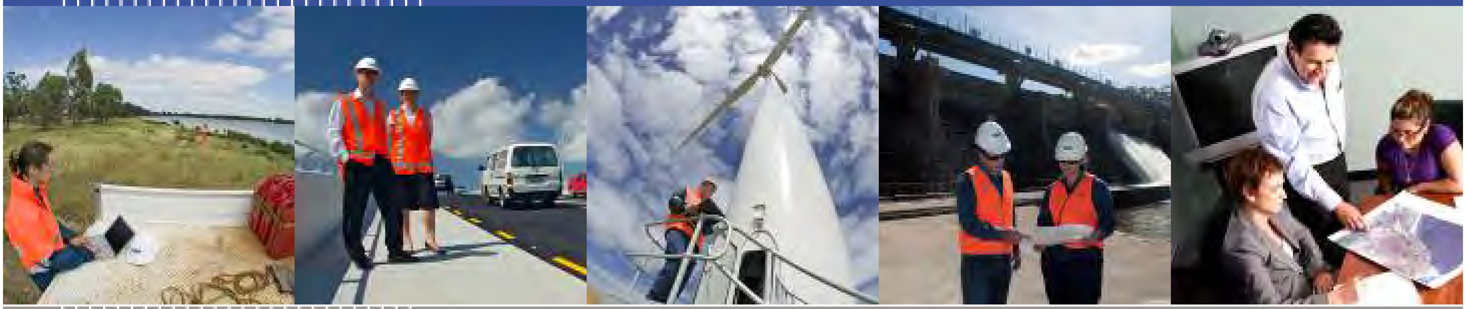
Appendix E

Water Management Report



Report

Water and Wastewater Management

3 MAY 2013

Prepared for

Caltex Refineries (NSW) Pty Ltd

Kurnell Refinery
2 Solander Street,
Kurnell, NSW 2231

43177836

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Abbreviations

Abbreviation	Description
API	American Petroleum Institute
ASRIS	Australia Soil Resource Information System
ASS	Acid Sulphate Soil
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethyl-benzene, Xylene
CAMBA	China-Australia Migratory Bird Agreement.
CDU	Crude Distillation Unit
CEMP	Construction Environment Management Plan
CLOR	Caltex Lubricating Oils Refinery
CRN	Caltex Refinery (NSW)
CRU	Catalytic Reforming Unit
DGRs	Director General's Requirements
DHTU	Diesel Hydrotreater Unit
DIPNR	Department of Infrastructure, Planning and Natural Resources
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPL	Environment Protection Licence
FCCU	Fluid Catalytic Cracker Unit
FSS	Fire Safety Study
HEM	n-Hexane Extractable Materials
HNCMA	Hawkesbury-Nepean Catchment Management Authority
IAF	Induced Air Floatation
JAMBA	Japan-Australia Migratory Bird Agreement
LPG	Liquefied Petroleum Gas
LSH	Level Switch High
LSHH	Level Switch High-High
MEK	Methyl Ethyl Ketone
NatCASS	National Community for Acid Sulphate Soils
NFR	Non-Filterable Residue
OMC	Oil Movements Centre
PAH	Polycyclic Aromatic Hydrocarbon
PDU	Propane De-asphalting Unit
PMF	Probable Maximum Flood
POEO	Protection of the Environment Operations Act
PRPs	Pollution Studies and Reduction Programs
RAMSAR	Ramsar Convention on Wetlands of International Importance
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
ROW	Right of Way
SMCMA	Sydney Metropolitan Catchment Management Authority
SPULP	Super Premium Unleaded Petrol
T&I	Turnaround & Inspection
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorous
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solid
ULP	Unleaded Petrol
WWTP	Wastewater Treatment Plant

Introduction

1.1 Background

Caltex Refineries (NSW) Pty Ltd (Caltex) announced in July 2012 that it would progress with converting its Kurnell Refinery (the Site) (**Figure A-1**) to a finished product terminal (the Project). This Project is being proposed in response to increased competition from refineries in Asia, and the balance of supply and demand for petroleum products in Australia. Caltex is seeking development approval to facilitate this conversion.

The conversion would involve the continued use of parts of the Project Area, in a manner similar to that currently in place, for the storage and distribution of petroleum product. A number of existing crude oil tanks would be cleaned and modified to facilitate the storage of refined product (i.e. conversion to finished product tanks). Other tanks already storing one type of refined product would be converted to store a different product. This work would require associated pipeline, pump and other infrastructure upgrade works. The refinery plant would be shut down, depressurised, cleaned and left in situ. A range of ancillary works would be undertaken to improve operational efficiency and to facilitate the conversion of the refinery into a terminal. These ancillary works would include upgrades to the utilities and management systems on the Site.

No demolition, dismantling or remediation works would be undertaken on the Site as part of this Project. Any such work that should be required would be subject to separate approval consideration at later stage.

The proposed finished product terminal would manage the following products:

- Gasoline – Unleaded Petrol (ULP), Premium Unleaded Petrol (PULP) and Super Premium Unleaded Petrol (SPULP);
- Diesel;
- Jet Fuel; and
- Fuel Oil.

The proposed terminal would also manage the following by-products:

- Slop[1]; and
- Wastewater.

The Site is located at Kurnell, approximately 15 km due south of the Sydney Central Business District (CBD). It is located near the end of the Kurnell Peninsular, which bounds the south of Botany Bay. Botany Bay is located to the north of the Site, Quibray Bay to the west, and the Tasman Sea (i.e. 'the ocean') to the east. In between the Site and the ocean is the Kamay Botany Bay National Park, which also bounds the Site to the south. There is residential landuse within close proximity of the Site (Kurnell), with the closest residences immediately adjacent to the Site boundary in the north (off Cook Street), and separated by buffer land off Reserve Road.

1.2 Scope of Works

This report presents, in support of the required development application, an assessment of the water and wastewater management aspects of the Project. The assessment addresses relevant Director General Requirements (DGRs) presented in **Section 1.3**.

[1] Slop or slop oil is a petrochemical industry term for recovered petroleum hydrocarbons in a refinery or terminal, which requires further processing to make it suitable for sale and use.

This assessment only addresses those aspects of the DGRs as they apply to the Project Area, where the aspects can be geographically bounded e.g. stormwater management is only addressed for the Project Area catchments, rather than for the Site as a whole.

An assessment has been made of the impacts of the Project on surface water and wastewater in the Project Area with reference made to relevant legislation, planning policy, the Site's current Environment Protection Licence (EPL) and management plans. Assessments conducted herein are based on previous reports and assessments that have been conducted and no additional investigation or modelling works were performed.

1.3 Director General's Requirements (DGRs)

This Project requires development approval. It is considered to be State Significant Development (SSD) under the provisions of the *Environmental Planning and Assessment Act* (1979) (EP&A Act). The Director General's Requirements (DGRs) for the Caltex Kurnell Refinery Conversion (Major Project SSD-5544) that are relevant to the surface water, water supply and wastewater component in the Environmental Impact Statement (EIS) state that the EIS must include:

- a description of existing environment, using sufficient baseline data;
- an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statues;
- a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposal for adaptive management and/or contingency plans to manage any significant risks to the environment;
- the identification of any water licencing requirements or other approvals under the *Water Act 1912* and/or the *Water Management Act 2000*;
- a demonstration that water for the development can be obtained from an appropriate authorised and reliable water supply in accordance with the operating rules of the relevant Water Sharing Plans;
- a detailed description of the mitigation and management controls that would be put in place to manage erosion and sediment, stormwater, spills and acid sulphate soil (if present);
- proposals to reduce water supply and increase water reuse; and
- the identification of potential impacts of flooding, with consideration of climate change and projected sea level rises.

Acid sulphate soils have not been addressed within this assessment but have been included in **Chapter 9 Soils, Groundwater and Contamination** of the EIS.

Environmental Setting

2.1 Location

The Site is located on Sir Joseph Banks Drive, Kurnell NSW 2231, at the eastern end of Kurnell Peninsula, approximately 15 km due South of the Sydney CBD. The Site covers an overall area of approximately 187 Hectares. It is located within the Sutherland Local Government Area.

The Site is bounded by the Kamay Botany Bay National Park to the South and East, Captain Cook Drive to the North West and St Joseph Banks Drive to the south west. The northern Site boundary is bordered by Solander Street, a small southern section of Cook Street, undeveloped land, light industry and residences off the eastern side of Cook Street, and undeveloped land on the southern side of Reserve Road. Additional residences are located on the north side of Reserve Road. The Kurnell residential area is generally located to the immediate north and north west of the Site. Cronulla residential areas are located approximately 5 km to the south west.

Marton Park, comprising a developed recreational park area and an undeveloped wetland area, is located on the northern side of Solander Road. Kurnell Substation is located on the western side of Captain Cook Drive opposite the Site. Sydney Water Kurnell Desalination Plant is located opposite the Refinery on the western side of Sir Joseph Banks Drive. Continental Carbon Australia facility is located south of the southern Site boundary.

In addition to the Kamay Botany Bay National Park and Marton Park, there are a number of other reserves within proximity of the Site. Captain Cook's Landing Place Park is located approximately 500m to the north of the Site, while Bonna Point Reserve is located approximately 1.4 km to the north west of the Site. Towra Point Nature Reserve (on Towra Point Peninsular) is predominately located on the other side of Quibray and Weeney Bays, which are located west of the Site. These bays form part of the Towra Point Aquatic Reserve. Some of the Towra Point Nature Reserve extends as a vegetated fringe around the edge of Quibray Bay to an area close to the Site, north of Captain Cook Drive. The Quibray Bay wetland area extends beyond the Towra Point Reserve area to the shores of Quibray Bay.

The general site context in relation to Botany Bay and the wider area of Kurnell is shown in **Figure A-2** in **Appendix A.**

2.2 Site Overview

The Site was commissioned in 1956 and processes crude oil. It is the largest oil refinery in NSW and the second largest of the seven fuel refineries in Australia, based on crude oil processing capacity. The refinery currently produces predominately petrol, diesel and jet fuel. The volume of product varies from year to year depending on the type of crude processed in the refinery and changes in product demand. Currently the Site also serves as a terminal, receiving, storing and distributing finished petroleum products that have been refined elsewhere.

The Site can be separated into several sub-areas.

The refinery infrastructure, which incorporates process units such as Crude Oil Distillation units, Catalytic Reforming unit, Fluid Catalytic Cracker unit, Propane De-asphalting and Power plant, is located within the central area of the Site. The central area also includes a yard office, café, workshop and store house.

The wastewater treatment plant is located on the north eastern corner of the Site. To the north of the Site are the offices, former staff houses, gardens, the employees' and contractors car parks and an undeveloped area (wetland). The storage tanks are mainly located on the east and northern boundary of the Site.

The south western corner of the Site is occupied by the Caltex Lubricating Oil Refinery (CLOR) which has been decommissioned and partly demolished. Remaining CLOR infrastructure includes offices, workshops, laboratory, and tank compound.

Presently the Site discharges offsite:

- stormwater runoff;
- clean and treated intermediate cooling water effluents; and
- treated wastewater effluents.

The stormwater runoff from the Site is currently discharged to:

- Quibray Bay;
- Botany Bay; and
- Marton Park Wetland.

Clean and intermediate cooling water effluent is discharge directly into Botany Bay off Silver Beach near the Kurnell Wharf.

Treated oily water effluent is discharged via outfall to the Tasman Sea at Yena Gap.

The intermediate sewer system water (i.e. cooling water) and treated oily water are regulated under the Site's existing Environment Protection Licence (EPL). This is discussed further in **Section 2.3**.

These features are shown in **Figure A-3**. The stormwater treatment system, cooling water and oily water treatment system are further discussed in **Section 3, Section 6** and **Section 7** of this report.

2.3 Site Environment Protection Licence (EPL)

The Site holds product and operates in a manner so as to achieve compliance with the conditions of its Environment Protection Licence (EPL) No 837. The current Licence is dated 27 April 2012. It is issued under Section 55 of the *Protection of the Environment Operations Act 1997* (POEO Act) and is administered by the NSW EPA.

The EPL sets out conditions regulating a range of aspects of Site operations with potential to impact on the environment, including aspects associated with managing impacts on surface waters.

The EPL licence nominates environmental monitoring and/or permissible discharge points with corresponding identification numbers.

The EPL defines treatment/monitoring requirements and/or nominates limits for the emissions utilising the corresponding identification number. The existing EPL identification numbers related to systems interacting with surface waters are summarised in **Table 2-1.**

Table 2-1 Summary of Existing Surface Water Related EPL Monitoring/Discharge Points.

EPA Identification No.	Location Description
1	Cooling water pipe discharge into Botany Bay.
2	Submerged ocean outfall at Yena Gap.
3	Submerged ocean outfall at Tabbigai Gap.
26	Final manhole in cooling water system. Discharge quality monitoring location for cooling water discharge at Point 1.
27	Sampling port in wastewater treatment plant. Effluent quality and volume monitoring location for treated wastewater discharge at Point 2.
28	Caltex Lubricant Oil Refinery (CLOR) (now decommissioned) wastewater treatment plant. Effluent quality and volume monitoring location for treated wastewater discharge at Point 2.
33	Pump located on the Kurnell Wharf. Total volume monitoring location for cooling water intake.

Although Tabbigai Gap (EPA Identification No. 3) and the associated monitoring point (EPA Identification No 28) are still listed as licenced discharge and monitoring points, the associated infrastructure has been removed as part of the CLOR decommissioning. Therefore it is expected that this EPL identification point will be removed from the EPL in a future amendment.

The discharge limits and monitoring requirements related to the points identified in **Table 2-1** (excluding the redundant Tabbagai Gap EPA Identification Nos 3 and 28) are presented in **Tables C-1** to **Table C-2** in **Appendix C.**

In addition to regular pollution control limits, and monitoring and treatment requirements nominated in the EPL, from time to time the EPA may require additional studies and/or investigations to be undertaken. This is often implemented through a requirement for Caltex to undertake Pollution Studies and Reduction Programs (PRP), nominated as conditions of the EPL.

EPL compliance and PRP requirements related to specific refinery water systems, are discussed in **Section 3.2**, **Section 6.2**, **Section 7.2**, and **Section 8.2** of this report.

The Site is currently operating under an existing EPL and would continue to do so for the duration of the Project. On completion of the Project, and in consultation with the EPA, the EPL would be modified and/or re-issued to meet the requirements for operation of the finished product terminal.

2.4 Surface Water Setting

2.4.1 Introduction

The Site is located on a peninsula surrounded by marine and estuarine water bodies and surface water bodies, which, in addition to land (via infiltration), constitute the receiving environments for surface water discharges from the Site.

2 Environmental Setting

The main water bodies in proximity to the Site are:

- Tasman Sea ('the South Pacific Ocean'), located approximately 750m due east of the Site, on the other side of the Kamay Botany Bay National Park;
- Botany Bay, located about 500m to the north of the Site;
- Quibray Bay, approximately 1 km to the west of the Site at its closest point. There is a mangrove wetland area between the Site and the Quibray Bay shoreline;
- Weeney Bay, about 2.5 km due west of the Site on the other side of Quibray Bay; and
- wetland area in Marton Park, on the northern Site boundary.

Quibray Bay and Weeney Bay are part of the Towra Point Aquatic Reserve and are connected to Towra Point Nature Reserve. Both these water bodies are connected to Botany Bay, which in turn is connected to the Tasman Sea and Pacific Ocean (refer to **Figure A-2** of **Appendix A**).

2.4.2 Catchment

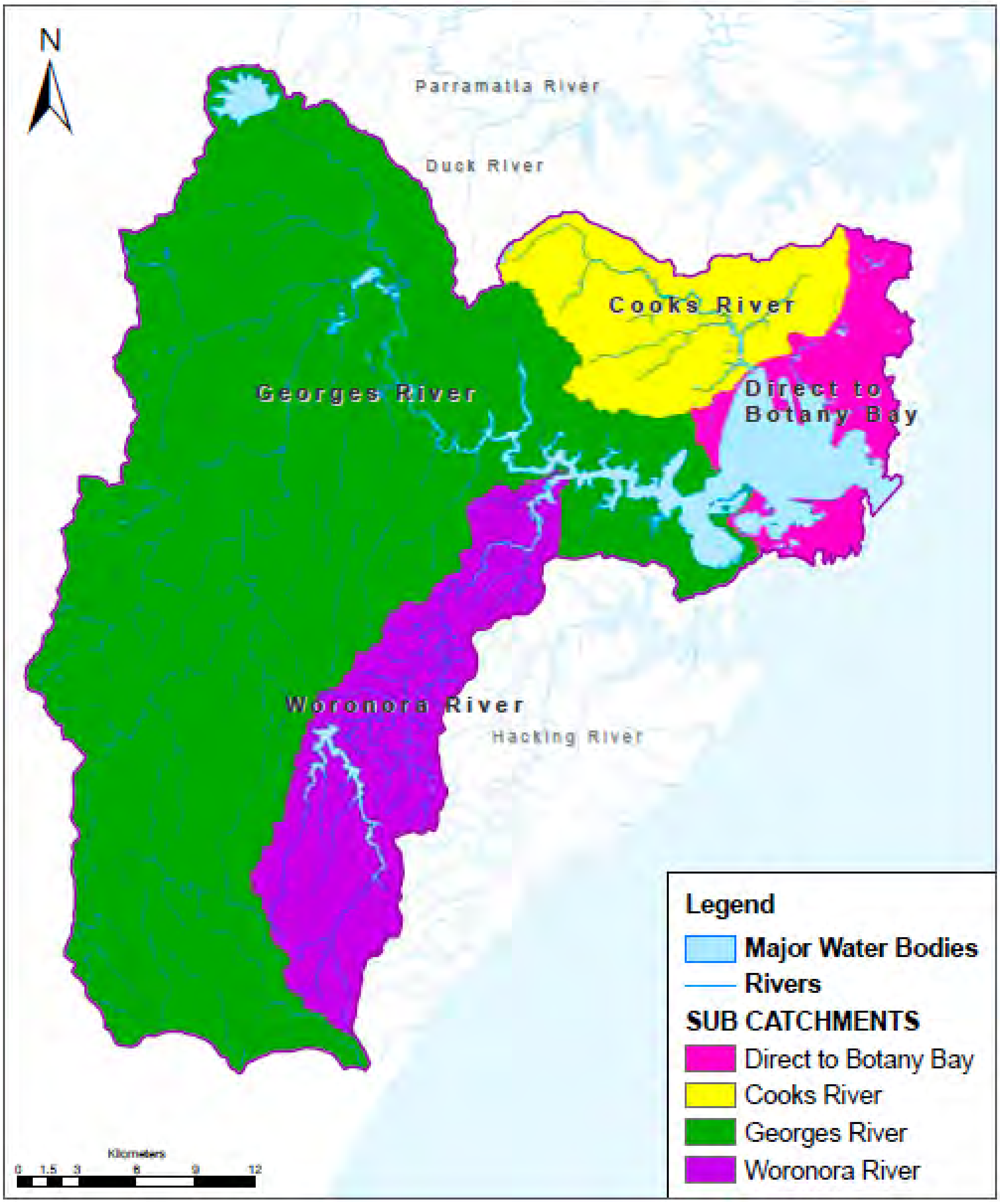
The Site is located within the Botany Bay catchment, extending across an area of 1,165 km^2. This catchment lies within Hawkesbury-Nepean Catchment Management Authority (HNCMA) area. Until recently, the catchment was within the Sydney Metropolitan Catchment Management Authority (SMCMA) area, but the SMCMA was recently merged into the Hawkesbury-Nepean Catchment Management Authority. The Botany Bay Catchment has four main sub-catchments, based on the major river systems and other areas which drain to it. These are the:

- Georges River catchment;
- Cooks River catchment;
- Woronora catchment; and
- Botany Bay (direct discharge) catchment.

The Site is located in the catchment area that drains directly to Botany Bay, as shown in **Figure 2-1**.

