Site Audit Report - Western Area Remediation Project - Remedial Action Plan (Stage 2 Area)

Viva Energy

13 August 2021

The Power of Commitment

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Glossary

Acronym	Description
ACM	Asbestos Containing Material
AECs	Areas of Environmental Concern
AEVR	Air Emissions Verification Report
AF	Asbestos Fines
AHD	Australian Height Datum
ANSTO	Australia Nuclear Science and Technology Organisation
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines.
AOC	Accidentally Oil Contaminated
AQIA	Air Quality Impact Assessment
AQMP	Air Quality Management Plan
AS	Australian Standard
ASC	Assessment of Site Contamination.
ASS	Acid Sulphate Soil
BGL	Below Ground Level
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CC	Continually Contaminated
CLM	Contaminated Land Management
COC	Chain of Custody
CoPC	Contaminant of Potential Concern
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment.
CSM	Conceptual Site Model
CT	Contaminate Threshold
CTCP	Clyde Terminal Conversion Project
DO	Dissolved Oxygen
DPIE	Department of Planning, Industry, and Environment
DQIs	Data Quality Indicators
DQOs	Data Quality Objectives
EC	Electrical Conductivity
EIL	Ecologically Based Investigation Level
EIS	Environmental Impact Statement
ENM	Excavated Natural Material
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ERM	Environmental Resources Management
ESA	Environmental Site Assessment
ESL	Ecological Screening Level

Acronym	Description
eV	Electron Volt
FA	Fibrous Asbestos
GME	Groundwater Monitoring Event
GMP	Groundwater Management Plan
Ha	Hectares
HHERA	Human Health and Ecological Risk Assessment
HIL	Health-Based Investigation Level
HSL	Health Screening Level
IMW	Intrusive Maintenance Workers
km	Kilometre
LCS	Laboratory Control Samples
LEP	Local Environment Plan
LFG	Landfill Gas
LGA	Local Government Area
LNAPL	Light Non-Aqueous Phase Liquid
LOR	Limit of Reporting
LPG	Liquid Petroleum Gas
LTEMP	Long Term Environmental Management Plan
m	Metre
m AHD	Metres Australian Height Datum
m bgl	Metres Below Ground Level
m btoc	Metres Below Top of Casing
m^3	Cubic metres
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
MJ/Kg	Mega joule per Kilogram
MPa	Mega Pascal
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
NSW	New South Wales
OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OPP	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PCB	Polychlorinated Biphenyls
PFAS	Per and Polyfluoroalkyl Substances
PFHxS	Perfluorohexanesulfonate
PFOS	Perfluorooctanesulfonic acid

Acronym	Description
PID	Photo-Ionisation Detector
POEO	Protection of the Environment Operations
PPE	Personal Protective Equipment
PPM	Parts per Million
PSI	Preliminary Site Investigation
QA	Quality Assurance
QC	Quality Control
RAP	Remedial Action Plan
REMP	Remediation Environmental Management Plan
RLs	Relative Levels
ROA	Remedial Options Analysis
RPD	Relative Percentage Difference
RSI	Remediation Site Investigation
RSW	Restricted Solid Waste
SAQP	Sampling and Analytical Quality Plan
SCC	Specific Contaminate Concentration
SIA	Specific Immobilisation Approval
SPOCAS	Suspension Peroxide Oxidation – Combined Acidity and Sulphate
SSD	State Significant Development.
SSTLs	Site Specific Target Levels
SVE	Soil Vapour Extraction
SVOC	Semi-Volatile Organic Compound
SWL	Standing Water Level
SWMP	Soil and Water Management Plan
TCLP	Toxicity Characteristic Leaching Procedure
TP	Test Pit
TRH	Total Recoverable Hydrocarbons
UCS	Unconfined Compressive Strength
µg/kg	micrograms per kilogram
µg/L	micrograms per litre
VENM	Virgin Excavated Natural Material
VOC	Volatile Organic Compound
WARP	Western Area Remediation Project
WWTP	Wastewater Treatment Plant

1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) was commissioned by Viva Energy Australia Pty Ltd. (Viva Energy) to conduct an environmental site audit of the assessment, remediation and validation works in the Western Area of the former Clyde Refinery (Western Area Remediation Project or WARP). The WARP is located at Durham Street, Rosehill on the Camellia Peninsula. Figure F1 from the Stage 2 Remedial Action Plan (RAP) in **Appendix A** shows the site locality. The Stage 2 RAP prepared by Environmental Resources Management Australia Pty Ltd (ERM) is listed in **Section 1.4**.

Viva Energy intends to remediate the WARP to facilitate future commercial and/or industrial development under the existing land use zoning, IN3 – Heavy Industrial. Given the scale of remedial works, the WARP was declared State Significant Development (SSD) and as such, to assess the potential environmental impacts from remediation, an Environmental Impact Statement (EIS) containing a Conceptual RAP (AECOM, 2019) was submitted to Department of Planning, Industry, and Environment (DPIE) in late 2019. Consent Conditions for SSD 9302 were issued on 7 May 2020.

The remediation will be completed in three different stages as follows:

- Stage 1 – Former Process West
- Stage 2 – Former Utilities and Movements
- Stage 3 – Former Process East

Figure F2 from the ERM Stage 2 RAP in **Appendix A** shows the location of the WARP and the areas that comprise Stages 1 to 3. Staging of the remediation of the WARP will be completed as per Consent Condition A9 for SSD 9302.

In consideration of the redevelopment strategy proposed for the Stage 2 area (sub-division into 13 separate lots), the auditor notes the proposed lots will be progressively validated such that Section A Site Audit Statements (SAS) will be prepared for each lot or block of lots.

1.1 Site audit details

This audit is statutory as per Consent Condition B3 for SSD 9302. The site has also been notified to the NSW Environment Protection Authority (EPA) under section 60 of the *Contaminated Land Management Act 1997.* It is the auditor's knowledge that the former Clyde Refinery is the subject to the Declaration nº 20131110 (Preliminary Investigation Order 20121001), issued under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985.* The audit triggers are further discussed in **Section 1.3**.

This SAR and associated SAS have been produced to document the findings of a site audit that incorporated review of the RAP and supporting reports for the Stage 2 Area. The reports reviewed as part of this audit as well as relevant background reports are listed in **Sections 1.4** and **1.5**. The site audit details are presented in **Table 1.**

Table 1 Site audit details

Information	Details
Site auditor	Mr. Andrew Kohlrusch
NSW EPA site auditor accreditation nº	0403
NSW EPA site audit statement nº	065/2127799
Stage 2 - Legal property description [1]	Part Lot 100 in Deposit Plan (DP) 1168951
Council	City of Parramatta Council
Stage 2 area	28 hectares
Site owner	Viva Energy

[1] The areas and legal property descriptions for each of the lots for the Stage 2 Area are further discussed in **Section 2.**

Information	Details
Current land use	Vacant site
Proposed land use	Commercial and/or industrial

This site audit has been conducted in accordance with the requirements of *the Contaminated Land Management Act 1997* (the 'Act'). The Act defines the Site Audit as follows:

"site audit" means a review:

- *(a) that relates to management (whether under this Act or otherwise) of the actual or possible contamination of land, and*
- *(b) that is conducted for the purpose of determining any one or more of the following matters:*

  (i) the nature and extent of any contamination of the land,

  (ii) the nature and extent of any management of actual or possible contamination of the land,

  (iii) whether the land is suitable for any specified use or range of uses,

  (iv) what management remains necessary before the land is suitable for any specified use or range of uses,

  (v) the suitability and appropriateness of a plan of management, long-term management plan or a voluntary management proposal.

Furthermore, the Act provides the following definitions:

- *"Site Audit Report" means a site audit report prepared by a site auditor in accordance with Part 4 [of the Act].*
- *"Site Audit Statement" means a site audit statement prepared by a site auditor in accordance with Part 4 [of the Act].*

1.2 Site audit purpose

The purpose of this site audit is to independently review the Stage 2 RAP prepared by ERM and determine whether the document followed EPA made or endorsed guidelines listed in **Section 1.6.**

It is understood that the Stage 2 Area is proposed to be redeveloped into a combination of commercial and industrial land uses, subdivided into 13 lots. Details regarding those lots are presented in **Section 2.1**. To achieve this objective, the auditor has reviewed the works undertaken by ERM in the Stage 2 area and assessed whether actions listed in the RAP can make the land suitable for the proposed uses, following completion of the nominated remedial works and validation program. The statutory audit triggers are discussed in **Section 1.3**.

1.3 Audit triggers

Following the announcement of the closure of the former Clyde Refinery, on 22 June 2012, the NSW EPA issued a Preliminary Investigation Order to Viva Energy under the CLM Act requesting reports on environmental contamination.

Following receipt of a number of reports, in June 2016, the NSW EPA declared Lot 398 in DP 41324, Lot 2 in DP224288, Lot 1 in DP383675, Lot 101 in DP809340 and, Lot 100 in DP1168951 (which includes the WARP) as contaminated land under the CLM Act (Declaration nº 20131110).

1.3.1 Consent Conditions for SSD 9302

The NSW DPIE on 7 May 2020 issued the Consent of Conditions for the remediation of contaminated soils and management of contaminated groundwater to enable future commercial and industrial land uses. Consent Conditions for SSD 9302 (from the audit perspective) require the following:

"The development may only be carried out:

(a) in compliance with the conditions of this consent;

(b) in accordance with all written directions of the Planning Secretary;

(c) in accordance with the EIS and RtS;

(d) in accordance with the Detailed RAP;

(e) in accordance with the Development Layout in Appendix 1. and

(f) in accordance with the management and mitigation measures in Appendix 2."

Part B of the Conditions of Consent SSD 9302 specified the environmental conditions for the remediation, which included the following:

"*Prior to the commencement of preparation works, the Applicant must prepare a Detailed RAP for the development, in consultation with the EPA and to the satisfaction of the Site Auditor and the Planning Secretary. The Detailed RAP must:*

- *be prepared by a suitably qualified and experienced person in accordance with Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (OEH, 2011).* [2]*The auditor notes that this Guidelines was updated in April 2020 and are currently referenced as EPA (2020) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.*
- *be reviewed by the Site Auditor in accordance with the requirements of Condition B3.*
- *be approved by the Site Auditor and Planning Secretary, prior to the commencement of preparation works.*
- *be submitted to the EPA for reference once approved and prior to the commencement of preparation works.*
- *detail all final remediation methods and technologies including layouts and design.*
- *detail the decision protocol for determining which remediation method applies to different materials.*
- *incorporate the recommendations of the Air Emissions Verification Report approved in accordance with condition B15.*
- *include triggers for contingency actions and alternate treatment methods to ensure the remediation objectives are achieved.*
- *detail all procedures and plans to be implemented to reduce risks to an acceptable level for the proposed final land use."*
- *The Validation report should be submitted within six months of the completion of demobilisation, or as otherwise agreed with the Planning Secretary, the auditor must submit a Validation Report to the EPA, Council and the Planning Secretary.*
- *The SAR and SAS should be submitted within 12 months of the completion of demobilisation, or as otherwise agreed with the Planning Secretary, the auditor must submit a SAR and Section A, SAS to the EPA, Council and the Planning Secretary. The reports must confirm that the remedial works approved under this consent have been completed in accordance with the remediation objectives listed in the Detailed RAP and the risks to human health and the environment have been addressed in accordance with the objectives of the Detailed RAP.*
- *The Conditions of Consent requires that prior to the finalisation of the SAS and SAR, a Long Term Environmental Management Plan (LTEMP) should be prepared to the satisfaction of the auditor and the Planning Secretary.*

The auditor noted that the RAP for the Stage 2 Area (and other supporting documentation) was submitted to NSW EPA for consultation in accordance with Consent Condition B1 of SSD 9302. The NSW EPA on 27 July 2021 issued Notification DOC21/520515, acknowledging that as part of the Stage 2 works, Viva Energy has provided the EPA with the following documents for review and comment:

- Clyde Western Area Remediation Project – Stage 2 Detailed Remediation Action Plan (RAP), dated 9 July 2021.

– Clyde Western Area Remediation Project – Stage 2 Air Emissions Verification Report (AEVR), dated 11 June 2021.
– Clyde Western Area Remediation Project – Stage 2 Air Emissions Verification Report – Key Issue Summary Letter (AEVR-KISL), dated 24 May 2021.

Following its review of the Stage 2 RAP, the NSW EPA stated:

– *Based on the review of the RAP, the EPA currently have no comments to add.*

1.3.2 Sydney Central Industrial Estate and Downer Sustainable Road Resource Centre - SSD 10459

The Stage 2 Area is within the extent of site redevelopment works proposed to be completed as per SSD 10459. ERM reported in the Stage 2 RAP that while remediation activities are not subject to the SSD 10459 and associated consent conditions, consideration of the proposed subdivision of the Stage 2 Area for commercial/industrial land used has been incorporated into aspects of remedial planning and approaches outlined within the Stage 2 RAP.

1.3.3 Clyde Western Area Remediation Project - SSD 9302

Consent Conditions related to the remediation of the WARP were issued on 7 May 2020 by NSW DPIE. Condition Consent B1 state that a detailed RAP is to be reviewed prior to the commencement of preparation works.

Viva Energy has subsequently reviewed its approach to remediating the WARP and intends to conduct the remediation in three stages based on geographical portions of the WARP.

DPIE was informed of the staging of remediation on 19 May 2020. A letter containing all relevant documentation required by the Consent Conditions for the WARP was submitted for all stages. DPIE on 3 June 2020 approved the proposed staging of remediation as follows *The Department has carefully reviewed the Staging Plan and is satisfied with the proposed approach.*

Accordingly, the Planning Secretary has approved the Staging Plan, dated 19 May 2020. You are advised that if the staged remediation works result in any additional impacts to those assessed under SSD 9302, you may be required to provide further information and additional mitigation controls to demonstrate the impacts can be managed. This may require supporting advice from technical experts.

The auditor notes that the first stage of the remediation, the Stage 1 Area, was completed in February 2021. The Site Audit Statement (SAS) nº 043/2127799 was issued in February 2021, attesting the suitability of the Stage 1 Area for future commercial/industrial land uses, subject to compliance with a passive Long Term Environmental Management Plan (LTEMP). Currently, the Stage 1 Area is under development by Downer EDI Works Pty Ltd (Downer).

1.4 Reports reviewed

This SAR has been prepared following review of information presented in the documents listed below:

– AECOM (2021). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan Groundwater Monitoring and Management Plan*, dated 21 July 2021 (the **GMP**).
– ERM (2021h). *Clyde Western Area Remediation Project, Stage 2 - Detailed Remediation Action Plan*, dated 9 July 2021 (the **Stage 2 RAP**).
– ERM (2021g). *Clyde Western Area Remediation Project, Stage 2 Air Emissions Verification Report*, dated 11 June 2021 (the **Stage 2 AEVR**).
– ERM (2021f). *Clyde Western Area Remediation Project, Stage 2 Stockpile Validation Report*, dated 17 June 2021 (the **Stockpile Validation**).
– ERM (2021e). *Clyde Western Area Remediation Project – Remediation Options Analysis (AEC-4)*, dated 07 June 2021 (the **AEC-4 ROA**).

– ERM (2021d). *Clyde Western Area Remediation Project – Supplementary Site Assessment – Southern Buried Waste Area (AEC-4)*, dated 07 June 2021 (the **AEC-4 ESA**).
– ERM (2021c). *Clyde Western Area Remediation Project – Stage 2 Environmental Site Assessment*, dated 17 June 2021 (the **Stage 2 ESA**).
– ERM (2021b). *Clyde Western Area Remediation Project – Stage 2 Drainage Decommissioning Validation Report*, dated 17 June 2021 (the **Stage 2 Drainage**).
– ERM (2021a). *Clyde Western Area Remediation Project – Quarter 4 (2020) Groundwater Monitoring Event*, dated 24 March 2021 (the **2020 GME**).

The outcome of the review of these documents associated with the characterisation and planning for remediation of the Stage 2 Area was presented in interim audit advice letters (IAA) or tracked in an audit commentary spreadsheet. Copies of IAAs, as well as the consultant's responses (where relevant) are presented in **Appendix B**.

1.5 Background reports

Given the nature of the works undertaken in the WARP to date, the auditor also considered the following documents as background information relevant to this audit.

– ERM (2020d). *Clyde Western Remediation Project, Remedial Options Assessment*, dated 3 June 2020 (the ROA).
– ERM (2020c). *Clyde Western Remediation Project, Air Emissions Verification Report*, dated 17 June 2020 (the Stage 1 AEVR).
– ERM (2020b). *Clyde Western Area Remediation Project, Human Health and Ecological Risk Assessment*, dated 16 February 2020 (the HHERA).
– ERM (2020a). *Remediation Site Investigation*, dated 7 February 2020 (the RSI).
– AECOM (2019). *Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan*, dated 21 January 2019 (the Conceptual RAP).
– ERM (2018). *PFAS Conceptual Site Model and Flux Assessment Report*, dated December 2018 (the PFAS CSM).

1.6 Regulatory requirements

This SAR was prepared with reference to the following statutory legislation, guidelines and/or standards which have been endorsed for use by NSW EPA:

– NSW EPA (2020). Contaminated sites: Guidelines for Consultants Reporting on Contaminated sites (the Consultant Guidelines).
– NSW EPA (2020). Assessment and Management of Hazardous Ground Gases (the Ground Gases Guidelines).
– CRC CARE (2018). CRC for Contamination Assessment and Remediation of the Environment, National Remediation Framework, Guideline on Performing Remediation Options Assessment, Version 1 August 2018.
– ANZAST (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
– NSW EPA (2017). Contaminated Land Management: Guidelines for the New South Wales Site Auditor Scheme (3rd edition) (the Auditor Guidelines).
– CRC Care (2015). A Practitioner's guide for the analysis, management and remediation of LNAPL. Technical Report Nº 34.
– NSW EPA (2014). Waste Classification Guidelines Part 1: Classifying Waste, NSW EPA (the Waste Guidelines).
– NEPC (2013). National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended by the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (nº 1), National Environment Protection Council, May 2013 (the ASC NEPM).

– EnHealth (2012). Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards, Department of Health and Ageing and enHealth Council, Commonwealth of Australia.
– NHMRC & NHMRC (2004). Guidelines for Drinking Water Quality in Australia, National Health and Medical Research Council and Natural Resource Management Ministerial Council, Canberra.
– WA Department of Health (2009). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (the **Asbestos Guidelines**).
– NSW DEC (2007). Guidelines for the Assessment and Management of Groundwater Contamination (the **Groundwater Guidelines**).
– NSW EPA (1995). Sampling Design Guidelines (the **Sampling Guidelines**).

1.7 Proposed and permitted land uses

The Stage 2 Area is zoned as IN3 under the Parramatta Council Local Environmental Plan 2011. Permissible uses allowed under this zoning (with consent), includes the following:

– *Agricultural produce industries; Building identification signs; Business identification signs; Depots; Freight transport facilities; General industries; Hardware and building supplies; Hazardous storage establishments; Heavy industries; Horticulture; Kiosks; Medical centres; Offensive storage establishments; Pubs; Roads; Rural supplies; Sawmill or log processing works; Take away food and drink premises; Timber yards; Warehouse or distribution centres; Water storage facilities.*

1.8 Site auditor visits

The auditor has conducted a series of site visits as part of this audit. During the site visits, the auditor observed the key features of the WARP, including the Stage 2 Area. The Stage 2 Area is currently a vacant site and access is restricted/controlled by Viva Energy. The auditor noted that the Stage 2 Area is relatively flat with a gradual slope to the south towards Duck River. Apart from some surface water drainage features, the site no longer contains any infrastructure associated with the former activities conducted at the site.

The Duck River forms the southern boundary of the site. The nearest human receptors would be workers at the adjacent Clyde Terminal and construction workers at the Downer development to the immediate east of the Stage 2 Area.

1.9 Site audit report structure

This report documents the audit of the reports referenced in **Sections 1.4**. Where the auditor has provided comments on the work, these are highlighted in blue shaded dialogue boxes. The remainder of this report is organised as follows:

Section 2 Site conditions and environmental setting

Section 3 Historical land use

Section 4 Characterisation reports

Section 5 Stage 2 - Contamination characterisation

Section 6 Remedial option analysis

Section 7 Stage 2 - Air emissions verification report

Section 8 Remediation criteria evaluation

Section 9 Conceptual site model

Section 10 Stage 2 Remedial action plan

Section 11 Data quality objectives

Section 12 Other consideration

Section 13 Compliance with regulatory requirements

Section 14 Audit conclusions

Section 15 Disclaimer

1.10 Limitations of this report

The information and opinions given in this SAR are based on reviewing information presented in the documentation referenced in **Section 1.4** and other supporting information provided by Viva Energy and the consultant.

The auditor has not carried out any independent investigations in relation to the condition of the site. This audit is subject to the limitations presented in **Section 15** of this report.

The auditor assumes no responsibility or liability for any errors or omissions in the information provided in the reports reviewed or that the consultant did not confer any reliance on the reports to the auditor.

The purpose of this SAR is to assess if the Stage 2 RAP was prepared in accordance with the guidelines made or endorsed by the NSW EPA and complied with relevant Condition Consent for SSD 9302 required by the DPIE as previously discussed in **Section 1.3**. No other warranties, expressed or implied, are made.

This SAR relates only to the subsurface to define the nature and extent of contamination at the site, and related identified off-site impacts from surface water, groundwater, or soil vapour. It does not comment on the evaluation of geotechnical issues, or any other issues associated with the site.

2. Site conditions and environmental setting

2.1 Site identification

The following section is based on information presented in the Stage 2 RAP. The Stage 2 Area is located in the south-western portion of the WARP and extends from Devon Street in the north to the Duck River at the southern boundary of the former Clyde Refinery. A site location plan and a site layout are provided in **Appendix A** (Figures F1 and F2 from the Stage 2 RAP).

Site identification information, along with the proposed lots is summarised in **Table 2.**

Table 2 Site identification

Information	Details	
Site identification:	Stage 2 Area	
Site area:	Proposed Lot 51 – 8,060 m^2 Proposed Lot 52 – 8,060 m^2 Proposed Lot 53 – 2.755 ha Proposed Lot 54 – 1.067 ha Proposed Lot 55 – 1.067 ha Proposed Lot 56 – 2.133 ha Proposed Lot 58 – 2.125 ha	Proposed Lot 59 – 2.135 ha Proposed Lot 60 – 3.318 ha Proposed Lot 61 – 1.553 ha Proposed Lot 62 – 3.097 ha Proposed Lot 63 – 3.633 ha Proposed Lot 64 – 2.351 ha
Proposed Stage 2 Area Lots within Part Lot 100 in DP1168951[3]	Proposed Lot 51 - DP 1168951 Proposed Lot 52 – DP 1168951 Proposed Lot 53 – DP 1168951 Proposed Lot 54 – DP 1168951 Proposed Lot 55 – DP 1168951 Proposed Lot 56 – DP 1168951 Proposed Lot 58 – DP 1168951	Proposed Lot 59 – DP 1168951 Proposed Lot 60 – DP 1168951 Proposed Lot 61 – DP 1168951 Proposed Lot 62 – DP 1168951 Proposed Lot 63 – DP 1168951 Proposed Lot 64 – DP 1168951
Site occupant:	Viva Energy	
Local Government Authority	City of Parramatta Council	
Current land use:	Vacant site	
Proposed land use:	Commercial and/or industrial	
Land use zoning:	IN3 – Heavy Industrial under the *Parramatta Local Environmental Plan 2011.*	

2.2 Stage 2 Area description

Before decommissioning, the Stage 2 Area contained former refinery processing infrastructure, tank farms and pipe tracks along with numerous warehouses, workshops, a fire station, sub stations, office space and an area formerly leased to AutoNexus Pty Ltd for the storage of imported vehicles (ERM, 2020a). The Stage 2 Area is currently vacant, and the following key features are noted:

- The majority of the Stage 2 Area is covered with concrete and bitumen hardstand. Grassed and vegetated areas are present in its north-western and southern portions.
- Subgrade drainage lines remain in-situ, with pits, sumps and interceptor units backfilled with stabilised sand following completion of decommissioning activities.
- Concrete Bund walls are present but have been partially demolished near former Tank farm A1 (Figure F2 from the Stage 2 RAP in **Appendix A**).

[3] The survey plans showing the lost location are presented in **Appendix A**.

– Fifteen stockpiles of demolition waste, predominantly containing concrete and bricks, and three stockpiles of soil material sourced from demolition of refinery infrastructure (Figure F3 from the Stage 2 RAP in **Appendix A**).
– Three covered stockpiles (SP75, SP75 and SP75) of biopiled material from Stage 1 Area remain within former Tank farm A1.
– One Corrugated Plate Interceptor (CPI) remains at the ground surface within Tank farm A2 and has been backfilled with imported stabilised sand.
– Duck River is immediately off-site to the southern of the Stage 2 Area.
– The Stage 1 Area to the eastern of the Stage 2 Area is currently being redeveloped by Downer.

2.3 Topography and drainage

ERM reported in the Stage 2 RAP that the surface of the Stage 2 Area was reshaped over time with the use of imported fill to provide a relatively flat site. Until July 2020, rainfall and surface water were collected through the Continuously Oil Contaminated (COC) and Accidentally Oil Contaminated (AOC) drainage systems which diverted the water to the Clyde Terminal Drainage network and Wastewater Treatment Plant (WWTP).

ERM reported in the Stage 2 RAP that the drainage system was decommissioned and decontaminated in-situ between July 2020 and February 2021 and subsequently has been isolated from the Clyde Terminal Drainage network and WWTP. The drainage decommissioning and validation works are discussed in the Stage 2 Drainage report. The drainage network is shown in Figure F4 from the Stage 2 RAP in **Appendix A**.

ERM described in the Stage 2 ESA that the Duck River is lined with mangroves adjacent to the southern margin of the Western Area. The Duck River is considered a moderately disturbed catchment. As reported by ERM in the RSI, the tidal limit of the Duck River extends approximately one kilometre upstream of the site to the Clyde Railway culvert (Cardno Lawson-Treloar, 2008). The upper reaches of the Duck River extend approximately 10 kilometres south to Condell Park, within the Bankstown LGA where stormwater flows in a series of storm water pipes and open concrete drains.

The downstream extent of the Duck River discharges into the Parramatta River to the north-east of the Stage 2 Area. ERM reported that the Parramatta River is the major tributary of Sydney Harbour located approximately 15 kilometres downstream of the site which, in turn, discharges into the Pacific Ocean.

2.4 Geology

ERM documented the following general soil profiles within the Stage 2 Area:

– Across the majority of the Stage 2 Area is a fill layer with an average thickness of 0.6 metre. The fill layer thickens to approximately 1.2 to 1.5 metres in the southern portion of the Stage 2 Area in close proximity of the Duck River. The fill was described as a poorly compacted mixture of silt, clay and gravel, with localised areas of slag, furnace ash and concrete. ERM did note that LNAPL and ‘sludge materials’ were identified within the fill at various depths and locations.
– The Southern Buried Waste Area (referred to as AEC-4) contains at least 4.0 metres of heterogenous fill described as poorly compacted mixture of silt, clay, and gravel, with localised areas of slag, furnace ash, black sludge, concrete, and other anthropogenic waste such as bricks, timber, metal pipes, tiles and glass
– Underlying the fill is a high plasticity clay (alluvial sediments) that is present across most of the Stage 2 Area. Based on the descriptions in logs prepared by ERM and observations made by the auditor of the underlying soil profile, the clay underlying the fill is more likely to be residual (weathered shale) soils rather than alluvial sediments.

The Acid Sulfate Soil (ASS) Risk Map for Parramatta/Prospect (scale 1:25,000) produced by the Department of Land and Water Conservation (1997) classified soils in the Stage 2 Area as predominantly as Class 4. However, a small portion of soil identified as Class 2 may exist in natural

soils below the fill in AEC-4. ERM noted that remediation of AEC-4 would not intercept natural soil, as the depth for the engineered capping layer is 0.5 mbgl.

2.5 Hydrogeology

A detailed discussion of the hydrogeology across the WARP was presented in the RSI report in 2020. A summary of the hydrogeology relevant to the Stage 2 Area is present in **Table 3.**

Table 3 Hydrogeology summary

Data	Results
Groundwater Depth	A shallow unconfined aquifer is present at the Stage 2 Area within fill material and estuarine-alluvial sediments at depths between 1 and 3 mbgl. ERM reported that a preferential pathway for groundwater flow had been identified within sandy lenses in the fill and estuarine units along with anthropogenic structures, such as the on-site storm water drainage network.
Groundwater Flow Direction	In the majority of the Stage 2 Area, groundwater flow direction was inferred be to the south and south-east towards the Duck River. ERM noted that the flow direction may vary following rainfall events and due to localised groundwater mounding ERM reported in the Stage 2 RAP that within AEC-4, groundwater flows radially, mirroring site topography from the central-northern portion of the buried waste mound towards the Duck River in the south and southeast. Groundwater contours indicated a westerly to south-westerly flow towards an unlined drainage channel west of the buried waste mound. The groundwater flow direction map is shown in Figure F3 from the 2020 GME in **Appendix A**.
Hydraulic Gradient	ERM reported in the Stage 2 RAP that the average hydraulic gradient ranged between 0.003 along the up-gradient portion of the WARP to 0.011 across the southern portions of the WARP.
Hydraulic conductivity	ERM reported in the Stage 2 RAP that the hydraulic conductivity has been established to be low across the large majority of the WARP, with estimated hydraulic conductivity values for wells that were screened across clay, sandy clay and gravelly clay typically ranging from $5x10^{-5}$ m/day to $6x10^{-3}$ m/day. Based on the field data collected from AEC-4, ERM concluded that the laterally continuous higher hydraulic conductivity lithological units (sand clay and gravel clay close to Duck River) are not expected to be encountered within the Stage 2 Area.

The Stage 2 RAP highlighted two hydrologic aspects that form key elements of the Conceptual Site Model (CSM) for the Stage 2 Area, as follows:

- Vertical migration of groundwater is limited by the soil profile which comprises unconsolidated fill underlain by low permeability clay. Industrial infrastructure included aboveground systems as well as pipework and drainage systems installed in the near surface. Therefore, ERM concluded that vertical migration of contaminants in the Stage 2 Area is limited by the nature of the soil profile and the aquifer.
- Lateral migration of CoPC in groundwater is limited by the low permeability of the lithology and relatively flat hydraulic gradient. ERM reported that this conclusion was supported by the limited lateral extent of impacted groundwater, indicating that, where present, areas of impacted groundwater are stable and do not appear to be migrating.

2.6 Auditor discussion - Site conditions and environmental setting

The auditor considered that the information presented by ERM in the Stage 2 RAP and in the reports reviewed as part of this audit listed in **Sections 1.4** and **1.5** together provided an appropriate description of the Stage 2 Area. The auditor notes that recently, additional data was obtained specifically for AEC-4 and Stage 2 Area. The outcomes of these assessments were discussed in the AEC-4 ESA and in the Stage 2 ESA. The reports that provided data used to prepare the Stage 2 RAP are further discussed in **Section 4**.

The auditor noted that an appropriate and detailed description of the former Clyde Refinery and environmental conditions has been documented in the past 29 years, as further discussed in **Section 3**.

The site description and the immediate surrounding land uses reported in the Stage 2 RAP were consistent with the auditor's observations made during the site inspections. The site is zoned as IN3 under the Parramatta Local Environmental Plan 2011. The auditor notes that the proposed future commercial/industrial land uses are consistent with the Parramatta Council zoning.

The nearest water body is the Duck River which is located off-site to the south of the Stage 2 Area.

The Stage 2 RAP and the supporting reports together provided a detailed summary of site geology and hydrogeology that provides a basis for understanding these elements of the conceptual site model (CSM) and their influence on impacts distribution and mobility. The CSM is further discussed in **Section 9**.

The auditor concurred that the site conditions and environmental setting information provided by ERM in the Stage 2 RAP together with other reports reviewed as part of this audit were sufficient and largely in accordance with the Schedule B2 of the ASC NEPM and the Consultant Guidelines.

3. Historical land use

3.1 Former Clyde Refinery

AECOM in the Conceptual RAP described that the former Clyde Refinery was originally included as part of an 850-acre land grant by the Crown to John Macarthur. In 1908, a parcel of 140 acres of land was transferred to the Commonwealth Oil Corporation (COC). The COC struck financial difficulties and went into receivership. In 1913 the land was then acquired from COC by John Fell and Co.

The new owner began purchasing crude oil to refine at Clyde and refining commenced in 1926. In 1928, Shell Refining Pty Ltd took over as owner and operator of the site. Shell purchased an additional seven acres of land and a further 150 acres in June 1930. The duration of the first stage of expansion of the site was from 1929 to 1939 with the purchase and construction of new equipment and buildings, increasing the crude product intake to approximately 250 tonnes/day by 1934.

The former Clyde Refinery operations primarily comprised the receipt and refining of crude oil and finishing product piped from the Gore Bay Terminal until cessation of refining activities in 2012. Since the completion of refining operations, the former Clyde Refinery has been partially utilised as a terminal, which primarily involves the receipt, storage, and distribution of finished petroleum products.

Since the cessation of refining operations in 2012, the Clyde Terminal continues to receive finished petroleum products from the Gore Bay Terminal via an existing product transfer pipeline and distributes the products by separate pipelines from the Clyde Terminal to the adjacent Parramatta Terminal.

A figure showing the former Clyde Refinery location is presented in Figure F1 from the Stage 2 RAP in **Appendix A**.

3.2 The Western Area Remediation Project

Following completion of the Clyde Terminal Conversion Project (SSD 5147), the Western Area was no longer required for operational purposes. Given the identified presence of contaminated soil and groundwater in the Western Area, remediation as per conditions listed in SSD 9302, is taking place to enable future commercial and/or industrial land uses.

A figure showing the location of the Western Area is presented in Figure F1 from the Stage 2 RAP in **Appendix A**.

