APPENDIX A CALL-IN REQUEST

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Viva Energy Clyde Western Area Remediation Project
Viva Energy Australia Pty Ltd
27-Sep-2017

Viva Energy Clyde Western Area Remediation Project

Request for State Significant Development Declaration

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Request for State Significant Development Declaration

Client: Viva Energy Australia Pty Ltd

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Prepared by

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Final	27-Sept-17	Final for DPE	William Miles CEnvP IA Associate Director - Environment	

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Glossary and Abbreviations

Glossary

Term	Definition
the Site	Viva Energy owned land on the Camellia peninsula consisting of the following lots: Lots 100 and 101 of DP1168951, Lot 101 DP809340, Lot 2 DP224288, and Lot 1 DP383675. It includes the Clyde Terminal, the Parramatta Terminal, the Wetland, the Western Area and other land that is either currently vacant or leased to third parties.
the Western Area	A largely vacant area of land, approximately 40 ha in size, located in the south western part of the Site. This land previously contained a variety of refinery assets that have now been removed.
the Clyde Terminal	A part of the Site currently operating as an import, storage and distribution terminal for finished petroleum products including diesel, jet and gasoline fuels. The Clyde Terminal makes up the majority of the central part of Site and operates under EPL 570.
the Parramatta Terminal	A part of the Site currently used for distribution activities involving road transport and packed products. The Parramatta Terminal is located in the north western part of the Site and operates under EPL 660.
the Wetland	A large undeveloped wetland area in the north eastern part of the Site close to the confluence of the Parramatta and Duck Rivers.
the Project	The proposal to remediate the contaminated soils and groundwater in the Western Area to a commercial / industrial standard
The Project area	The land where the Project will take place.

Abbreviations

Acronym	Definition
AS/NZS	Australian / New Zealand Standard
ABN	Australian Business Number
ACM	Asbestos Containing Material
AFFF	Aqueous Film Forming Foam
AGO	Automotive Gas Oil
AHD	Australian Height Datum
AMP	Asbestos Management Plan
ANZECC	Australia and New Zealand Environment and Conservation Council
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CBD	Central Business District
CLM Act	NSW Contaminated Land Management Act 1997
CMP	Contamination Management Plan
Coastal Management SEPP	Draft State Environmental Planning Policy (Coastal Management) 2016
CoPC	Contaminants of Potential Concern
CPI	Corrugated Plate Interceptor

Acronym	Definition
CSM	Conceptual Site Model
DPE	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Communities
EHC	Epichlorhydrin
EMS	Environmental Management System
ENM	Excavated Natural Material
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EP&A Regulation	NSW Environmental Planning and Assessment Regulation 2000
EPA	NSW Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 2000
EPL	Environment Protection Licence
EPIs	Environmental Planning Instruments
ERA	Environmental Risk Assessment
ESA	Environmental Site Assessment
GDE	Groundwater Dependent Ecosystems
GME	Groundwater monitoring event
GPOP	Greater Parramatta and the Olympic Peninsula
GSC	Greater Sydney Commission
GWMP	Groundwater Management Plan
ha	Hectares
HSL	Health Screening Level
ISEPP	NSW State Environmental Planning Policy (Infrastructure)
LEP	Local Environment Plan
LGA	Local Government Area
LNAPL	Light Non-Aqueous Phase Liquid
LPG	Liquefied Petroleum Gas
m	metres
m^3	metres cubed
m/s	metres per second
mbgl	metres below ground level
MHF	Major Hazard Facility
min	minutes
ML	megalitres
MNA	Monitored Natural Attenuation
MNES	Matter of National Environmental Significance
MPE	Multiphase Extraction

Acronym	Definition
MW	Monitoring Well
NAPL	Non-Aqueous Phase Liquid
NEPM	National Environment Protection Measure
NOW	NSW Office of Water
NSW	New South Wales
NSZD	Natural Source Zone Depletion
OEH	Office of Environment and Heritage
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PCB	Polychlorinated Biphenyls
PFAS	Polyfluoroalkyl Substances
POEO Act	NSW Protection of the Environment Operations Act 1994
PPE	Personal Protective Equipment
PRP	Pollution Reduction Program
PSH	Phase Separated Hydrocarbon
RAP	Remediation Action Plan
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy No. 55 – Remediation of Land
SEPP SRD	State Environment Planning Policy (State and Regional Development) 2011
SSD	State Significant Development
SVE	Soil Vapour Extraction
Sydney Harbour SREP	Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005
t	tonne
TCLP	Toxicity Characteristics Leaching Procedure
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
VENM	Virgin Excavated Natural Material
Viva Energy	Viva Energy Australia Pty Ltd
VOCs	Volatile Organic Compounds
WH&S Regulation	NSW Work Health and Safety Regulation 2011
WM Act	Water Management Act 2000
wt%	percentage by weight

Executive Summary

Viva Energy currently operates the Clyde Terminal on part of the Site, however, a large part of the former refinery land in the south-western part of the Site (the 'Western Area') is no longer required for operational purposes. As such, Viva Energy is proposing to remediate the contaminated soils and groundwater in the Western Area (the 'Project').

The purpose of this report is to request that the Minister for Planning declare the Project as State Significant Development (SSD) in accordance with Section 89C(3) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Western Area is approximately 40 ha in size and was previously used for refining operations including hydrocarbon processing, fuel storage and fuel transfer. The long-term and historic use of the area has resulted in a number of contamination impacts to the soils and groundwater within this area. As with many industrial sites, a secondary source of contamination may be caused by imported fill likely used for historical levelling works.

The current understanding of the nature and extent of the impacts within the Western Area is based on investigation works which were conducted between 1992 and 2016. Based on these investigations, Chemicals of Potential Concern (CoPCs) within the area include:

- Total Petroleum/Recoverable Hydrocarbons (TPH/TRH);
- Benzene, Ethyl-benzene, Toluene and Xylenes compounds (BTEX);
- heavy metals;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- phenols;
- Polychlorinated Biphenyls (PCBs);
- tetraethyl lead;
- perfluorocarbons; and
- asbestos containing materials.

The Western Area is declared as significantly contaminated land under the *Contaminated Land Management Act 1997* (Declaration Number 20131110).

The remediation of the Western Area may be complex and require a number of remediation techniques. The Conceptual RAP being developed for this Project will identify which remediation techniques will be used and the overarching remediation strategy for the Western Area. Once complete, the Conceptual RAP would be used to help complete the environmental assessment required under the EP&A Act for the Project.

State Significance Discussion

In accordance with the DPE '*Guideline on 'call-in' of state significant development under the Environmental Planning and Assessment Act 1979*', the Project has been assessed against the six general determining issues relating to the State and Local significance of projects. A summary of this discussion is provided below.

General Determining Issue	Summary of Response
Whether the proposal is of regional or State importance because it is in an identified strategic location, or is critical in advancing the nominated strategic direction or achieving a nominated strategic outcome, contained in a relevant State policy, plan or strategy, or regional or sub-regional strategy.	The Project involves the remediation of an area approximately 40 ha in size in one of the most strategically important locations for the future development of Sydney. As outlined in the draft West Central District Plan (Greater Sydney Commission (GSC), 2016a) and the Greater Parramatta and the Olympic Peninsula (GPOP) Vision (GSC, 2016b), the Western Area is located in the heart of the GPOP area which is a major focus for the GSC and is considered one of Sydney's most crucial centres of economic activity. In its current condition, large parts of the Western Area are too contaminated for certain industrial or commercial land uses to be granted development consent. The contaminated nature of the land means that, without remediation, the proposed use of this land for "*modern enterprise with relatively high density employment*" in the GPOP Vision (GSC, 2016b) would not be achieved. Remediation of the Western Area would allow this land to be developed for commercial / industrial purposes, thereby supporting the GCS's employment aspirations for the land and meeting the vision for the area. The Project would also support the delivery of the fifth of the GPOP Vision's 12 Strategic Directions. Therefore, the project is considered to be critical to advancing the strategic direction and outcomes of the draft West Central District Plan (GSC, 2016a) and the GPOP Vision (GSC, 2016b).
Whether the proposal delivers major public benefits such as large-scale essential transport, utility infrastructure, or social services to the community.	The Western Area contains various levels of soil and groundwater contamination. The presence of certain pollutants at elevated levels potentially limits the redevelopment potential of the Western Area. The Project would deliver a major public benefit by addressing CoPC that are above the established criteria at the Western Area, thereby reducing the human health and environmental risks currently associated with this large area under a site redevelopment scenario. Following completion of the Project, the land could be redeveloped delivering a major public benefit, by delivering the GPOP vision.
Whether the proposal is likely to have significant environmental, social or economic impacts or benefits, be of a significant hazardous or environmentally-polluting nature, or is located in or in close proximity to areas or locations that have State or regional environmental, archaeological or cultural heritage significance.	Once the remediation of the Western Area is completed, the Project is likely to allow the realisation of numerous beneficial impacts. These include positive environmental effects related to the remediation of the soil and groundwater in addition to the positive social and economic impacts relating to the opportunity to support the GPOP Vision to create more a more diverse economic centre on the Camellia peninsula. There are various established controls to minimise the potential for impacts as a result of the remediation works required for the Project. However, given the sensitivity of certain receptors surrounding the Western Area (such as the Duck River and its associated ecological communities), and the scale and potential for impacts as a result of the Project, it is considered that the Project should be managed at the State level. In addition, the significance of the Clyde Terminal supplying the State's fuel needs and its designation as a MHF mean that any risks associated with completing the remediation works adjacent to this facility requires careful assessment and management. DPE's experience in assessing MHFs and their previous experience managing and coordinating the Clyde Terminal Conversion Project (SSD 5147) mean that they are best placed to coordinate and assess the development application for the proposed remediation works.

General Determining Issue	Summary of Response
Whether the proposal is of significant economic benefit to a region, the State or the national economy, such as those with high levels of financial investment and continuing or long-term employment generation.	The remediation of the Western Area to commercial / industrial standards will support the commercial / industrial development of the GPOP area and deliver the fifth of the GPOP Vision's 12 Strategic Directions: "*No 5 - Transform Camellia, Rydalmere, Silverwater and Auburn into 21st Century essential urban service, advanced technology and knowledge assets*". Therefore the Project is of significant economic benefit to not only Sydney's 'Central City' but to Metropolitan Sydney as a whole, and potentially the State.
Whether the proposal is geographically broad in scale, including whether it crosses over multiple council and other jurisdiction boundaries, or impacts a wide area beyond one local government area.	Whilst the Western Area does not cross multiple local government area boundaries it is subject to the aspirations of both the Greater Sydney Commission and Parramatta City Council. The size of the Western Area and the possibilities that this area provides for realising the GPOP Vision mean that this Project can be considered important at a 'precinct scale'. In addition, the size of the Western Area, the variety of CoPC and the need to potentially remediate both the soils and the groundwater mean that the likely scale and nature of Project will require discussions and/or consultation with a wide variety of stakeholders.
Whether the proposal is complex, unique or multi-faceted and requires specialist expertise or State coordinated assessment, including where councils require or request State assistance	The size and location of the Western Area, the variety of CoPC and the need to potentially remediate the soils, the groundwater and remove or manage redundant subsurface infrastructure mean that the Project is likely to be complex and potentially involve numerous remediation technologies. The precise remediation strategy for the Western Area is not yet confirmed, however, it is likely to be multi-facetted (in that a number of approaches may be required concurrently) and unique to a large area with a number of contaminants and sensitive receptors nearby. In addition, there would be operational and environmental benefits to commencing the remediation works as soon as possible after the conversion and demolition works (SSD 5147) are completed. DPE's knowledge of, and continued involvement with, the Site would help ensure that key issues for the SSD application and relevant stakeholders are efficiently managed. This in turn would provide the best opportunity of reducing any downtime between completion of the conversion and demolition works and commencing the Project. Given the complexities of the Project, the need to involve numerous stakeholders and specialist expertise and the Department of Planning and Environment's (DPE's) history with the Site and its current operation, Viva Energy requests and accordingly believes it is appropriate for the development application to be managed and coordinated by the DPE.

Based on the reasoning outlined above and in further detail throughout this report, Viva Energy considers the Project of State significance and accordingly requests a SSD declaration for the Project in accordance with the provisions of Section 89C (3) of the *Environmental Planning and Assessment Act 1979*.

1.0 Introduction

Viva Energy Australia Pty Ltd (Viva Energy) owns the land associated with the former Clyde Refinery (the 'Site') located at Durham Street, Rosehill on the Camellia Peninsula. Viva Energy currently operates the Clyde Terminal on part of the Site, however, a large part of the former refinery land in the south-western part of the Site (the 'Western Area') is no longer required for operational purposes. As such, Viva Energy is proposing to remediate the contaminated soils and groundwater in the Western Area (the 'Project').

The purpose of this report is to request that the Minister for Planning declare the Project as State Significant Development (SSD) in accordance with Section 89C(3) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report has been prepared by AECOM Services Pty Ltd on behalf of Viva Energy having regard to the Department of Planning and Environment (DPE) '*Guideline on 'call-in' of state significant development under the Environmental Planning and Assessment Act 1979*'. This report is also accompanied with the prescribed $3,000 lodgement fee.

1.1 Proponent and landowner

The proponent and landowner is Viva Energy. The relevant contact details for the Project are:

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Durham Street

Rosehill NSW 2142

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Telephone: +61 2 9897 8624

2.0 The Site

2.1 Site overview

Viva Energy's land holdings on the Camellia peninsula (the 'Site') consist of the following lots: Lots 100 and 101 of DP1168951, Lot 101 DP809340, Lot 2 DP224288, and Lot 1 DP383675. All of these lots are located within the Parramatta City Council Local Government Area (LGA). The whole Site is zoned as IN3 Heavy Industrial under the *Parramatta Local Environmental Plan 2011* (Parramatta LEP 2011).

The Site and the surrounding general industrial area are located on the Camellia peninsula which is bounded by Parramatta River to the North and by Duck River to the South and East (refer to **Figure 1**). The topography is generally flat and ranges from 2 to 4 metres (m) Australian Height Datum (AHD) in elevation.

Groundwater is encountered at relatively shallow depths, generally at 1 to 3 m below ground level (mbgl). Groundwater flows to the South-East towards the Duck River.

Part of the Site is currently operating as a fuel storage terminal, which receives, stores and distributes fuel products including diesel, jet fuel and gasoline products. This part of the Site is referred to as the Clyde Terminal. The Clyde Terminal makes up the majority of the central part of the Site. Within the Site and to the North of the Clyde Terminal is Parramatta Terminal which is used to distribute fuels via road, a large wetland area and various areas of land that Viva Energy leases to 3rd parties.

To the South-West of the Clyde Terminal is an area approximately 40 hectares (ha) in size which previously included a variety of refinery assets and is now largely vacant. This part of the Site is referred to as the 'Western Area'. It is this part of the Site that is proposed to be remediated. It is located on Lot 100 DP1168951 (alongside the Clyde Terminal).

Figure 2 shows the Site and its key components including the location of the Western Area.

2.2 Surrounding land use

The Site is surrounded by a mixture of land uses but is primarily an industrial setting. To the West is the Rosehill Gardens Racecourse and a mix of industrial and commercial development. To the South is Duck River, beyond which there is the industrial and commercial development of Silverwater. Industrial development within the suburb of Rosehill is adjacent to the North and East of the Site. Duck River runs along the South-East boundary of the Site and eventually joins the Parramatta River at the eastern most point of the Site.

The nearest residential areas to the Western Area are Silverwater, Rosehill and Rydalmere (refer to **Figure 1**). These communities are located 550 m to the South, 880 m to the West and 1,050 m to the North-East, respectively. Industrial and infrastructure land uses are located between these areas and the Western Area.

FIGURE 1 - SITE LOCATION

AECOM

N 0 250 500 m

KEY

- Approximate Western Area Boundary
- Site boundary
- Motorway
- Primary road
- Local road

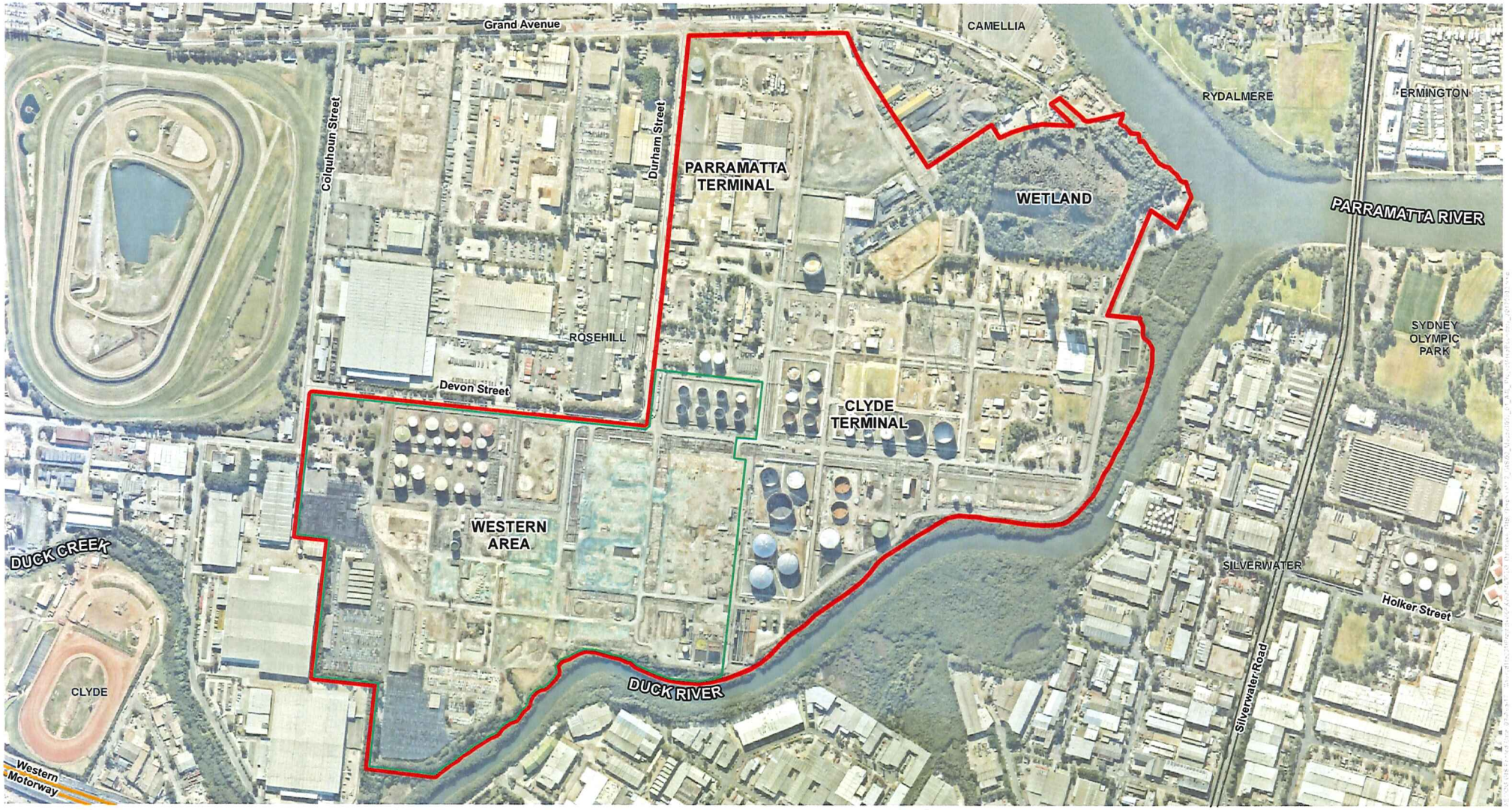


FIGURE 2 - SITE FEATURES

AECOM

0 100 200 300 m

KEY

- Approximate Western Area Boundary
- Site boundary
- Motorway
- Primary road
- Local road

2.3 Site history

2.3.1 Site history and the Clyde Refinery

The Site was originally included as part of an 850-acre land grant by the Crown to John Macarthur on 8 October 1816. The land on which the refinery was established comprised flat, unfenced scrublands and mangrove swamps at the confluence of Parramatta and Duck Rivers. In 1908, a parcel of 140 acres of land, including the current Site, was transferred to the Commonwealth Oil Corporation who established an oil refinery. In 1918 a shale oil refinery was also established at the Site. Shell took over as owner and operator of the Clyde Refinery on 1 January 1928 (CH2M HILL, 2007).

Between 1929 and the mid-1970s numerous expansions and upgrades of the refinery took place. These works included constructing new refinery plant, buildings, pipework and infrastructure. The expansion of the operations at the Site included upgrading and expanding the refinery assets (e.g. crude distillers, catalytic cracking complex etc.) and also commissioning a lubricating oil plant, introduction of a chemical and hydrocarbon solvents plant, expansion of the Site itself with the purchase of additional land and development of a polypropylene plant.

Following the conclusion of the major phases of expansion and development of the Clyde Refinery in the mid-1970s, only minor additions and modifications were made. In the mid-1980s, the butane de-asphalting plant and oil interceptor were demolished. The site that these elements had occupied was redeveloped, with the central control room constructed at that location in 1988. In 1991, a new propylene unit and platformer unit were commissioned, and in 1994, the mounded LPG storage facility was built (Shell, 1993).

The refinery continued to operate in the early years of the twenty-first century, however in 2011, Shell publically announced its decision to cease refining at the Clyde Refinery prior to mid-2013. In June 2012, Shell confirmed that from late 2012, the Clyde Refinery would cease processing crude oils and other products.

The fuel and other chemical products that were received, stored and processed at the Clyde Refinery before refining operations ceased in 2012 included:

- crude oil;
- residue;
- condensate;
- gasoline;
- jet fuel;
- automotive gas oil (AGO) otherwise known as diesel;
- intermediates;
- hydrofluoric acid;
- catalyst materials; and
- caustic (sodium hydroxide).