2 Environmental Setting

Figure 2-1 Botany Bay Sub-catchment Boundaries (SMCMA, 2011)



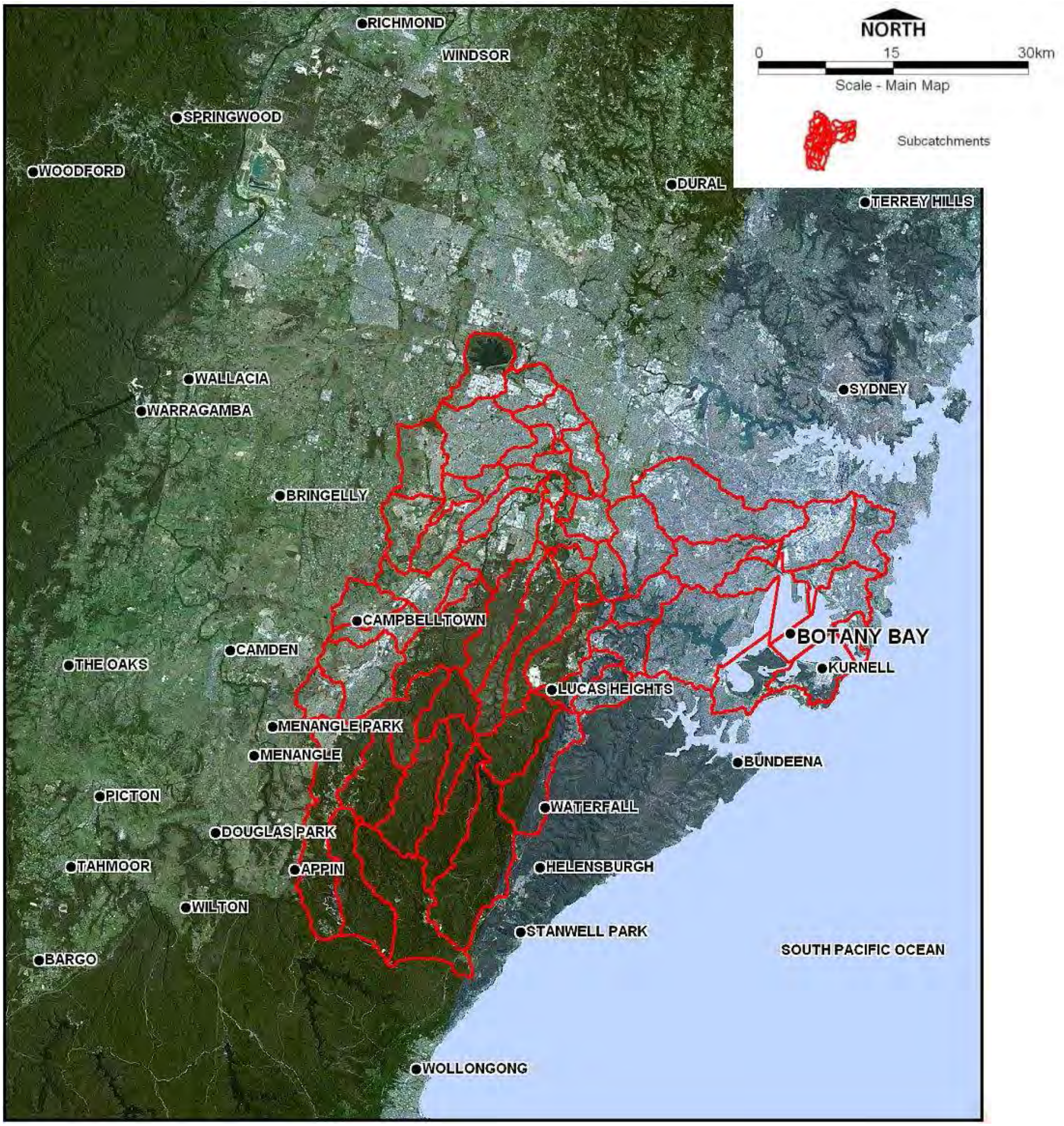
According to Department of Sustainability, Environment, Water, Population and Communities (2010), Botany Bay and its catchment waterways are subject to ongoing threats arising from nutrient and sediment-laden run-off from various non-agricultural land uses. A substantial part of the catchment is highly developed with almost 40% of its area being used for urban, industrial or commercial purposes. Pollutants of concern are nitrogen, phosphorus and total suspended solids.

A number of studies have been commissioned through the Botany Bay Water Quality Improvement Program. This has included the *Modelling the Catchments of Botany Bay* Project conducted in October 2007 to simulate the generation of constituent pollutants under range of catchment land uses including rural lands, urban residential areas, and commercial, industrial and special use zones, e.g. airports and significant parklands and areas of native vegetation.

2 Environmental Setting

To facilitate the more detailed assessment of the modelling project, including the preparation of impact assessment modelling, the main catchments of Botany Bay have been further divided into sub-catchments, based on smaller drainage areas and drainage lines. These smaller sub-catchments have been defined, and named, in different ways within several references, e.g. in some references the Site is in the Mill Creek sub-catchment, which takes in all of the land adjoining southern Botany Bay, including the Kurnell Peninsula, while in others, there is a further catchment boundary through the spine of Towra Point Peninsula, with the eastern side referred to as Kurnell sub-catchment, shown in **Figure 2-2**.

Figure 2-2 Botany Bay Sub-Catchment (SMCMA, 2007)



The predicted pollutant load contributions from the Kurnell sub-catchment for the existing condition, as previously modelled by the SMCMA (2007), are presented in **Table 2-2**.

Table 2-2 Flow and Pollutant Load - Kurnell Sub-Catchment (SMCMA, 2007)

Parameter	Load	Concentration (mg/L)*
Total Catchment Flows (ML/yr)	6,300	N/A
Biological Oxygen Demand (BOD) (tonne/yr)	41	6.51
Faecal Coliforms (*10^9 counts/yr)	1,500	N/A
Total Organic Carbon (TOC) (tonne/yr)	66	10.48
Total Suspended Solid (TSS) (tonnes/yr)	300	47.62
Total Nitrogen (TN) (tonne/yr)	5.1	0.81
Total Phosphorous (TP) (tonne/yr)	0.58	0.09

*Calculated based on modelling results presented in the SMCMA report (2007)

2.4.3 Surface Waters and Environmental Values

The surface waters and related environments in proximity to the Site have varying environmental values and sensitivities.

The Project Area is in close proximity to areas of significant ecological value (**Figure A-2**) including:

- Botany Bay;
- Quibray Bay;
- Towra Point Nature Reserve (including Ramsar wetland area);
- Towra Point Aquatic Reserve;
- SEPP 14 Wetlands;
- SEPP 71 Coastal Protection Zone;
- Marton Park Wetland (a Groundwater Dependent Ecosystem); and
- Kamay Botany Bay National Park.

These areas and values are summarised in the following sections.

Botany Bay

Botany Bay is a shallow bay covering 4600 ha located approximately 10 km south of the Sydney CBD. It is used to access Sydney's main commercial port (Port Botany). The Bay is designated a Special Port Area, and as such there are as number of controls regarding the management of the waters and waterside lands of the Bay (Sydney Ports, 2012). 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 (e.g. fishing), aesthetic interests and cultural and spiritual values (SMCMA, 2007). As discussed in **Section 2.4.2**, Botany Bay and its catchment waterways are subject to ongoing environmental pressures.

Botany Bay contains areas of saltmarsh, seagrass and mangrove, particularly around the Towra Point Nature Reserve and the Towra Point Aquatic Reserve. It contains 40% of Sydney's remaining mangrove communities and 60% of its remaining saltmarsh communities (DECCW & SMCMA, 2010). It is also host to many important bird species, including many listed in international migratory bird agreements, such as JAMBA, CAMBA, and ROKAMBA.

Quibray Bay

Quibray Bay is a small bay within Botany Bay that, in comparison to much of Botany Bay, has reasonable ecological condition. It lies within the Towra Point Aquatic Reserve. The bay contains significant seagrass, mangrove and saltmash habitat within its waters and around its shoreline (BBWQIP, 2011). The Towra Point Nature Reserve extends in a narrow fringe around Quibray Bay, encompassing a band of remnant saltmash. The northern side of the Bay is characterised by an extensive mangrove habitat area.

Towra Point Nature Reserve

Towra Point Nature Reserve (a Ramsar Wetand) consists of 603.7 ha of wetlands that lie on the southern shores of Botany Bay, located approximately 16 km from the Sydney CBD (DECCW, 2010). The Reserve is bounded by the Kurnell Headland, Botany Bay, and Dolls Point. The most eastern extent of the Ramsar listed portion of the reserve is approximately 150 m west of the Project Area, on the western side of Captain Cook Drive (part of the Reserve fringes Quibray Bay, capturing remnant saltmash).

Stormwaters from part of the Project Area discharge into Quibray Bay (as discussed in **Section 3**), through the Towra Point Nature Reserve Ramsar site.

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 Fisheries Section of the NSW DPI and is divided into two zones. The aquatic wildlife refuge zone, in which some recreational fishing is permitted, extends around Towra Point Nature Reserve into Botany Bay. The “no-take” sanctuary zone is located within Quibray Bay and Weeney Bay (see **Figure A-2**). The reserve supports high levels of aquatic biodiversity, with more than 230 species of fish recorded within the reserve (NSW OEH National Parks and Wildlife Services (NPWS) 2012).

State Environmental Planning Policy 14 (SEPP14) - Coastal Wetlands

SEPP14 - Coastal Wetlands aims to protect and conserve coastal wetlands by ensuring: that the coastal wetlands are preserved and protected in the environmental and economic interests of the state. SEPP 14 provides guidance for consent authorities, in terms of issues to consider when determining whether there is potential for a listed wetland to be affected by a Project. The provisions of this SEPP are not directly relevant to the Project, as no SEPP 14 designated wetlands are present within 5km of the Project Area.

State Environmental Planning Policy (SEPP71) – Coastal Protection

SEPP 71 - Coastal Protection aims to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast through the preservation of a range of coastal assets. The policy aims to:

- guide development in the NSW coastal zone so that it is appropriate and suitably located,
- ensure that there is a consistent and strategic approach to coastal planning and management, and
- ensure there is a clear development assessment framework for the coastal zone.

2 Environmental Setting

The Project Area is outside the defined coastal zone areas in proximity to the Site, with the exception of the Yena Gap outfall that passes through a section of coastal zone along the Tasman Sea shoreline.

Marton Park Wetland – Groundwater Dependant Ecosystem

Marton Park to the north of the Site comprises a wetland area with a small recreational park area. It is a receiving environment for some Site stormwater runoff (refer to **Section 3**). It has been identified that the wetland area is a groundwater dependant ecosystem (GDE).

The online Groundwater Dependent Ecosystems Atlas (funded by National Water Commission and hosted by the Bureau of Meteorology) was accessed to determine the proximity of the Project to potential GDEs. As outlined in **Chapter 9 Soil, Groundwater and Contamination** of the EIS (including Figures 9-1 and 9-2), a vegetation related GDE, noted as 'previously identified within a previous desktop study' is located adjacent to the Project Area. This GDE is the Marton Park Wetland; a freshwater wetland which includes fringing *Threatened Species Conservation Act 1995* (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. Much of the Site is bunded and surface runoff is treated onsite before discharging to Quibray Bay and Botany Bay, however, surface runoff from some non-industrial areas of the Site (e.g. the administration centre and some car parks) flows into this wetland. Marton Park Wetland is recharged by ground water seepage through the sandy bed during dry periods. Although not directly identified as a GDE within the Management Plan (Molino Stewart Pty Ltd, 2009), the interaction between the surface water and the ground water is acknowledged to be potentially high given the sandy nature of the soil.

Kamay Botany Bay National Park

Kamay Botany Bay National Park extends north to south along the eastern coastline of Kurnell Peninsula bound by Tasman Sea marine waters and the Site. The total area of the National Park occupies approximately 492 Ha and supports a diversity of natural resources including threatened species and ecological communities and is recognised for its significant cultural heritage values (OEH, 2012a; NSW NPWS, 2002).

2.4.4 Environmental Water Quality Objectives

Introduction

The federal and all state and territory governments have adopted the National Water Quality Management Strategy for managing water quality, as set out in the Australian and New Zealand Environment Conservation Council (ANZECC) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) ('the ANZECC Guidelines').

The way in which these are applied in NSW is set out in *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (Department of Environment and Conservation, 2006). The process involved establishing, in consultation with the community, the existing human uses and environmental values of a particular waterway, e.g. protection of aquatic ecosystems, primary contact recreation, irrigation water supply, etc. Water Quality Objectives, applicable to the agreed and endorsed (by the NSW State Government) environmental values, are then set, based on the ANZECC Guidelines. A protection level is applied based on the condition of the waterway e.g. high conservation value, highly disturbed ecosystem, etc., and specific waterway issues and risks are identified. Water quality indicators and trigger levels can then be established to allow the assessment and monitoring of the condition of the waterway.

Water quality objectives have been developed for all freshwaters and estuarine waters, and marine waters in NSW. Whilst water quality indicators and trigger values derived from the nominated objectives are not intended to be applied directly as regulatory criteria, limits or conditions, they are one factor to be considered by industry, the community, planning authorities or regulators when making decisions affecting the future of a surface water body to which they apply (DECCW 2009).

Water quality objectives are based on maintaining or improving the environment and the different uses of the waterway by the community. The guiding principles for responsible water quality management agencies, including Catchment Management Authorities, can be summarised as:

- Where environmental values are being achieved in a waterway, these should be maintained; and
- Where the environmental values are not being achieved the focus of activities should be towards achieving these values over time (SMCMA, 2007).

When considering the application of receiving water quality objectives to the Site, it is expected that these have already been applied by the regulators in setting the existing EPL discharge criteria (**Appendix C**). The EPL does not, however, currently nominate stormwater discharge quality criteria, and therefore the water quality objectives for the respective receiving waters, and the impact of discharges from the Site, require consideration within this EIS.

Botany Bay Catchment Water Quality Objectives

The water quality objectives for Botany Bay are broadly set out in the *Marine Water Quality Objectives for NSW Ocean Waters: Sydney Metropolitan and Hawkesbury*-Nepean (Department of Environment and Conservation NSW, 2005). The SMCMA was conducting the Botany Bay Water Quality Improvement Program through which it ultimately developed and published the *Botany Bay & Catchment Water Quality Improvement Plan* (SMCMA 2011). Through this process, specific Botany Bay water quality objectives were developed and published in the: *Botany Bay Coastal Catchments Initiative Environmental Values – Background Paper* (SMCMA, June 2007).

The water quality values defined for the Georges River Catchment, including the southern parts of Botany Bay (including receiving environments relevant to Project Area) are the protection of:

- aquatic ecosystems – to maintain or improve the ecological condition of waters;
- primary contact recreation – to maintain or improve water quality so that it is suitable for activities such as swimming and other direct water contact sports;
- secondary contact recreation– to maintain or improve water quality so it is suitable for activities such as boating and fishing where there is less bodily contact with the waters;

- visual amenity – to maintain or improve water quality so that it looks clean and is free of surface films and debris; and
- aquatic foods (cooked) – to maintain or improve water quality for the production of aquatic foods for human consumption (whether derived from aquaculture or recreational, commercial or indigenous fishing).

Specific catchments within the Georges River catchment, including part of Botany Bay that are potentially applicable to the Site, their current environmental conditions, the desired outcomes and goals for those areas, as well as the ANZECC levels of protection afforded to them are summarised in Table 2-3.

Table 2-3 Management Goals and ANZECC Protections Levels – Botany Bay (Healthy Rivers Commission of New South Wales, 2007)

Catchments	Environment condition	Desired outcomes	Management goal	ANZECC Levels of Protection
Upper Georges River, Towra wetlands & Woolooware Bay	Slightly modified	Restore natural processes and biodiversity as much as practicable.	Restore natural condition	Slightly to moderately disturbed
Georges River estuary and southern Botany Bay.	Moderately modified	Retain or restore important natural processes/ biodiversity and protect desired public uses.	Maintain or restore healthy modified conditions	Slightly to moderately disturbed

Marine Water Quality Objectives

The Tasman Sea, to which treated effluent from the Site flows, is classified as a marine water environment. The marine water quality objectives are set out in the *Marine Water Quality Objectives for NSW Ocean Waters: Sydney Metropolitan and Hawkesbury-Nepean* (Department of Environment and Conservation NSW, 2005). The Marine Water Quality Water Objectives/Environmental Values set out for marine waters in the vicinity of the Site are:

- aquatic ecosystem health – to maintain or improve the ecological condition of oceans waters;
- primary contact recreational – to maintain or improve ocean water quality so that it is suitable for activities such as swimming and other direct water contact sports;
- secondary contact recreation – to maintain or improve ocean water quality so it is suitable activities such as boating and fishing where there is less bodily contact with the waters;
- visual amenity – to maintain or improve water quality so that it looks clean and is free of surface films and debris; and
- aquatic foods – to maintain or improve ocean water quality for the production of aquatic foods for human consumption (whether derived from aquaculture or recreational, commercial or indigenous fishing).

Stormwater

3.1 Introduction

This section provides an assessment of the stormwater impacts of the Project, and their proposed management at the Site. The assessment provides:

- descriptions of the existing catchments;
- a description of the existing stormwater collection and treatment infrastructure;
- a description of the stormwater discharge points from the Site; and
- an assessment of the water quantity and quality impacts of stormwater, with reference to the proposed modifications on Site to convert the refinery to a finished product terminal.

3.2 Existing Environment

3.2.1 Overview

Stormwater generated on the Site is collected in the Site's stormwater system, some is treated, and it is discharged offsite to two receiving water bodies, Quibray Bay and Botany Bay. The stormwater system only collects runoff from areas of the Site that have been designated low risk with respect to interaction with petroleum products, including primarily 'non-process' areas of the Site, such as roadways and building roofs.

The Site has a separate oily water system to handle water that is or may be impacted by petroleum products, including a proportion of stormwater runoff collected from areas where there is or may be interaction with petroleum products such as tanks, bunds and refinery process areas. The oily water system is addressed briefly in **Section 3.2.3** and in detail in **Section 6.**

Topography within the Site is generally flat, although steeper areas exist toward the eastern Site boundary. Soils within the Site are sandy with sandstone bedrock.

The Site has seven (7) main stormwater catchment areas, which eventually discharge to Quibray Bay, Botany Bay, or to land (infiltration/evaporation). Stormwater runoff generally flows from the eastern boundary through pipes and open channels towards the northwest into the Quibray Bay, Botany Bay, and Marton Park. Some stormwater flows onto the Site across the eastern Site boundary from the Kamay Botany Bay National Park.

Caltex has prepared a Stormwater Management Plan (dated 5/10/11) in response to EPL No 837 Condition U10.1 PRP U24.1. This condition was imposed by EPA in response to several incidents in 2010/11 arising from flooding on the Site. The Stormwater Management Plan was based on a comprehensive review of the stormwater system, including hydraulic modelling, conducted in 1992 (*CRL/ALOR Stormwater Management Study* (GHD, 1992)). This was a major update of an assessment undertaken in 1981 entitled: *Stormwater Drainage Investigation* (Davy McKee, 1991).

3.2.2 Site Catchments

There are seven main catchment areas on the existing Site, as shown in **Figure A-3 (Appendix A)**. Details of the catchment areas is provided in **Table 3-1.**

3 Stormwater

Table 3-1 Stormwater Drainage System Catchments

Catchment	Location Description
A	Eastern and northern area of the Site which includes the large eastern tank area, as well as an area of the adjacent Kamay Botany National Park.
B	Central area of the refinery which contains the majority of the refinery process areas as well as offices, cafe, workshops and store houses; and western part of the Site which contains wastewater treatment plant, western tank area, LPG loading area and storage plant, the Quibray Bay Stormwater Retention Basin and parking area.
C	Northern corner of the Site which includes main offices, former staff houses, gardens, employee car park and wetland.
D	An area between the CLOR and the refinery, and which contains a flare stack and concrete channel.
E	South western corner of the Site occupied by the now decommissioned and largely demolished CLOR, and which contains offices, workshops, laboratory, and tank compounds.
F	South eastern corner of the Site, which predominately comprises relatively undeveloped land and a small area of tank compound, land farm, recycling area and sludge lagoon, as well as an area of the adjacent Kamay Botany National Park.
G	North eastern undeveloped area mostly outside of the Site boundary, which is part of the Kamay Botany National Park.

As shown in **Table 3-1,** the infrastructure present and activities conducted within each catchment varies. An indication of the types of infrastructure present within each catchment is presented in **Table 3-2**.

Table 3-2 Existing Structures within each Catchment

Structure	Catchment						
	A	B	C	D	E	F	G
1 – Roadways, parking and paved areas	x	x	x	x	x	x	
2 – Stormwater collection and treatment systems (including underground drains and open channels)	x	x	x	x	x	x	x
3 – Grassed area/undeveloped/vacant land	x		x	x	x	x	x
4 – Process plant		x			x		
5 – Tanks and bunds	x	x			x	x	
6 – Storage areas	x	x					
7 – Buildings e.g. office, workshop, cafeteria, laboratory		x	x		x		
8 – Flares				x			
9 – Wastewater treatment infrastructure		x					
10 – Ponds/retention basins/wetlands	x	x		x	x	x	

3.2.3 Stormwater System Description

The Site has a stormwater management system that separates stormwater from potentially impacted water, including some impacted stormwater (for management via the oily water sewer system).

Rainwater that falls within tank bund areas or within the refinery infrastructure area (including the former CLOR oily water sewer system), and which would potentially be impacted, is directed to the Site oily water sewer system, for treatment in the wastewater treatment plant (WWTP). The treated wastewater from the WWTP is then discharged via outfalls to the ocean in accordance with the Site's EPL. This is discussed further in **Section 6**.

There is also an intermediate sewer system (part of the cooling water system) to which potentially impacted stormwater from the stormwater system can be manually directed.

Water in this system is treated in oil/water separators prior to discharge via the Botany Bay outfall. This is discussed further in **Section 6**.

The stormwater system collects runoff predominately from roadways and hardstand areas, roof runoff, and pipeways, as well as undeveloped areas of the Site. Some runoff from offsite is also intercepted by the Site's stormwater system, e.g. Catchment G includes part of the Kamay Botany National Park.

The stormwater collection system comprises a system of underground reticulation and open channels. There are various retention, retarding and treatment systems incorporated into the Site's stormwater system.

The specific stormwater retention, treatment and disposal systems in each catchment are discussed further in **Appendix C** and summarised in **Table 3-3**. This table also identifies where offsite inflow into the Site catchments is occurring (also shown on **Figure A-3**).