3.3 Stage 2 Area

The following features were associated with the former refining operations in the Stage 2 Area from approximately 1960 until their demolition from 2012 to 2020:

- Administration buildings, car parking areas and offices.
- Fuel and product storage infrastructure, including tank farm Areas A1, A2, A3, J and above-ground pipe tracks.
- Oil Refining infrastructure, including boilers, Platformer 3 and flare areas to the south
- A water treatment plant and control room.
- Bitumen loading gantry and associated rail sidings.
- Contractor support services buildings, including warehouses and workshops, laboratory and fire station electrical sub-stations and associated transformer yards.
- Underground drainage infrastructure (Accidentally Oil Contaminated and clean water council drainage), pump house 1 and corrugated plate interceptor unit.
- Southern Buried Waste Area which is known to have been the source of burial of refinery wastes and soil materials sourced from excavations across the Clyde Refinery footprint.
- The former substation #11 were cleared of the presence of PCBs.

In-situ decommissioning and decontamination of the sub-grade drainage network was undertaken between July 2020 and February 2021 and subsequently has been isolated from the Clyde Terminal Drainage network and WWTP.

3.4 Auditor discussion - Historical land use

The auditor considered that the primary historical usage of the WARP and the Stage 2 Area which had the potential to result in soil and groundwater contamination was the storage and processing of petroleum hydrocarbons, the former sub-stations, the drainage systems, former buildings, and fill imported to the WARP.

The auditor noted that most of the former infrastructure within Stage 2 Area was aboveground, including fuel and product storage infrastructure, associated pipe tracks, oil refining facilities, and administration buildings.

The auditor concurred that the information provided by ERM was sufficiently detailed and adequate for the purposes of identifying potential contamination issues at the Stage 2 Area.

4. Characterisation reports

4.1 Former Clyde Refinery and WARP

ERM reported in the Stage 2 RAP that investigations across the Clyde Refinery have been conducted since 1991. A summary of the outcomes of the investigations presented in **Appendix D** are relevant to the WARP and were utilised in developing the Conceptual RAP, RSI and the HHERA.

4.2 Stage 2 Area – Relevant historical reports

ERM reported in the Stage 2 RAP that 51 groundwater monitoring wells, 198 test pits, 88 soil bores and six soil vapour wells within the Stage 2 Area had been sampled as part of the works completed between 2020 and 2021. These data were considered during the development of the Stage 2 RAP. A summary of reports relevant to the Stage 2 Area is provided in **Table 4**.

Table 4 Relevant historical reports – Stage 2 Area

Author	Year	Scope of works	Investigation locations completed	Relevance
Groundwater Technology	1994	Assessment of soil and groundwater conditions	Six monitoring wells	General information on-site geology to develop the CSM and the Stage 2 RAP.
Woodward Clyde	1998	Groundwater monitoring well installation	Four monitoring wells (MW98/2, MW98/3, MW98/4, MW98/5). 13 soil bores	General information on-site geology to develop the CSM and the Stage 2 RAP. ERM noted that soil data were not used as they are more than 22 years old.
Coffey	1998	Green Mound Environmental Site Assessment (AEC-4)	15 test pits	Overall contaminant characterisation of AEC-4. No specific location data available for test pits, evidence of re-working of material since investigation.
ERM	2009	Shallow soil investigation of 'Old Admin Area'	15 soil bores (SB01-SB15)	Soil data were used in development of CSM and the Stage 2 RAP.
ERM	2009	Autonexus UST Validation	Five soil validation samples	Confirmation of UST removal and validated soils.
ERM	2008 to 2020	GMEs	Existing monitoring well network	Monitoring of LNAPL and dissolved phase CoPC concentrations. Assessment of CoPC trends in groundwater. Additional hydrogeological assessments. All data listed above were incorporated the CSM and the Stage 2 RAP.
Douglas Partners	2010	Sydney Metro – geotechnical investigation	Five monitoring wells (BH115, BH116,	General information on-site geology and groundwater

Author	Year	Scope of works	Investigation locations completed	Relevance
			BH209, BH210, BH341).	conditions to develop the CSM and the Stage 2 RAP.
ERM	2011	Tank 30 Release Investigation	Six soil bores. Two temporary groundwater monitoring wells.	General information on nature and extent of historical release to inform requirement for remediation or management.
ERM	2012	Stage 1 and 2 ESA	11 Soil Bores (BH12/29-BH12/39). 12 Groundwater monitoring wells.	General information on-site history, LNAPL distribution, site characterisation to develop the CSM and the Stage 2 RAP.
AECOM	2018	TSI	Two groundwater monitoring wells (MW18/23, MW18/24) Five soil bores. 15 test pits	General information on-site history, LNAPL distribution, site characterisation to develop the CSM and the Stage 2 RAP.
ERM	2018	PFAS Mass Flux assessment and CSM	Groundwater sampling (existing wells). Hydraulic testing (existing wells).	Additional hydrogeological data, including transmissivity tests close to the Duck River. Evaluation of potential PFAS sources. Assessment of potential ecological risks from PFAS for consideration in remedial approach.
ERM	2018	Autonexus – Lease Exit Investigation	15 Soil bores (SB1B – SB15B).	Soil data used in development of CSM and the Stage 2 RAP.
ERM	2019	RSI	57 test pits. Eight hand auger bores. Six soil bores wells.	Address data gaps noted in the Conceptual RAP. General information on-site history, LNAPL distribution, site characterisation to develop the CSM and the Stage 2 RAP.
ERM	2019 to 2020	Remediation Trials	Excavation of ~1,200 m^3 of soil l from Process West for bioremediation treatability trials. The biopiling was transferred to the Stage 2 Area.	Information regarding handling, treatability of material via landfarming and biopiling. Air quality data collected during excavation and soil handling activities, as per the Conditions of Consent.
ERM	2020	Stage 2 Drainage Decommissioning Validation	14 test pits. Nine sludge samples.	Information regarding residual hydrocarbons in drainage network requiring management, location of compromised pipework and characterisation of surrounding soil impact.
ERM	2020	AEC-4 ESA	22 Groundwater monitoring wells.	Refinement of CSM and LNAPL CSM. Confirmation of AEC-4 remedial approach.
ERM	2020	Stage 2 – Stockpile Validation. Discussion from the source of the	Sampling of four soil stockpiles. Visual inspection of 11 demolition waste	Provision of stockpile register. Waste Classification of stockpiles requiring offsite disposal.

Author	Year	Scope of works	Investigation locations completed	Relevance
		stockpile, characterisation etc is presented in **Section 4.4.5**.	stockpiles on site for presence of ACM.	Assessment of re-use suitability for existing materials.
ERM	2021	Stage 2 – Additional ESA for increased sample density for validation of future subdivision.	97 Test pits. 63 Sampled with lab analysis. 34 Visual observation and field screening.	Increased spatial coverage and confirmation of CSM. Refinement of remediation extents and areas requiring management across Stage 2.

The locations of soil, groundwater and soil vapour sampling points are shown in Figure F5 from the Stage 2 RAP in **Appendix A**.

The reports summarised in the following subsections were considered by the auditor to be key documents from which information was used in preparing the Stage 2 RAP.

4.2.1 The RSI

The scope of works undertaken as part of the RSI comprised excavating an additional 57 test pits to a maximum depth of 4.8 mbgl to collect data to assess the risk of contamination to on-and off-site human and ecological receptors from the AECs listed in **Table 5**. Figure F5 from the Stage 2 RAP shown the location of each AEC.

Table 5 Summary of AECs - RSI

Identification	Description
AEC-1	Old Administration Area
AEC-2	Buried Waste Area 8 – CDU tank farm sludge
AEC-3 [4]	Southern Contractor Area
AEC-4	Southern Buried Waste Area
AEC-5	Platformer 3
AEC-6	Buried Waste – Ex Solvents Plant
AEC-7 [5]	Pipe Track Areas
AEC-8	Tank farm J
AEC-9	Process West
AEC-10	Process East
AEC-11	Tank farms A1, A2, A3
AEC-12	Tank farm C
AEC-13	Substation Areas and Transformer Yards
AEC-14	Subsurface drainage network
AEC-15	Other areas within the WARP

A summary of the key findings of the RSI is presented in **Table 6**.

[4] Grey – AEC within Stage 2 Area.
[5] Green - AECs partially within Stage 2 Area.

Table 6 Summary of RSI results

Objective/Data gap	Outcomes
Refine the nature and extent of petroleum hydrocarbon impacts and LNAPL	Data gap met. ERM considered it collected sufficient data to characterise the nature and extent of impacts requiring remediation within the WARP.
Potential pre-validation of low-risk areas to potentially exclude from remediation and / or management	ERM reported in the RSI that based on the results of the RSI and historical investigations low risk areas were AEC-1 and AEC-3.
Further characterisation of buried waste areas (nature and extent of impacts).	ERM reported that test pitting within AEC-4 was terminated in fill at a depth of 4.0 mbgl.
Drainage and subsurface infrastructure characterisation.	Fill underlying pipe tracks was identified to be generally shallow, extending to a depth of approximately 0.1 to 0.2 mbgl. ERM stated that concentrations of CoPC in soil samples were less than the adopted Tier 1 screening criteria. Based on the extensive nature of the drainage network, ERM recommended that an unexpected finds protocol be implemented during future excavation and removal of the subsurface drainage network, which will allow appropriate management and assessment of isolated soil impacts during remediation and sub-grade infrastructure removal.
Collect data to support HHERA and development of risk- based Site-Specific Target Levels (SSTLs) for remediation.	ERM considered the RSI and historical assessments provided sufficient data for the purposes of developing a HHERA to refine the potential risks to human and ecological receptors, the development of SSTLs and remedial end points.
Further characterisation of non-petroleum CoPC to confirm the remediation methodology/ management.	ERM in the RSI reported the following: **Asbestos** – was identified in the form of ACM fragments at isolated locations (AEC-1, AEC-3 and AEC-4) believed to be associated with demolished former infrastructure. ERM noted that the presence of ACM identified during investigations was confined to shallow fill and surface soils in localised areas. Soils within AEC-4 were found to contain ACM fragments and fibres at variable depths and is consistent with historically documented waste burial activities within the south-western area of the WARP. **Heavy metals** – concentrations of all heavy metals in all soil samples were less than the adopted assessment criteria except for one isolated sample located within AEC 11, which exceeded the assessment criterion for lead. Historical results also identified the presence of total chromium results above adopted criterion (for Cr VI) associated with buried waste within AEC-4. **Dioxins** – were reported less than limit of reporting (LOR) and/or the adopted assessment criterion. ERM noted that dioxin concentrations discussed in the TSI (AECOM, 2018) were not previously screened against Tier 1 criteria, and those were below the adopted screening criteria. **PFAS** - Australian Standard Leaching Procedure (ASLP) tests and excavation water samples identified PFAS within localised areas of the site. Reported concentrations of PFAS were below adopted screening criteria for current and future on-site receptors. Although concentrations of PFOS were reported at some individual locations exceeding off-site ecological criteria, potential risks for these receptors were considered negligible based on previous mass flux modelling undertaken by ERM (the PFAS CSM).
Collect data from likely remediation areas to assist with technical specification development for remediation contractors.	ERM stated that the collection of additional data relating to soil properties (density, porosity, total organic carbon etc.) was sufficient for the development of technical specifications for remediation.

4.2.2 The HHERA

The HHERA was developed to evaluate the significance of potential risks where Tier 1 screening levels were exceeded. SSTLs were derived based on the updated CSM from the RSI. The specific objectives of the HHERA were as follows:

- Assess whether the on-site soil and groundwater impacts in the WARP (which include the Stage 2 Area) can pose a potential risk to human or ecological receptors under the proposed future land use scenario.
- Assess whether the identified on-site impacts can pose a potential risk to off-site human or ecological receptors based on the current and future land uses.
- Develop SSTLs for remedial works.

ERM developed an exposure assessment and derived SSTLs for the following pathways and CoPC for the Stage 2 Area:

- Direct contact or ingestion of impacted soils by future on-site intrusive maintenance workers (IMW) or construction workers undertaking earthworks for the following:
  - (a) AEC-3 - carcinogenic polycyclic aromatic hydrocarbons (PAHs), total recoverable hydrocarbons (TRH) C_{10}-C_{34}.
  - (b) AEC-4 - carcinogenic PAHs, TRH C_{10}-C_{34} and hexavalent chromium.
  - (c) AEC-11 – lead.
  - (d) AEC-15 - TRH C_{10}-C_{34}.
- Inhalation of vapours by future on site workers in indoor or outdoor air for the following:
  - (a) AEC-3 - benzene, naphthalene, and TRH C_6-C_{10} (less BTEX).
  - (b) AEC-4 - benzene, naphthalene, and TRH C_6-C_{10} (less BTEX).

ERM reported that Tier 1 screening of groundwater along the boundary of the WARP indicated that off-site migration of LNAPL or dissolved phase petroleum hydrocarbons was not occurring to a degree that could potentially cause unacceptable risks to the identified environmental or ecological receptors. ERM concluded that this exposure pathway was incomplete and no potential risks to on-and off-site receptors was identified from CoPC detected in groundwater samples. Similarly, ERM considered that screening for PFAS and metals from soil leachate and groundwater in the WARP did not represent potential risks to on-and off-site receptors.

ERM reported that in accordance with SSD approval for the WARP, future on-site intrusive works and construction exposures should be managed via the Remedial Environmental Management Plan (REMP) and its sub-plans, incorporating safety procedures for management of asbestos and ground gases during excavation.

ERM reported that on-site ecological receptors had limited value under the current and future land use and that potential risks to off-site adjacent receptors were unlikely. The summary of potential risks for on-site receptors is presented in **Table 7**.

Table 7 HHERA conclusions – Stage 2 Area

AECs	Soil - direct contact risk			Commercial – VI [6]	Asbestos	LNAPL [7]
	Commercial worker	Construction worker	IMW			
AEC-1	✓[8]	✓	✓	✓	×[9]	✓

[6] Potential vapour intrusion risks assume the presence of future buildings.
[7] Consideration of the management of LNAPL is warranted separately to potential health risks.
[8] Indicates potential risks are unlikely or within acceptable lev-els.
[9] Indicates a potential risk or need for remediation and/or management.

AECs	Soil - direct contact risk			Commercial – VI [6]	Asbestos	LNAPL [7]
	Commercial worker	Construction worker	IMW			
AEC-2	✓	✓	✓	✓	✓	×
AEC-3	× Benzo(a)pyrene (BaP)	✓	✓	× Benzene Naphthalene, TRH F1 TRH C_8-C_{12} (aliphatic)	×	×
AEC-4	× TRH C_{10}- C_{34} BaP	× Hexavalent chromium	✓	× Benzene TRH C_6-C_{10}	×	×
AEC-5	✓	✓	✓	✓	✓	×
AEC-7	✓	✓	✓	✓	✓	✓
AEC-11	✓	✓	✓	✓	✓	×
AEC-13	✓	✓	✓	✓	×	✓
AEC-14	✓	✓	✓	✓	✓	✓
AEC-15	✓	✓	✓	✓	×	×

4.3 Auditor discussion - Stage 2 Area – Relevant historical reports

The RSI report was reviewed by the auditor as documented in IAA02. The auditor concurred in IAA02 that the RSI largely followed the endorsed SAQP, and the relevant guidelines made or endorsed by the NSW EPA, providing sufficient information to portray the characterisation of the WARP and assist in the preparation of the HHERA and detailed RAP.

The HHERA was reviewed by the auditor as documented in IAA03. The auditor concurred in IAA03 that the methodology and guidelines adopted by ERM in preparing the HHERA were appropriate and in largely accordance with Schedule B4 of the ASC NEPM.

The auditor agreed with ERM in IAA03 that the residual LNAPL, as well as the dissolved phase groundwater plumes, did not pose unacceptable potential human and ecological risks to current and future on-and off-site receptors.

The risk assessment demonstrated that the key exposure risks related to the presence of volatiles were vapour inhalation in a future development scenario where buildings are constructed, as well as direct contact with contaminated soil. These exposure scenarios were identified as the key drivers for remediation and contamination management.

The auditor noted in IAA03 that although ACM can pose a potential risk to IMW during remedial activities, exposure can be managed by construction management plans and in the interim via Viva Energy HSE protocols. Further, the potential for the presence of asbestos will be managed through the passive LTEMP (as noted in SSD 9302 Consent Conditions). A copy of IAAs accompanied by the site audit tracking sheet is presented in **Appendix B**.

4.4 Stage 2 Reports

4.4.1 The AEC-4 ESA

The objectives of the investigation and key outcomes of the supplementary AEC-4 ESA are summarised in **Table 8**.

Table 8 Summary of AEC-4 ESA

Objective	Outcomes
Delineate the vertical extent of impacted soil material within AEC-4	The depth of buried waste was inferred as follows: – Western extent: between 1 and 1.2 mbgl (MW12/03 and MW12/04). – Central area: between 4.2 and 4.5 m bgl (MW20/13, MW20/07). – Southern access road (boundary with Duck River): between 1.2 and 3.5 mbgl. Depth of visual observations of impacts identified within the Buried waste area extended to depths of up to 6 metres. These impacts have been vertically delineated via soil analysis to below relevant SSTLs. The lateral extent of buried waste within AEC-4 is limited to the Viva Energy's property boundary. A figure showing all soil investigation location is presented in Figure F5 from the Stage 2 RAP (**Appendix A**).
Collect data to support acid sulfate soil assessment of the wider WARP area	ERM collected soil samples of natural material for assessment of the likelihood of ASS or PASS being present within AEC-4 which may require management during remediation works. Evidence of PASS was indicated by exceedances of the Acid Sulfate Soils Management Advisory Committee (ASSMAC, 1998) net acidity criteria (acidity and sulphur units) within samples collected at or below the water table. ERM, therefore concluded that that should excavation of such soils be required, or dewatering undertaken, that an acid sulfate management plan would be required to manage oxidisation and potential acidification of this material.
Provide a comprehensive groundwater monitoring well network downgradient of the site to investigate current conditions and enable future management and monitoring	Twenty additional groundwater monitoring wells were installed, including 10 down gradient wells to supplement the existing two installed wells across the AEC-4 boundary with Duck River. The groundwater monitoring well network is presented in Figure F6D from the Stage 2 RAP in **Appendix A**. The down gradient monitoring well spacing of approximately 15 metres is suitable for future monitoring and longer-term management of in-situ buried waste material.
Investigate the nature and extent of groundwater impacts associated with buried waste	The following key observations were noted by ERM regarding groundwater quality: No exceedances of SSTLs for current and future on-site receptors were reported for CoPC in groundwater. Reported that soil exceedances were situated within the AEC-4 buried waste area and are directly associated with observation of LNAPL in the soil profile at locations into which groundwater samples were installed. No exceedances of assessment criteria relevant to off-site receptors on the down gradient site boundary bordering Duck River. An exceedance of the recreational criterion for benzene and ecological criterion for PAHs noted on the western extent of the AEC-4 area.
Determine if groundwater impacts pose a potential for risk to off-site receptors	ERM stated that groundwater contamination in AEC-4 is unlikely to pose unacceptable risks to off-site receptors. Dissolved phase groundwater impacts are confined to within the AEC-4 Buried waste area. Dissolved phase groundwater impacts beyond AEC-4 have been delineated to below adopted screening criteria, except for benzene exceeding the recreational assessment criterion and PAHs exceeding ecological assessment criterion at MW20/03, situated on the western extent of the AEC-4 area adjacent an unlined storm water channel.

Based on the results of the AEC-4 ESA, ERM identified the following potentially complete exposure pathways within area AEC-4 which will require remediation and/or management:

- Vapour intrusion in future buildings and indoor inhalation (benzene and TRH F1 fraction) by commercial/industrial workers from LNAPL and hydrocarbon impacted soil.
- Inhalation of dusts or asbestos fibres from ACM within soil during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.
- Direct contact or ingestion of soils contaminated with TRH (>C_{10}-C_{16} (F2) fraction), TRH (>C_{16}-C_{34} fraction), PAHs, and hexavalent chromium, by on-site intrusive maintenance workers or construction workers undertaking earthworks.
- Based on the observed presence of LNAPL within soil/ and groundwater within the AEC-4, there is potential for accumulation of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers as well in enclosed air spaces in future buildings. The potential effects of LNAPL on future buried infrastructure and aesthetics (particularly odour generation) will require consideration in an LTEMP for AEC-4.

The scope of sampling locations used to characterise AEC-4 is shown in Figure F5 from the Stage 2 RAP in **Appendix A**. The laboratory results are presented in **Appendix C**.

4.4.2 The Stage 2 ESA

The Stage 2 Area is proposed to be subdivided into 13 commercial/industrial lots and a road corridor. The location of the proposed 13 lots is presented in Figure F10 from the Stage 2 RAP in **Appendix A**.

The objective of the Stage 2 ESA was to increase existing sampling density within each proposed lot (given the WARP had been assessed as a contiguous area), achieve greater lateral and vertical coverage at AEC-4, to close data gaps identified during drainage decommissioning works, and to facilitate assessment of site suitability for each proposed lot as part of future works.

In addition, the outcomes of the Stage 2 ESA were to be incorporated into the Stage 2 RAP and future site suitability assessments for proposed lots where remediation is not necessary.

The locations of soil, groundwater and soil vapour sampling locations within the Stage 2 Area are shown in Figure F5 from the Stage 2 RAP in **Appendix A**. The laboratory results are presented in **Appendix C**. A summary of the sampling density by lot and discussion regarding the appropriateness in relation to guidance listed in the *Sampling Guidelines* (NSW EPA, 2005) and ASC NEPM is presented in **Appendix C**.

A summary of the results and conclusions for the Stage 2 ESA is presented in **Table 9.**

Table 9 Stage 2 ESA results and conclusions

Objective	Discussion/conclusion
Increase sample densities and spatial coverage within the Stage 2 Area	Discussion - The scope of works comprised advancing 97 test pits to a target depth of 2 mbgl, and analysing 150 soil samples for TRH, BTEX, PAHs, metals, and asbestos. Sample locations were selected to refine the lateral and vertical extent of AECs and address data gaps identified during recent drainage decommissioning works ERM's conclusion - The sample density achieved for each lot was considered appropriate to enable validation of individual lots where remediation is deemed not necessary.
Ensure field and laboratory information collected were appropriate in nature and quality to enhance the conceptual	Discussion - Soil sampling and analysis was completed in general accordance with the SAQP previously reviewed by the auditor. ERM reported that minor deviations to the SAQP did not result in a reduction of overall data appropriateness. ERM's conclusion - The quality of the data was assessed and evaluated to be of acceptable quality. The data will be used alongside historical data collected within the Stage 2 Area to establish remediation and management requirements.

Objective	Discussion/conclusion
understanding of the Stage 2 site	The complete Stage 2 Area dataset will be presented in the Stage 2 RAP.
Screen data against the relevant assessment criteria	Discussion - Laboratory and ACM field results were screened against relevant assessment criteria. Of the 150 samples analysed, 10 samples (from seven test pit locations) had reported concentrations of CoPC above the assessment criteria. Results - The following exceedances of the assessment criteria were noted: – TRH C_{10}-C_{16} fractions (following silica gel clean up) were above Management Limits at five locations (TP21/68, TP21/07, TP21/23, TP21/74, and TP21/79). – TRH C_{16}-C_{34} fractions (following silica gel clean up) were above Management Limits at five locations (TP21/68, TP21/07, TP21/11, TP21/74, and TP21/79). – TRH C_6-C_{10} fraction was above Management Limits at one location (TP21/79). – TRH C_6-C_{10} less BTEX and three of the TRH CWG fractions (TRH C_{10}-C_{12} Aliphatic, TRH C_{10}-C_{12} Aromatic and TRH C_{12}-C_{16} Aromatic) were above the Clyde WARP SSTLs (Vapour Intrusion – Commercial) at one location (TP21/79). – Benzo(a)pyrene TEQ (medium bound) was above the Clyde WARP SSTLs (Vapour Intrusion – Commercial) at one location (TP21/07). It is noted by ERM that lead was above the NEPM (1999) HIL D at one location (TP21/21). However, the 95% UCL for all data from within proposed lot 63 was below the HIL D criterion.

4.4.3 The 2020 GME

ERM stated the Quarter 4 GME represented the baseline understanding of groundwater conditions within the WARP at the time of Stage 2 RAP preparation. ERM made the following conclusions regarding groundwater conditions within the WARP, which includes the Stage 2 Area:

- Following Stage 1 Area remediation works, ERM did not observe changes to groundwater conditions that could pose unacceptable risks to off-site receptors.
- The direction of groundwater flow was consistent with previous GMEs and generally flows to the south-east towards the Duck River.
- The extent of LNAPL impacts in groundwater was consistent with previous GMEs. ERM stated LNAPL impacts had been delineated laterally by sampling downgradient of the plume. Given the LNAPL characteristics (too viscous) its thickness could not be measured. Based on the apparent thickness observed in bailers LNAPL thickness was estimated between millimetres to less than 10 centimetres.
- Dissolved-phase concentrations of CoPC in groundwater did not exceed the SSTLs in any of the samples.

ERM noted that overall, stable groundwater conditions and natural attenuation processes were similar to those observed in previous GMEs. ERM reported decreasing trends in dissolved-phase hydrocarbon concentrations.

Regarding other CoPC, the following were reported by ERM:

- Heavy metals concentrations in the WARP exceeded the adopted ecological screening criteria for copper, lead, mercury, nickel, and zinc. The spatial distribution of metals exceedances did not appear to be confined to a particular portion of the WARP. Exceedances were considered likely to be related to regional background water quality, associated with imported fill materials across the Camellia peninsula.
- Exceedances of the PFOS, ecological criterion in groundwater were consistent with previous sampling events and supported the existing CSM and mass flux assessment previously undertaken (ERM, 2018).

The groundwater exceedances plan is shown in Figure F6D from the Stage 2 RAP in **Appendix A**. The laboratory results are presented in **Appendix C**.

4.4.4 Auditor discussion – Stage 2 Reports

SAQPs

The SAQPs were prepared by ERM prior to the commencement of each assessment and were reviewed by the auditor to establish that they had been prepared in a manner consistent with NSW EPA guidance and contained key elements such as CSM, DQOs and quality assurance plans. Auditor commentary on the SAQPs were registered in the audit tracking sheet and/or IAAs presented in **Appendix B.**

Data quality assurance/Data quality control

The auditor noted that ERM adopted the seven-step DQO process as required by the NSW EPA Auditor Guideline in all assessment phases completed in the Stage 2 Area as well as stage specific data quality indicators as referenced in the ASC NEPM. The auditor notes that both field and laboratory quality assurance/quality control (QA/QC) programs were conducted during the assessments works.

The auditor noted that intra-laboratory and inter-laboratory samples were collected and analysed as part of the WARP and Stage 2 Area assessment programs. The rates of collection and analysis demonstrated that the PARCC (Precision, Accuracy Representativeness, Comparability and Completeness) parameters were achieved. The DQOs for the RSI, Stage 2 ESA, AEC-4 are presented in **Appendix E**.

The reported RPDs calculated by ERM were generally within acceptable ranges, with an acceptable number (compared with the number of analysis completed) of RPDs exceeding criteria primarily for low-concentration results. The auditor concurs with ERM that these did not affect the reliability of the data reported.

The auditor considered that field trip blanks and trip spikes, where analysed, were largely within acceptable criteria.

Matrix spike recoveries and surrogate spike recoveries reported by the laboratory were within the control limits indicating that the accuracy of the results is acceptable for assessing the suitability of the environmental condition of the Stage 2 Area.

ERM reviewed the laboratory QA/QC results which showed that the laboratory analytical program achieved adequate levels of precision and accuracy for the analyses. While minor non-conformities with some aspects of the QA/QC program were observed, analytical and quality protocols undertaken by the consultant were considered satisfactory and the data is adequately reliable for the purpose of assessing the contamination status of the site for the proposed mixed use.

The auditor's review of the quality assurance/quality control measures employed by ERM, and the laboratories identified there was adequate information for the purpose of characterizing the Stage 2 Area.

Extent of impacts – AEC-4

The auditor agreed with ERM's evaluation that the vertical extent of impacts (principally petroleum hydrocarbons) identified within AEC-4 extends to depths of up to 6 metres. These impacts have been vertically delineated via soil analysis to below relevant SSTLs. The lateral extent of impacts associated within AEC-4 is confined within Viva Energy's property boundary.

The auditor noted that no SSTLs for on-site future human receptors were exceeded for any of the CoPc in groundwater. Similarly, no ecological criteria for surface water were exceeded for off-site

receptors bordering Duck River, apart from the recreation criterion for benzene and ecological criterion for PAH within the western extent of AEC-4 at sample collected in MW20-3.

The auditor noted that this exceedance was restricted to the MW20/3 and should not affect off-site receptors, given the tidal flux, that Duck River is not used for recreational purposes and there is likely to be biodegradation and dilution between AEC-4 and the Duck River.

Extent of impacts and data gaps - Stage 2 ESA

The auditor noted that the additional 97 test pits and analyses of 150 soil samples for CoPC were sufficient to refine the lateral and vertical extent of previously identified AECs within the Stage 2 Area and address data gaps identified during the Stage 2 drainage decommissioning works.

The auditor considered that the sample density was appropriate to enable characterisation of some of the proposed individual lots where remediation is deemed to not be required. It is therefore the auditor's opinion that the objectives of the Stage 2 ESA were met, and the data produced to date is sufficient to refine the CSM and to develop the Stage 2 RAP.

The reports reviewed as part of this site audit provided sufficient evidence that the former activities that lead to soil and groundwater contamination had been identified and appropriate sampling plans prepared to characterise these sources. The auditor notes that the CoPC identified for the characterisation of the Stage 2 Area are consistent with the documented historical use. Further discussion regarding CoPC per AECs is presented in **Section 9** in the CSM.

ERM demonstrated in its investigations that vertical migration of contamination to groundwater was limited by the natural clay layer that acted as a natural "barrier".

Q4 2020 Groundwater characterisation

The auditor noted that LNAPL was observed in the same monitoring wells as previous and there was no change to the spatial extent.

The data validation procedure adopted for the evaluation of field and laboratory QA/QC data indicated that the reported analytical results were representative of groundwater conditions and that the quality of the analytical data produced was acceptable and free of systematic bias.

The auditor considered that sufficient evidence of stable groundwater conditions and natural attenuation processes was provided by ERM.

The auditor concurred that the extent of LNAPL and petroleum hydrocarbons are stable and appropriately delineated in the context of proposed future commercial/industrial land use. The potential human health risks to future on-site receptors are low and acceptable. However, groundwater conditions shall be monitored (and if necessary managed) by the LTEMP, and groundwater extraction should not occur for any purposes other than monitoring.

Reporting

The auditor noted that ERM provided tables that summarised all laboratory results. The reported concentrations of contaminants were reviewed by the auditor and found to be consistent with those presented in the laboratory reports.

Exceedances were highlighted for each media analysed and SSTLs or adopted criteria were included in tables.

The site plans provided by the ERM were to scale and adequately identified the sampling locations per depth (when applicable) relevant to the main site features such as former buildings, remaining drainages, boundaries, and roads.

The auditor noted that the RSI, HHERA, AEC-4 ESA and Stage 2 ESA were standalone reports, presenting sufficient information for the understanding of the site conditions leading to the preparation

of the Stage 2 RAP. As such it is the auditor's opinion that the reports reviewed as part of this site audit met the key requirements of the NSW EPA Consultant Guidelines and ASC NEPM.

4.4.5 Stage 2 Stockpile validation

ERM reported that the objective of the Stage 2 Stockpile Validation Report was as follows:

- Produce a stockpile register and site plan to inform future materials tracking and management.
- Characterise stockpiled materials with regards to potential suitability for re-use and backfill as part of the WARP.
- Establish a waste classification for off-site disposal for materials considered unsuitable for re-use.

The stockpile register produced as part of the investigation is provided as Appendix G of the Stockpile Characterisation Report. Of the 15 stockpiles, 12 were deemed suitable by ERM for unrestricted placement and beneficial on-site reuse for commercial/industrial land use. The remaining three stockpile were characterised as follows:

- Stockpile SP29 – comprised a combination of asbestos and soil generated during demolition works will be subject to off-site disposal (Special Waste – Asbestos).
- Stockpile SP30 – A fragment of bonded ACM was identified within this stockpile during an inspection by a licenced asbestos assessor. This stockpile comprised demolition waste including gravel, concrete, and bricks. The stockpile is considered unsuitable for reuse and has been classified as Special Waste (Asbestos) for off-site disposal.
- Stockpile SP37 – one isolated fragment of ACM was observed during an inspection by a licensed asbestos assessor. Laboratory calculated quantification results for asbestos in the fragment were below the commercial/industrial assessment criterion. This material was considered suitable for re-use on site, subject to validation of no visible asbestos at the final ground surface.

The laboratory results are presented in **Appendix C**.

4.4.6 Auditor discussion – Stage 2 Stockpile validation

The auditor noted that there are currently 15 stockpiles located in the Stage 2 Area. Most of this material comprises soil and demolition material from the refinery demolition works. Each stockpile has been characterised to determine suitability for on-site beneficial re-use during planning for Stage 2 Area remediation or off-site disposal.

The auditor considered the sampling locations to characterise each stockpile were sufficient. The number of sampling locations was consistent with the requirements listed in the ASC NEPM.

It is the auditor's opinion that apart from stockpiles SP29 and SP30, all stockpiles are deemed suitable for beneficial on-site re-use under a commercial and industrial land use.

Regarding stockpile SP37, the auditor noted that a fragment of ACM was observed during its characterisation. However, as laboratory quantification results for asbestos in this fragment were below commercial/industrial criteria, the auditor acknowledged ERM's conclusion that the material of this stockpile is suitable for on-site re-use subjected to final visual validation of the material as it is being placed within the Stage 2 Area. In addition, the auditor noted that based on the proposed commercial or industrial future use, the majority of the Stage 2 Area will be hardstand covered, limiting access to these soils.

