

# *Groundwater Management Plan (GWMP)*

*Rutherford Refinery – 41 Kyle St, Rutherford NSW*

**Date:** April 2023  
**Prepared by:** AECOM  
**Updated by:** Cleanaway  
**Version:** Rev 3

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#### Revision History

Rev	Date	Review Trigger	Details of changes	Certified by:	
				Name	Title
0	20/03/2007	Initial	-	Stuart Douglas	-
1	27/09/2019	2018 IEA	Revision of GWMP	Bart Downe	Environmental Business Partner
2	30/06/2022	2021 IEA	Update OEMP	Scott McLeod	Regional Manager – Refineries
3	21/04/2023	2022 AEMR	Update GWMP	Scott McLeod	Regional Manager – Refineries

# Abbreviations

Abbreviation	Term
ADWG	Australian Drinking Water Guideline
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CEC	Cation Exchange Capacity
Cleanaway	Cleanaway Pty Ltd
COC	Chain of Custody
Council	Maitland City Council
DO	Dissolved Oxygen
DPE	Department of Planning and Environment
EC	Electrical conductivity
EPL	Environment Protection Licence
ESA	Environmental Site Assessment
GME	Groundwater Monitoring Event
GWMP	Groundwater Management Plan
HSL	Health Screening Level
LGA	Local government area
LOR	Limit of Reporting
LRTV	Low Reliability Trigger Value
MMMs	Management and mitigation measures
MW	Monitoring Well
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NL	Not Limiting
NSW	New South Wales
OEMP	Operational Environmental Management Plan
PAH	Polycyclic Aromatic Hydrocarbon

Abbreviation	Term
PCE	Perchloroethene/Tetrachloroethene
Site	Cleanaway Refinery located at 41 Kyle Street, Rutherford, NSW
TCE	Trichloroethene
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
VOC	Volatile Organic Carbons

# 1. Introduction

This Groundwater Management Plan (GWMP) has been prepared for Cleanaway Pty Ltd (Cleanaway) to identify and provide management solutions for potential environmental impacts arising from the operation of the Cleanaway Refinery located at 41 Kyle Street, Rutherford, New South Wales (NSW) (the 'Site').

The Site was initially granted project approval PA 05\_0037 on 4 July 2006 for the construction and operation of a resource recovery and recycling facility.

Project Approval MP05\_0037 was modified on five occasions between 2006 and 2021. This included the following modifications:

- Modification 1 (MOD 1): Construction of additional plant to improve the quality of the final waste oil product, determined 16 May 2007;
- Modification 2 (MOD 2): Modification of monitoring requirements to ensure consistency with the EPL, determined 18 October 2011;
- Modification 4 (MOD 4): Replacement of the stack at monitoring point 19, determined 10 December 2014;
- Modification 5 (MOD 5): Construction and operation of new equipment (oil polishing system, multi-fuel burner, six additional oil storage tanks with total combined storage of 2.4 ML and safety and fire-fighting systems) and increase the height of the Multi-Fuel Burner Stack, to enable the facility to produce both Class I and Class II product oils, determined 9 September 2016; and
- Modification (MOD 6): Construction and operation of a Mobile Oil Polishing Plant (MOPP) for a trial period of 30 months, determined 20 August 2021.

Please note, Modification 2<sup>1</sup> for the relocation of oil storage tanks was withdrawn. Works associated with MOD 5 have not commenced, while MOD 6 is still within the 30-month trial period.

## 1.1 Scope

The scope of this GWMP includes the operational activities undertaken by Cleanaway employees, contractors and subcontractors at the Cleanaway Rutherford site as they relate to groundwater.

This GWMP forms part of the Operational Environmental Management Plan (OEMP) for the Cleanaway Rutherford Refinery site. Therefore, consideration of the following documents should occur when considering the environmental management activities undertake onsite:

- Operational Environmental Management Plan (OEMP)
- Air Quality Management Plan (AQMP)
- Stormwater Management Plan (SWMP)

## 1.2 Objectives

The objectives of this GWMP are to:

- Outline measures to minimise and manage groundwater impacts associated with site operations; and
- Ensure compliance with licence and approval requirements.

## 1.3 Consultation

The GWMP was provided to the EPA and DPI Water for consultation on 22 November 2019. No comments were received on the GWMP from either agency.

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<sup>1</sup> It is noted that there are two separate modifications called Modification 2, as result there is no Modification 3.

An updated version of this plan (i.e. Rev3) shall also be provided to DPE, Council and EPA for further consultation in April 2023.

## 2. Compliance Requirements

### 2.1 Conditions of Consent

This GWMP has been prepared to meet the requirements of Condition 3.6 of PA 05\_0037, to prepare and implement a GWMP for the operations at the Site. The specific requirements of this Condition are outlined in **Table 1** as are other conditions relating to groundwater.

**Table 1:** PA 05\_0037 Conditions of Approval relating to Groundwater

Condition	Requirement	Reference Section
3.6	The OEMP for the project shall include the following Management Plans:	
(c)	A Groundwater Management Plan to detail measures to monitor, and where applicable, manage the impact on groundwater. The Plan shall be prepared in consultation with the EPA and DPI Water <sup>2</sup> , and shall include, but not necessarily be limited to:	<b>Section 1.3</b>
	i) details of baseline groundwater quality, as present prior to the commencement of construction of the development;	<b>Section 4</b>
	ii) groundwater assessment criteria for a broad range of parameters, including, heavy metals, total nitrogen and total phosphorous;	<b>Section 5</b>
	iii) monitoring program of groundwater quality, including frequency of monitoring and monitoring locations;	<b>Section 6</b>
	iv) details of contingency measures and management options should monitoring of groundwater quality indicate that the development has had, or is having, an adverse effect on groundwater quality;	<b>Section 7</b>
	v) details of the nominated contingency measures and management options, should monitoring of groundwater quality indicate that the development has exceeded this criteria. These levels and contingency and management options must be developed to the satisfaction of the EPA.	<b>Section 7</b>
2.15	Except as may be expressly provided in an EPL for the project, the Proponent shall comply with section 120 of the Protection of the Environment Operations Act 1997.	<b>Section 7</b>

<sup>2</sup> PA 05\_0037 originally referred to Department of Environment and Conservation (DEC) and Department of Natural Resources (DNR). It is noted that DEC is now the NSW Environment Protection Agency (EPA) and DNR is now NSW Department of Primary Industries Water (DPI Water).