Since 2012, the Site has predominantly operated as the Clyde Terminal.

2.3.2 The Clyde Terminal

Since the cessation of refining operations in late 2012, the Site has been known as the Clyde Terminal, and is used for the receipt, storage and distribution of finished petroleum products. Product dosing and product sampling (which is worked back into products) is also undertaken.

Development consent for the Clyde Terminal Conversion Project (SSD 5147) was granted on 14 January 2015. This consent allowed Viva Energy to consolidate the terminal operations at the Site into the current Clyde Terminal operation, undertake a number of construction works to upgrade the terminal operations, to convert certain tanks to finished product service, to demolish and remove redundant refinery equipment and infrastructure and to operate solely as a finished petroleum products terminal into the future.

The Conversion Project is almost complete. The majority of terminal assets have been consolidated into the new terminal footprint, have been upgraded where necessary, and much of the redundant refinery infrastructure has been demolished and removed. The Clyde Terminal continues to receive finished petroleum products from the Gore Bay Terminal via the existing product transfer pipeline, and distributes them by separate pipelines from the Clyde Terminal to the adjacent Parramatta Terminal road gantry, to Sydney Airport, and to Newcastle via existing infrastructure.

Since refining activities ceased, only the following finished petroleum products are stored at the Clyde Terminal:

- gasoline (unleaded 91, 95 and 98);
- diesel (AGO); and
- jet fuel.

Clyde Terminal has consent to store 264 megalitres (ML) of finished petroleum products and 1,550 m^3 of petroleum gases under SSD 5147.

The Clyde Terminal operates 24 hours a day, seven days a week.

2.3.3 The Western Area

Following completion of the Clyde Terminal Conversion Project, the Western Area will no longer be required for operational purposes. At present, the far South-West corner of the Site is leased to a third party, whilst the North-West portion contains two operating tank farm assets currently in Diesel and Jet A1 product storage service. These assets will be decommissioned in the near future. The area that is currently leased will also become vacant in a similar timeframe. With the exception of these two activities, the rest of the area is no longer in use but does retain some redundant subsurface refinery infrastructure (inclusive of a significant drainage network) which will be addressed as part of the future remediation of the Western Area.

2.4 Site regulation

The NSW Environment Protection Authority (EPA) wrote to Shell Refining (Australia) Pty Ltd (Shell) following the announcement of closure in 2012 outlining its expectations that an investigation and remediation program be developed and implemented for the refinery site such that all contamination legacies be addressed in a timely and comprehensive manner.

On 22 June 2012, the EPA issued a Preliminary Investigation Order to Shell under the *Contaminated Land Management Act 1997 (NSW)* (CLM Act) requesting reports on environmental contamination (sediment, soil, water), data gaps and proposed investigation plan by 1 August 2012. The Preliminary Investigation Order nominated a number of contaminants potentially affecting the Site.

Following receipt of a number of reports and discussions with Viva Energy, in June 2016 the EPA declared the land identified as Lot 398 DP41324, Lot 2 DP224288, Lot 1 DP383675, Lot 101 DP809340, and Lot 100 DP1168951 as 'significantly contaminated land' under the CLM Act (Declaration Number 20131110). The EPA concluded that the groundwater at the Site is contaminated with the following substances:

- light non-aqueous phase liquid;
- total petroleum hydrocarbons;
- benzene, toluene, ethylbenzene and xylenes;
- polycyclic aromatic hydrocarbons;
- lead and chromium including hexavalent chromium; and
- perfluorooctane sulfonate.

The Western Area falls within Lot 100 DP1168951 and is therefore declared as significantly contaminated land.

At present, there is no Voluntary Management Proposal for any portion of the Site.

The Western Area operates under EPL No. 570 issued under the *Protection of Environment Operations Act 1997* (NSW) (POEO Act). EPL 570 applies to the majority of the Site and includes the following land Part Lot 2 DP224288, Part Lot 1 DP383675, Part Lot 101 DP809340, Lot 100 DP1168951. It authorises and regulates the carrying out of two scheduled activities: Waste processing; and chemical storage. It provides discharge and emission limits for a number of potential pollutants. It also prescribes reporting requirements for Viva Energy.

The operation of the Clyde Terminal is consented by SSD 5147, which is granted under the EP&A Act and which has associated conditions of consent for the operation of the terminal.

The Clyde Terminal is also a Major Hazard Facility (MHF) under the *Work Health and Safety Regulation 2011* (NSW) (WH&S Regulation).

2.5 Previous investigations

Soil and groundwater investigations have been ongoing at the Site and have been both proactive and compliance driven in nature. Reports presenting the results of these investigations describe the geology, hydrogeology and nature and extent of affected soil and groundwater, and have previously (post 2004) been submitted either in full or summary to the EPA via the annual reporting process. In 2008, a Conceptual Site Model (CSM) was prepared to provide a holistic understanding of the Site and provide a means to identify data gaps for further consideration. Since then, the program of both routine and non-routine environmental site assessments have continued, including the quarterly groundwater monitoring program. The objectives of these investigations have been to address identified data gaps, and to assist in the prevention of exposure risks to human health and the environment. The previous investigations undertaken at the Site are listed in **Table 1** below.

Table 1 Previous investigations for the Site

Date	Investigation Detail
1991	• Duck River Benthic Ecology assessment, reported by Dr. K Brown, University of Technology, Sydney. • Duck River Sediments assessment, reported by Lucas Heights research laboratories.
1992	• Geotechnical model developed by Coffey Partners International Pty Ltd. Ten groundwater wells were also installed along the south-eastern Site boundary to determine if the migration of contaminants into Duck River was occurring.
1992	• ANSTO groundwater water sampling event.
1993	• Groundwater monitoring event (GME) conducted by Groundwater Technology in March.
1993	• GME conducted by Groundwater Technology in July.
1994	• GME conducted by Groundwater Technology in February.
1994	• Environmental Site Assessment (ESA) conducted by Groundwater Technology in June.
1995	• ESA conducted by Groundwater Technology in March in the old chemical plant and TankfarmE1.
1995	• ESA conducted by Groundwater Technology in April near the refuelling facility on the western site boundary.
1999	• Sludge pilot conducted by IT (formerly Groundwater Technology) in February.
1999	• ESA conducted by IT in May near the refuelling facility on the western Site boundary.
1999	• GME conducted by IT in October.
2000	• GME conducted by IT in October.
2001	• GME conducted by IT in February.
2001	• ESA conducted by IT in March near the sludge drying area.
2001	• GME conducted by IT in August.

Date	Investigation Detail
2002	• Pollution Reduction Program Remedial Action Plan produced by Shell Engineering Pty Ltd in July.
2003-2004	• GME conducted by IT in December 2003 and January. • Groundwater gauging events conducted by IT in February, April, May, August, and September, October, and December • GME conducted by IT in July. • Limited ESA conducted by IT in September.
2005	• GME conducted by IT in March. • Gauging events conducted by IT in June, July, November, and December. • GME conducted by IT in August-September.
2006	• Gauging events conducted by IT in January and July. • GME conducted by IT in March. • GME conducted by Coffey in September/October. • Gauging event and limited GME conducted by Coffey in December.
2007	• GME Activities Report conducted by C.M. Jewell & Associates in 2006-2007 • GME conducted by HLA ENSR in September 2007.
2008	• Factual GME conducted by ERM Australia in February. • Phase Separated Hydrocarbon Evaluation in the Central Refinery Area completed by ERM. • Factual GME (GME 9) conducted by ERM, Shell Refinery and Parramatta Terminal.
2009	• Water Quality of Upper Parramatta River 1990-2009 assessment conducted by J.H & E.S Laxton. • Soil Investigation of Old Administration Area, conducted by ERM. • Phase separated hydrocarbons assessment for CSM2, conducted by ERM. • Leased area Underground Storage Tank removal validation, reported by ERM • Tank Farm E2 (Tank 83) Alkylate Release Investigation conducted by ERM. • Factual Groundwater Monitoring Report (GME10) conducted by ERM, Clyde Refinery and Parramatta Terminal. • Factual Groundwater Monitoring Report (GME11) conducted by ERM, Clyde Refinery and Parramatta Terminal.
2010	• Quarter 1 to 2 (2010) GME - Clyde Refinery. • Hexavalent Chromium Investigation Clyde Refinery and Parramatta Terminal reported by ERM.
2011	• Tank T92 Release Investigation – Shell Clyde Refinery, reported by ERM. • Quarter 1 to 4 GMEs conducted by ERM – Clyde Refinery. • Stage 1 and 2 Environmental Site Assessment conducted by ERM – Shell Clyde Refinery and Parramatta Terminal (CSM Sub Area 3 Investigation). • Phase 1 Environmental Site Assessment conducted by ERM – Clyde Refinery – Lot 101 DP809340.
2012	• Tank 30 Release Investigation conducted by ERM - Clyde Refinery and Parramatta Terminal. • Quarter 1 to 4 GMEs conducted by ERM – Clyde Refinery. • Environmental Conditions Summary reported by ERM – Shell Clyde Refinery. • Stage 1 and 2 Environmental Site Assessment conducted by ERM – Shell Clyde Refinery and Parramatta Terminal – (CSM Sub Area 3). • Phase II Environmental Site Assessment conducted by ERM - Shell Clyde Refinery and Parramatta Terminal Lot 101 DP 809340.
2013	• Quarter 1 to 4 Groundwater Monitoring Events conducted by ERM – Clyde Refinery.
2014	• Quarter 1 to 4 Groundwater Monitoring Events conducted by ERM – Clyde Refinery. • Annual Progress Report (2013) provided by ERM – Shell Clyde Terminal. • Detailed Site Investigation conducted by ERM, Clyde Terminal Lot 101 DP 809340.

Date	Investigation Detail
2015	• Shallow Soil Assessment and Lead Dust Survey conducted by ERM – Tetraethyl Lead Plant – Clyde Terminal.
2016	• Quarter 1 to 4 GMEs conducted by ERM – Clyde Refinery. • Demolition spoil assessment reported by Coffey – Clyde Refinery. • Annual Progress Report (2015) provided by ERM – Shell Clyde Terminal. • Tank Lot 101 Detailed Site Investigation, reported by ERM – Clyde Refinery. • Tank Farm B2 Investigation, reported by ERM – Clyde Refinery. • Clyde Condition Report and Environmental Management Plan, prepared by ERM – Clyde Refinery. • Clyde Soil and Groundwater Management Plan, prepared by ERM.
2017	• Annual Progress Report, prepared by ERM – Clyde Refinery.

3.0 Western Area Contamination

3.1 Introduction

The Western Area is approximately 40 ha in size and was previously used for refining operations including hydrocarbon processing, fuel storage and fuel transfer. The Western Area layout is presented in **Figure 3** below.

The long-term and historic use of the area has resulted in a number of contamination impacts to the soils and groundwater within this area. As with many industrial sites, a secondary source of contamination may be caused by imported fill likely used for historical levelling works.

The current understanding of the nature and extent of the impacts within the Western Area is based on investigation works which were conducted between 1992 and 2016 (refer to **Section 2.5**). Based on these investigations, Chemicals of Potential Concern (CoPCs) within the area include:

- Total Petroleum/Recoverable Hydrocarbons (TPH/TRH);
- Benzene, Ethyl-benzene, Toluene and Xylenes compounds (BTEX);
- heavy metals;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- phenols;
- Polychlorinated Biphenyls (PCBs);
- tetraethyl lead;
- perfluorocarbons; and
- asbestos containing materials.

These CoPCs are discussed in more detail below.

Future works to close out data gaps (most notably, assessment under now demolished infrastructure and in the vicinity of the drainage network) will supplement the current understanding of the nature and extent of impact, and the risk profile, as detailed below.

3.2 TPH/TRH and BTEX

3.2.1 Soil

Multiple soil impacts are present across the Western Area in the vicinity of previous operations, predominantly within former process areas known as Process Area West and Process Area East, within Tank Farms (Tank Farms A1, A2, A3, C, H, and J), and also in an area currently leased to a 3rd party for vehicle storage (located on the far western side of the Western Area). It is likely that the observed impacts are associated with discrete, localised hydrocarbon product losses to ground, which have occurred over the refinery's history. The soils are impacted by both lighter end and heavier end petroleum hydrocarbons. The vertical extent of impact is typically within the uppermost 3 metres, which typically comprises fill, silty gravels or silty clays.

There is a significant reduction in contaminant concentrations in deeper soils (> 3 mbgl), which is likely due to the low permeability clays found at this depth reducing downward migration of contamination. Clay has been found to occur as shallow as 1.5 mbgl and extends to at least 8 mbgl.

The distribution of soil impacts within the Western Area is presented on **Figures 4 to 7**, and on **Cross Section 1** below.

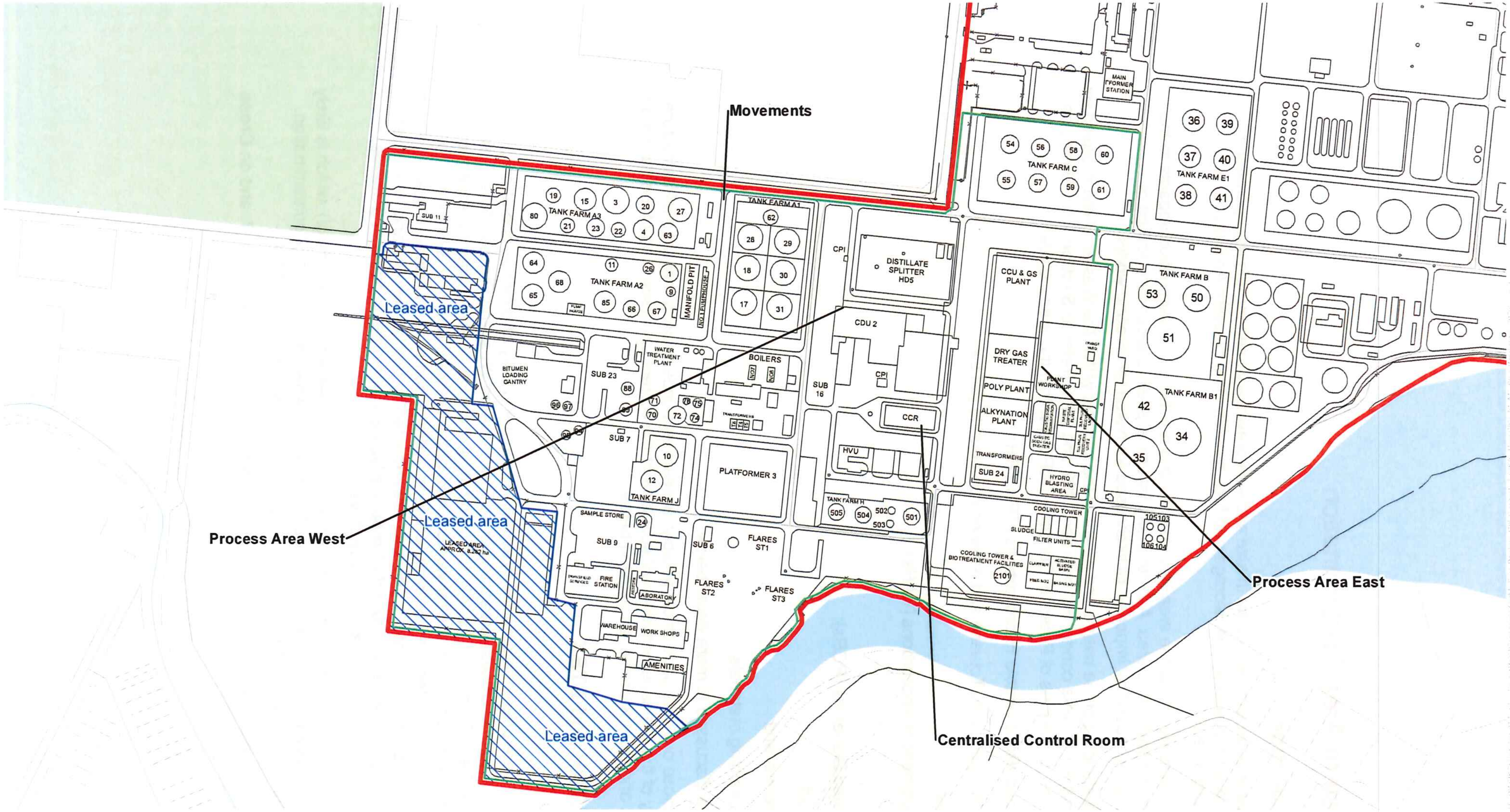


FIGURE 3 - WESTERN AREA LAYOUT

AECOM

0 50 100 200 m

KEY

- Approximate Western Area Boundary
- Site boundary
- Leased area
- Local road

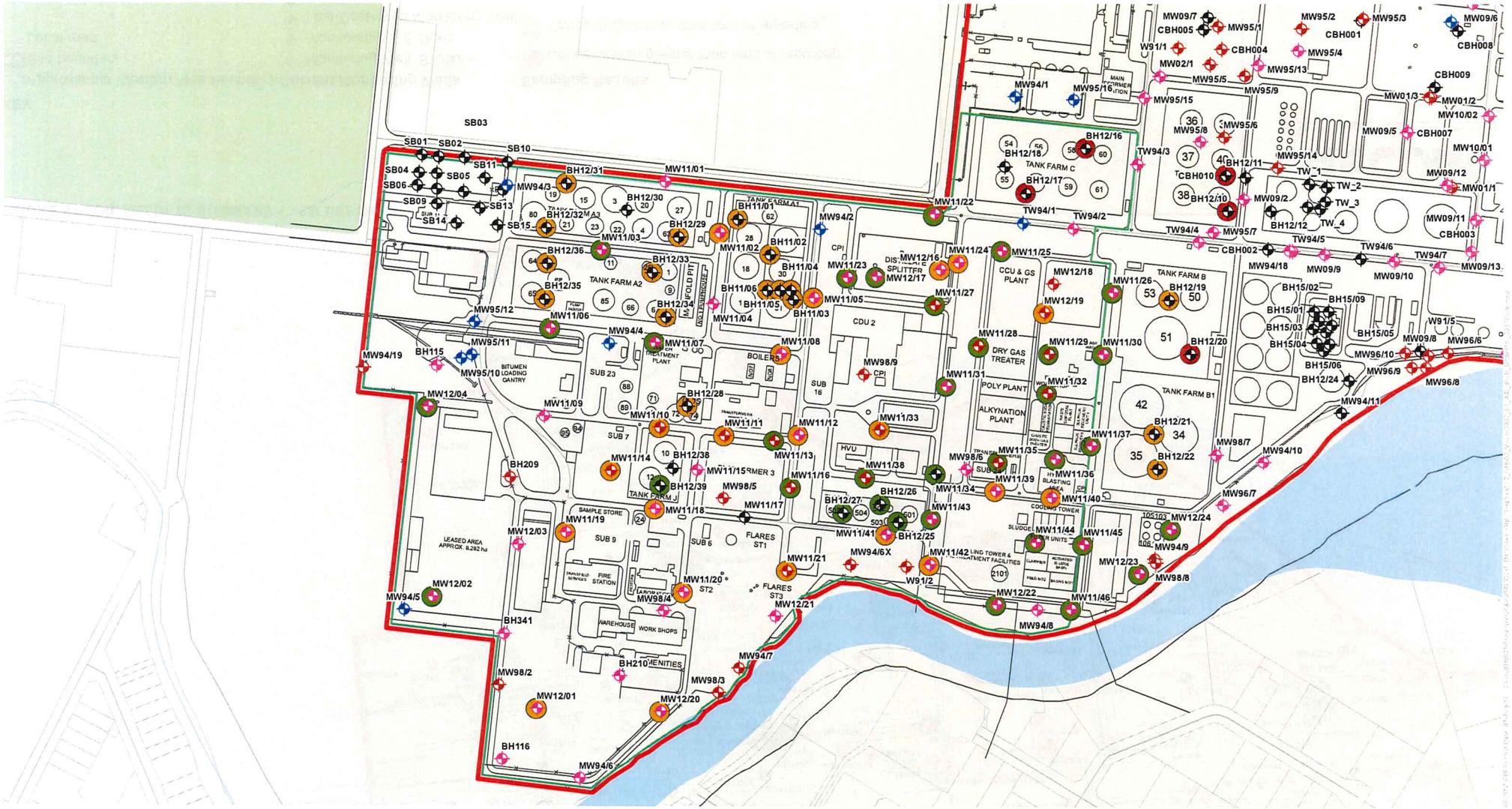


FIGURE 4 - SOIL RESULTS SUMMARY LESS THAN 1M DEPTH

AECOM

0 50 100 200 m

KEY

Approximate Western Area Boundary
Site boundary
Local road

Current Monitoring Wells

Monitoring Well, Shallow
Monitoring Well, Deep
Lost/Destroyed Monitoring Well
Other monitoring well/borehole

Sampling Results

Concentration exceeds HSL-D < 1m (NEPM 2013)
Concentration greater than limit of reporting
Concentration less than limit of reporting