Table 3-3 Stormwater Storage, Treatment and Disposal within each Catchment

Catchment	Offsite Inflow	Retention	Treatment/Control	Discharge Point(s)
A	Inflow from the Kamay Botany National Park at five (5) points along the eastern boundary	There is a natural retention area present, receiving inflow from the National Park and surrounding area.	Skimmer and siphon system, followed by API oil/water separator. Provision for pipeway isolation and use of skimmer pump to the oily water sewer system. Retention in the south east part of the catchment.	Botany Bay at Silvers Beach
B	None	Quibray Bay Stormwater Retention Basin. Basin overflow	API separator. Retention basin. Siphon system. Final discharge pit. Provision for isolation, skimming and diversion of Pipeway A & B drainage to intermediate sewer (cooling water) and use of skimmer pump to the oily water sewer system.	Quibray Bay via Captain Cook Drive roadway drains discharging through the mangrove wetland.

3 Stormwater

Catchment	Offsite Inflow	Retention	Treatment/Control	Discharge Point(s)
C	None identified	Possibly some in onsite wetland area.	None identified, though some treatment would be provided in the onsite wetland area.	Marton Park Wetlands
D	None	None.	Transferred to Catchment B, Treatment as indicated for that Catchment.	Transferred to Catchment B. Discharge as indicated for that catchment.
E	None	Some onsite infiltration occurs in the former process area.	Stormwater collected in the former CLOR oily water sewer system is pumped to the refinery oily water sewer system.	Quibray Bay via Sir Joseph Banks Drive and Captain Cook Drive roadway drains discharging through the mangrove wetland. Onsite infiltration.
F	Inflow from the Kamay Botany National Park via two (2) main drainage lines along the eastern Boundary	Natural retention basin	Retention	Quibray Bay via Sir Joseph Banks Drive and Captain Cook Drive roadway drains discharging through the mangrove wetland.
G	Inflow from the Kamay Botany National Park in the north west corner of the Site.	None	None	Sutherland Shire drain, which discharges to Marton Park Wetlands

With reference to **Table 3-1**, **Table 3-2** and **Table 3-3** above, Catchment D is no longer a separate catchment, and is now part of Catchment B. It was originally a separate catchment that drained to an infiltration area in the west of the Site in an area now occupied by a tank. The drainage was modified to accommodate the construction of this relatively new tank. This has been maintained as a separate catchment within this report for consistency with the Stormwater Management Plan for the Site and the preceding stormwater catchment definitions.

The main Site catchments with the potential for interaction between petroleum products and stormwater are Catchments A and B (including Catchment D), primarily along the pipeways. The systems incorporated into the stormwater system to regulate flow and discharge rates and prevent discharge of impacted stormwater from the Site are summarised as follows:

- provision for isolation of drainage in pipeways;
- installation of manually operated skimmer pumps at pump transfer points (pumping to the oily water sewer system);
- ability to redirect stormwater to the intermediate sewer (Catchment B only);
- retention in an onsite retention basin (Catchment B only);
- discharge via siphon systems; and
- treatment in API oil/water/solids separators.

3 Stormwater

Until recently when the CLOR was operating, runoff from parts of this area (Catchment E) was treated in a manner similar to that described above for Catchments A and B. The CLOR has ceased operation and is currently being demolished. Runoff from this area is no longer treated prior to offsite discharge, except any water that collects in the former CLOR oily water sewer system, which is now pumped to the refinery oily water sewer system.

Activities and infrastructure in Catchment C and part of Catchment F are not dissimilar to those generally in commercial urban areas. Catchment G and much of Catchment F is undeveloped land. Runoff from these areas is, consequently, similar to urban or undeveloped land runoff and is discharged offsite without onsite treatment.

An analysis of the stormwater system's operational hydraulics was conducted in 1992 using the ILSAX computer modelling program. The model was run for each of the catchments, for a range of storm durations. The modelling assessed and identified hydraulic and treatment capacity constraints within the Site's stormwater system. A range of consequential modifications and improvements were made to the system over a period of time. Also, modifications to the Site catchment and stormwater system have occurred in the intervening period due to operational and infrastructure changes on the Site, e.g. diversion of Catchment D to Catchment B due to the construction of a new tank.

Some capacity constraints were identified in Catchment B in the early 2000's prompting the EPA to require an assessment and improvements under a Pollution Study and Reduction Program (PRP) for stormwater water quality (PRP U5). This plan was submitted on 5th October 2005 and subsequently implemented.

The response of the system to some high rainfall events in 2010/11 indicated that there were some further capacity constraints within Catchment B. In response, EPA required that Caltex prepare a new Stormwater Management Plan (discussed in detail in **Section 3.2.6**). This has been completed, and one of the commitments made is that the stormwater system hydraulic model will be updated to identify the current system capacity and any further improvements that might be required to the system, including those that arise as a consequence of the Project.

3.2.4 Stormwater Quality

The stormwater discharge quality from the Site is not currently measured, although a daily visual check is conducted. Stormwater discharge quality is not required to be measured regularly by the EPL. There is, consequently, no data available on stormwater quality discharged from the Site.

The current stormwater treatment systems described in **Section 3.2.3** are designed to address the following types of contaminants:

- suspended solids (settleable); and
- phase separated petroleum hydrocarbons.

The stormwater treatment systems on Site do not generally address dissolved phase hydrocarbons, or dissolved organics more generally, although some limited removal of volatile dissolved phase species might be expected from retention systems. Some dissolved phase species removal would be expected in wetland systems.

The key water quality management strategy adopted by the Site has been to prevent, to the extent practicable, interaction between petroleum hydrocarbons and stormwater.

3 Stormwater

As discussed in **Section 3.2.3** the main stormwater quality threats arise from Catchments A and B. The remaining catchment areas have a lower risk of impacting significantly on stormwater quality.

It is expected that when stormwater flows are within the hydraulic and treatment capacity of the Site's systems, the stormwater quality would exhibit similar characteristics to stormwater runoff from urban areas. This assessment is based on:

- the nature of the existing infrastructure, products, and activities (refer to **Table 3-2** and **Table 3-3**) within the stormwater system catchments;
- the fact that the Site's stormwater management system separates stormwater and oily water; and
- the reduced risk of discharging impacted stormwater as a result of retention treatment of stormwater for the removal of oil and sediment.

As discussed in **Section 3.2.3**, a Pollution Study and Reduction Program (PRP) for stormwater water quality (PRP U5) was completed in March 2005. This PRP sought to improve the quality of stormwater treatment so as to ensure that no visible oil and grease would be released within the waters discharged adjacent to Gate 5 to Quibray Bay (EPA[a] 2012). Under PRP U5, the Quibray Bay Stormwater Retention Basin (formerly known as basin B1) was upgraded to allow stormwater from Pipeways A and B to be directed to the basin before discharging offsite.

On three (3) separate occasions in June 2010, March 2011 and April 2011, during periods of very high rainfall, oily water has been discharged from the Site This occurred due to flooding in Catchment B and the discharge occurred through the cooling water outfall into Botany Bay. Therefore, the ability of the Site's stormwater systems to mitigate and manage offsite impacts during flood events has required further assessment.

In response to these additional stormwater quality impact issues within the Catchment B stormwater system, the EPA imposed a requirement for additional stormwater improvement investigations within *U10 PRP U24: Stormwater Catchment and Management Program.* Caltex was required to prepare a Stormwater Management Plan to prevent the discharge of contaminated waters from the Site at all times. This plan was prepared and submitted as required on 5 October 2012. Its' findings were considered as part of this assessment.

In relation to the specific incidents in 2010 and 2011, the plan identified that the incidences were due to heavy rainfall that resulted in localised flooding at the WWTP and adjacent properties, which resulted in oily water being discharged offsite. The assessment found that during heavy rainfall, due to the slow release rate of stormwater from the Main Pipeway skimmer and syphon system, stormwater may back up and form pools upstream of the syphon, and if the stormwater backs up as far as the Oil Movement Centre (OMC), it could enter the oily water sewer. This would put pressure on the capacity of the WWTP potentially causing flooding at the Oily Water Separators. This would discharge to stormwater, which is what occurred. In addition, the assessment found that if the stormwater backs up all the way to where Pipeways A and B intersect the Main Pipeway, the stormwater in the Main Pipeway can enter Pipeway A and B, thus overloading Catchment B drainage system, which may also cause flooding further down the system.

The Stormwater Management Plan provides a detailed description and assessment of the existing stormwater management system. It includes time bound management strategies and plans, to be largely implemented by end of 2013, so as to improve the stormwater management system, minimise onsite flooding and prevent the discharge of impacted stormwater offsite. Details of the Stormwater Management Plan strategies are discussed further in **Section 3.2.6.**

3.2.5 Stormwater Discharge

Stormwater from the Site is discharged, ultimately, to three receiving environments, namely:

- discharge by open drainage lines to Quibray Bay through a narrow strip of the Towra Point Nature Reserve and the mangrove wetland;
- discharge into Botany Bay (at Silver Beach near the loading wharf); and
- discharge to Marton Park – loss primarily by infiltration.

A description of the discharge arrangements from each catchment is provided in **Appendix C**, and summarised is **Table 3-3**.

Catchments B, D, E & F, comprise in the order of 70% of the total Site catchment area. These catchments all discharge ultimately to Quibray Bay via aboveground drainage lines passing through a narrow strip of the Towra Point Nature Reserve (of remnant saltmarsh) and the mangrove wetland on the northern side of Quibray Bay.

Quibray Bay (and surrounds) is therefore the main receiving environment and is also the most environmentally sensitive of the current stormwater receiving environments.

3.2.6 Further Stormwater System Assessment and Improvement

The Stormwater Management Plan prepared for the Site under EPL Condition U10.1 PRP U24.1, committed Caltex (by EPL Condition U10.2 PRP U24.2) to implementing a stormwater management strategy and to completing a number of stormwater management measures in a staged manner. The various element of the strategy are as follows:

1. Ongoing maintenance of the existing stormwater system (ongoing).
2. Implement a number of projects to improve the infrastructure, reduce the potential for the Site to flood, and prevent contaminated stormwater leaving the Site (commenced in 2012).
3. Work with the NSW Office of Environment and Heritage, NSW EPA and Sutherland Shire Council to divert to flow of stormwater from the National Park away from the Site's stormwater system to the Sutherland Shire Council's stormwater infrastructure (commenced in 2012).
4. Carry out stormwater flow monitoring from 2013 through to 2014.
5. Updating the Site's stormwater system performance model to account for the changes to the stormwater system infrastructure that can then be used as a tool to assess future modifications, as necessary (will commence once Strategy Item 2 has been finished).

Catchments A and B, the main Site catchments in which the review and improvement measures are focussed, are within the Project Area. The Project would be a consideration in relation to the implementation of stormwater system improvements. As implied within Strategy Item 5, the updated hydraulic and Site stormwater model would be utilised as a tool to assess the impact of any proposed stormwater system modifications associated with the Project.

3.2.7 Offsite Stormwater Interceptions and Groundwater Interaction

Offsite Stormwater Interception

As noted in **Table 3-1** and **Table 3-3**, the Site intercepts stormwater that enters into Catchments A, F & G from the Kamay Botany Bay National Park. The offsite catchment areas and points at which this stormwater enters the Site are shown in **Figure A-3** of **Appendix A**.

3 Stormwater

The offsite catchments were clearly defined, and some inflow modelling was conducted, in the 1992 stormwater study (GHD 1992). This report considered the potential diversion of this stormwater from the National Park but indicated that this could not be achieved by simply installing a cutoff drain outside the boundary due to topographical constraints. The report suggested that it would need to be piped separately through the Site. It is recommended that the modelling be updated (as proposed – refer to **Section 3.2.6**) to accommodate the changes that have subsequently been made to the Site stormwater system.

The minor Catchment G inflows are currently diverted around the Site into Sutherland Shire drainage network (ultimately discharging into Marton Park).

Inflows into Catchment F, whilst significant, do not interact with the stormwater system in the operational areas of the Site and so are effectively diverted around the southern Site boundary (ultimately discharging to Quibray Bay).

The inflows into Catchment A are the main area for consideration in relation to the Project. The Stormwater Management Plan indicated that the offsite inflow into Catchment A was potentially contributing to stormwater system capacity constraints and operational issues on the Site during high rainfall events. Stormwater Management Plan Strategy item 3 involves discussing the potential diversion of the National Park inflows with the Sutherland Shire Council and other State Agencies.

Groundwater Interactions

There is the potential for interaction between stormwater and groundwater at the Site. Groundwater is addressed separately in **Chapter 9 Soil, Groundwater and Contamination** of the EIS.

As for any location, infiltration of stormwater to soil, and potentially, underlying groundwater occurs in parts of the Site that are unpaved and pervious. Where there are permanent or temporary water bodies, such as ponds, natural retention basins or wetlands, the interaction may be more direct. Areas such as this on Site have been identified (refer to **Figure A-3**) and include:

- natural retention area in Catchment A;
- Quibray Bay stormwater retention basin overflow retention areas (Catchment B);
- an onsite wetland area (adjacent to Marton Park wetland), north of the contractors carpark (Catchment C);
- a natural retention Basin near the southern site boundary (Catchment F); and
- parts of the former CLOR process area (Catchment E).

Marton Park wetland, one of the identified destinations for Site stormwater (Catchments C and G) is a designated Groundwater Dependant Ecosystem, as discussed in **Section 2.4.3,** in **Chapter 9 Soil, Groundwater and Contamination,** and in **Chapter 19 Ecology** of the EIS. Groundwater interaction and infiltration could also be expected within the Quibray Bay wetland area, which is the destination for stormwater from Catchments B, D, E & F.

The Kamay Botany Bay National Park, located across the eastern Site boundary, is generally elevated above the level of the Site. It is a dune area with sandy soils, and so relatively high stormwater infiltration rates would be expected in this area. It is conceivable, though not confirmed, that groundwater may be contributing to intercepted stormwater flows on the Site (i.e. from spring contributions), particularly following high rainfall events.

The stormwater/groundwater interactions at the Site have not previously been quantified. Further such interactions may be identified as a result of preparing the Site stormwater model required under the Stormwater Management Plan (refer to **Section 3.2.6**).

3.3 Impact Assessment

3.3.1 Construction Phase

The construction activities for the Project would occur within Catchments A and B. The construction phase of the Project is expected to have minimal impact on the quality of stormwater discharged from the Site.

Much of the construction activity that would be undertaken in the Project Area would be associated with upgrades to tanks and pipework, with associated excavation and earthworks activities. Potential impacts related to stormwater associated with the proposed construction works would include erosion and high suspended solids in stormwater. Such impacts would be relatively small due to the minor nature of the works to be undertaken. Nevertheless, appropriate mitigation and control measures would be implemented. These measures would also consider the potential for interactions with hydrocarbon impacted soils, if encountered.

Activities such as tank cleaning would occur in bunded areas and any washwater generated would be directed to the oily water sewer system, as during normal operation. There would be no interaction with the stormwater system.

The management of potential impacts on stormwater runoff quality during the construction phase of the Project would be detailed within a Construction Phase Environmental Management Plan (CEMP).

All construction works would 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* (NSW Department of Housing, 2004) (commonly referred to as the Blue Book guidelines). Areas that would be disturbed would be managed through the installation and maintenance of appropriate erosion and sedimentation control devices. This may include the installation of sediment filters. These devices would remain in place until the surface is restored to capture any gross pollutants. Temporary containment bunds would be constructed with provision for collection of any spilt construction material. Waste collection areas would be designated. Bunding would be installed and containers for any liquids would be provided. Waste collection and disposal would be undertaken by licensed contractors.

Catchments A and B, both have controls in-place that remove suspended solids from stormwater by sedimentations and oil by gravity separation (**Section 3.2**).

3.3.2 Operational Phase

The Project Area is shown in **Figure A-1** and **Figure A-3** of **Appendix A**. The Site stormwater catchments that are within the Project Area are:

- Catchment A – all of the existing catchment except a small area in the south west corner;
- Catchment B – the western part of the catchment comprising the western tanks area; the wastewater treatment plant, as well as Pipeway A and a small area in the north east corner;
- Catchment G – the part that falls within the Site and excluding the eastern part that falls within Kamay Botany Bay National Park.

Following completion of the Project, the existing Site stormwater system would remain intact, including the stormwater retention and treatment systems. The Site stormwater receiving environments would not change, however, only Botany Bay, Quibray Bay and Marton Park wetland would receive stormwater from the Project Area.

The Site stormwater system would be reviewed and improved in line with the requirements of the Stormwater Management Plan, as indicated in **Section 3.2.6**.

Within Catchment B, the stormwater system within the Project Area is unmodified, except in line with the requirements of the Stormwater Management Plan, although there would no longer be the ability to transfer water from Pipeways A & B to the intermediate sewer system, as this system would be decommissioned. Modification may be required to the stormwater system within the catchment outside of the Project Area, however, with consideration of the impacts of the refinery shutdown.

The quality of stormwater arising from the Project Area during the operation of the Project would be of a similar character as is currently the case, as the activities and types of products stored would be effectively the same. The shutdown and decommissioning of the refinery would reduce the potential for impact on stormwater quality by petroleum products in both Catchment A and B stormwater due to the shutdown of the process units and associated product transfers.

Overall, the change in volume and quality of stormwater discharged from the Project Area, arising from the Project would be negligible.

There may be changes in the discharge volume from Catchment B and reduced contaminant loads from Catchment A and B arising from works associated with the eventual demolition and remediation of the refinery infrastructure, but this would be addressed as a separate approval at a later stage and does not form a part of this Project (refer to **Chapter 4 Project Description** of the EIS).

The implementation of the Stormwater Management Plan will allow quantification of the current stormwater system hydraulic performance and capacity, and the impacts of potential modifications arising from actual and potential improvements to the system. The Stormwater Management Plan modelling will also allow assessment of the adequacy of the existing stormwater treatment systems relative to their hydraulic capacity. Impacts on stormwater quality will not be quantified as no quality measurement of stormwater has been or is proposed to be conducted.

3.3.3 Offsite Stormwater Interceptions and Groundwater Interaction

During Project operation, the interception of offsite stormwater flows and interaction between groundwater and stormwater within the Project Area would be expected to be unchanged as a consequence of implementation of the Project. Other factors such as the implementation of any measures through the Stormwater Management Plan, e.g. possible diversion of Kamay Botany Bay National Park inflows from Catchment B, could influence both stormwater inflows and groundwater interactions within the Project Area.

3.4 Summary

The existing Site stormwater management system is expected to be adequate for treatment and discharge of stormwater when stormwater flows are within the hydraulic and treatment capacity of the Site's systems. The stormwater quality would be expected to exhibit similar characteristics to stormwater runoff from urban areas. This assessment is based on:

- the nature of the existing infrastructure, products, and activities within the stormwater system catchments;
- the fact that the Site's stormwater management system separates stormwater and oily water; and
- the reduced risk of discharging impacted stormwater as a result of retention treatment of stormwater for the removal of oil and sediment.

Notwithstanding that these systems are in place, three oil contaminated water releases occurred during 2010/11 during very high rainfall events highlighted hydraulic capacity constraints on the system that exist during extreme events or conditions, particularly within Catchment B. The origins of these constraints have been investigated and identified. Measures are being undertaken to address the identified deficiencies through the implementation of the Stormwater Management Plan. The key elements of the Plan to be implemented by Caltex are described in **Section 3.2.6**.

The Project would not result in changes to the existing stormwater system within the Project Area, including the stormwater retention and treatment systems.

The Site stormwater receiving environments would not change, with Botany Bay, Quibray Bay and Marton Park wetland receiving stormwater from the Project Area.

The construction phase of the Project is expected to have minimal impact on the quality of stormwater discharged from the Site provided appropriate management and mitigation measures are implemented (as proposed and outlined in **Section 3.3.1**).

The quality of stormwater arising from the Project Area following construction of the Project would be expected to be of the same character as is currently the case, since the Project has no impact on the actual catchments. The shutdown and decommissioning of the refinery would reduce the potential for impact on stormwater quality in both Catchment A and B due to the decommissioning of the process units and cessation of associated product transfers.

The hydraulic impacts of the Project on site stormwater discharges are negligible for both Catchment A and B.

The interception of offsite stormwater flows and interaction between groundwater and stormwater within the Project Area would be expected to be unchanged as a consequence of implementation of the Project.

As discussed previously, there could potentially be some impacts on the Catchment B discharge arising from the proposed refinery demolotion and remediation, but this would be addressed as a separate approval at a later stage and does not form a part of this Project (refer to **Chapter 4 Project Description** of the EIS).

Flood Risk

4.1 Introduction

This section presents an assessment of the flood risk at the Site. The assessment provides:

- descriptions of the existing flood risk including tsunami and surface water/flash flooding; and
- an assessment of the flood risk, with reference to modifications as a result of the Project.

4.2 Existing Environment

4.2.1 Introduction

The Site lies at south eastern portion of the Kurnell township catchment. According to the *Kurnell Township Flood Study Final Report* (WMAwater, 2009), prepared on behalf of Sutherland Shire Council, Kurnell is susceptible to flooding from both rainfall and tidal inundation. Its localised depression and low lying topography can make it vulnerable to extensive flooding (WMAwater, 2009).

Flooding within the Kurnell Catchment may occur as a result of the following factors, which may occur in combination or in isolation:

- high tide or storm surge which causes water levels to elevate in Botany Bay and Quibray Bay;
- intense rainfall which causes water levels to elevate within the open channel that runs beside Captain Cook Drive and along roads and through private property. The rise in water level may also be affected by constrictions, e.g. culverts, blockages, fences and buildings;
- local runoff ponding in low lying areas that has limited potential for drainage. Flooding may be exacerbated by inadequate or blocked local drainage provisions and restricted overland flow paths; and
- tsunami impact on the east coast of Australia from a tsunami arising from subduction zone earthquakes in the Pacific.