Condition	Requirement	Reference Section
2.18	<p>Within six months of the granting of modified consent, the Proponent must complete the following groundwater contamination investigations and works which includes, but need not be limited to, the following:</p> <p>(a) An assessment of the potential for off-site migration of chemicals of potential concern (including Tetrachloroethene);</p> <p>(b) Identification, based on the activities carried out on the site, of suspected source locations. If suspected source locations are identified, an evaluation of the presence of DNPLs trapped in or above lower permeability zones above the regional groundwater aquifer must be undertaken (note that care must be taken to ensure that the regional aquifer is not penetrated at suspected source locations);</p> <p>(c) Works to assess regional groundwater and determination of hydrogeological characteristics (such as flow and direction). Such works must include the installation of additional wells across the site to:</p> <ul style="list-style-type: none"> <li>- enable the groundwater flow direction to be determined;</li> <li>- further investigate the lateral and vertical extent of groundwater contamination;</li> <li>- enable more accurate falling head tests and/or a pump test to be undertaken; and</li> <li>- allow collection of soil samples within the water bearing zone.</li> </ul> <p>(d) Soil samples collected must be analysed for organic carbon content and cation exchange capacity to allow fate and transport modelling to assess the potential for adsorption and retardation of dissolved organic compounds;</p> <p>(e) An assessment of risk posed by the contamination and recommendations for appropriate management requirements.</p> <p>The Secretary and the EPA must be provided with a copy of the report detailing the results of the investigations within seven months of the modified development consent being granted.</p> <p>The Proponent shall comply with all reasonable requirements of the Secretary and the EPA in respect of the implementation of any measures presented in the Report. Any such works shall be completed within such time as the Secretary or the EPA may require.</p> <p>Note: should it be established that there are no ongoing contamination sources at the site, that the regional groundwater has no beneficial uses, and that groundwater is not used in the area, then more detailed investigations into contaminant concentrations in the regional aquifer, groundwater flow direction and flow velocity may not be necessary. If applicable, the reasons for not undertaking this further investigation must be detailed in the report.</p>	<b>Section 4.4</b>

## 2.2 Environment Protection Licence

The site operates under an Environment Protection Licence (EPL) No.12555, issued by the NSW Environment Protection Authority (EPA) for the Scheduled Activity of “chemical storage” and “petroleum products and fuel production”. The requirements of the EPL relevant to air quality are summarised in **Table 2**.

**Table 2: EPL Conditions relevant to Groundwater**

Condition	Requirement	Reference Section			
P1.3	Location of groundwater monitoring points	Sections 4.5 & 6.1			
	<table><tr><th>EPA Identification no.</th><th>Type of Monitoring Point</th><th>Location Description</th></tr></table>		EPA Identification no.	Type of Monitoring Point	Location Description
	EPA Identification no.		Type of Monitoring Point	Location Description	
	6		Groundwater quality monitoring	Bore MW21 as shown in Figure 2 of the document "Phase 1 & 2 Environmental Site Assessment: Transpacific Refiners, Kyle Street, Rutherford, NSW" prepared by ENSR Australia Pty Ltd and dated 8 July 2008.	
	10		Groundwater quality monitoring	Bore MW12 as shown in Figure 2 of the document "Phase 1 & 2 Environmental Site Assessment: Transpacific Refiners, Kyle Street, Rutherford, NSW" prepared by ENSR Australia Pty Ltd and dated 8 July 2008	
	22		Groundwater quality monitoring	Bore MW15 as shown in Figure 2 of the document "Phase 1 & 2 Environmental Site Assessment: Transpacific Refiners, Kyle Street, Rutherford, NSW" prepared by ENSR Australia Pty Ltd and dated 8 July 2008. DOC17/203920	
23	Groundwater quality monitoring	Bore MW19 as shown in Figure 2 of the document "Phase 1 & 2 Environmental Site Assessment: Transpacific Refiners, Kyle Street, Rutherford, NSW" prepared by ENSR Australia Pty Ltd and dated 8 July 2008. DOC17/203920			
L1.1	<p>Pollution of Waters</p> <p>Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.</p>	Section 7			
M2.3	Groundwater monitoring requirements	Sections 6			
M3.2	<p>Testing methods – concentration limits</p> <p>Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.</p>	Section 6.4			

## 2.3 Legislative Requirements

An overview of the legislative requirements relevant to groundwater are summarised in **Table 3**.

**Table 3: Overview of Legislative Requirements**

Legislation	Overview of obligations
Protection of the Environment Operations Act 1997 (PEEO Act)	<p>The PEEO Act sets the statutory framework for managing water pollution in NSW, including establishing the licensing scheme for major industrial premises and a range of water pollution offences and penalties.</p> <p>Under S120 it is an offence to pollute water (including groundwater) except in accordance with the conditions of an EPL.</p>
Protection of the Environment Operations (General) Regulation 2022	The PEEO General Regulation provides for the administration of the licensing scheme.
Water Act 2014	It is an offence to interfere with sub-surface water or obstruct its flow except in accordance with the Water Act or the written satisfaction of the Ministerial Corporation.
Contaminated Land Management Act 1997 (CLM Act)	The CLM Act establishes a process for investigating and (where appropriate) remediating land that EPA considers to be significantly contaminated.

## 3. Site Description

### 3.1 Site Description and Layout

The Site is located in the Rutherford Industrial Estate, approximately 5 km north/west of Maitland. The Site is located within the Maitland City Council local government area (LGA) (refer to **Figure 1**). The refinery has been operational since May 2007.

The site topography is flat and primarily devoid of any significant vegetation with the exception of some boundary tree plantings along the western boundary. A large portion of the site is undeveloped grassland with the existing facility concentrated on the western end of the site. The site is located on Lot 223 DP 1037300.

The nearest residential area is located in Rutherford, with the closest receptors approximately 1 km from the Site.

The refinery processes up to 40,000 tonnes per annum (tpa) of re-refined waste oil. This waste oil is refined via hydrogenation into base oil for use in lube oil blending and industrial processes.

The site operates 24 hours a day, 7 days a week with a workforce of up to 35. Major components of the Site include:

- Hydrogenation plant
- Hydrogen (H<sub>2</sub>) plant
- Nitrogen (N<sub>2</sub>) plant
- Cooling towers
- Storage tanks
- Control room and office building
- Workshop
- Process store
- Truck unloading and loading bays
- Mobile Oil Polishing Plant (MOPP)

Activities and operations required for the receipt, storage, processing and supply of refined oils are outlined in the Standard Operating Procedures (SOPs) for the Site.

As part of the waste management and recycling operations, Cleanaway Rutherford forms a key part of the closed loop used oil recycling business, by providing the facilities to return oil and lubricants to base oil quality for purchase and reuse in the marketplace. Other facilities located throughout the east coast support the Rutherford site in the collection, initial cleaning/processing, and transportation of waste and base oils.

### 3.2 Surrounding Land Use

As shown in **Figure 1**, the Site is located within the Rutherford Industrial Estate, which contains a number of industrial businesses. Industrial land uses immediately surrounding the Site can be summarised as:

- North – Industrial land uses
- South – Industrial land uses
- West – Vacant vegetated land (Cleanaway site) and Industrial land uses
- East – Primarily vacant industrial land

The Site is situated approximately 400m to the north east of Stoney Creek, a tributary of the Hunter River and 6km to the north west of Maitland.

There are no registered groundwater bores within 1.0km of the Site with the nearest bore approximately 1.5km to the north east used for monitoring purposes. The nearest sensitive bore is used for irrigation purposes and is located approximately 4.5km to the north of the site.