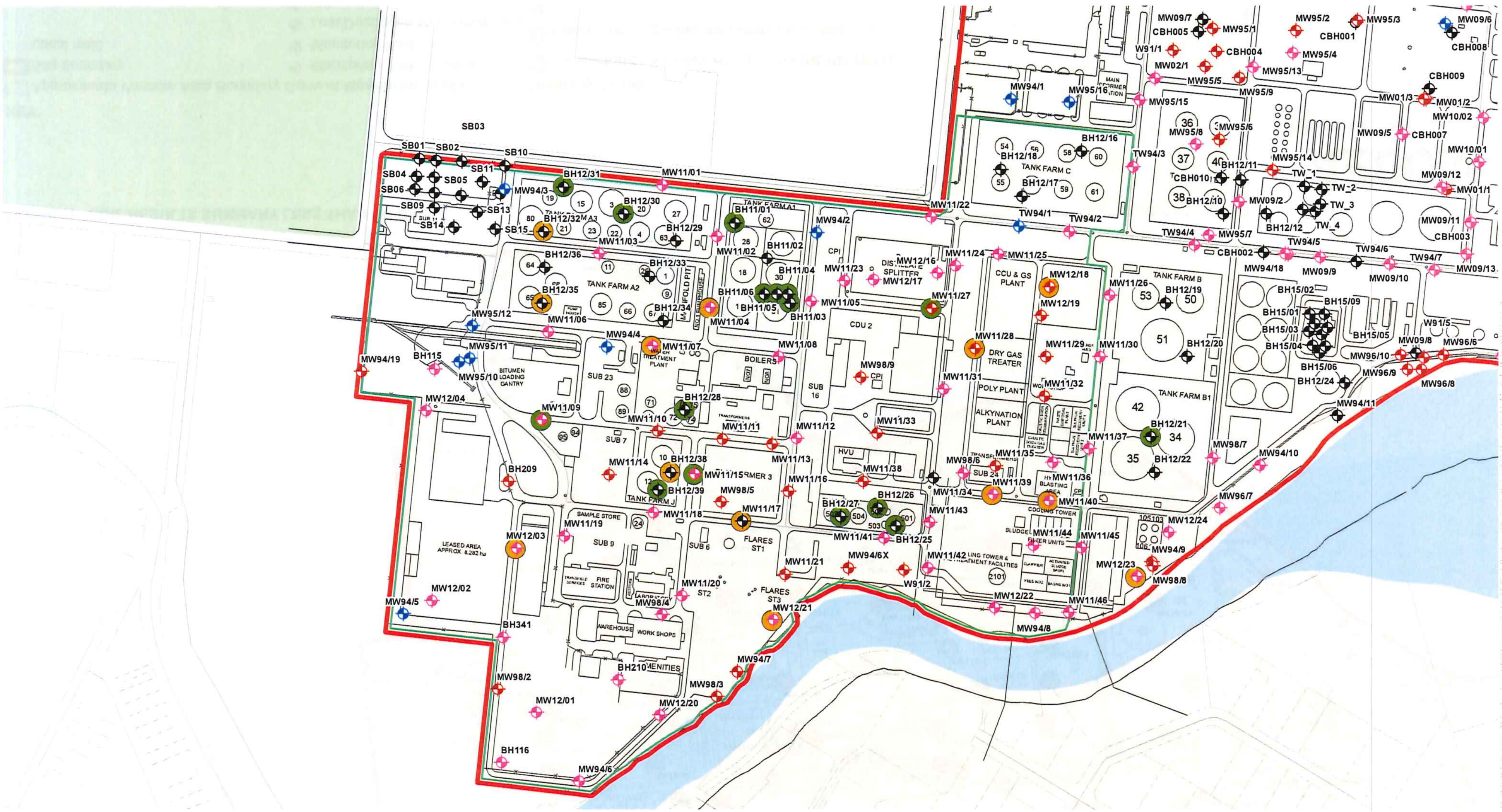


FIGURE 5 - SOIL RESULTS SUMMARY 1 - 2M DEPTH

AECOM

0 50 100 200 m

KEY

- Approximate Western Area Boundary
- Site boundary
- Local road

Current Monitoring Wells

- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- Other monitoring well/borehole

Sampling Results

- Concentration greater than limit of reporting
- Concentration less than limit of reporting

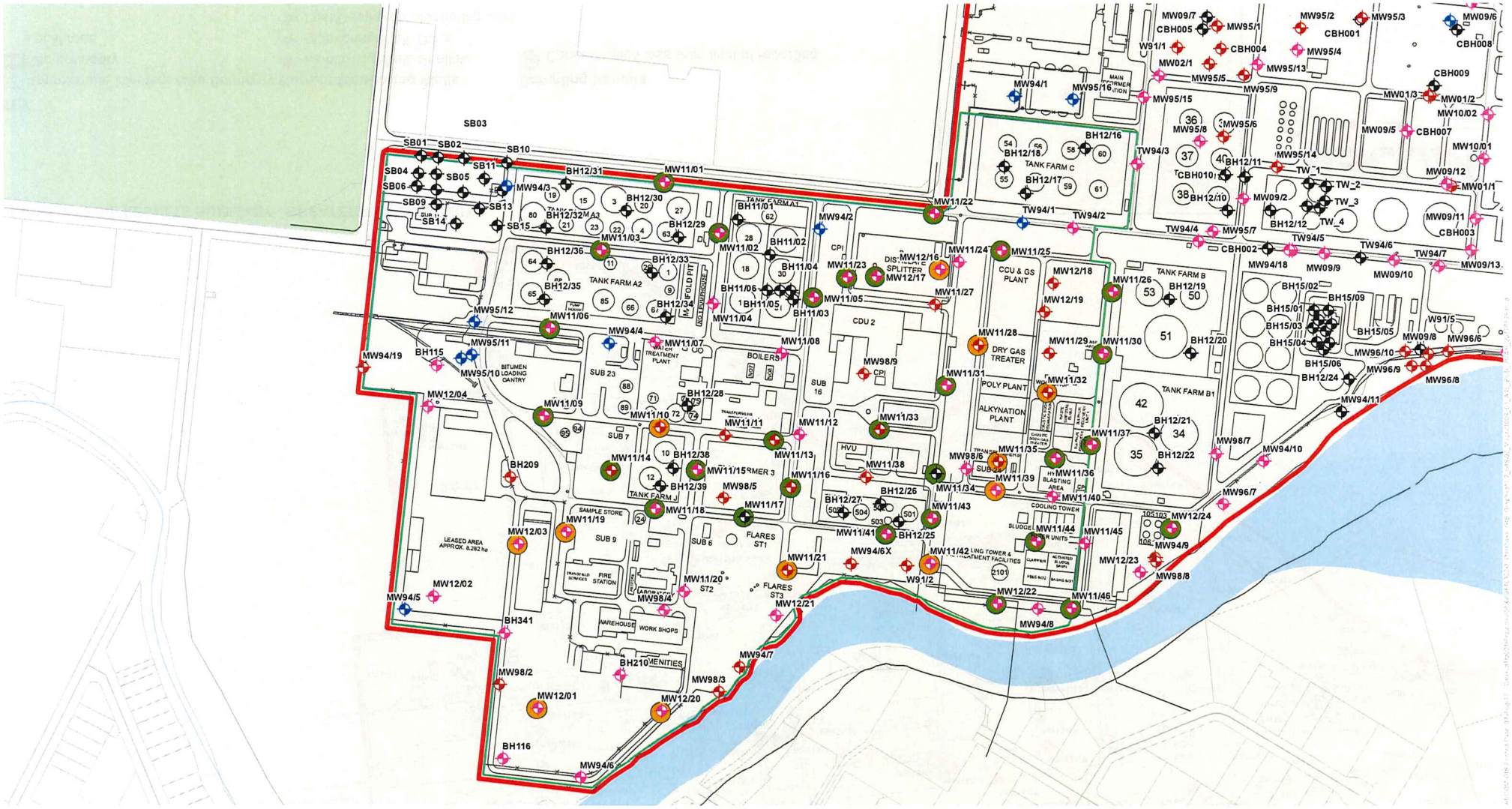


FIGURE 6 - SOIL RESULTS SUMMARY - 2 - 4M DEPTH

AECOM

N 0 50 100 200 m

KEY

Approximate Western Area Boundary
Site boundary
Local road

Current Monitoring Wells

Monitoring Well, Shallow
Monitoring Well, Deep
Lost/Destroyed Monitoring Well
Other monitoring well/borehole

Sampling Results

Concentration greater than limit of reporting
Concentration less than limit of reporting

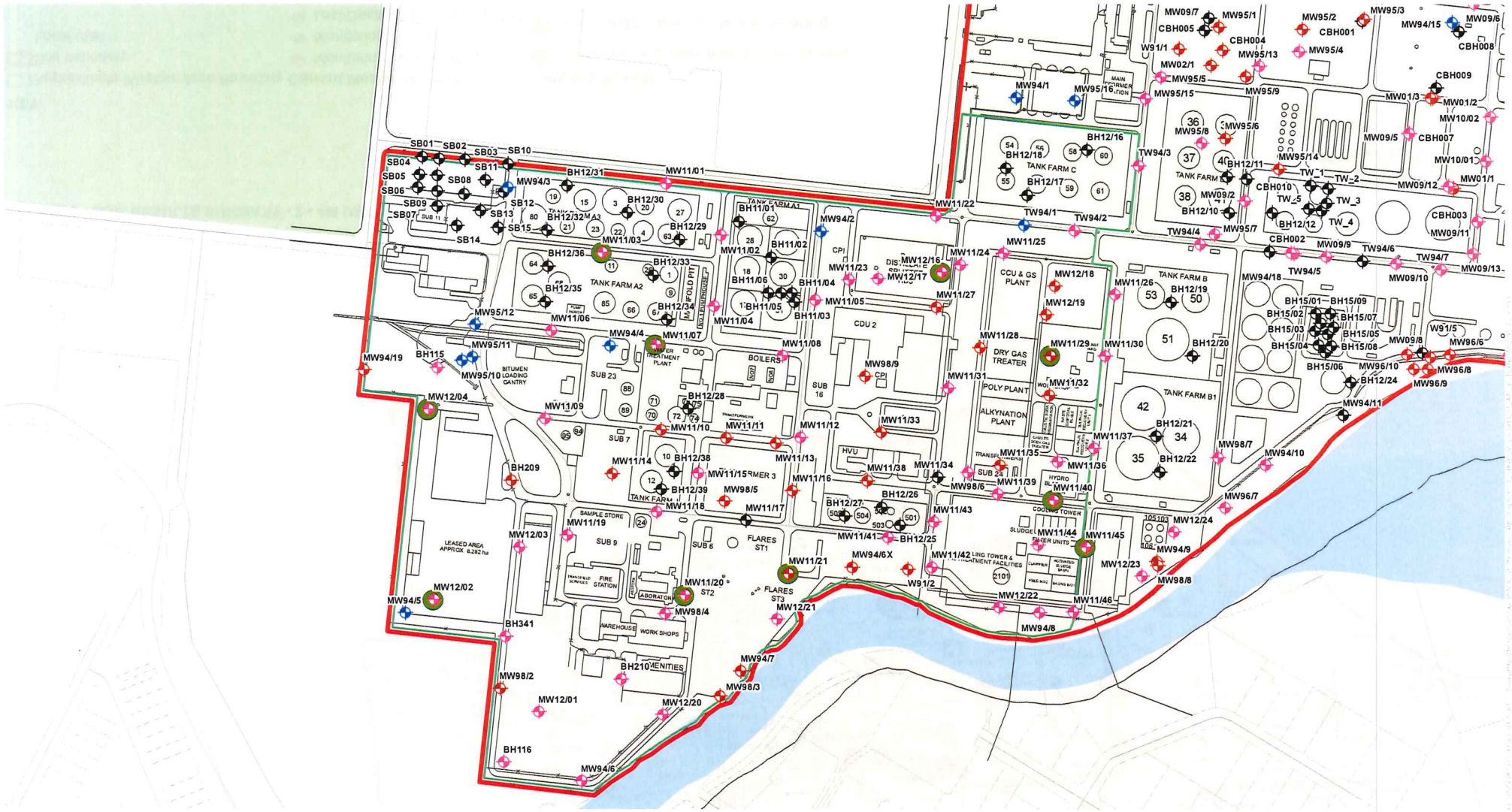


FIGURE 7 - SOIL RESULTS SUMMARY - GREATER THAN 4M DEPTH

AECOM

0 50 100 200 m

KEY

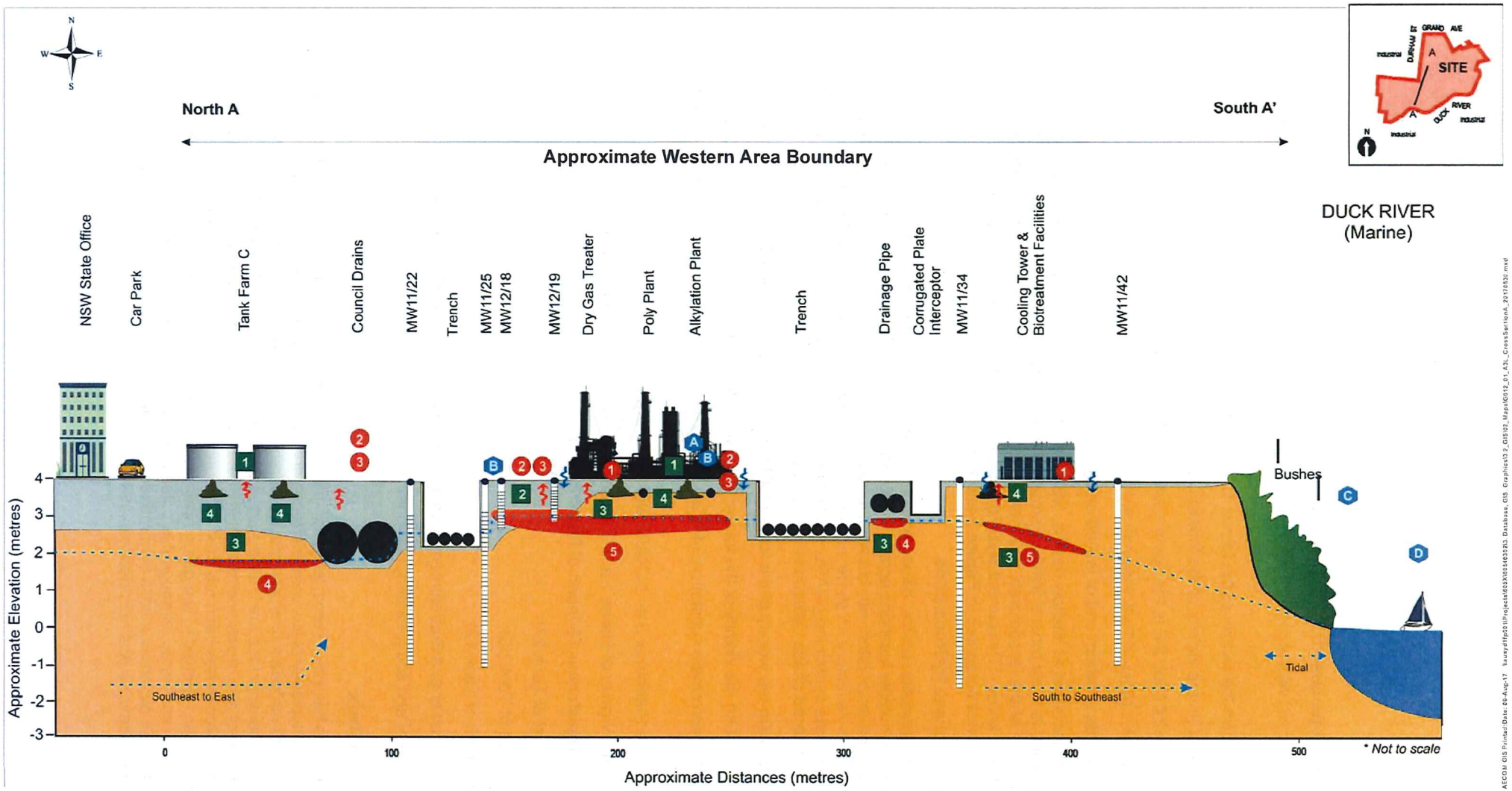
- Approximate Western Area Boundary
- Site boundary
- Local road

Current Monitoring Wells

- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- Other monitoring well/borehole

Sampling Results

- Concentration less than limit of reporting



CROSS SECTION A - APPROXIMATE WESTERN AREA BOUNDARY

POTENTIAL SOURCES	POTENTIAL PATHWAYS	POTENTIAL RECEPTORS
1 Historic leaks from tanks and pipes	1 Indoor inhalation of vapours migrating from shallow soil / groundwater through service lines or the floor slab.	A Onsite workers
2 LNAPL	2 Outdoor inhalation of vapours from shallow soil / groundwater	B Onsite Intrusive Workers
3 Dissolved Phase Impacts	3 Incidental ingestion and dermal contact with surface soil, shallow soil and groundwater	C Duck River Ecosystem
4 Soil Impacts	4 Groundwater flow in trench and/or pipe backfill	D Duck River Recreational Users
	5 Groundwater flow	

LEGEND

- Fill
- Alluvium / Stiff Clay
- Dissolved Phase
- LNAPL
- Soil Impacts
- Groundwater Monitoring Well
- Tanks / Pipeworks
- Oxygen Ingress
- Vapour Migration
- Groundwater Potentiometric Surface

AECOM

AECOM GIS Printed/Date: 06-Aug-17 I:\survey\ffps01\Projects\605X\60569263\5. Database, GIS, Graphics\3.2_GIS\02_Maps\IG612_01_A3L_CrossSectionA_20170530.mxd

3.2.2 Light Non Aqueous Phase Liquid (LNAPL)

LNAPL (petroleum product) was reported in five separate locations within the Western Area. These were:

- Process Area East (in the vicinity of the former CCU and GS Plant);
- Process Area West (in the vicinity of the former Distillate Splitter);
- West of Substation 24 (Sub 24) in the south eastern part of the Western Area;
- South of Platformer 3 (east of Tank Farm J); and
- leased area (towards southern end of leased area).

The LNAPL has been recorded at shallow depths, typically occurring between 0.5 and 3 mbgl. Its lateral extent varies and is likely most significant around the groundwater wells in Process Area East and at the southern end of the leased area. The distribution of LNAPL in the vicinity of the drainage network is currently not known. The current understanding of LNAPL (and dissolved phase hydrocarbon) distribution is presented in **Figure 8** and **Figure 9**.

3.2.3 Dissolved phase hydrocarbons

Similar to the soil contamination profile, dissolved phase hydrocarbon impacts in the groundwater have been recorded in multiple locations across the Western Area. Similar to the soil impacts, its occurrence is likely to be associated with discrete, localised hydrocarbon losses to ground that have occurred over the refinery's history. In some instances, the dissolved phase hydrocarbon impact is close to groundwater wells containing LNAPL, suggesting a broader or more significant area of impact. The distribution of dissolved phase detections is detailed below:

- Process Area East (in the vicinity of the former CCU and GS Plant and LNAPL wells in this area);
- Process Area West (in the vicinity of the former Distillate Splitter and LNAPL well in this area);
- in the vicinity of transformers substation 24 and south of the waste disposal plant (eastern edge of the Western Area);
- in the vicinity of the Platformer 3 and LNAPL well in this area;
- Flares area (in the vicinity of Flares 1 and 3 at the southern end of the project area);
- in the vicinity of Transformer T8 (north of Platformer 3);
- Tank Farm A3 (East of Tank 27);
- Tank Farm C (East of Tank 60);
- Tank Farm J (South of Tank 12);
- South of Cooling Tower and Biotreatment Farm (south eastern corner of Western Area); and
- leased area (central and south-eastern portions).

3.3 Heavy metals

A range of heavy metals have been reported within the shallow soils and groundwater of the Western Area. These metals are typically at low concentrations and potentially associated with imported (previously impacted) fill materials or representative of regional background conditions, although this is to be confirmed. Detections include lead, chromium, copper, nickel, and zinc. Generally low concentrations of trivalent and hexavalent chromium impact have been recorded in a number of soil locations. Trivalent chromium has been reported in groundwater. Low concentrations of hexavalent chromium have also been reported in two groundwater wells south of Tank Farm A2. The source of the impact has not been confirmed, although it is potentially associated with the chromium impacts (within waste used as fill) observed across the broader Camellia Peninsula, which resulted from the activities of Chrome Chemicals Australia between 1940 and 1970.

