended ASC NEPM and are primarily based on screening criteria in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000). These Guidelines provide a range of criteria for each contaminant, and offer different levels of protection for species in fresh and marine waters depending on the value of that ecosystem. These protection levels are:

- 99% species protection for pristine aquatic environments *(high ecological value* systems);
- 95% protection for slightly modified environments (*slightly to moderately disturbed* ecosystems); and
- 90% or 80% species protection for *highly disturbed ecosystems*.

Groundwater Health Screening Levels – similarly to **Soil Health Screening Levels,** Groundwater HSLs are based on vapour risk and the potential for a contaminant in groundwater to volatilise and percolate upwards through the soil. HSLs are intended to

protect receptors at the surface above the impact. They are derived for exposure scenarios of people spending time in an enclosed space above a volatile contaminant present in the groundwater.

3.4 Extent of Impacts across the Demolition Works Area

In considering the extent of impacts across the demolition works area, the lateral and vertical extent of excavations is initially considered. The lateral extent of impacts is defined by each CMZ identified in **Figure 9-3 and Table 9-1** in **Chapter 9 Soils, Groundwater and Contamination** of the SEE, with the vertical extent further discussed in this section. By identifying the lateral and vertical extent of impacts in the demolition works area, and considering the timeframe of the works, the COPC within each zone and their associated exposure pathways (i.e. the potential for direct contact, or inhalation of a COPC) can be further assessed.

As part of the demolition works, foundations, redundant slabs and redundant infrastructure (e.g. the oily water sewer) associated with the refinery process units would be removed. Removal of this infrastructure would require excavation work which may extend down to 2 mbgl. This work would be staged across a 2 year period. At the end of this process, the refinery process units area would be levelled and crushed concrete would be spread across the area.

Ground disturbance associated with the removal of tanks would extend to a maximum of 1 mbgl. This ground disturbance would be minimal and would mostly entail the removal of small pipelines/infrastructure within the tank bund. The hardstand below each of the tanks would remain intact. This work would be staged across a 2.5 year period.

Ground disturbance associated with infrastructure and building demolition would extend to a maximum of 1 mbgl. It is understood that this work would be staged across a 1.5 year period.

Ground disturbance associated with removal of the pipelines in the Eastern and Western ROW in the north of the Site would be approximately 2.0 m deep (refer to **Figure 9-4)**. Within the Continental Carbon Pipeline easement, excavation to approximately 2 mbgl would be required to remove this pipeline. This work would be staged across a 2 year period.

The Site is divided into 22 CMZs (Zone A to Zone V) (refer to **Figure 9-3** of **Chapter 9 Soils, Groundwater and Contamination** of the SEE). Each individual CMZ is a portion of the Site associated with a particular activity and with an identifiable and limited group of potential contaminants associated with that activity. The demolition works would be conducted in Zones A, B, C, D, E, F, G, H, I, J, K, L, M, P, S, T and V and it is the identified contamination in these CMZ only that have been considered within this assessment. In addition, there may be impacts due to movement of contaminants from other sections of the refinery (for example, oily water overflow from the sewer system during intense rainfall periods).

As noted above, a summary of potential contamination across the Site, focusing on the demolition works area, characterised by the relevant CMZ is presented in **Table 9-1** of **Chapter 9 Soils, Groundwater and Contamination** of the SEE. **Table C-1** presents a summary of the potential sources and types of contaminants by CMZ. CMZs that are outside the demolition works area, or do not have any excavation occurring within them (i.e. the works to be undertaken on Kurnell Wharf) were not summarised in the table.

Table C-1 Potential Sources and Types of Contaminants by Site CMZ (Contamination Management Zone)

CMZ [1]	Contaminants of Concern
Zone A	TPH, PAHs, BTEX, MEK and Furfural *Potential asbestos associated with the insulation of some pipes.*
Zone B	TPH, PAHs, BTEX *Additional potential contaminants: Asbestos from building wastes noted in temporary soil stockpiles, and contaminants from other Site areas transported by oily water sewer system and stormwater network.*
Zone C	TPH, PAHs, BTEX *Additional potential contaminants:* *PCBs from previous substation use, metals (Cr) and contaminants from other areas of Site transported by oily water sewer system and stormwater network.*
Zone D	TPH, PAHs, BTEX *Additional potential contaminants: mercaptan (organic sulphur compounds) and Lead (Pb) (and possibly TEL) and contaminants from other areas of Site transported by oily water sewer system and stormwater network.*
Zone E	TPH, PAHs, BTEX, lead (tetraethyl lead and inorganic lead).
Zone F	TPH, PAHs, BTEX, Lead (tetraethyl lead and inorganic lead).
Zone G	TPH, PAHs, BTEX, MEA, PCE, DMDS, Phenol, Ammonia and Metals (Hg, Cr, Pb). Potentially fluoride and MEA. *Potential asbestos associated with the insulation of some pipes and equipment.*
Zone H	TPH, BTEX, PAHs. Metals (Al) from the FCCU's. *Possible asbestos associated with the insulation of some pipes and equipment.*
Zone I	TPH, PAHs, BTEX, *Additional potential contaminants:* Asbestos, *Metals, and contaminants from other areas of Site transported by oily water sewer system and stormwater network.*
Zone J	TPH, PAHs, BTEX, *Additional potential contaminants:* Asbestos, *Metals, PCBs and contaminants from other areas of Site transported by oily water sewer system and stormwater network.*
Zone K	TPH, PAHs, BTEX, Phenols, lead and asbestos
Zone L	TPH, BTEX, PAHs, Phenols, lead and asbestos. *Potentially contaminants from off-site transported by the OWSS and stormwater network*
Zone M	TPH, PAHs, BTEX *Additional potential contaminants: Metals and contaminants from other areas of Site transported by oily water sewer system and stormwater network.*
Zone P	TPH, BTEX, PAHs and Asbestos
Zone S	TPH, BTEX, PAHs Potentially Ammonia Phosphate Tetrachloroethylene Pesticides associated with chemical storage. *Possibly contaminants from products derived from other zones connected via the oily water sewer system and stormwater network.*
Zone T	TPH, naphthalene, BTEX
Zone V	Salinity

[1] CMZ = Contamination Management Zone = a portion of the Site associated with a particular activity and with an identifiable and limited group of contaminants associated with that activity. The entire Site is divided into 22 separate CMZs (Zone A to Zone V).

Groundwater Considerations

Historically, monitoring wells PWM25 and PMW27 were reported as displaying an increasing trend in hydrocarbon contamination. Equally some monitoring wells in CMZ B and CMZ C were also reported as displaying an increasing trend in hydrocarbon contamination in 2007-2008. This increase is likely to relate to some spills or leaks around 2007-2008 or soon after the Coffey 2007 report was compiled. In both instances the converse is now noted with these same locations generally showing a decrease in contamination indicating that natural bioattenuation is likely to be occurring.

TPH fractions were also identified in boundary wells in the north west of the Site, although no NSW recognised screening levels are available for environmental receptors.

Asbestos

Asbestos is noted to be present across various zones including A, B, G, H, I, J, K, L, O, and P. Coffey (2007) reports that an asbestos investigation was undertaken in 2006 during a remediation program for some product transfer pipeways (above ground pipes) in Zone L. The investigation reports that a total of 103 out of 140 samples of sand bedding material collected from the pipeways contained asbestos. The asbestos contamination was considered most likely to have been sourced from break-up of asbestos insulation covering some pipes during maintenance/removal works on the pipeways, or as a result of the “water hammer” that occurs in the pipework when stormwater fills up to pipe level and enters the sheathing.