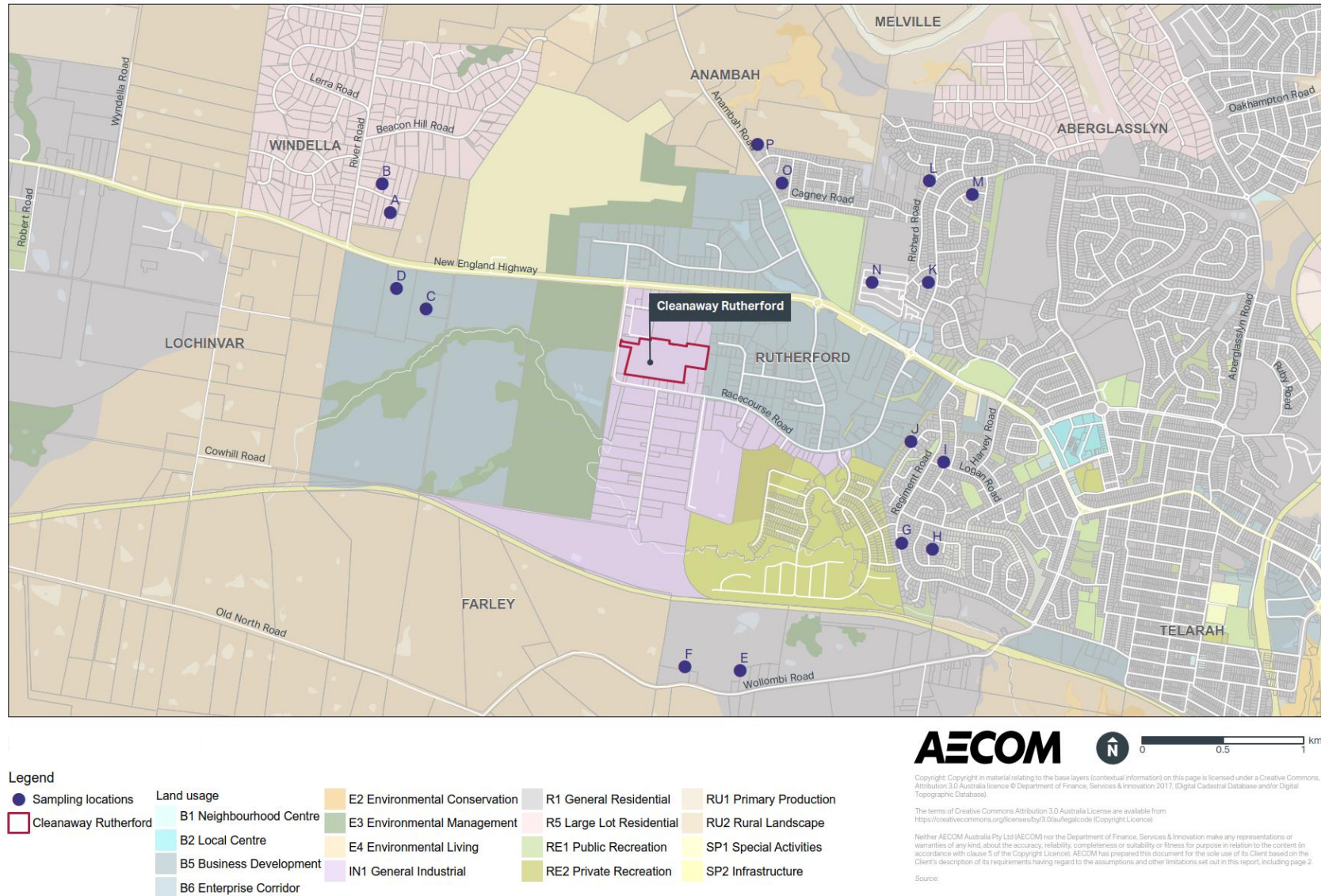
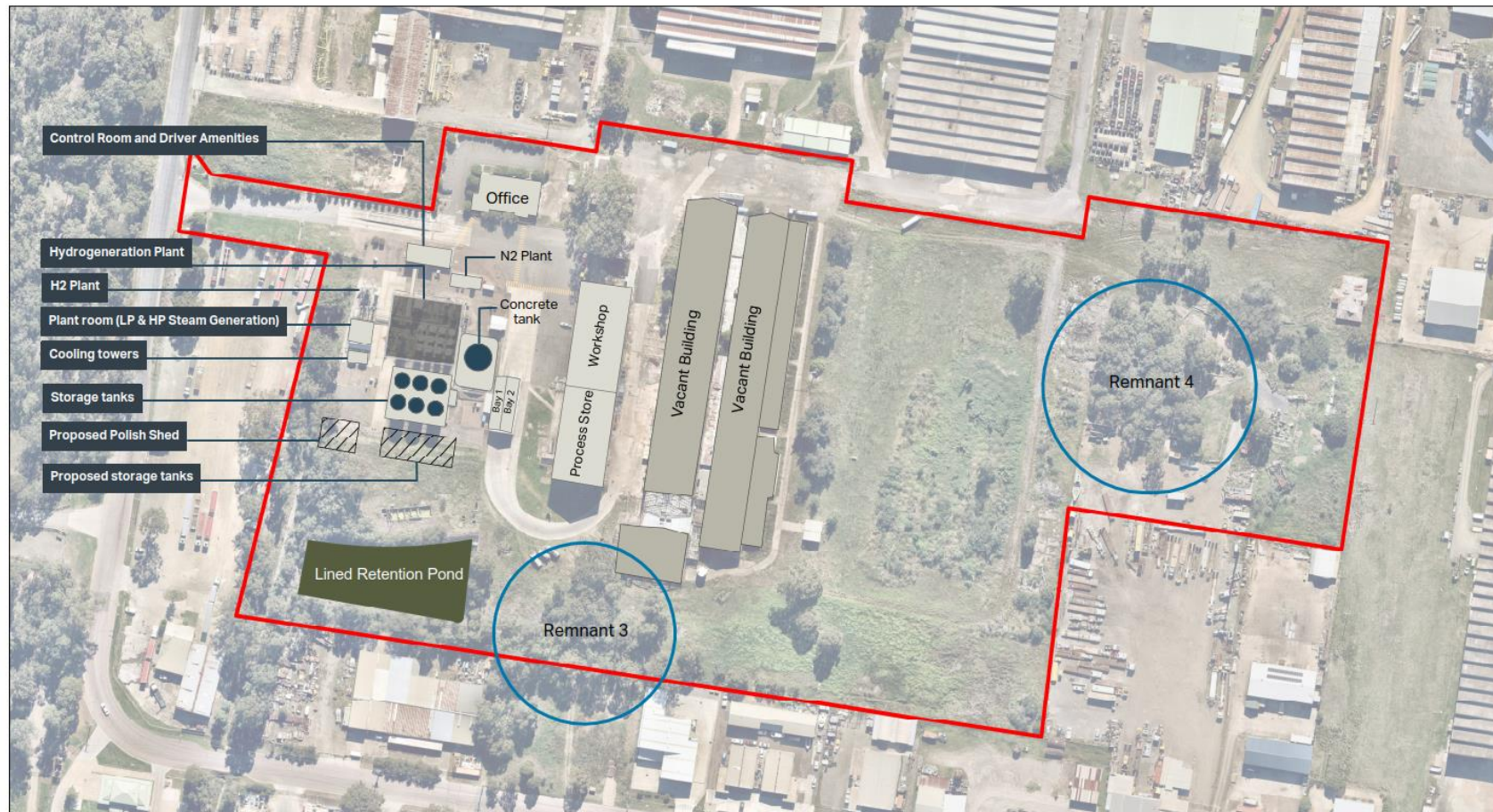


Figure 1: Location of the Site





#### Legend

Site boundary

**Figure 2: Site layout** (Note, “proposed” infrastructure relates to MOD 5 approval)

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## 4. Historical Groundwater Quality

### 4.1 Site History

Historical information (ENSR, 2008) indicates that the Cleanaway Refinery site was open land granted by the crown from 1903 until 1944. Anecdotal reports indicate that the Site was used for the munition's storage during the Second World War (1941-1944).