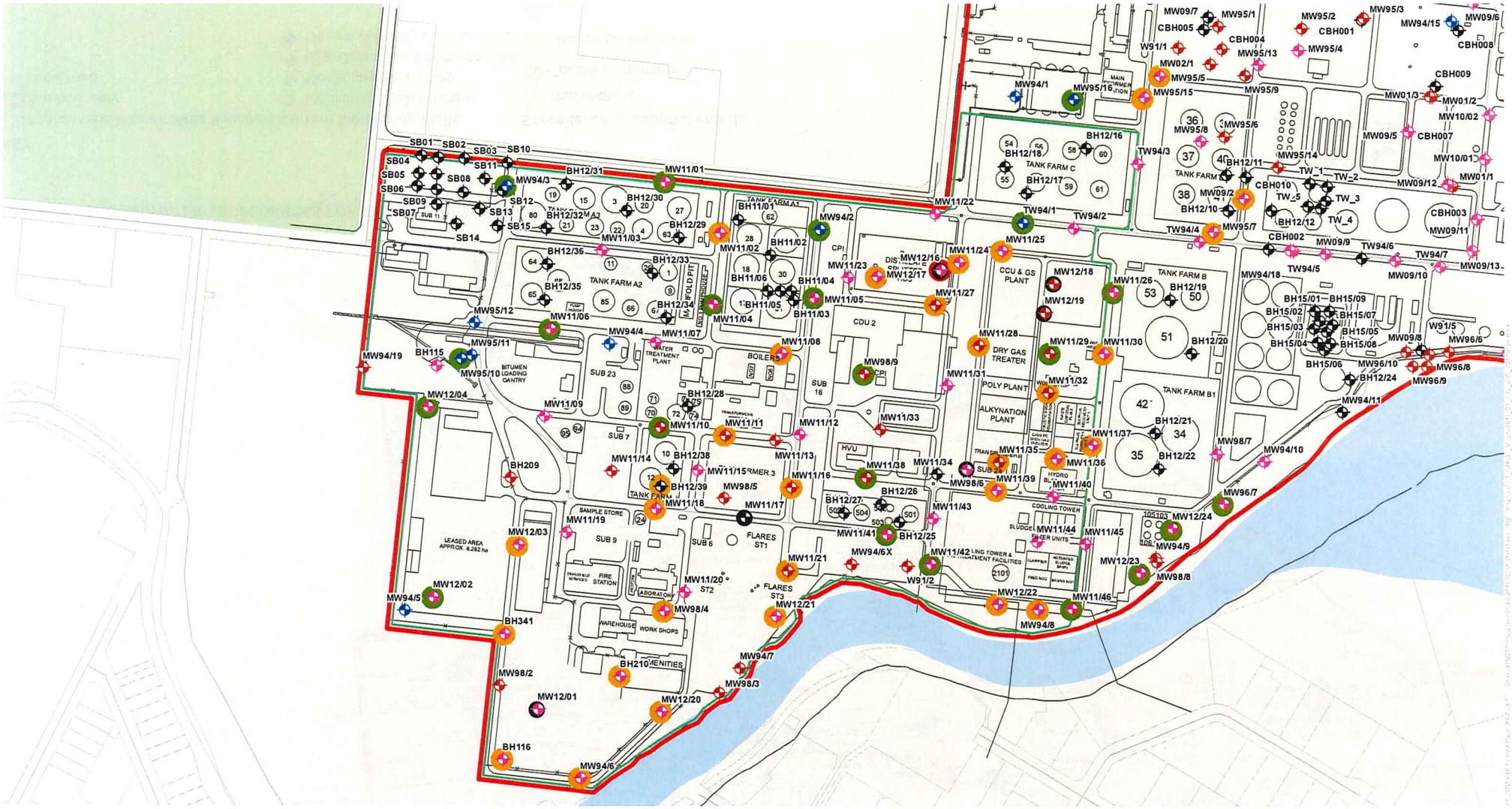


FIGURE 8 - HYDROCARBONS IN GROUNDWATER DETECTIONS SUMMARY (2012-2016)

KEY

- Approximate Western Area Boundary
- Site boundary
- Local road

Current Monitoring Wells

- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- Other monitoring well/borehole

Sampling Results

- LNAPL detected (one or more rounds)
- Concentration exceeds HSL-D (NEPM 2013)
- Concentration greater than LOR (one or more rounds)
- Concentration less than limit of reporting

AECOM

0 50 100 200 m

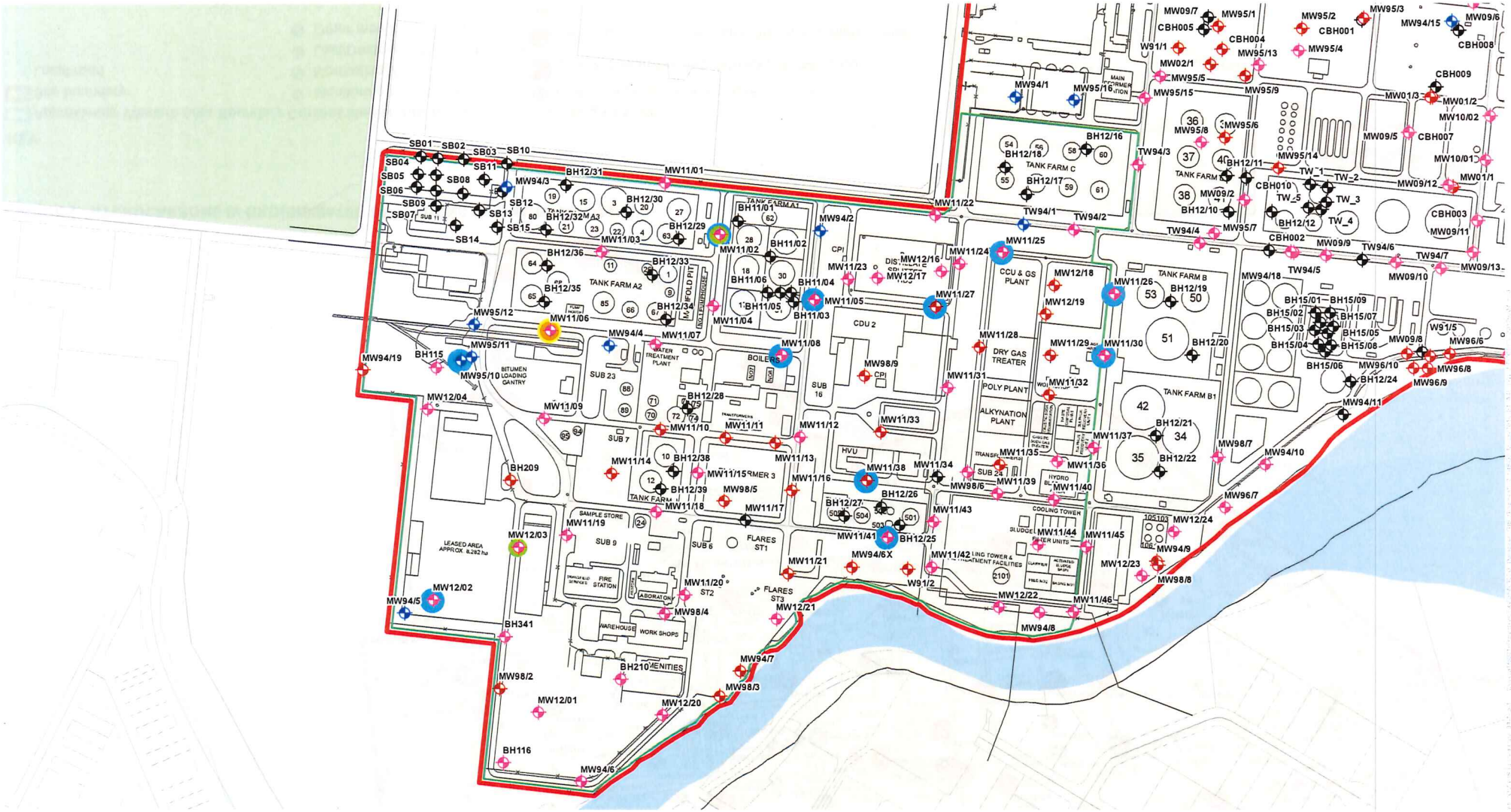


FIGURE 9 - GROUNDWATER EXCEEDENCES FOR NON PETROLEUM COPCs (2012-2016)

KEY

Approximate Western Area Boundary
Site boundary
Local road

Current Monitoring Wells

Monitoring Well, Shallow
Monitoring Well, Deep
Lost/Destroyed Monitoring Well
Other monitoring well/borehole

Exceedence of adopted criteria

Naphthalene
Trivalent chromium
Hexavalent chromium
Lead

AECOM

0 50 100 200 m

3.4 Perfluorocarbons

Various aqueous film forming foam (AFFF) products which contain per- and polyfluoroalkyl substances (PFAS) have been historically stored, handled and used at the Site during fire training exercises. The fire training area is situated outside of the Western Area (to the North- East).

Groundwater monitoring data for PFAS is available from 2011. A Groundwater Monitoring Report from 2017 (ERM, March 2017) indicates that low concentrations of PFAS have been recorded in groundwater in the southern part of the Western Area as follows:

- southern end of leased area;
- in the vicinity of the former Workshop, Fire Services station and the Laboratory (East of the leased area);
- South of Tank Farm J;
- in the Flares area;
- South of Tank Farm H;
- in the Hydroblasting area (eastern edge of Western Area); and
- on the south-eastern corner of Western Area south of basins number 1.

There was also a single PFAS detection in the North-West of the Western Area (west of Tank Farm A3).

3.5 Asbestos containing materials

The Stage 1 and Stage 2 Environmental Site Assessment for the Site (ERM, October 2012) reported that "*asbestos was not visually observed during the advancement of any of the 91 boreholes, and returned only one positive identification (MW11/14) in the 46 samples analysed by the laboratory. MW11/14 [located West of Tank Farm J] was observed to be within the footprint of a former building structure at 0.3m below ground surface (bgs), which is considered to be the likely source (during demolition)*". The presence of this observation and the likely presence of demolition waste in the Western Area, mean that asbestos remains a CoPC at this stage.

3.6 Other chemicals of potential concern

Although there is limited laboratory data available to date, the Environmental Condition Summary Report (ERM, August 2012) identifies seven areas within the Western Area where anecdotal information has suggested potential locations of buried waste (Annex B, Figure B3 of that report). These include:

1. Alkyl waste (one area at the southern end of the leased area, and one area North-East of this towards Flares Stage 3 area).
2. Corrugated Plate Interceptor (CPI) South-West of the fire station (within leased area).
3. Tank Farm containing possible lead and hydrocarbons (within central part of leased area).
4. Platformate floating on groundwater (eastern side of Tank Farm C). It is to be confirmed whether this is buried waste or whether the groundwater impact is a result of a loss of primary containment.
5. Hydrofluoric acid sludge (proximal to Flares Stage 3 area).
6. Water treatment solids (PAH contamination) (within leased area).
7. Di-phenol propane, Epichlorhydrin (ECH) xylene, epoxy resins (within leased area).
8. Tank Farm C: Buried Leaded sludge.

In addition, Figure B4 within Annex B of the ERM summary report (ERM, August 2012) indicates that buried leaded sludge may be present at the southern end of the leased area and the flares area.

3.7 Tier 1 screening

3.7.1 Introduction

As part of the preparation of the Conceptual Remediation Action Plan (RAP) for the Western Area, appropriate soil and groundwater criteria will be reconfirmed and data sets will be re-evaluated.

Screening will also take into account the 2013 National Environment Protection Measure (NEPM) Management Limits, which consider the formation of LNAPL, fire and explosion risks, damage to buried infrastructure and aesthetics.

Following this screening, identified data gaps will be closed, with any new data incorporated into the screening/risk assessment process to support the detailed RAP. The site contamination risk profile may be updated as a result of new data, however, for the purposes of this SSD call in, existing screening assessments (and the current extensive data set) have been deemed as sufficient at this stage.

3.7.2 Soils

A Tier 1 screening assessment was completed by ERM (ERM, October 2012) against commercial/industrial criteria and exceedances of the criteria for TRH (C6 – C10) (HSL D - Vapour Intrusion) were identified in two locations, both within Tank Farm C at the north-eastern end of the Western Area.

3.7.3 Groundwater

The 2016 groundwater monitoring report (ERM, March 2017) detailed the following exceedances of criteria[1] relevant to the Western Area:

- in the vicinity of Tank Farm A3 - Naphthalene (NEPM 2013 – Marine Water);
- on the eastern edge of leased area - Naphthalene (NEPM 2013 – Marine Water); and
- South of Tank Farm A2 - Trivalent chromium (NEPM 2013 – Marine Water).

None of the reported detections of PFAS analytes in the Western Area were found to exceed human health or ecological criteria[2]. There have been measured exceedances of PFAS criteria to the North-East of the Western Area, however, these are not within nor considered to be related to the former operations within this part of the Site.

The 2015 groundwater monitoring report (ERM, March 2016[3]) detailed the following exceedances of criteria relevant to the Western Area:

- in vicinity of Tank Farm A3 - Naphthalene (NEPM 2013 – Marine Water);
- on eastern edge of leased area - Naphthalene (NEPM 2013 – Marine Water); and
- South of Tank Farm A2 - Trivalent chromium (NEPM 2013 – Marine Water).

The 2013 groundwater monitoring report (ERM, April 2014[4]) detailed the following exceedances of criteria relevant to the Western Area:

- in the vicinity of Tank Farm A3 - Naphthalene (NEPM 2013 – Marine Water);
- South of Tank Farm A2 – Hexavalent and trivalent chromium (NEPM 2013 – Marine Water);
- East of Tank Farm A1 – Lead (NEPM 2013 – Marine Water);
- two wells in the vicinity of the former CGU and GS Plant – Lead (NEPM 2013 – Marine Water);

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[1] CRC CARE Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (Friebel and Nadebaum, 2011), with site specific modifications; and NEPM 2013 values which reference ANZECC/ARMCANZ, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000 (ANZECC 2000).
[2] EnHealth (2016) Interim National Guidance on Human Health Reference Values for Per- and Polyfluoroalkyl Substances for Use in Site Investigations in Australia (recreational water quality and site specific groundwater incidental direct contact); and Marine Waters 95% Species Protection - Interim Trigger Value, Department of the Environment and Energy (2016), Commonwealth Environmental Management Guidance on Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA). October 2016.
[3] Quarter 4 (2015) Groundwater Monitoring Event and Annual Summary – Clyde and Parramatta Terminal, March 2016 (ERM, March 2016).
[4] Quarter 4 (2013) Groundwater Monitoring Event– Shell Clyde Terminal, April 2014 (ERM, April 2014).

- East of Tank Farm A1 – Lead (NEPM 2013 – Marine Water); and
- on the eastern edge of leased area - Naphthalene (NEPM 2013 – Marine Water).

The 2012 groundwater monitoring report (ERM, March 2013[5]) detailed the following exceedances of criteria relevant to the Western Area:

- In the vicinity of Tank Farm A3 – Lead (ANZECC 2000 – Marine Water);
- in the vicinity of Tank Farm A3 – Lead (ANZECC 2000 – Marine Water);
- South of Tank 31 – Lead (ANZECC 2000 – Marine Water);
- in the vicinity of the former CGU and GS Plant – Lead (ANZECC 2000 – Marine Water);
- South of the Distillate splitter– Lead (ANZECC 2000 – Marine Water);
- North of Tank Farm H– Lead (ANZECC 2000 – Marine Water);
- North of Tank Farm H– Lead (ANZECC 2000 – Marine Water);
- central part of leased area– Lead (ANZECC 2000 – Marine Water);
- northern edge of leased area– Lead (ANZECC 2000 – Marine Water); and
- Process Area West (CRC Care HSL Commercial Vapour Intrusion and ANZECC 2000 – Marine Water).

[5] Quarter 4 (2012) Groundwater Monitoring Report – Shell Clyde Refinery and Parramatta Terminal, March 2013 (ERM, March 2013).

4.0 Remediation Approach

4.1 Overview

The Western Area is considered to be significantly contaminated under the CLM Act (refer to **Section 2.4** and **Chapter 3**).

The remediation of the Western Area may be complex and require a number of remediation techniques. **Chapter 3** has provided an overview of the contamination identified in the Western Area. This chapter presents the relevant business and remediation objectives for the Project and also presents a summary of the remediation techniques that are currently being considered.

The Conceptual RAP being developed for this Project will identify which remediation techniques will likely be required and the overarching remediation strategy for the Western Area. Once complete, the Conceptual RAP would be used to help complete the environmental assessment required under the EP&A Act for the Project (refer to **Section 6.1**).

4.2 Viva Energy business objectives

The overarching Viva Energy business objectives that are directly relevant to the Project objectives are as follows:

1. Ensure the on-going operational viability of Clyde terminal assets and associated licenses to operate (including but not limited to Safework NSW MHF License, EPA license, SSD consent conditions).
2. Ensure any future redevelopment decisions are considerate of the operational requirements of the existing terminal.
3. Meet applicable regulatory requirements.

4.3 Project objectives

The remediation objectives for the Western Area (which will be confirmed in the Conceptual RAP) are:

1. Assess the need for remediation, and where remediation is required, evaluate appropriate technologies to establish remedial end points which are realistic and achievable.
2. Remediate the soil and groundwater in the Western Area, where required, to enable the land to be used for commercial / industrial purposes in the future.
3. Remediate the soil and groundwater in the Western Area, where required, to reduce the risk of contamination from the land adversely affecting human health and the environment.
4. Ensure any approved remediation process implemented adheres to all applicable regulatory requirements so as to limit or eliminate where possible adverse effects to human health or ecological receptors. Particular focus is to be placed on ensuring the drainage system is designed to be adequate to support both the remediation period and the post remediation period (requirements for other utilities should also be considered).
5. Establish post remediation management and/or monitoring measures (if required, and with end dates) that can be implemented once remediation works have been completed to the extent practicable.

4.4 Nature and extent of remediation required

There are multiple locations across the Western Area that will require remediation in order to meet the remediation objectives stated above (refer to **Chapter 3**). However, although remediation is required in certain parts of the Western Area, it is not likely to be necessary everywhere, with impacts confined to particular areas or linear features.

Where remediation is required, the focus of this remediation will be on:

- addressing petroleum hydrocarbons in shallow horizons that are likely to pose a dermal contact or vapour inhalation risk to future site occupiers;
- removing LNAPL to the extent practicable; and
- ensuring short or long term risks to the environment are removed or mitigated.

The remediation will predominantly be within 4 metres of the ground surface, and will be generally focused on horizons within 2 m of the ground surface, including soil impact, LNAPL (in limited areas), and likely soils/sludges in the drainage network and surrounds.

Shallow LNAPL impacts would be addressed as part of the soil works, however the requirement, if any, for additional groundwater remediation is currently not confirmed and would be based on the findings of the data gap works. As such, groundwater remediation techniques have been included in the discussion on remediation technologies provided in **Section 4.6** below. The requirements, if any, relating to buried waste areas will also be confirmed as the investigations proceed.

The remediation broadly assumes that the major primary sources of Contaminants or Potential Concern (CoPC) have already been removed and remedial works are to mainly address secondary sources (impact within shallow soils, LNAPL, and sludges). However, it is likely that some relic infrastructure could potentially remain (in addition to the drainage network), which will be factored into contingency measures within the final remediation design. The management of asbestos in soils may also be required.

4.5 Project Remediation Action Plan development

The RAP for the Project would be developed in general accordance with the applicable environmental legislation and standards, including:

- The *Contamination Land Management Act 1997 (NSW)*;
- *State Environmental Planning Policy 55 – Remediation of Land* (SEPP 55);
- Guidelines for the Assessment and Management of Groundwater (DEC, 2007); and
- Guidelines for the NSW Site Auditor Scheme (2nd edition), (DEC, 2006).

The structure of the Conceptual RAP will be in general accordance with the Guidelines for Consultants Reporting on Contaminated Sites (OEH, 1997, reprinted 2000 & 2011).

In order to develop the document, a number of steps need to be completed. These include:

- confirming the ground conditions at the site (refer to **Chapter 3**);
- identifying the land use objectives for the site (currently commercial / industrial land uses);
- agreeing remediation objectives (refer to **Section 4.3**);
- reviewing and agreeing appropriate remediation technologies; and
- confirming the remediation strategy for the land based on the above.

The Conceptual RAP will document the work required to support the bullet points above.

A key part of developing the Conceptual RAP will be to identify which remediation technique or group of techniques are recommended to be implemented to achieve the remediation objectives.

Remedial measures can be used to effectively remove or block exposure pathways to human health or the environment. The application of a single remediation technique for the Western Area could be appropriate, scaled accordingly based on the volume requiring treatment. However, multiple remedial approaches could also be warranted to achieve the remediation objectives.

Furthermore, remediation can often be complemented with management controls, where comprehensive remediation is not deemed as practicable. Management measures can also be useful where clean up to the extent practicable has been achieved (e.g. post LNAPL removal during remediation, restriction on groundwater abstraction whilst Monitored Natural Attenuation (MNA) continues to reduce concentrations of dissolved phase hydrocarbons).

The relative advantages and disadvantages of each potential remediation technology are being considered within the Conceptual RAP based on five factors:

1. Technical viability: both to implement and timeframe required.
2. Logistical requirements.
3. Financial: capital and operational cost of implementation.
4. Sustainability considerations.
5. Regulatory and community acceptance.

Each technology will ultimately be retained or removed from further discussion based on these factors.

For the purposes of this document, each of the remediation technologies that are being assessed (technologies A to K) are introduced in **Section 4.6** below.

For the Conceptual RAP, a qualitative assessment of potential remediation technologies against the five factors listed above is being undertaken. Following preparation of the Conceptual RAP, additional characterisation and assessment works are likely to be completed, which have the potential to modify the scale/scope of remediation required. With this more detailed information (e.g. volume of impact requiring remediation), a quantitative approach can be taken to re-evaluate the remedial technologies; this re-evaluation will be presented in the Detailed RAP.

4.6 Overview of remediation technologies

Table 2 below provides an overview of remediation technologies that could be used to meet the remediation objectives for the Project, given the nature and extent of the contamination in the Project area.

Tables 3 to 13 below present a discussion on remediation technologies A to K. These technologies are appropriate given the ground conditions and remediation objectives described and include:

A. In-Situ Biological Treatment Techniques to Target Soils
B. In-Situ Physical or Chemical Treatment to Target Soils
C. In-Situ Thermal Treatment to Target Soils
D. Engineering Controls to Target Soils
E. Ex Situ Biological Treatment to Target Soils
F. Ex Situ Thermal to Target Soils
G. Offsite Disposal to Target Soils
H. In-Situ Biological Treatment Techniques to Target Groundwater
I. In-Situ Physical or Chemical Treatment to Target Groundwater
J. In-Situ Thermal Treatment to Target Groundwater
K. Ex-Situ Treatment to Target Groundwater.

Table 2 Remediation technologies overview

	Soil	Groundwater
In Situ Remediation Alternatives	**(A) In Situ Biological Treatment** - Bioventing - Enhanced bioremediation **(B) In Situ Physical/Chemical Treatment** - Soil Vapour Extraction - Soil Flushing **(C) In Situ Thermal Treatment** **(D) Engineering Controls** - Vapour Barrier and Mitigation	**(H) In Situ Biological Treatment** - Natural Zone Depletion* - Monitored Natural Attenuation* - Biosparging **(I) In Situ Physical/Chemical Treatment** - Air Sparging **(J) In Situ Thermal Treatment**
Ex Situ Remediation Alternatives	**(E) Ex Situ Biological Treatment** - Biopiles/Landfarming/Compositing **(F) Ex Situ Thermal** - Thermal Desorption **(G) Off-site disposal**	**(K) Ex Situ Treatment** - Pump and Treat Systems (total fluids) - Dual Phase Extraction - Multiphase Extraction - Excavation of (LNAPL) impact (+/- dewatering)

* it is noted that these approaches are not typically recognised as remedial technologies in isolation, however, they have been included given their potential role in mass reduction.