4.4.7 Stage 2 Drainage validation

The objectives and outcomes presented in the decommissioning and validation report of the subsurface drainage infrastructure are presented in **Table 10.**

Table 10 Summary of drainage decommissioning and validation works

Objective	Outcomes
Ensure the sub-grade drainage infrastructure:	
Is not an ongoing primary source of soil and groundwater impact or a preferential pathway for migration of contaminants	ERM reported that upon completion of cleaning, drainage pit junctions were backfilled with aggregate or stabilised sand to prevent lateral migration of residual sludges (where present) within the drainage network. ERM stated the remaining in-situ pipework within the Stage 2 Area had been cleaned and was generally free of sludge and non-aqueous phase-liquids. Residual hydrocarbon sludges remained within identified pipe sections and were planned to be managed during future excavation works as part of the LTEMP. Some residual hydrocarbon impacted soils have been identified as requiring additional investigation and inclusion into the Stage 2 RAP. ERM identified eight data gaps where additional investigations were required for future environmental management. This data gaps were further addressed during the Stage 2 ESA works.
Does not present an unacceptable future safety risk via accumulation of gases in sub grade void spaces	ERM stated the risk of exposure to ground gases to human health are considered low as the primary sources of ground gas were removed. Monitoring results indicated concentrations of hazardous ground gases (Volatile organic compounds (VOC), Lower Explosive Limit (LEL), methane, carbon dioxide and hydrogen sulphide) within the drainage network were below adopted screening levels. Screening levels were based on published safety standards (NIOSH) and the NSW EPA *Assessment and management of hazardous ground gases – contaminated guidelines*. The auditor considered these were appropriate to qualify risk of exposure.
Is isolated from the wider Clyde Terminal network, such that future site operations will not contribute discharge to the site's wastewater treatment plant	ERM reported that isolation of drainage flows at the Stage 2 Area were isolated from the surrounding network in Stage 1 and Stage 3 Areas (both downstream to the east). Pit's servicing trunk mains within the Stage 1 and Stage 2 Areas were backfilled with stabilised sand to plug flows to the Clyde WWTP. ERM reported that permanent isolation of mains downstream of the WARP, including Stage 2 Area, was undertaken via draining of lines, excavation, air gapping and cement filling of these lines to adequately isolate flows from the WWTP.
Cannot be recommissioned for use in future	ERM stated that the Stage 2 Area drainage network was considered unserviceable and cannot be recommissioned. Furthermore, the drainage network has been permanently isolated from the wastewater treatment plant.

The Stage 2 Area drainage layout is shown in Figure F4 from the Stage 2 RAP in **Appendix A**. The soil laboratory results are presented in **Appendix A**.

Based on the results from the drainage decommissioning discussed in table above, ERM concluded the objectives of the drainage commissioning were met. However, the following were recommended by ERM to mitigate residual risks:

- Health and safety control, such as PPE for future workers undertaking removal of pipework or sludges.
- Identification of areas of residual hydrocarbons in soil which could be stained and/or generate odours or vapours during future excavation works.

4.4.8 Auditor discussion – Stage 2 Drainage validation

The auditor noted that the pipework within the Stage 2 Area was cleaned and is free of sludge and petroleum hydrocarbons phase-liquids. The residual sludges remained within identified pipe sections are planned to be managed during remedial works and managed as part of the LTEMP.

It was the auditor's understanding that some residual hydrocarbon impacted soils around the pipeline have been identified, but additional works addressing the significance of these in relation to human health exposure were carried out in the Stage 2 ESA.

The auditor notes that the drainage pit junctions were backfilled with aggregate or stabilised sand to prevent lateral migration of residual sludges (where present) within the drainage network.

The auditor was satisfied with the drainage decommissioning works and concurs that the subgrade drainage infrastructure is no longer a source of impacts to soil and groundwater that could constitute an unacceptable exposure risk.

The auditor noted that as the ground gases assessment carried out as part of the validation of the cleaning of the drainage lines did not record the presence of gases at levels greater than relevant trigger levels, the former drainage infrastructure does not present an unacceptable safety risk via accumulation of gases in sub grade void spaces.

The auditor acknowledged that the former drainage structure was isolated from the Clyde Terminal network, such that future site operations will not discharge to the site's wastewater treatment plant.

4.4.9 AEC-4 ROA

Before preparation of the Stage 2 RAP, ERM completed two remedial option analyses (ROA). The first, the 2020 ROA was presented for all three Stages and was based on data collected up until June 2020. In the second ROA, ERM provided specific remediation options for AEC-4 following the completion of the AEC-4 ESA.

ERM stated that based on the outcomes of further investigation works undertaken within AEC-4, the purpose of the ROA – AEC-4 was to refine the understanding of potential remedial options for identified contamination within AEC-4. The remedial options assessment followed the approach presented CRC CARE (2018).

ERM reported in the ROA – AEC-4 that the scope of works included the following:

- Review of site characterisation previously carried out in AEC-4, detailing the nature and extent of contamination within the AEC-4.
- Definition of remedial goals based on the CSM and LNAPL CSM developed within the RSI and HHERA and refined CSM that incorporated data from most recent assessments (AEC-4 ESA and Stage 2 ESA).
- Assessment of potential remedial options against the criteria of effectiveness, timeframes, health and safety, sustainability, cost and in consideration of NSW EPA regulatory guidance relating to remedial hierarchy.
- Outlining the preferred remedial strategy for AEC-4.

ERM noted that all site-specific requirements relating to the implementation and ongoing site management associated with remedial works will be presented within the subsequent Stage 2 RAP.

ERM reported in the ROA - AEC-4 that to assist in estimating the extent or volume of material requiring remediation or management, fill thicknesses from available borelogs and field density measurements of the encountered materials were utilised to provide the estimation of volume and mass within the AEC-4. A summary of the key findings of the remedial options assessment is presented as follows:

- Area requiring remediation: 13,936 m^2
- Maximum contamination depth: 3.6 metres
- Pathway and CoPC in soil requiring remediation:
  (a) Vapour Intrusion for Benzene, TRH> C6-C10

(b) Inhalation – Asbestos

(c) Direct Contact for TRH >C10- C34, Carcinogenic PAHs and hexavalent Chromium

– An LNAPL management plan would be required to:

(a) Manage potential acute exposure to ground gases during future excavation

(b) Consider hazardous ground gases for the development of enclosed spaces (i.e., buildings)

– Volume requiring remediation: 50,588 m^3

– Volume calculation assumptions:

(a) Due to the heterogeneous nature of buried waste in this area, it had been assumed all fill material within AEC-4 will require remediation or management to an average depth of 4 metres.

(b) Average depth of fill material has been used for calculations.

Due to the heterogeneous nature of the soil contamination within AEC-4 (including fibrous asbestos within the fill), consideration of the low mobility of contamination via groundwater migration and subsequent low risk of harm to Duck River, ERM concluded in the ROA - AEC-4 that the appropriate remedial option is through management via an engineered cap and contain strategy.

ERM reported that the cap and contain approach would effectively limit exposure to current and future site users through the construction of an engineered cap that prevents direct contact by future commercial receptors.

It was reported by ERM in the ROA - AEC-4 that the proposed future use of the site is for car parking and/or container storage and that no permanent or occupied buildings are proposed. In addition, an LTEMP will be required to document the presence of residual impacts, monitor conditions for a short period time following cap establishment, and control works that have the potential to disturb managed material.

4.4.10 Auditor discussion – AEC-4 ROA

It was the auditor's opinion that the AEC-4 ROA followed the approach presented in the CRC CARE (2018) considering relevant Australian and international guidance. Additionally, the hierarchy for site clean-up and/or management outlined in the ASC NEPM was considered by ERM during its analysis.

The auditor considered that results reported from previous investigations and risk assessments have demonstrated that soil and groundwater contamination within AEC-4 is delineated, non-mobile and does not pose an unacceptable risk to human health or any off-site ecological receptors. As such, in conjunction with the construction of a managed capping layer, ongoing management of LNAPL can be incorporated in an LTEMP.

The auditor noted that an LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative/active remedial approaches if a change in site conditions results in a potential risk to human health or off-site ecological receptors.

5. Stage 2 – Contamination characterisation

5.1 Soil

ERM reported in the Stage 2 ESA that several soil samples had CoPC greater than the nominated investigation levels (SSTLs presented in the HHERA or NEPM HSLs. These exceedances are summarised in **Table 11**.

Table 11 Summary of soil exceedances at the Stage 2 Area

AEC	CoPC	Criteria exceeded	Sampling locations (depth in mbgl)
AEC -1	Asbestos (ACM > 7mm)	NEPM HSL D - Asbestos	TP19/01 (0.1)
AEC-3A	TRH F1	WARP SSTLs - Vapour Intrusion (commercial worker)	MW18/24 (1.2) TP18/20 (0.45, 0.7,1.2)
AEC-3B	Asbestos (ACM >7mm)	NEPM HSL-D - Asbestos	TP19/32 (0.1)
AEC-3C	Benzo(a)pyrene TEQ TRH >C_{16}-C_{34} Fraction	WARP SSTLs - Direct Contact (commercial worker, construction worker)	TP19/16 (0.8)
AEC-3D	TRH >C_{12}-C_{16} Aromatic	WARP SSTLs - Vapour Intrusion (commercial worker)	TP19/17 (0.5)
AEC-3E	TRH F1 TRH >C_{10}-C_{12} aliphatic TRH >C_{10}-C_{12} aromatic TRH >C_{12}-C_{16} aromatic	WARP SSTLs - Vapour Intrusion (commercial worker). WARP SSTLs - Direct Contact (commercial worker, construction worker).	TP21/79 (0.2)
AEC-4	Vapour Intrusion Benzene TRH F1 TRH C_6-C_{16} aliphatic TRH C_7-C_{16} aromatic Inhalation – Asbestos Asbestos (ACM > 7mm) Asbestos (FA+AF < 7mm) Direct Contact TRH >C_{10}-C_{34} Benzo(a)pyrene TEQ Hexavalent chromium	WARP SSTLs Vapour Intrusion (commercial worker). NEPM HSL-D (Asbestos). WARP SSTLs - Direct Contact (commercial worker, construction worker).	TP18/27 (1.2, 1.8, 3.0) TP19/19 (0.6) SB5B (1.0) TP19/77 (1.5, 4.0) TP19/23 (1.5) TP19/25 (1.3) TP19/75 (1.5) TP19/81 (1.0) TP19/68 (1.0) TP19/76 (1.0) TP19/74 (1.5) TP19/21 (2.0, 2.8) TP19/74 (1.4) TP19/76 (2.2) MW12/01 (2.0) TP19/83 (1.0) TP19/84 (1.0, 2.0)
AEC-11[10]	TRH >C_{10}-C_{12} aliphatic TRH >C_{12}-C_{16} aliphatic	WARP SSTLs - Vapour Intrusion (commercial worker)	HA19/04 (0.4) HA19/05 (0.5) HA19/09 (0.8)

[10] Vapour intrusion risk for AEC-11 assessed via direct soil vapour measurement (SV19/06)

AEC	CoPC	Criteria exceeded	Sampling locations (depth in mbgl)
AEC-14A	TRH F1 TRH >C_{10}-C_{12} aliphatic	WARP SSTLs - Vapour Intrusion (commercial worker)	TP20/28 (1.55)
AEC-14B	TRH F1 TRH >C_{12}-C_{16} aromatic TRH >C_{10}-C_{12} aliphatic TRH >C_{21}-C_{35} aromatic	WARP SSTL - Vapour Intrusion (commercial worker). WARP SSTL - Direct Contact (Commercial worker).	TP20/29B_0.5 TP20/29C_0.5 TP20/30_0.5 TP20/28 (1.55)

5.2 LNAPL

LNAPL has been historically identified in the following four wells within the Stage 2 Area:

- MW11/17 (AEC-5) – located immediately south of former Platformer 3 Location.
- MW12/01 (AEC-4) – situated within the Southern Buried Waste Area.
- MW20/06 (AEC-4) – situated within the Southern Buried Waste Area.
- MW18/24 (AEC-3A) – situated within the footprint of the former laboratory.

ERM stated LNAPL impacts were spatially isolated and had not migrated downgradient as no product has been detected in nearby monitoring wells. Similarly, ERM has demonstrated that the plume of dissolved phase contamination is limited in extent and was delineated within the Stage 2 Area.

ERM developed a CSM for LNAPL impacts in accordance with CRC Care (2015) Report nº 34. The LNAPL CSM is further discussed in **Section 9**.

The locations where LNAPL contamination has been identified and the estimated extent of contaminated soils where the ASC NEPM Management Limits have been exceeded are presented in Figures F6A to F6D from the Stage 2 RAP in **Appendix A**.

5.3 Groundwater

Dissolved-phase concentrations of CoPC in groundwater within the Stage 2 Area were below the on-site human-health SSTLs. Exceedances for the off-site human health and ecological criteria were detected between 2016 and 2020 in groundwater collected from the following on-site groundwater monitoring wells:

- MW12/03 (AEC-3D), MW20/03 and MW20/13 (AEC-4): naphthalene exceeding off-site ecological criteria.
- MW20/01A, MW20/03, MW20/06, MW20/07, BH116, MW20/13 (AEC-4): PAHs including phenanthrene, fluoranthene, anthracene and benzo(a)pyrene exceeding off-site ecological criteria.
- MW11/06: hexavalent chromium exceeding ecological criteria.
- MW20/03 and MW20/13 (AEC-4): benzene exceeding off-site recreational (human health) criteria.

The auditor notes that concentrations of CoPC in groundwater at down gradient wells (in particular those along the southern boundary of Stage 2) have not exceeded nominated investigation levels or are less than the laboratory levels of reporting. These measurements have demonstrated the localised nature of the groundwater contamination that has been identified in Stage 2 and that both LNAPL and dissolved phase hydrocarbons have limited mobility.

Leachate solutions obtained from soil samples collected from the buried waste mound within AEC-4 using the Australian Standard Leaching Procedure (ASLP) showed exceedances of the groundwater

ecological criteria for naphthalene and zinc (ERM, 2021a). PFOS and the TRH C_{10}-C_{40} fraction were detected at concentrations lower than the nominated groundwater assessment criteria.

ERM (2021a) indicated that groundwater migrating downgradient of the site towards Duck Creek had concentrations lower than the adopted assessment criteria and is unlikely to pose unacceptable risks to the environment.

5.4 Soil vapour

Six soil vapour monitoring bores have been installed and sampled at the Stage 2 Area, namely AEC-2, AEC-3A, AEC-3C, AEC-3D, AEC-5, and AEC-11. Their locations are shown in Figure 6E in **Appendix A**, while the dataset is provided in **Appendix C**.

Two soil vapour samples exceeded the SSTLs, namely sample AEC-3D (SV19/03) where exceedances for the TRH >C_8-C_{10} aliphatic, TRH >C_{10}-C_{12} aliphatic, naphthalene, and methane were recorded and sample AEC-3A (SV19/05) where exceedances for the TRH >C_6-C_8 aliphatic, TRH >C_8-C_{10} aliphatic, TRH >C_8-C_{10} aromatic, benzene, naphthalene, and methane were recorded.

Methane concentrations measured at SV19/03 and SV19/05 were classified as having a “low” safety risk based on the NSW EPA (2020) Ground Gases Guidelines. However, ERM stated in the Stage 2 RAP that ground gas shall be considered in future management of these areas if their source (i.e., LNAPL) is not appropriately remediated. In addition, further assessment or management of ground gas risks was recommended in area AEC-4 as no soil vapour data are available (ERM, 2021a). Regarding other areas within the Stage 2 Area, ERM stated that management or remediation of methane impacts was not warranted.

5.5 Auditor discussion – Stage 2 Contamination characterisation

The auditor recognised that the understanding of the site history led to the selection of the distribution of the sampling locations used to characterise the nature and extent of contamination within Stage 2 Area. These aspects were sufficient to prepare the Stage 2 RAP.

The auditor considered that works carried out during the RSI, AEC-4 ESA and Stage 2 ESA in combination were sufficient to provide adequate site coverage for the condition of the Stage 2 Area.

The auditor noted that sample locations have been systematically positioned across the Stage 2 Area with the collection of samples largely focused on shallow fill, with deeper samples collected sporadically across the Stage 2 Area, in particular in areas where site observations identified the potential for contamination in the overlying fill. A greater focus has been placed on AEC-4, especially in relation to characterising impacts to groundwater between this area and the Duck River. The soil sample intervals and depths of sampling locations were considered appropriate given the sources of potential contamination and the site geology.

6. Remedial option analysis

ERM completed two remedial option analyses (ROA). The first ROA was prepared for all three Stages and was based on data collected up until June 2020. The second ROA prepared in 2021 provided specific remediation options for AEC-4 following the completion of the AEC-4 ESA.

6.1 Objective

ERM stated in the Stage 2 RAP that the objective of the ROAs was to defined clear and measurable remedial objectives, and to identify potential methods and/or management approaches that have the potential to reduce contamination and meet remedial objectives.

6.2 Remedial options

ERM (2021a) provided a list of remediation methods for AECs identified within the Stage 2 Area, and evaluated each method against criteria of effectiveness, timeframe, health and safety, complexity, sustainability, and cost (as per CRC Care 2018). Following this analysis, a preferred remedial option was identified for each AEC. ERM stated the overall selected approach for most of the AECs was source removal with either off-site disposal or on-site biopiling. Cap and contain was selected for AEC-4. For some AECs where the soil/groundwater contamination has been deemed to not present an unacceptable risk, but exceed NEPM management limits, the selected option has been to manage the material in-situ as part of an LTEMP.

The methods selected for each AEC are listed in **Table 12** and described in the following subsections.

Table 12 Selected remedial options – Stage 2 Area

AEC	CoPC requiring remediation	CoPC requiring management	Preferred remediation method
AEC – 1: Old Administration Area	Asbestos (ACM)	Not Applicable	Excavation and off-site disposal
AEC – 2: Buried Waste Area 8 – CDU tank farm sludge	No remediation Required	Residual LNAPL and soil concentrations exceeding Management Limits for TRH	On-site management (LTEMP)
AEC-3A: Former Laboratory	Benzene, naphthalene, TRH F1 fraction, methane (from LNAPL)	Residual LNAPL and soil concentrations exceeding Management Limits for TRH	Excavation or on-site biopiling for re-use.
AEC-3B: Former Laboratory (ACM impacted Area)	Asbestos (ACM)	Not applicable	Excavation and off-site disposal
AEC-3C: Former Contactor Warehouse (PAH hotspot)	No remediation required	Direct Contact: Carcinogenic PAHs Residual LNAPL or soil concentrations exceeding Management Limits for TRH	On-site management (LTEMP)
AEC-3D: Former Contactor Warehouse	TRH >C_8-C_{12} (aliphatic) fraction; benzene; naphthalene, methane (from LNAPL)	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	Excavation or on-site biopiling for re-use.
AEC-3E: TRH hotspot (TP21/79)	TRH F1 fractions, TRH >C_{10}-C_{12} aliphatic fraction	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	Excavation or on-site biopiling for re-use.

AEC	CoPC requiring remediation	CoPC requiring management	Preferred remediation method
AEC – 4: Southern Buried Waste Area	Vapour Intrusion or Ground Gas – benzene TRH F1 fraction, methane	Inhalation: Asbestos Direct Contact: TRH >C_{10}-C_{34} fraction carcinogenic PAHs hexavalent chromium Residual LNAPL or soil concentrations exceeding Management Limits for TRH. Off-site ecological: Monitoring of groundwater for COPC associated with in-situ soil material (BTEX, TRH C_6-C_{40}, PAH, hexavalent chromium, PFAS)	On-site management (under engineered cap). LTEMP to restrict the construction of buildings, monitoring of groundwater conditions
AEC – 5: Platformer 3	No remediation required	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	On-site management (LTEMP)
AEC – 8: Tank farm J	No remediation required	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	On-site management (LTEMP)
AEC – 11: Tank farms A1, A2, A3	No remediation required	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	On-site management (LTEMP)
AEC – 14: Subsurface drainage network	NA	Residual LNAPL or soil concentrations exceeding Management Limits for TRH. Management of Residual hydrocarbons within pipework post- decommissioning	On-site management (LTEMP)
AEC-14A: Compromised Pipe 18D300-5	TRH F1 fraction	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	Excavation or on-site biopiling for re-use.
AEC-14B: Compromised Pipes 15D100-4, 15D100-5	TRH F1 fraction	Residual LNAPL or soil concentrations exceeding Management Limits for TRH Direct Contact - Carcinogenic PAHs (TP21/07)	Excavation or on-site biopiling for re-use On-site management (LTEMP) for direct contact exceedances post remediation (as required)
AEC- 15	No remediation required	Residual LNAPL or soil concentrations exceeding Management Limits for TRH	On-site management (LTEMP)

6.3 Auditor discussion – Remedial option analysis

The auditor noted that that both ROAs (ERM, 2020d and ERM, 2021e) were developed in a manner consistent with guidance provided in the relevant Australian and international guidance. Additionally, the hierarchy for site clean-up and/or management outlined in the ASC NEPM were considered by ERM during its analysis of remedial options.

The auditor concurred that the remedial methods selected by ERM were the most appropriate considering the CoPC, local geology and potential human risks to future commercial and IMW receptors.

7. Stage 2 Air emissions verification

The Stage 2 Area AEVR provided an assessment of air emission control requirements for the Stage 2 Area remediation. This was a requirement of Conditions of Consent B15 and B16 of the SSD 9302 (issued by the DPIE on 7 May 2020). Given the staging of remedial works at the WARP, AEVRs are required for each stage.

The objective of the AEVR was to develop a set of air emission control and management measures specific to the remedial actions that are planned for the Stage 2 Area, based on review and assessment of the most current project information, inclusive of the Stage 1 air quality monitoring data, the RSI, HHERA, ROA and AEC-4 ROA and Stage 2 RAP. ERM reported that to meet this objective, the Stage 2 Area AEVR comprised the following tasks as well as considering the nature of the contaminants that will be remediated:

– Stage 1 AEVR monitoring review.
– Activity-specific characterisation of air emissions.
– Identification and benchmarking of emission controls
– Air emission risk ranking.
– Review of requirement for emission control enclosures.
– Selection of emission controls.

7.1 Stage 1 AEVR monitoring review

ERM presented an overview of the air quality monitoring conducted as part of the Stage 1 remedial works, in relation to evaluating the need for establishing air emission controls Stage 2 remediation works. A summary of the Stage 1 monitoring results (conducted as per the Stage 1 Air Quality Management Plan – AQMP) is described in the following subsections.

7.1.1 Photo-ionisation detector monitoring

This monitoring provided real-time information on the VOC emissions during soil handling works (which included excavation of the contaminated soils and the screening of materials into stockpiles). The following was noted in relation to the PID monitoring:

– *PID measurements were below 1 ppm for much of the works, and were highest between 19 and 23 of October 2020, with maximum daily work area concentrations ranging between approximately 3 ppm and 7 ppm during this period.*

7.1.2 Boundary VOC monitoring

Boundary monitoring was undertaken during Stage 1 remediation to check air quality at the boundary was less than nominated trigger levels.

The boundary monitoring was conducted near the northern boundary (AS01), southern boundary (AS02) and western boundary (AS03) of the Western Area. In addition, an ‘at-source’ location (AS04) was included to allow assessment of the contribution of the remedial works to air quality relative to other local and regional VOC emission sources.

Figure 1 shows the monitoring locations relative to the Stage 1 remedial works area, whilst **Figure 2** shows the locations of AS01, AS02 and AS03, both extracted from the Stage 2 AEVR.

Figure 1 **Aerial imagery showing monitoring locations relative to excavation area**

Figure 2 **Air sampling locations AS01, AS02 and AS03 (left to right)**

Three rounds of air quality monitoring were completed during the Stage 1 remediation, targeted to the intensive phases site remediation works, as follows:

- Round 1: Excavation and stockpiling (14/10/2020 – 15/10/2020).
- Round 2: Excavation and stockpiling (15/10/2020 – 16/10/2020).
- Round 3: Excavation, stockpiling and screening (22/10/2020 – 23/10/2020).

The following was noted with regard of the Boundary VOC monitoring:

- *It is noted that of the 64 TO-15 analytes reported by the laboratory, results above the Limit of Reporting (LOR) were limited to toluene, xylenes, 1,2,4-trimethylbenzene and naphthalene. Detections above the LOR were less than an order of magnitude below respective screening criteria. In addition, the maximum toluene detection, was significantly higher than the corresponding at-source sample, accordingly, this measurement is indicative of an external toluene source not associated with the Stage 1 remediation works.*

7.1.3 Biopile soil vapour extraction system monitoring

Vapour monitoring was undertaken in accordance with the AQMP and the Environment Protection Licence (EPL) requirements, including PID daily monitoring of exhaust concentrations (Monday to Friday) and weekly reporting to the NSW EPA of monitoring data and operational data. The following was noted regarding the system operation:

- Inlet concentrations were observed to decrease rapidly throughout the first week of treatment, prior to a more progressive decrease across the duration of the biopile treatment.
- Treatment capacity was observed to be consistent with breakthrough estimates and change out of carbon filter media in the lead vessel was not required, nor was implementation of a contingency vessel.
- VOC concentrations at the outlet of lead vessel were less than or equal to 0.1 ppm for the duration of the biopile treatment, indicative of no breakthrough of VOCs from the lead to the lag vessel.
- VOC concentrations at the EPL discharge points were less than or equal to 0.1 ppm for the duration of the biopile treatment.
- Ambient VOC concentrations in close proximity to the biopile covers were indicative of negligible fugitive VOC emissions from the covered biopiles. This condition was observed irrespective of the operating condition of the SVE system, as demonstrated by the monitoring conducted during the Christmas shutdown period.

Based on the results, the auditor considered that the air emission monitoring conducted during the Stage 1 Area remediation largely followed the AQMP report and EPL requirements, indicating that the general of air emissions (VOCs) associated with the Stage 1 Area contamination was minimal during excavation and biopiling activities.

7.2 Air emission characterisation

The Stage 2 AEVR comprised a review of environmental monitoring data collected within the Stage 2 Area, as relevant to the characterisation of air emissions that may be generated from excavation, handling, and remediation of soils from remediation of the AECs.

The key VOCs associated with the Stage 2 Area contamination are as follows:

- Ethylbenzene
- Xylenes
- Trimethylbenzenes
- Naphthalene

The auditor noted that although benzene concentrations were detected in-situ in soil vapour, soil and groundwater samples, benzene was not detected in ambient air measurements in the immediate vicinity of either excavation, stockpiling or biopiling operations.

Hydrocarbon odours similar in nature to diesel oil were noted during the excavation process during Stage 1 remedial works. However, these odours were not observed beyond 165 metres from the excavation. The auditor notes that the potential for odours will need to be managed as part of the Stage 2 operations.

In regards of ACM removal within AEC-1 and AEC-3b, the auditor notes that impacted soils should be removed in accordance with the SafeWork NSW Code of Practice for asbestos removal.

7.3 Air emission control review

As part of the review of best practice emission control and management measures as relevant to Stage 2 Area remediation, a review of local and international best practice references was carried out by ERM.

The level of prescriptive detail was variable across the identified references. Several references contained limited detail, and hence have not been replicated here (US EPA, 1997; 2010; 2019).

Whilst the European Union Best Available Techniques (BAT) reference manual reviews biopiling as a method for the treatment of excavated contaminated soil, BAT conclusions are not provided for this method (EU IPPC, 2018).

Based on this review the following emission control measures have been considered by ERM as applicable to the control of air emissions from remediation operations (inclusive of excavation, biopiling operations and material handling):

- Application of dust suppression techniques including:
  - (a) Use of water sprays in a manner that suppresses dust whilst minimizing runoff.
  - (b) Use of bunds/windbreaks.
- Application of odour suppression methods.
- Ambient monitoring with reactive management of operational factors.
- Control of VOCs from SVE system exhausts (e.g., NSW EPA, 2014).
- Consideration of emission control enclosures based on potential risks for adverse air quality impacts.

7.4 Qualitative risk ranking

A qualitative risk ranking was undertaken by ERM to provide consideration that influence potential air quality impacts and qualitatively rationalise air quality risks for key remediation activities within Stage 2 Area. The factors considered by ERM included the following:

- Proximity to sensitive receptors.
- Duration of operations.
- Scale of operation.
- Unmitigated emission intensity (VOC, odour, dust) – recognising scale and contamination levels.

Effectiveness of mitigation encompassing:

- the efficiency, practicality, and timeliness of implementation.
- the availability of contingency approaches that allow progression of works.

The proximity of off-site receptors relevant to the WARP is shown in **Figure 3** from the Stage 2 AEVR.

Figure 3 **Off-site receptors relevant to the WARP**

The detail of the factors listed above, as outlined for each hydrocarbon excavation area is presented in **Table 13**, whilst **Table 14** and **Table 15** present a summary of these factors for other AECs and soil handling processes.

Table 13 **Summary of risk ranking factors – Excavation of hydrocarbon impacted soils**

Parameter	AEC-9 (Stage 1 Area)	AEC-3				AEC-14	
		A	B	D	E	A	B
Proximity (industrial receptors)	100	250 m	200 m	150 m	100 m	150 m	200 m
Proximity (residential receptors)	750	500 m	450 m	550 m	500 m	700 m	650 m
Duration of Operations	2-3 weeks	~2 weeks	~1 week	~1 week	~1 week	~1 week	~1 week
		~ 8 weeks					
Relative Scale	Small (0.3 ha)	Small (0.16 ha)	Small (0.08 ha)	Small (0.04 ha)	Small (0.14 ha)	Small (50 m²)	Small (190 m²)
Level of Contamination	Low – Moderate*[11]	Moderate					
Emission Intensity (Unmitigated)	Moderate - High	Moderate - High	Moderate	Moderate	Moderate	Minor	Minor
Effectiveness of Mitigation	High	High					

[11] Material anticipated to be equal to or less contaminated than that encountered during the excavation trials.

Table 14 Summary of risk ranking factors – ACM removal and AEC-4 capping

Parameter	AEC-1	AEC-3	AEC-4
Proximity (industrial receptors)	50 m	250 m	50 m
Proximity (residential receptors)	1000 m	450 m	350 m
Duration of Operations	~2 days	~1 week	~ 6 weeks
Relative Scale	Small (0.01 ha)	Small (0.09 ha)	Large (1.4 ha)
Level of Contamination	Moderate	Moderate	Low
Emission Intensity (Unmitigated)	Moderate	Moderate	Potential for dust generation
Effectiveness of Mitigation	High[12]	High	High

Table 15 Summary of risk ranking factors – Soil handling and treatment

Parameter	Soil screening and segregation area	Biopile area
Proximity (industrial receptors)	~ 100 m (east)	~ 150 m (north)
Proximity (residential receptors)	~ 600 m (south)	~ 800 m (southeast)
Duration of Operations	Intermittent operations over within approximately 8 weeks.	Ongoing throughout Project
Relative Scale	Small (Active operations typically within a ~20 x 30 m area)	Small (Operations within a ~20 x 10 m area)
Contamination of Handled Materials	Low – Moderate*	Clean to Moderate
Emission Intensity (Unmitigated)	Moderate - High	Moderate (intermittent active operations) –biopile construction.
Effectiveness of Mitigation	High	High

7.5 Review of requirement for emission control enclosures

As noted in Consent Condition B15 (i) of the conditions of consent for the project requires that the Stage 2 AEVR *Include robust justification for any part of the remediation process that is not proposed to be conducted in an emission control enclosure (ECE).*

ERM reported in the Stage 2 AEVR that within NSW, emission control enclosures have been employed for the excavation of contaminated materials on a range of remediation projects. The requirements for these emission enclosures have been driven by the materiality of ambient air quality risks, inclusive of the nature of the contamination, anticipated magnitude and extent of emissions, duration of activities, and proximity to receptors.

Viva Energy commissioned a review of enclosures, as detailed in Best Practice Remediation - Environmental Control Enclosures (Ventia, 2019), which references the following NSW remediation cases for which excavations were performed within an ECE as follows:

- Lendlease Barangaroo gasworks remediation.
- HMAS Platypus gasworks remediation.
- Railcorp Macdonaldtown Gasworks Remediation.

[12] Safework Code of Practice for asbestos removal to be implemented, inclusive of validation monitoring.

– Orica Former Chloralkali Plant Remediation.

As outlined in Ventia (2019), the Stage 1 works were not considered consistent with examples for which excavation is undertaken in an ECE. It is noted that all the projects listed above featured the following:

– High toxicity contaminants inclusive of those listed as either principal toxic air pollutants under the Approved Methods, and/or persistent organic pollutants under the Stockholm Convention.
– Proximity to off-site receptors (often in the vicinity of 10 to 20 metres to residential receptors).

Long excavation durations on the scale of year/s, with high volumes excavated over small footprints.

Considering the discussed above, ERM concluded that given the short duration, shallow nature of the excavation and manageable risk of (non-principal toxic4[13]) air emissions associated with Stage 2 Area, an emission control enclosure is not considered a practical or effective emission control measure for Stage 2 Area remediation.

7.6 Selection of emission controls

ERM considered a range of emission controls based on those identified in best practice references and the risks associated with each remediation operation, as a function of the proximity, duration, and intensity of the proposed activity, as well as the practicality with which contingency measures can be implemented and managed by ERM during the Stage 2 Area remediation.

Air quality management protocols should include performance indicators that assure that prescribed emission controls are being operated effectively, similarity it was carried out during Stage 1 Area remediation.

7.7 Auditor discussion - Stage 2 Air emissions verification

The auditor noted that the proposed remediation and validation program for the Stage 2 Area involves three different remediation methodologies at AEC-1, AEC-2, AEC-3a, AEC-3b, AEC-3c, AEC-3d, AEC-4, AEC-5, AEC-8, AEC-11 and portions of AEC-7, AEC-13, AEC-14a, AEC-14b, and AEC-15 within the Stage 2 Area, totalising approximately 28 hectares.

The auditor considered that similar to the Stage 1 remedial methodology, the refinement of the Stage 2 remediation approach will reduce the area and time of remediation operations from that initially presented in the EIS. The selected remediation approaches are as follows:

– Excavation and off-site disposal of ACM impacted soils from AEC-1 and AEC-3b, comprising 0.3% of the Stage 2 Area.
– Excavation and on-site treatment (biopiling) of petroleum hydrocarbon and LNAPL impacted shallow soils from AEC-3a, AEC-3d, AEC-3e, AEC-14a, and AEC14b using a similar remediation approach applied in Stage 1. Excavation would occur sequentially across these AEC's, which together only comprise 1.3% of the Stage 2 Area. The auditor notes that the proposed excavation volume is similar in scale to those completed for the Stage 1 Area.
– Construction of an engineered capping layer at AEC-4 to a maximum depth of 0.5 m below existing grade, comprising approximately 5% of the Stage 2 Area.