Since 1958, the largest flood event in the area occurred on 11 March 1975. The area also experienced tidal flooding on 25 May 1974, corresponding to the largest recorded tidal event (WMAwater, 2012).

4.2.2 Rain Event and Tidal Flooding

4.2.2.1 Kurnell Catchment Flooding

The proximity of the Site to Quibray Bay means flood behaviour for the Site is influenced by storm tide effects. Flooding of the Site can be caused by:

- high rainfall over the catchment;
- elevated tidal levels at the drainage outfalls; or
- a combination of both.

Flooding of land from surface water runoff is usually caused by intense rainfall events. The resulting water follows natural valley lines, creating flow paths along roads, through and around developments and ponding in low spots, which often coincide with fluvial floodplains in low lying areas. All surface water flooding on the Site would be attributed to an exceedance of the design capacity (or significant blockage) of the stormwater system. The capacity of the existing and future stormwater system is discussed in **Section 3** of this report.

4 Flood Risk

Flood maps for various storm events were produced as part of a flood study conducted of the Kurnell catchment by WMAWater for the Sutherland Shire Council in 2009 (WMAWater, 2009). As part of this study, hydrologic and hydraulic modelling was conducted, which covered areas upstream of the township to encompass part of the Site. However, the flood modelling of the township extended to the north-west boundaries of the Site only, and did not include the Site. The hydrologic and hydraulic model boundary and inflow locations are shown in **Figure 4-1** and **Figure 4-2**.

The flood modelling results indicated that Captain Cook Drive, near the western boundary of the Site would be overtopped during the 1% year (also known as a 1 in 100 year) Annual Exceedance Probability (AEP) flood (WMAwater, 2009). The peak flood levels for 1% AEP event are shown in **Figure 4-3** and **Figure 4-4**, with the peak flood depths shown in **Figure 4-5** and **Figure 4-6**.

It is notable that the peak flood levels within the modelled domain vary in different locations, which may seem counter-intuitive as you might expect that the water level in flood should be largely the same. This is because the levels shown are the peak levels in a particular location during the event modelled, and the peak in different locations will not necessarily occur at the same time during the event. Stormwater runoff during the modelled event will respond to the underlying topography and the drainage lines and infrastructure. For example, as the stormwater runs off, there may be a temporary build-up of water in a location such as a channel that will be transient and subside, whereas water accumulated in low lying areas, such as wetlands, may persist for some time after the event; the mapping however shows what the peak level that occurred during the event was at each location. The water level is described against a standard reference level, referred to as the Australian Height Datum (AHD), whereas the flood depth shows the water depth above the underlying ground level.

Figure 4-1 Hydrologic Model Layout (WMAwater, 2009)

4 Flood Risk

Figure 4-2 Hydraulic Model Layout (WMAwater, 2009)

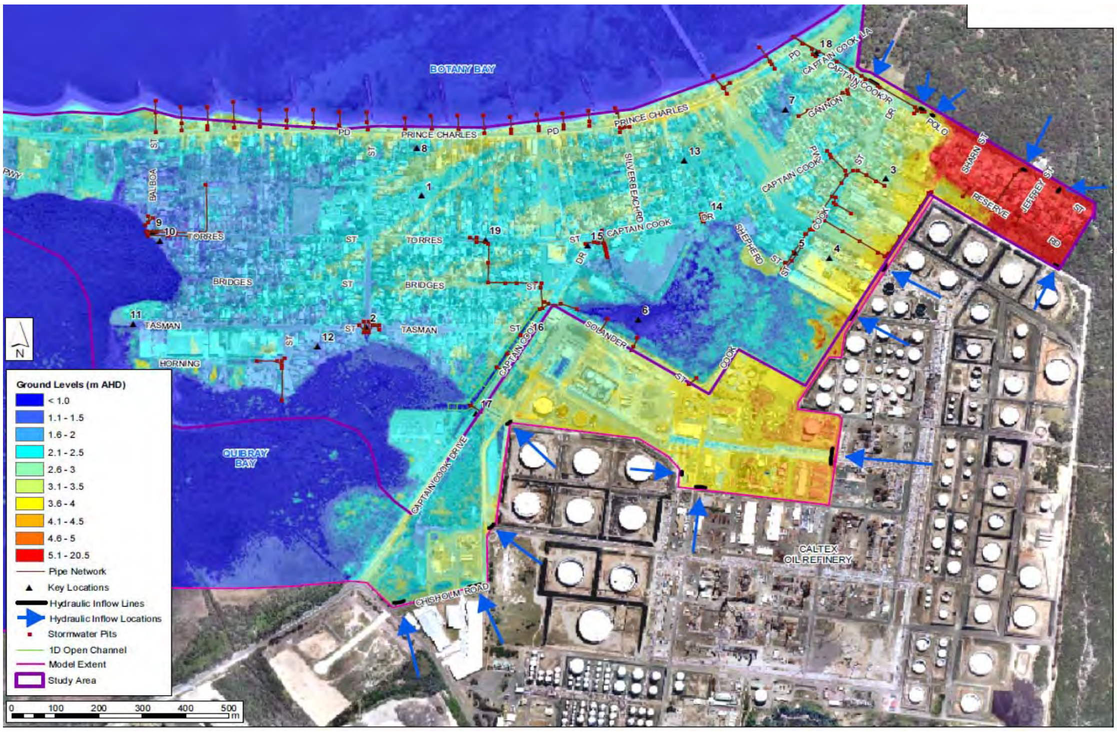
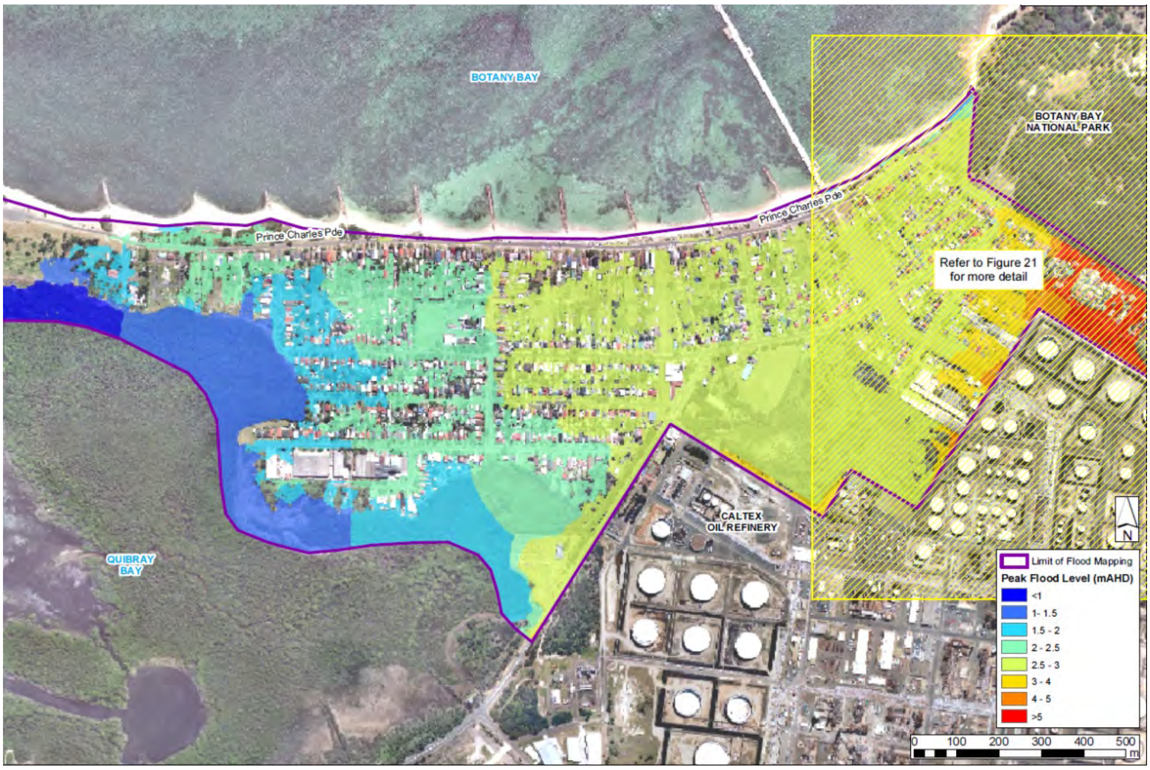
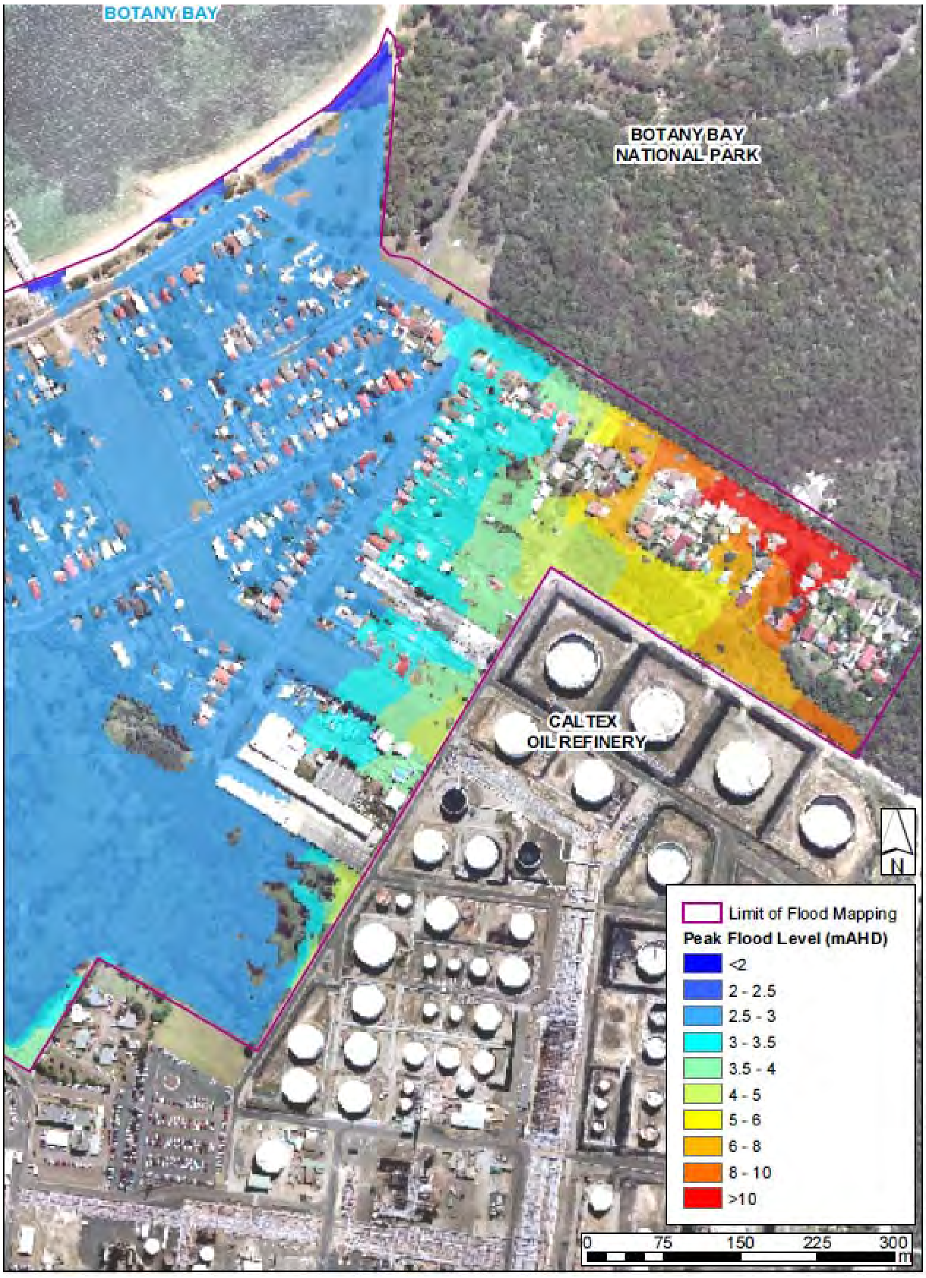


Figure 4-3 Peak Flood Levels 1% AEP Event (WMAwater, 2009)



4 Flood Risk

Figure 4-4 Peak Flood Levels 1% AEP Event Inset (WMAwater, 2009)

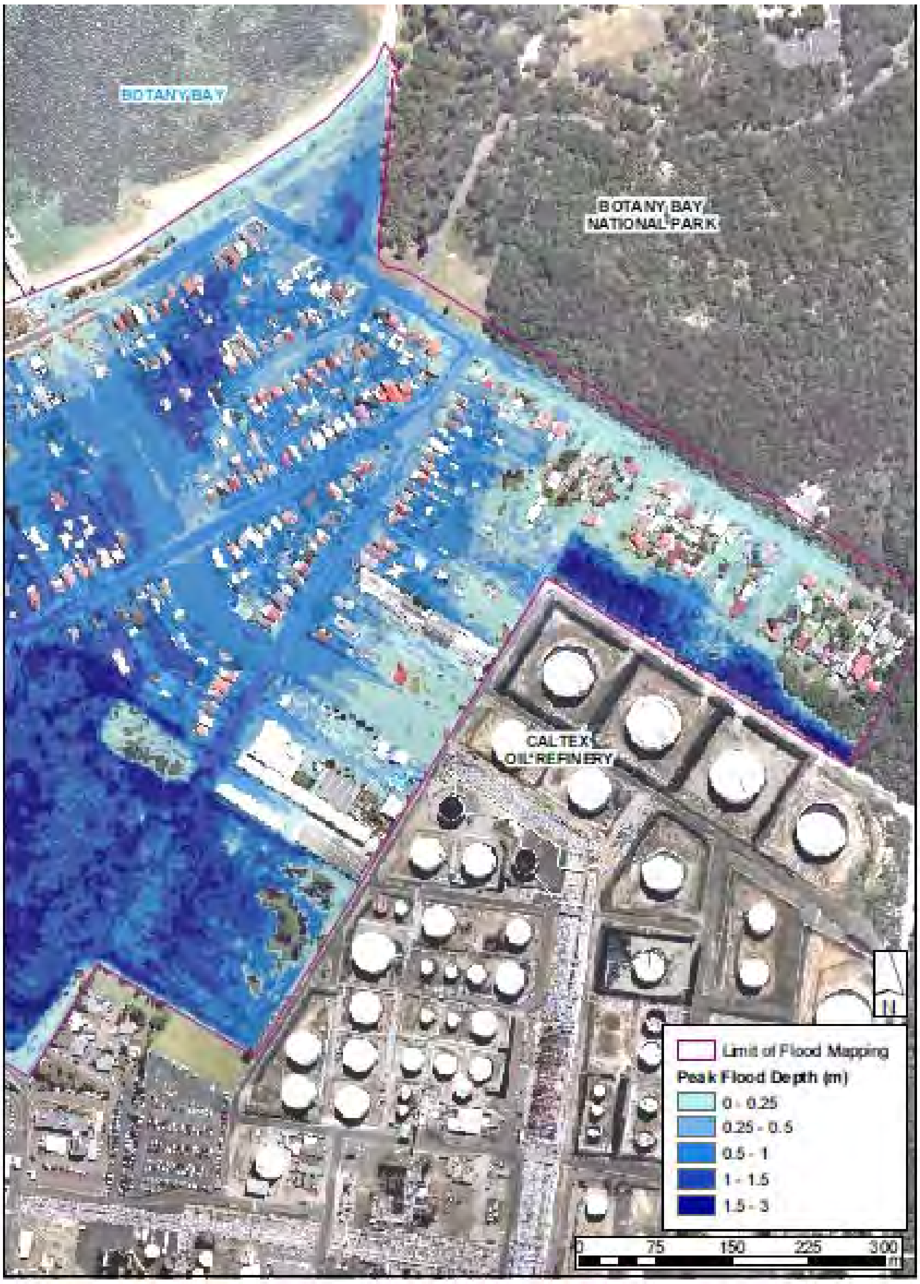


4 Flood Risk

Figure 4-5 Peak Flood Depths 1% AEP Event (WMAwater, 2009)

4 Flood Risk

Figure 4-6 Peak Flood Depth 1% AEP Event Inset (WMAwater, 2009)



Provisional hydraulic hazard mapping of the Kurnell Township was also generated as part of the *Kurnell Township Flood Study* (2009), based on depth and velocity for the 1% AEP and Probable Maximum Flood (PMF) event, which is defined as the flood calculated to be the maximum ever likely to occur (though the PMF drawings were not available for this study). The provisional hydraulic hazard mapping, shown in **Figure 4-7** and **Figure 4-8** show that most of the areas which were classified as high risk are wetlands (including part of the Quibray Bay wetlands and Marton Park wetlands) located near the western and northern boundaries of the Site, reiterating that the Site itself has not been classified.

4 Flood Risk

Figure 4-7 Provisional Hydraulic Hazard Categories 1% AEP Event (WMAwater, 2009)

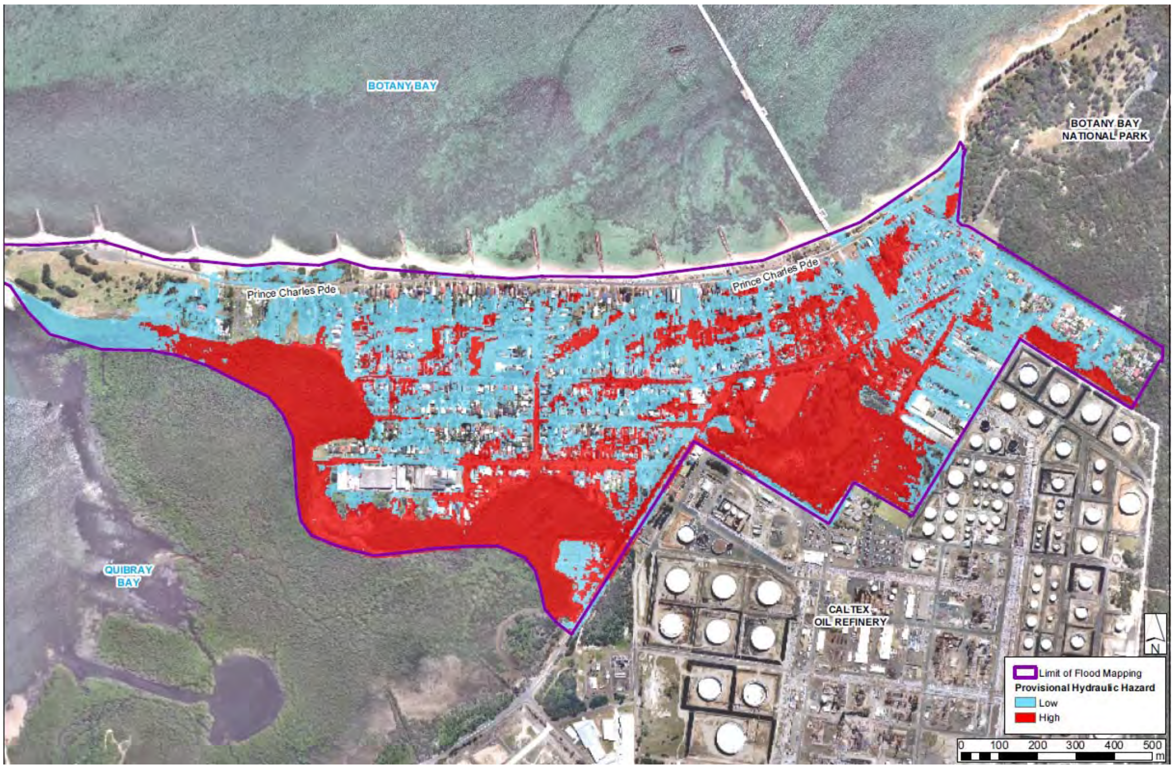
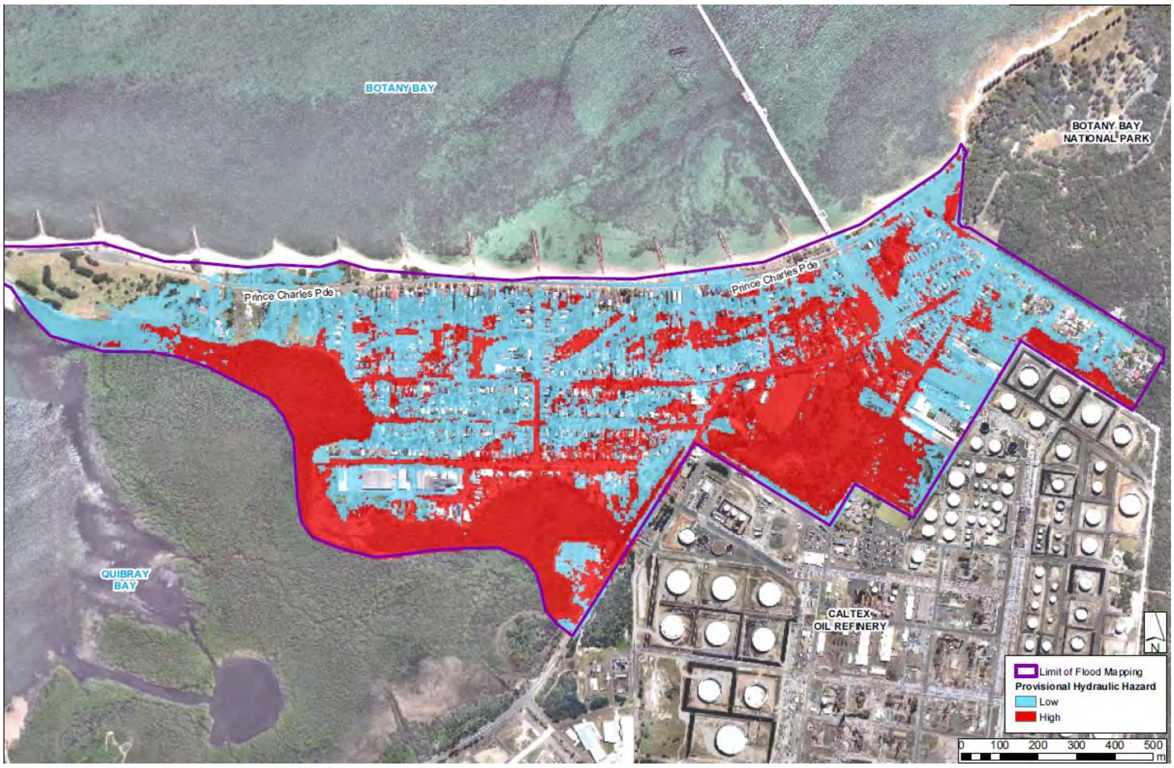


Figure 4-8 Provisional Hydraulic Hazard Categories PMF Event (WMAwater, 2009)



The *true hazard,* which is a measure of the overall effects of flooding including threat to life, danger and difficulty in evacuating people and possessions and the potential for damage, social disruption and loss of production, was also assessed in a subsequent study in 2012 (WMAwater, 2012). The results are summarised in **Table 4-1**.