Table 3 A. In-Situ Biological Treatment Techniques to Target Soils

Method	Discussion
Bioventing	***Technical*** Bioventing is a commonly used technology whereby oxygen is delivered to unsaturated soils by forced air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate biodegradation of aerobically degraded compounds. In contrast to soil vapour vacuum extraction, bioventing uses low air flow rates to provide only enough oxygen to sustain microbial activity. Oxygen is most commonly supplied through direct air injection into residual soil contamination. In addition to degradation of adsorbed fuel residuals, volatile compounds are biodegraded as vapours move slowly through biologically active soil. ***Logistical*** Bioventing is a short to medium-term remedial technology (potentially 1-3 years). Health and safety risks are primarily associated with the installation of wells and can be managed through the application of standard management practices. ***Financial*** Capital costs associated with this approach are considered moderate and driven primarily by well installation and oxygen delivery systems. Operational costs are considered low to moderate and primarily associated with maintenance of the oxygen delivery system and wells together with performance monitoring. ***Sustainable*** The waste stream generated by this approach would essentially be limited to drilling cuttings management. ***Regulator and Community Acceptance*** As the technology is well established, it is anticipated that regulatory and community acceptance would be favourable.

Method	Discussion
Enhanced Bioremediation	***Technical*** Enhanced bioremediation is a process in which indigenous or inoculated micro-organisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or groundwater. Nutrients, oxygen, or other amendments may be used as an additional step to enhance bioremediation and contaminant desorption from subsurface materials. Bioremediation techniques have been successfully used to remediate petroleum hydrocarbon impacted soils and groundwater and they are especially effective for remediating low level residual contamination in conjunction with source removal. Bioremediation often does not require subsurface heating, requires relatively inexpensive inputs, such as nutrients, and usually does not generate residual bi-products requiring additional treatment or disposal. Compared with other technologies, such as thermal desorption and incineration (which require excavation and heating), thermally enhanced recovery (which requires heating), chemical treatment (which may require relatively expensive chemical reagents), and in situ soil flushing (which may require further management of the flushing water), bioremediation presents a cost advantage in the treatment of petroleum hydrocarbons. Factors that may limit the applicability and effectiveness of the process include: • The circulation of water-based solutions through the soil may increase contaminant mobility and necessitate treatment of underlying ground water; • preferential colonization by microbes may occur causing clogging of nutrient and water injection wells; and • preferential flow paths may severely decrease contact between injected fluids and contaminants throughout the target zones. The system should not be used for clay, highly layered, or heterogeneous subsurface environments because of oxygen (or other electron acceptor) transfer limitations. ***Logistical*** Bioremediation clean up timeframes can be considered as short to medium term (in the order of 1 to 3 years). Health and safety risks are primarily associated with the installation of wells and handling of nutrients that can be managed through the application of standard management practices. ***Financial*** Capital costs associated with this approach are considered moderate and driven primarily by well and nutrient delivery system installation. Operational costs are considered moderate and primarily associated with maintenance of the nutrient delivery system, the bio-fouling of wells and performance monitoring. ***Sustainable*** The waste stream generated by this approach would essentially be limited to drilling cuttings management. ***Regulator and Community Acceptance*** As the technology is well established, it is anticipated that regulatory and community acceptance would be favourable.

Table 4 B. In-Situ Physical or Chemical Treatment to Target Soils

Method	Discussion
Soil Vapour Extraction (SVE)	***Technical*** SVE is an in-situ unsaturated zone soil remediation technology in which a vacuum is applied to induce the controlled flow of air and remove volatile and some semi-volatile contaminants from the subsurface. The gas extracted from the soil may be collected and treated to recover or destroy the vapour phase contaminants. Geomembrane or other relatively impermeable covers are often required over the soil surface to prevent short circuiting and to increase the radius of influence of the wells. This is typically required at sites within a widespread lateral distribution of fill materials and impacts are present. The technology is typically applicable only to volatile compounds, however, because the process involves the continuous flow of air through the soil, it often promotes the in-situ biodegradation of low-volatility organic compounds. Complexities associated with implementation of SVE at a site include the following: • vapour partitioning from the smear zone is likely to be slow; • ex-situ vapour treatment is typically required which can increase implementation costs and operational complexities; • unless undertaken in conjunction with groundwater remediation, smear zone impacts have the potential to be redistributed due to water level fluctuations and negate the effects of SVE; and • SVE can be somewhat ineffective in the saturated zone and would require groundwater drawdown to expose a greater depth of impacted soil. ***Logistical*** SVE clean up timeframes to achieve the greatest redevelopment potential can be considered to be short to medium term (2 to 5 years) and is based on the volatility of constituents in soil. Health and safety risks are primarily associated with the installation of wells and operational risks associated with maintaining and operating a vacuum system. These risks can, however, be managed relatively easily through the implementation of standard management practices. ***Financial*** Capital costs associated with this approach are considered moderate to high and driven primarily by vacuum equipment and vapour management requirements together with well installation. Operational costs are considered moderate and primarily associated with vapour management. ***Sustainable*** The waste stream generated by this approach is primarily associated with vapour extraction and drilling cuttings management. ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.

Method	Discussion
Soil Flushing	***Technical*** In situ soil flushing is the extraction of contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids are recovered from the underlying aquifer and, when possible, are recycled. Cosolvent flushing involves injecting a solvent mixture (e.g., water plus a miscible organic solvent such as alcohol) into either the unsaturated zone, saturated zone, or both to extract organic contaminants. Cosolvent flushing can be applied to soils to dissolve either the source of contamination or the contaminant plume emanating from it. The cosolvent mixture is normally injected upgradient of the contaminated area, and the solvent with dissolved contaminants is extracted downgradient and treated above ground. The target compounds for soil flushing are typically inorganics, however, the technology has been used to treat hydrocarbons. ***Logistical*** Clean up timeframes can be considered as short to medium term (in the order of 1 to 3 years). Health and safety risks are primarily associated with the management and storage of materials and waste streams. ***Financial*** The separation of surfactants from recovered flushing fluid, for reuse in the process, is a major factor in the cost of soil flushing. Whilst the application of soil flushing can be considered feasible, the typically high costs compared to alternative approaches and more importantly the inherent risk that the flushed contaminants can move beyond capture zones limits the appeal of this option. ***Sustainable*** Recovered ground water and flushing fluids with the desorbed contaminants may need treatment to meet appropriate discharge standards prior to recycle or release. Treatment of the recovered fluids results in process sludges and residual solids, such as spent carbon and spent ion exchange resin, which must be appropriately treated before disposal. Air emissions of volatile contaminants from recovered flushing fluids should be collected and treated, as appropriate, to meet regulatory standards. ***Regulator and Community Acceptance*** Discharge and emissions standards require planning, engagement and management during the process.

Table 5 C. In-Situ Thermal Treatment to Target Soils

Method	Discussion
In Situ Thermal	***Technical*** In-situ Vacuum Enhanced Thermal Treatment uses thermal processes to increase the volatility, to burn, decompose, destroy or melt the contaminants. It uses electrical resistance/electromagnetic/fibre optic/radio frequency heating or hot air/steam injection to increase the volatilization rate of semi-volatile contaminants and facilitate their extraction. The process uses a combination of soil heating processes to enhance soil vapour extraction (SVE). A thermal treatment area is usually covered with an impermeable surface cover (such as concrete, asphalt, or a heavy-duty tarp) to keep the heat and steam underground. Such seals also help prevent the release of chemical vapours to the air. In-situ validation sampling to steam/hot air injection or electrical resistance/electromagnetic/fibre optic/radio frequency heating is used to increase the volatilization rate of semi-volatiles and to facilitate extraction and is typically applied in parallel with SVE to capture vapour emissions. ***Logistical*** Clean up timeframes can be considered as short to medium term (in the order of 6 months to 3 years). Health and safety considerations are associated with the installation, operation, and maintenance of remediation infrastructure. ***Financial*** High costs can often lead to this technique not being a realistic alternative. ***Sustainable*** Vapour recovery off gases must be collected and treated. ***Regulator and Community Acceptance*** Specific consideration of this factor is of particular importance with this technique to ensure stakeholder expectations are addressed.

Table 6 D. Engineering Controls to Target Soils

Method	Discussion
Vapour Barriers	***Technical*** Management/institutional controls for hydrocarbon impacts identified at a site include implementation of an environmental management plan and requirements to control potential vapour intrusion into buildings. Vapour intrusion mitigation typically requires periodic indoor monitoring and incorporation of vapour barriers into the design of new buildings, noting that the development of supporting risk assessment is required to assess viability of this option. Controls can be in the form of vapour barriers and/or increased ventilation within basements. In addition, controls such as a restriction on construction of basements (if ever proposed) in areas where potential vapour risks are present may also be a consideration. ***Logistical*** The timeframe to achieve the greatest redevelopment potential can be considered to be short in that the measures would be effective and in place during redevelopment works with health and safety risks primarily associated with construction. ***Financial*** Coupled with a risk assessment, institutional controls can be readily implemented during site redevelopment with limited long term liability and are considered a cost effective option when compared to alternative remedial approaches with low to moderate capital costs and low operational costs. ***Sustainable*** Reduces waste to landfill and manages impact in-situ reducing emissions to remedial or transport works. Long term air emissions from venting process to be considered. ***Regulator and Community Acceptance*** Whilst this approach has been demonstrated to be an effective management technique, the passive nature of the approach may be perceived to be marginally less favourable by regulators and stakeholders than more active techniques which target the potential vapour source. Institutional controls are, however, commonly adopted for both commercial/industrial and residential development sites.

Table 7 E. Ex Situ Biological Treatment to Target Soils

Method	Discussion
Biopiles/ Composting/ Landfarming	***Technical*** Biopiling, (also known as landfarming or composting) is a treatment technology in which excavated soils are mixed with soil amendments and placed on an on-site treatment area that includes leachate collection systems and some form of aeration (induced flow or tilled). The approaches are used to reduce concentrations of petroleum constituents in excavated soils through the use of biodegradation. Moisture, heat, nutrients, oxygen, and pH are usually controlled to enhance biodegradation and expedite remediation timeframes. The treatment area will generally be based on hard stand or contained with an impermeable liner to minimize the risk of contaminants leaching into surrounding uncontaminated soil. Soil piles and cells commonly have an air distribution system buried under the soil to pass air through the soil either by vacuum or by positive pressure. Soil piles may be covered with plastic to control runoff, evaporation, and volatilisation and to promote solar heating. In instances where contaminants may volatilise into the air stream, the air leaving the soil may be treated to remove or destroy the volatile organic compounds (VOCs) before they are discharged to the atmosphere. Following treatment, the remediated soils have the potential to be re-used on site. ***Logistical*** Biopiling is a short-term technology where the duration of operation and maintenance may last a few months to 1 year. Health and Safety risks are primarily associated with the movement of heavy machinery and excavation works which can be effectively managed through the application of standard management practices. ***Financial*** Capital costs are considered low to moderate, in the context of anticipated soil volumes requiring treatment and are primarily associated with excavation, soil stockpiling and treatment setup. Operational costs are considered moderate associated with vapour management which also provides the primary waste stream. ***Sustainable*** Management of air emissions and prevention of surface water run-off are critical elements of this approach. ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.

Table 8 F. Ex Situ Thermal to Target Soils

Method	Discussion
Thermal Desorption	***Technical*** Thermal desorption is a physical separation process and is not designed to destroy organics. Wastes are heated to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to the gas treatment system. The bed temperatures and residence times designed into these systems will volatilize selected contaminants but will typically not oxidize them. ***Logistical*** Clean up timeframes can be considered as short to medium term (in the order of 6 months to 3 years). Health and safety considerations are associated with the installation, operation, and maintenance of remediation infrastructure. ***Financial*** The viability of thermal desorption techniques is mainly associated with economies of scale given the costs of set up. High costs can often lead to this technique not being a realistic alternative. ***Sustainable*** Vapour recovery off gases must be collected and treated. ***Regulator and Community Acceptance*** Specific consideration of this factor is of particular importance with this technique to ensure stakeholder expectations are addressed.

Table 9 G. Offsite Disposal to Target Soils

Method	Discussion
Offsite Disposal	***Technical*** Contaminated materials are removed and transported to licensed off-site treatment and/or disposal facility. ***Logistical*** This remediation approach is generally considered advantageous because it is fast and effective with limited or no storage or treatment requirements. Excavation and cartage (significant truck movements) provide the primary health and safety considerations. ***Financial*** Capital costs associated with excavation and disposal are considered high. Limited operational costs are likely as works are completed prior to the redevelopment/use of a site. ***Sustainable*** This option falls low within the waste hierarchy. ***Regulator and Community Acceptance*** Whilst the approach is well established, it is anticipated that regulatory and community acceptance would likely not be as favourable compared to reuse in the context of the waste hierarchy. Furthermore, given the potential short timeframe between remediation and development, the approach assumes assurance can be obtained that the soil excavations will be/are sufficient (and validated) to ensure remediation objectives are met prior to construction works.

Table 10 H. In-Situ Biological Treatment Techniques to Target Groundwater

Method	Discussion
Natural Source Zone Depletion (NSZD)	***Technical*** LNAPL within the subsurface can potentially be lost from the source zone due to volatilisation and dissolution processes, resulting in the occurrence of hydrocarbon soil vapour and dissolved phase contamination. Subject to the appropriate conditions (e.g. volatility of the hydrocarbons, depth, etc.) the losses can often be considered as a meaningful contribution to the reduction in LNAPL mass itself. Specifically, the LNAPL mass loss to the vapour and dissolved phases include the following: • volatilisation into the vadose zone which is subsequently migrating away from the LNAPL via diffusion and advection; • dissolution into the groundwater which is subsequently transported away from the LNAPL with the groundwater; and • (subsequent) biological degradation of the dissolved phase hydrocarbons. The dissolved phase is replenished by the LNAPL (dissolution), resulting in a net loss in the mass of hydrocarbon present in the LNAPL phase (depletion). It must be noted that, although the rate of natural source zone (LNAPL) depletion will continue to decline over time (as the more soluble/volatile components are depleted, resulting in a drop in the rates of vaporisation and dissolution), the processes involved can potentially play a significant role in the reduction in the longevity of the LNAPL at a site. NSZD is of particular use when evaluating the mass reduction potential and overall net benefit versus other (more active) remedial options. It can also be used in conjunction with a more active technology, potentially playing a role after the active technology remedial works cease, and residual impact remains. ***Logistical*** Timeframes are typically long term (e.g. 5-40 years). Health and safety considerations are associated with the monitoring works to investigate NSZD parameters at the site. ***Financial*** Costs are typically associated with monitoring and demonstration that NSZD rates are significant enough to be of benefit to mass reduction at the site. ***Sustainable*** Limited considerations for this factor. ***Regulator and Community Acceptance*** On its own this approach typically requires strong technical lines of evidence to justify this selection in lieu of an active technique. It is often accepted more readily in conjunction, and following, implementation of an active technique.

Method	Discussion
Monitored Natural Attenuation (MNA)	***Technical*** Natural subsurface processes such as volatilisation, biodegradation, adsorption, and chemical reactions with subsurface materials can serve to reduce contaminant concentrations to acceptable levels under certain conditions. Naturally occurring soil micro-organisms are often capable of degrading hydrocarbon contaminants through normal metabolic pathways. Where it can be proved that this is taking place at a sufficient rate that it prevents further migration of the contamination plume, an engineered remediation system may not be required. Monitoring must be conducted throughout the process to confirm that degradation is proceeding at rates consistent with the derived remediation objectives. ***Logistical*** Timeframes for this approach are highly variable, with the short term focus being on ensuring the rate of attenuation is demonstrably sufficient to ensure plume stability (or plume contraction), with long term requirements being the restoration of groundwater to a level sufficient to protect environmental values (e.g. within 5-25 years). Health and safety considerations are associated with the monitoring works to investigate MNA parameters at the site. ***Financial*** Costs are typically associated with monitoring to demonstrate that MNA is occurring, and is significant enough to be of benefit to mass reduction at the site. Long term monitoring may also be required. ***Sustainable*** Limited considerations for this factor. ***Regulator and Community Acceptance*** On its own this approach typically requires strong technical lines of evidence to justify this selection in lieu of an active technique (particularly if LNAPL is still present). It is often accepted more readily in conjunction, and following, implementation of an active technique.
Biosparging	***Technical*** Biosparging is an in-situ remediation technology that uses indigenous microorganisms to biodegrade organic constituents in the saturated zone to treat groundwater and capillary fringe impacts. In biosparging, air (or oxygen) and nutrients (if needed) are injected into the saturated zone to increase the biological activity of the indigenous microorganisms. Biosparging can be used to reduce concentrations of petroleum constituents that are dissolved in groundwater, adsorbed to soil below the water table, and within the capillary fringe. When volatile constituents are present, biosparging is often combined with SVE or bioventing and can also be used with other remedial technologies. When biosparging is combined with vapour extraction, the vapour extraction system creates a negative pressure in the unsaturated zone through a series of extraction wells that control the vapour plume migration. Biosparging is relatively easy to implement, enhances the effectiveness of technologies such as air sparging and typically uses lower air injection rates than air sparging often limiting the requirements for vapour capture and treatment. Factors that may limit the applicability and effectiveness of the process include: • preferential colonization by microbes may occur causing clogging of nutrient and water injection wells; and • preferential flow paths may severely decrease contact between injected fluids and contaminants throughout the target zones. The system should not be used for clay, highly layered, or heterogeneous subsurface environments because of oxygen (or other electron acceptor) transfer limitations. ***Logistical*** Clean up timeframes can be considered as short to medium term (in the order of 1 to 3 years). Health and safety risks are primarily associated with the installation of wells and operational risks associated with maintaining and operating the oxygen and nutrient delivery system. These risks can however, be managed relatively easily through the application of standard management practices. ***Financial*** Capital costs associated with this approach are considered moderate and driven primarily by oxygen and nutrient requirements together with well installation. Operational costs are considered moderate oxygen and nutrient delivery together with well maintenance.

Method	Discussion
	Sustainable The waste stream generated by this approach is primarily associated with drilling cuttings management during installation ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.

Table 11 I. In-Situ Physical or Chemical Treatment to Target Groundwater

Method	Discussion
Air Sparging	***Technical*** Air sparging is an in-situ technology in which air is injected through a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes contaminants by volatilisation. This injected air helps to flush the contaminants from groundwater up into the unsaturated zone where a SVE system is usually installed to remove the generated vapour phase contamination. This technology is designed to operate at high flow rates to maintain increased contact between groundwater and soil. Oxygen added to contaminated ground water and unsaturated zone soils can also enhance biodegradation of contaminants below and above the water table. ***Logistical*** Clean up timeframes can be considered as short to medium term (in the order of 1 to 3 years). Health and safety risks are primarily associated with the installation of wells and operational risks associated with maintaining and operating the air delivery system. These risks can be managed relatively easily through the application of standard management practices. ***Financial*** Capital costs associated with this approach are considered moderate to high and driven primarily by vapour management requirements and well installation. Operational costs are considered moderate and primarily associated with vapour management and well maintenance. ***Sustainable*** The waste stream generated by this approach is primarily associated with vapour management together with drilling cuttings management during installation. ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.

Table 12 J. In-Situ Thermal Treatment to Target Groundwater

Method	Discussion
In Situ Thermal	***Technical*** Steam/hot air injection or electrical resistance/electromagnetic/fibre optic/radio frequency heating is used to increase the volatilization rate of semi-volatiles and to facilitate extraction and is typically applied in parallel with SVE to capture vapour emissions. ***Logistical*** Clean up timeframes can be considered as short to medium term (in the order of 1 to 3 years). Health and safety considerations are associated with the installation, operation, and maintenance of remediation infrastructure. ***Financial*** Capital and operational costs are considered high, particularly given the infrastructure requirements at set up and energy use throughout the process. ***Sustainable*** Vapour recovery off gases must be collected and treated. ***Regulator and Community Acceptance*** Specific consideration of this factor is of particular importance with this technique to ensure stakeholder expectations are addressed.

Table 13 K. Ex-Situ Treatment to Target Groundwater

Method	Discussion
Pump and Treat (Total Fluids)	***Technical*** Groundwater pump and treat comprises the extraction of impacted groundwater for above ground treatment and disposal. This approach is typically used as hydraulically control to limit potential migration to imminent receptors in scenarios where an imminent risk is present. ***Logistical*** This approach can involve long time frames (e.g. 5-10 years) to achieve clean up objectives with no certainty as to likely outcomes. Health and safety considerations are primarily associated with the installation, operation, and maintenance of the remediation infrastructure. ***Financial*** Capital and operational costs are high given the infrastructure requirements at set up and the process is energy intensive. ***Sustainable*** Approach can produce a large waste stream which requires management. ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.
Dual Phase Extraction	***Technical*** Dual-phase extraction uses separate pumps or a pump and skimmer to remove LNAPL and groundwater in separate streams either within the same wells or separate wells. Liquids are pumped via pipework to a treatment facility which typically consists of an oil / water separator, LNAPL storage tank, air stripper to remove volatiles from groundwater or activated carbon for less volatile contaminants. Recovered LNAPL is typically periodically disposed off-site and treated groundwater to municipal waste or re-injection gallery. Vapours from the air stripper may require further treatment and this is typically completed by vapour phase activated carbon. ***Logistical*** Approach can involve long time frames (e.g. 5-10 years) to achieve clean up objectives with no certainty as to likely outcomes. Health and safety considerations are primarily associated with the installation, operation, and maintenance of the remediation infrastructure.