The northern end of Zone L contained widely distributed asbestos so the whole of this portion of the pipeway was considered asbestos contaminated for the purposes of access or remediation. The assessment indicates that the asbestos contamination was in the form of fibres.

No asbestos investigations were reported to have been conducted in other CMZs, but Coffey (2007) noted that the results of the Zone L assessment are relevant to other zones with similar above-ground pipeways (in particular Zones I and K).

In addition, some asbestos was noted in waste material stockpiled in Zone B. Considering the nature and age of the pipes and other infrastructure across the demolition works area and the likely waste products, it is possible that asbestos is dispersed across the Site.

Caltex (2013a) reports a 2011 investigation that identified asbestos fibres (AF) in two of 41 locations in Zone P. Asbestos cement material (ACM) and asbestos in gaskets were identified at nine of these locations.

A soil contamination assessment/characterisation was undertaken by AECOM (2013) for waste classification purposes within the pipeways (Zone K and L) and within the CLOR (Zone A). This identified that although asbestos is a COPC for Zone A, K and L, out of the 84 samples undertaken, only 17 were above criteria in the surface layers, and five were above criteria in the subsurface layer.

Acid Sulfate Soils

The probability of occurrence of acid sulfate soils across the demolition works area is considered to be low according to available Acid Sulfate Soil Mapping (refer to **Chapter 9 Section 9.5.2**). Environmental impacts associated with these soil types can occur as a result of development works which expose soil with the potential to undergo oxidation reactions on contact with oxygen and water. The result of the oxidation reactions typically produces low pH runoff which in turn acidifies soil, groundwater and surface waters.

Acid sulfate soils have been recorded and classified by Sutherland Shire Council[2] across the demolition works area. These maps show the demolition works area extends across land classified as Class 4 (the main Site) and Class 3 (Eastern and Western ROWs) with respect to Potential Acid Sulfate Soils (PASS). Works to the north of the in the Western Right of Way and the Eastern Right of Way would extend into a Class 5 area. Measures to manage acid sulphate soils have been provided in **Section 9.7** of **Chapter 9 Soils Groundwater and Contamination** of the SEE**.**

Other Hazardous Materials

Hazardous materials may exist within the existing infrastructure and could include, but not be limited to, asbestos, PCBs, and the contents of tanks and associated pipework. These materials have not been considered in this assessment, but recommendations are made to minimise further impacts to soil or groundwater during demolition works.

Acute Risks and Aesthetic Considerations

In addition to health and ecological risks, volatile COPC or their degradation products may pose acute risks to on-site workers through explosive or asphyxiating atmospheres in excavations or below ground services. These risks can be addressed by implementing existing refinery practices and this is noted in the recommendations.

The COPC may also be associated with visual or odour impacts to soil or groundwater. In view of the industrial nature of the Site, these have not been considered further.

3.5 Data Gaps

Data gaps are discussed in **Section 9 Soil, Groundwater, Contamination** of the SEE and Caltex 2013b. It is further noted that Caltex has provided NSW EPA with a plan to address these data gaps (Caltex 2014).

The data gaps mainly relate to limited sampling in the areas of potential or known contamination, due to the presence of structures and/or limited coverage of the site boundaries adjacent to sensitive off-site receptors.

There are a number of detections of COPC in groundwater at the boundary of the Site. While a groundwater well network is present, there are a number of potential contamination source zones (including the former CLOR) that could warrant further assessment.

[2] http://www.sutherlandshire.nsw.gov.au/General/Shire_maps

Dependant on the approval of this modification application, and subsequent demolition of redundant areas of the Site, further assessments of certain data gaps could be completed once access to these areas is available.

3.6 Conclusion

Taking all the available information into account, including site history, contamination incident reporting and the groundwater monitoring program over nearly 20 years, and considering the nature and scale of the proposed demolition works, it is considered that the Site is sufficiently characterised to enable a qualitative assessment of the risks.

4 QUALITATIVE HUMAN HEALTH RISK ASSESSMENT

4.1 Introduction

This chapter assesses the potential risks to human health from the demolition works at the Site and is based on the information provided in **Sections 1 - 3**.

The assessment addresses the SEARs for the SEE and includes the requirement for consideration of contamination, specifically "*how ecological and human health risks posed by contaminants on the site would be mitigated and managed*".

Given that the demolition works are planned to proceed only following the deinventory, depressurisation and cleaning of redundant plant, it is expected that only minor amounts of hydrocarbon residues would potentially be present prior to the demolition works occurring. Caltex and its contractors would follow strict protocols to prevent such occurrences and to protect health, safety and environment and therefore this HHRA does not address any potential additional contamination that may occur during the demolition works.

To assess the health risk from existing contamination, URS considered that a source – pathway – receptor (SPR) model to understand the potential for exposure was appropriate, based on a review of information (refer to **Section 3**) and a general understanding of the refining process, the Site, the demolition works area, and of the proposed demolition works. For a risk to be realised, there must be a source of risk, a receptor that could be impacted, and a pathway for the source to impact the receptor. This SPR model looks at the potential for a complete pathway by analysing these three elements.

4.2 Potential Sources of Contamination

Following the review of the available data, primary COPC for impacts to human health have been identified (refer to **Section 3**). These include TPH, BTEX, PAHs, phenols, lead, and asbestos. Based on the previous reports the COPC exceed Tier 1 screening levels across most areas where excavation and demolition would occur. A number of additional COPC were identified in isolated locations, given that the exposure routes are common with the primary COPC, management and mitigation measures have also addressed the additional COPC identified herein.

These COPCs may be encountered in soils or groundwater during excavations. These COPC are a combination of both volatile and non-volatile compounds.

During demolition works there is the potential for additional sources of contamination to be identified (e.g. beneath and around infrastructure). These materials have not been considered further, but recommendations are made to ensure that additional contaminated materials are not placed in excavations in **Section 6.2.1**.

4.3 Pathways of Exposure

This Section presents the relevant exposure pathways for human health receptors for the demolition works.

Contaminated Soils

Potentially complete pathways for human health receptors during the demolition works include:

- direct contact with exposed soil on-site while working;
- incidental ingestion of soil and dust on-site while working;
- inhalation of vapour on-site from VOCs in the soil;
- inhalation of dust on- and off-site;
- inhalation of asbestos fibres in the soil, if present in a friable form or in a form that can produce fibres;
- contact with soil impacted stormwater run-off by workers on-site or members of the public off-site; and
- contact with dust or inhalation of vapours by members of the public in close vicinity to work areas.

Recommendations have been made to minimise and monitor these impacts in **Section 6.2.1**

Contaminated Groundwater

Potentially complete pathways for human health receptors during the demolition works include:

- direct contact with groundwater on-site while working;
- inhalation of vapour on-site from VOCs in the groundwater;
- contact with groundwater impacted stormwater run-off by workers on-site or members of the public off-site; and
- inhalation of groundwater vapours by members of the public in close vicinity to work areas.

It is noted that disturbance of soils during infrastructure removal has the potential to unearth contaminated soils, which if exposed may result in the impacted soil/sediment contaminant leaching or migrating to groundwater. Recommendations have been made to minimise and monitor these impacts in **Section 6.2.1**.