Table 4-1 Flood Hazard Classification (WMAwater, 2012)

Criteria	Weight	Comment
Rate of rise of floodwaters	Medium	The rate of rise in the catchment may lead to the Kurnell village being cut off rapidly, which would not allow time for residents to prepare.
Duration of flooding	Medium	The duration of the event will be a few hours and would not significantly increase the hazard. Post flood drainage will be slow.
Effective flood access	High	Roads within the catchment can be inundated and may restrict vehicular access during flood.
Size of the flood	Low	The hazard does not significantly increase with the magnitude of the flood. The Kurnell village may be cut-off for the duration of the flood.
Effective warning and evacuation times	High	There is very little, if any, warning time. During the day residents will be aware of the heavy rain but at night (if asleep) residential and non-residential building floors may be inundated with no prior warning.
Additional concerns such as bank erosion, debris, wind wave action	High	The main concern would be debris blocking culverts or pits. This is considered to have high probability to occur and thus of high impact.
Evacuation difficulties	Low	Given the quick response of the catchment, evacuation is not considered to be necessary and therefore is not significant.
Flood awareness of the community	Medium	The flood awareness of the community is due to frequency and severity of nuisance flood.
Depth and velocity of flood water	Low	Flow velocities and depths are flow

4.2.2.2 Site Flooding

Screening Assessment

The impacts of flood events on the Site were not directly assessed in the WMAwater study (2009) for the Sutherland Shire Council (SSC). The Site is generally elevated above the surrounding low lying areas on the western and northern boundaries, and the onsite bunding around petroleum products storage areas effectively increases the flood height that would need to be present for any interaction between petroleum products and flood waters to occur.

To better understand the likelihood of a flood event affecting the Site, a preliminary analysis of the flood risk was conducted considering the flood scenarios presented in the WMAwater study (2009) in the context of the known Site levels. The SSC commissioned flood modelling was used as the basis for this assessment, as SSC has requested the consideration of flooding of the Site as part of this assessment, and their studies were the only data available.

This preliminary assessment was undertaken to determine the indicative flood risk to the Site by utilising the available flood depth and level information (refer to **Figures 4-3** to **4-6**) provided in the Kurnell Township Flood Study Final Report (WMAwater 2009). Effectively boundary level flood

4 Flood Risk

levels/depth data was projected onto the Site. The topographic survey information available for the local area and Site was disjointed and varied in detail. Detailed level survey information, sufficient to develop contours, was available for the north western portion of the Site (in the vicinity of the wastewater treatment plant). For the remainder of the Site there was not enough information to create a model of the existing surface but surveyed spot levels were available to allow consideration of the potential for flooding within the Site..

This assessment involved projecting the available data on flood levels at the Site boundary from the SSC modelling study (WMAWater, 2009) for a 1% AEP event onto the Site. As discussed in **Section 4.2.2.1**, the peak flood levels within the modelling domain vary due to topography and drainage features and behaviour, and this can be seen at the boundary of the Site. Along most of the western boundary of the Site, the 1% AEP event peak flood level is about 2.82 m AHD, however, in the north west corner of the Site, near Gate 5, the peak level is about 4.25 m, and even higher in the north east corner. Three different flood levels for the same 1% AEP event were therefore selected to be applied to three separate parts of the Site boundary for this screening assessment. For each of these Site boundary sections, a Site area was selected to which the boundary flood level would be applied, considering the Site catchment and drainage arrangements, as well as the topography within the Site.

The flood level applied to corresponding Site areas for this assessment is shown in **Figure 4-9** (which also contains Site spot levels for comparison purposes). The three areas and applied floods levels are:

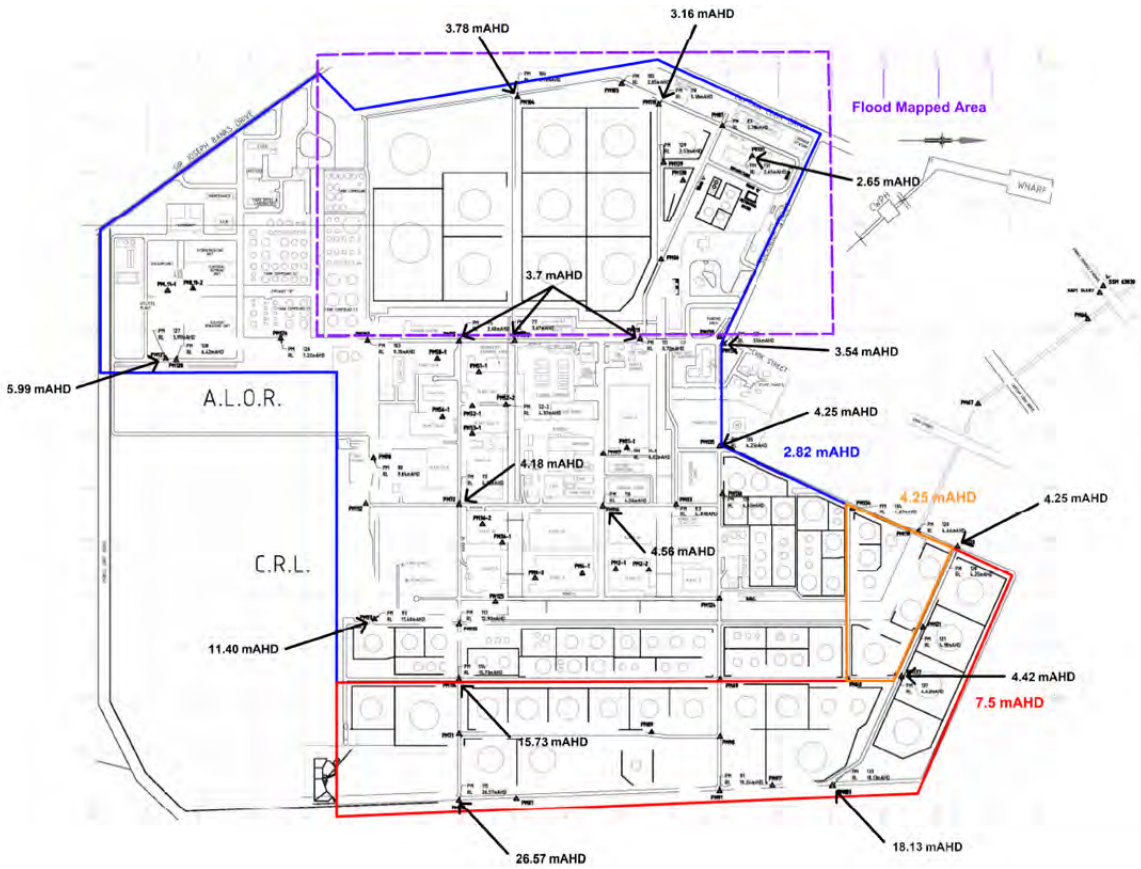
- Western and central part of the Site, 2.82 m AHD flood level (blue area in **Figure 4-9**, Catchment B, C and the south west part of Catchment A, shown on **Figure A-3, Appendix A**);
- North east corner of the Site, 4.25 m AHD (orange area in **Figure 4-9**, part of Catchment A, shown on **Figure A-3, Appendix A**); and
- Northern boundary and eastern part of the Site, 7.5 m AHD (corresponding to an approximate 3 m flood depth at the Site boundary) (red area in **Figure 4-9**, most of Catchment A shown on **Figure A-3, Appendix A**).

The three screening flood levels, mentioned above, were obtained by examining both the flood height and depth maps from WMAwater (2009). Where the land adjacent to the Site is lower than the Site, it is appropriate to use the flood level for screening purposes to consider flooding extent onto the Site, but where the adjacent land is higher, it may not be appropriate (e.g. if the Site is at 4 m AHD, but the adjacent land is at 7 m AHD and the flood level is 10 m AHD, the flood water depth adjacent the Site boundary is effectively only 3 m, rather than 6 m that would be assumed if the flood level was adopted rather than the depth).

The local topography is at its highest along the eastern boundary of the Site and gradually becomes lower to the north west of the Site, dipping towards Botany Bay. Therefore for the north western part of the Site the land immediately beyond the Site boundary is lower.

4 Flood Risk

Figure 4-9 Site Spot Levels and Applied Flood Levels



Beyond the north-eastern corner of the Site however, the land slopes into the Site and is therefore higher beyond the boundary (within both Kurnell and the National Park) than at the Site boundary where a natural low point exists. At this location a catchment drain has been constructed that carries stormwater runoff from the offsite areas to the north-west of the Site, into the Marton Park Wetland (refer to **Figure A-3, Appendix A**). In this area therefore, as discussed above, we have utilised the flood depth at the Site boundary to develop a flood level at the Site boundary, rather than directly extrapolating the flood level data shown in **Figures 4-3** and **4-4**.

Flood depths adjacent to the Site at the north-east boundary are very coarsely mapped as 1.5 – 3 m. The depth of flooding presented in WMAwater (2009) is likely to be an over-estimate as close examination of the report suggests there may be a significant anomaly in the elevations that have been used in the flood modelling along the northern boundary. It is possible that the catchment drain along the north-eastern boundary has not been modelled correctly. The 3 m depth of water is most probably related to the catchment drain, and therefore adoption of this level as an extreme is considered to be overly conservative. Nevertheless in the absence of less coarse or alternate data, this level was adopted for this preliminary review. A level of 7.5 m AHD was applied to this area based on the approximate ground level of less than 4.5 m AHD in the north east corner of the Site.

4 Flood Risk

Flood Projections

Detailed survey information was available for the north western part of the Site in the vicinity of the wastewater treatment plant (inset area shown on **Figure 4-9**). As discussed in **Section 3.2.4**, this is the area where some localised flooding has recently occurred following significant storm events. In this area, where more detailed level and contour information was available, a digital elevation model (DEM) was prepared in ArcGIS to interpolate the ground surface level between surveyed points, and the 1% AEP event flood level of 2.82 m across the surveyed area. No hydraulic modelling was carried out. The results of this work are shown in **Figure 4-10**.

Figure 4-10 shows that there is a relatively shallow depth of flooding within the Site near the intersection of Captain Cook Drive and Solander Street, which is consistent with recent experience of flooding in that area. The plan also shows that the area of flooding within the Site is limited and would not overtop any bunds within the surveyed area.

4 Flood Risk

Figure 4-10 Flood Projection (2.82 m AHD) on the North West of the Site

4 Flood Risk

Permanent Mark (PM) levels were available in various locations throughout the Site, but not detailed contour information, other than aforementioned for the north west corner. These PMs were used to give an approximation of the ground levels where detailed survey data was not available. Consideration was also given to the level of bunds, so that the potential for overtopping by floodwaters could also be considered. PM levels were available to indicate bund heights in the north west of the Site, but not elsewhere. Hydrocarbon tanks in the western tank area typically had a bund height above ground level of at least 3 m.

Extrapolation of flood levels and depths, as described above, indicated that the adopted flood levels were below Site ground level at all locations on the Site, with the following exceptions:

- Limited areas in the north west part of the Site, as shown in **Figure 4-10**;
- Possibly some very minor flooding (<0.1 m depth) across the western boundary in the area immediately to the north of Gate 5; and
- The Site area immediately across the north eastern boundary (area occupied by the first row of tanks only).

Data on the tanks bund heights along the north eastern boundary are not available, although typical Site bund heights may be of the order of 3 m. It is expected therefore that the existing bunding in this area would be sufficient to prevent interaction of flood waters with the storage tanks in a 1% AEP storm event, but based on the current data this cannot be stated conclusively. The available data is coarse, there are concerns regarding the available flood modelling and mapping as it has been applied to this localised area, and local topographic data (including bund heights) is limited. A future review is therefore recommended, focussed on this area to better understand the actual flood risk in this area.

Flood Risk Category

Sutherland Shire Council (SSC) has planning controls relating to flood risk levels and requires that infrastructure standards and safety measures be suitable for the associated risk level. SCC has expressed the view that some of the Site may be classified in the medium risk category (no high risk). The medium risk category is defined by Council as the 1% AEP level plus 100 mm freeboard, plus 900 mm sea level rise (Phillippa Biswell, 5 April 2013, *pers. comm.*), which has been indicated by Council as corresponding to 3.6 m AHD (SCC has assumed a 1%AEP flood level of 2.6m on the western boundary of the site rather than the 2.82m adopted for this aforementioned assessment). This criterion was used to assess medium flood risk category areas on the Site.

The level of 3.6 m AHD was compared to ground level spot levels within the Site. All areas were assessed for flood risk and the only area that was identified as medium risk based on available ground level data was in the same area as shown in **Figure 4-10** near the corner of Captain Cook Drive and Solander Street. A small area immediately near the intersection of Cook Street and Solander Street is also marginally below 3.6 m AHD and therefore in the medium risk category. As indicated previously, the product tank bunds in the medium risk area are all of a height well in excess of the nominated risk level.

4.2.3 Tsunamis

Tsunami risk profiles around the Australian coastline are represented by offshore tsunami hazard maps that have been prepared by Geosciences Australia, under its Probabilistic Tsunami Hazard Assessment (PTHA) program. This provides the likelihood and relative tsunami amplitude at the 100 m depth contour around the coastline. This work focuses on the hazard arising from the main source of tsunami risk; subduction zone earthquakes, but does not consider other lower probability and less predictable tsunami risk factors such as volcanoes, asteroids, submarine landslides or non-subduction zone earthquakes. While the tsunami hazard maps provide a relative offshore tsunami hazard around Australia, the maps are not intended to determine the inundation extent, run-up, damage or other onshore phenomena that may result from a tsunami event (but could be used as the basis to derive this).

The Tsunami hazard for the offshore area adjacent to Kurnell, derived from the PTHA maps, is presented in **Table 4-2**. The information in **Table 4-2,** derived from the PTHA maps, indicates the maximum tsunami amplitude which could be expected at an adjacent offshore location (100 m depth) in any given year for a stated probability or chance. As discussed previously, the extent to which the approximate tsunami amplitudes provided in **Table 4-2** may influence the Site has not specifically been assessed.

Table 4-2 Tsunami Hazard for the Offshore Region Adjacent to Kurnell

AEP	Average Recurrence Interval (Years)	Maximum Tsunami Amplitude (Meters)[1]
1%	100	0.20
0.2%	500	0.60
0.10%	1000	0.80
0.05%	2000	1.10
0.02%	5000	1.6

[1] Measured at 100 m depth contour

In order to more quantitatively assess the risk to the Site and potential impact arising from tsunamis, a detailed inundation model would be required for Botany Bay, including Quibray Bay, taking into account the detailed local bathymetry and topography. A detailed inundation model such as this would normally be prepared to consider the regional risk, rather than specifically focussed on an individual site.

Whilst specific information on inundation modelling for the Botany Bay area is not yet publically available, it is being undertaken (Garber, *et. al*., 2011). The NSW Office of Environment and Heritage in conjunction with the NSW State Emergency Service are conducting tsunami inundation modelling in five areas along the NSW coastline, including Botany Bay/Kurnell.

4.3 Impact Assessment

4.3.1 Operational Phase

The risk profile of the Project Area with respect to the ability to accommodate high rainfall events and/or broader flooding events would not change from that which currently exists.

4 Flood Risk

As indicated in **Section 4.2.2.2**, a small section of the north west of the Site is classified as medium flood risk, based on SSC criteria. This area has been subject to some localised flooding in recent times (as discussed in **Section 3.2.4**), in response to which Caltex has assessed, identified, and is in the process of implementing, a range of improvement measures, including:

- implementation of the Stormwater Management Plan (described in **Section 3.2.6**), which is in part specifically focussed on addressing flooding in this area;
- completion of a review of all electrical equipment, which has identified the need to increase the height of a substation and switchroom in the medium risk area; and
- modifications to the wastewater treatment system and infrastructure that would occur as a consequence of the refinery shutdown.

The SMP will improve the ability of the Site to handle stormwater and thus will reduce the risk of catchment flooding. The monitoring component of the SMP will inform a stormwater model, which in turn will provide the basis for identifying future stormwater management improvements, where required.It has also been identified in **Section 4.2.2.2**, that some further consideration of the flood risk along the north eastern boundary is required. The implementation of the SMP and further changes to the stormwater system following completion of the Project and following any future demolition or remediation works would result in changes to flood risk on the Site. As such, Caltex will reassess the flood risk during the remediation works to ensure that any future flood risks to the Site are understood and appropriately managed.

4.3.2 Climate Change

The NSW Government, *Floodplain Development Manual – the Management of Flood Liable Land* (Department of Infrastructure, Planning and Natural Resources, 2005) requires the consideration of climate change as part of all flood studies.

Sea Level Rise:

Sea level rise is a continuous rising of the water level of the oceans and estuaries. The NSW Sea Level Rise Policy Statement (NSW Government 2009) suggests that sea level may rise by 0.4m by 2050 and 0.90m by 2100. The tide levels will also rise accordingly, which will affect the natural processes responsible for shaping the coastline. The increased sea levels can heavily affect the capacities of the drainage systems discharging to seas and estuaries.

Tidal flooding is influenced by the height and timing of tides and tidal surges. Tidal surges are caused by regional weather conditions such as pressure systems, wind direction and speed and local bathymetry. The combination of tidal surge and high rainfall in a catchment would produce the worst flooding. However, this coincidence is considered to be unlikely.

Tidal locking from raised tailwater conditions can extend flooding risks well beyond the immediate areas of the estuaries causing tidal inundation by saltwater and reducing the ability of low lying areas to drain effectively. Flooding from the sea and tidal water can be more severe than flooding from water courses due to the hazards associated with potential flood velocities and depth.

4 Flood Risk

The *Kurnell Township Flood Study* (2009) conducted sensitivity analysis of the following climate change scenario:

Sea level rise:

- Low: +0.18m
- Medium: +0.55m
- High: +0.91m

Peak rainfall volume:

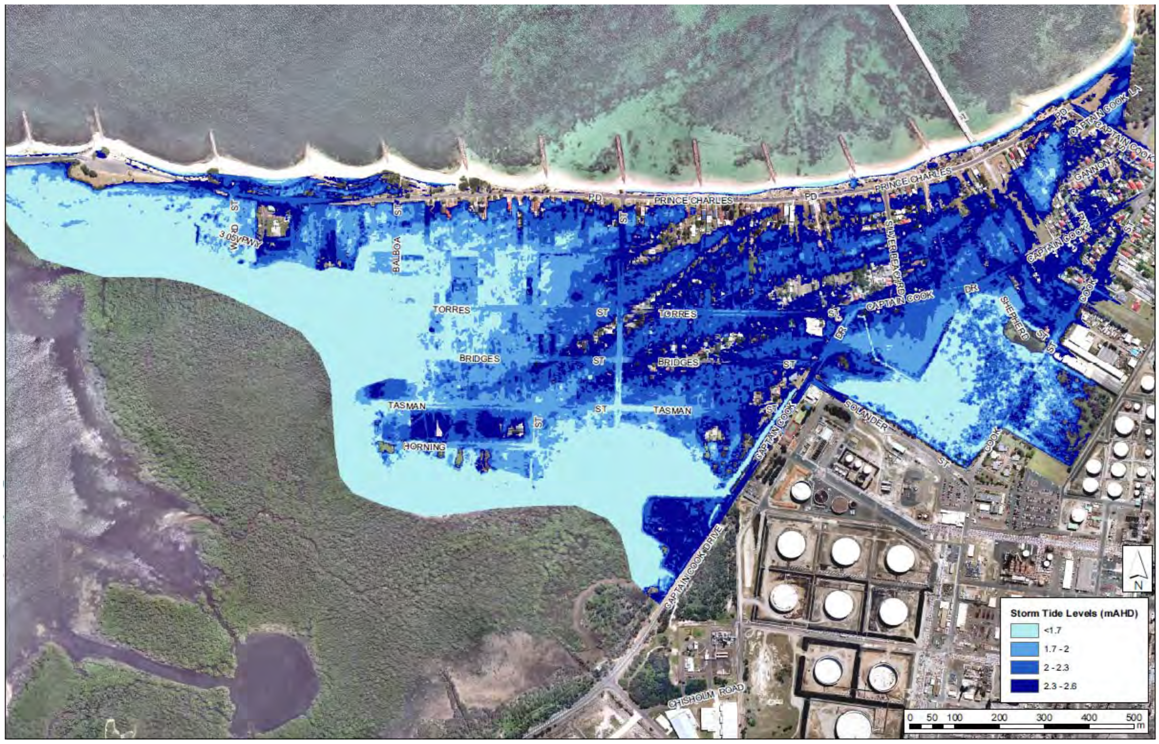
- Low: +10% rainfall
- Medium: +20% rainfall
- High: +30% rainfall

Twenty two (22) scenarios were considered for the assessment of potential impacts of climate change on sea level rise and catchment flooding (due to increase in rainfall intensity) independently, as well as the combined effects. The sensitivity of both 5% and 1% AEP events to climate change has been modelled to provide an indication of the magnitude of impacts for both smaller, more frequent flood events as well as major events.