[13] Noting that ambient air benzene measurements were conducted in the immediate vicinity of heavily impacted material, and (as non-detects) were at the lower range of concentrations measured in typical ambient air within Sydney (DEC, 2004; NEPC, 2010), benzene emissions from remediation operations are not considered material, and thus principal toxic air pollutants are not considered of significance.

The auditor considered that the Consent Condition for SSD9302 B15 had been considered in the Stage 2 AEVR.

It was the auditor's opinion that ERM provided sufficient lines of evidence to support that an emissions control enclosure within Stage 2 Area is not required, such as CoPC, size of AECs, proposed progressive excavation by AECs, and robust data obtained from the Stage 1 Area remediation.

The auditor concurred that the air quality management protocols considered by ERM in the Stage 2 AEVR are sufficient to monitor and control air emissions during the remediation of the Stage 2 Area. Nevertheless, the auditor notes that ERM during the preparation of the Stage 2 AEVR has considered the NSW EPA comments following review of Stage 1 AEVR in Notification DOC20/444311-5 dated 3 July 2020, as well as the Responses to the NSW EPA – Stage 1 AEVR prepared by ERM, dated 15 July 2020.

The auditor noted that a draft version of the Stage 2 AEVR, dated 24 May 2021, had been reviewed by the auditor, who issued comments in the audit project tracking sheet. Further, the final AEVR was issued on 11 June 2021 and the IAA14 endorsing this document was issued on 20 June 2021. A copy of the audit tracking sheet and IAA 14 are presented in **Appendix B**.

8. Remediation criteria evaluation

ERM reported in the Stage 2 RAP that SSTLs developed for soil, groundwater and soil vapour were appropriate to act as remediation assessment criteria. The HHERA discussed in **Section 1.5**, evaluated potential risks to off-site adjacent receptors as unlikely. The risk assessment derived SSTLs for vapour inhalation and direct contact were developed for the following receptors where there was a plausible linkage to contaminated material:

– Future commercial/industrial workers.
– Future construction workers conducting intrusive works.
– Future intrusive maintenance workers conducting intrusive works.

A summary of the nominated remediation assessment criteria is presented in the following sections. A complete list of assumptions and limitations of the SSTLs is provided within the HHERA (ERM, 2020b).

A copy of remediation criteria and beneficial on-site re-use soil criteria is presented in **Appendix C**.

8.1 Petroleum hydrocarbons

The Stage 2 RAP stated that the remediation approach in AECs-3a, AEC-3d, AEC-3e, AEC-14a and AEC-14b is excavation and biopiling for on-site re-use. The Stage 2 RAP documented that the applicable risk-based remediation criteria for excavation bases and walls are as follows:

– Soil SSTLs (Direct Contact) for commercial workers, construction workers and intrusive maintenance workers.
– Soil SSTLs (Vapour Intrusion) for commercial workers, construction workers and intrusive maintenance workers.

In addition to the above risk-based criteria, the following is to be used to assess the potential presence of LNAPL or residual TRH concentrations requiring future management under the LTEMP:

– The visible presence of LNAPL or sheen in the walls or base of the excavation.
– NEPM Management Limits for TRH, which trigger indicate the potential formation of LNAPL or potential for future acute hazards during excavation.

8.2 Asbestos

The Stage 2 RAP stated that the remediation approach for AEC-1 and AEC-3b is excavation and off-site disposal of asbestos soil.

The remediation criteria for excavation bases and walls are the NEPM HSL D for asbestos management.

8.3 AEC-4 – Capping layer

For AEC-4, the nominated criteria relate to verification that the capping layer construction has been completed in accordance with the detailed design, namely that it comprises VENM and has a minimum thickness of 500 mm.

If the required documentation and lines of evidence show the cap has be, constructed in accordance with the design, the placement of the cap can be validated as complete. Any changes to the design will require verification from the design engineers that the capping layer meets the design intent.

8.4 Soil beneficial on-site reuse criteria

For soils that have been treated via biopiling, reuse will be based on meeting the following:

- Soil SSTLs (Direct Contact) for commercial workers, construction workers and intrusive maintenance workers.
- Soil SSTLs (Vapour Intrusion) for commercial workers, construction workers and intrusive maintenance workers.

8.5 Auditor discussion - Remediation criteria evaluation

The Stage 2 RAP nominated appropriate remediation targets levels based on Schedule B1 and B7 of the ASC NEPM and considered the land use scenarios/activities during and after remediation.

The auditor noted that ERM also considered the management limits referred to in s.2.9 and Table 1B (7) of Schedule B1 of the ASC NEPM.

9. Conceptual site model

Based on the outcomes of the HHERA and considering the most recent results from the assessments carried out in 2021, ERM updated the CSM for the Stage 2 Area.

9.1 Potential migration pathways

ERM identified the following potential migration pathways for CoPC in soil, groundwater, and soil vapour:

- Leaching of impacted soils from historical waste burial, compromised sections of the drainage network or historical surface spills to shallow groundwater or via runoff to the surface water drainage network.
- Lateral migration of contaminants in groundwater.
- Off-site groundwater migration and discharge to the nearest surface water bodies.
- Vapour intrusion of petroleum hydrocarbon contaminated groundwater or LNAPL to indoor building.
- Dust entrainment from impacted soils exposed during excavation.

9.2 Potential exposure pathways

ERM identified the following potential exposure pathways for on-site receptors in the HHERA:

- Inhalation of dusts or potential asbestos fibres from impacted soils during excavation or landscaping works.
- Direct contact or ingestion of impacted soils, groundwater or surface water drainage during intrusive maintenance works or sampling works.
- Inhalation of vapours by on-site workers from hydrocarbon impacted soil, groundwater and/or LNAPL in indoor air.
- Potential acute hazards during intrusive works and/or in future buildings due to the generation and pooling of ground gases from residual LNAPL in AEC-4 and AEC-3.

Additionally, the following exposure pathways for offsite receptors (specific to PFAS) were identified:

- Direct exposure to impacted surface water in the Duck River.
- Indirect human health exposure via consumption of PFAS-containing biota (bioaccumulation).

9.3 Receptors

ERM identified the following human receptors that may be exposed to the identified CoPC in soil and groundwater:

- Future on-site commercial workers in indoor buildings, noting no slab on grade buildings exist on the Stage 2 Area.
- Off-site commercial workers in outdoors setting, noting that this exposure pathway is currently considered relevant only during remediation.
- Current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.
- Off-site recreational users of the Duck and Parramatta River Systems.

– Recreational anglers who may consume seafood potentially impacted with PFAS caught in the Duck River / Parramatta River downstream from the former Clyde Refinery.

The following key information was noted by ERM in the Stage 2 RAP:

Groundwater beneficial use assumptions

– Beneficial groundwater users (potable or non-potable) were not considered a potential receptor given the absence of registered extraction bores down gradient of the WARP, poor natural background quality of groundwater and likely low yields.

On-site ecological receptors assumptions

– Current on-site employees and contractors are subject to Viva Energy's Health, Safety and Environment controls which restrict on-site workers potential exposure to soil contamination. Therefore, potentially complete SPR linkages are currently considered managed. However, future land users would not be subject to the same controls and thus, remediation or management of any potentially SPR linkage would be required.
– Given the extensive coverage of the WARP in concrete hardstand and limited available on-site habitat, on-site ecological receptors were not further considered in the CSM. Given the proposed slab- on-grade commercial/industrial future land use, ecological on-site receptors were also not considered in the CSM under future development scenarios.

Off-site ecological receptors assumptions

– The nearest off-site ecological receptor is the Duck River, bordering the Stage 2 Area to the south. Due to the estuarine nature of these river systems and receipt of runoff from multiple industrial catchment areas, Duck River is a slightly to moderately disturbed marine ecosystem, as per the ANZG (2018) Guidance. ERM in the HHERA reported that the SPR Linkages for off-site ecological receptors were incomplete.

9.4 Source pathway receptor linkages

The Stage 2 Area comprises areas of concern AEC-1, AEC-2, AEC-3, AEC-4, AEC-5, AEC-8, AEC-11 and portions of AEC-7, AEC-13, AEC-14, and AEC-15.

The following SPR linkages were considered relevant by ERM to the specific AECs and may constitute exposure risks to future commercial/IMW receptors:

– Indoor inhalation of vapours by future on site commercial workers from hydrocarbon impacted soil and LNAPL.
– Direct contact with contaminated soils by future on-site commercial workers and construction workers undertaking intrusive works.
– Inhalation of asbestos fibres by future on site commercial workers, construction workers and intrusive maintenance workers from bonded asbestos fibres liberated during future excavation works or exposed at the ground surface.
– Potential acute hazards within future indoor settings where potential for hazardous ground gas accumulation from LNAPL (AEC-3A and AEC-3D).

Residual soil and groundwater impact and LNAPL which have been identified to not present a risk to human health or the environment, but will require management via the LTEMP include the following:

– Areas of aesthetic impact (staining, sheen, LNAPL) for appropriate waste management, odour management during future excavations.
– Sections of pipework left in-situ containing residual hydrocarbons.
– Prevention of groundwater extraction on-site.
– Unexpected finds.

A program of post-remediation groundwater monitoring will also be implemented as part of the LTEMP. A copy of the SPR linkage table is presented in **Appendix C**.

9.5 LNAPL CSM

The Stage 2 RAP (Appendix F of the RAP) stated that the LCSM was based on the framework provided in the CRC Care (2015) Report Nº 34.

The LCSM was developed using historical reports issued from 2018 (the TSI) to most recent data from the Stage 2 ESA and AEC-4 ESA.

ERM reported that based on the CSM the potential receptors associated with LNAPL were limited to the following:

- Current and future on-site intrusive maintenance workers.
- Future onsite construction workers conducting excavation works.
- Future onsite commercial/industrial workers in indoor buildings.

ERM concluded that given that the extent of LNAPL is confined within the Stage 2 Area boundary, complete SPR linkages to off-site human health or ecological receptors have not been identified.

ERM reported that the potential exposure pathways associated with the presence of LNAPL in the subsurface within the Stage 2 Area are limited to the following on site human receptors:

- Direct contact or ingestion of impacted soils, groundwater containing LNAPL during future intrusive maintenance works or sampling works.
- Inhalation of vapours by future on site workers from hydrocarbon impacted soil, groundwater and/or LNAPL in indoor air.
- Potential acute hazards due to the generation and pooling of ground gases from LNAPL and impacted soil.

In addition to these aspects, ERM stated that the potential for aesthetic impacts (soil staining) or generation of odours may occur during future excavation works.

Users of groundwater (potable or non-potable) were not considered a potential receptor given the absence of registered extraction bores down gradient of the WARP, poor natural background quality and likely low yields from the underlying site aquifer.

ERM reported that while no potential human or ecological risks associated with LNAPL were identified, management considerations under a LTEMP shall be to incorporate the identification of the location(s) of LNAPL for awareness of aesthetic impacts (soil staining, LNAPL) and management of odours during future earthworks or excavation conducted in areas where LNAPL in groundwater has been observed. The potential complete SPR linkage for LNAPL is presented in **Appendix C**.

9.6 Auditor discussion – Conceptual site model

The auditor noted that the presence of contaminated soil and/or groundwater at the WARP was based on the findings of the prior site assessments and most recent studies undertaken specifically at the Stage 2 Area and AEC-4.

The auditor considered that the list of contaminants is suitably comprehensive noting the site location and history. Therefore, the auditor was satisfied that the CoPC identified were appropriate for the characterisation of the Stage 2. The nature and extent of each AEC was defined on the basis of targeted characterisation in a series of investigations.

The CSM developed by ERM for the Stage 2 Area considered known areas of concern and the pathways in which identified receptors may be exposed.

The auditor considered that the CSM developed by ERM was prepared as per the ASC NEPM method and that the LCSM largely followed the framework provided in the CRC CARE Report nº 34.

The auditor noted that the key exposure routes to residual contamination would only occur if the areas in which residual contamination are disturbed and the management of these areas is outlined in the LTEMP.

10. Stage 2 Remedial action plan

10.1 Objectives

The remedial objectives for the WARP as defined within the Conceptual RAP (AECOM, 2019) are:

– *Remediate the soil and manage groundwater within the appropriate parts of the Western Area (i.e. the Project Area), to enable the land to be used for commercial/ industrial purposes in the future, thereby reducing the risk of contamination from the land adversely affecting human health and the environment; and*

– *Ensure any approved remediation process that is 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 adequately support both the remediation period and post-remediation period.*

The remedial strategy for the Stage 2 Area is consistent with the Conceptual RAP which states the following:

– Where remediation is required, the focus of the works would be on:
  (a) Addressing petroleum hydrocarbon impacts on shallow soil horizons.
  (b) Addressing soil/sludge impacts in the drainage network and surrounds.
  (c) Removing shallow LNAPL in soils to the extent practicable.
  (d) Ensuring short or long-term contamination risks to the environment are removed or mitigated.

The Stage 2 RAP stated that the requirement to remove LNAPL from groundwater is often based on the degree of potential human health risk to future commercial/industrial land occupants. However, given the established stability and delineation of LNAPL and associated dissolved phase contamination and the absence potential risks associated with groundwater, removal of LNAPL in groundwater was not considered a remediation driver. The proposed remedial strategy will focus on excavation of impacted soils (where an inhalation risk has been identified) for on-site treatment will appropriately remove LNAPL to the extent practicable.

ERM also reported that the timeframes for achieving the remediation objectives were driven by the potential divestment and redevelopment of the Stage 2 Area, in which progressive validation and issue of SAS for discrete portions of the Stage 2 Area will be completed throughout 2021.

10.2 Requirements of remediation

The Stage 2 RAP stated that the primary driver for remediation within the Stage 2 Area is the potential for indoor inhalation of vapours by future on site commercial workers from hydrocarbon impacted soil and LNAPL associated with soils.

Exceedances of the SSTLs in soil are shown in Figures F6A (0 to 1 m), F6B (1 to 2 m) and F6C (2 to 4 m) from the Stage 2 RAP in **Appendix A**.

The potential for vapour intrusion risks from soils at depths greater than 4 metres were not identified through Tier 1 screening, thus ERM did not consider remediation necessary.

Based on the outcomes of the historical assessments and the most recent AEC-4 ESA and Stage 2 ESA, a summary of CoPC and AECs that requires remediation or management under the LTEMP is presented in **Table 16.**

Table 16 Contaminants of concern requiring remediation and/or management

AEC	CoPC requiring remediation	Remediation/Management	Comments
AEC-1	ACM	Excavation and off-site disposal	No comment
AEC-2	No remediation required	– Residual LNAPL in soil – Soil concentrations exceeding Management Limits for TRH	No comment
AEC-3A	– Benzene – Naphthalene – TRH >C6-C10 – Methane	– Residual LNAPL in shallow soil – Soil concentrations exceeding Management Limits for TRH	Methane associated with LNAPL in soils.
AEC-3B	ACM	Excavation and off-site disposal	No comment
AEC-3C	No remediation required	– Direct Contact - Carcinogenic BaP – Residual LNAPL in soil – Soil concentrations exceeding Management Limits for TRH	Direct contact risk only – management under futureslab
AEC-3D	– TRH >C8-C12 (aliphatic) fractions – Benzene – Naphthalene – Methane[14]	– Residual LNAPL in soil – Soil concentrations exceeding Management Limits for TRH	Methane and naphthalene concentrations considered to be associated with residual LNAPL in soils.
AEC-3E	– TRH> C6-C10 – TRH >C10-C12 Aliphatic Fractions	– Residual LNAPL in soil – Soil concentrations exceeding Management Limits for TRH	No comment
AEC–4	Vapour Intrusion/ Ground Gas - – Benzene – TRH> C6-C10 Fractions – Methane	Inhalation Asbestos Direct Contact – TRH >C10-C34 Fractions, – Carcinogenic BaP – hexavalent Cr – Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH Off-site ecological Monitoring of groundwater for CoPC associated with in-situ material (BTEX, TRH, PAH, hexavalent chromium, PFAS)	Rationale for management of vapour intrusion risks vs remediation provided in Sections 8 2 and 8 3
AEC–5	No remediation required	Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH	No comment
AEC-8	No remediation required	Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH	No comment
AEC-11	No remediation required	Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH	No comment
AEC-14	Not applicable	– Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH – Management of Residual hydrocarbons within pipework post- decommissioning	Details of residual hydrocarbons associated with the subsurface drainage network are presented within the Stage 2 Drainage Decommissioning Validation Report (ERM, 2021d)
AEC-14A	TRH>C6-C10	Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH	No comment
AEC-14B	TRH>C6-C10	Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH Direct Contact - Carcinogenic PAHs (TP21/07)	No comment
AEC-15	No remediation required	Residual LNAPL/ Soil concentrations exceeding Management Limits for TRH	No comment

[14] As per the HHERA, given the data gap of no ground gas data for AEC-4, consideration of hazardous ground gas concentrations for the development of enclosed spaces is warranted.

10.3 Remediation extent

The estimated extents of contaminated soil requiring remediation at each AEC are shown on Figure 7 from the Stage 2 RAP in **Appendix A**. Details of the vertical and lateral extent of remediation required are provided in **Table 17**.

Table 17 Estimated remediation extent

AEC	Estimated Area (m2)	Estimated remediation depth (mbgl)	Estimated in-situ soil remediation volume (m3)	Assumptions
AEC-1	113	0 2	23	Volume and footprint reduced based on lateral delineation achieved around TP19/1.
AEC-3A	1,583	2	3,166	Average 2 m excavation depth based on max depth of impacts at MW18/24 of 2.2 m shallower (to 0.5 m at TP18/2). LNAPL in soil removal required to remove source of potential methane.
AEC-3B	78	1	78	Excavation of fill material containing demolition waste (0.8 mbgl) based on TP19/32 and similar material observed across surface of area.
AEC-3D	421	2	842	2 m excavation to remove source of vapour impacts (shallows soils and LNAPL in soil to groundwater level) based on PID readings at TP19/17 to 2 m within clay. LNAPL in soil removal required to remove source of potential methane.
AEC-3E	1,400	1	1,400	Lateral extent subject to further refinement through data gap investigation.
AEC-4	13,396	0.5	6,968	Assumes nominal upper 0.5 m of surface soils disturbed during future surface reforming and capping.
AEC-14A	50	1.8	90	Assumes backfill sands to a width of 2 m will be excavated along alignment of pipe.
AEC-14B	192	1	192	Assumes backfill sands to a width of 2 m will be excavated along alignment of pipe. Max depth of backfill to be excavated 1 m based on observed pipe depth of approximately 0.5 m.
Total	**18,543**	**-**	**13,359**	**-**

The Stage 2 RAP outlined the following considerations regarding the extent of the remedial works:

- No remediation required for AEC-2, AEC-3C, AEC-5, AEC-8, AEC-11 and AEC-15. Residual LNAPL in soil and soil concentrations exceeding Management Limits for TRH will be managed by the LTEMP.
- For the Stage 2 Area, where LNAPL or shallow soil impacts have been identified at concentrations below SSTLs for vapour risk, active remediation has not been proposed. This is due to the isolated nature of these exceedances and low potential for these areas of the site to act as an ongoing source of impact to groundwater.
- Management of residual conditions, including aesthetically impacted areas (staining) with potential to generate odours during future excavation will be managed via the preparation and implementation of the LTEMP for future site occupation.

10.4 Subsurface drainage infrastructure

The Stage 2 RAP stated that the former subsurface drainage network remains in-situ. Residual conditions remaining following drainage decommissioning works which require management include the following:

- Release of residual sludge/ LNAPL to soil and/or groundwater during excavation of pipework or drainage infrastructure.
- Safety controls for workers undertaking removal of pipework or sludges to mitigate against hydrocarbon exposure via dermal contact/ ingestion and/or inhalation of vapours.
- Identification of known areas of residual hydrocarbons in soil which have potential for the presence of visible staining and/or generation of odours/ vapours during future excavation works.

The location of residual contamination within pipework and within backfill material surrounding pipes which requires remediation or management is presented in Figure F9 from the Stage 2 RAP in **Appendix A**.

10.5 Asbestos remediation – Excavation and off-site disposal

ERM reported that excavation and off-site disposal has been selected for AEC-1 and AEC-3B where ACM exceeded commercial/industrial land-use criteria (NEPM HSL-D).

Further ERM reported that contaminated soils at other AECs would be considered for off- site disposal as a contingency action under the following scenarios:

- Unexpected levels of contamination which cannot be treated via biopiling.
- Unexpected finds of different contaminant types are identified and cannot be treated via biopiling or managed on-site, such as asbestos or metals.

Contingency planning for the remediation is further detailed within **Section 10.11.2.**

10.6 On-site management – Capping layer

The preferred strategy for AEC-4 is an engineered capping layer and ongoing management under the LTEMP. ERM reported that the selection of this method was based on the following:

- The future land uses for AEC-4 is commercial/industrial.
- The contaminated materials at AEC-4 have been in place for more than 40 years. The refined CSM and LCSM indicated that contamination within AEC-4 is laterally delineated within the Western Area boundary, is non-mobile and does not pose a risk of harm to adjacent off-site

receptors (the Duck River). LNAPL within groundwater has been identified to be degrading, immobile, insoluble, and not migrating as per the LCSM.

- Thermal treatment of soils was considered unsuitable due to the presence of asbestos.
- The current CSM for the AEC-4 area has not identified risks to on-site or off-site receptors from groundwater. The construction of an engineered cap for AEC-4 has been proposed primarily to mitigate potential direct contact risks to future on-site workers. However, ERM considered that given the proximity of off-site receptors, the design and construction of the cap will provide additional confidence in ongoing stability of LNAPL, and groundwater impacts into the future by limiting potential for infiltration at the ground surface and therefore reducing potential contaminant mass flux in groundwater.
- Containment of impacted fill within the existing in-situ location mitigates potential air quality issues and other environmental risks associated with handling of material during excavation and / or other remedial approaches.
- On-site management is a more sustainable approach to "aggressive" remedial approaches such as thermal treatment and meets the principles of waste minimisation and sustainable development.
- A reduction in the volume of material requiring off-site disposal of soils is preferable from a sustainability, cost and safety perspective as offsite disposal of materials will involve significant truck movements of contaminated waste materials including asbestos impacted soils.
- The construction of an engineered and managed capping layer further reduces the potential for future infiltration of surface waters and mobilisation of LNAPL, dissolved phase groundwater contamination from changes to groundwater levels / conditions.

ERM reported yet that due to the presence of soils which present a potential vapour intrusion risk to future commercial/industrial workers in indoor air environments, and to protect the long-term integrity of the capped surface, the LTEMP will restrict the construction of buildings within the capped area.

In accordance with the Auditor Guidelines, the LTEMP for the AEC-4 area must include a notification mechanism to ensure that the capped area is protected from any unintentional or controlled disturbance that could breach the integrity of the physical barrier. All requirements shall be legally enforceable via existing Development Consent Condition B10 (a) and (b) of the SSD nº 9302, as issued under Section 4.38 of the Environmental Planning and Assessment Act 1979 (the 'EP&A Act').

ERM reported in the Stage 2 RAP that asbestos identified within soils to be remediated within AEC-1 and AEC-3B has been identified as 'bonded' or 'non-friable'. In accordance with Safework NSW, the following minimum requirements apply to the works:

- Safework NSW are to be notified of asbestos removal work to be undertaken a minimum of 5 calendar days prior to commencement.
- Asbestos removal works are to be undertaken by a contractor holding a valid Class B Asbestos Removal Licence.

While the presence of degraded ACM and free fibres within fill materials has been identified at AEC-4, friable asbestos has not been identified at the depth of proposed disturbance for capping installation (<0.5 m). This requirement is to be reviewed by the contractor executing the works following completion of detailed capping design.

Should friable asbestos be identified during works, works will be required to be undertaken under friable asbestos conditions, which requires a Class A asbestos removal licence and the presence of a Licenced Asbestos Assessor (LAA) to conduct air monitoring and issue clearances prior to removal of asbestos controls.

10.7 On-site management - LTEMP

ERM reported that historical groundwater monitoring indicated stable to decreasing concentrations of TRH and BTEX over time within monitoring wells across the Western Area. Thus, ERM concluded that following source removal, petroleum hydrocarbons dissolved phase in groundwater are expected to show a continual reduction.

ERM reported that risks to human health and ecological receptors have not been identified based on groundwater data. As such, the requirement for active remedial approaches for groundwater is not warranted.

A program of groundwater monitoring will be undertaken both during remediation (as detailed within the Groundwater Monitoring and Management Plan (GMMP)) and post remediation (as specified within the LTEMP). Assessment of groundwater conditions would involve a risk-based evaluation, including, if necessary, fate and transport considerations and groundwater flux. This approach would be aimed at demonstration of stable groundwater conditions post remediation and that residual groundwater impacts continue to not present a risk to the ecological values of the Duck River.

ERM reported in the Stage 2 RAP that the final detailed design for the AEC-4 cap is required to be undertaken prior to commencement of work. The final specification for landform, surface drainage, type of barrier layer to be used, geotechnical requirements and handstand finish will be included within this detailed design.

The scope of works to be executed on site is anticipated to involve the following tasks:

- Removal of existing asphalt hardstand capping across the AEC-4 for off-site disposal or recycling.
- Re-working and grading of soil material as required to achieve desired landform within upper 0.5 metre of the soil profile across the area to be disturbed.
- Waste classification sampling and off-site disposal of surplus materials (as required) to achieve final landform.
- Construction of a capping layer to the specification of final detailed design to manage direct contact with impacted soils and minimise infiltration of precipitation.
- Importation, placement, and compaction of appropriate backfill material for capping and final pavement design (as required).
- Reinstatement of hardstand covering (as specified in detailed design).
- Survey of relative levels throughout works.
- Reinstatement of groundwater monitoring wells, as required by the GWMP.
- Implementation of odour, emission controls and monitoring, as required by the AEVR and/or agreed EPL570 licence conditions.
- Materials tracking (on-site or off-site).

ERM stated that a Detailed Capping Design document will be prepared by the Remediation Contractor or a specialist Engineering Consultant separately to this RAP prior to the commencement of works. The Detailed Capping Design will address these specific objectives, the minimum requirements outlined within the following sub-sections, along with consideration of geotechnical suitability and final landform for future land-use.

10.8 Petroleum hydrocarbon remediation – Biopiling methodology

ERM reported that the excavation and material screening process for remediation areas targeting hydrocarbon impacted soils for biopiling involves the following stages:

- breaking up and removing concrete hardstand, separate stockpiling of this material for crushing and re-use during site redevelopment works.
- removal of subgrade drainage pipework and other infrastructure to access contaminated soils.
- excavation will take place to the required depth and will nominally be undertaken by a single bucket excavator.
- temporary stockpiling in small stockpiles piles adjacent to the excavation.

Materials to be segregated based on field screening undertaken by the validation consultant:

- Materials with potential for re-use: <100 ppm headspace screening with PID.
- Materials for biopiling: >100 ppm and/or containing visible LNAPL.
- segregated material will be loaded into trucks, at which point the material will be transported to the soil screening area for separate stockpiling as 'Materials with potential for re-use' or 'Materials for biopiling'
- Materials with potential for re-use will be sampled for suitability for re-use on site in accordance with the validation strategy in **Section 10.14**.
- Materials for biopiling will be subject to screening to homogenize soil materials and allow sufficient surface areas for placement in biopiles.

Upon validation, excavations will be progressively backfilled with Virgin Excavated Natural Material (VENM) or other suitably validated and approved material, with restoration of the surface to the local grade. It is anticipated that the active phase of excavations will occur over an approximately eight-week period, with excavation rates being variable given the nature and extent of each AEC.

10.8.1 Biopiling construction

Biopiling will take place in the biopile treatment area, formerly known as Tank Farm A1, as shown on Figure 9 from the Stage 2 RAP in **Appendix A**.

Apart from the soil vapour extraction system, which would run continuously, biopiling operations would only occur during approved operating hours for the Stage 2 Area remediation.

Remediation Contractor work method statements will incorporate the below minimum requirements for construction:

- Confirmation of treatment requirement at the excavation face, conducted by the Validation Consultant.
- Inclusion of a leachate collection system, which utilises the existing clay base beneath the proposed footprint of the biopiles. An indicative biopile construction schematic is presented in **Figure 4.**

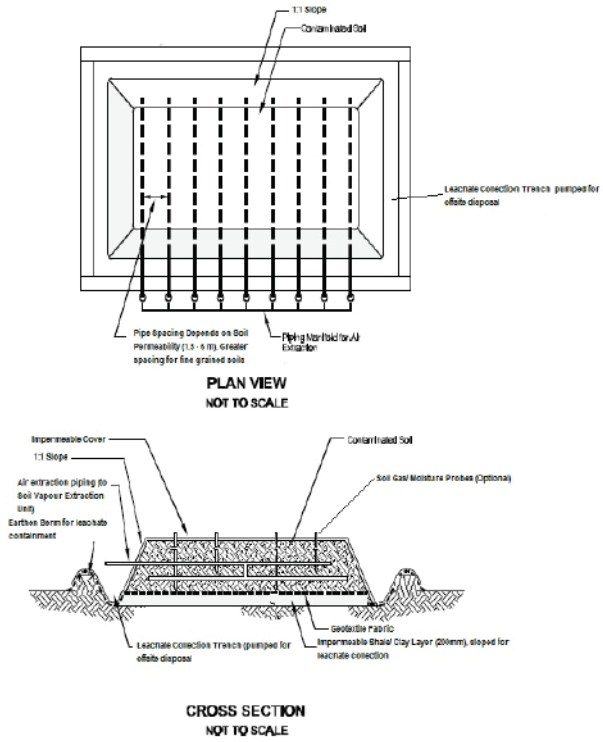


Figure 4 **Biopile construction schematic (adapted from USEPA, 2017)**

– Excavated soil would be transported to the biopile treatment area by truck. On arrival, the soil would be loaded directly onto the prepared biopiling pad. Odorous material would be covered on an as required basis during the construction of biopiles.
– Biopiles would be constructed and operated in general accordance with the USEPA (2017) guidance.

10.8.2 Biopile monitoring

Air quality monitoring during biopile construction and operation (along with boundary monitoring) was discussed in the AVER report in **Section 7**.

10.9 Wastewater management

Wastewater associated with remediation activities may be generated via:

– impacted surface water runoff from contact with contaminated soils.
– leachate from remediation technologies.
– impacted groundwater infiltrating into excavations.

As the site drainage network within the Stage 2 Area has been decommissioned and isolated from the Clyde Terminal WWTP, wastewater generated from the above sources/activities will be disposed off-site.

ERM concluded that based on the Stage 1 Area remediation works, the following observations and key learnings were made in relation to wastewater management:

– Surface water was diverted away from contaminated soils, with any surface water in the base of impacted excavations mixed in-situ with dry soil materials to aid with moisture conditioning prior to biopiling;

– *Leachate was not generated from biopiles;*
– *Groundwater ingress into the excavations was observed to be minor, and did not require dewatering*

ERM considered that despite low potential to generate leachate from biopiling operations, a leachate collection system is proposed to be incorporated if moisture addition is required to effectively treat the biopiled material. It is noted that significant volumes of leachate are unlikely to be generated from biopiling operations associated with Stage 2 Area due to the following controls and conditions:

– *Covering of biopiles in impermeable sheeting which limits potential leachate generation via infiltration from rainfall events; and*
– *Existing soil is expected to be within optimal moisture ranges without the need for significant moisture amendment. Soils are unlikely to be saturated following excavation and blending and as such would not provide a source of leachate once placed in the biopiling area.*

10.10 Additional soil characterisation

10.10.1 Future roadway characterisation

The Stage 2 RAP documented that four additional characterisation samples are to be collected within the future roadway which crosses several AECs. Two samples are to be collected from test pits advanced by an excavator to a maximum target depth of 2.0 mbgl. Samples will be selected for analysis based on visual and olfactory indicators of contamination.

A summary of proposed additional investigation locations and rationale is provided in **Table 18.**

Table 18 Data gap investigation summary - Proposed Road

Test pit ID	Depth (m)	Minimum sample numbers	Laboratory analysis	Rationale
TP21/98 TP21/99 TP21/100 TP21/101	2.0 m or depth of vertical delineation	2 - 1 in fill and 1 in natural clay	TRH C6-C40 and BTEXN (all samples) PAH/ 8 metals (fill samples) Asbestos %w/w (if demolition waste materials encountered)	Increased spatial coverage of elongated proposed road alignment

Any assessment criteria exceedances will be managed as unexpected finds discussed in **Section 10.12**.

10.10.2 AEC-3E Delineation

The Stage 2 RAP stated that four additional site characterisation samples will be collected to delineate impacts identified at TP21/79 (AEC-3e). Two samples will be collected from each of four test pits advanced five metres in four directions from TP21/79.

Test pits are to be advanced by an excavator to a maximum target depth of 2.0 mbgl. Samples will be selected for analysis based on visual and olfactory indicators of contamination

At several depths within each test pit, soils will be placed in a zip lock bag and screened in the field for head space vapours. If soils appear contaminated with hydrocarbons, then another test pit will be excavated five metres beyond the previous test pit until PID readings are lower than 100 ppm.

A summary of proposed additional investigation locations and rationale is provided in **Table 19.**

Table 19 Data gap investigation summary - AEC-3E

Test pit ID	Depth (m)	Minimum sample numbers	Laboratory analysis	Rationale
TP21/102	2.0 m or depth of vertical delineation as indicated by field screening and/or observations	2 - 1 in fill and 1 in natural clay	TRH C6-C40 and BTEXN (all samples) TRH CWG (if volatile impacts suspected)	Lateral delineation of AEC-3E excavation extent (north)
TP21/103	2.0 m or depth of vertical delineation as indicated by field screening and/or observations	2 - 1 in fill and 1 in natural clay	TRH C6-C40 and BTEXN (all samples) TRH CWG (if volatile impacts suspected)	Lateral delineation of AEC-3E excavation extent (east)
TP21/104	2.0 m or depth of vertical delineation as indicated by field screening and/or observations	2 - 1 in fill and 1 in natural clay	TRH C6-C40 and BTEXN (all samples) TRH CWG (if volatile impacts suspected)	Lateral delineation of AEC-3E excavation extent (south)
TP21/105	2.0 m or depth of vertical delineation as indicated by field screening and/or observations	2 - 1 in fill and 1 in natural clay	TRH C6-C40 and BTEXN (all samples) TRH CWG (if volatile impacts suspected)	Lateral delineation of AEC-3E excavation extent (south)

Any assessment criteria exceedances will be managed as unexpected finds.