On-going risks to Site workers and adjacent residents following the demolition works are considered to be lower than during the works as many of the residual sources of impact (e.g. redundant pipework) on the Site would be removed.

Excavations would be returned to grade with excavated natural material (ENM), virgin excavated natural material (VENM), or appropriately remediated material.

The migration of groundwater off-site would be managed in accordance with the existing procedures (**Section 6.2.1**). The mitigation and management recommendations proposed in **Section 6.2.1** are considered appropriate for the post-demolition phase (i.e. once the demolition works have been completed at the end of 2017).

Therefore, risks in the post-demolition phase are not considered further.

4.4 Potential Human Health Receptors

4.4.1 On-site Receptors

On-site human health receptors include workers conducting demolition works (including excavations), other site workers involved with terminal operations, and site visitors. Site workers or visitors may be exposed to dust and vapours. Additionally, demolition workers may have direct contact with impacted soil or groundwater. Recommendations to minimise and monitor these impacts have been made in **Section 6.2.1.**

4.4.2 Off-site Receptors – Soil, Dust, Storm Water and Vapour

There is a low risk of contaminated soil and dust moving off-site onto residential areas. The Site is generally surrounded by bushland and vegetated areas, which would provide a buffer to residents against dust deposition. The exceptions include areas at the north-western boundaries, along Cook St (adjacent to Zone F) and along Tasman St and Bridges St (adjacent to Zone C). Excavations within the rights-of-way and road reserves within residential areas may pose an increased risk to adjacent residential receptors.

The meteorological dataset prepared for **Section 9.5** of the SEE shows that winds are reasonably distributed in all directions, with a slight accentuation of north easterly sea breezes, south-south westerly and north-westerly winds, as common to the coastal areas of Sydney. This indicates that the majority of winds blow in a direction away from the north and north-west residential areas, i.e. the wind appears to blow from the coast via the residential areas and then onto the Site.

Additionally, off-site human health receptors may be exposed via direct contact should impacted stormwater run-off leave the Site.

Recommendations have been made to minimise and monitor these impacts in **Section 6.2.1.**

4.4.3 Off-site Receptors - Groundwater

Based on a series of groundwater sampling monitoring programs of off-site private bores from 1994, 2001 and 2008, Caltex 2013a reported that there is no evidence of groundwater contamination from the refinery impacting off-site receptors.

Groundwater in the area is too saline to be potable but the salinity levels may be suitable for irrigation or potentially for filling swimming pools. A number of Kurnell residents have groundwater bores generally used for watering gardens. During the community groundwater monitoring conducted in relation to the Site's voluntary investigation agreement with NSW EPA, Coffey (2003) reported that "*The community groundwater monitoring did not show evidence of migration of contaminated groundwater from the Refinery*." Caltex has noted that ammonia concentrations are generally elevated across the Site above the screening levels

and throughout the Kurnell area including residential areas to the north (Caltex 2013a). The wells at the Site boundary are part of the monitoring that Caltex are undertaking for their preliminary investigation order (PIO) (Caltex, 2014). The distribution of ammonia concentrations does not suggest a point source but rather Caltex suggest the concentrations are indicative of a broader area of elevated ammonia.

There is an on-going PIO from NSW EPA to manage contamination across the Site. This includes measures to address data gaps, commence an on-going monitoring program and install new monitoring wells. This program would provide further information that would inform the requirements for any further monitoring and / or management of potential off-site impacts. Based on the current data, groundwater impacts to off-site human receptors are not considered further in this report, but recommendations are made to ensure that additional potential groundwater impacts from demolition works are minimised.

4.4.4 On-site and Off-site Receptor Conclusion

Based on the relevant exposure pathways for contaminated soil and groundwater, the likely complete source – pathway – receptors that are present are:

- On-site Workers – general staff, and Project-specific staff during the preparation for and completion of the demolition works;
- On-site Visitors – due to the shorter exposure duration, this group of receptors are less likely to be at risk from the contamination associated with the demolition works compared to on-site workers, and
- Off-site Residents – potentially exposed to dusts, vapours and run-off from nearby excavations.

Off-site ingestion of groundwater is considered unlikely based on the information provided in Caltex 2013a, as discussed in **Section 4.4.3**. Therefore this issue has not been assessed further.

4.5 Assessment and Management of Potential Risk to Human Health Receptors

Based on the primary COPCs exceeding soil or groundwater investigation limits in historical reports, potentially complete exposure pathways, and identified human health receptors, the following risks are considered to require management:

- Site demolition workers exposed to direct contact with:
  - soils impacted by asbestos and/or COPCs; or
  - groundwater impacted by LNAPL or dissolved phase COPC;
- Site workers or visitors exposed to dust, vapours or impacted run-off from the above; and
- Off-site residents exposed to dust, vapours or impacted run-off.

In order to manage these risks, the Demolition Environment Management Plan (DEMP) for the demolition works should include:

- A plan to stage (where possible) the removal of redundant infrastructure in order to minimise soil disturbance;

- Measures to monitor air quality where demolition works are occurring and at the site boundary for the relevant COPCs to assess the potential for COPC and / or odour impacts;
- A description of the appropriate PPE for workers involved in the demolition works;
- Measures outlining the appropriate management and disposal of waste;
- Measures to manage stormwater run-off from stockpiles or disturbed areas; and
- Measures to manage impacted groundwater if encountered, and treat prior to disposal if removed.

Additional recommendations have been made regarding: acute risks due to explosive or asphyxiating atmospheres; management of hazardous material in existing infrastructure; on-site recycling of concrete; and import of backfill material in **Section 6.2.1**.

5 QUALITATIVE ECOLOGICAL RISK ASSESSMENT

5.1 Introduction

This assessment presents the potential risks posed to the environment from the demolition works and is based on the information provided in **Sections 1 to 3**.

This assessment addresses the SEARs for the SEE which included the requirement for consideration of contamination, specifically "*how ecological and human health risks posed by contaminants on the site would be mitigated and managed*". The SEARs also specify that potential impacts on the surrounding Botany Bay National Park, Towra Point Nature Reserve, Towra Point Aquatic Reserve, watercourses, riparian land, wetlands and groundwater dependant ecosystems be considered.

Given that the proposed demolition works are planned to proceed only following the deinventory, depressurisation and cleaning of redundant plant etc., it is expected that only minor amounts of hydrocarbon residues would potentially be present in redundant infrastructure prior to the demolition works occurring. Therefore, the demolition works do not increase the likelihood of spills and leaks to occur from redundant infrastructure and therefore would not increase the risk of contamination on the Site or off-Site. Caltex and its contractors would follow strict protocols to prevent such occurrences and to protect health, safety and environment.

5.2 Additional Regulatory Framework

In addition to the legislation, policy and guidance discussed in **Section 2.2,** the following legislation and policy was reviewed to help guide the completion of the Qualitative ERA.

5.2.1 Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act applies to actions that have the potential to significantly impact on Matters of National Environmental Significance (NES) protected under the Act. The EPBC Act policy statements published by the Australian Government provide guidance on the practical application of the EPBC Act, and include consideration of the following:

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance (including Ramsar Wetlands);
- Listed threatened species and ecological communities;
- Listed migratory species protected under international agreements (e.g. CAMBA and JAMBA);
- Protection of the environment from nuclear actions; and
- Commonwealth marine areas.

Where relevant, the ERA has considered ecological values listed above.