The report concluded that the combination of an ocean flood event with sea level rise has the most significant impact on flooding in Kurnell. It was estimated that the flood levels may increase as much as 900 mm in areas close to Quibray Bay.

The potential storm tide extent is shown in **Figure 4-11**. This figure shows that it is likely that the dominant flooding mechanism in some areas of Kurnell may shift from catchment flooding to ocean flooding (WMAwater, 2009).

Figure 4-11 Potential Storm Tide Extents (WMAwater, 2009)



In addition, the influence of varying tailwater conditions on the design flood behaviour were also assessed for the 5% and 1% AEP design storm events, with a tailwater level of 0.6m. Then the sensitivity analyses were carried out for 5% and 1% AEP with a 1.7 mAHD (1% AEP tide) and a 2.0 mAHD (extreme tide); and 0.9 mAHD (high spring tide) and 1.7m AHD tailwater level respectively. It was concluded that the impact on flood levels is generally greater for the 20% AEP event, as tidal flooding becomes the main cause of flooding adjacent to Quibray Bay, while the flooding from rainfall is still a significant component for 1% AEP event (WMAwater, 2009). This assessment was not extended by WMAwater to within the Site boundary.

Climate change induced sea level rise could potentially lead to an increased flooding risk in the part of the Project Area adjacent to Captain Cook Drive that has already been identified as having an elevated flood risk. The Project would not make any changes to this area; however the Waste Water Treatment Plant (WWTP) that occupies this area would be modified after conversion to a terminal. This modification would address the changes in wastewater load and characteristics due to the conversion into a terminal (and considering the shutdoiwn of the refinery). Any changes, required to make this area and the infrastructure in it less susceptible to flooding, will be considered during the modification of the WWTP.

4.4 Summary

The studies conducted by Sutherland Shire Council indicated that the areas around the Site are susceptible to flooding from both rainfall and tidal inundation, and this would be exacerbated by climate induced sea level rise. The impacts of the assessed flood events on the Site were not directly assessed.

The Site is generally elevated above the surrounding low lying areas on the western and northern boundaries, and the onsite bunding around petroleum products storage areas effectively increases the flood height that would need to be present for any interaction between petroleum products and flood waters to occur.

The Project is not expected to change the flood risk profile in the Project Area nor would it change the ability to accommodate high rainfall events and/or broader flooding events from that which currently exists. Based on the studies conducted by the Sutherland Shire Council, the capacities of the Site drainage systems may be constrained by high tailwater conditions in particular.

The implementation of the SMP and further changes to the stormwater system following completion of the Project and following any future demolition or remediation works would result in changes to flood risk on the Site. As such, Caltex will reassess the flood risk during the remediation works to ensure that any future flood risks to the Site are understood and appropriately managed.

Water Supply and Usage

5.1 Introduction

This section presents an assessment of the water supply and usage at the Site. The assessment provides:

- descriptions of the existing water supply and usage; and
- an assessment of the water supply and usage impacts, with reference to modifications of the existing operation to convert it to a working finished product terminal.

5.2 Existing Environment

5.2.1 Water Supply

Currently the Site's potable water is supplied by Sydney Water from the Cronulla Main.

5.2.2 Water Licensing and Sharing Plans

The Site currently only sources water from the Sydney Water municipal supply, and so is not subject of any water licensing requirements or other approvals under the *Water Act 1912* and/or the *Water Management Act 2000*, including any obligations associated with a Water Sharing Plan.

5.2.3 Water Usage

The current Site consumes approximately 6 ML of potable water per day for operations and 1 ML per day for amenities. The recent usage for both for Caltex Refinery (NSW) (CRN) and Caltex Lubricating Oil Refinery (CLOR) are shown in **Table 5-1** below.

Table 5-1 CRN/CLOR Portable Water Usage (excluding Firewater), 2010/11

Month	Caltex Refinery NSW (kL)	Caltex Lubricating Oils Refinery (kL)	Total
May-10	170,538	5,240	175,778
Jun-10	168,167	7,431	175,598
Jul-10	193,760	10,244	204,004
Aug-10	167,593	7,774	175,367
Sep-10	167,593	10,840	178,433
Oct-10	170,493	0	170,493
Nov-10	211,516	12,341	223,857
Dec-10	95,022	5,556	100,578
Jan-11	230,571	8,159	238,730
Feb-11	168,303	14,570	182,873
Mar-11	194,933	20,353	215,286
Apr-11	173,664	11,206	184,870
Total	2,112,152	113,714	2,225,866
Average daily use	5787 kL/d	311 kL/d	6098 kL/d

Domestic

Potable water is utilised for a range of domestic and commercial type uses on the Site, including:

- toilet flushing;
- hand basins;
- change-room showers;
- lunchroom and kitchen sinks;
- café/canteen; and
- drinking water.

Process

Industrial water demands represent the majority of the overall Site water demand. Most of the water is consumed in the refinery operations, including the following units:

- Plant 6 LPG loading;
- Plant 7 (MMT and Dye Plant);
- N_2 Plant;
- Power Plant;
- Propane De-asphalting Unit (PDU);
- Merox;
- Crude Distillation Unit (CDU); and
- Naphtha sweetening.

Other process area usage includes:

- safety shower;
- eyewash;
- laboratory sink and fume cupboard;
- wash pads;
- firewater; and
- utility station.

If required, with Sydney Water permission, potable water can also be used in the emergency power generator.

5.3 Impact Assessment

5.3.1 Construction Phase

Water supply would be required during the construction phase for a range of uses including:

- construction use, e.g. dust suppression;
- tank cleaning; and
- general workforce amenities.

This water would be potable water supplied by Sydney Water. Existing supply infrastructure would be utilised. The overall Site water demand during the construction period would not be expected to exceed that of current Site usage.

5.3.2 Operational Phase

The finished product terminal would have a significantly lower overall potable water usage than the current Site, as the main processes that utilised potable water would cease operation.

Potable water will continue to be supplied from municipal supply by Sydney Water and therefore no licensing requirements or other approvals under the *Water Act 1912* and/or the *Water Management Act 2000*, including any obligations associated with a Water Sharing Plan, will apply.

The workforce would also decrease from approximately 950 to 100, so the domestic type potable water use would decrease proportionately.

Following the shutdown of the refinery operations, approximately 90% of the portable water consumption would be removed.

The existing potable water distribution infrastructure on the Site would be left largely intact, and significant modifications in the Project area are not anticipated.

5.3.3 Water Reduction and Reuse

Potable water consumption, as discussed in **Section 5.3.2**, will reduce on the Site by approximately 90%.

Options to reduce water consumption through the implementation of efficiency measures, such as usage avoidance, reuse and recycling, have been considered, however to date limited opportunities have been identified. No water efficiency measures have currently been identified to be implemented under the Project. Potential water efficiency measures will continue to be considered during the further design stages of the Project, and if viable, will be implemented.

5.4 Summary

Following the shutdown of the refinery operations and reduction of the workforce, the long term water demand at the Site, is expected to reduce the overall potable water consumption by approximately 90%.

Oily Water Generation and Management

6.1 Introduction

This section presents an overview of the oily water generation and management at the Site, including a description of the existing Oily Water Management System (OWMS) outlining the:

- existing oily water source and quality;
- wastewater treatment; and
- discharge locations and criteria.

The oily water management system for the operation of the Project has yet to be finalised. There will be a significant reduction in the oily water load at the Site arising from the shut-down of the refinery, which will be a major influence the ultimate oily water management arrangements, but is outside the scope of this assessment. Caltex has reached an “in principal” agreement with NSW EPA that, in consultation with the EPA, a PRP condition would be developed and included in the terminal EPL, that would apply when the terminal is operational. The process agreed with the EPA would:

- characterise the terminal wastewater stream;
- identify and assess terminal wastewater management options;
- recommend preferred options; and
- confirm applicable EPL conditions, including those related to discharge points, quality and monitoring.

6.2 Existing Environment

6.2.1 Background

The Site’s OWMS (also referred to as the oily water sewer system) collects process effluent and stormwater from areas of the Site where there is potential for interaction of water streams with petroleum products. Oily water is collected in the Site’s oily water sewer system and is transferred to the wastewater treatment plant. Treated effluent is discharged to the Tasman Sea via the Yena Gap outfall under conditions of the Site EPL.

6.2.2 Wastewater Sources

Sources of oily water discharged to the OWMS include the following:

- stormwater runoff within tank bund areas, near process units and pump slabs;
- any fuel released from any of the storage tanks or their associated piping which is contained within the bunded area surrounding the tank;
- any firewater used in combating a fire which is contained in the bunded areas;
- hydrocarbon contaminated groundwater from groundwater remediation system;
- landfarm;
- tank dewatering;
- tank washing
- ballast water;
- pipeline wash water;
- slops from Banksmeadow;
- equipment wash pads; and
- stormwater that collects in the former CLOR oily water sewer system.

Oily water generated within bund areas is drained to the Site oily water sewer via a manual drain valve. These valves are closed under normal operating conditions, thereby retaining any released fuel and impacted water within the bunded area. Oily water accumulated within the bunded area is released in a controlled manner to the OWMS, in accordance with Site standard procedures.

6.2.3 Wastewater Treatment Plant

Oily water is treated in the Site's oily water Waste Water Treatment Plant (WWTP), which includes a biotreater process.

Capacity and Feed Wastewater

The nominal operational maximum treatment capacity for the biotreator WWTP is 14,400 kL/day, with a supplementary wastewater treatment system that has a capacity of approximately 24,000 kL/day (including all treatment steps except biotreater). However, the operational maximum treatment capacity may change depending on the number of healthy organisms in the biotreator WWTP.

Treatment Process

The Site WWTP utilises physical, chemical and biological treatment to treat the oily water. The main processes applied in the WWTP are:

- equalisation in the retention/surge tank and equalisation tank:
- aerobic biological treatment; and
- clarification (i.e. sedimentation).

Some chemicals may be applied in the process to assist in treatment, such as of coagulants to aid settling, and alkali reagents for neutralisation (caustic dosing).

Oily water discharged to the OWMS is sent to the WWTP for treatment by the biotreater, or alternatively is transferred to a diversion or equalisation tank for storage and treatment in the biotreater at a later time.

The biotreater WWTP also has a biotreator bypass system. Bypass of the WWTP can occur only when excess wastewater resulting from stormwater falling on the Site within the oily water sewer catchment cannot be treated by the WWTP due to plant maintenance or operating problems. The objective is to ensure that the WWTP is operating at full capacity before wastewater is diverted to the supplementary wastewater treatment system, which comprises oil-water separators and an induced air flotation (IAF) system.

Under the current EPL conditions, all wastewater must be treated using the biotreater WWTP or the oil-water separators/IAF system prior to discharge at Yena Gap, and the main WWTP can only be bypassed to the supplementary oil-water separator/IAF system when:

- the influent flow rate exceeds the biotreator operational maximum treatment capacity and both the effluent diversion tank and the equalisation tank are more than 85% full;
- the transfer capacity of the diversion pumps and the equalisation tank feed pumps are insufficient to deal with the wastewater flow;
- the biotreator WWTP is offline for essential maintenance; or
- an assessment of the pump capacity of the bypass pumps is being conducted to check maximum pump capacities and equipment availability.

6 Oily Water Generation and Management

Whenever wastewater bypasses the biotreater WWTP and is discharged at Yena Gap, the flow rate through the biotreater WWTP must be maintained at its maximum treatment capacity, unless the biotreater WWTP is off-line for essential maintenance. Any reduction in flow rate must be recorded and reported to the EPA within 7 days.

6.2.4 Treated Wastewater Discharge

Yena Gap Outfall

Treated effluent from the WWTP is discharged to the Tasman Sea via the Yena Gap outfall.

The Yena Gap is shown on **Figure A-2 (Appendix A)**. The outfall consists of approximately 2.4 km of 600 mm diameter cement lined steel pipe. The diffuser outlet is located approximately 100 m offshore, at a water depth of about 6 m.

The Site EPL requires that treated wastewater discharge quality monitoring be conducted at Point 27 to determine compliance with concentration limits specified for discharge Point 2. The discharge limit for Point 2, and monitoring frequency and sampling method for Point 27, as outlined in the EPL as well as the Annual Return Report for Yena Gap for period 2010 – 2011 and 2011 – 2012, is presented in **Table C-2** and **Table D-1** in **Appendix C** and **Appendix D** of this report, respectively.

Tabbigai Gap Outfall

The Tabbigai Gap outfall was used to discharge the treated effluent outfall from the former CLOR. Therefore as the CLOR has been shut down and decommissioned, the Tabbigai Gap outfall has also been decommissioned.

6.3 Impact Assessment

6.3.1 Sources and Load

As part of the Project, no significant changes have been proposed for the OWMS in the Project Area. The OWMS in the existing process plants would be kept in service throughout the Project, and stormwater runoff from the bunded areas would continue to be routed to WWTP.

Tank bunded areas and tank water drains would remain largely unchanged and flow from these areas would continue to be treated in the WWTP. The Site would continue to handle ballast and pipe wash water, though the quantities may vary from those currently handled.

6.3.2 Treatment

Following the shutdown of the refinery, it is envisaged that the overall oily water volume and contaminant load would reduce substantially.

Due to significant reduction of wastewater volume and contaminant load, the existing WWTP would need to be reassessed to determine the potential for related changes in efficiency and performance. Caltex and the EPA have initiated discussions on this issue, and have an ‘in principal’ agreement with the following approach:

- the existing WWTP would be retained for treatment of oily water for the construction of the Project and the beginning phases of the operation of the Project. It would be operated under the current EPL conditions;
- in consultation with the EPA, a PRP condition, would be developed and included in the terminal EPL, and it would:
  - apply when the terminal is operational,
  - characterise the terminal wastewater streams,
  - identify and assess terminal wastewater management options,
  - recommend preferred options, and
  - confirm applicable EPL conditions, including those related to discharge points, quality and monitoring; and
- continue consultation with the EPA.

6.3.3 Disposal

The treated wastewater effluent would continue to discharge to Yena Gap in accordance with the current EPL conditions. These conditions may be revised following the process outlined in **Section 6.3.2**.

6.4 Summary

The Site's OWMS collects process effluent and stormwater from areas of the Site where there is potential interaction with petroleum products. This is then transferred to the WWTP. Treated effluent is discharged to the Tasman Sea via the Yena Gap outfall under conditions of the Site's EPL.

The oily water characteristics and load arising from the Project Area once the Project is operational would not differ significantly from that currently generated from the same area.

There would be a significant impact on the overall oily water sewer system from the shutdown of the Refinery. The overall volume and contaminant load would reduce significantly, but this is yet to be quantified.

Caltex and the EPA have initiated discussion on this issue, and have an 'in principal' agreement outlined in **Section 6.3.2**, to manage the WWTP under the existing EPL, whilst developing an appropriate PRP for oily water management for terminal operations.

Cooling Water System

7.1 Introduction

This section presents an assessment of the cooling water system at the Site. The assessment provides:

- descriptions of the existing cooling water system; and
- assessment of the cooling water system, with reference to modifications of the existing operation on Site to convert it to a working finished product terminal.

7.2 Existing Environment

7.2.1 Background

The Site's cooling water system, incorporating the intermediate sewer system, is used for the removal of excess heat in condensers and coolers. The cooling water system is also used as a source of water for fire-fighting.

7.2.2 Cooling Water Source

The Site's cooling water system utilises seawater which is pumped from Botany Bay by any of the five (5) electric driven pumps located at the pumphouse on the Kurnell Wharf. This seawater is pumped to two saltwater tanks. The tanks are equipped with remote level indication and level alarms and provision for local and remote starting and stopping of the pumps as required.

The Site's existing EPL conditions requires total volume monitoring be conducted at Point 33. The volumetric flowrate monitoring frequency and sampling method adopted as outlined in the EPL is presented in **Table C-1** in **Appendix C**.

The total volume of seawater taken from Botany Bay which was used in the cooling water system, as reported in the Annual Return Report for period 2010-2011 and 2011-2012, is presented in **Table 7-1**. Results for both return periods indicate that the cooling water total volume is below the allowable limit of 400 ML/d discharged at identification point 1.

Table 7-1 Cooling Water Total Volume Monitoring Annual Return Report for 2010 to 2012 (Point 33)

Reporting Year Identification Point	Unit	2010 – 2011			2011 – 2012		
		Lowest Result	Mean Result	Highest Result	Lowest Result	Mean Result	Highest Result
33	ML/day	154.7	266.9	307.8	217.4	266.9[1]	307.8

[1] Median result

7.2.3 System Protection and Distribution

A screen system is installed on the suction side of the pumps to minimise the amount of foreign matter and marine growth entering the saltwater system, preventing the plugging of pipes, coolers and condenser tubes, and to prevent injuring any marine life. Chlorine (gas), an oxidising biocide, is injected into the cooling water at the wharf to minimise the growth of fouling organisms. The cooling water system has no active de-chlorination process, but relies on the degradation of free chlorine by natural biochemical and chemical degradation processes within the system.

The cooling water flows from Tank 1 and 2 by gravity, by means of pipeways and independent take-offs, to most refinery process units.

It is notable that there is no usage of cooling water in the eastern or western tank areas.

7.2.4 Cooling Water Discharge

Cooling water is discharged into Botany Bay at Silver Beach via an outfall pipeline on the western side of the Kurnell Wharf. The cooling water outfall pipeline travels from the WWTP and travels along an easement, passing through the Kurnell Village.

Cooling water leaving the refinery process units is separated into two streams – clean and intermediate cooling water effluent, depending on its potential to contain product in the event of a leak or other upset, e.g. manual diversion of impacted stormwater to the intermediate sewer in Catchment B.

The clean cooling water effluent coming from the light end condenser, power plant and Fluid Catalytic Cracker Unit (FCCU) surface condensers discharges directly into the Botany Bay outfall.

Remaining cooling water streams are classified as intermediate effluents. These streams are sent to the intermediate oil/water separators for treatment before discharging to the same location as the clean cooling water outfall.

The Site's EPL requires that cooling water discharge quality monitoring is conducted at Point 26. The pollutant and monitoring frequency and sampling method adopted as outlined in the EPL is presented in **Table C-1** in **Appendix C**.

The discharge quality at point 26, as reported in the Annual Return Report for period 2010-2011 and 2011-2012, is presented in **Table 7-2**. Results for both return periods indicate that the cooling water discharge quality at identification point 1 is below the respective EPL concentration limits for chlorine residual (0.5 mg/L 100 percentile limit and 0.2 mg/L 50 percentile limit) and temperature (42 ^{o}C).

Table 7-2 Cooling Water Discharge Quality Annual Return Report for 2010-2012 (Point 26)

Reporting Year	Unit	2010 – 2011			2011 – 2012		
		Lowest Result	Mean Result	Highest Result	Lowest Result	Mean Result	Highest Result
Chlorine (free residual)	mg/L	<0.1	<0.1	0.2	<0.1	<0.1	0.1
Temperature	°C	24	33	39	24	32	38

Environmental sampling, to investigate the impact of cooling water effluent discharge on the fauna surrounding the seabed, was conducted in 1991. An assessment of the ecological risks posed by cooling water discharge into Botany Bay was conducted in 2000.

In the study conducted in 1991, sampling was performed at three locations – east of the opening of the cooling water outfall pipe, and at two control locations approximately 500 m from the shore, 900 m and 200 m west of the Site respectively. The fauna of sandy soft sediments along the southern side of the Botany Bay was diverse and reasonably abundant.

Quantitative sampling conducted at variety of spatial scales showed no pattern of difference in abundances of major in faunal taxa between the three studied locations (Underwood et al., 1991). The study concluded that the impacts from the cooling water discharge (if any), was small, or had no biological significance.

In the study conducted in 2000, a risk assessment based on a conceptual model was developed to identify key components of the ecosystem potentially at risk due to cooling water discharge effluents. The study concluded that the discharge of cooling water is unlikely to pose an unacceptable risk to the Botany Bay ecosystem, although it recommended some further investigations (URS, 2000).