From at least 1973 until 1991 the Site was operated by National Textiles Limited, and again from 1995 until 1997 the Site was used for the manufacturing of textiles. Site operations during this time would have included washing, dyeing, weaving, mercerising, bleaching and finishing.

In 1988, a portion of the Site was leased by a munitions manufacturing company, though it has not been possible to determine the exact location.

Since 2003, the Site has been used by the owner, Cleanaway Refiners (formerly Transpacific Refiners), as a waste oil refinery.

Based on the site history there is a significant risk of historical site derived contamination largely resulting from the use of the Site as an industrial textiles factory between 1973 and 2000. Potential contaminants may include, but are not limited to, metals, Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene and Xylenes (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs), PFAS / PFOA and chlorinated solvents/volatile organic carbons (VOCs).

### 4.2 Baseline Groundwater Quality Monitoring (2005)

Baseline groundwater quality monitoring was carried out by Parsons Brinckerhoff (PB) prior to commencement of construction in 2005. Groundwater sampling was carried out at 3 locations (MW10, MW11 and MW12), shown in **Figure 3**. The groundwater contamination assessment report is provided in **Appendix A**.

The main findings in this report were elevated levels of hydrocarbon, chloroform and tetrachloroethene.

### 4.3 Groundwater Quality Monitoring (2007)

Further samples were taken from MW10 and MW12 on 23 March 2007 following completion of construction, and these results are provided in **Appendix B**.

### 4.4 Phase 1 & 2 Environmental Assessment (2008)

As required by Project Approval Condition 2.18 and a Pollution Reduction Program which was included in the EPL as Condition U3, a Phase 1 & 2 Environmental Site Assessment (ESA) was undertaken by ENSR Australia P/L (ENSR) in 2008. The ESA included a review of historical information and previous investigation reports, collection of soil samples, groundwater monitoring and sampling, and laboratory analysis of soil and groundwater samples. Sampling was carried out at 5 locations (MW10, MW12, MW14, MW15, MW21).

The site layout at the time of the ESA, together with sampling locations shown in **Figure 4**. ESA groundwater test results are provided in **Appendix C**.

The ESA report concluded that groundwater impacts at the Site included (TPH), selected heavy metals and Perchloroethene/Tetrachloroethene (PCE). Additional aesthetic impacts to groundwater were noted by way of strong solvent odours encountered within two groundwater wells (MW17 and MW18) located in the central eastern portion of the site, and the groundwater quality at the Site is poor due to salinity in the regional area.

The ESA concluded that the nature and extent of contamination at the Site remained unclear, and additional assessment was required to assess the source of solvent odour noted in the toilets at the Former Dye and Finishing Warehouse, the solvent odour detected in groundwater collected from wells east of this warehouse, identification of source area(s) for the detected chlorinated solvent impacts to groundwater, and the potential



for off-site migration. The ESA also concluded that more information was required to determine if yet unidentified more heavily impacted areas remained at the Site and if off-site migration had occurred.

Results of the soil analysis for Total Organic Carbon (TOC) and Cation Exchange Capacity (CEC) indicated that contaminants in groundwater are mobile and therefore slow to biodegrade.

The ESA was submitted to the EPA to satisfy the requirement of Condition U3 in the EPL. The EPA reviewed the report and considered it met the requirement of the condition and subsequently it was removed from the licence.

## 4.5 Ongoing Historical Groundwater Monitoring

Groundwater monitoring has been required by the EPL since it was granted in May 2007. Originally the EPL required groundwater monitoring at six locations (EPA Points 6, 7, 8, 9, 10, 11, correlating to MW13, MW14, MW15, MW10, MW11, MW12 respectively) on a quarterly basis for the following pollutants:

- Benzene
- Ethyl benzene
- Phenols
- PAHs
- Tetrachloroethene
- Toluene
- TPH
- Xylene

In addition to the above, monitoring of the following additional analytes was also undertaken for the period 2008-2009:

- Cadmium
- Chromium
- Copper
- Manganese
- Lead
- Mercury
- Iron
- Zinc
- Total nitrogen
- Total phosphorus
- Chloroform
- pH
- Conductivity

In August 2010, the EPL was varied and monitoring required at five locations (still referred to as EPA Points 6, 7, 8, 9 and 10 but now correlating to MW21, MW18, MW17, MW20 and MW12 respectively). In addition, the monitoring frequency was reduced from quarterly to six monthly and the pollutants required to be monitored were reduced to:

- Tetrachloroethene
- TPH C10-C3r Fraction

- TPH C6-C9 Fraction

Since this time, monitoring has been undertaken of the pollutants specified in the EPL. No additional heavy metal monitoring has been undertaken.

The EPL was further varied in September 2015 to reduce the monitoring frequency from six monthly to yearly.

In June 2017 the EPL was varied to remove three groundwater monitoring points (EPL Point 7 (MW18), EPL Point 8 (MW17), and EPL Point 9 (MW20) from the licence and replace them with two alternative groundwater monitoring points (EPL Point 22 (MW15) and EPL Point 23 (MW19)).

The locations of all monitoring points (historical and current) are shown in **Figure 4**. A summary of the historical monitoring well locations, and how these have varied over time, are identified in **Table 4**.