5.2.2 State and Local Government

The following key pieces of biodiversity legislation and policy were reviewed and the implications for the demolition works were assessed accordingly:

- Environmental Planning and Assessment Act 1979 (EP&A Act), including:
  - State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14);
  - State Environmental Planning Policy No. 17 (Kurnell Peninsula) 1989;
- Threatened Species Conservation Act 1995 (TSC Act);
- Fisheries Management Act 1994 (FM Act);
- Native Vegetation Act 2003 (NV Act);
- Noxious Weeds Act 1993 (NW Act); and
- Sutherland Shire Local Environment Plan, 2006 (Sutherland Shire LEP).

5.3 Data Review

The following information was reviewed as a part of this ERA.

5.3.1 Ecology Impact Assessment

The terrestrial Ecology Impact Assessment for the demolition works was prepared by Biosis Pty Ltd (Biosis, 2014). This assessment is provided in full in **Appendix G1 Ecology Impact Assessment** of this SEE. This assessment has been used to inform this ERA. Biosis undertook their assessment within the 'study area' as defined on **Figure 1** of **Appendix G1 Ecology Impact Assessment.**

5.3.2 Marine Ecology Assessment

The Marine Ecology Impact Assessment for the demolition works was prepared by Carndo Pty Ltd (Cardno 2014a) and is provided in full in **Appendix G2 Marine Ecology Impact Assessment** of this SEE. This assessment focused on the potential impacts associated with the removal of the cooling water outlet pipeline from beneath Silver Beach and from a small part of Botany Bay. As a part of this assessment, Cardno reviewed seagrass and seaweed distributions in the vicinity of the pipeline, provided advice on mitigation measures to minimise disturbance associated with the demolition of the pipeline, and provided a qualitative assessment of the likelihood of impacts of the proposed removal of the pipeline on other protected species in Botany Bay.

5.3.3 Coastal Processes Assessment

Cardno also reviewed and reported on the potential impacts of removing the pipeline on coastal processes and dune stability (Cardno, 2014b). This assessment is provided in **Appendix H Coastal Processes** of this SEE. This report describes the data, methods of investigation, outcomes and mitigation advice related to the removal of the cooling water outfall pipeline from under Silver Beach and part of Botany Bay.

5.4 Ecological Site Setting

The Site is in close proximity to several areas of significant ecological value including:

- Botany Bay;
- Towra Point Nature Reserve (Ramsar wetland);
- Towra Point Aquatic Reserve;
- Marton Park Wetland; and
- Kamay Botany Bay National Park.

The following sections describe the terrestrial and aquatic environment on and around the site in more detail.

5.4.1 Site Context

The Site is located on land that was originally a low-lying sandy / swampy area. Prior to the construction of the refinery, the Site was levelled and filled by excavating and spreading local sand dunes across the Site, and supplementing this fill with a significant quantity of dredged sediment from Botany Bay.

The Site is surrounded by and includes coastal dunes, wetlands and heath, and the surrounding environment includes areas of high ecological significance. Past studies (referenced by Biosis, 2014) found that while no threatened flora or fauna were found across the demolition works area, areas off-site provide some habitats of high ecological value. These are described in more detail below.

5.4.1.1 Terrestrial Habitat

The majority of the demolition works area is devoid of vegetation and associated habitat due to the highly modified nature of the Site. The exceptions to this are the Eastern ROW, the Western ROW, the continental carbon pipeline easement and the Silver Beach foreshore. Outside of the areas mentioned, the vegetation that remains on the Site is significantly degraded, providing limited value for native fauna. Across these portions of the Site amongst the tanks and bunded areas, hard stand areas, roads and pipeline easements a range of weeds and exotic grasses exist. Biosis (2014) specifically noted that

- the Eastern and Western ROWs comprise exotic grasslands; and
- the easement for the continental carbon pipeline comprises exotic grasslands and native regeneration with a number of noxious weeds.

Biosis (2014) reported that 113 flora species were recorded within their study area (which is largely contiguous with the demolition works area), including 54 native species and 59 exotic species, of which four were classed as noxious weeds. No threatened flora species, ecological communities or Rare or Threatened Australian Plants (ROTAP) were recorded. A total of 40 fauna species were recorded within the study area comprising 37 bird species, two amphibians and one reptile. One threatened species and one migratory species were recorded. Three of the recorded birds were introduced species.

The Biosis study area supports one patch of vegetation - Silver Beach foreshore vegetation.

The study area also supports three exotic patches of vegetation within the ROWs and easements (Biosis, 2014). As these three patches consist of only exotic grasses and groundcover, they will not be considered further in this assessment.

5.4.2 Aquatic Habitat

Several surface water features comprising both shallow water bodies and swampy areas exist in the southern part of the Site. Marton Park Wetland is adjacent to the northern boundary of the Site (shown in **Figures 9-1, Chapter 9 Soils, Groundwater and Contamination**) and is classified as a Groundwater Dependent Ecosystem. This vegetation community is a freshwater wetland, which includes fringing Swamp Oak Floodplain Forest.

The waters offshore from Silver Beach contain the largest beds of seagrass in Botany Bay (Cardno, 2014a). The largest of these is located 500 m to the west of the proposed demolition works. Patches of three species of seagrass occur approximately 21.5 m seaward of the point at which the cooling water outlet pipeline is proposed to be removed, including an endangered ecological community containing the strapweed *Posidonia australis* (Cardno, 2014a). *Posidonia australis* in Botany Bay was listed as an ecologically endangered community in 2010 (NSW Fisheries 2010). Refer to **Section 4** in **Appendix G2 Marine Ecology Impact Assessment**Cardno (2014a) for further detail.

5.4.3 Ecological Receptors

5.4.3.1 On-Site Receptors

While most of the study area is covered with roads, hard stand areas and infrastructure etc., it also supports one patch of native vegetation, namely the Silver Beach foreshore vegetation. This vegetation patch forms the primary fauna habitat in the demolition works area. Other potential fauna habitat or foraging related assets include; perch structures (i.e. tower infrastructure), for birds of prey, and debris, such as concrete blocks in areas around the edges of the demolition works area providing sheltering sites for common reptiles and potentially amphibians.

Within the main refinery Site, aquatic habitat was limited to a single reservoir of water occurring at Chisholm Drive at the western extent of the study area near Captain Cook Drive. This reservoir has sheer exposed sides, negligible aquatic habitat and does not provide culvert roosting opportunities for organisms such as microbats that may use these features. Other water bodies include concrete stormwater drainage channels and pipelines (Biosis, 2014).

As described in **Section 5.4.2**, aquatic receptors are located at Silver Beach.

The following habitat resources were searched for during the fauna survey, however were not found within the Biosis study area:

- hollow bearing trees;
- caves and culverts;
- coarse woody debris;
- ephemeral and intermittent water bodies / wetlands; and
- rock outcrops.

In general, the Site has been substantially modified and is of negligible habitat value except for common native and introduced fauna species. There is limited connectivity across the study area; however given that the Kamay Botany Bay National Park surrounds a large portion of Site, some dispersal across the Site is possible.

5.4.3.2 Off-site receptors

Potential off-site ecological receptors include (refer to **Figure 1-1**):

- Botany Bay;
- Towra Point Nature Reserve (which includes Ramsar and SEPP 14 wetlands);
- Towra Point Aquatic Reserve;
- Kamay Botany Bay National Park;Marton Park Wetland (a Groundwater Dependent Ecosystem); and
- EPBC Act & TSC Act listed species.

These off-site receptors are described in more detail below.