10.11 Contingency plan

10.11.1 Remediation contingency

The Stage 2 RAP documented that there is a potential scenario whereby the removal of soils and/or LNAPL which has been identified as posing a potential risk to receptors is not successful after completion of the proposed vertical and lateral extent of remediation. If this occurs, the remediation strategy will be reassessed using the latest information on site conditions and remedial contingencies developed and implemented in consultation with the auditor.

The remedial contingencies may include one of or a combination of the following actions:

- Conduct additional excavation to remove residual impacts and collect validation samples.
- Conduct additional soil vapour investigation following the backfill of the excavation and monitoring to demonstrate residual impacts result in soil vapour concentrations below the relevant SSTLs.
- Conduct additional risk assessments, based on a revised understanding of future site layout. It would be noted that the LTEMP may require modification to restrict future building design or incorporating vapour barriers beneath future building slabs.
- Consideration of short-term active LNAPL remediation solutions (such as mobile MPVE) if changes to groundwater conditions are identified that may present an unacceptable risk to human health or the environment.

For asbestos remediation areas the remedial contingencies are as follows:

- conduct additional excavation and off-site disposal to remove residual impacts and collect validation samples.
- conduct excavation to remove surface impacts which pose a risk, modify LTEMP to manage deeper materials.
- If large volumes of previously unidentified asbestos impacted soils are identified, altered approaches such as in-situ management under capping may be considered, subject to approval of the auditor and relevant project and regulatory stakeholders.

For the AEC-4 Capping Area, the remedial contingencies are as follows:

- requirement for impermeable material or liner to be constructed beneath hardstand pavement, should minor cracking or settlement of hand standing occur in the future.
- contingency items as specified in the GWMP should contaminant concentrations in groundwater be detected above adopted offsite criteria for downgradient monitoring wells including:
  - (a) conduct further investigation, flux assessment and/or risk assessment.
  - (b) consideration of in-situ LNAPL extraction technologies, such as Multi Phase Vapour Extraction (MPVE), as required.

10.11.2 Soil treatment contingencies

ERM stated that the following contingency measures would be implemented if unforeseen conditions are encountered during soil treatment works.

- Extended treatment duration: Although a 10-week timeframe is anticipated for the biopiling, the remediation program has been designed to accommodate longer treatment timeframe if required.
- Dust and odour impacts: The dust and odour management measures described within the Air Quality Management Plan (AQMP) will include contingency actions that can be taken to mitigate unacceptable dust/odours. PID screening to assess volatile air quality impacts may be supplemented by alternative field measurements or collection of ambient air samples for laboratory analysis, if necessary, to assess the speciation (and therefore exposure potential) of elevated PID readings or odours more accurately.
- Bioremediation area construction/ maintenance deficiencies: In the event that bioremediation area construction/maintenance deficiencies are observed during the fortnightly inspections, repairs will be implemented as soon as reasonably practicable. In addition, a root cause analysis will be performed to determine the cause of the deficiency and measures that can be taken to prevent recurrence.
- Releases from bioremediation area: In the event of a release of impacted soil and/or storm water from the bioremediation area, measures will be taken as soon as reasonably practicable to stop the release, perform necessary repairs and collect released soil/storm water.

10.12 Unexpected finding during remediation

Appendix C in the Stage 2 RAP, outline relevant actions and communications to be undertaken should unexpectedly finds of contamination be identified during the remediation. Based on the CSM for the WARP, potential contamination which constitutes an unexpected find includes:

- ACM: In the event of unexpected finds of asbestos, the area of suspected asbestos impact should be isolated and assessed by a 'Competent person' or 'Licenced Asbestos Assessor' in accordance with the Safework NSW Codes of Practice and associated Work Health and Safety Regulation. Isolated asbestos finds will be isolated, investigated and removed with a clearance certificate issued to recommence works within the area.
- LNAPL (unexpected high contaminant concentrations or of a different nature than identified during previous investigations).
- Chromium (hexavalent and trivalent) contaminated fill.
- Other buried waste or unexpected contamination.

10.13 Environmental incidents or releases

Incidents which are considered to have the potential to adversely affect the soil or groundwater quality outside the remediation area, pose an increased risk to the groundwater resource, or exceed the

specified air quality/ odour levels will be reported to ERM who will be responsible for notifying Viva Energy and preparing an Environmental Incident Report within 48 hours of the incident.

The Environmental Incident Report will provide a description of the incident, analysis of the cause of the incident, details of corrective action required, person(s) responsible for acting, and the outcome of previous actions taken.

In the unlikely event of a release of impacted soil and/or storm water from the Stage 2 Area, measures will be taken as soon as reasonably practicable to stop the release and collect released soil/storm water. Areas affected by the release will be assessed and managed consistent with the requirements of the EPL, POEO and CLM Act.

Dust and odour impacts: The dust and odour management measures described within the Air Quality Management Plan and AEVR will include contingency actions that can be taken to mitigate unacceptable dust/odours. PID screening to assess volatile air quality impacts will be supplemented by alternative field measurements (Summa canister analysis) to assess the more accurately speciation (and therefore exposure potential) of elevated PID readings or odours.

10.14 Validation program strategy

The remediation and beneficial soil on-site re-use validation program is presented in **Table 20.**

Table 20 Validation program strategy

Contamination/Area	Validation approach	Required analysis	Sampling density
Hydrocarbon petroleum excavation: AEC-3a AEC-3d, AEC-3e AEC14a AEC-14b	– Visual assessment of excavation surface on a systematic basis for the presence of LNAPL or soils with PID screening >100 ppm. – The presence of LNAPL and/ or PID screening >100 ppm should be used to guide further excavation to the extent practicable. – Validation sampling from final excavation walls and floor surfaces.	– BTEXN. – Carcinogen BaP. – PID. If PID >100 ppm and/or reported concentrations > SSTL then TRH speciation (CWG fractions). – If TRH C10-C40 > Management Limits, then the silica gel clean-up analysis will be used to confirm the result.	**Wall:** 1 sample per 10 lineal metres or 1 sample from each wall if excavation wall <10 m. Additional sampling ate the same frequency to be conducted for each material type present. **Base:** 10 x 10 m off-set grid (herringbone pattern).
Asbestos removal: AEC-1 AEC-3b	– Visual assessment of excavation surface and walls for the presence of ACM. – Field sieving (to 7 mm) of 10 L samples for gravimetric assessment and calculation of % ACM. – Documentation of condition of ACM. – Based on the existing dataset, asbestos is expected to be present in the form of bonded ACM. However, should ACM be identified as degraded with potential for AF/FA, collection of a 500 g sample of sieved soil material will be required for quantification of asbestos fines.	– Confirmatory laboratory analysis (asbestos ID) of suspected ACM (if identified). – If potential for asbestos fines identified: Laboratory quantification for asbestos fines/fibrous asbestos (%).	**Wall**: 1 sample per 10 lineal metres or 1 sample from each wall if excavation wall <10 m. Additional sampling ate the same frequency to be conducted for each material type present. **Base**: 10 x 10 m off-set grid (herringbone pattern).
Capping layer: AEC-4	– Verification that capping layer construction has been completed in accordance with the detail design. – Groundwater monitoring at boundary locations to confirm continuation of no unacceptable impacts to off-site receptors (as detailed in the GMP).	As detailed in the GMP.	As detailed in the GMP.

Contamination/Area	Validation approach	Required analysis	Sampling density
Stockpiles from: AEC-3a AEC-3d AEC-3e AEC-14a AEC14b	– Visual assessment of soil for the presence of LNAPL. – Sampling of stockpiled soil to determine suitability for beneficial re-use or if further treatment is required.	– BTEXN. – Carcinogen BaP. – PID. If PID >100 ppm and/or reported concentrations > SSTLs then TRH speciation (CWG fractions). – If TRH C10-C40 > Management Limits, then the silica gel clean-up analysis will be used to confirm the result.	– Up to 250 m^3 - 1 sample per 25 m^3 (minimum three samples per stockpile) – Between 250 and 2,500 m^3 - 10 samples (minimum number for calculation of 95% UCL). – >2,500 m3 - 1 sample per 250 m^3.
Stockpiles from: AEC-1 AEC-3b	– Classification of soil in accordance with the NSW EPA (2014) Waste Classification Guidelines: Part 1: Classifying Waste and – Disposal to an appropriately licensed facility.	– Use of existing in-situ data, plus the following: (a) BTEXN (b) TRH C6-C40 (c) VOC (d) PAHs (e) Phenols, (f) As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+} (g) PCBs (h) OCPs	– Up to 250 m^3 - 1 sample per 25 m^3 (minimum three samples per stockpile) – Between 250 and 2,500 m^3 - 10 samples (minimum number for calculation of 95% UCL). – >2,500 m3 - 1 sample per 250 m^3.
Temporary stockpile footprint (if not conducted on hardstand)	– Should a stockpile be placed on the footprint of a planned remediation to be undertaken at later stages of the WARP, separate validation for residual stockpile impacts is not considered warranted.	– Use of existing in-situ data, plus the following: (a) BTEXN (b) TRH C6-C40 (c) VOC (d) PAHs (e) Phenols, (f) As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+} (g) PCBs (h) OCPs	– 10 x 10 m off-set grid (herringbone pattern).

Contamination/Area	Validation approach	Required analysis	Sampling density
Additional sampling al alignment of proposed roadway	Collection of additional samples to confirm suitability for proposed land use and/or LTEMP requirements.	– BTEXN. – TRH C6-C40. – PAHs (50% of samples) – Metals (50% of samples). – If building or demolition material noted within fill: field sieving for gravimetric quantification of AF + FA quantification.	2 samples at each of 4 additional sample locations to reduce spatial gaps in the data.
Additional delineation sampling around TP21/79 in AEC-3e	Collection of additional samples to refine remediation area AEC- 3E.	– BTEXN. – TRH C6- C40. – Carcinogenic BaP – PID. If PID >100 ppm and/or reported concentrations > SSTLS then TRH speciation (CWG fractions). – If TRH C10-C40 > Management Limits, then the silica gel clean-up analysis will be used to confirm the result.	2 samples at each of 4 additional sample locations to delineate impacts at AEC- 3e.
Waste	If off-site disposal of excavated materials is required, this will be undertaken in accordance with the Waste Classification Guidelines.	– As per the Waste Classification Guidelines.	– Up to 250 m^3 - 1 sample per 25 m^3 (minimum three samples per stockpile) – Between 250 and 2,500 m^3 - 10 samples (minimum number for calculation of 95% UCL). – >2,500 m3 - 1 sample per 250 m3.
Imported material	Classified as VENM, ENM as defined under the Protection of the Environment Operations (POEO) Act 1997.	– As required.	– As required.

10.15 Validation reporting

The Stage 2 RAP stated that in consideration of the redevelopment strategy proposed for the Stage 2 area as part of SSD 10459, subdivided 'lots' will be progressively validated such that SASs (Section A) will be issued for individual lots or groups of lots.

Based on anticipated schedule of remedial works, validation reporting for the Stage 2 area will be undertaken via the following approach. The proposed reporting staging by future lot subdivision is shown on Figure 10 from the Stage 2 RAP in **Appendix A**, as follows:

- Where active remediation is not required – Proposed Lots 52, 53, 54, 55, 56 and 61: Preparation of a 'Stage 2 Site Suitability Report' which will provide an assessment of the consolidated historical dataset for lots where remediation is not required. This report will be required to be accompanied by legally enforceable LTEMP addressing residual contamination which undisturbed will not present an unacceptable exposure risk.
- Where remediation and validation works are required – Proposed Lots 51, 58, 59, 60, 62 and 63: Preparation of one or more 'Stage 2 Validation Reports' to validate successful completion of remediation works (by excavation and on-site treatment and re-use or excavation and offsite disposal) as detailed in the Stage 2 RAP.
- Validation of AEC-4 completion – Proposed Lot 64: The remediation of AEC-4 by on-site management is anticipated to be the last area completed within Stage 2 given the requirement for detailed design, groundwater monitoring and production of an LTEMP reflective of the site conditions, controls, and restrictions specific to this area.

Each Validation Report will document the scope, methods, results, and conclusions of the works that meets requirements of NSW EPA (2020) *Consultant Guidelines*. The report will include conclusions regarding the suitability, from a contamination perspective, of each of the proposed lots (or group of lots) within the Stage 2 Area for the relevant proposed land use.

10.16 Auditor discussion - Stage 2 Remedial action plan

The auditor considered that ERM appropriately identified the areas of contamination that would be require remediation. The proposed remediation areas have concentrations of CoPC in soils that exceeded the nominated remediation target levels. The selected remedial options for each AECs are technically sound and consistent with NSW EPA policies.

ERM has provided an appropriate unexpected finds protocol in the event that additional contamination is identified during remediation or development works. In addition, the auditor notes that each proposed lot (or group of lots) will be subjected to a LTEMP.

Two additional areas of the site (proposed roadworks and AEC-3e western boundary) have been identified by ERM as requiring supplementary investigation to confirm the land suitability for commercial/industrial use from a contamination perspective. These areas will be assessed in conjunction with the remedial works and in the event that contamination is identified, these areas will be remediated in accordance with the remedial options presented in the Stage 2 RAP.

The auditor noted that the validation-sampling program prepared by ERM is based on a systematic sampling of each excavation to evaluate the efficacy removal of the contaminated soil. There is also a sampling program to demonstrate whether soil treated using biopiling can be reused on-site and for waste classification for materials to be disposed off-site (e.g., asbestos impacted material).

The auditor considered the validation sampling strategy is appropriate with implementation by a qualified environmental professional.

Based on the outcomes of the historical reports and more recent AEC-4 and Stage 2 ESA results and in accordance with the relevant guidelines, the auditor considered that the engineering capping layer is an appropriate remedial mitigation for AEC-4.

The auditor noted that the Stage 2 RAP was prepared based on a series of robust assessments, including two ROAs, AEVR and the outcomes and lessons learnt with the Stage 1 Area remediation. The Stage 2 RAP was considered by the auditor to have been prepared in a manner consistent with relevant guidelines; and meets the site audit objective, as discussed in **Section 1.2.**

11. Data quality objectives

ERM reported that the Data Quality Objectives (DQOs) for the AEC-4 ESA, Stage 2 ESA and for the validation program have been developed in accordance with the ASC NEPM (NEPC, 2013) and the Australian Standard AS4482.1 Guide to the Sampling and Investigation of Potentially Contaminated Soil.

A summary of the DQOs presented by ERM in its AEC-4 ESA, Stage 2 ESA and Stage 2 RAP is presented in **Appendix E**.

11.1 Auditor discussion - Data quality objectives

The auditor considered that the DQOs prepared for the AEC-4 ESA, Stage 2 ESA and Stage 2 RAP were most relevant to the characterisation of the AECs and the subsequent establishment of remedial options for each.

The seven DQO steps were appropriately documented and were consistent with the stated objectives of the assessments providing detail on the rationale for the collection and management of data used to make decisions on site suitability.

12. Other considerations

12.1 Ecological considerations

The Stage 2 RAP demonstrated that off-site migration of LNAPL in groundwater or dissolved phase petroleum hydrocarbons was not occurring at levels that could potentially cause risk to the identified environmental/ecological receptors. The presence of PFAS and metals (either from soil leachate and/or groundwater data) within the WARP were not considered to represent a risk to off-site receptors.

ERM reported that while on-site environmental habitats were of limited value under the current and future land use, exceedance of ecological investigation levels/ecological screening levels suggested that future site management, particularly for design and planning of landscaping, will need to consider the quality of on-site soils.

12.2 Aesthetic impacts

ERM included ASC NEPM (NEPC, 2013) TRH Management Limits for LNAPL management as trigger levels for future site management considerations. Management considerations included aesthetic impacts (odorous or stained soils).

12.3 Chemical mixtures

ERM did not specifically examine potential additive or synergistic effects of chemical mixtures into the Stage 2 RAP.

12.4 Auditor discussion - Other considerations

The auditor noted that the site was a petroleum refinery process area mostly covered in hardstand and it would not be expected that the presence, or protection, of ecological receptors would be relevant at such facilities. Additionally, the primary sources of contamination within the Stage 2 Area were aboveground, although it is noted that soil has been contaminated as a result of some of the former site operations.

ERM reported concentrations of CoPC generally less than adopted trigger levels for ecological receptors in groundwater wells positioned down gradient of the Stage 2 Area. As such, the auditor agreed there is no identified complete pathway between identified groundwater impacts on-site and off-site ecological receptors.

Following completion of the proposed remedial works in the Stage 2 Area, LNAPL (in soils or groundwater) is unlikely to be encountered during routine use of the site or subsurface maintenance activities immediately off-site Aesthetic issues are not considered relevant for a commercial/industrial site that will incorporate large areas of concrete/bitumen cover, that will rarely be disturbed. The presence of stained/odorous soils (and relevant management measures) will be noted in the LTEMP.

The key CoPCs (TRH, BTEX, asbestos and some heavy metals) are not likely to present an increased or different risk in combination than as individual compounds/elements. Further, the absence of any identified complete SPR linkages has demonstrated that any potential chemical mixtures are unlikely to affect the assessment of potential human health risks.

13. Compliance with regulatory requirements

Evaluation of the Stage 2 RAP in respect of its compliance with regulatory requirements is discussed in the following subsections.

13.1 Consultant guidelines

The auditor's evaluation of the draft Stage 2 RAP – through comparison to the requirements of the Consultant Guidelines is presented in **Appendix B** (IAA16 and project tracking sheet). The auditor considered that all matters raised in IAA03 were appropriately addressed in the final version of the Stage 2 RAP.

13.2 Auditor guidelines

The evaluation of compliance of the Stage 1 RAP with Section 4.3.6 of the Auditor Guidelines is presented in **Table 21.**

Table 21 Auditor guidelines evaluation

Item	Present (Y/N)	Comment
The Stage 2 RAP demonstrates adequate safeguards for the protection of human health and the environment.	Y	The auditor noted an ecological and human risk assessment evaluated the significance of contamination and whether it posed an unacceptable risk of exposure, both in the long-term site use and during remediation. The plans required as part of SSD9302 will allow appropriate monitoring during the remedial works to protect the health of site workers and the environment.
The potential for uncontrolled emissions of, for example, volatile organic compounds, leachates and odours and any other adverse effects from treatment must be considered on a site-specific basis according to the nature of the contamination and the conditions of the site.	Y	The auditor noted that a series of assessments had been undertaken in the preparation of the Stage 2 RAP. The Stage 2 AEVR presented data gathered during Stage 1 to support the monitoring protocols recommended for Stage 2. These data demonstrated that emissions that could affect human health are not likely to occur during the Stage 2 Area remediation. The Stage 2 RAP includes appropriate monitoring protocols for air, water, and leachate emissions.

14. Audit conclusions

The auditor has independently reviewed the Stage 2 RAP prepared by ERM and concludes that it has been prepared in a manner consistent with relevant NSW EPA made or endorsed guidelines. The following aspects of the Stage 2 RAP support this conclusion:

- Data from historical investigations were used to identify areas of concern that warrant remediation and/or management as follows:
  - (a) AEC-2, AEC-3a, AEC-3d, AEC-3e, AEC14a and AEC14b (potential for indoor inhalation of vapours by future on-site commercial workers from hydrocarbon and LNAPL impacted soil)
  - (b) AEC-1 and AEC-3b - asbestos contaminated soils to be excavated and disposed to landfill.
  - (c) AEC 4 to be capped.
  - (d) All other AECs within Stage 2 Area shall be managed under the LTEMP.
- The Stage 2 RAP presented a clear objective of remediating soil and managing groundwater contamination to allow the site to be used for commercial/industrial land uses.
- The selected remediation methodologies for each AEC were consistent with the remediation methodologies outlined in the EIS (AECOM, 2018) and the Conceptual RAP (AECOM, 2019). The validation sampling program for each of the AECs is appropriate based on the size and nature of the areas to be remediated.
- Petroleum hydrocarbons (and LNAPL) in groundwater have been demonstrated to be stable to decreasing. It is expected that the proposed remediation will enhance the current natural attenuation processes to reduce residual groundwater impacts over time.
- Preparation and implementation of a LTEMP (incorporating groundwater monitoring) will provide sufficient notification of the presence of contaminated soil and the manage responses should they be encountered and/or disturbed.

It is the auditor's opinion that following remedial and validation activities discussed in the Stage 2 RAP, the lots will be suitable for the proposed future use (commercial and/or industrial).

In consideration of the redevelopment strategy proposed for the Stage 2 area, the auditor noted that as part of SSD 10459, subdivided lots will be progressively validated such that separate SAS will be prepared for each proposed lot or group of lots.

15. Disclaimer

This SAR and accompanying SAS have been prepared in accordance with relevant provisions of the Contaminated Land Management Act 1997. The Site Audit Statement represents the auditor's opinion of the suitability and appropriateness of the RAP prepared by ERM for Stage 2 Area of the Western Area Remediation Project to effectively remediate contaminated soil so that it was suitable for commercial/industrial use, based on the condition of the site at the date the Site Audit Statement is signed.

This Report:

- Has been prepared the auditor and his support team as indicated in the appropriate sections of this SAR ("GHD") for Viva Energy.
- May be used and relied on by Viva Energy.
- May be used by and provided to the NSW EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the.
- May be provided to other third parties but such third parties use of or reliance on the SAR is at their sole risk, as this SAR must not be relied on by any person other than those listed above without the prior written consent of GHD.
- May only be used for the purpose as stated in **Section 1.2** of the SAR (and must not be used for any other purpose).

GHD and its servants, employees, and officers (including the auditor) otherwise expressly disclaim responsibility to any person other than Viva Energy arising from or in connection with this SAR.

To the maximum extent permitted by law, all implied warranties, and conditions in relation to the services provided by GHD and the SAR are excluded unless they are expressly stated to apply in this Report.

The services undertaken by the auditor, his team and GHD in connection with preparing this SAR:

- Were undertaken in accordance with current profession practice and by reference to relevant guidelines made or approved by the NSW EPA.
- The opinions, conclusions and any recommendations in this SAR are based on assumptions made by the auditor, his team and GHD when undertaking services and preparing the SAR ("Assumptions"), as specified throughout this SAR.
- GHD and the auditor expressly disclaim responsibility for any error in, or omission from, this SAR arising from or in connection with any of the Assumptions being incorrect.
- Subject to the paragraphs in this section of the SAR, the opinions, conclusions and any recommendations in this SAR are based on conditions encountered and information reviewed at the time of preparation of this SAR and are relevant until relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this SAR arising from or in connection with those opinions, conclusions and any recommendations.

The auditor and GHD have prepared this SAR on the basis of information provided by Viva Energy and others who provided information to GHD (including Government authorities), which the auditor and GHD have not independently verified or checked ("Unverified Information") beyond the agreed scope of work.

The auditor and GHD expressly disclaim responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the SAR, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

This SAR and SAS should be read in full, and no excerpts are taken to be representative of the findings of this SAR.

The opinions, conclusions and any recommendations in this SAR are based on information obtained from, and testing (if undertaken as specified in this SAR) undertaken at or in connection with the Stage 2 Area.

Although reasonable care has been used to assess the extent to which the data collected from site is representative of the overall site condition and its beneficial uses, investigations undertaken in respect of this SAR are constrained by the particular conditions as discussed in this SAR.

Site conditions may change after the date of this SAR. The auditor and GHD expressly disclaim responsibility:

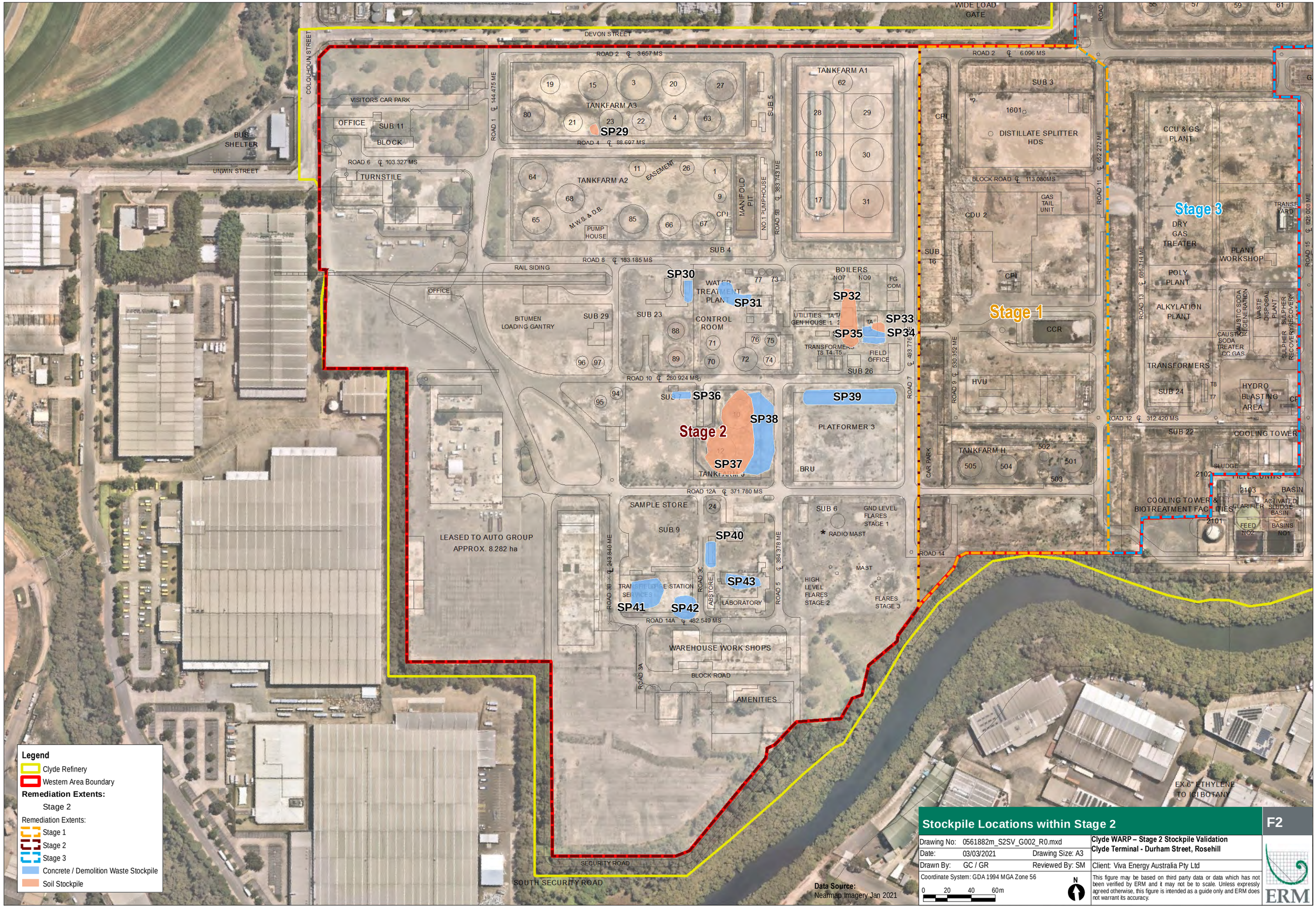
– Arising from, or in connection with, any change to the site conditions.
– To update this SAR if the site conditions change.

These Disclaimers should be read in conjunction with the entire SAR and no excerpts are taken to be representative of the findings of this SAR.

Appendices

Appendix A Figures

Figures - Stockpiles Validation Report

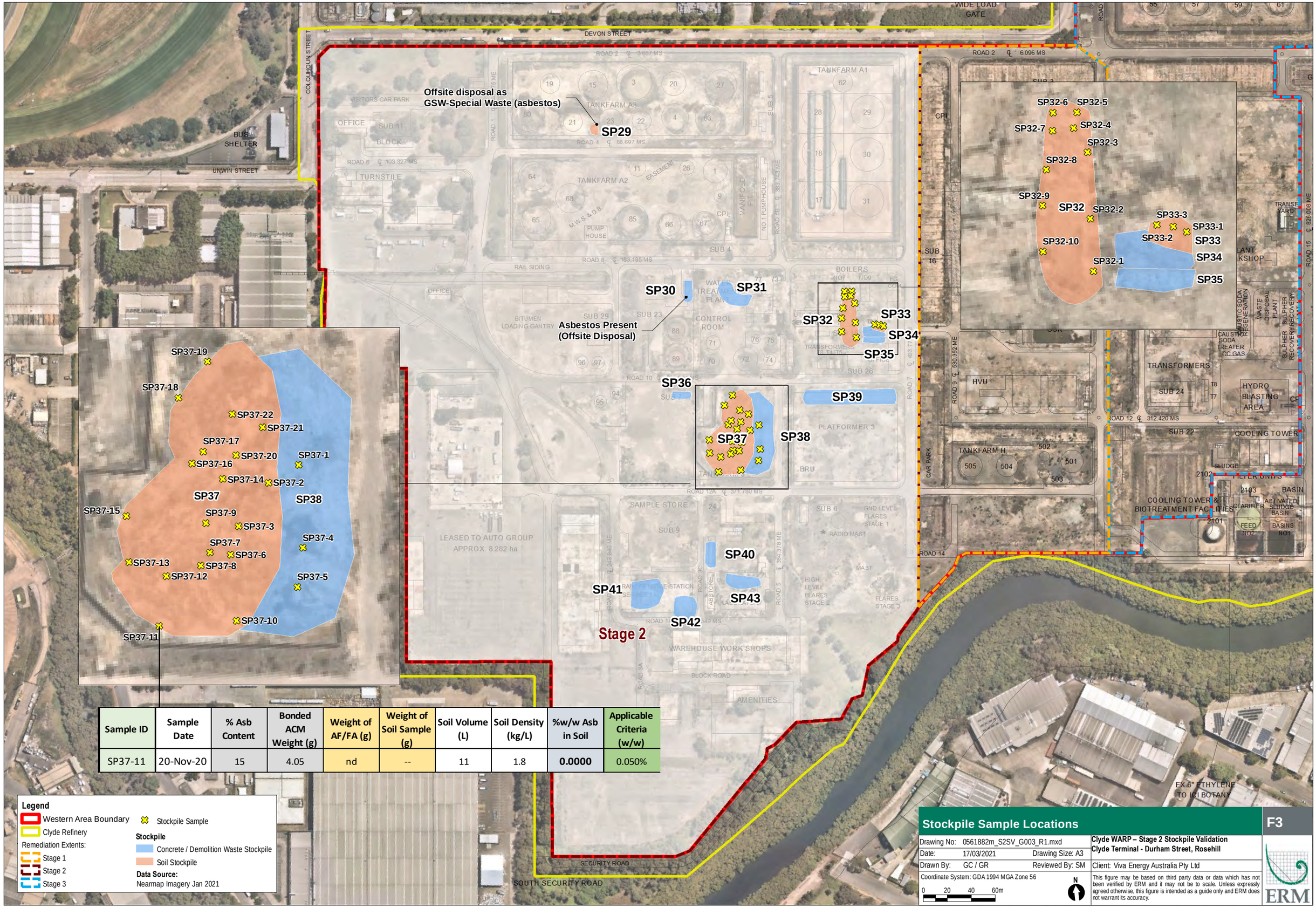


Stockpile Locations within Stage 2

F2

Drawing No: 0561882m_S2SV_G002_R0.mxd		Clyde WARP – Stage 2 Stockpile Validation Clyde Terminal - Durham Street, Rosehill
Date: 03/03/2021	Drawing Size: A3	
Drawn By: GC / GR	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Sample ID	Sample Date	% Asb Content	Bonded ACM Weight (g)	Weight of AF/FA (g)	Weight of Soil Sample (g)	Soil Volume (L)	Soil Density (kg/L)	%w/w Asb in Soil	Applicable Criteria (w/w)
SP37-11	20-Nov-20	15	4.05	nd	--	11	1.8	**0.0000**	0.050%

Legend

- Western Area Boundary
- Clyde Refinery
- Remediation Extents:
  - Stage 1
  - Stage 2
  - Stage 3
- Stockpile Sample

Stockpile

- Concrete / Demolition Waste Stockpile
- Soil Stockpile

Data Source:
Nearmap Imagery Jan 2021

Stockpile Sample Locations

F3

Drawing No: 0561882m_S2SV_G003_R1.mxd		**Clyde WARP – Stage 2 Stockpile Validation**
Date: 17/03/2021	Drawing Size: A3	**Clyde Terminal - Durham Street, Rosehill**
Drawn By: GC / GR	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