Method	Discussion
	Financial Capital and operational costs are high given the infrastructure requirements at set up and the process is energy intensive. ***Sustainable*** Approach can produce a large waste stream which requires management ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.
Multiphase Extraction (MPE)	***Technical*** Multiphase Extraction (MPE) is a technology that uses a high vacuum system to remove various combinations of contaminated ground water, separate-phase petroleum product, and hydrocarbon vapour from the subsurface. Extracted liquids and vapour are typically treated and collected for disposal. In MPE systems for liquid/vapour treatment, a high vacuum system is utilised to remove liquid and vapour from low permeability or heterogeneous formations. The vacuum extraction well includes a screened section in the zone of contaminated soils and ground water. It removes contaminants from above and below the water table. The system lowers the water table around the well, exposing more of the formation. Contaminants in the newly exposed unsaturated zone are then accessible to vapour extraction. Once above ground, the extracted vapours or liquid-phase organics and ground water are separated and treated. ***Logistical*** This approach can involve medium to long term time frames (e.g. 2-8 years) to achieve clean up objectives with no certainty as to likely outcomes. Health and safety considerations are primarily associated with the installation, operation, and maintenance of the remediation infrastructure. ***Financial*** Capital and operational costs are high given the infrastructure requirements at set up and the process is energy intensive. ***Sustainable*** Approach can produce a large waste stream which requires management. ***Regulator and Community Acceptance*** As the technology is well established it is anticipated the regulatory and community acceptance would be favourable.
Excavation of (LNAPL) impact	***Technical*** Direct excavation of impact is suitable where shallow impact (e.g. <4 mbgl) is prevalent on a site, and the impact is safely accessible with an excavator. The fate of the LNAPL impacted soil once extracted to the surface requires planning, it may be processed through another ex-situ remediation technology being run at the site or disposed of offsite. Dewatering requirements and the potential for 'rebound' of impact back into the excavated areas should be considered when planning such a technique. ***Logistical*** Health and safety considerations are primarily associated with creation of excavations (damage to underground utilities, working at height, etc.). Initial timeframes are typically short term, typically 1-3 months (for the excavation process itself), remediation timeframes once at the surface are subject to the other technique being employed. ***Financial*** There is significant time benefit to this works and potential cost efficiencies should the soil being removed anyway to address other remediation objectives (e.g. to removal dermal risk from soils). ***Sustainable*** Subject to the volume of waste being generated. ***Regulator and Community Acceptance*** Given the potentially improved certainty of remedial outcome (against other groundwater techniques presented above, in some instances) it is anticipated the regulatory and community acceptance would be favourable, assuming offsite disposal could be kept to a minimum.

4.7 Likely Project soil remediation methods

Based on the initial evaluation in **Section 4.6**, the following remediation approaches are likely to be used for the Project:

- For vapour related risks, the shallow nature of the impact indicates that an ex situ method of treatment is the most appropriate, with petroleum hydrocarbon impact being reduced prior to replacement of the soils. Biopiling could potentially be the most appropriate technique, given the comparatively granular nature of the shallow soils, the nature of the impact, and the space available within the Western Area to create such a system;
- for LNAPL removal, the shallow nature of its occurrence means that an excavation approach is potentially the most appropriate;
- for dermal risks, where impact cannot be practicably reduced (e.g. pockets of heavy metal impact), in situ capping/installation of hard standing is considered likely the most appropriate remedial measure to manage risk; and
- soils which cannot be remediated or managed in situ may be subject to offsite disposal, however this should be considered as low on the hierarchy given this is not deemed a sustainable approach.

A detailed remediation strategy for the Project will be presented with the detailed RAP following a more detailed qualitative analysis of the options and consideration of any additional investigations.

5.0 Statutory considerations

5.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the primary legislation that governs land use and provides a framework for development control in NSW. The EP&A Act is supported by the *Environmental Planning and Assessment Regulation 2000* (NSW) (EP&A Regulation) and a number of Environmental Planning Instruments (EPIs) which include State Environmental Planning Policies (SEPPs) and Local Environment Plans (LEPs).

5.1.1 Development consent

Part 4 of the EP&A Act establishes a framework for assessing development that requires consent under an EPI. It allows development to be classified as 'exempt development' (where no consent is required), 'complying development', 'development that needs consent', or 'prohibited development'. The term 'development' is defined under section 4 of the EP&A Act.

Section 76A of the EP&A Act states that where "*an EPI provides that specified development may not be carried out except with development consent, a person must not carry the development out on land to which the provision applies unless: (a) such a consent has been obtained and is in force, and (b) the development is carried out in accordance with the consent and the instrument.*"

Therefore this section of the EP&A Act allows EPIs to specify when development consent is required.

5.1.2 State Environmental Planning Policy No. 55 – Remediation of Land

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) is an EPI. Clause 8 (1) of SEPP 55 states that "*a person may carry out remediation work in accordance with this Policy, despite any provision to the contrary in an environmental planning instrument, except as provided by clause 19 (3)*". This clause makes remediation work permissible in any location in New South Wales, including the Site.

Clause 8 (2) of SEPP 55 states that: "*a person must not carry out a category 1 remediation work except with the consent of the consent authority.*" Clause 9 defines 'category 1 remediation work' and notes that category 1 remediation work is, amongst other things, remediation work that is considered 'designated development'.

Schedule 3 of the EP&A Regulation defines designated development. Clause 15 (c) (ii) and (iii) of this schedule apply to the Project. The relevant parts of this clause state:

"*Contaminated soil treatment works (being works for on-site or off-site treatment of contaminated soil, including incineration or storage of contaminated soil, but excluding excavation for treatment at another site):*

(c) that treat contaminated soil originating exclusively from the site on which the development is located and:

(ii) treat otherwise than by incineration and store more than 30,000 cubic metres of contaminated soil, or

(iii) disturb more than an aggregate area of 3 hectares of contaminated soil."

It is understood that up to 80,000 cubic metres of contaminated soil is likely to be treated by a method other than incineration and that the remediation works are likely to disturb more than an aggregate area of 3 hectares of contaminated soil. Therefore, the Project would be considered designated development, and in turn, category 1 remediation works. As such, the Project requires development consent.

5.1.3 State Environment Planning Policy (State and Regional Development) 2011

Clause 8 of *State Environment Planning Policy (State and Regional Development) 2011* (SEPP SRD)) states that a project is to be determined as State Significant Development (SSD) if it is "*by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and the development is specified in Schedule 1 or 2*".

Schedule 1 of the SEPP SRD provides a list of 24 different types of development and a number of associated criteria. Clause 24 of Schedule 1 relates to the 'Remediation of Contamination Land'. If the Project meets the criteria under Clause 24 of Schedule 1 of this SEPP then it would be considered State Significant Development (SSD) rather than designated development.

To be designated SSD under this clause, the Project would need to be considered category 1 remediation works on significantly contaminated land and the works would need to be carried out under a management order that requires:

- taking an action to remediate the land; or
- taking an action to treat, store or contain on the land, or remove from the land and treat or dispose of, any solid or liquid materials including any soil, sand, rock or water; or
- the preparation of a plan of management that provides for the taking of any such action described in the two points above.

As discussed in **Section 6.1.2**,the Project is considered category 1 remediation works and as discussed in **Section 2.4** the Western Area is considered to be 'significantly contaminated land', however, the land is not under a CLM Act management order. Therefore the Project does not meet the criteria under Clause 24 of Schedule 1 of the SEPP SRD and is not considered SSD under this EPI.

As the Project does not met the requirements of SEPP SRD, this application is being made so that the Project can be declared to be SSD and therefore to be subject to the SSD provisions of the EP&A Act.

5.1.4 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

The Site falls within the boundary of the 'Foreshore and Waterways area' and is therefore subject to the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (Sydney Harbour SREP), which is a deemed SEPP.

The Sydney Harbour SREP outlines a number of planning principals for the Foreshore and Waterways area and requires that these principals are considered, and where possible, achieved for environmental studies and masterplans. There are nine principles in total which request that:

a) "*development should protect, maintain and enhance the natural assets and unique environmental qualities of Sydney Harbour and its islands and foreshores,*

b) *public access to and along the foreshore should be increased, maintained and improved, while minimising its impact on watercourses, wetlands, riparian lands and remnant vegetation,*

c) *access to and from the waterways should be increased, maintained and improved for public recreational purposes (such as swimming, fishing and boating), while minimising its impact on watercourses, wetlands, riparian lands and remnant vegetation,*

d) *development along the foreshore and waterways should maintain, protect and enhance the unique visual qualities of Sydney Harbour and its islands and foreshores,*

e) *adequate provision should be made for the retention of foreshore land to meet existing and future demand for working harbour uses,*

f) *public access along foreshore land should be provided on land used for industrial or commercial maritime purposes where such access does not interfere with the use of the land for those purposes,*

g) *the use of foreshore land adjacent to land used for industrial or commercial maritime purposes should be compatible with those purposes,*

h) *water-based public transport (such as ferries) should be encouraged to link with land-based public transport (such as buses and trains) at appropriate public spaces along the waterfront,*

i) *the provision and use of public boating facilities along the waterfront should be encouraged."*

Under the provisions of the Foreshore and Waterways area the SREP zones the Duck River as W2 – Environmental Protection which has the following objectives:

a) *"to protect the natural and cultural values of waters in this zone,*

b) *to prevent damage or the possibility of longer term detrimental impacts to the natural and cultural values of waters in this zone and adjoining foreshores,*

c) *to give preference to enhancing and rehabilitating the natural and cultural values of waters in this zone and adjoining foreshores,*

d) *to provide for the long-term management of the natural and cultural values of waters in this zone and adjoining foreshores."*

The SREP also lists certain heritage items. Whilst there are no items listed in the Western Area, there are two items on and close to the wider Site, namely No. 35 Shell Oil Refinery Wharf on the Duck River and No. 36 Industrial Wharves at 33 Grand Avenue, Camellia.

In addition, the SREP also designates certain parts of the Western Area adjacent to the Duck River as 'Wetlands Protection Area' (refer to **Figure 10**). This designation requires that development in this area is only carried out with development consent and that a number of 'matters' are taken into consideration by consent authorities before granting consent to development under Part 4 of the EP&A Act.

The matters to be taken into consideration in relation to any development in this area are as follows:

a) *"the development should have a neutral or beneficial effect on the quality of water entering the waterways,*

b) *the environmental effects of the development, including effects on:*

   i. *the growth of native plant communities,*

   ii. *the survival of native wildlife populations,*

   iii. *the provision and quality of habitats for both indigenous and migratory species,*

   iv. *the surface and groundwater characteristics of the site on which the development is proposed to be carried out and of the surrounding areas, including salinity and water quality and whether the wetland ecosystems are groundwater dependent,*

c) *whether adequate safeguards and rehabilitation measures have been, or will be, made to protect the environment,*

d) *whether carrying out the development would be consistent with the principles set out in The NSW Wetlands Management Policy (as published in March 1996 by the then Department of Land and Water Conservation),*

e) *whether the development adequately preserves and enhances local native vegetation,*

f) *whether the development application adequately demonstrates:*

   i. *how the direct and indirect impacts of the development will preserve and enhance wetlands, and*

   ii. *how the development will preserve and enhance the continuity and integrity of the wetlands, and*

   iii. *how soil erosion and siltation will be minimised both while the development is being carried out and after it is completed, and*

   iv. *how appropriate on-site measures are to be implemented to ensure that the intertidal zone is kept free from pollutants arising from the development, and*

v. *that the nutrient levels in the wetlands do not increase as a consequence of the development, and*

vi. *that stands of vegetation (both terrestrial and aquatic) are protected or rehabilitated, and*

vii. *that the development minimises physical damage to aquatic ecological communities, and*

viii. *that the development does not cause physical damage to aquatic ecological communities,*

g) *whether conditions should be imposed on the carrying out of the development requiring the carrying out of works to preserve or enhance the value of any surrounding wetlands."*

The provisions of the Sydney Harbour SREP will need to be considered for the Project.

5.1.5 Draft State Environmental Planning Policy (Coastal Management) 2016

The *Draft State Environmental Planning Policy (Coastal Management) 2016* (Coastal Management SEPP) intends to establish a new, strategic land use planning framework for coastal management. Specifically, it aims to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the *Coastal Management Act 2016* (NSW).

This draft SEPP will introduce four new 'coastal areas', namely Coastal wetland and littoral rainforests area, Coastal vulnerability area, Coastal environment area, and Coastal use area. Developments that are located within one or more of these areas will need to ensure that the consent authority is satisfied that certain considerations have been addressed.

The maps that support draft SEPP indicate that the part of the Western Area adjacent to the Duck River falls within three of the proposed coastal areas. These are: Coastal wetland and littoral rainforests area, Coastal environment area, and Coastal use area. Therefore, the considerations listed in the draft SEPP may need to be addressed in the future.

5.1.6 Parramatta Local Environmental Plan 2011

The Site is zoned as IN3 – Heavy Industrial in the Parramatta LEP 2011 (refer to **Figure 11**). The objectives of this zone are:

- *"To provide suitable areas for those industries that need to be separated from other land uses.*
- *To encourage employment opportunities.*
- *To minimise any adverse effect of heavy industry on other land uses.*
- *To support and protect industrial land for industrial uses.*
- *To allow a wide range of industrial and heavy industrial uses serving the Greater Metropolitan Area of Sydney and beyond.*
- *To ensure that opportunities are not lost for realising potential foreshore access on land that is contaminated and currently not suitable for public access."*

The land use table for IN3 lists development that is permitted without consent, development that is permitted with consent, and development that is prohibited. Remediation is not listed in the land use table however any development that is not specified under the three categories is considered permitted with consent as an innominate permissible use. Notwithstanding this point, the Project is considered permissible under Clause 8 (1) of SEPP 55 as explained in **Section 5.1.2** above.

The Parramatta LEP contains a number of other considerations for development in the Western Area. Of note are that the Western Area falls under Class 3 and 4 Acid Sulfate Soil Classes, a Riparian Land and Waterways designation is applied to land adjacent to Duck River and Schedule 5 lists Duck River and Parramatta River as part of the heritage listed Camellia Wetlands (and Ermington; Parramatta; and Rydalmere) (refer to **Figure 12** and **Figure 13**).

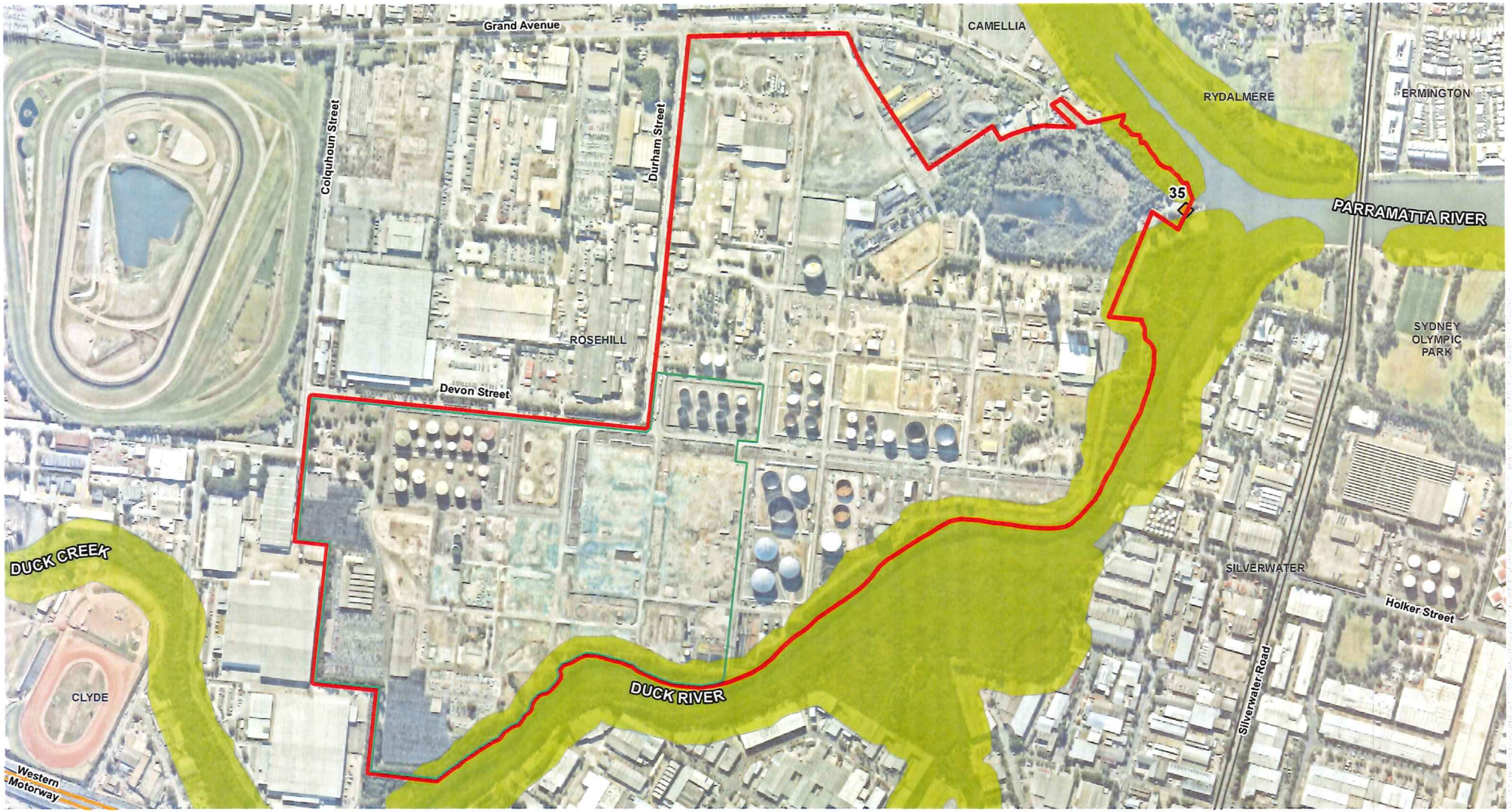


FIGURE 10 - SYDNEY REP (SYDNEY HARBOUR CATCHMENT) 2005 - PROTECTED AREAS AND BIODIVERSITY

AECOM

0 100 200 300 m

KEY

- Approximate Western Area Boundary
- Site boundary
- Motorway
- Primary road
- Local road

Heritage Item

- 35. Shell Oil Refinery Wharf

Sydney REP Protected Areas

- Wetlands Protection Area

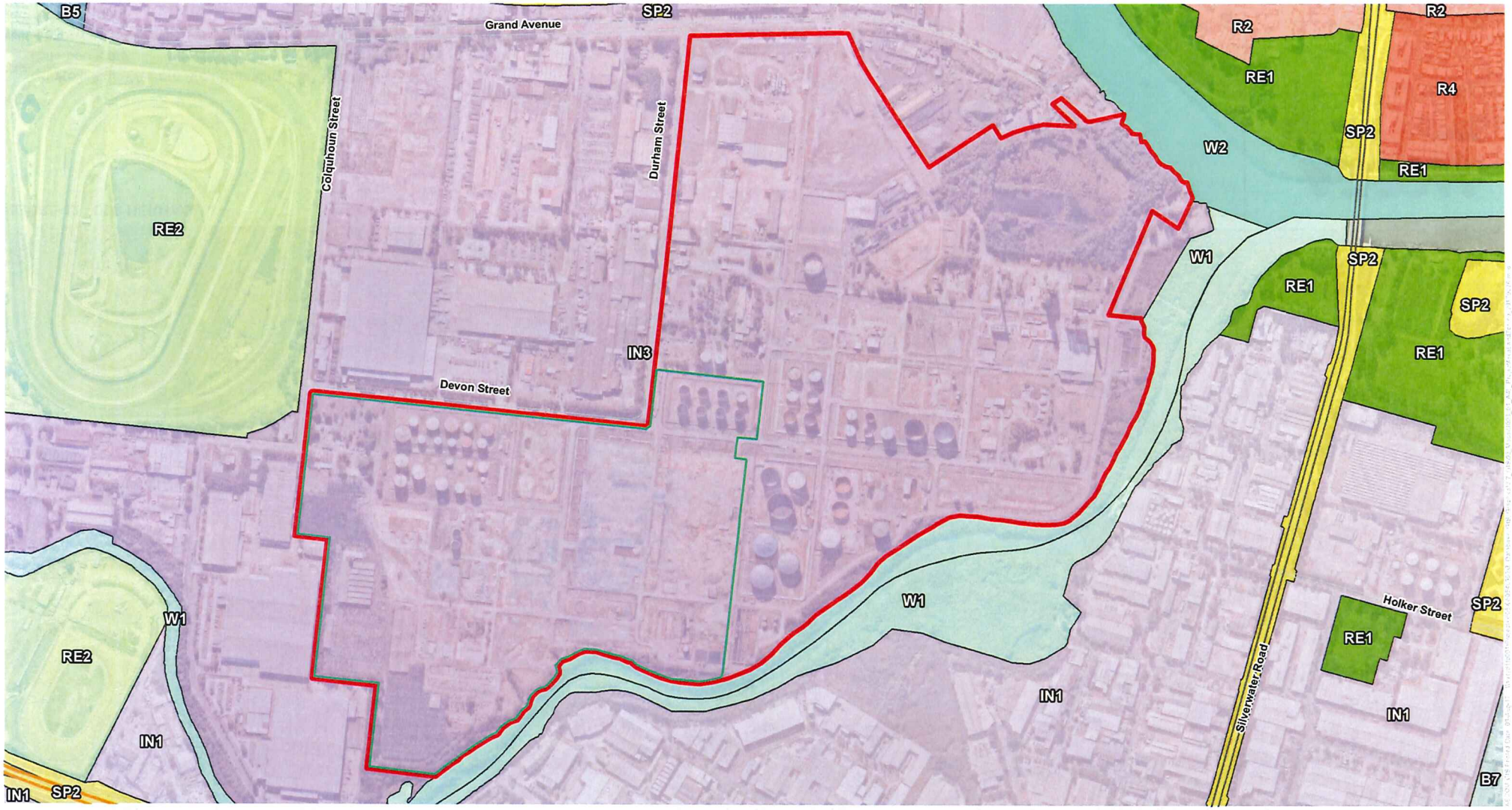


FIGURE 11 - LAND USE ZONES

KEY

- Approximate Western Area Boundary
- Site boundary
- Motorway
- Primary road
- Local road