**Table 4:** Historical Monitoring Well Locations

Year	Monitoring Well Locations									
	MW10	MW11	MW12 (EPA No.10)	MW14	MW15 (EPA No.22)	MW17	MW18	MW19 (EPA No.23)	MW20	MW21 (EPA No.6)
<b>Baseline 2005</b>	X	X	X							
<b>March 2007</b>	X		X							
<b>ESA 2008</b>	X		X	X	X					X
<b>May 2007 – July 2010</b>	X	X	X		X					
<b>Aug 2010 – May 2017</b>			X			X	X		X	X
<b>June 2017 – Current</b>			X		X			X		X

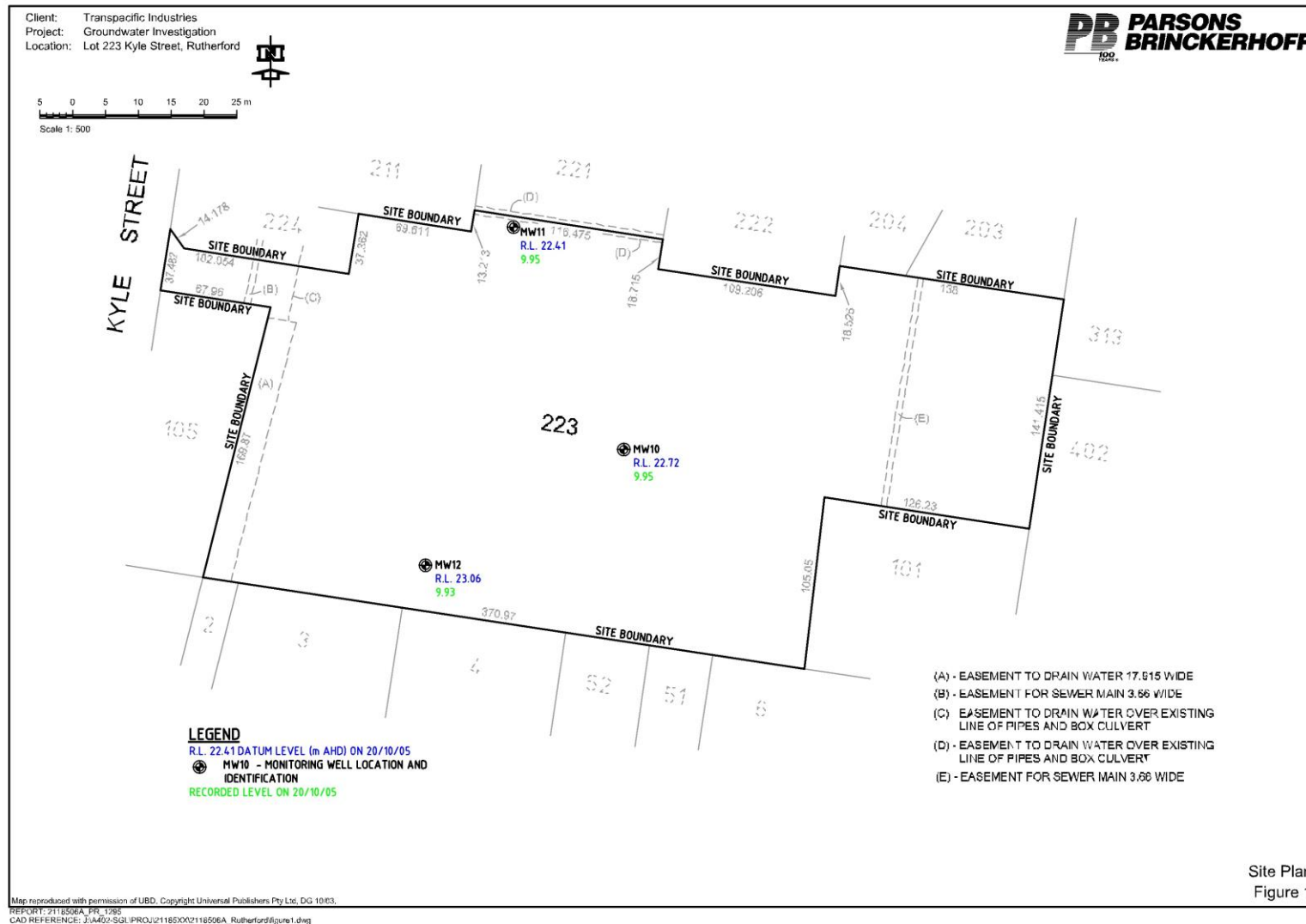


Figure 3: Baseline Sampling Locations (PB, 2005)