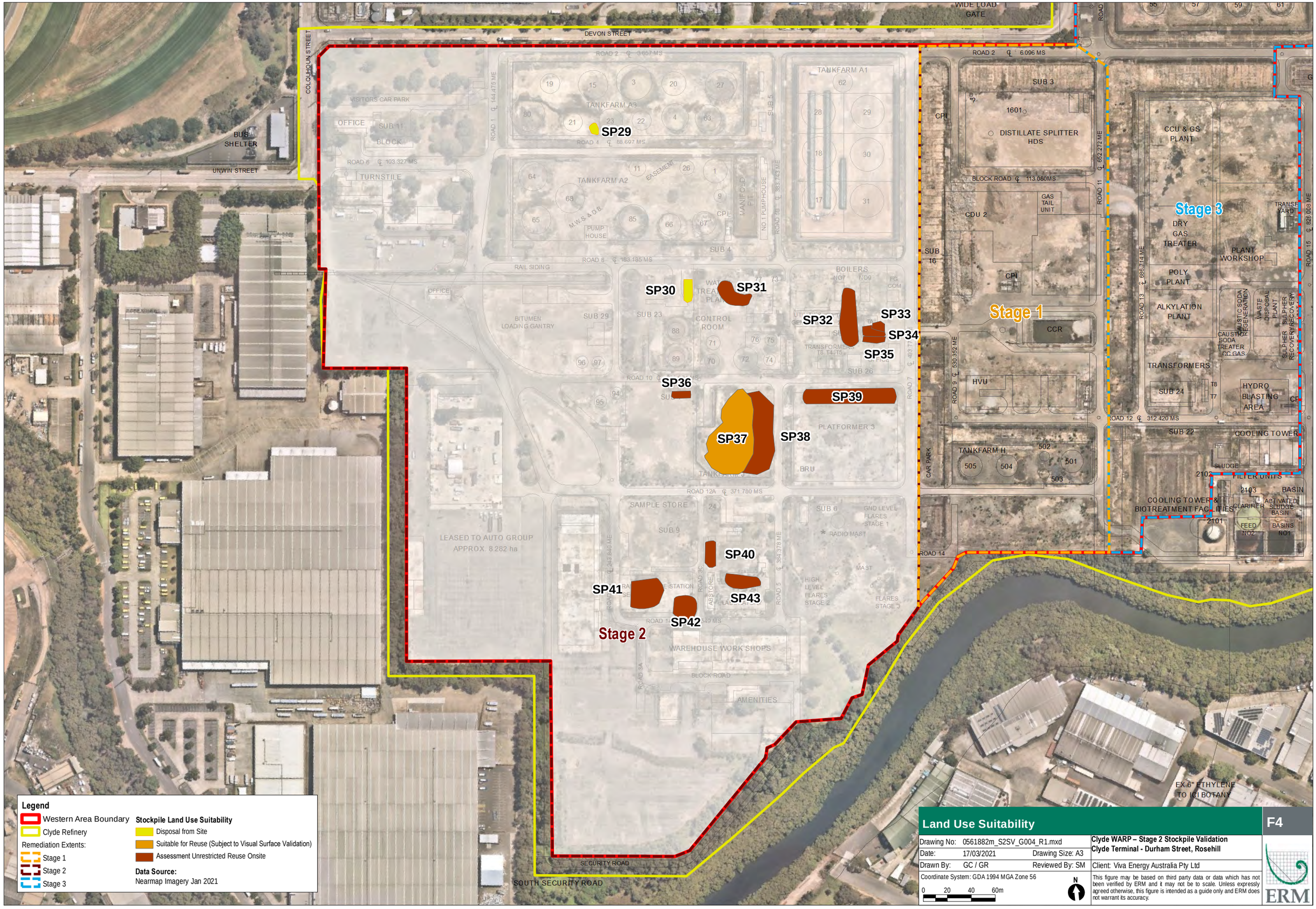
Coordinate System: GDA 1994 MGA Zone 56

0 20 40 60m

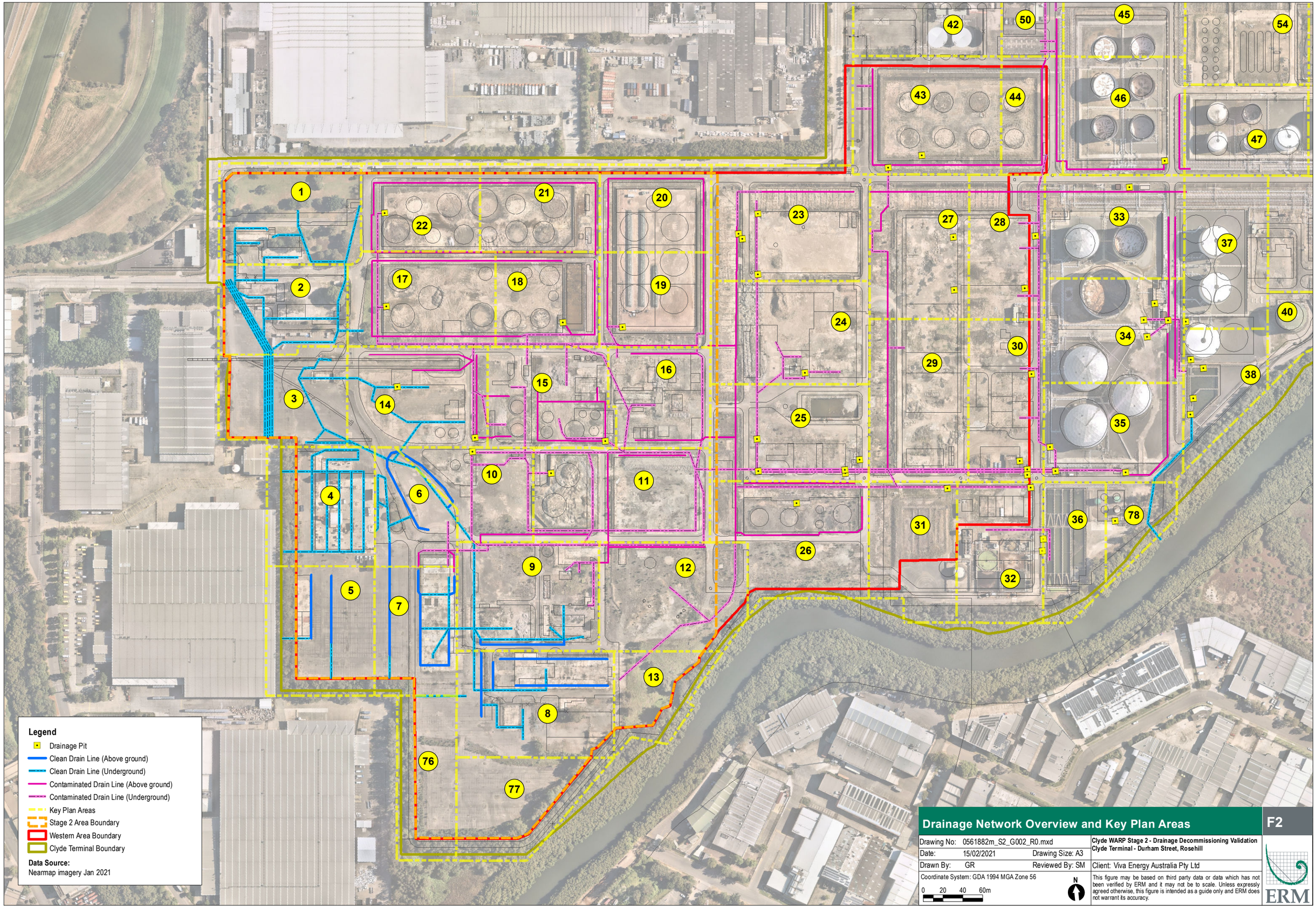
N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM


DEVON STREET
COLQUHOUN STREET
UNWIN STREET
BUS SHELTER
WIDE LOAD GATE
VISITORS CAR PARK
OFFICE
TURNSTILE
TANKFARM A3
TANKFARM A2
TANKFARM A1
TANKFARM H
SP29
SP30
SP31
SP32
SP33
SP34
SP35
SP36
SP37
SP38
SP39
SP40
SP41
SP42
SP43
Stage 1
Stage 2
Stage 3
DISTILLATE SPLITTER HDS
CDU 2
CCR
HVU
CCU & GS PLANT
DRY GAS TREATER
POLY PLANT
ALKYLATION PLANT
TRANSFORMERS
HYDRO BLASTING AREA
PLANT WORKSHOP
COOLING TOWER
COOLING TOWER & BIOTREATMENT FACILITIES
CONTROL ROOM
BITUMEN LOADING GANTRY
PLATFORMER 3
BRU
SAMPLE STORE
LEASED TO AUTO GROUP APPROX. 8.282 ha
WAREHOUSE WORK SHOPS
AMENITIES
SECURITY ROAD
SOUTH SECURITY ROAD
EX 8" ETHYLENE TO ICI BOTANY
Legend
Western Area Boundary
Clyde Refinery
Remediation Extents:
Stage 1
Stage 2
Stage 3
Stockpile Land Use Suitability
Disposal from Site
Suitable for Reuse (Subject to Visual Surface Validation)
Assessment Unrestricted Reuse Onsite
Data Source:
Nearmap Imagery Jan 2021
Land Use Suitability
F4
Drawing No: 0561882m_S2SV_G004_R1.mxd
Date: 17/03/2021
Drawing Size: A3
Drawn By: GC / GR
Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 20 40 60m
N
Clyde WARP – Stage 2 Stockpile Validation
Clyde Terminal - Durham Street, Rosehill
Client: Viva Energy Australia Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Figures - Drainage Validation Report

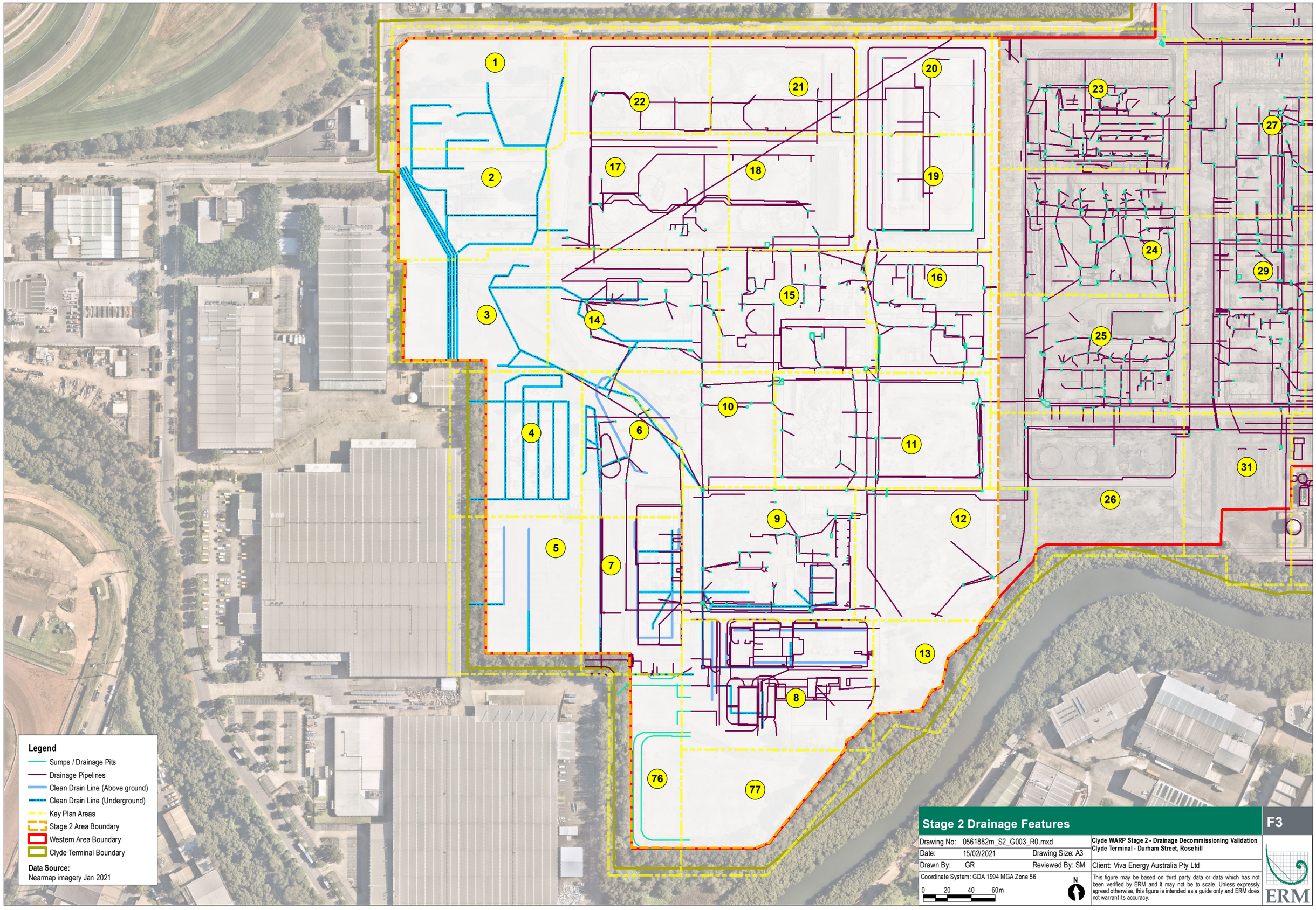


Drainage Network Overview and Key Plan Areas

F2

Drawing No: 0561882m_S2_G002_R0.mxd		Clyde WARP Stage 2 - Drainage Decommissioning Validation Clyde Terminal - Durham Street, Rosehill
Date: 15/02/2021	Drawing Size: A3	
Drawn By: GR	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

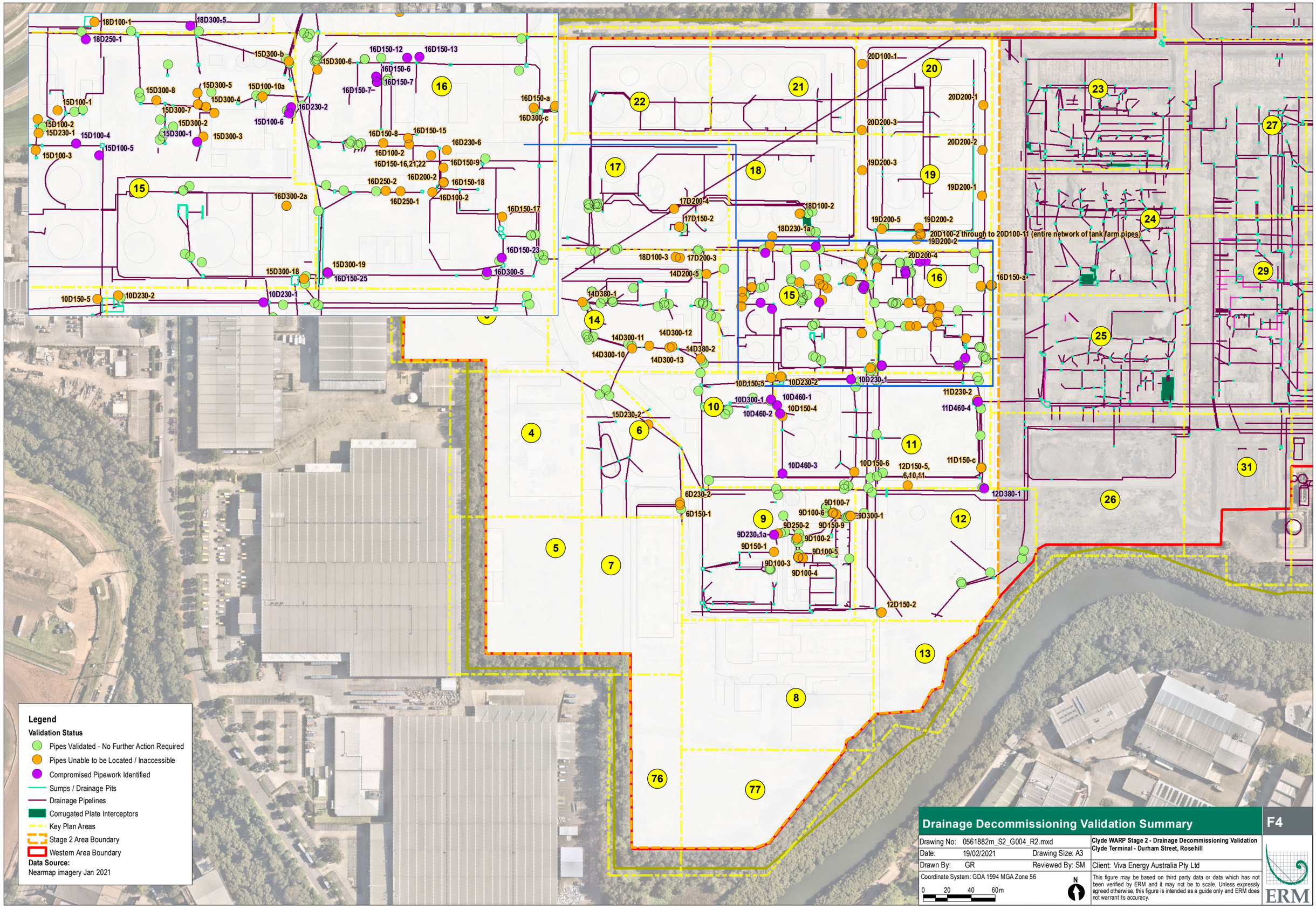


Stage 2 Drainage Features

F3

Drawing No: 0561882m_S2_G003_R0.mxd		Clyde WARP Stage 2 - Drainage Decommissioning Validation Clyde Terminal - Durham Street, Rosehill
Date: 15/02/2021	Drawing Size: A3	
Drawn By: GR	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM


18D100-1
18D250-1
18D300-5
15D300-b
15D300-6
16D150-12
16D150-13
16D150-6
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16D150-7–
15D300-8
15D300-5
15D300-4
15D100-10a
16D230-2
15D100-1
15D300-7
15D300-2
15D100-6
15D100-2
15D230-1
15D100-4
15D300-1
15D300-3
15D100-5
15D100-3
16D150-a
16D300-c
16D150-8
16D150-15
16D230-6
16D100-2
16D150-16,21,22
16D150-9
16D250-2
16D200-2
16D150-18
16D250-1
16D100-2
16D300-2a
16D150-17
16D150-23
16D300-5
15D300-19
15D300-18
16D150-25
10D150-5
10D230-2
10D230-1
20D100-1
20D200-1
20D200-3
20D200-2
19D200-3
19D200-1
19D200-5
19D200-2
20D100-2 through to 20D100-11 (entire network of tank farm pipes)
19D200-2
17D200-4
17D150-2
18D100-2
18D230-1a
18D100-3
17D200-3
14D200-5
20D200-4
16D150-a
14D380-1
14D300-11
14D300-12
14D380-2
14D300-10
14D300-13
10D150-5
10D230-2
10D230-1
10D300-1
10D460-1
10D460-2
10D150-4
11D230-2
11D460-4
15D230-2
10D460-3
10D150-6
12D150-5,
6,10,11
11D150-c
12D380-1
6D230-2
6D150-1
9D100-7
9D100-6
9D300-1
9D250-2
9D150-9
9D230-1a
9D100-2
9D150-1
9D100-5
9D100-3
9D100-4
12D150-2
4
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Legend
Validation Status
Pipes Validated - No Further Action Required
Pipes Unable to be Located / Inaccessible
Compromised Pipework Identified
Sumps / Drainage Pits
Drainage Pipelines
Corrugated Plate Interceptors
Key Plan Areas
Stage 2 Area Boundary
Western Area Boundary
Data Source:
Nearmap imagery Jan 2021
Drainage Decommissioning Validation Summary
F4
Drawing No: 0561882m_S2_G004_R2.mxd
Date: 19/02/2021
Drawing Size: A3
Drawn By: GR
Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
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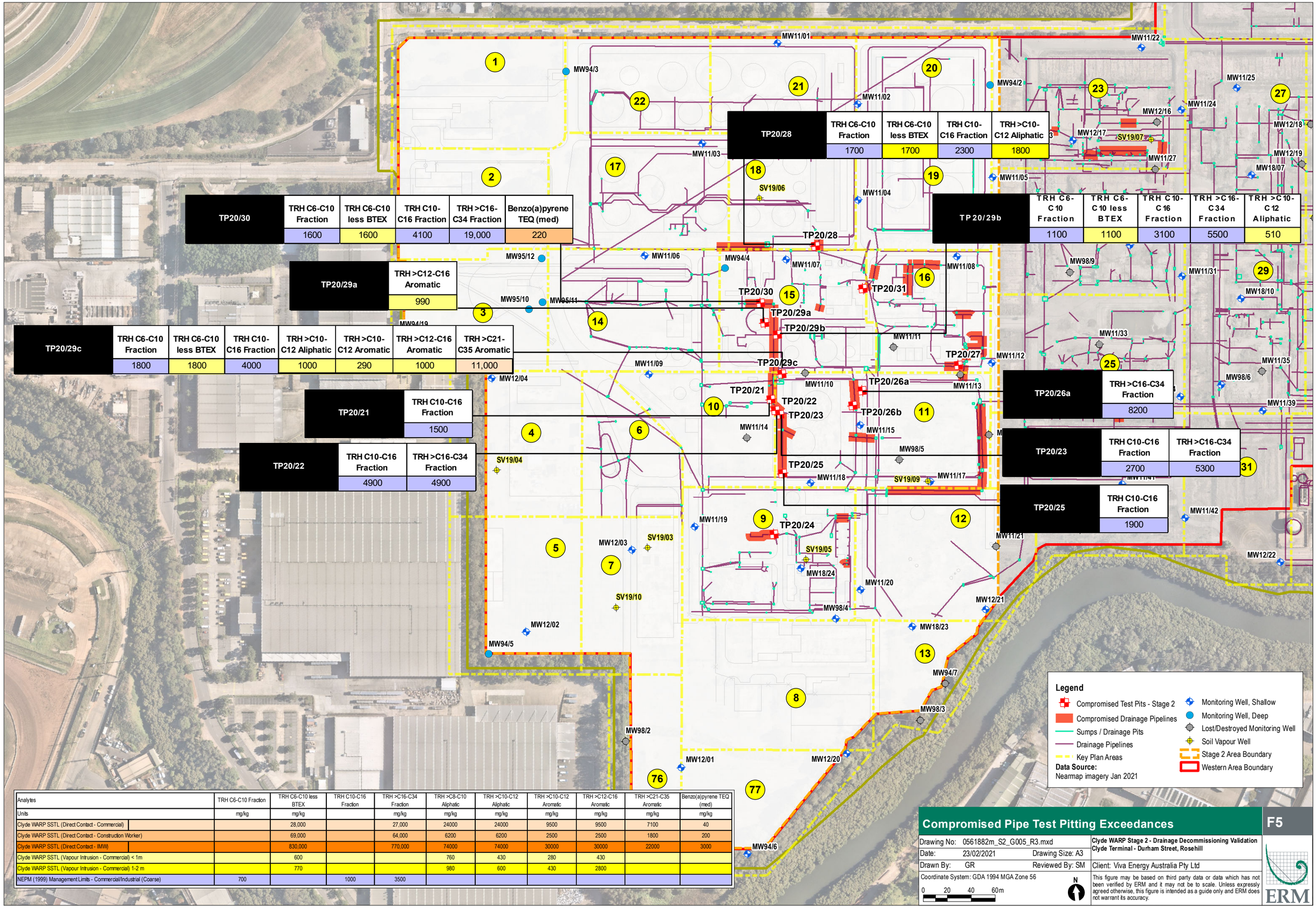
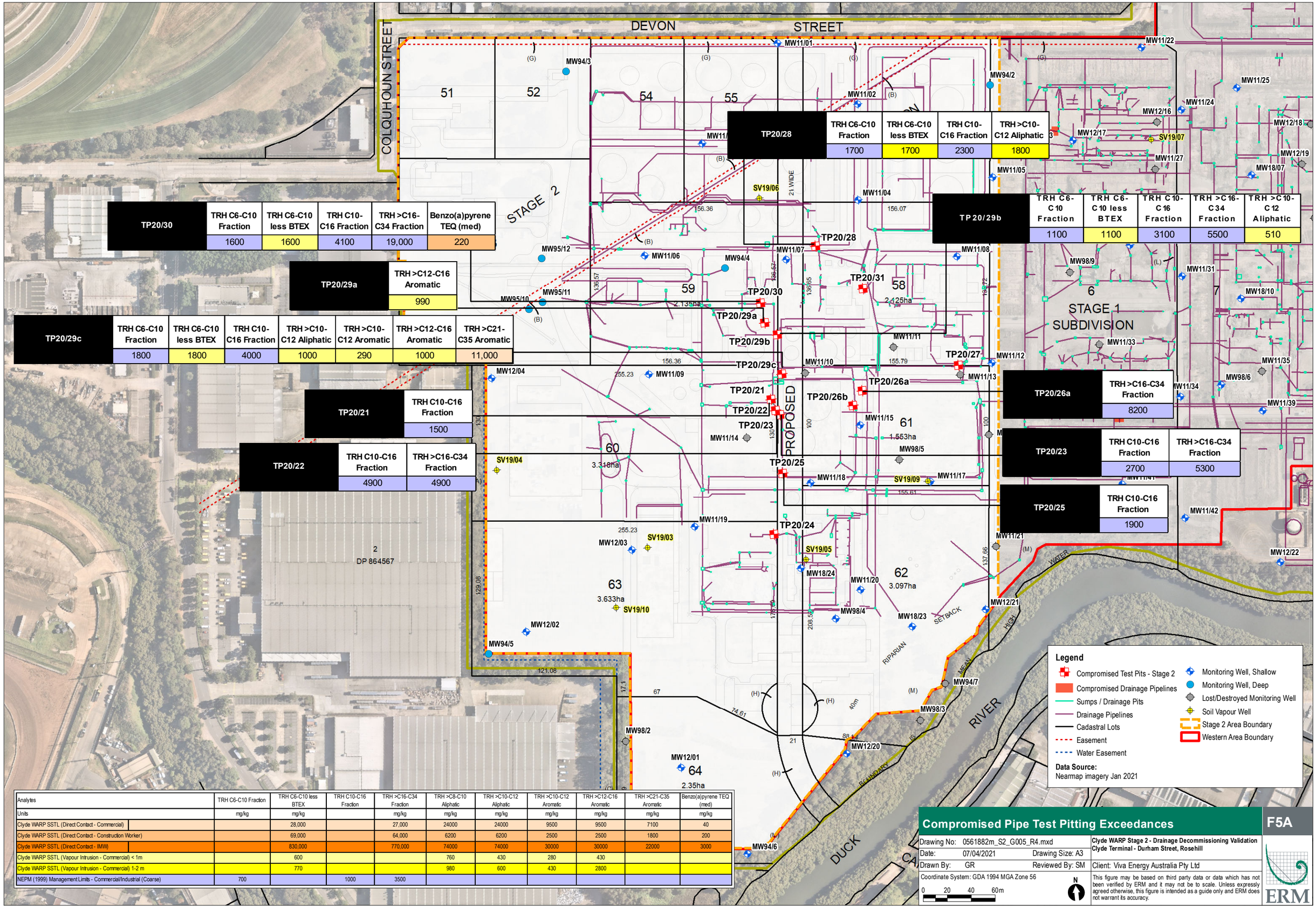
Clyde WARP Stage 2 - Drainage Decommissioning Validation
Clyde Terminal - Durham Street, Rosehill
Client: Viva Energy Australia Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM



Analytes	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH C10-C16 Fraction	TRH >C16-C34 Fraction	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C21-C35 Aromatic	Benzo(a)pyrene TEQ (med)
Units	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)		28,000		27,000	24000	24000	9500	9500	7100	40
Clyde WARP SSTL (Direct Contact - Construction Worker)		69,000		64,000	6200	6200	2500	2500	1800	200
Clyde WARP SSTL (Direct Contact - IMW)		830,000		770,000	74000	74000	30000	30000	22000	3000
Clyde WARP SSTL (Vapour Intrusion - Commercial) < 1m		600			760	430	280	430		
Clyde WARP SSTL (Vapour Intrusion - Commercial) 1-2 m		770			980	600	430	2800		
NEPM (1999) Management Limits - Commercial/Industrial (Coarse)	700		1000	3500						



Analytes	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH C10-C16 Fraction	TRH >C16-C34 Fraction	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C21-C35 Aromatic	Benzo(a)pyrene TEQ (med)
Units	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)		28,000		27,000	24000	24000	9500	9500	7100	40
Clyde WARP SSTL (Direct Contact - Construction Worker)		69,000		64,000	6200	6200	2500	2500	1800	200
Clyde WARP SSTL (Direct Contact - IMW)		830,000		770,000	74000	74000	30000	30000	22000	3000
Clyde WARP SSTL (Vapour Intrusion - Commercial) < 1m		600			760	430	280	430		
Clyde WARP SSTL (Vapour Intrusion - Commercial) 1-2 m		770			980	600	430	2800		
NEPM (1999) Management Limits - Commercial/Industrial (Coarse)	700		1000	3500						

Compromised Pipe Test Pitting Exceedances

F5A

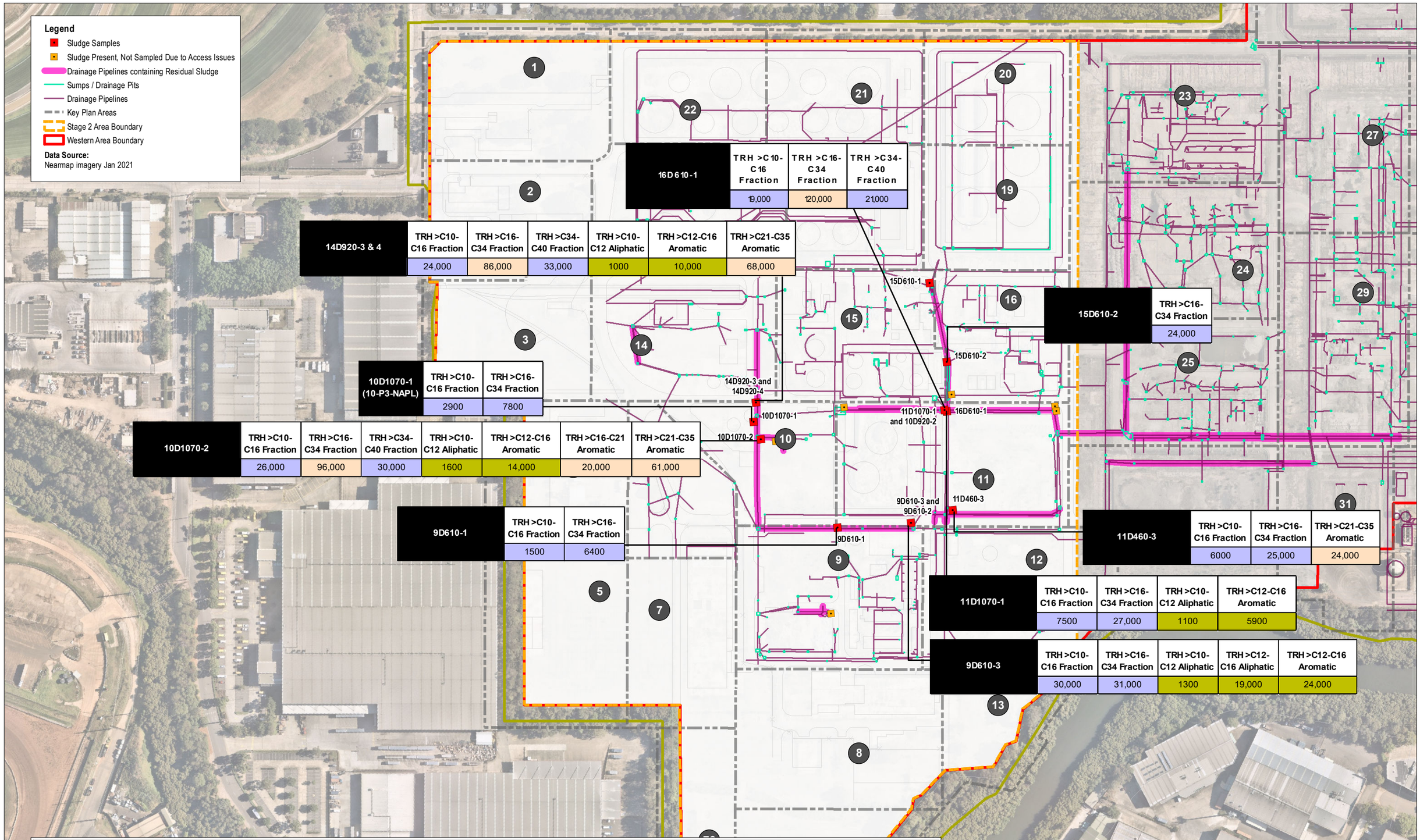
Drawing No: 0561882m_S2_G005_R4.mxd
Date: 07/04/2021 Drawing Size: A3
Drawn By: GR Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56

Clyde WARP Stage 2 - Drainage Decommissioning Validation
Clyde Terminal - Durham Street, Rosehill

Client: Viva Energy Australia Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Analytes	TRH C10-C16 Fraction	TRH >C16-C34 Fraction	TRH >C34-C40 Fraction	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)		27,000	27,000	24000	24000	9500	7100	7100
Clyde WARP SSTL (Direct Contact - Construction Worker)		64,000	64,000	6200	6200	2500	1800	1800
Clyde WARP SSTL (Direct Contact - IMW)		770,000	770,000	74000	74000	30000	22000	22000
Clyde WARP SSTL (Vapour Intrusion - Commercial) 2 - 4 m				980	17,000	5100		
NEPM (1999) Management Limits - Commercial/Industrial (Coarse)	1000	3500	10,000					

Sludge Sample Exceedances and Residual Sludge in Pipes

F6

Drawing No: 0561882m_S2_G006_R1.mxd
Date: 19/02/2021 Drawing Size: A3
Drawn By: GR Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 20 40 60m
N

Clyde WARP Stage 2 - Drainage Decommissioning Validation
Clyde Terminal - Durham Street, Rosehill