Botany Bay

Botany Bay is to the north of the Site and is a shallow bay covering 4,600 ha. It is used to access Sydney's main commercial port (Port Botany). There are a number of competing economic, recreational and ecological interests related to the aquatic environment within the Bay, including aquatic ecosystems, primary industries such as aquaculture, recreation and aesthetics interests.

An inactive aquaculture lease is located adjacent to Kurnell Wharf. The Site remains leased but unfarmed.

Oyster farming has also been prioritised in Botany Bay and Quibray Bay by the NSW Oyster Industry Sustainable Aquaculture Strategy.

Towra Point Nature Reserve

Towra Point Nature Reserve is the site of a Ramsar-listed wetland managed by NSW Office of Environment and Heritage (OEH). The reserve is located approximately to the west of the Site and extends for approximately 6 km around Quibray Bay, covering a total area of 603 hectares. It is the largest wetland of its type in the Sydney Basin. Together with Towra Point Aquatic Reserve, the nature reserve provides critical habitat for threatened bird, fish and shellfish species in the region and is a vital link in the global chain of habitats used by many migratory waders and shorebirds.

Towra Point Aquatic Reserve

Towra Point Aquatic Reserve surrounds Towra Point and covers an area of approximately 1,400 ha. The reserve is managed by the NSW Department of Primary Industries (DPI). The reserve is considered to support high levels of aquatic biodiversity.

Marton Park Wetland

The online Groundwater Dependent Ecosystems Atlas (funded by National Water Commission and hosted by the Bureau of Meteorology) notes a vegetation related GDE located adjacent to the demolition works area. This GDE is the Marton Park Wetland, a freshwater wetland which includes fringing TSC Act listed *Swamp Oak Floodplain Forest*. According to the Marton Park Wetland Management Plan (Molino Stewart Pty Ltd, 2009), the wetland is currently a freshwater wetland with limited tidal influence. The wetland plays an important role in the drainage of the surrounding area, including the eastern portion of Kurnell, part of the Site and the Kamay Botany Bay National Park. Surface runoff from some of the non-industrial components of the refinery (e.g. the administration centre and car parks) flows into this wetland.

Kamay Botany Bay National Park

Kamay Botany Bay National Park (KBBNP) covers an area of 456 ha and includes land on both the northern and southern entrances of Botany Bay. It supports a diverse range of natural resources including threatened species and ecological communities, and is recognised for its significant cultural heritage values.

EPBC Act & TSC Act listed species

Appendix G1 Ecology Impact Assessment and **G2 Marine Ecology Impact Assessment** of the SEE list significant species recorded or predicted to occur within 5 km of the study area. This study also includes an assessment of the likelihood of these species occurring in the Biosis study area. A summary of those terrestrial species recorded or with a moderate or higher likelihood of occurring in the study area is provided in **Appendix G1** of this SEE. Biosis note that the *Senecio spathulatus* (Coast Groundsel) is the only TSC with a moderate likelihood of occurring within the study area.

Appendix G2 Marine Ecology Impact Assessment investigated the likelihood of EPBC and TSCs listed species in the marine environment in the vicinity of the cooling water outlet pipe on Silver Beach, and found that the endangered ecological community of the strapweed *Posidonia australis* occurs approximately 21 m beyond the demolition works area (refer to **Section 4** in **G2 Marine Ecology Impact Assessment** for further detail).

Database searches have indicated that no known threatened freshwater fish species listed under the Fisheries Management Act and/or EPBC Act have been recorded within the Sydney Metropolitan Catchment Management Authority(SMCMA) (DPI Fisheries Database). Database searches indicate that threatened marine fish species listed under the EPBC Act are known to occur in Botany Bay (Biosis, 2014).

Key Flora and Fauna considered in this Ecological Risk Assessment.

Appendix G1 Ecology Impact Assessment and **G2 Marine Ecology Impact Assessment** of the SEE contain a summary of the flora and fauna considered during the development of this ERA. Several key species were identified as organisms that may be found in the Biosis study area and may also be potentially impacted by the demolition works.

Flora that have been considered include the vegetation associated with the stormwater receiving environments, including wetlands that connect with the Towra Point Nature Reserve and Towra Point Aquatic Reserve, a stormwater outlet that discharges on Silver Beach near the Silver Beach Aquaculture, and seagrasses and seaweeds that may be impacted by the removal of the cooling water pipeline (**Figure 1-1**).

While the Site is highly modified, threatened fauna that may potentially disperse across the Site and become trapped in excavations include the Green and Golden Bell Frog and the Wallum Froglet. The Green and Golden Bell Frog is listed as Vulnerable under the EPBC Act and Endangered under the TSC Act. The Wallum Froglet is listed a Vulnerable under the TSC Act. These species may be mobile during the demolition works.

5.5 Potential Sources of Contamination

Following a review of the available data, the primary COPC for impacts to ecological environment have been identified. These COPC are presented in **Section 3.2**.

5.5.1 Potentially Contaminated Groundwater

Coffey (2007) notes that groundwater beneath the Site is currently impacted by elevated nutrients. Of particular note is the presence of phosphorous and phosphate, which were elevated across the Site including the demolition works area (with the source located in CMZ O). Coffey (2007), in reference to the potential impacts that elevated nutrients may have on nearby aquatic habitats, states that "*The effects of nutrient abundance may not threaten the viability of the habitat, but may result in excessive plant growth and other symptoms of nutrient abundance*." Coffey also state that the limestone pits have recently been closed with the impacted waste excavated and remediated before being encapsulated on the Site, and "*as a result of this the phosphorous concentrations in groundwater are anticipated to decrease*". This has been demonstrated by the results of the 2011 groundwater monitoring, which showed that no significant phosphorus or phosphate concentrations were detected in the monitoring wells on the Site (Coffey, 2011). A phyto remedial system, planting 700 trees over the groundwater plume, has also been established to address groundwater impacts.

In addition, there is non-aqueous phase liquid (NAPL) present in the groundwater in monitoring well PMW20 (Zone I), which may pose a potential risk to off-site sensitive areas and a vapour risk to burrowing animals if extensive off-site plumes of LNAPL are present. Monitoring well PMW20 is approximately 270 m from the down-gradient (north-eastern) Site boundary. A LNAPL remediation system was designed to recover LNAPL and also to exert hydraulic controls on the plume and has been operational since 2009. There is also a vertical barrier wall installed downgradient of the plume as an additional contingency measure, so in the short-term the risk of off-site migration is low.

5.5.2 Potential Acid Sulfate Soils (PASS)

Environmental problems associated with PASS occur as a result of development works which expose soil with the potential to undergo oxidation reactions on contact with oxygen and water. The result of the oxidation reactions typically produces low pH runoff which in turn acidifies soil, groundwater and surface waters.

Acid sulfate soils have been recorded and classified by Sutherland Shire Council[3] across the demolition works area. These maps show the demolition works area extends across land classified as Class 4 (the main Site) and Class 3 (Eastern and Western ROWs) with respect to PASS. Works to the north of the in the Western Right of Way and the Eastern Right of Way would extend into a Class 5 area. Measures to manage acid sulphate soils have been provided in **Section 9.7** of **Chapter 9 Soils, Groundwater and Contamination** of the SEE.

The sand close to shore near the cooling water pipeline demolition area is classified in the low risk category (Class 5). This is due to the mobile nature of these recently deposited sediments which have low potential to cause significant acidification of estuarine waters, and hence little to no potential to damage seagrass or fish in the area (Cardno, 2014a).