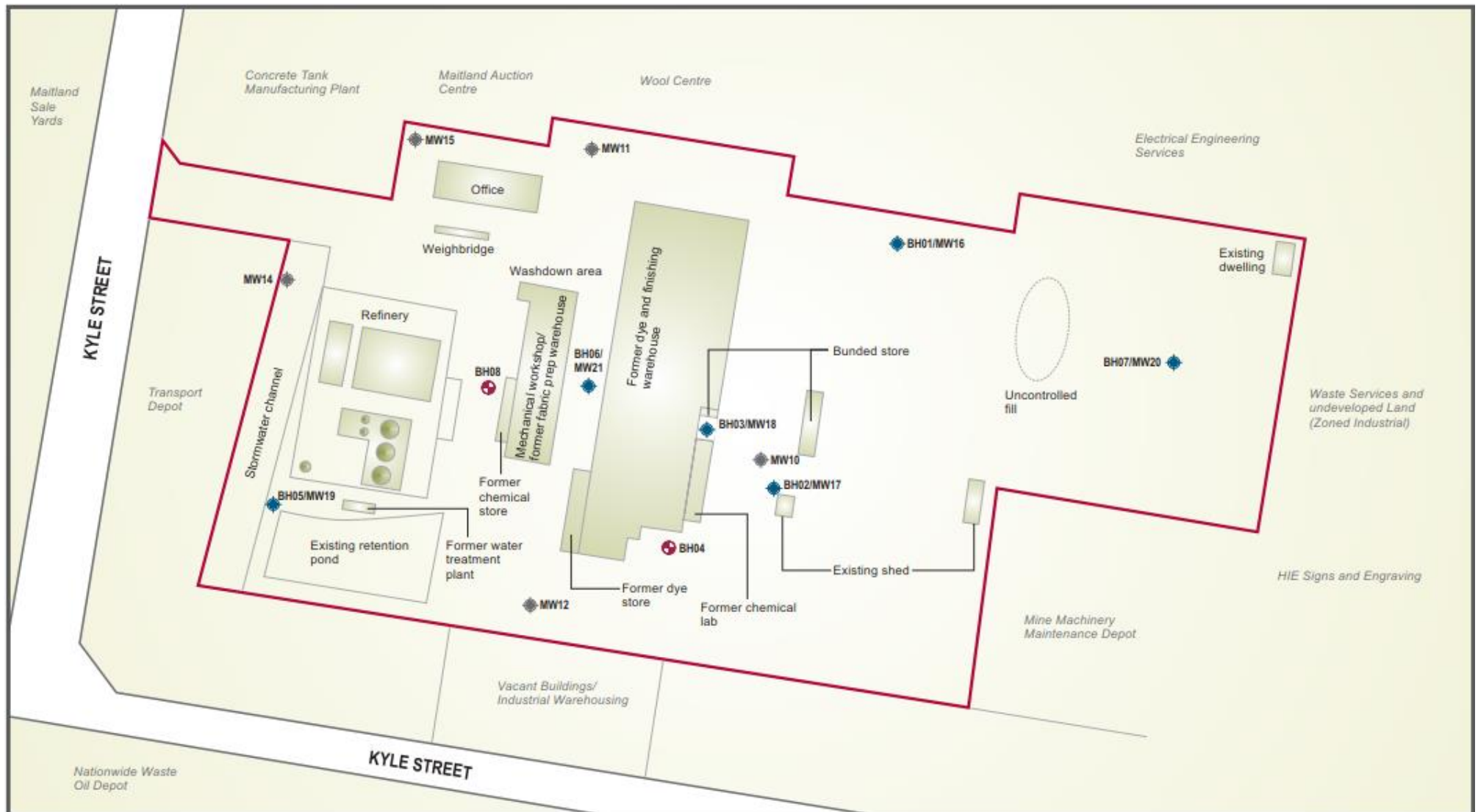
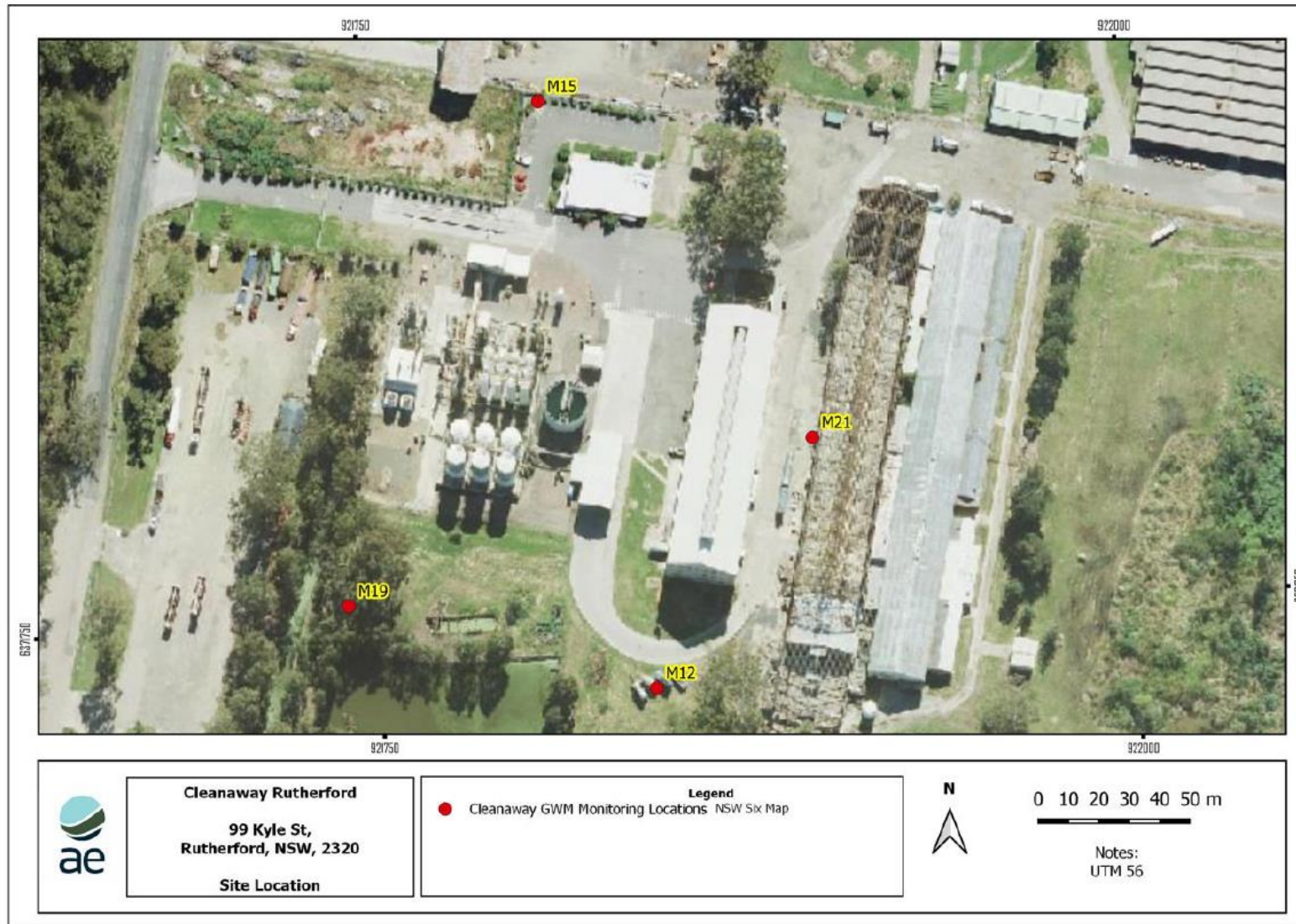


Figure 4: ESA Site Layout and Sampling Locations (ENSR, 2008)



**Figure 5:** Current Sampling Locations (2017 – Today)

## 5. Groundwater Assessment Criteria

Project Approval 05\_0037 requires the GWMP to include groundwater assessment criteria for a broad range of parameters including heavy metals, total nitrogen and total phosphorus.

The initial GWMP prepared in 2007 included trigger limits for further groundwater investigations for the following contaminants:

- TPH (C6-C9)
- TPH (C10-C14)
- TPH (C15-C28)
- TPH
- Cadmium
- Chromium
- Copper
- Manganese
- Lead
- Zinc
- Mercury
- Iron
- Total Nitrogen
- Total phosphorus
- Chloroform
- Tetrachloroethene
- Trichloroethene

The monitoring program has undergone significant consolidation in consultation with the EPA through the EPL as discussed in Section 4. The EPL does not include assessment criteria or concentration limits for groundwater pollutants. The EPL requires monitoring on an annual basis for the following pollutants:

- Tetrachloroethene (tetrachloroethylene)
- TPH C<sub>10</sub>-C<sub>36</sub> Fraction
- TPH C<sub>6</sub>-C<sub>9</sub> Fraction

On this basis, groundwater assessment criteria have been included only for the contaminants monitored as summarised in **Table 5**. A discussion of how these have been derived is provided below.

### 5.1 Groundwater Environmental Values

The New South Wales Department of Environment and Conservation (DEC) *Guidelines for Assessment and Management of Groundwater Contamination* (DEC, 2007) provide environmental values of groundwater that should be protected. Consideration has been given to the potential beneficial uses of groundwater within proximity to the Site and the applicable environmental values of groundwater considered to require protection are discussed below and include:

- Aquatic ecosystems



- Aquaculture and human consumers of food
- Agricultural water
- Recreation water users
- Drinking water
- Industrial water

### **Aquatic Ecosystems**

Given the location of the site and its proximity to Stony Creek and Hunter River, the applicable groundwater acceptance criteria have been derived from the trigger values provided in ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality – 95% protection for Freshwater. Concentrations of several constituent chlorinated aliphatics have been compared to the 99% level of protection to account for bioaccumulation. Additionally, in the absence of a 95% trigger value for particular compounds the ANZG (2018) Low Reliability Trigger Values (LRTVs) have been applied.

### **Aquaculture and Human Consumers of Food (Irrigation)**

Trigger levels have been adopted from the National Health and Medical Research Council (2011) *Australian Drinking Water Guidelines* (ADWG) (NHMRC 2013) for the protection of the environmental value aquaculture and human consumers of food.

### **Recreation and Aesthetics**

The *NHMRC Guidelines for Managing Risks in Recreational Water* (NHMRC 2008) have been adopted as the investigation levels relevant for the protection of this value. The NHMRC Guidelines reference the ADWG and as such they have been adopted in this instance.