Client: Viva Energy Australia Pty Ltd

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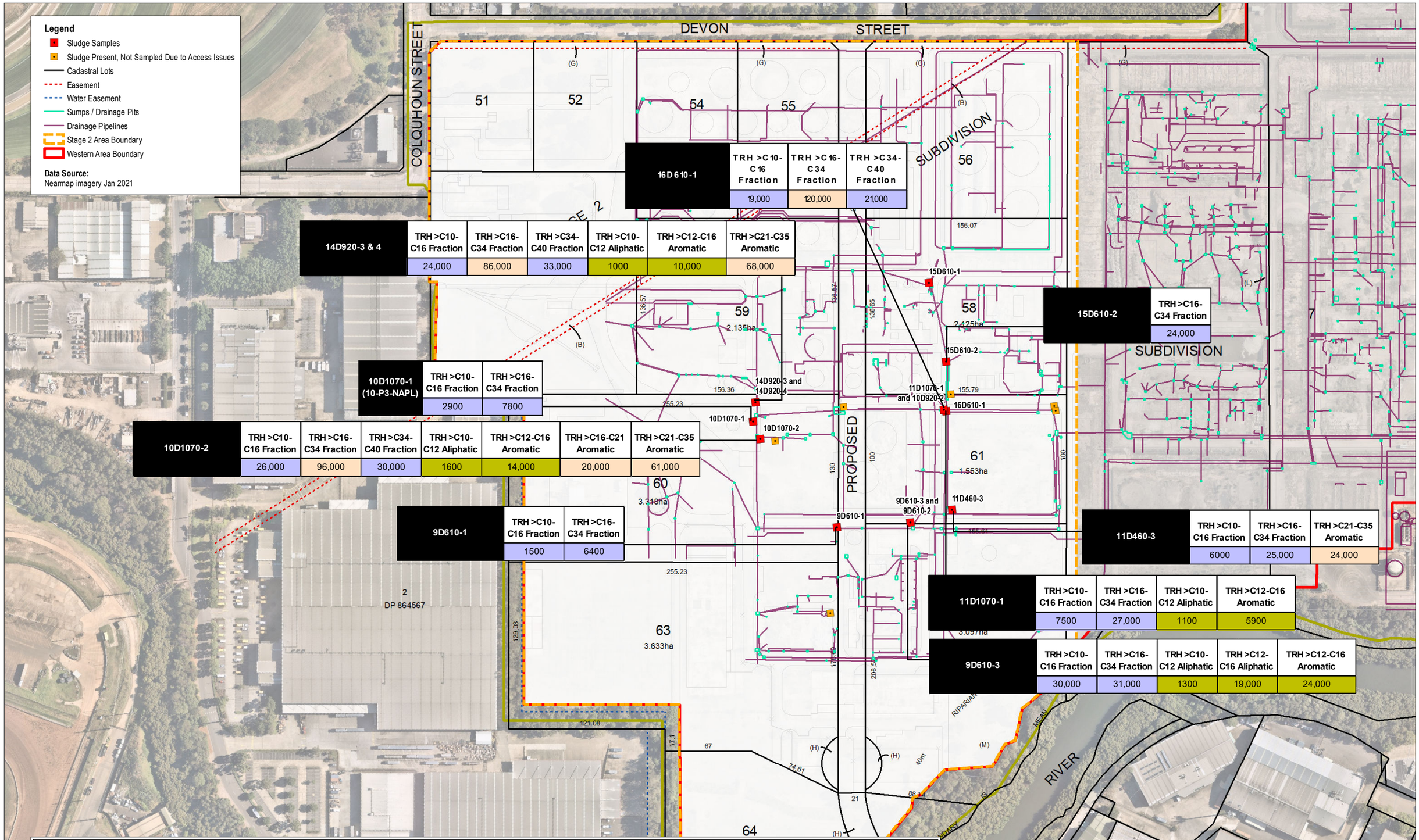
ERM



Analytes	TRH C10-C16 Fraction	TRH >C16-C34 Fraction	TRH >C34-C40 Fraction	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)		27,000	27,000	24000	24000	9500	7100	7100
Clyde WARP SSTL (Direct Contact - Construction Worker)		64,000	64,000	6200	6200	2500	1800	1800
Clyde WARP SSTL (Direct Contact - IMW)		770,000	770,000	74000	74000	30000	22000	22000
Clyde WARP SSTL (Vapour Intrusion - Commercial) 2 - 4 m				980	17,000	5100		
NEPM (1999) Management Limits - Commercial/Industrial (Coarse)	1000	3500	10,000					

Sludge Sample Exceedances and Residual Sludge in Pipes

F6A

Drawing No: 0561882m_S2_G006_R2.mxd
Date: 07/04/2021 Drawing Size: A3
Drawn By: GR Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 20 40 60m
N

Clyde WARP Stage 2 - Drainage Decommissioning Validation
Clyde Terminal - Durham Street, Rosehill
Client: Viva Energy Australia Pty Ltd

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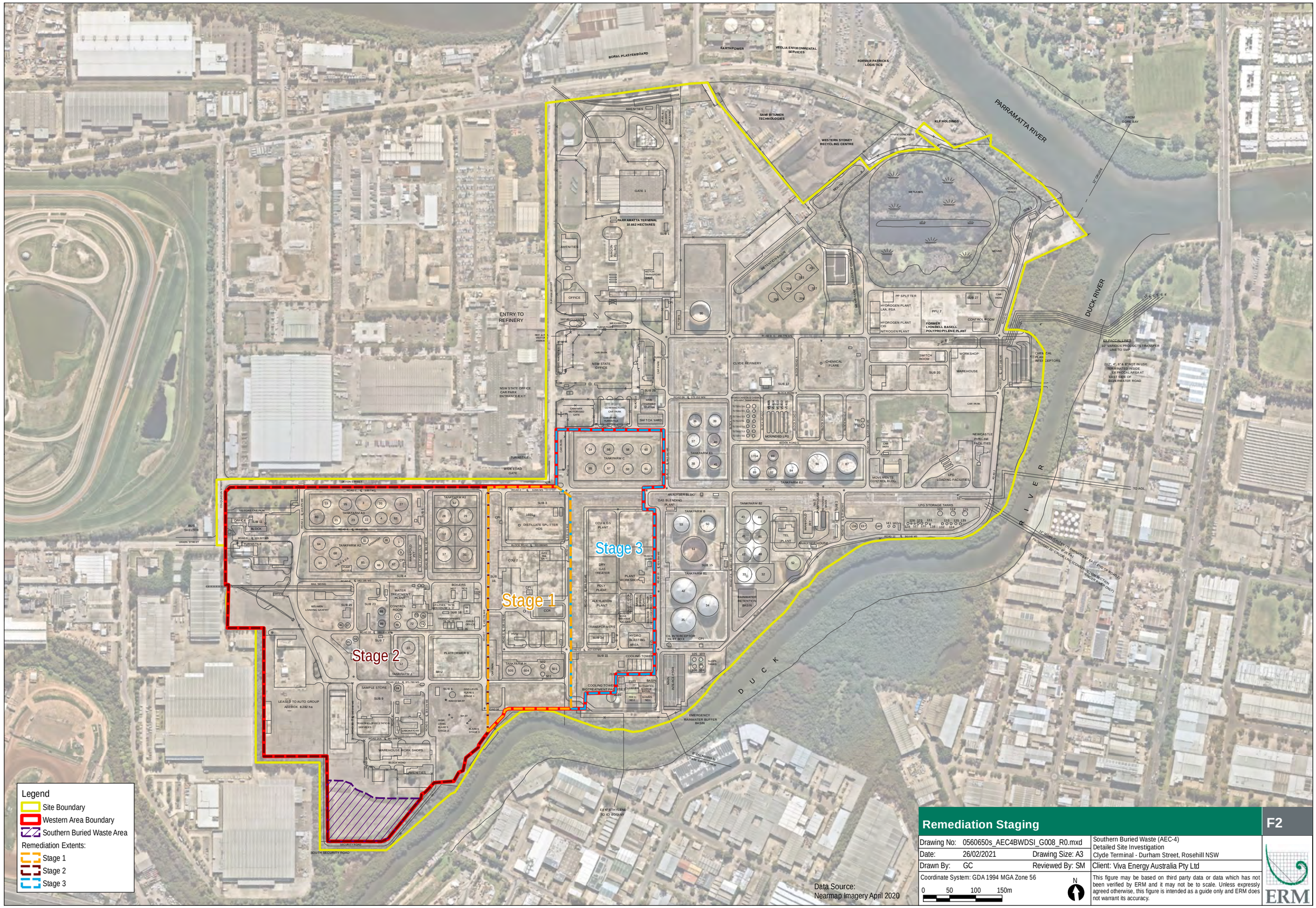
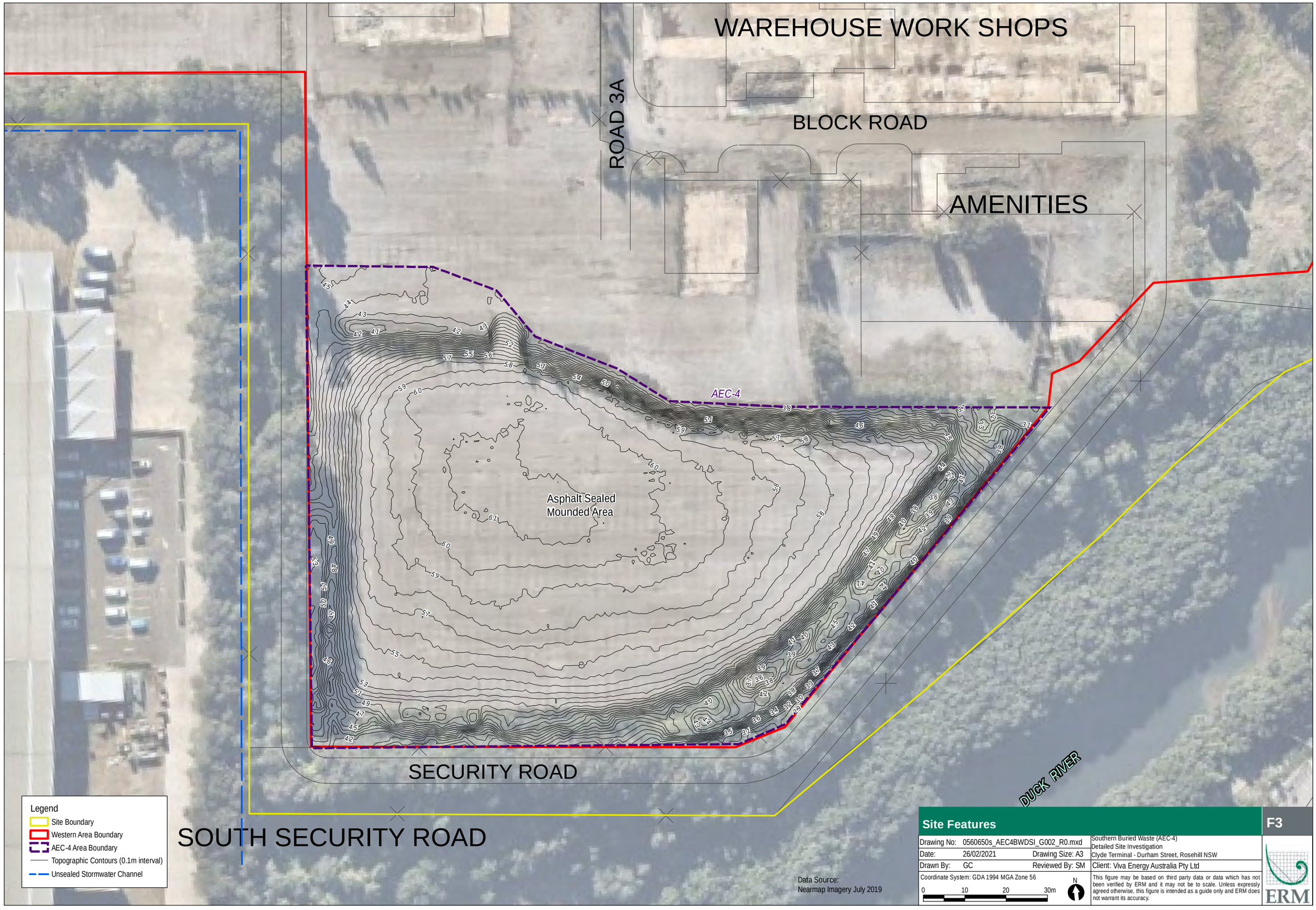
ERM

Figures - AEC-4 ESA Report


Stage 1
Stage 2
Stage 3
Legend
Site Boundary
Western Area Boundary
Southern Buried Waste Area
Remediation Extents:
Stage 1
Stage 2
Stage 3
Data Source:
Nearmap Imagery April 2020
Remediation Staging
F2
Drawing No: 0560650s_AEC4BWDSI_G008_R0.mxd
Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Date: 26/02/2021
Drawing Size: A3
Drawn By: GC
Reviewed By: SM
Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 50 100 150m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

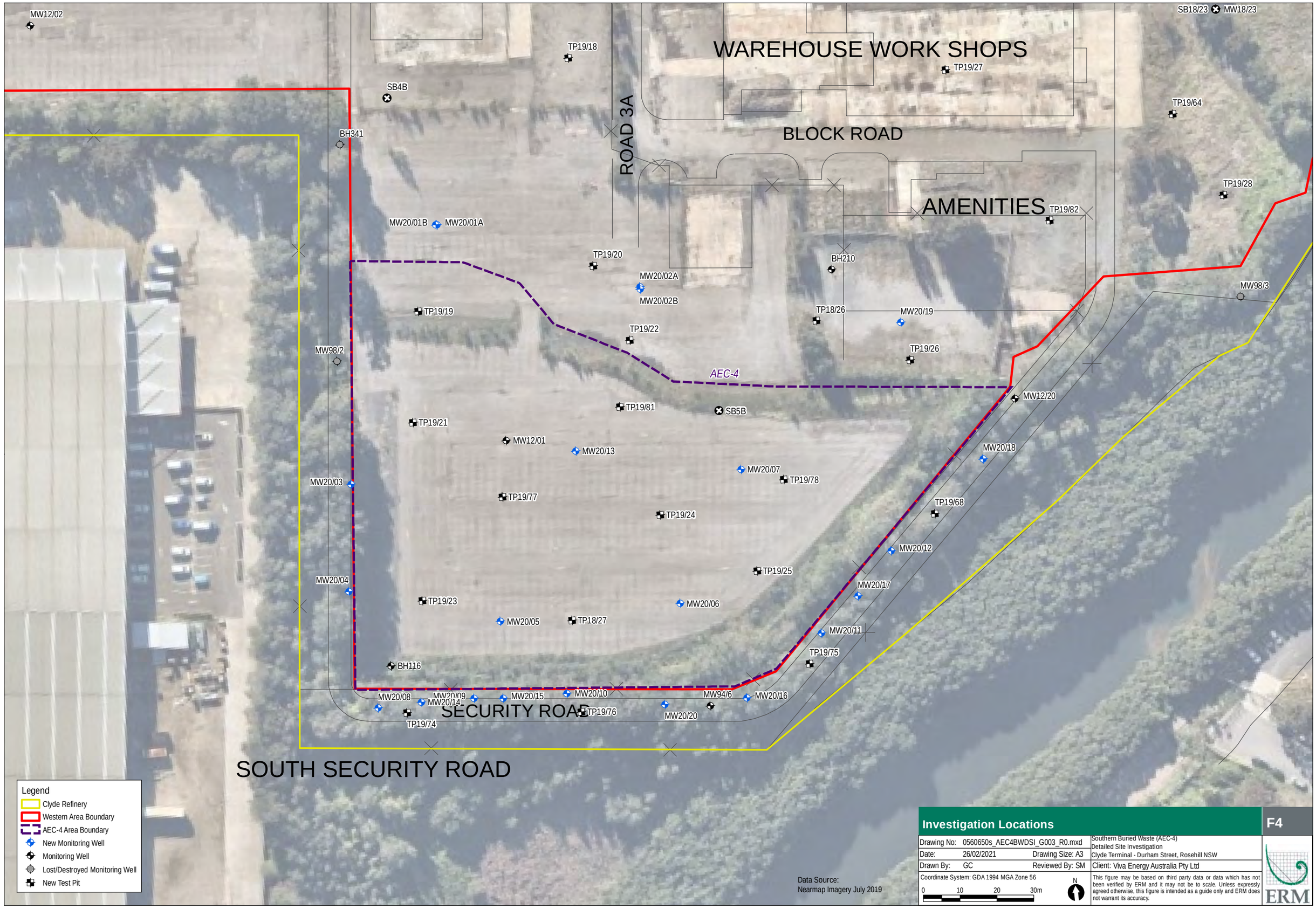


Site Features

F3

Drawing No: 0560650s_AEC4BWDSI_G002_R0.mxd		Southern Buried Waste (AEC-4) Detailed Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 26/02/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Investigation Locations

F4

Drawing No: 0560650s_AEC4BWDSI_G003_R0.mxd		Southern Buried Waste (AEC-4)
Date: 26/02/2021	Drawing Size: A3	Detailed Site Investigation
Drawn By: GC	Reviewed By: SM	Clyde Terminal - Durham Street, Rosehill NSW
Coordinate System: GDA 1994 MGA Zone 56		Client: Viva Energy Australia Pty Ltd

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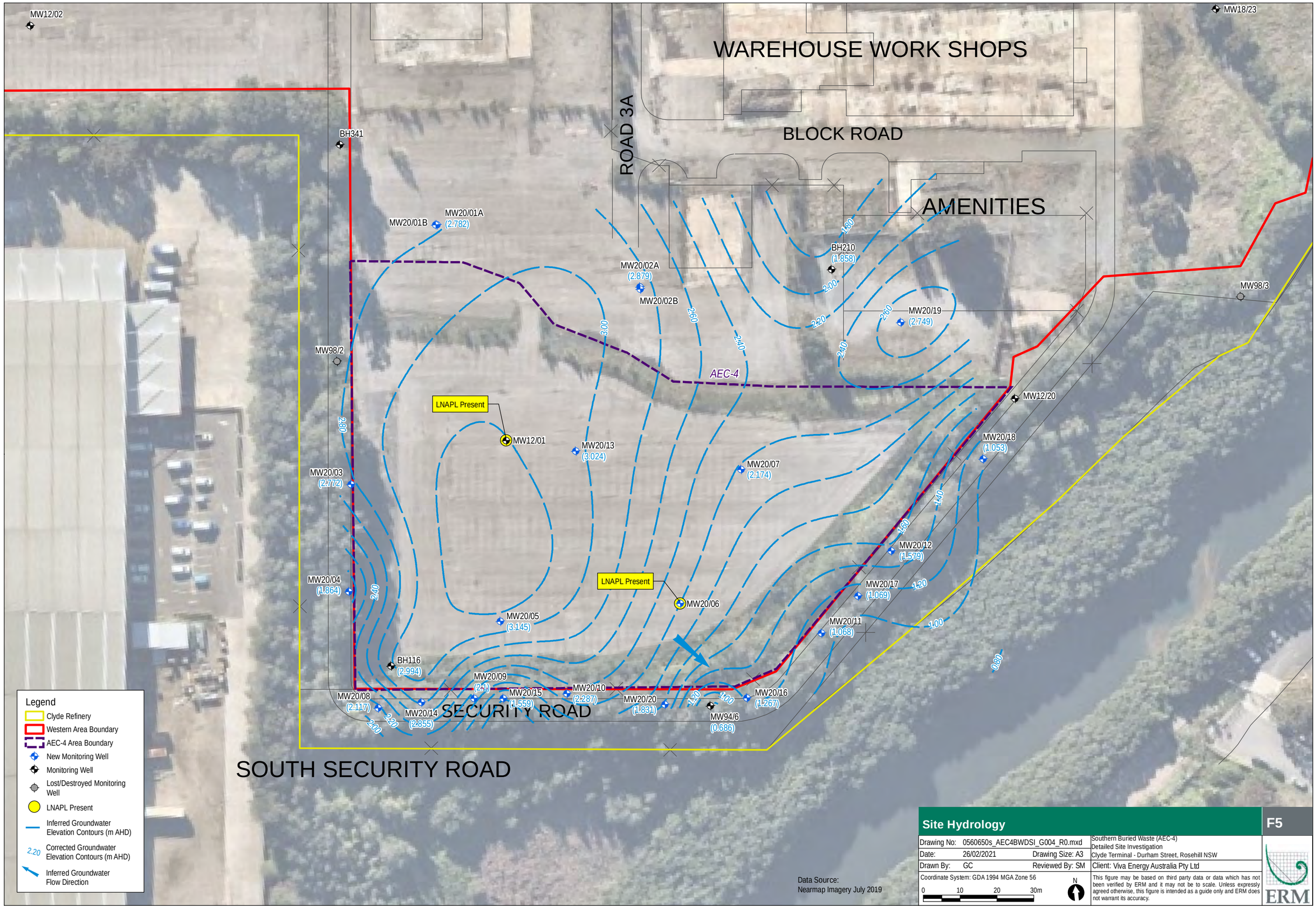
ERM



Site Hydrology

F5

Drawing No: 0560650s_AEC4BWDSI_G004_R0.mxd		Southern Buried Waste (AEC-4) Detailed Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 26/02/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Analytes	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction	TRH >C16-C34 Fraction	Chromium	Benzo(a)pyrene TEQ (medium bound)*
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)	1200000	24000	24000	9500	9500	7100	7100	400		28,000		27,000	21,000	40
Clyde WARP SSTL (Direct Contact - Construction Worker)	310000	6200	6200	2500	2500	1800	1800	420		69,000		64,000	100,000	50
Clyde WARP SSTL (Direct Contact - IMW)	3700000	74000	74000	30000	30000	22000	22000	5000		830,000		770,000	8200	540
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m														
0-0.99m	480	760	NL	110	NL			3.2		390				
Clyde WARP SSTL (Vapour Intrusion - Commercial) 1m														
1-1.99m	610	980	NL	150	NL			3.2		770				
Clyde WARP SSTL (Vapour Intrusion - Commercial) 2m														
2-6m	880	1400	NL	230	NL			3.2		790				
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)								NL		NL				
NEPM (1999) Management Limits - Commercial/Industrial (coarse)									700		1000	3500		

TP19/19	Depth (m)	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	0.6	1100	19000	140	7900	9800	15000	14	2000	110000

TP19/21	Depth (m)	TRH C6-C10 less BTEX
	2.8	860

MW12/01	Depth (m)	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	2	510	61000

SB5B	Depth (m)	Chromium
	1	37800

MW20/03	Depth (m)	TRH >C10-C16 Fraction (SG)
	0.7-0.9	<50
	2.9-3.1	2400
	5.9-6.1	<50

MW20/07	Depth (m)	TRH C6-C10 Fraction
	5.8-6.0	970

TP19/77	Depth (m)	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.5	-	-	-	-	-	-	-	-	-	38000
	4	1000	2300	27000	550	11000	12000	23000	24	4500	70000
(D01)	1.5	-	-	-	-	-	-	-	-	-	28000
(T01)	1.5	-	-	-	-	-	-	-	-	-	49300

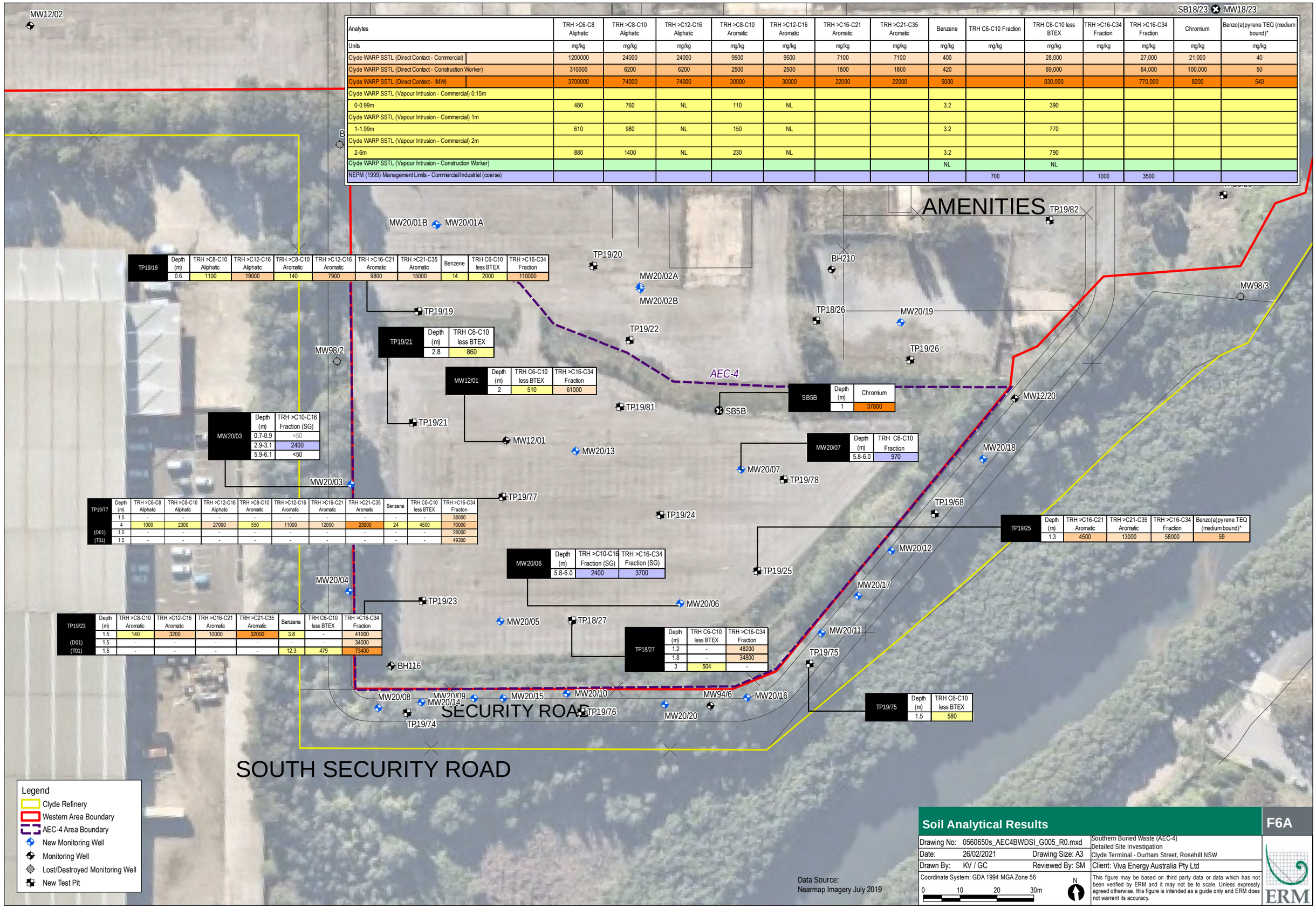
TP19/25	Depth (m)	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	TRH >C16-C34 Fraction	Benzo(a)pyrene TEQ (medium bound)*
	1.3	4500	13000	58000	59

MW20/06	Depth (m)	TRH >C10-C16 Fraction (SG)	TRH >C16-C34 Fraction (SG)
	5.8-6.0	2400	3700

TP19/23	Depth (m)	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.5	140	3200	10000	32000	3.8	-	41000
(D01)	1.5	-	-	-	-	-	-	34000
(T01)	1.5	-	-	-	-	12.3	479	73400

TP18/27	Depth (m)	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.2	-	48200
	1.8	-	34800
	3	504	-

TP19/75	Depth (m)	TRH C6-C10 less BTEX
	1.5	580



Soil Analytical Results

F6A

Drawing No: 0560650s_AEC4BWDSI_G005_R0.mxd
Date: 26/02/2021 Drawing Size: A3
Drawn By: KV / GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 10 20 30m
N

Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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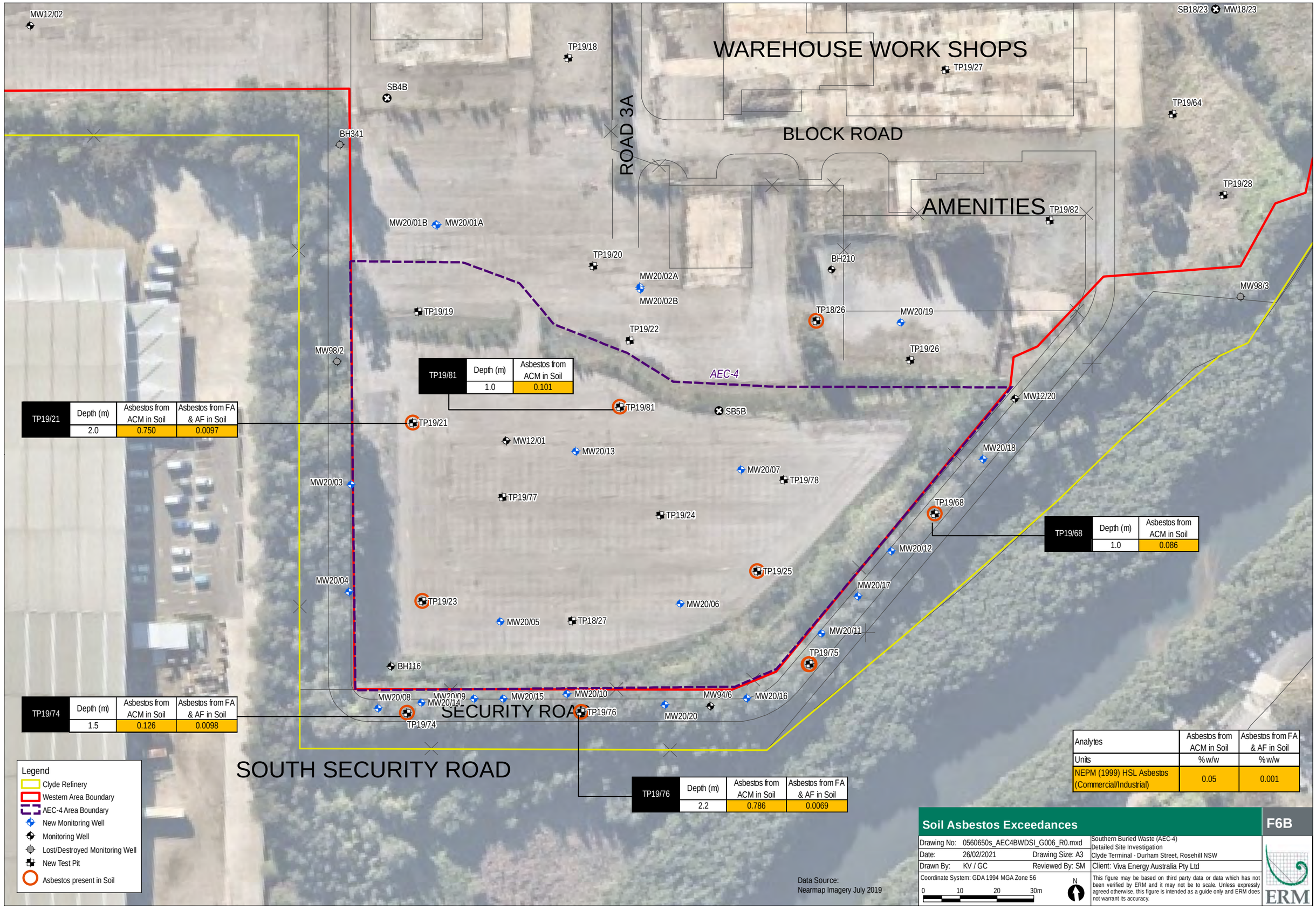
ERM



TP19/21	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.0	0.750	0.0097

TP19/81	Depth (m)	Asbestos from ACM in Soil
	1.0	0.101

TP19/68	Depth (m)	Asbestos from ACM in Soil
	1.0	0.086

TP19/74	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	1.5	0.126	0.0098

TP19/76	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.2	0.786	0.0069

Analytes	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
Units	%w/w	%w/w
NEPM (1999) HSL Asbestos (Commercial/Industrial)	0.05	0.001

Soil Asbestos Exceedances

F6B

Drawing No: 0560650s_AEC4BWDSI_G006_R0.mxd
Date: 26/02/2021 Drawing Size: A3
Drawn By: KV / GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56

Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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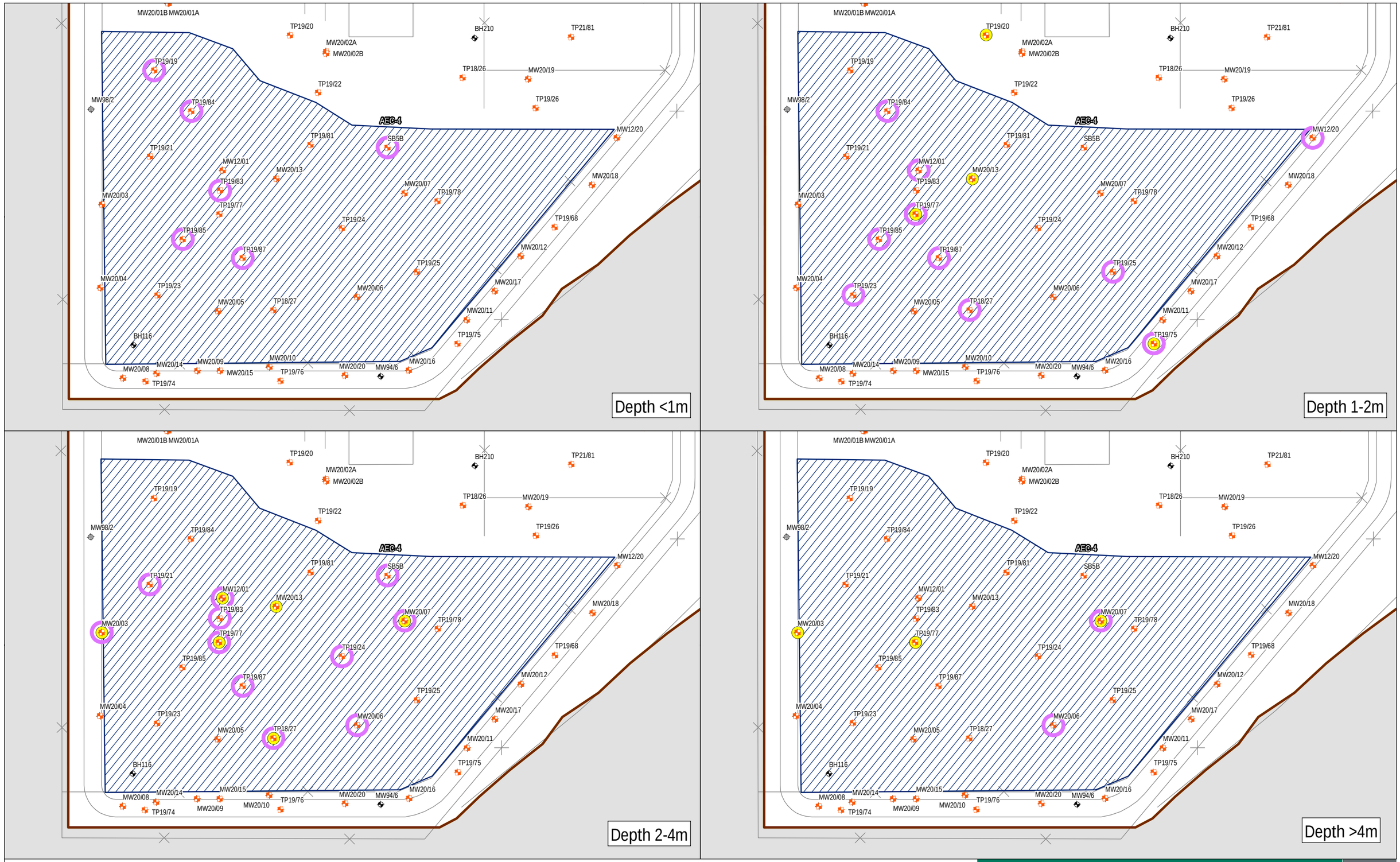