5.5.3 Potential Sediment-bound Contaminants

Although no information is available for the presence of other contaminants of concern on Silver Beach, contamination data is available for the area surrounding the fixed berths at the end of Kurnell Wharf (refer to Zone N in Caltex, 2013a and URS, 2012). Concentrations of BTEX, pesticides, PCBs and volatile compounds were below the analytical limits of reporting (LOR) in all samples collected within the area surrounding the fixed berths at the end of Kurnell Wharf (URS, 2012). Hydrocarbons and heavy metals were detected within sediment samples. However, the 95% upper confidence level of each was below the guideline limits set for waste classification, contamination and toxicity for all but one analyte, namely tributyltin (TBT) (URS, 2012).

5.6 Pathways of Exposure

5.6.1 Sources and Pathways Assessment

An assessment of potentially complete exposure pathways is discussed below. The area outside the Site (and study area) is the area that may be impacted by the demolition works now or, in the case of contaminant migration, in the future.

Where pathways are partial or complete, appropriate management procedures would be required to minimise the potential for COPC to mobilise. Also, where practicable, measures should be put in place to reduce or eliminate the possibility that organisms known to be found in the area would come into contact with these contaminants. These management measures are outlined in more detail in **Section 6**.

[3] http://www.sutherlandshire.nsw.gov.au/General/Shire_maps

Table C-3 Assessment of ecological receptors and exposure pathways

Source	Receptor	Pathway/s	Complete / Incomplete?
Contaminated Soils	Flora present in study area	Direct contact Active uptake	**Incomplete**: one parcel of vegetation is present in the study area (refer to **Section 5.4.2.1**). The sand beneath this vegetation is not likely to have been impacted by historic activities. Therefore this pathway has been excluded.
Contaminated Soils	Fauna present in study area	Direct contact Ingestion of COPC Vapour inhalation Bioaccumulation	Incomplete: no fauna are expected to come into contact with the contaminated soils (provided adequate measures are put in place (refer to **Section 6**).
Contaminated Soils	Flora present outside study area	Mobility of COPC (from the Site via stormwater runoff, leading to (further) contamination of / deposition of contaminants onto soils outside the zone.	**Partial**
Contaminated Soils	Fauna present outside study area	Direct contact with soils during periods of migration (e.g. frogs being exposed to COPC in trenched areas while moving across the study area)	**Partial**
Contaminated Groundwater	Flora present in study area	Active uptake (especially by deep-rooted species). VOC damage to root systems.	**Partia**l: one parcel of vegetation is present in the study area.
Contaminated Groundwater	Fauna present in study area	Vapour inhalation by burrowing animals	**Partial**
Contaminated Groundwater	Flora present outside study area	Active uptake (especially by deep-rooted species). VOC damage to root systems.	**Partial**
Contaminated Groundwater	Fauna present outside study area	Vapour inhalation by burrowing animals.	**Partial**
Contaminated Sediment	Aquatic flora and fauna	Direct discharge of impacted sediment to surface water.	**Partial**: demolition works disturbing contaminated material could release it into the surrounding environment. Available data suggests that the sand and sediment at Silver Beach are not likely to be significantly contaminated, so this potential pathway has been excluded.
Increased turbidity	Aquatic flora and fauna	Reduction in light reaching aquatic plants and smothering of aquatic plants with sediments.	**Complete**
Discharge of contaminated surface water to surface water bodies	Aquatic flora and fauna	Direct discharge of impacted groundwater or stormwater to surface water.	**Potentially Complete**
Physical excavation / disturbance of habitat	Terrestrial Fauna	Potential hazards posed by trenching works to mobile organisms	**Potentially Complete**

The ecological pathway model developed has been based on information from the reports listed in **Section 3.1**, the Flora and Fauna Assessments **(**refer to **Appendix G1 Ecology Impact Assessment** and **G2 Marine Ecology Impact Assessment** of the SEE) and **Appendix H Coastal Processes** of the SEE and a general understanding of the refining process and the chemicals used.

The extent of the demolition works (refer to **Section 1.4**) has been considered in the preparation of this ecological pathway model.

5.6.2 Potential Impacts; Ecological Receptors

Chemical Impacts – Terrestrial Receptors

Soils would be excavated across the demolition works area to a maximum depth of 2 mbgl. Approximately 150,000 tonnes of soil is expected to be disturbed during the works. Mobilisation of contaminants within the demolition works area may occur as a result of the removal of concrete and the increased potential for rainfall infiltration, over the short-term to the subsurface. Other potentially complete pathways include surface water run-off, surface water ingress and the mobilisation of contaminants via leaching.

While impacts within the demolition works area are generally quite well understood, less certainty exists around the nature and extent of existing off-site impacts, and the stability of these off-site impacts. It is possible that activities associated with the demolition works could increase the mobilisation of COPC that may potentially have a negative impact on sensitive ecological receptors that are in close proximity to the Site. Care must therefore be taken to minimise surface disturbances where practicable, and to back-fill excavations and holes as soon as possible after excavation.

Several management procedures have been identified to minimise this risk in **Section 6.**

Chemical Impacts – Aquatic Receptors

Coffey (2007, 2011) reported identified COPC in the soil and groundwater within and nearby to the areas where excavations are proposed to occur. During demolition works the main pathway of concern in these areas involve rain events potentially mobilising COPC through the infiltration of rainwater through impacted soil followed by the mobilisation of contaminants via leaching and potential discharge of contaminated groundwater to aquatic receptors (e.g. the Towra Point Nature Reserve, Towra Point Aquatic Reserve, Marton Park Wetland and the Aquaculture in Quibray and Botany Bay). In addition, direct surface water and sediment run-off from the demolition works may also provide a potentially complete pathway.

If excavation works were to occur during a rain event there may be a limited window of time when exposed soils may provide a pathway for impact to ecological receptors from increased infiltration of rainwater and potential mobilisation of COPC.

Sutherland Shire Council provide acid sulphate soils maps for the whole of the local government area including the demolition works area, including the area where the cooling water outlet is being removed from Silver Beach and Botany Bay (refer to **G2 Marine Ecology Impact Assessment**). The sand close to shore is classified in the low risk category (Class 5). This is due to the mobile nature of these recently deposited sediments which have low

potential to cause significant acidification of estuarine waters, and hence little to no potential to damage seagrass or fish in the area.

Recent investigations of TBT in sediments near the Kurnell Wharf have identified hotspots in their concentration, consistent with the areas used by large vessels, but none or very low levels in the nearshore environment, (URS 2013). The suspension of nearshore sediments as a result of the cooling water outlet pipeline removal works in Botany Bay, together with the use of silt curtains present little to no likelihood of impacts on oysters and marine snails in the intertidal and shallow subtidal zones due to dispersion of TBT.

Several management procedures have been identified to minimise this risk in Section 6.

Physical Disturbances - Terrestrial Fauna

Protected species that may potentially be directly impacted by the demolition works, in particular in the Continental Carbon Pipeline works area, are the Green and Golden Bell Frog and the Wallum Froglet. A total of 36 records of Wallum Froglet are located within the 5 km locality of the study area, the majority of which are within 2 km of the study area and within KBBNP. Although a significant population is known to occur in close proximity to the study area, only limited potential habitat for Wallum Froglet was identified within the Biosis study area and therefore along the Continental Carbon Pipeline. It is possible that the boundary of the study area may be used by individuals moving between habitat pockets within both KBBNP and the greater Kurnell Peninsula; however it is unlikely that they would enter the majority of the study area given the lack of breeding or foraging habitat present. Given the demolition works would impact on only very small areas of marginal breeding or foraging habitats along the Continental Carbon Pipeline it is considered unlikely that the removal of this pipeline would impact on the lifecycle of the species (Biosis, 2014).