### **Agricultural Water**

The potential for groundwater use for agricultural purposes such as stock watering is considered possible given the surrounding land use and proximity of the site to rural areas. Further, several registered bores (including one hydraulically downgradient) have been confirmed to be used for irrigation purposes. In this instance the ADWG (NHMRC 2013) have been adopted for the protection of this environmental value.

### **Drinking Water**

The NHMRC ADWG have been adopted to protect this environmental value in this instance. As total dissolved solids (TDS) concentrations exceed the threshold trigger level of 2,000 mg/L, it is unlikely that the groundwater would be suitable for drinking purposes, however trigger levels have been used for completeness.

### **Industrial Water**

There are no current guidelines relating to industrial water use for the chemicals of potential concern targeted in this investigation. Therefore, no assessment of groundwater from the site has been made with respect to industrial water use.

## **5.2 Groundwater Health Screening Levels for Vapour Intrusion**

The NEPM provides Tier 1 groundwater health screening levels (HSLs) for vapour intrusion from petroleum hydrocarbon compounds for the protection of site users from vapours migrating from volatile hydrocarbon impacted groundwater.

The Tier 1 HSLs have been developed to assess risk based on soil texture which directly influences vapour migration, assuming a uniform soil profile. Based on previous site walkovers the underlying lithology is assumed to consist of silty clay, sandy clay and clayey sand. To this end, as sand-based soil texture has been adopted for groundwater depths of 4m to 8m and 8m or more.

### **5.3      *Adopted Groundwater Assessment Criteria***

The groundwater assessment criteria adopted for this GWMP are provided in **Table 5**. These are based on the default values outlined by the Guidelines discussed above. These can be further refined by adopting site specific assessment criteria, developed using historical monitoring data collected by the Site.



**Table 5: Adopted Groundwater Assessment Criteria**

Chemical of Potential Concern	Groundwater Assessment Criteria (µg/L)					Vapour Intrusion	
	Aquatic Ecosystems <sup>1</sup>	Irrigation <sup>2</sup>	Agriculture, Primary Contact Recreation & Aesthetics <sup>3</sup>	Agricultural <sup>3</sup>	Drinking Water <sup>5</sup>	HSL D 4m<8m (µg/L) <sup>6</sup>	HSL D 8m+ (µg/L) <sup>6</sup>
<b>F1 C6-C10</b>	-	-	-	-	-	5,000	6,000
<b>F2 &gt;C10-C16</b>	-	-	-	-	-	NL	NL
<b>TRH &gt;C10-C40</b>	600 <sup>7</sup>	-	-	-	-	-	-
<b>1,1,2-Trichloroethane</b>	6,500	-	-	-	-	-	-
<b>Vinyl Chloride</b>	-	-	0.3	0.3	0.3	-	-
<b>Bromomethane</b>	-	-	1	-	1	-	-
<b>1,1-Dichloroethene</b>	-	-	0.3	-	30	-	-
<b>1,2-Dichloroethane</b>	1,900 <sup>9</sup>	-	10	-	60	-	-
<b>1,1,1-Trichloroethane</b>	270 <sup>9</sup>	-	-	-	-	-	-
<b>Carbon Tetrachloride</b>	240 <sup>9</sup>	-	3	-	-	-	-
<b>Trichloroethene</b>	500	-	30	-	-	-	-
<b>Tetrachloroethene</b>	-	-	10	50	50	-	-
<b>Hexachlorobutadiene</b>	0.04	-	0.7	0.7	0.7	-	-
<b>1,1,2,2-Tetrachloroethane</b>	400 <sup>9</sup>	-	-	-	-	-	-
<b>Pentachloroethane</b>	80	-	-	-	-	-	-
<b>1,2-Dibromomethane</b>	-	-	1	-	1	-	-
<b>Hexachlorobenzene</b>	0.05 <sup>9</sup>	-	-	-	-	-	-
<b>Chlorobenzene</b>	55 <sup>9</sup>	-	-	-	300	-	-

<b>1,2-Dichlorobenzene</b>	160	-	1,500	1,500	1,500	-	-
<b>1,3-Dichlorobenzene</b>	260	-	20	-	-	-	-
<b>1,4-Dichlorobenzene</b>	60	-	-	-	400	-	-
<b>1,2,4-Trichlorobenzene</b>	170	-	-	-	30	-	-
<b>1,2,3-Trichlorobenzene</b>	10	-	-	-	-	-	-
<b>Chloroform</b>	770 <sup>9</sup>	-	-	-	-	-	-

1 Australia and New Zealand Guidelines for Fresh and Marine Water Quality - 95% protection for Freshwater (ANZG, 2018)

2 Australian Drinking Water Guidelines (Health) - default for potable water, agriculture, parks and gardens and stockwatering (NHMRC 2013)

3 Guidelines for Managing Risks in Recreational Waters (NHMRC 2013)

4 National Water Quality Management Strategy (ANZECC 2000)

5 Australian Drinking Water Guidelines 6 (NHMRC 2013)

6 Groundwater health screening level for commercial and industrial: Sand - 4m - 8m and 8m+ (NEPM 2013)

7 Dutch 2000 Groundwater Intervention Value

8 99% level of protection (recommended where chemical may bioaccumulate or 95% provides inadequate protection for test species)

9 Insufficient data to derive a reliable trigger value. In these instances, reference has been made to low reliability trigger levels contained in ANZECC/ARMCANZ (2000)

F1 = TRH C<sub>6</sub>-C<sub>10</sub> fraction minus BTEX

F2 = TRH C<sub>10</sub>-C<sub>40</sub> fraction minus naphthalene

- No criteria specified

NL - Not Limiting

## 6. Groundwater Monitoring

### 6.1 Groundwater Monitoring Locations

Four monitoring points are identified in the EPL for the purpose of groundwater monitoring (refer **Table 6** and **Figure 5**).

### 6.2 Groundwater Monitoring Program

The current monitoring program developed to meet the requirements of the EPL is provided in **Table 6**.

**Table 6:** Groundwater Monitoring Program

Sampling locations	Pollutant	Units of measure	Frequency	Sampling method
EPA Point 6 (MW21)	Tetrachloroethene	Micrograms per litre	Annually	Representative sample
EPA Point 10 (MW12)	TPH C10-C36 Fraction			
EPA Point 22 (MW15)	TPH C6-C9 Fraction			
EPA Point 23 (MW19)				

### 6.3 Field Groundwater Quality Parameters

In addition to the pollutants monitored as outlined in Section 6.2 above, the following groundwater quality parameters will be measured during each groundwater sampling event:

- Groundwater level
- Dissolved oxygen (DO)
- Redox potential (Eh)
- Electrical conductivity (EC)
- pH
- Temperature

### 6.4 Groundwater Sampling Methodology

Groundwater monitoring will be undertaken in accordance with the Approved Methods Publication, as required by the site EPL.