Land Use Zones

- B5 Business Development
- B7 Business Park
- IN1 General Industrial
- IN3 Heavy Industrial
- R2 Low Density Residential
- R4 High Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- SP2 Infrastructure
- W1 Natural Waterways
- W2 Recreational Waterways

AECOM

0 100 200 300 m

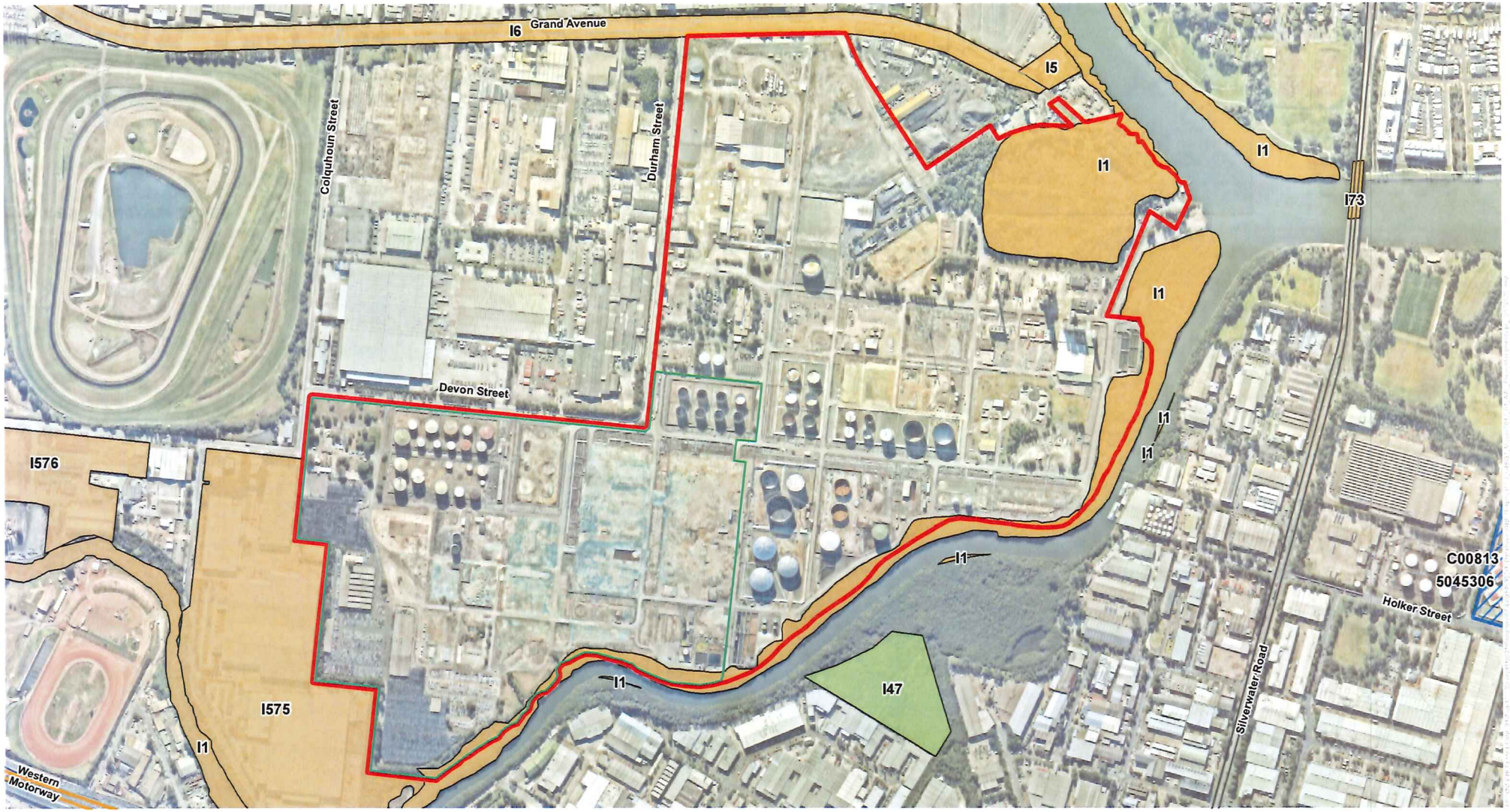


FIGURE 12 - LEP HERITAGE

AECOM

0 100 200 300 m

KEY

- Approximate Western Area Boundary
- Site boundary
- Motorway
- Primary road
- Local road

LEP Heritage

- State Heritage Act
- Conservation Area - General
- Item - General
- Item - Landscape

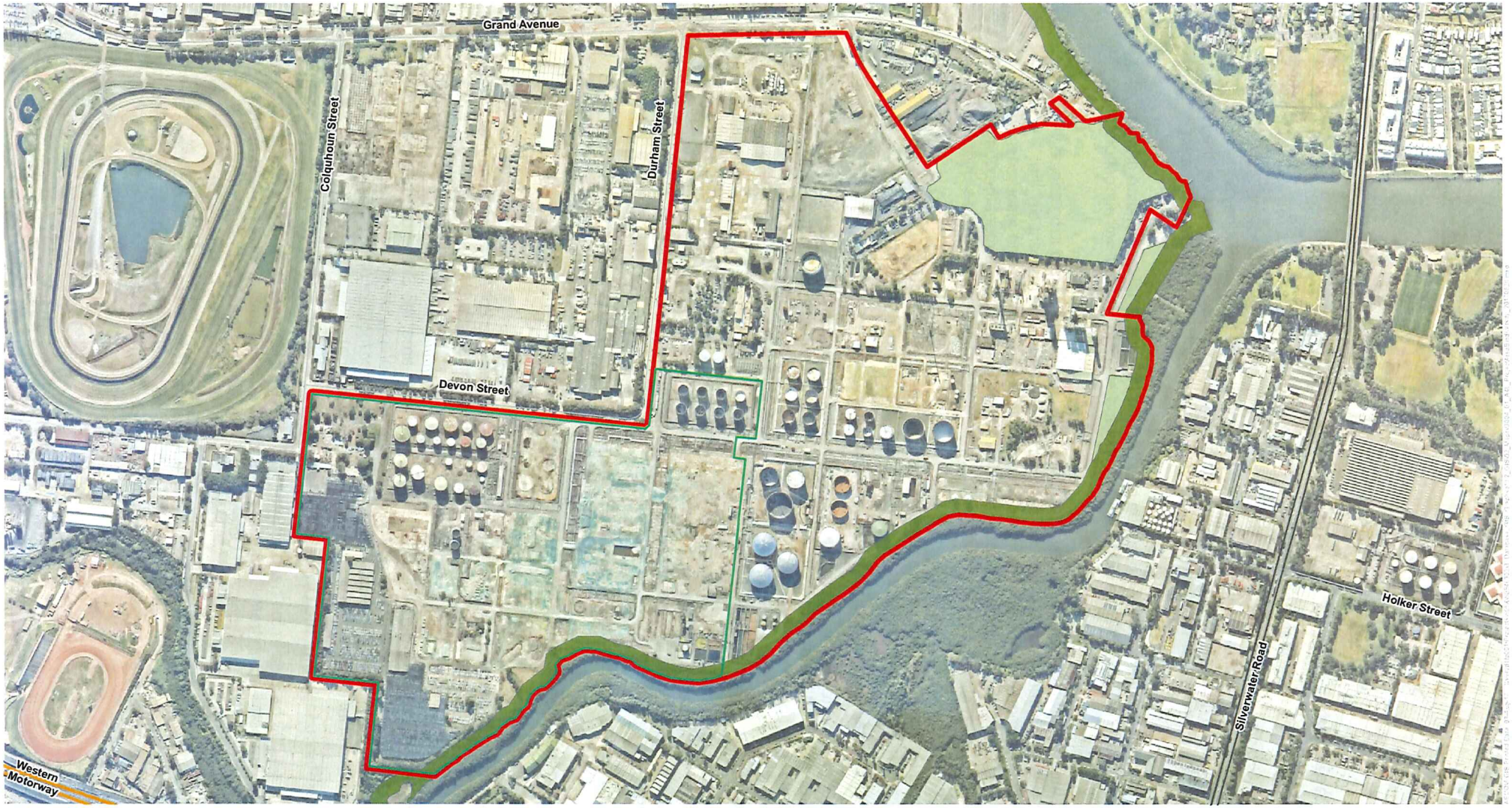


FIGURE 13 - BIODIVERSITY AND RIPARIAN AREAS

KEY

- Approximate Western Area Boundary
- Site boundary
- LEP Biodiversity
- LEP Riparian Areas
- Motorway
- Primary road
- Local road

AECOM

0 100 200 300 m

5.2 Strategic plans

5.2.1 Greater Sydney Regional Plan – A Plan for Growing Sydney

In 2014, *A Plan for Growing Sydney* (The Plan) (Department of Planning and Environment, 2014) was released with the primary purpose of providing key directions and actions to guide Sydney's productivity, environmental management, and liveability in the Sydney Metropolitan Area over the next 20 years. This includes guidance for the delivery of housing, employment, infrastructure and open space.

By 2031, Sydney's population will grow by 1.6 million people, with 900,000 of this population growth occurring in Western Sydney. There will be 689,000 new jobs and economic output will almost double to $565 billion a year.

The Government has set down goals for Sydney, including that it will be a city of housing choice with homes that meet our needs and lifestyles, and that it will be a sustainable and resilient city that protects the natural environment and has a balanced approach to the use of land and resources. Each goal has a number of priority areas which provide a focus for the actions needed to meet the goals for Sydney. This includes growing Greater Parramatta and to accelerate urban renewal across Sydney – proving homes closer to jobs.

The Plan also identifies the protection of our natural environment and biodiversity and to manage the impacts of development on the environment as key to meeting the goals for growing Sydney.

5.2.2 Greater Sydney Commission Draft West Central District Plan

In November 2016, the Greater Sydney Commission (GSC) released the draft West Central District Plan (GSC, 2016a). This draft District Plan sets out a vision, priorities and actions for the development of the West Central District of Greater Sydney. This District is at the core of Greater Sydney's newly conceived 'Central City'. It stretches from Wisemans Ferry in the north to Mount Druitt in the south-west and Sydney Olympic Park in the south-east.

This draft District Plan proposes a 20-year vision for the West Central District, which includes the local government areas of Blacktown, Cumberland, Parramatta and The Hills. *A Plan for Growing Sydney* identified three planning principles that remain current and underpin many of the priorities of this draft District Plan. These were:

- Principle 1: Increasing housing choice around all centres through urban renewal in established areas.
- Principle 2: Stronger economic development in strategic centres and transport gateways.
- Principle 3: Connecting centres with a networked transport system.

At the heart of the district is the strategically important "*area known as Greater Parramatta and the Olympic Peninsula (GPOP) – a place with so much potential that it is subject to its own planning process*" (GSC, 2016a).

The Site and the Western Area fall within the GPOP area. Within this area, the Site and the Camellia peninsula as a whole are designated as the Central Advanced Technology, Urban Services and Industrial Area. Indeed, as stressed in the draft plan, "*GPOP is a major focus of the Central City and is one of Sydney's most crucial centres of economic activity*" (GSC, 2016a).

5.2.3 Greater Parramatta and the Olympic Peninsula

The GPOP area is a 4,000 ha area in the heart of Sydney. It spans 13 km east–west from Strathfield to Westmead, and 7 km north–south from Carlingford to Lidcombe and Granville. It is the geographic and demographic centre of Greater Sydney. In October 2016, a vision for the GPOP area was released by the Greater Sydney Commission.

The Camellia peninsula, and therefore the Site and Western Area, are located in the centre of the GPOP area. The vision recognises that this area currently provides a number of essential activities that service Parramatta and in many cases Sydney and the whole of New South Wales (e.g. fuel distribution).

The vision goes on to note the proposed infrastructure linkages across the GPOP area, including the light rail and potentially the Sydney Metro. It then discusses each of the precincts within the GPOP area. The Site falls within 'Quarter 3' – Essential Urban Services, Advanced Technology and Knowledge Sectors. With regards to Viva Energy's site the following is stated:

"*Viva Energy's evolution from an oil refinery to an oil distributor — a change brought about by changes in the global fuel supply chain — represents a landmark change and an opportunity for GPOP. Around 40 hectares of surplus land in Camellia will become available for modern enterprise with relatively high density employment. Its future use must be compatible with the requirements of Viva's* [sic] *fuel terminal.*"

The vision for 'Quarter 3' is to maintain this central employment and urban services area, intensify employment uses and connect with the 21st century global economy. To do this, the focus will be on creating "*unique and positive connections between Science, Technology, Engineering, Art and Mathematics (STEAM), health, education, sports, culture and business sectors — to drive innovations that arise from an eco-system of interdependency, growth and change.*" The Site and the Western Area are within this vision and the expected transformation of Camellia.

5.3 Other NSW legislation

5.3.1 Water Management Act 2000

The *Water Management Act 2000* (NSW) (WM Act) establishes a framework for managing water in NSW. The Site is within the jurisdiction of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* and the *Greater Metropolitan Region Unregulated River Water Sources Water Sharing Plan 2011*.

The WM Act creates:

- mechanisms for protecting and restoring water sources and their dependent ecosystems;
- improved access rights to water; and
- partnership arrangements between the community and the Government for water management.

Section 91 of the WM Act discusses activity approvals and notes that there are two types of approvals, namely controlled activity approvals and aquifer interference approvals.

Controlled activity approvals may be required for the Project if works are required within 40 m of the Duck River.

The WM Act defines an aquifer interference activity as that which involves any of the following:

- the penetration of an aquifer;
- the interference with water in an aquifer;
- the obstruction of the flow of water in an aquifer;
- the taking of water from an aquifer in the course of carrying out mining or any other prescribed activity; and
- the disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The Project may require an aquifer interference approval in order to remediate the groundwater at the Western Area.

5.3.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (NSW) (PoEO Act) provides for the issue of an Environment Protection Licence (EPL) for premises based scheduled activities pursuant to section 48 of the PoEO Act, and non-premises based scheduled activities pursuant to section 49 of the PoEO Act. Activities requiring an EPL are listed in Schedule 1 of the Act. An EPL can also be sought for an activity if discharges to waters are proposed which would otherwise constitute pollution of waters.

Clause 15 of Schedule 1 lists 'contaminated soil treatment' as a scheduled activity. Contaminated soil treatment, means "*the on site or off site treatment of contaminated soil (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site).*" The definition is the same as the definition for soil treatment works in Schedule 3 of the EP&A Regulation (refer to **Section 5.1.2**). Therefore, this clause applies to the Project.

Clause 16 of Schedule 1 lists 'contaminated groundwater treatment' as a scheduled activity. Contaminated groundwater treatment, is a scheduled activity "*if it has the capacity to treat more than 100 megalitres per year of contaminated water.*" It is considered unlikely that the Project will reach this limit, however as the RAP is developed this will be reviewed.

Therefore, the Project would be considered a scheduled activity under the POEO Act and the existing EPL for the Site (No. 570) would need to be varied to allow the remediation activities to occur.

The PoEO Act also provides for the management of water, air and noise pollution and the control of wastes. These requirements would also need to be met.

5.3.3 Contaminated Land Management Act 1997

The overarching objective of the *Contaminated Land Management Act 1997* (NSW) (CLM Act) is to establish a process for investigating and, where appropriate, remediating land that the NSW Environment Protection Authority (NSW EPA) has reason to believe is significantly contaminated so as to warrant regulation under the CLM Act.

Under section 60 of the CLM Act, an owner of land that has been contaminated (whether before or during the ownership of the land) must notify the NSW EPA that the land is contaminated where certain criteria are satisfied. Section 60 also states that a person whose activities have contaminated the land must notify the NSW EPA in writing.

Ground investigations completed to date have concluded that contaminants of potential concern (e.g. heavy metals, total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAHs), asbestos etc) are variably present within soil and fill material at the Site. Contamination conditions at the Site have been discussed in **Chapter 3**.

The CLM Act establishes a process for investigating and remediating land areas where contamination presents a significant risk of harm to human health or some other aspect of the environment. Where land is identified as potentially contaminated, consultation with the EPA should be undertaken.

On 22 June 2012, the EPA issued a Preliminary Investigation Order under the CLM Act requesting reports on environmental contamination (sediment, soil, water), data gaps and a proposed investigation plan. Following receipt of a number of reports and discussions with Viva Energy, the EPA declared the Site, including the Western Area, as 'significantly contaminated land' under the CLM Act (Declaration Number 20131110). At present, there is no Voluntary Management Proposal for any portion of the Site. Equally Viva Energy is not subject to a Management Order relating to the Site under the CLM Act.

5.3.4 Work Health and Safety Act 2011

The *Work Health and Safety Act 2011* (WH&S Act) and its supporting Regulation 2011 (WH&S Regulation) defines major hazard facilities (MHFs), regulates their operation and includes measures to prevent accidents occurring at MHFs. They also include specific provisions regarding the management of asbestos and asbestos containing materials (ACMs). The Clyde Terminal is classified as a MHF.

Any works to or modifications of a MHF need to be discussed with Safework NSW as the administrators of the WH&S Act. The proposed remediation works would not occur within the part of the Site where the terminal is located. Viva Energy regularly consults with Safework NSW regarding the terminal and will continue to do so moving forward. However as the Project would not affect the MHF, consent and approval of Safework NSW is not required.

The WH&S Regulation sets out the procedures for dealing with asbestos in the workplace, as well as the process of licensing certain personnel as official asbestos removalists. The Project is expected to yield a certain amount of asbestos waste, or waste materials containing asbestos. Viva Energy would abide by these regulations for dealing with asbestos waste.

6.0 State or regional planning significance

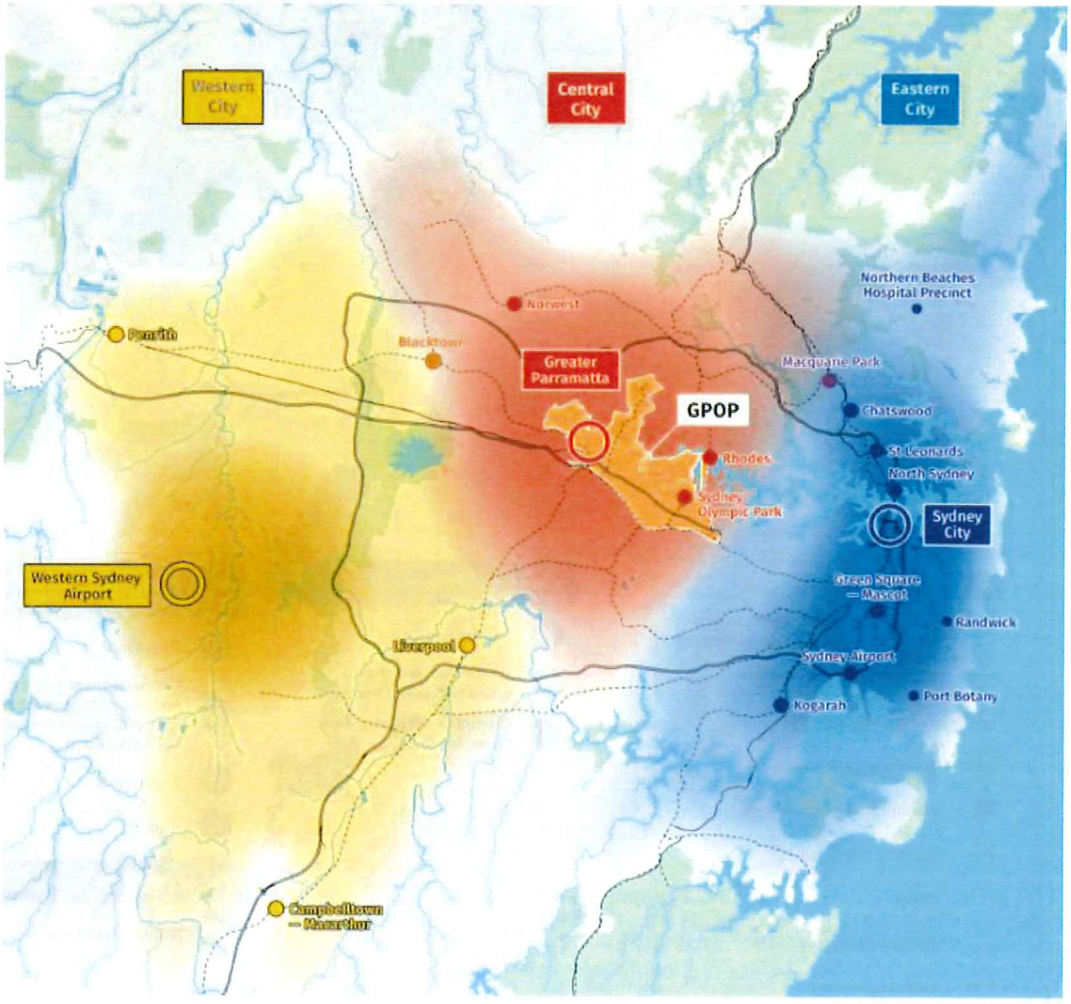
In accordance with the DPE '*Guideline on 'call-in' of state significant development under the Environmental Planning and Assessment Act 1979*', the Project has been assessed against the six general determining issues relating to the State and Local significance of projects. The assessment and applicability of the Project against these considerations is outlined below.

6.1 General determining issue 1

Whether the proposal is of regional or State importance because it is in an identified strategic location, or is critical in advancing the nominated strategic direction or achieving a nominated strategic outcome, contained in a relevant State policy, plan or strategy, or regional or sub-regional strategy.