7.3 Impact Assessment

With the closure of the refining operation at the Site, the cooling water system used for the purpose of removing heat generated from the refinery process would cease operation. Consequently the daily cooling water pumping and effluent discharge to Botany Bay would also cease. This would eliminate any environmental impacts on the receiving environment due to discharge of cooling water effluent, which previous assessments had concluded were not significant. The infrastructure involved in the cooling water system would remain in place, so no impacts related to construction would be expected.

7.4 Summary

There is no use of cooling water in the Project Area. With the closure of the refining operations, the daily cooling water pumping and effluent discharge to Botany Bay would cease.

This would remove any insignificant environmental impacts that may occur at present.

Domestic Wastewater

8.1 Introduction

This section presents an assessment of the domestic wastewater management at the Site. The assessment provides:

- descriptions of the existing domestic wastewater treatment; and
- an assessment of the domestic wastewater quantity and quality impacts, with reference to modifications of the existing operation on Site to convert it to a working finished product terminal.

8.2 Existing Environment

Sources of Domestic Wastewater

Domestic wastewater, also referred to as sewage, sanitary effluent, and septic effluent, comprising grey and black water wastewater streams, is generally derived from toilets and showers and other domestic water uses described in **Section 5.2**.

Currently the Site domestic wastewater is generated from the following areas:

- Yard Offie South;
- 45 East Control Room;
- Plant 36 Control Room;
- Area 2 Workshop
- 45 West Control Room;
- Plant 5 Control Room;
- Central Control Building;
- Main Workshop;
- OMC;
- Office opposite OMC;
- Plant 33 and Yard Toilet;
- Yard Office North/Technical Service/Training;
- Area 1 Workshop;
- Plant 34 Control Room;
- Cafeteria Floor Waste;
- Storehouse;
- Power Plant;
- Power Plant Shutdown Hut;
- Reliability;
- Storehouse South;
- Cafeteria;
- Laboratory;
- LPG Driver Loading Area;
- Main Change House;
- Main Office;
- Housing Area;
- Separators Control Room;
- Tennis/Recreational Club

Septic Effluent Quantity

The discharge volume of sewage is not normally metered or otherwise measured. Its volume was last estimated in 2001, as reported in the Septic Effluent Study conducted for the Site under EPL Condition *PRP U6 Septic Effluent Study*. The total annual domestic wastewater load in 2001 was about 52 ML (determined over the month of November 2001 and extrapolated to approximate annual contributions). At that time, domestic wastewater was discharged from the Site via the Yena Gap and Tabbigai Gap outfalls (26.3 ML/a and 25.5 ML/a respectively).

Since then, the Site has redirected domestic wastewater from the outfalls to the Sydney Water sewerage system. The load would have reduced significantly since 2001, as the CLOR is no longer operational and Site staff numbers have reduced.

Domestic Wastewater Quality

Domestic wastewater quality is not routinely monitored. The most recent assessment of quality, conducted in 2001 as part of the Septic Effluent Study, did not indicate variation from typical domestic wastewater quality.

8.2.1 System Description

The Site domestic wastewater system generally consists of a sewage collection tank at generation locations. Each tank is fitted with a duty and standby sewage pump. The sewage tanks are equipped with level switches (Level switch High (LSH) and Level Switch High-High (LSHH)) to detect the level of sewage present. When the sewage level rises to a predetermined level, the pump is initiated to lift the sewage through a rising main from where the sewage is discharged into the Sydney Water Vacuum Pit.

8.2.2 Destination

Prior to 2004/05, the Site domestic wastewater was discharged to the ocean at the Yena Gap and Tabbigai Gap, via two effluent lines. However, as a result of the Septic Effluent Study, which concluded that the disposal of domestic wastewater to Yena Gap and Tabbigai Gap had the potential to reduce recreational and aquatic ecosystem amenity, the Site domestic wastewater was diverted to the Sydney Water's sewerage system for treatment at the Cronulla Treatment Plant.

8.3 Impact Assessment

The Project would utilise the existing domestic wastewater infrastructure. The amount of sewage generated, however, is expected to decrease significantly following the shutdown of the refinery operations. This decrease is likely to be approximately in proportion to the reduction in the workforce, i.e. approximately 950 to 100 employees.

8.4 Summary

There will be no significant changes to domestic wastewater management in the Project Area arising from the Project. It will continue to be pumped to the Sydney Water sewerage system for treatment at the Cronulla Treatment Plant. The overall Site load however will significantly reduce.

Fire Water System

9.1 Introduction

This section presents an assessment of the fire water system at the Site. The assessment provides:

- descriptions of the existing fire water system; and
- an assessment of the existing fire water suitability and requirements, with reference to modifications of the existing operation to convert it to a working finished product terminal.

9.2 Existing Environment

The Site has a comprehensive fire protection system, which (amongst many other features) includes an extensive fire water ring main and fire hydrant system. Fire water is delivered via six (6) 12,000 L/min firewater pumps located at the two (2) pumphouses. One of the firewater pumps is electronically driven, while the remaining five (5) are driven by diesel. Two (2) water storage tanks at capacity of 8 ML each are available from the north and south (R4Risk, 2012).

The Site's firewater is supplied by both municipal potable water and seawater drawn from the cooling water system. Firewater usage (municipal water) estimate from the Power Plant Meters for period May 2010 to April 2011 is presented in **Table 9-1**. Potable water is the primary supply with seawater available as backup water supply.

Table 9-1 Firewater Usage for Period May 2010 to April 2011 (estimated from the Power Plant Meters)

Month	Monthly Usage (kL)
May-10	9,923
Jun-10	7,994
Jul-10	5,159
Aug-10	6,545
Sep-10	4,255
Oct-10	5,624
Nov-10	6,000
Dec-10	4,248
Jan-11	29,588
Feb-11	19,407
Mar-11	20,595
Apr-11	7,437
Total	126,775

Firewater usage on Site represents approximately 6% of the potable water that is currently used for process and domestic purposes (refer to **Table 5-1** in **Section 5.2**). This usage is not normally for actual fire incidents, rather it is the consumption associated with pump, hydrant, monitor and other system testing that is regularly conducted, as well as fire training conducted on the fire training ground and elsewhere on the Site.

Any firewater used in combating a fire would be managed in a manner similar to that used for management of oily water, where contaminated firewater is contained in the bunded area before being drained to the oily water sewer system via manual valve actuation in accordance with standard oily water management system procedure currently adopted on the Site.

9.3 Impact Assessment

As discussed earlier, when the refinery is shutdown, the seawater cooling water system would be retired. Consequently, seawater which is currently available as back-up fire water supply would no longer be available. The Site's fire water supply would be sourced from potable water supply only.

Maximum firewater demand and storage was determined by R4Risk (2012) as part of the Fire Safety Study (FSS). The study was conducted by R4Risk to provide assessment of the suitability of the existing fire systems to manage fire hazards associated with the planned change of service.

Maximum firewater demand and storage from the maximum firewater demand for a full-surface tank fire was estimated based on the following:

- cooling water to protect surrounding tanks exposed to heat radiation from tank on fire;
- cooling water for the tank on fire;
- water for foam applied to the tank on fire;
- supplementary hydrant streams; and
- water for supplementary foam hose streams.

A maximum firewater demand case was identified and assessed assuming a full-surface tank fire, to allow estimation of the maximum fire water storage volume to be maintained. The components are listed in **Table 9-2**.

Table 9-2 Maximum Firewater Demand and Storage Requirement

Application	Water Requirement (L/min)	Volume Required (kL)
Cooling water for adjacent tanks	9,706	8,74
Cooling water for the tank on fire	11,874	1,069
Water for foam applied to the tank on fire	11,609	348
Supplementary hydrant streams	1,800	162
Water for supplementary foam hose streams	550	17
Total	35,539	2,469

The assessment indicated the 16 ML firewater storage available onsite significantly exceeds the maximum firewater storage requirement. The performance of the current firewater system has been deemed adequate to satisfy demand under the proposed Project (R4Risk, 2012).

The fire water requirement for fire equipment testing, however, has not been estimated. Nonetheless, the requirement is expected to be less than is currently required (347 kL/d), as usage for refinery equipment would be no longer required.

9.4 Summary

The existing fire water system would be used in the Project Area. The available fire water storage capacity has been identified as being more than adequate to support the proposed Project. The cooling water system seawater would no longer be available as back-up fire water supply following the shutdown of the refinery, and the Project would be supplied by potable water only. The fire water system potable water usage has not been estimated but would be a reduction on the current usage of about 350 kL/d.

9 Fire Water System

When the refinery is shutdown, modifications to the fire water system would occur to isolate redundant parts of the system associated with the refinery. As part of this assessment, consideration may also be given to modifying fire water storage arrangements, as there is currently 2 x 8 ML fire water supply available for a 2.5 ML volume requirement for the Project. The individual tank fire protection systems would be reviewed, and upgraded as required, e.g. on jet fuel tanks.

Loss Control

10.1 Introduction

There is existing infrastructure and a number of systems and procedures in place at the Site that would largely continue to be utilised as part of the operation of the Project. These include systems for the prevention and management of loss of containment of petroleum hydrocarbons and other potential contaminates to manage impacts on surface waters.

10.2 Tank Design and Bunding

10.2.1 Introduction

The primary and secondary containment systems to prevent loss of petroleum products for the Project are the tanks and their bunds. The Project would comprise tank areas that are currently the eastern and western tank areas of the Site. As described in **Chapter 4 Project Description** of the EIS (Section 4.2), a number of the tanks would be refurbished, and others would change service.

10.2.2 Tanks

Caltex has a programme focussed on the maintenance of integrity of its primary containment systems i.e. bulk storage tanks, and prevention of loss of containment from these tanks and associated transfer systems.

A number of tanks would be refurbished as part of the Project (refer to **Chapter 4 Project Description** Section 4.2.2. of the EIS). All tanks that would be refurbished would incorporate a number of features related to best practice integrity management, including:

- repair or replacement of tank floors, as appropriate;
- tanks that are rebuilt during the Project and in the future would incorporate an underfloor liner;
- independent high and high-high tank level alarms (where not already present);
- installation of internal floating roofs (with air scoops, hinged covers and stainless mesh screens) and an external dome on refurbished flammable liquids tanks. This arrangement protects the contents from external contaminants, e.g. water, and ensures safer operation;
- improvements to water draw-off system on some tanks;
- internal painting of the entire floor and all or the lower part of the shell (depending upon the service);
- painting of the external side of tanks as required; and installation of fast flush systems on jet fuel tanks; and
- internal cleaning and inspection of all tanks nominated for change of service.

All tanks would be subject to continuation of Caltex's existing comprehensive inspection, maintenance and repair program. This applies to all Site infrastructure, not just the tanks.

10.2.3 Tank and Bund Floors

Some of the bunds present within the existing Site are earthen with bitumen or shotcrete lined bund walls. Caltex is currently undertaking a review of the condition and capacity of the tank bunds in the Project Area. Caltex has committed that the bunding capacity for tanks retained in service would comply with the requirements of AS1940*:* The Storage and Handling of Flammable and Combustible Liquids, including in relation to stormwater and firewater storage capacity. In addition, some additional improvements to monitoring would be initiated to ensure that if a loss of containment into a bund occurs it is detected, early and contingency actions can be taken promptly.

The measures for tanks containing low flash materials[2] include:

- explosive vapour detectors within the bunds;
- triple infrared scanners on tank roofs; and
- CCTV in conjunction with infrared cameras as a confirmation for alarms.

All tanks on-site would be subject to:

- an automated high level shut off system[3]; and
- continuance of a comprehensive inspection/repair program.

Caltex's focus during the construction and operation of the Project would be on inspections, maintenance and spill prevention within the tank and tank bund areas. Extensive spill prevention measures would continue to be incorporated into the operation of the Project as outlined above.

Any tank floors that are rebuilt during the Project and during the ongoing operation of the terminal would incorporate an underfloor tank liner.

10.3 Spill Management

The primary loss control strategy to be adopted by Caltex for the Project can be summarised as follows:

- primary focus on ensuring that a spill does not occur from the primary containment systems (i.e. tank and transfer systems);
- if a spill occurs it is detected quickly and responded to rapidly;
- it is contained in normally isolated adequately sized bunds; and
- supplementary capacity and tertiary containment systems are available outside of the bunds in the oily water sewer and stormwater management systems.

In the reasonably unlikely event of a significant spill, the Site has significant contingency arrangements. Initially it would be contained in the bunds. The bunds are dewatered or drained of product in accordance with well-established and rigorous bund operating, contingency and response procedures. The normal drainage route is to the oily water system. The oily water system has WWTP diverting capability and supplementary containment capacity to contain spilt product.

[2] The flash point of a chemical is the lowest temperature where it will evaporate enough fluid to form a combustible concentration of gas. The flash point is an indication of how easy a chemical may burn.
[3] This includes multiple high level detection instruments wired to an automatic valve which closes the tank inlet after a defined fill height has been reached.

Any firewater used in response to an incident would similarly managed, where impacted firewater would be contained in the bunded area before being manually drained to the oily water treatment system in accordance with standard Site procedures.

In the event that a significant loss of containment occurs and product escapes a bund, or is released in, or enters a pipeway, the spill can still potentially be contained and stormwater treated. In effect, the stormwater system storage capacity (along with the aforementioned storage capacity within the oily water system) represents tertiary containment capacity. The stormwater systems within Catchments A and B (within which the Project Area is located) have the following important features:

- the pipeways are isolatable, allowing spill containment and providing additional storage capacity;
- they have manually operated skimmer pumps for product removal to the oily water system;
- each catchment has a syphon system and API oil/water separator to control discharge stormwater rate and quality; and
- Catchment B has the Quibray Bay Stormwater Retention Basin and overflow capacity, providing additional storage.

10.4 Conclusions

The Project would result in an overall improvement in the integrity of tanks within the Project Area. This would be achieved primarily through an upgrade program for refurbished and re-serviced tanks to be implemented as part of the Project.

A review of the bund condition and capacity is being undertaken, and all tank bunds within the Site would meet the capacity requirements of AS1940.

Additional spill detection measures would be installed in the bunds as part of the Project.

All tanks and bunds would be subject to continuation of Caltex's existing comprehensive inspection, maintenance and repair program (applicable to Site infrastructure, not just the tanks).

The existing supplementary capacity and control systems present within the existing oily water sewer and stormwater systems would be maintained as part of the ongoing operation of the Site.

The primary loss control strategy to be continued by Caltex for the Project can be summarised as follows:

- primary focus on ensuring that a spill does not occur from the primary containment systems (i.e. tank and transfer systems;
- if a spill occurs it is detected quickly and responded to rapidly;
- it is contained in normally isolated adequately sized bunds; and
- supplementary capacity and tertiary containment systems are available outside of the bunds in the oily water sewer and stormwater management systems.

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Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Caltex Australia Limited and only those third parties who have been authorised in writing by URS to rely on this Report.

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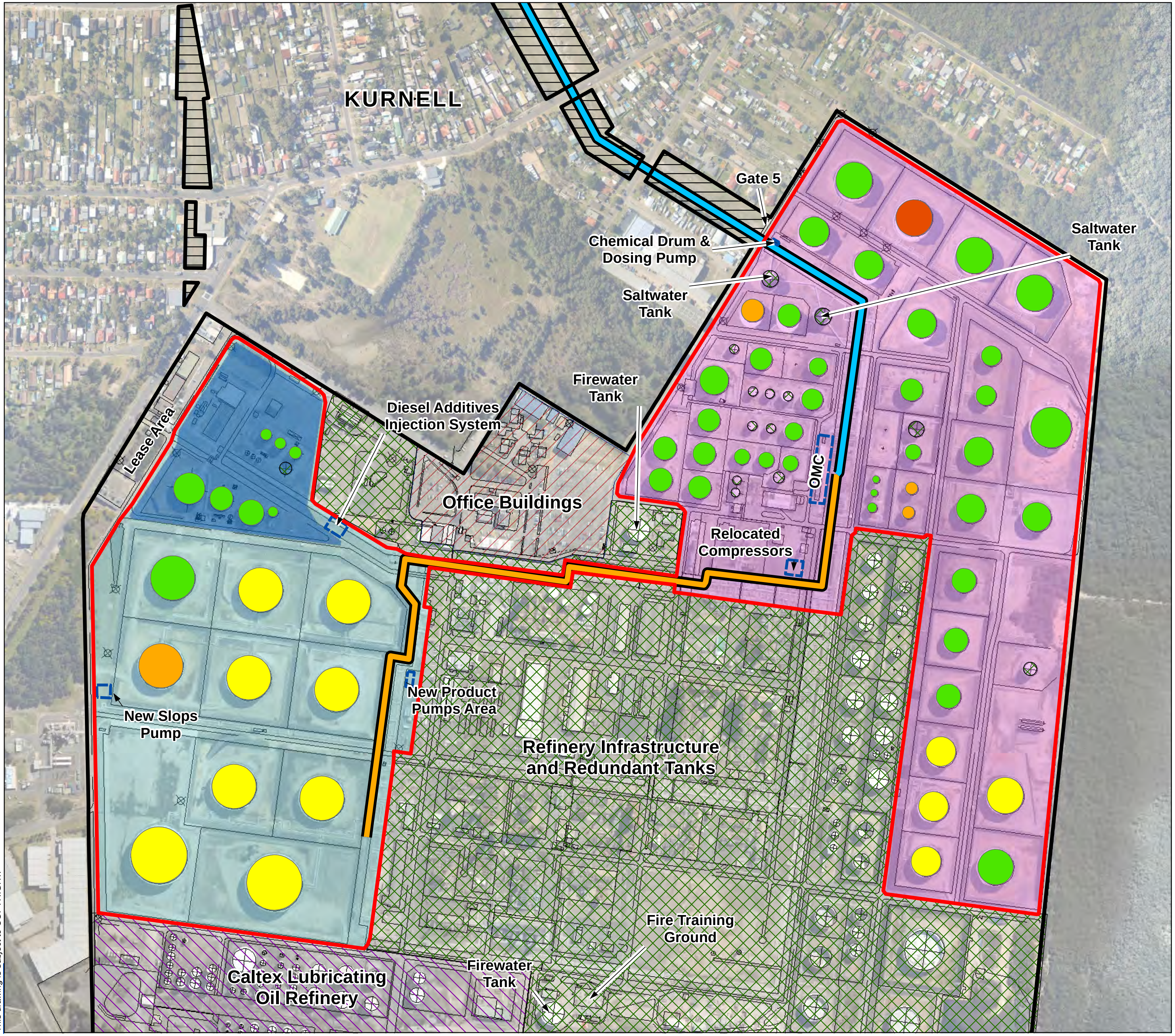
Appendix A List of Figures



Legend

- The Site
- Project Area
- New Infrastructure

Pipeline

- Pipeline Easement 1
- Pipeline Easement 2

Tank Conversion

- Conversion Required
- No Works Required
- Change of Service
- Restore in Kind

Tank Areas

- Eastern Tanks Area
- Western Tanks Area
- Office Buildings
- Refinery Infrastructure and Redundant Tanks
- Caltex Lubricating Oil Refinery (CLOR)
- Pipeline Right of Way
- Waste Water Treatment Plant (WWTP)

N E S W

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

0 50 100 200 Meters

Source: Aerial Imagery - Nearmap Hypertiles 2012

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FILE NO: 43177836.025

DRAWN: STB APPROVED: RO DATE: 25/02/2013

CALTEX (REFINERIES) NSW PTY LTD

KURNELL REFINERY CONVERSION

SITE LAYOUT AND PROPOSED WORKS

URS Figure: **A-1**
Rev. **A** A4

Legend

- Captain Cook Drive
- Minor Roads
- The Site
- Towra Point Aquatic Reserve ^
- National Park
- Towra Point Nature Reserve

N / W / E / S

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

0 250 500 1,000 Meters

Source: Aerial Imagery from Bing Maps © 2010 Microsoft Corporation and its data suppliers.
^ Office of Environment and Heritage (OEH)
Map compiled using MapInfo StreetPro data. © 2011 MapInfo Australia Pty Ltd and PSMA Australia Ltd.