Excavation works may be hazardous to wildlife that cross the Site; particularly amphibians and reptiles. Several management procedures have been identified to minimise the risk posed to amphibians and reptiles. These are summarised in **Section 6**.

Physical Disturbances - Terrestrial Flora

A number of vegetated areas on the Site have been excluded from the demolition works area and are not located in areas where there would be ground-disturbance activities. Therefore, the demolition works are unlikely to pose an unacceptable risk to remnant vegetation on-site. In addition, no threatened plant species would be removed as a part of the demolition works (Biosis, 2014).

The vegetation within the Continental Carbon Pipeline corridor is predominantly comprised of exotic grasses and groundcovers with limited native regeneration along the boundary fence, to a total area of 1.90 ha (Biosis, 2014). The linear nature of the Continental Carbon Pipeline easement and its location within a large area or remanent native vegetation means that its original construction did fragment habitat for the threatened ecological community (TEC) (Freshwater Wetlands habitat). The demolition works would be confined to the existing easement and therefore would not further fragment or isolate Freshwater Wetlands habitat beyond the current state (Biosis, 2014).

Loss of the dune vegetation at Silver Beach during the excavation and removal of the cooling water outlet pipeline may result in increased dune erosion. As winds are common in Botany

Bay, it is highly likely that during the removal of the cooling water outlet pipeline and subsequent rehabilitation works, un-vegetated dune sands would be subject to erosive winds for extended periods (possibly up to two weeks). A management procedure has been identified to manage this risk. This measure is summarised in **Section 6**.

Physical Disturbances - Marine Flora

Increased turbidity is known to impact seagrass beds two ways; firstly by reducing photosynthetic capacity and secondly by smothering. Disturbance and suspension of sediments within the water of Botany Bay would be associated with the excavation, cutting, extraction and lifting of the cooling water outlet pipeline for up to 20 m seaward from the low tide mark into Botany Bay; and the emplacement of material to to backfill and rehabilitate the area.

Cardno undertook an assessment of the likely extent of suspended sediment plumes that may be created during the backfilling of the trench (**Appendix H Coastal Processes**). Physical disturbances in the vicinity of the works have potential to impact seagrass beds if elevated levels of turbidity caused by the proposed pipe removal persist for long periods of time (greater than two months during growing season). While the removal of the cooling water outlet pipeline will be over a period of days / weeks rather than months, additional management measures have been recommended to minimise the disturbance associated with this activity. These are summarised in **Section 6.**

5.7 Conclusions

Within the terrestrial environment, the proposed demolition works present a low and acceptable risk to the environment as there are limited on-site receptors, and appropriate management measures would be put in place to mitigate risks to mobile and off-site receptors (refer to **Section 6** for more detail).

Within the aquatic environment the proposed removal of the cooling water outlet pipeline is considered to present a low to negligible risk to protected habitats, communities and species for the following reasons:

- The proposed pipeline removal works would be in very shallow water with sandy substratum making the habitat unlikely for the vast majority of protected species such as seabirds, whales, dolphins, sharks etc.;
- The works would be of short duration, with the expected demolition period of two weeks unlikely to disrupt breeding migrations, block access to significant feeding grounds or fragment populations of migratory species;
- The works would be staged from land, eliminating potential spills and leaks from boats;
- Short-term disturbance to protected shorebirds using the groynes as foraging or roosting habitat would be limited to groynes 2 and 3 and alternative, suitable habitat occurs along Silver Beach (other groynes) and along the intertidal zone of Kamay Botany Bay National Park to the east of Kurnell Wharf; and
- Formal assessment of potential impacts on protected areas, species and communities undertaken for works of greater duration and involving higher levels of sediment and shoreline disturbance have concluded that impacts on these protected ecological components were unlikely. Subsequent monitoring of such works have demonstrated no

impacts to protected species and communities associated with much larger projects of longer duration (URS 2013, Cardno Ecology Lab 2014).

The demolition works would be conducted in a manner that would minimise and/or mitigate potential impacts that may otherwise affect nearby ecological receptors.

6 OVERALL CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Outcomes

The demolition works would occur close to a number of sensitive areas, including residential areas and sensitive environmental receptors, including Botany Bay and the Ramsar-listed Towra Point Nature Reserve. The demolition works area is not considered to provide any significant habitat for threatened or endangered biota.

URS assessed the potential exposure pathways for human and ecological receptors from soil and groundwater contamination during the demolition works. The assessment was based on a review of previous investigations including site assessments, groundwater modelling assessments, flora and fauna assessments, air quality assessments and stormwater/wastewater management assessments.

Key contaminants of concern for human health and the environment currently present on the Site include the 'primary' Contaminants of Concern expected on a petroleum-based site: TPH, BTEX, Phenols and lead. Some asbestos is also present in soil, mainly from old pipes and wastes. Additional COPC may also be present. A preliminary review found that these chemicals do not warrant specific assessment, as the scope of works is not likely to increase the potential mobilisation of contamination on the Site.

Some primary COPC (refer to **Section 3.3**) have been identified at levels that have potential to impact on off-site ecosystems if the contaminants migrate off-site. While the demolition works are unlikely to increase the mobility of these contaminants, the works must be controlled to ensure that these sources are managed appropriately and to minimise and/or mitigate any potential impacts that may otherwise affect nearby receptors. Some specific recommendations are presented in **Section 6.2**.

The physical disturbance caused by the demolition of the cooling water outlet pipeline may have some short-term impacts on the terrestrial and aquatic environment at Silver Beach. Management measures to minimise these disturbances are presented in **Section 6.2**.

As discussed, the proposed demolition works would be controlled to minimise and / or mitigate potential impacts that may otherwise affect nearby receptors. Where relevant the measures and recommendations presented in this assessment and summarised in **Section 6.2** would be incorporated and expanded on in the DEMP for the demolition works.

Overall, with the appropriate mitigation measures in place the potential impacts from the demolition works would also be limited and would not be expected to have any significant adverse impact on the surrounding environment. Due to the removal of the redundant infrastructure, the demolition works would likely result in a reduction of risk.

6.2 Specific mitigation measures

Caltex would perform the demolition works in accordance with a DEMP. The following management and mitigation measures should be incorporated into the DEMP.

6.2.1 HHRA Recommendations

Demolition, Dismantling and Removal Works

- Hazardous materials within the redundant infrastructure and the contents of tanks and associated pipework, should be identified prior to demolition, dismantling and removal works. The demolition, dismantling and removal works should be conducted to minimise further release of hazardous materials. The area should be assessed to ensure that these works would not create an explosive environment.
- Residual material should be cleaned from pipelines in such a way to minimise the release of impacts to the ground surface.