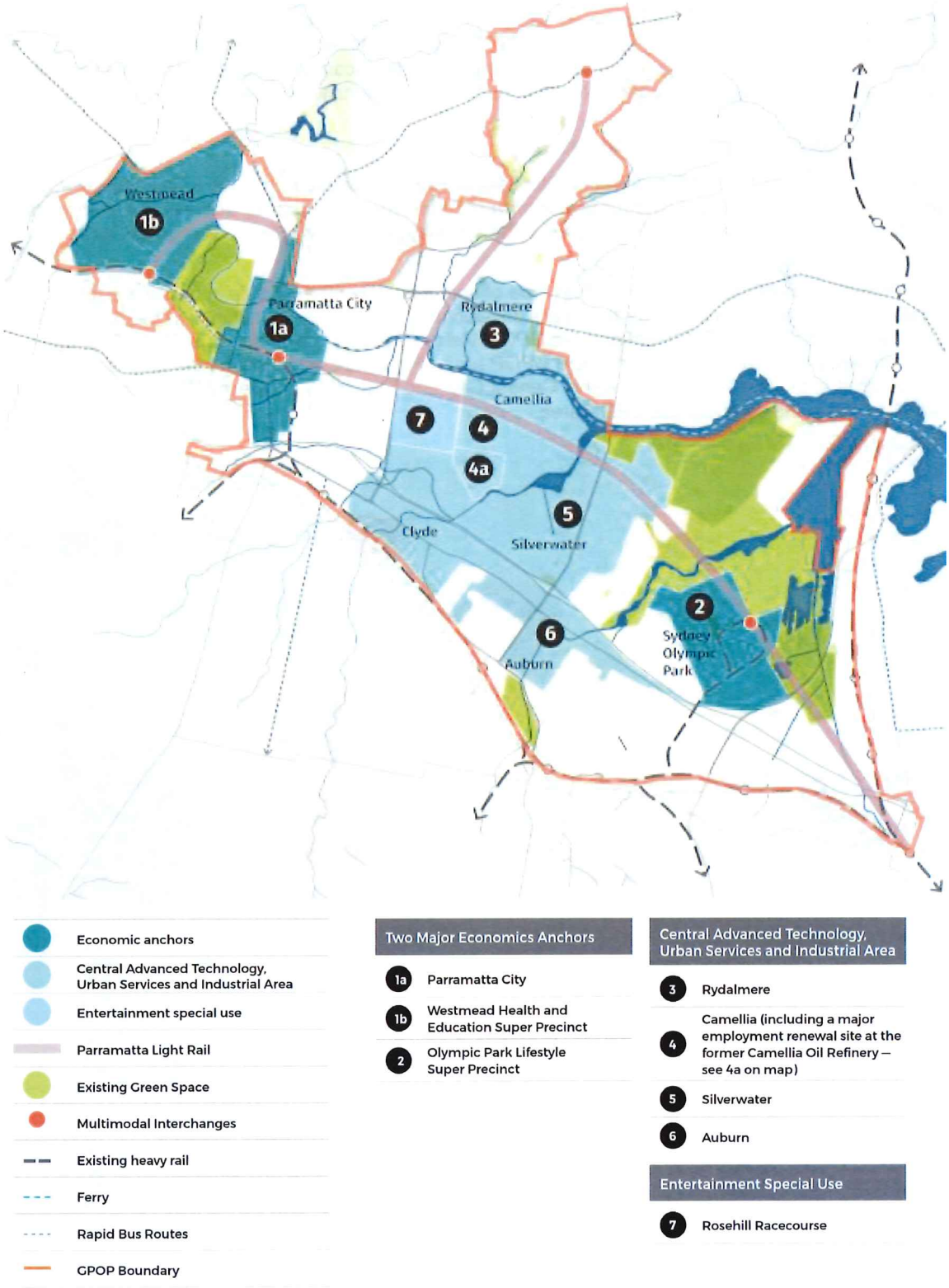
The Project involves the remediation of an area of approximately 40 ha in size in one of the most strategically important locations for the future development of Sydney. As outlined in the draft West Central District Plan (GSC, 2016a) and the GPOP Vision (GSC, 2016b) (refer to **Section 5.2**), the Western Area is located in the heart of the GPOP area. **Figure 14** below shows the location of the GPOP area in relation to Sydney and the 'Central City' and **Figure 15** shows the Western Area (labelled 4a) in the centre of the GPOP area.

Figure 14 Location of the GPOP area



Source: GPOP Vision (GSC, 2016b)

Figure 15 Location of the Western Area (labelled 4a)



Source: Figure 3-1, draft West Central District Plan (GSC, 2016a)

The GPOP area is a major focus for the GSC and is considered one of Sydney's most crucial centres of economic activity. The GSC recommends that the development of Camellia peninsula focus on "Essential Urban Services, Advanced Technology and Knowledge Sectors" in order to develop the area into a diverse economic asset that supports Sydney's 'Central City'. As stated in the GPOP Vision:

"*Today's Sydney is a metropolis of 4.3 million people and its focal point is the Sydney CBD in the east. We're growing fast — and our growth is in the west.*

As the city grows to house 6 million people in 2036 and 8 million people in 2056, a metropolis focused on a single eastern Sydney CBD will not meet the needs of all of Greater Sydney.

Greater Sydney needs a new city with a civic heart, services, housing, culture, education and enterprise at its centre. GPOP can become Greater Sydney's true centre: the connected, unifying heart."

The vision goes on to note the proposed infrastructure linkages across the GPOP area, including the light rail and potentially the Sydney Metro. It then discusses each of the precincts within the GPOP area. The Site falls within 'Quarter 3' – Essential Urban Services, Advanced Technology and Knowledge Sectors. With regards to the Site, and the Western Area in particular, the following is stated:

"*Viva Energy's evolution from an oil refinery to an oil distributor — a change brought about by changes in the global fuel supply chain — represents a landmark change and an opportunity for GPOP. Around 40 hectares of surplus land in Camellia will become available for modern enterprise with relatively high density employment. Its future use must be compatible with the requirements of Viva's* [sic] *fuel terminal.*"

The vision for 'Quarter 3' is to maintain this central employment and urban services area, intensify employment uses and connect with the 21st century global economy. To do this, the focus will be on creating "*unique and positive connections between Science, Technology, Engineering, Art and Mathematics (STEAM), health, education, sports, culture and business sectors — to drive innovations that arise from an eco-system of interdependency, growth and change*" (GSC, 2016b). The Site and the Western Area are expected to form part of the transformation of Camellia.

The purpose of the Project is to remediate the Western Area to commercial / industrial standards. In its current condition parts of the Western Area are too contaminated for certain industrial or commercial land uses to be granted development consent due to the requirements of SEPP 55 (refer to **Section 5.1.2**). The contaminated nature of the land means that, without remediation, the proposed use of this land for "*modern enterprise with relatively high density employment*" in the GPOP Vision (GSC, 2016b) would not be achieved.

Remediation of the Western Area would allow this land to be developed for commercial / industrial purposes, thereby supporting the GCS's employment aspirations for the land and meeting the Quarter 3 vision outlined above. The Project would also support the delivery of the fifth of the GPOP Vision's 12 Strategic Directions:

"*No 5 - Transform Camellia, Rydalmere, Silverwater and Auburn into 21st Century essential urban service, advanced technology and knowledge assets*"

Therefore the remediation of the Western Area is considered to be a critical part of achieving the GPOP Vision.

The Western Area, is also adjacent to the Clyde Terminal. The Clyde Terminal provides approximately 40% of the finished fuels to NSW and the ACT. This includes providing fuels to other terminals, Sydney Airport and via tanker across the State. The Clyde Terminal is the key asset in Viva Energy's supply network and critical for supporting the movement of people, goods and services across the State, country and internationally. As such, the Clyde Terminal and its related infrastructure are critical to the present day and future operation of Sydney, NSW and the ACT. As the Project would take place in an area of land that is adjacent to Clyde Terminal, it will be important to ensure that the Project does not adversely affect the operation of this facility or its related infrastructure. The presence of the Clyde Terminal adjacent to the Western Area and the terminal's importance to the State support the fact that the Project should be considered at the State level.

6.2 General determining issue 2

Whether the proposal delivers major public benefits such as large-scale essential transport, utility infrastructure, or social services to the community.

As discussed in **Chapter 3**, the Western Area contains various levels of soil and groundwater contamination.

Exceedances of the NEPM criteria for commercial / industrial land (NEPM, 2013) for these CoPC are present across the Western Area to a greater or lesser degree. The concentration of certain pollutants potentially presents an unacceptable risk to human health and certain environmental receptors close to the Site. The presence of certain pollutants at elevated levels potentially limits the redevelopment potential of the Western Area.

The Project would deliver a major public benefit by addressing CoPC that are above the established criteria at the Western Area, thereby reducing the human health and environmental risks currently associated with this large area under a site redevelopment scenario. Further, the potential redevelopment of the land following completion of the Project would deliver a major public benefit by helping to ensure that this land can deliver the GSC's GPOP Vision, which in turn will benefit the whole of Sydney and the State.

6.3 General determining issue 3

Whether the proposal is likely to have significant environmental, social or economic impacts or benefits, be of a significant hazardous or environmentally-polluting nature, or is located in or in close proximity to areas or locations that have State or regional environmental, archaeological or cultural heritage significance.

6.3.1 Significant environmental, social or economic impacts or benefits

As noted in **Chapter 3**, there are a range of CoPC present in the soils and groundwater at the Western Area. As noted in **Chapter 4**, the Project would involve the remediation of the soils and groundwater as well as the removal and/or management of any sub surface refinery infrastructure.

Viva Energy has extensive experience in managing various remediation projects across Australia. This experience means that Viva Energy is acutely aware of the potential environmental, social and economic impacts that could arise from the Project (e.g. air quality, noise, water quality etc.) and the measures required to avoid or mitigate these impacts. As such, both during the works and as a result of the Project the proposed remediation of the Western Area would ensure that a number of environmental, social and economic risks potentially associated with its remediation are either avoided or their likelihood or consequence reduced.

From an environmental standpoint, the Project would improve the quality of the soil and groundwater within the Western Area and make it suitable for commercial / industrial redevelopment in the future thereby supporting realisation of the GPOP Vision for the Camellia Peninsula. At present, the contaminated ground conditions within the Western Area present a potential risk to people or biotia on the Site. By remediating the Western Area, potential adverse human health and ecological impacts related to the contaminated soil and groundwater would be mitigated.

From a social and economic point of view, as discussed above, the Project would help unlock the economic potential of the area creating future jobs and allowing the redevelopment of a new employment area.

As outlined in Chapter 4, a number of remediation techniques could be employed as part of the Project. These remediation techniques require various established controls in place to ensure the environmental success of their implementation. Given the sensitivity of certain receptors surrounding the Western Area (such as the Duck River and its associated ecological communities which have a 'State' level of significance), and the scale and potential for impacts as a result of the Project, it is considered that the Project should be managed at the State level.

6.3.2 Significant hazardous or environmentally-polluting nature

The Western Area is currently designated as a 'significantly contaminated land' under the CLM Act (Declaration Number 20131110) (refer to **Section 2.4** and **Chapter 3**). Left untreated, the Western Area could potentially be polluting in nature, however Viva Energy intends to implement the appropriate controls via the Project to ensure that significant adverse impacts are avoided or mitigated.

6.3.3 Proximity to areas or locations of State or regional environmental, archaeological or cultural heritage significance

The Western Area does not contain any known areas or locations of State or regional environmental, archaeological or cultural heritage significance. However, adjacent to this area is the Duck River which contains a number of riparian ecological communities, some of which are Endangered Ecological Communities (EECs) (i.e. the *Estuarine Fringe Forest – Swamp Oak floodplain forest* community and the *Estuarine saltmarsh* community). These ecological values have a 'State' level of significance, are adjacent to the Western Area and could potentially be impacted by the Project if it was not properly managed and regulated.

In addition, as noted in **Section 6.1**, the Western Area is also adjacent to the Clyde Terminal. The Clyde Terminal supplies approximately 40% of NSW's liquid fuel needs and is a critical supply point for jet fuel to Sydney Airport via a dedicated pipeline from the facility. The Clyde Terminal plays a critical role in delivering fuel safely and efficiently to both metropolitan Sydney as well as the broader NSW market. The vast majority of fuel is supplied to the terminal via pipeline, and is subsequently distributed to customers across the state by road transport.

The amount of fuel stored and handled at the terminal means that it is also designated as a MHF under WH&S Regulation. There are 39 MHF in NSW. The regulations require increased safety, security, emergency, notification and consultation requirements for MHFs due to the amount of chemicals present on these sites.

The terminal's size and designation as a MHF mean that the risks associated with completing the remediation works adjacent to this facility would need to be carefully assessed and managed. DPE's experience in assessing MHFs and their previous experience managing and coordinating the Clyde Terminal Conversion Project (SSD 5147) mean that they are best placed to coordinate and assess the development application for the proposed remediation works.

6.3.4 General Issue 3 conclusion

Once the remediation of the Western Area is successfully completed, the Project is likely to allow the realisation of numerous beneficial impacts. These include positive environmental effects related to the remediation of the soil and groundwater which in turn will potentially benefit the local ground water quality, air quality and ecology. They also include positive social and economic impacts relating to the opportunity to support the GPOP Vision to create more a more diverse economic centre on the Camellia peninsula. Certain adverse impacts could potentially occur during the delivery of the Project, however various established controls are available to ensure that these potential impacts would be mitigated or avoided. As such, it is considered that the Project has the potential to result in a number of significant environmental, social or economic impacts and benefits during both its delivery and as a result of completing the remediation. Equally the significance of the Site in supplying a large proportion of NSW's fuel needs, and DPE's past experience assessing MHFs and major projects at the Site means that they are best placed to coordinate and assess the development application for the proposed remediation works.

6.4 General determining issue 4

Whether the proposal is of significant economic benefit to a region, the State or the national economy, such as those with high levels of financial investment and continuing or long-term employment generation.

The Project proposes to remediate the Western Area to a commercial / industrial standard which will allow the approximate 40 ha are to be redeveloped in line with the GPOP Vision. As part of this Vision, GSC has recommended that development of Camellia peninsula focuses on "Essential Urban Services, Advanced Technology and Knowledge Sectors" in order to develop the area into a diverse economic asset that supports Sydney's 'Central City'.

The remediation of the Western Area to commercial / industrial standards will support the commercial / industrial development of the GPOP area and deliver the fifth of the GPOP Vision's 12 Strategic Directions:

"*No 5 - Transform Camellia, Rydalmere, Silverwater and Auburn into 21st Century essential urban service, advanced technology and knowledge assets*"

As such, the Project would be of significant economic benefit, not only Sydney's 'Central City' but to Metropolitan Sydney as a whole, and potentially the State, through provision of employment, services and patronage on public transport.

6.5 General determining issue 5

Whether the proposal is geographically broad in scale, including whether it crosses over multiple council and other jurisdiction boundaries, or impacts a wide area beyond one local government area.

Whilst the Western Area does not cross multiple local government area boundaries it is subject to the aspirations of both the Greater Sydney Commission and Parramatta City Council. The GSC provides the strategic planning direction for the area and Parramatta City Council provide the local planning direction through the LEP and Development Control Plan. The size of the Western Area and the possibilities that this area provides for realising the GPOP Vision mean that this Project can be considered important at a 'precinct scale'.

In addition, the size of the Western Area, the variety of CoPC and the need to potentially remediate both the soils and the groundwater mean that the Project is likely to be complex and may involve numerous remediation technologies. The likely scale and nature of Project will require discussions and/or consultation with a wide variety of stakeholders which may include:

- The EPA
- The Department of Primary Industries (DPI) – Office of Water
- Office of Environment and Heritage (OEH)
- Roads and Maritime Services (Roads and Maritime)
- Safework NSW may wish to comment on the Project given the proximity of the Clyde Terminal (a major hazard facility);
- GSC
- Parramatta City Council

As well as the stakeholders listed above, the Project is also likely to receive interest from the local Parramatta community.

The complexity of the Project, the various aspirations for the Western Area, its 'precinct scale' and the multiple stakeholders that are likely to be involved, mean that it is appropriate that the development application for the Project is managed and coordinated by the DPE. It is Viva Energy's belief that is best achieved by declaring the Project as SSD.

6.6 General determining issue 6

Whether the proposal is complex, unique or multi-faceted and requires specialist expertise or State coordinated assessment, including where councils require or request State assistance

The size and location of the Western Area, the variety of CoPC and the potential need to remediate the soils, the groundwater and remove or manage redundant subsurface infrastructure mean that the Project is likely to be complex and potentially involve numerous remediation technologies. The precise remediation strategy for the Western Area is not yet confirmed, however, it is likely to be multi-facetted (in that a number of approaches may be required concurrently) and unique to a large area with a number of contaminants and sensitive receptors nearby.

The development application for the Project will require a number of environmental assessments to be completed by various specialists. The development of the RAP and the strategy within it for the Western Area will require particular specialist expertise. In turn, and as discussed above, the Project, the remediation strategy and the environmental assessment will be discussed with a wider variety of government stakeholders and the community.

As outlined in General Issue 5, the likely scale and nature of Project will require discussions and/or consultation with a wide variety of government stakeholders including the state agencies and the council. The key government bodies and their likely involvement is outlined below:

- The EPA is likely to be the key government stakeholder for the Project. Their key areas of responsibility involve matters relating to the POEO Act and the CLM Act (refer to **Section 5.3**). The EPA is interested in potential impacts related to soil and water pollution, air quality, noise, waste and human health. The EPA will be involved throughout the SSD application process and post approval. The remediation plan will need to be agreed with the EPA. The EPA will also be involved in revising or issuing a new EPL for the works.
- NSW Health is likely to be interested in potential impacts and/or risks associated with air quality and human health. They are likely to be involved during the SSD application process.
- The DPI – Office of Water will want to ensure that potential impacts to groundwater and surface water resources are avoided or reduced. They will also want to make sure that any water licencing issues under the WM Act are appropriately addressed. The Office of Water is likely to be involved through the SSD application process and possibly during the remediation works.
- OEH will want to ensure that potential impacts relating to ecology and heritage are avoided or minimised. They are likely to be involved during the SSD application process.
- Roads and Maritime are likely to have limited involvement as the roads around the Site are not classified roads. Nevertheless they are likely to require that a traffic management plan is produced for the Project and may want to make sure that related traffic movements are considerate of any works on nearby classified roads (e.g. James Ruse Drive).
- Safework NSW (specifically the Major Hazard Facility Team) may comment on the Project during the SSD application process given the proximity of the Clyde Terminal (a major hazard facility).
- GSC may comment on the Project during the SSD application process given the strategic location of the Western Area (refer to **Section 6.1**).
- Parramatta City Council will want to ensure that potential impacts relating to its assets and the community are assessed and where necessary mitigated. These could include traffic and access, ecology, heritage, flooding and other amenity issues. Parramatta City Council are likely to be involved through the SSD application process and possibly during the remediation works.

As well as the stakeholders listed above, the Project is also likely to receive interest from the local Parramatta community.

Therefore given the likely complexity of the Project, the wide range of environmental assessments and specialists required, and the multiple stakeholders that are likely to be involved, Viva Energy believes it is appropriate that the development application for the Project is coordinated, managed and assessed by the DPE.

As demonstrated on the Major Projects Website[6], DPE has considerable experience in managing development applications for large remediation projects and for reviewing major environmental assessments with numerous technical studies. The DPE also managed and coordinated the Clyde Terminal Conversion Project (SSD 5147) application and therefore has a strong understanding of the site, the sensitive environmental and community receptors in the surrounding area, and which stakeholders would be most interested in the Project. Following development consent of the Clyde Terminal Conversion Project (SSD 5147), DPE remain involved with the Site through their compliance team. In addition, the DPE also has a strong understanding of the hazards and risks associated with the operation of a MHF site and the constraints that may apply to completing works close to this operation.

The precise timing of the Project is yet to be confirmed; however there would be operational and environmental benefits to commencing the remediation works as soon as possible after the conversion and demolition works are completed. DPE's knowledge of, and continued involvement with, the Site would ensure that key issues for the SSD application and relevant stakeholders are efficiently managed. This in turn would provide the best opportunity of reducing any 'downtime' between completion of the conversion and demolition works and commencing remediation.

Given the complexity and importance of the Project as outlined above, Viva Energy believes that it is appropriate for the development application to be SSD and managed and coordinated by DPE.

[6] http://majorprojects.planning.nsw.gov.au/

7.0 Conclusion

The Western Area represents a major opportunity for the future development of Sydney and particularly the GPOP area. Its size and location mean that it is ideally located to act as a catalyst for the development of new economic assets at the heart of Sydney's Central City, supporting the GPOP Vision and providing employment, services and patronage for future public transport.

Certain parts of the Western Area are currently contaminated with various CoPC. This contamination is present in and on the soils, in the groundwater and in certain sub-surface infrastructure. In its current condition, the Western Area presents potential human health and ecological risks and cannot meet its development potential under the GPOP Vision.

Viva Energy are proposing to remediate this area to a commercial / industrial standard that would allow it to be appropriately redeveloped. This Project is likely to involve a number of remediation techniques, many of which will need to operate concurrently. The Project will need to have regard to its environmental and social context to ensure that potential adverse impacts are avoided or mitigated. Numerous stakeholders are likely to be involved given the history of the Site, the various remediation approaches and the strategic and land use planning aspirations for the land.

Given the reasons above, and given their previous involvement with SSD 5147, Viva Energy believe it is appropriate for the development application to be managed and coordinated by the DPE. This would ensure the requirements of the various stakeholders are appropriately coordinated and would ensure that the importance of the Western Area for realising the GPOP Vision is recognised. Declaring the Project as SSD would ensure that the Project is assessed at a State level commensurate with level of likely scrutiny the Project will receive during delivery and the economic, social and environmental potential that the land could bring in the future.

Therefore, for the reasons outlined in this report, the Project is considered of State significance and Viva Energy formally seeks a SSD declaration for the Project in accordance with the provisions of Section 89C (3) of the *Environmental Planning and Assessment Act 1979*.

8.0 References

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