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FILE NO: 43177836.013

DRAWN: STB APPROVED: RO DATE: 12/02/2013

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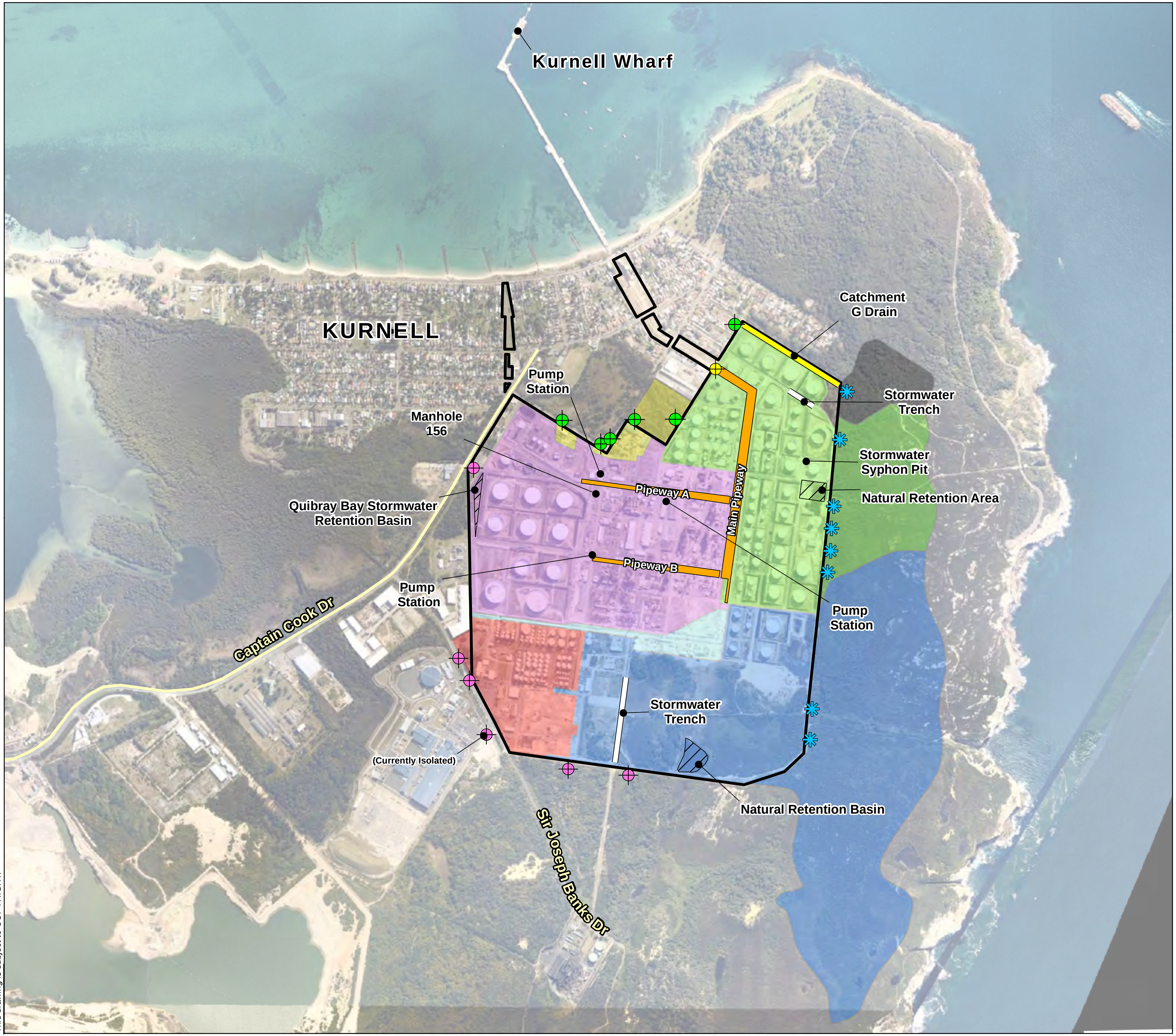
KURNELL REFINERY CONVERSION

SITE SETTING AND SURROUNDING ENVIRONMENT

URS Figure: A-2
Rev. A A4



Legend

The Site
Pipeway
Inflow Pt
From Kamay Botany Bay National Park
Discharge:
To Botany Bay
To Marton Park
To Quibray Bay

Catchments
Catchment A
Catchment B
Catchment C
Catchment D
Catchment E
Catchment F
Catchment G
Stormwater Trench
Catchment G Drain

N W E S

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

0 100 200 400 Meters

Source: *Aerial Imagery - Nearmap Hypertiles 2012*

PATH: T:\JOBS\43177836\Workspaces\
FILE NO: 43177836.006
DRAWN: STB/SB APPROVED: RO DATE: 27/02/2013

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KURNELL REFINERY CONVERSION

EXISTING STORMWATER CATCHMENT AREAS AND DISCHARGE AND INFLOW POINTS

URS Figure: **A-3**
Rev. **A** A4

Appendix B Catchment Stormwater System Descriptions

Appendix B - Catchment Stormwater System Descriptions

This Appendix discusses the stormwater collection and treatment system of each of the Site's catchments. This is based largely on information presented in the Stormwater Management Plan prepared by Caltex in 2012 in response to EPL No 837 Condition U10.1 PRP U24.1. This section should be read in conjunction with **Figure A-1** and **Figure A-3** (**Appendix A**).

B.1 Catchment A

Catchment A is the eastern tank area of the Site, located along the eastern boundary of the Site, and most of this area would be part of the Project Area post-conversion. It has two (2) main drainage paths that discharge to Botany Bay.

Drainage from within the bunded areas of this tank area is discharged to the oily water sewer system, and is not considered to be stormwater.

The major stormwater drainage path is provided by the Main Pipeway, where stormwater from the area around the tank area on the eastern and northern side of the pipeway, as well as areas surrounding the pipeway enters the pipeway and flows north to a skimmer and syphon system. It then flows to an American Petroleum Institute (API) oil-water separator at Gate 5 before flowing by gravity by underground pipe to discharge into Botany Bay at Silvers Beach near the Kurnell Wharf.

The second drainage path is provided by inflows from the Kamay Botany National Park and part of the area on the Sites eastern boundary which ultimately joins the flow from the Main Pipeway (downstream of the skimmer and syphon unit), upstream of the API Separator at Gate 5. Stormwater runoff from the National Park enters the catchment at five (5) locations (shown on **Figure A-3**). There are four (4) drains entering the Site from the National Park towards the southern end of the catchment (refer to **Figure A-1)**. Runoff from these drains collects in a natural retention area. The inflow rate from this retention area into the lower part of the Catchment A is controlled by a syphon system. In addition, some of the water from the retention area is lost by infiltration and evaporation.

There is an additional inflow drain from the National Park , into the lower part of the catchment, towards the northern end of the catchment. Drainage from the lower part of the catchment flows through open channels and underground pipes into the Main Pipeway, downstream of the syphon system, but upstream of the API Separator at Gate 5.

The Main Pipeway can be isolated at two points upstream of the API separator. In the event of a spill along the Main Pipeway, there is a skimmer pump that can be used to transfer minor releases to the oily water system or an eductor truck used to remove larger spills.

B.2 Catchment B

Catchment B is the largest onsite catchment and incorporates the main refinery process areas as well as the western tanks area and WWTP. The eastern tanks area would be retained in operation as part of the Project. The Catchment incorporates the central (predominately refinery infrastructure) and eastern (predominately tank area) parts of the Site.

Consistent with other parts of the Site, stormwater entering the tank bunds or process areas drains to the oily water system. The stormwater drainage system collects primarily runoff from roads, carparks and office buildings.

The catchment is serviced by Pipeways A and B which act as trunk drainage paths.

Appendix B - Catchment Stormwater System Descriptions

The southern part of the catchment drains to a stormwater drain running along Pipeway B. There is a pump station at the western end of this Pipeway.

The central part of the catchment drains to a pump station on Road 8.

A culvert running along Pipeway A receives stormwater from the northern part of the catchment, including the Contractors Main Car Park. It flows to the pump station near the Site Guardhouse.

All pump stations normally transfer stormwater to Manhole 156, from which it flows in a gravity main drain into the Quibray Bay Stormwater Retention Basin, located at the most westerly point of the site. In addition, the Pipeway A & B pump stations have the following:

- one (1) manually operated pump which has a skimmer system to collect potential surface oil which is discharged into the oily water sewer; and
- two (2) pumps normally operated automatically by level controllers in the pump pit, but can also be operated manually and can be directed to the intermediate (cooling water) sewer system as an alternative to stormwater.

The area in the north west of the catchment, in the vicinity of the wastewater infrastructure along Roads L and O, drains under gravity the stormwater main, which drains from Manhole 156 to the Quibray Bay Stormwater Retention Basin.

An API oil water separator is located on the inlet to the Quibray Bay Stormwater Retention Basin. It has a syphon outlet which flows to a final discharge pit (formerly an API separator) prior to flowing into the municipal drain that runs along and then under Captain Cook Drive before passing through a narrow strip of the Towra Point Nature Reserve and the adjacent mangrove wetland, ultimately discharging into Quibray Bay. In the event that the Quibray Bay Stormwater Retention Basin overflows during a larger storm event, there is an additional grassed area adjacent to the basin that can provide overflow onsite storage capacity. Stormwater in this overflow retention area can be allowed to infiltrate, or can be drained via the final discharge pit.

B.3 Catchment C

Catchment C is a small catchment located in the north of the Site. The catchment includes offices, former staff houses, gardens, roadways, the Employees Car Park and an undeveloped area (wetland) in the northern part. Stormwater runoff from this catchment drains, at a number of points, to the wetland areas and over the Site boundary on the west to the Marton Park wetland area where infiltration (and evaporation) occurs. Some new office buildings constructed in this catchment adjacent to the site boundary have been constructed with stormwater retention bladders located under the buildings, to allow slow release of stormwater to the adjacent wetland.

B.4 Catchment D

Catchment D is a narrow catchment located in the central part of the Site between the boundaries of the Caltex Refineries (NSW) (CRN) and, the no longer operational, CLOR. Stormwater runoff from the eastern and western part of this catchment flows through open channels to Pipe Track 3 and ultimately to the pumping station at the western end of Pipeway B, i.e. it discharges into Catchment B.

Strictly, this is no longer a separate catchment, and is now part of Catchment B. It was originally a separate catchment that drained to an infiltration area in the west of the Site in an area now occupied by a tank. The drainage was modified to accommodate the construction of this relatively recent tank.

Appendix B - Catchment Stormwater System Descriptions

This has been maintained as a separate catchment within this report for consistency with the Site's Stormwater Management Plan and the preceding stormwater catchment definitions.

B.5 Catchment E

Catchment E comprises the area occupies by the CLOR located in the south western corner of the Site. The CLOR is no longer operational and the process units have been demolished. Tanks, offices, roadways and carparks are still present.

There are three main drainage areas of the catchment. These are described below.

There is a drainage culvert running along the eastern side of the former process area. This collects drainage from the process area and tank area roadways. The culvert drains across the southern Site boundary, under an unnamed public (dirt) road and into a drainage trench running along the southern side of that road. This drain runs under Sir Josephs Bank Drive and intersects with the drainage channel running along the western side of that road. The Sir Josephs Bank Drive roadway drainage eventually passes under Captain Cook Drive and along drainage lines that pass through a narrow strip of the Towra Point Nature Reserve and the adjacent mangrove wetland, ultimately discharging into Quibray Bay.

The western part of the catchment, including the office and building rooves, carpark, workshops and proximal roadways, drain across the western boundary, under Sir Joseph Banks Drive and into the Sir Josephs Bank Drive roadway drainage channel at three (3) points. The southernmost of these three discharge points, in proximity to the workshops and part of the former process area is currently isolated. Drainage from this area formerly passed through and API.

The paving within the former operational area of the CLOR has been removed, and the majority of the rainfall that falls on this part of the catchment is expected to infiltrate.

As discussed in Section 6, the CLOR formerly had a separate oily water sewer and treatment system for treatment of water, including intercepted stormwater, from the process and tank bund areas. Treated effluent was discharged to the Tasman Sea via the Tabbigai Gap ocean outfall. The oily water system, including the Tabbigai Gap Outfall, has been decommissioned. Stormwater collected in the remaining parts of the CLOR oily water sewer is now pumped to the Site's WWTP.

B.6 Catchment F

Catchment F is located in the south eastern corner of the Site. The majority of the catchment is undeveloped. The only significantly developed part of the catchment is a tank area in the north east corner of the catchment with an adjacent recycling area, sludge lagoons and landfarm on the eastern boundary. There is also a hydroblast cleaning area, fire water tank, fire training area, and some additional small tanks on the northern boundary of the catchment. The tank bunds and land farm area discharge into the oily water sewer.

The catchment also receives significant inflows from the Kamay Botany National Park from across the eastern boundary via two main drainage lines.

The catchment (including the inflows) drains to a natural retention basin present midway along the southern boundary of the catchment. Water is lost from this basin by infiltration and evaporation. When this basin overflows it discharges into a channel drain running along the southern boundary of the site. It leaves the site across the southern boundary at a point across from Road 15. The drain passes under an unnamed public (dirt) road and into the same drainage trench running along the southern side of the road that part of Catchment E discharges into. From there it ultimately drains to Quibray Bay, as described for Catchment E.

Appendix B - Catchment Stormwater System Descriptions

B.7 Catchment G

Catchment G is located to the north east of the Site within the Kamay National Park with a very small area of the catchment within the Site boundary (north east corner). It is generally a low lying swampy area, with infiltration contributing to stormwater loss. The Site receives offsite inflow from the National Park. The catchment drains via a drain running along the northern Site boundary along Road A (within the Site boundary).

The Sutherland Shire Council has installed a drain that runs along the outside of the Site boundary parallel to Road 7 until it intersects with the Main Pipeway easement. It then travels along the easement until the point where it passes under Cook Street. It then drains parallel to Cook Street and discharges into Marton Park wetland, where it is lost by infiltration and evaporation. The Refinery drain, which runs along Road A, discharges,mainly the inflows from the National Park, into the Sutherland Shire drain at the northern most point of the Site (where Road A intersects with Road 7).

Appendix C EPL Monitoring and Discharge Requirements

Table C-1: Discharge to Waters at Point 1 - Cooling Water Intake Limit (Point 33), Monitoring Frequency and Sampling Method (Point 26)

Pollutant	Unit	50th Percentile Concentration Limit	100th Percentile Concentration Limit	Monitoring Frequency	Sampling Method
Chlorine (free residual)	mg/L	0.2	0.5	Daily	Representative sample
Temperature	°C		42	Continuous	Inline instrumentation
Volume	kL/day		400,000 (volume and mass limit)	Continuous	By calculation (volume flow rate or pump capacity multiplied by operating time)

Appendix C - EPL Monitoring and Discharge Requirements

Table C-2: Discharge to Waters at Point 2 - Treated Oily Wastewater Discharge Limit, Monitoring Frequency and Sampling Method at Yena Gap (Point 27)

Pollutant	Unit	50th Percentile Concentration Limit	90th Percentile Concentration Limit	100th Percentile Concentration Limit	Monitoring Frequency	Sampling Method
2,4-dimethylphenol	mg/L	-	-	-	Monthly	24 hour composite sample
Arsenic	mg/L	0.07	-	-	Monthly	24 hour composite sample
Benzene	mg/L	-	-	-	Monthly	24 hour composite sample
BOD	mg/L	20	30	-	Every 6 days	Grab Sample
BOD (Wet)[4]	mg/L	-	-	350	Special Frequency 2[5]	Grab Sample
Ethyl Benzene	mg/L	-	-	-	Monthly	24 hour composite sample
Lead	mg/L	0.025	-	-	Monthly	24 hour composite sample
Naphthalene	mg/L	-	-	-	Monthly	24 hour composite sample
Nickel	mg/L	0.03	-	-	Monthly	24 hour composite sample
Nitrogen (Ammonia)	mg/L	-	7.5	-	Every 6 days	Grab Sample
Oil and Grease	mg/L	-	10	-	Every 6 days	Grab Sample
Oil and Grease (Wet)[3]	mg/L	-	-	70	Special Frequency 2[4]	Grab Sample
pH[6]	pH	-	6.5 – 8.5	6.0 – 9.0	Continuous	In line instrument
Phenanthrene	mg/L	-	-	-	Monthly	24 hour composite sample
Phenols[7]	mg/L	0.3	-	2.7	Every 6 days	Grab Sample
Phenols (Wet)[3]	mg/L		-	5	Special Frequency 2[4]	Grab Sample
Polycyclic Aromatic Hydrocarbon	mg/L	0.03	-	0.5	Monthly	24 hour composite sample

[4] For periods when biotreater WWTP is under bypass conditions, only the concentration limits which include the term "Wet" applies for discharges from Points 2 and 3.
[5] Special Frequency 2 –daily only during any discharge under biotreater WWTP bypass conditions as described in Section 6.2.2
[6] pH limit specified for Points 2 and 3 is based on a 6 minutes rolling average
[7] Monitoring requirement for Phenols at Points 2 and 3 is to be read as total phenolics

Appendix C - EPL Monitoring and Discharge Requirements

Pollutant	Unit	50th Percentile Concentration Limit	90th Percentile Concentration Limit	100th Percentile Concentration Limit	Monitoring Frequency	Sampling Method
Sulphide (un-ionised hydrogen sulphide)	mg/L	-	-	-	Every 6 days	Grab Sample
Temperature	°C	-	-	40	Continuous	In line instrument
TSS	mg/L	35	50		Every 6 days	Grab Sample
TSS (Wet)[3]	mg/L			100	Special Frequency 2[4]	Grab Sample

Appendix D Summary of Recent Discharge Water Quality Monitoring

Table D-1: Annual Return Report for Yena Gap (Identification Point 27) for Period 2010 – 2011 and 2011 – 2012

Parameters	Unit	Number of Samples Collected		2010 – 2011			2011 – 2012		
		2010 – 2011	2011 – 2012	Lowest Result	Mean Result	Highest Result	Lowest Result	Mean Result	Highest Result
2,4 dimethylphenol	mg/L	12	12 (11)[8]	<0.2	<0.2	<0.2	<0.0002	0.0023	0.019
Arsenic	mg/L	12	12 (11)[8]	0.005	0.025	0.069	0.004	0.013	0.028
Benzene	mg/L	12	12 (11)[8]	<0.001	<0.001	0.001	<0.001	0.036	0.264
BOD	mg/L	61[9,10]	61 (59)[11]	<2	3	9	<2	3	39
BOD (Wet)[3]	mg/L	12[12]	26	<2	15	36	<2	17	69
Ehtyl Benzene	mg/L	12	12 (11)[8]	<0.002	<0.002	<0.002	<0.002	0.002	0.012
Lead	mg/L	12	12 (11)[8]	<0.001	0.002	0.006	<0.001	0.001	0.002
Naphthalene	mg/L	12	12 (11)[8]	<0.2	<0.2	0.8	<0.0002	<0.0002	0.0003
Nickel	mg/L	12	12 (11)[8]	0.001	0.004	0.01	0.002	0.004	0.007
Nitrogen (Ammonia)	mg/L	61	61 (59)[11]	<0.01	0.31	13.4	<0.1	0.46	5.44
Oil and Grease	mg/L	61	61 (59)[11]	<5	<5	9	<5	<5	7
Oil and Grease (Wet)[3]	mg/L	12	26	<5	8	25	<5	<5	30
pH		Continuous	Continuous	6.0	7.2	7.9	6.2	7.0	7.8
pH (Wet)[3]		Continuous	Continuous	60.	6.9	8.8	6.3	6.9	7.9
Phenanthrene	mg/L	12	12 (11)[8]	<0.2	<0.2	0.7	<0.0002	0.0003	0.0022
Phenols[6]	mg/L	61	61 (59)[11]	<0.05	<0.05	0.2	<0.05	<0.05	0.19
Phenols (Wet)[3]	mg/L	12	26	<0.05	0.64	1.84	<0.05	1.26	2.6

[8] 11 samples were collected during normal WWTP operations, and 1 was collected during Biotreater Bypass which was reported as 'Wet' sample.
[9] A 6 day set of samples was collected on 11 April 2011. However, the samples were lost in transit to the external laboratory, ALS. A second set of samples (i.e. field duplicates) that had been retained by the Caltex laboratory were sent to ALS for analysis. However, the BOD analysis was outside its holding time and therefore, was invalid.
[10] A 6 day set of samples was collected on Saturday 23 April 2011, which was during the extended Easter and ANZAC Day long holiday period. Due to the external laboratory's shutdown for the public holidays, it was anticipated that the BOD analysis would not be analysed within the 3 day holding time. Hence, an additional BOD sample was collected on 24 April 2011 in lieu of the sample taken on 23 April 2011
[11] 58 samples collected during normal WWTP operations, 3 were collected during Biotreater Bypass which was reported as 'Wet' samples and additional 1 was collected following a Biotreater Bypass which has been included in the dataset for normal WWTP operations.
[12] A sample was not collected during the CRN WWTP wet weather. Bypass on 24-25 April. Caltex standard practice for collecting Bypass (Wet) samples is to collect the first sample 6 hours after the start of the Bypass and then 24 hourly samples and a final sample prior to finishing the Bypass. However, the Bypass on 24-25 April was less than 4hours in duration and the WWTP was subsequently placed into diversion (i.e. no effluent discharge to Yena Gap). When it was taken out of diversion (i.e. commenced effluent discharge to Yena Gap), the WWTP was no longer in wet weather Bypass mode and therefore, no Bypass samples were collected as they would not be representative of Bypass conditions. Hence not considered as a licence non-compliance.

Appendix D - Summary of Recent Discharge Water Quality Monitoring

Parameters	Unit	Number of Samples Collected		2010 – 2011			2011 – 2012		
		2010 – 2011	2011 – 2012	Lowest Result	Mean Result	Highest Result	Lowest Result	Mean Result	Highest Result
Polycyclic Aromatic Hydrocarbons	mg/L	12	12 (11) [8]	<0.0002	0.0002	0.001	<0.0002	<0.0003	<0.0024
Sulphide (un-ionised hydrogen sulphide)	mg/L	61	61 (59)[11]	0	0.011	0.074	0	0.012	0.026
Temperature	°C	Continuous	Continuous	24	34	40	23	34	39
Temperature (Wet)[3]	°C	Continuous	Continuous	22	29	36	19	33	39
Toluene (mg/L)	mg/L	12	12 (11) [8]	<0.005	<0.005	<0.005	<0.005	0.039	0.208
Total Suspended Solids (TSS)	mg/L	61	61 (59)[11]	1	10	29	<1	11	69
TSS (Wet)[3]	mg/L	12	26	9	17	33	4	18	67

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