Excavation Works

- Acid Sulfate Soils (ASS) may be encountered in the demolition works area. As there is the potential for ASS in Zone F, ROWs, Silver Beach and Botany Bay, an ASS Management Plan would be prepared in accordance with the ASS Manual (ASS Management Advisory Committee 1998) to manage ASS if encountered. This ASS management plan would include management and disposal options for acid sulphate soils and, if necessary, monitoring surface water discharges from the Site to ensure stormwater discharge has not been affected.
- Excavation works should have a monitoring plan in place to assess the air space within the work zone and at the boundary for off-site receptors.This would be used to verify that the concentrations of volatile compounds within the ambient air and breathing zones would not present an unacceptable risk to on-site or off-site receptors.
- Odours and /or dust may be generated during excavation activities and from stockpiles. Measures to manage and monitor dust and odour impacts should be included with the DEMP and implemented as required.
- As outlined in **Chapter 6 Consultation** of the SEE, there are existing procedures in place for locals / members of the public to direct complaints should the generation of odour and dust be such that they have a concern.
- If the depth to excavation is likely to extend beyond the depth identified in **Figure 9-4** of the SEE there is the potential for additional contamination to exist. Therefore the DEMP should outline what should be done in the unlikely event that excavation works are required to be deeper than 2 mbgl.
- Material imported to Site to fill to existing ground levels should be certified as VENM, ENM or appropriately remediated material.
- Stockpiles should be managed to reduce the risk of vapours and erosion from stormwater run-off.
- Soil disturbance should be minimised to reduce potential impacts to groundwater. Works should be planned to minimise the length of time excavations remain open.

Soil and Waste Management

- Classify waste soil and other wastes, and store, treat and dispose correctly (according to local relevant legislation/policy).

- Minimise stockpiling and control erosion and other transport of soil, dust and sediment from the Site.
- Concrete to be retained on-site should be appropriately cleaned (if required) prior to crushing to remove cross contamination if reused on-site.

Groundwater and wastewater management

- Excavations may interact with groundwater. If groundwater is encountered and dewatering is required, it should be managed and disposed of through the on-site wastewater treatment plant.
- Surface water management – surface water accumulated through rainfall or other runoff should be prevented from accumulating in excavations or have other access to ingress to the sub-surface profile. It should be collected and directed to the wastewater treatment facilities.
- Groundwater monitoring should continue during the demolition works, and a plan for corrective action implemented should an unexpected increase in COPC be observed. This plan would be documented within the DEMP.

LNAPL

- There is reference to the presence of LNAPL in some areas of the Site. The intrusive works proposed under the demolition works may encounter LNAPL; therefore Site personnel must be made aware of it and appropriate plans be developed for managing LNAPL when or if encountered. If it is present in test pits, bores, or when excavating it can have serious consequences for health, environment, fire and explosive risk if not managed appropriately.

OH&S

- The location of potentially contaminated areas should be noted and provided to demolition personnel (especially with regard to certain specific contaminants such as asbestos, and potentially explosive or asphyxiating conditions in excavations and below ground services). Safety training should be provided and appropriate Personal Protective Equipment (PPE) used.
- If demolition workers are likely to work or come in contact with potentially contaminated soil, their Site induction should include an outline of the measures they can use to limit unnecessary disturbance (e.g. dust generation, asbestos fibre liberation, contaminant mobility and volatilisation etc.).
- Safety training, including information on Caltex's existing and demolition specific PPE requirements, should be provided to demolition staff. Where relevant, Site personnel will continue to work under the 'permit to work' system which includes the current practices described in **Chapter 9 Soils, Groundwater and Contamination** of the main report.

6.2.2 ERA Recommendations

The following recommendations have been made to minimise potential impacts on ecological values (also refer to **Chapter 17 Ecology** of the SEE).

Ecological management

- Fence the vegetation patches on the border of the demolition works areas to prevent access or damage to these areas by construction personnel, equipment, and/or vehicles.
- Control recognised Class 4 noxious weeds that were identified on or near the Site.
- 'Stop work' procedures must be implemented on the chance encounter of dispersing threatened frogs during works, should any be encountered.
- All trenches would be inspected prior to works each morning. If frogs become trapped within trenches and are injured they would be assessed by a suitably qualified Ecologist or wildlife veterinarian. If frogs become trapped and they are uninjured they would released into the nearest suitable habitat.
- Demolition workers on-site should be educated on appropriate management processes and provided with threatened frog recognition sheets.
- An inspection of suitable tall tower structures must be undertaken to determine presence of nesting raptors, prior to demolition.
- Appropriate noise control procedures should be adhered to when relevant.
- Care should be taken by plant accessing the demolition works area to avoid impacting areas outlined in **Figure 4** of **Appendix G1 Ecological Impact Assessment**.
- A trained professional (e.g. a licensed zoologist or wildlife veterinarian) is to be called in if wildlife is injured or killed during works.
- Injury or death of a threatened species as a result of the demolition works should be reported to the appropriate authority.
- Silt curtains are to be installed seaward of the approximate extent of the cooling water outlet pipeline removal works to protect the nearby seagrass communities.
- Works would should be timed such that they do not coincide with high-tide conditions or when there is significant wave action. Optimal timing for filling activities below the low tide mark on Silver Beach would be during spring tide phases when low tide occurs late morning to early afternoon.
- Measures should be taken to ensure that demolition equipment used in the water column is appropriately prepared, checked and cleaned to avoid potential pollution impacts / introduction of marine pests.
- Removal of the cooling water outlet pipeline from beneath the dune and sub-aerial beach would require excavation and stockpiling of the overburden sand. Once the pipeline has been removed this sand should be used to backfill the resulting trench together with additional sand to account for the pipeline volume. The additional sand should be of a similar grain size as the existing sand to allow for it to have a similar response to the wind and wave processes as the existing sand. The use of similar sized sand would also allow for consistent moisture retention properties for re-vegetation of the dune area.

- Once the pipe has been removed and the trench back-filled and appropriately graded, the dune area should be re-vegetated. The existing vegetation is limited to grasses, with no woody vegetation. The area should ideally be re-planted with similar grass species in a manner that ensures minimal loss of wind-blown sand from the dune while the area is re-vegetating (refer also to **Appendix G1 Ecology Impact Assessment** in this SEE).
- The most suitable options for achieving rehabilitation include the use of liquid sprays or geotextiles. These options are outlined in **Appendix H Coastal Processes**).

Stormwater and surface water management

- Potential impacts on stormwater runoff quality during the demolition works would be managed in accordance with a DEMP, which would include implementation of management measures outlined in the SMP undertaken as part of PRP 24. Surface water is to be collected and managed on-site prior to discharge.
- Temporary containment bunds would be constructed to collect spilt construction material.

Soil Erosion and Sediment Control

- All demolition works to be undertaken in a manner to minimise the potential for soil erosion and sedimentation and in accordance with the measures outlined in the *Managing Urban Stormwater – Soils and Construction Volume 1* (NSW Department of Housing, 2004) (commonly referred to as the Blue Book guidelines). Areas which are disturbed should be managed with appropriate erosion and sedimentation control devices installed and maintained in line with the Blue Book guidelines. This may include limiting slope length, the installation of sediment filters and the construction of a sedimentation basin downstream of the construction area. These devices would remain in place until the surface is restored. These devices would also capture any gross pollutants.

Waste

- Waste collection areas to be designated and appropriate containers to be provided.
- Waste collection and disposal to be undertaken by licensed contractors.

General

All vehicle and equipment maintenance and washing to be undertaken in the Site truck wash area.

7 REFERENCES

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8 LIMITATIONS

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URS Australia Pty Ltd
Level 4, 407 Pacific Highway
Artarmon NSW 2064
Australia

T: +61 2 8925 5500
F: +61 2 8925 5555

www.urs.com.au