#### Methodology

The following steps will be followed to obtain samples for laboratory analysis:

- Each monitoring well will be gauged using an interface probe to measure the depth to “top of liquid”, and the “thickness” of any phase separate hydrocarbons (PSH). If PSH is identified via interface probe it will be visually identified with a clear disposable bailer.
- Monitoring wells will be purged using an appropriate purging method.
- During purging field water quality parameters (temperature, dissolved oxygen (DO), electrical conductivity (EC), pH, redox potential (Eh)) will be recorded following the removal of each well volume, with a first reading recorded as the pre-purge reading. Field parameters will be recorded

using a pre calibrated water quality meter and recorded in Field Data Sheets. Calibration Certificates will be also be maintained for each event.

- The final sample reading will be recorded as the sample reading.
- Water samples to be analysed for TPH (C<sub>10</sub>-C<sub>40</sub>) will be drained into new acid washed unpreserved amber glass bottles and sealed with a plastic cap.
- Water samples to be analysed for TPH (C<sub>6</sub>-C<sub>9</sub>) and halogenated aliphatics will be drained into new acid washed VOC vials and sealed with a teflon septum to enable purge and trap analysis to be conducted.
- All water sample containers will be appropriately placed into an ice chilled cooler.

### **Sampling QA/QC**

Environmental scientists experienced and qualified in standard field sampling procedures and methodologies will be used to conduct groundwater sampling.

All field equipment used for the sampling of groundwater must be decontaminated between each sample by washing in an appropriate decontamination solution and rinsing with deionised water.

Only new sample containers will be used, and all samples will be stored in a cooler prior to dispatch to the laboratory. All groundwater samples will be labelled with reference to their sample location to ensure satisfactory tracking of samples and analytical results. Field notes detailing sampling locations, depths and physical description (odour, sheen, recharge) will be maintained during the field works.

The bottles/jars will be labelled with the following data:

- Sample identification number
- Job number
- Dates of sample collection
- Preservation method (if any)

Split samples (duplicate) and blind duplicate (triplicate) samples will be collected at a ratio of 1 duplicate per 20 primary samples. Duplicate and triplicate samples will be identified as a "QC sample" but not marked specifically as duplicate samples. Field triplicate samples will be analysed by a secondary NATA accredited laboratory different from the primary laboratory.

The samples will then be placed in a cooler with ice and refrigerated (where required). A "chain of custody" (COC) form will be filled out and sent with the sample via an overnight courier to a NATA registered analytical laboratory. Samples retained but not requiring immediate analysis will be kept in refrigerated storage at the laboratory.

### **Decontamination**

Decontamination of sampling equipment must be undertaken before each sampling interval. Non-dedicated sampling equipment must be cleaned with a brush in potable water, scrubbed and rinsed in laboratory grade detergent solution with potable water, a rinse with potable water and a final rinse with deionised water.

### **Laboratory Analysis**

All laboratories must be NATA registered for the required analyses.

### **Record Keeping and Reporting**

Records of all environmental monitoring undertaken for the Site will include:

- The date(s) on which a sample was taken
- The time(s) at which a sample was taken
- The point at which the sample was taken; and
- The name of the person who collected the sample

All records will be kept in a legible form for at least four years and be made available to any authorised officer for the EPA who asks to see them as required by the EPL.

## 6.5 Groundwater Monitoring Results Analysis

Groundwater quality monitoring results will be analysed to identify any potential impact on groundwater quality as a result of the development and to review groundwater quality against the assessment criteria identified in **Table 5**.

Where results indicate a potential decline in groundwater quality the contingency mitigation measures outlined in **Table 7** will be followed.

# 7. Groundwater Management

## 7.1 Management Measures

The following management and mitigation measures will be implemented to reduce potential environmental impacts to groundwater:

- Permanent storage tanks are fitted with automatic tank gauging, high levels alarms including automated high level shut off system, preventative maintenance is conducted on the alarm system, daily inventory reconciliation, and are located within bunds.
- Spills will be immediately cleaned up and spill management will be available throughout the site for example spill kits.
- Bunds will be inspected four times per day (twice during each shift) for contamination.
- Pipelines will be inspected weekly and detected leaks rectified and any maintenance required to be undertaken promptly.
- The MOD 5 tank bund will be designed to include<sup>3</sup>:
  - a) Include a bund lining system to achieve an impermeable barrier;
  - b) be designed, constructed and maintained in accordance with AS 1940:2004 and the EPA Technical Guideline Bunding and Spill Management;
  - c) Include the installation of an early warning leak detection and prevention systems, prior to commencement of operations, that are certified by a site auditor accredited under the Contaminated Land Management Act, 1997;
  - d) Include measures to manage liquids within the bund to ensure no migration of contaminants occurs that could cause pollution of land and/or groundwater;
  - e) contained materials within the bund are compatible with bund construction such that its long-term function is not impaired; and
  - f) be included in the Site's monitoring programs to ensure the bund achieves its performance objectives and continues to provide an effective barrier for the prevention of pollution of land and waters.
- All chemicals, fuels and oils will be stored in appropriately bunded areas, with impervious flooring and sufficient capacity to contain 110% of the largest container stored within the bund. The bund(s) shall be designed and installed in accordance with:
  - a) The requirements of all relevant Australian Standards; and
  - b) The EPA's Environmental Protection Manual Technical Bulletin Bunding and Spill Management.

In the event of an inconsistency between the requirements listed from a) to b) above, the most stringent requirement shall prevail to the extent of the inconsistency.

<sup>3</sup> Note, MOD 5 construction has not occurred at the site – therefore these requirements will become applicable once construction has occurred.

## 7.2 Contingency Measures

Where monitoring results indicate a potential decline in groundwater quality the contingency measures outlined in **Table 7** will be followed.

**Table 7: Contingency Measures**

Issue	Management and Mitigation Measure	Responsibility	Timing
Monitoring result/s exceed trigger value/s or Monitoring results indicate decline in groundwater quality over time	Provide groundwater monitoring results to the EPA (if exceedance occurs)	Cleanaway	Within one week of receiving groundwater quality results
	Investigate potential source/s of contamination	Cleanaway	Initiate within one week of receiving groundwater quality results
	In discussion with the EPA, review groundwater monitoring program including: <ul style="list-style-type: none"> <li>Consider increasing sampling frequency to monitor further decline in groundwater quality</li> <li>Consider installing additional monitoring wells to monitor for mobility of contaminants offsite</li> </ul>	Cleanaway	Within one month of receiving groundwater monitoring results
	In discussion with the EPA, consider remediation options	Cleanaway	As required

## 8. Review and Revision Process

The GWMP will be reviewed by site personnel and the Environmental Business Partner (or their delegate) once a year or when the following occur:

- The operations at the Site significantly change, for example following a modification to PA 05\_0037 or a significant variation to the EPL;
- Opportunities for improvement, or deficiencies in the existing system are identified through Audit Reports, Incident / Non-conformance Reports, and / or-site observations; or
- Within three months of an independent environment audit, in consultation with the EPA and Council, to the satisfaction of the DPE.



## **9. Attachment A – Groundwater Contamination Assessment (PB, 2005)**

## 10. Attachment B – Groundwater Monitoring Test Results (2007)

# **11. Attachment B – Environmental Site Assessment – Groundwater Monitoring Test Results (ENSR, 2008)**

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***End of Document***

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