Legend

- AEC-4 Extent
- Stage 2
- Western Area Boundary
- Clyde Refinery
- Monitoring Well
- Lost/Destroyed Monitoring Well
- Soil Sampling
- LNAPL Present
- TRH Management Limit

LNAPL in Soils

F6C

Drawing No:	0560650s_AEC4BWDSI_G009_R1.mxd		Southern Buried Waste (AEC-4) Detailed Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date:	07/06/2021	Drawing Size: A3	
Drawn By:	GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 10 20 30m

N

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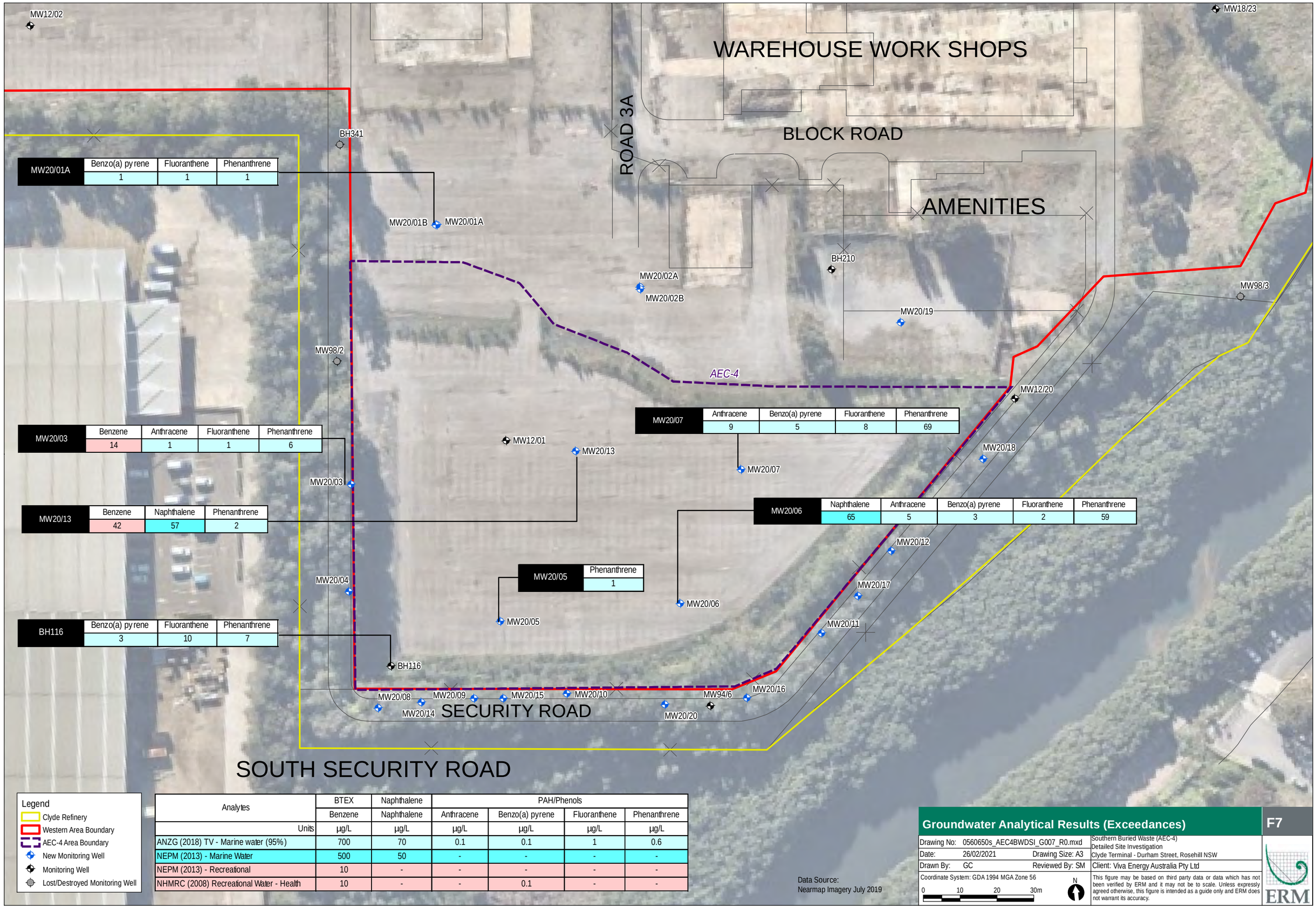
ERM



MW20/01A	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	1	1	1

MW20/03	Benzene	Anthracene	Fluoranthene	Phenanthrene
	14	1	1	6

MW20/13	Benzene	Naphthalene	Phenanthrene
	42	57	2

BH116	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	3	10	7

MW20/07	Anthracene	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	9	5	8	69

MW20/06	Naphthalene	Anthracene	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	65	5	3	2	59

MW20/05	Phenanthrene
	1

Legend
- Clyde Refinery
- Western Area Boundary
- AEC-4 Area Boundary
- New Monitoring Well
- Monitoring Well
- Lost/Destroyed Monitoring Well

Analytes	BTEX	Naphthalene	PAH/Phenols			
	Benzene	Naphthalene	Anthracene	Benzo(a) pyrene	Fluoranthene	Phenanthrene
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANZG (2018) TV - Marine water (95%)	700	70	0.1	0.1	1	0.6
NEPM (2013) - Marine Water	500	50	-	-	-	-
NEPM (2013) - Recreational	10	-	-	-	-	-
NHMRC (2008) Recreational Water - Health	10	-	-	0.1	-	-

Data Source:
Nearmap Imagery July 2019

Groundwater Analytical Results (Exceedances)

F7

Drawing No: 0560650s_AEC4BWDSI_G007_R0.mxd
Date: 26/02/2021 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 10 20 30m
N

Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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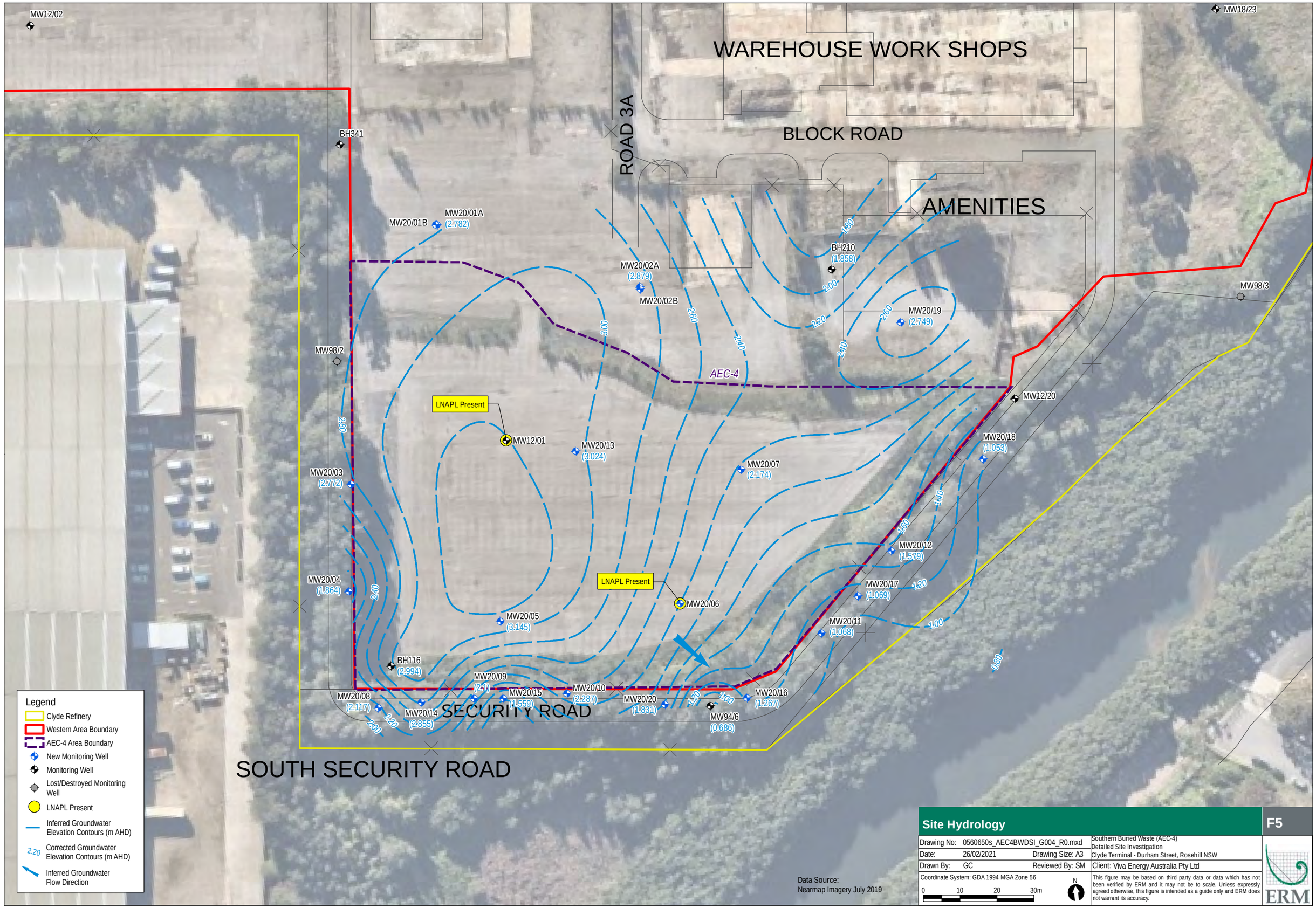
ERM



Site Hydrology

F5

Drawing No: 0560650s_AEC4BWDSI_G004_R0.mxd		Southern Buried Waste (AEC-4) Detailed Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 26/02/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Analytes	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction	TRH >C16-C34 Fraction	Chromium	Benzo(a)pyrene TEQ (medium bound)*
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)	1200000	24000	24000	9500	9500	7100	7100	400		28,000		27,000	21,000	40
Clyde WARP SSTL (Direct Contact - Construction Worker)	310000	6200	6200	2500	2500	1800	1800	420		69,000		64,000	100,000	50
Clyde WARP SSTL (Direct Contact - IMW)	3700000	74000	74000	30000	30000	22000	22000	5000		830,000		770,000	8200	540
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m														
0-0.99m	480	760	NL	110	NL			3.2		390				
Clyde WARP SSTL (Vapour Intrusion - Commercial) 1m														
1-1.99m	610	980	NL	150	NL			3.2		770				
Clyde WARP SSTL (Vapour Intrusion - Commercial) 2m														
2-6m	880	1400	NL	230	NL			3.2		790				
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)								NL		NL				
NEPM (1999) Management Limits - Commercial/Industrial (coarse)									700		1000	3500		

TP19/19	Depth (m)	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	0.6	1100	19000	140	7900	9800	15000	14	2000	110000

TP19/21	Depth (m)	TRH C6-C10 less BTEX
	2.8	860

MW12/01	Depth (m)	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	2	510	61000

SB5B	Depth (m)	Chromium
	1	37800

MW20/03	Depth (m)	TRH >C10-C16 Fraction (SG)
	0.7-0.9	<50
	2.9-3.1	2400
	5.9-6.1	<50

MW20/07	Depth (m)	TRH C6-C10 Fraction
	5.8-6.0	970

TP19/77	Depth (m)	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.5	-	-	-	-	-	-	-	-	-	38000
	4	1000	2300	27000	550	11000	12000	23000	24	4500	70000
(D01)	1.5	-	-	-	-	-	-	-	-	-	28000
(T01)	1.5	-	-	-	-	-	-	-	-	-	49300

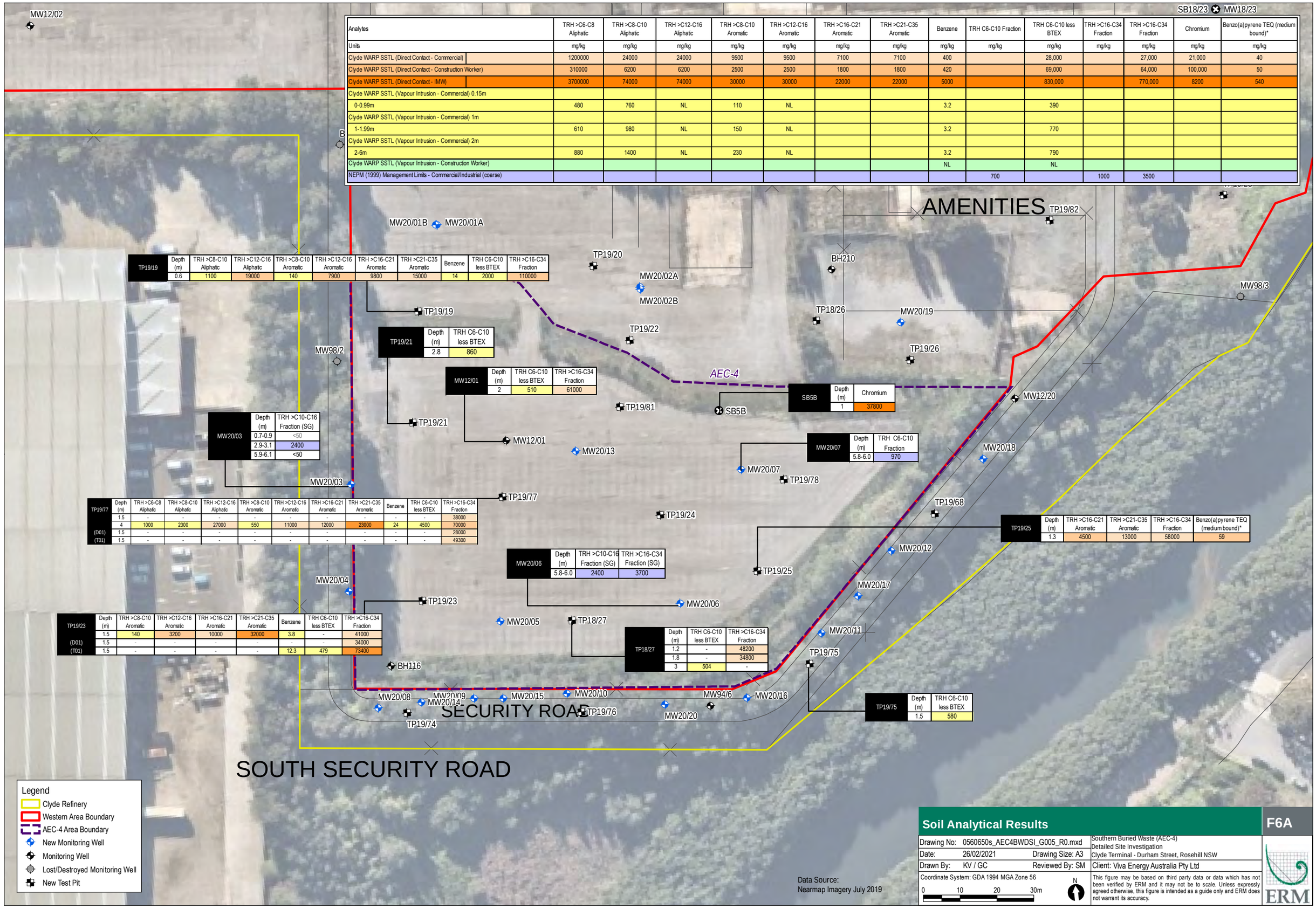
TP19/25	Depth (m)	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	TRH >C16-C34 Fraction	Benzo(a)pyrene TEQ (medium bound)*
	1.3	4500	13000	58000	59

MW20/06	Depth (m)	TRH >C10-C16 Fraction (SG)	TRH >C16-C34 Fraction (SG)
	5.8-6.0	2400	3700

TP19/23	Depth (m)	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.5	140	3200	10000	32000	3.8	-	41000
(D01)	1.5	-	-	-	-	-	-	34000
(T01)	1.5	-	-	-	-	12.3	479	73400

TP18/27	Depth (m)	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.2	-	48200
	1.8	-	34800
	3	504	-

TP19/75	Depth (m)	TRH C6-C10 less BTEX
	1.5	580



Soil Analytical Results

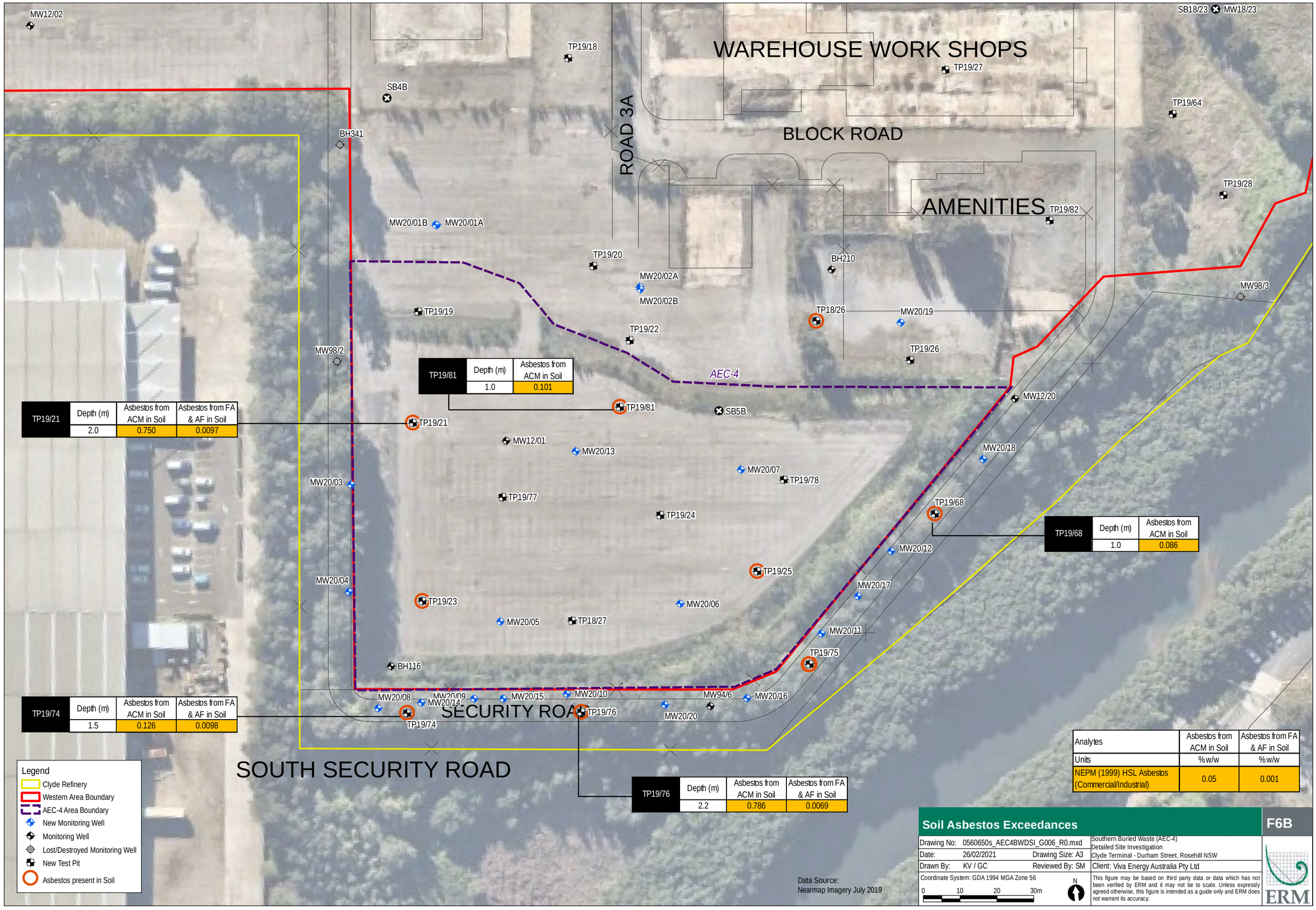
F6A

Drawing No: 0560650s_AEC4BWDSI_G005_R0.mxd
Date: 26/02/2021 Drawing Size: A3
Drawn By: KV / GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 10 20 30m
N

Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



TP19/21	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.0	0.750	0.0097

TP19/81	Depth (m)	Asbestos from ACM in Soil
	1.0	0.101

TP19/68	Depth (m)	Asbestos from ACM in Soil
	1.0	0.086

TP19/74	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	1.5	0.126	0.0098

TP19/76	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.2	0.786	0.0069

Analytes	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
Units	%w/w	%w/w
NEPM (1999) HSL Asbestos (Commercial/Industrial)	0.05	0.001

Soil Asbestos Exceedances

F6B

Drawing No: 0560650s_AEC4BWDSI_G006_R0.mxd
Date: 26/02/2021 Drawing Size: A3
Drawn By: KV / GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56

Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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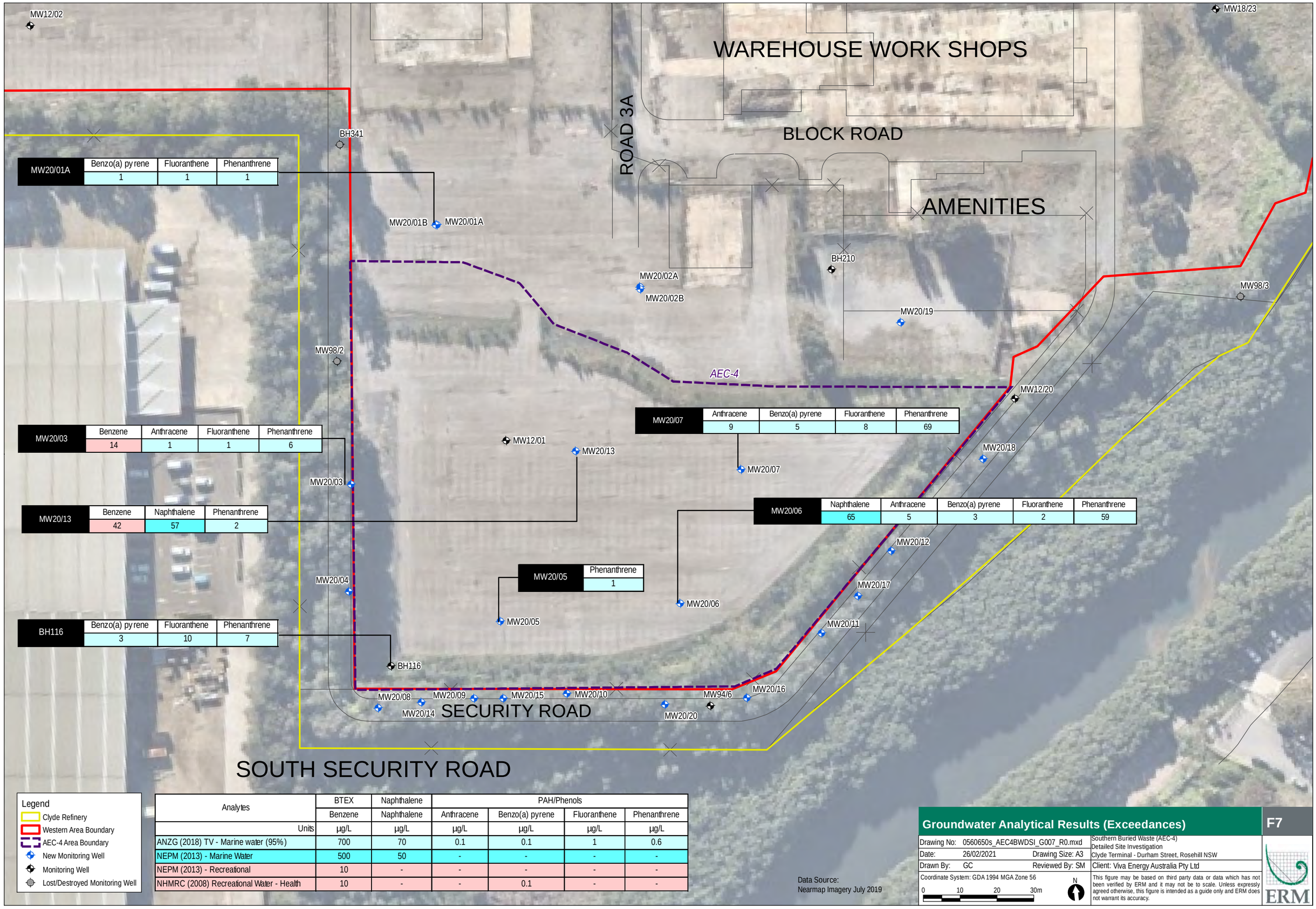

MW20/01A	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	1	1	1

MW20/03	Benzene	Anthracene	Fluoranthene	Phenanthrene
	14	1	1	6

MW20/13	Benzene	Naphthalene	Phenanthrene
	42	57	2

BH116	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	3	10	7

MW20/07	Anthracene	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	9	5	8	69

MW20/06	Naphthalene	Anthracene	Benzo(a) pyrene	Fluoranthene	Phenanthrene
	65	5	3	2	59

MW20/05	Phenanthrene
	1

Legend
- Clyde Refinery
- Western Area Boundary
- AEC-4 Area Boundary
- New Monitoring Well
- Monitoring Well
- Lost/Destroyed Monitoring Well

Analytes	BTEX	Naphthalene	PAH/Phenols			
	Benzene	Naphthalene	Anthracene	Benzo(a) pyrene	Fluoranthene	Phenanthrene
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANZG (2018) TV - Marine water (95%)	700	70	0.1	0.1	1	0.6
NEPM (2013) - Marine Water	500	50	-	-	-	-
NEPM (2013) - Recreational	10	-	-	-	-	-
NHMRC (2008) Recreational Water - Health	10	-	-	0.1	-	-

Data Source:
Nearmap Imagery July 2019

Groundwater Analytical Results (Exceedances)

F7

Drawing No: 0560650s_AEC4BWDSI_G007_R0.mxd
Date: 26/02/2021 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 10 20 30m
N

Southern Buried Waste (AEC-4)
Detailed Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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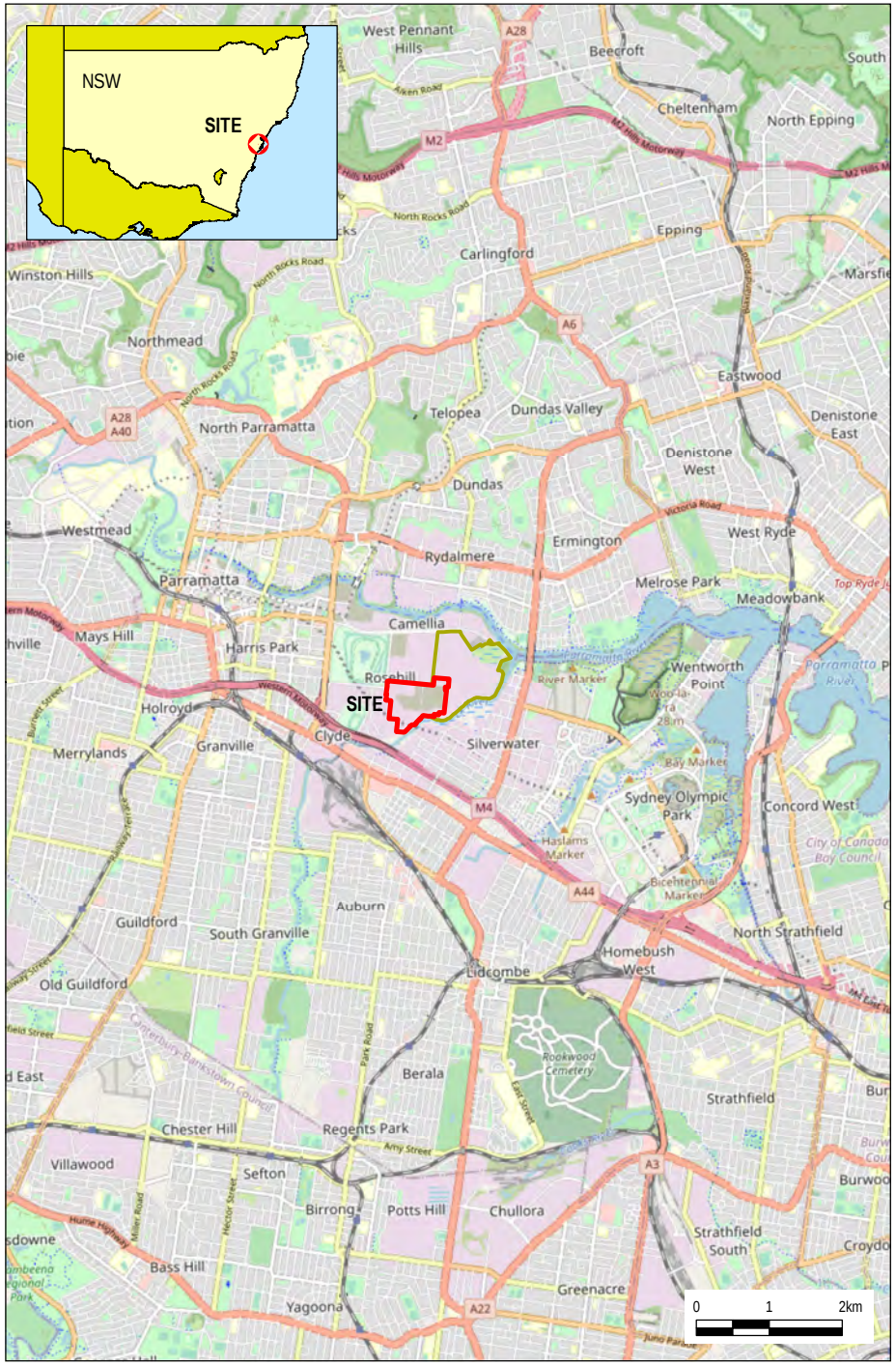
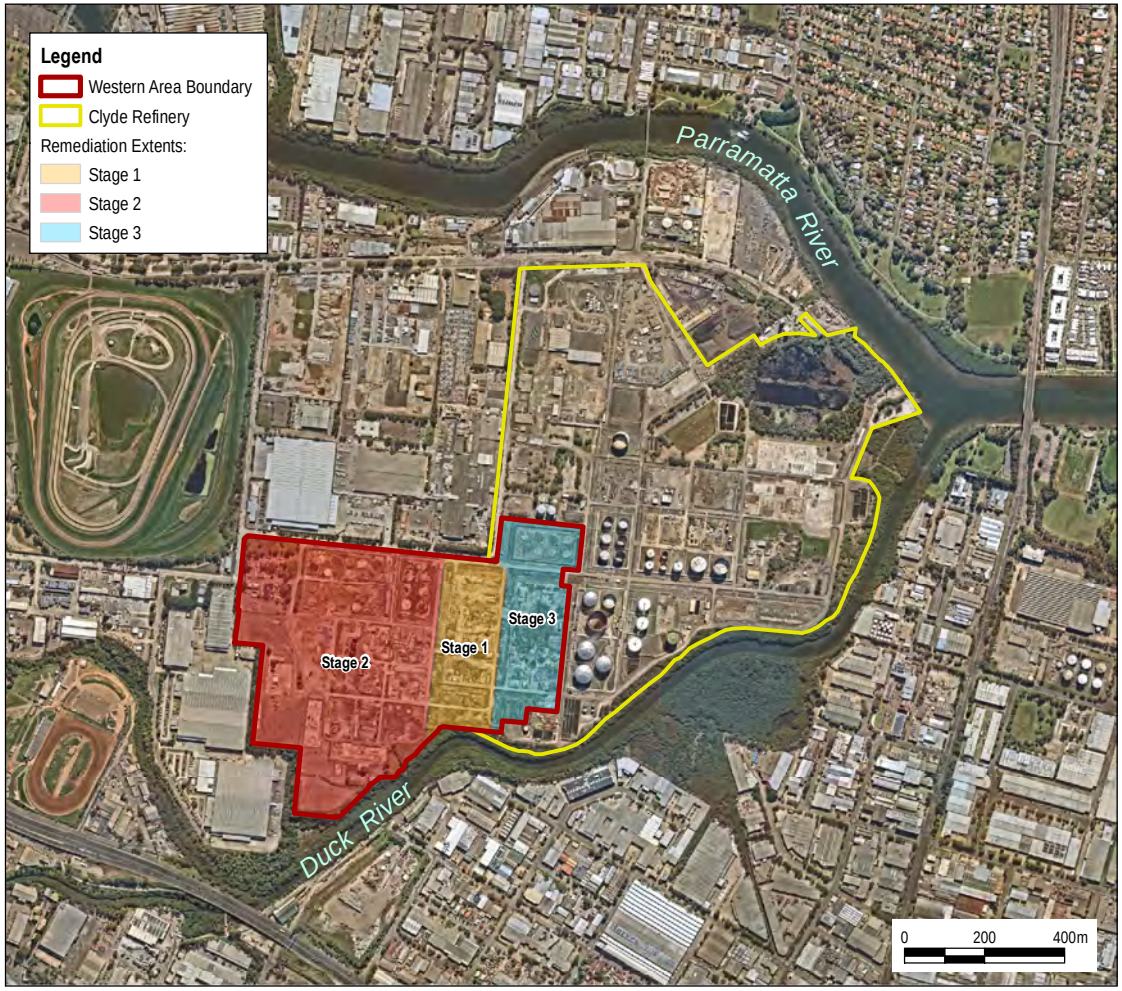
ERM

Figures - Stage 2 ESA Report





General Area Land Use:
Industrial
General Hydrogeology of Locality:
1. Soil Type:
Residual clay with minor silt and sand
2. Depth to aquifer:
0.5-2.5m bgs

Aquifer Usage:
Not known beneficial onsite extraction
Potentially Sensitive Receptors:
- Parramatta River (north eastern boundary)
- Duck River (southern boundary)

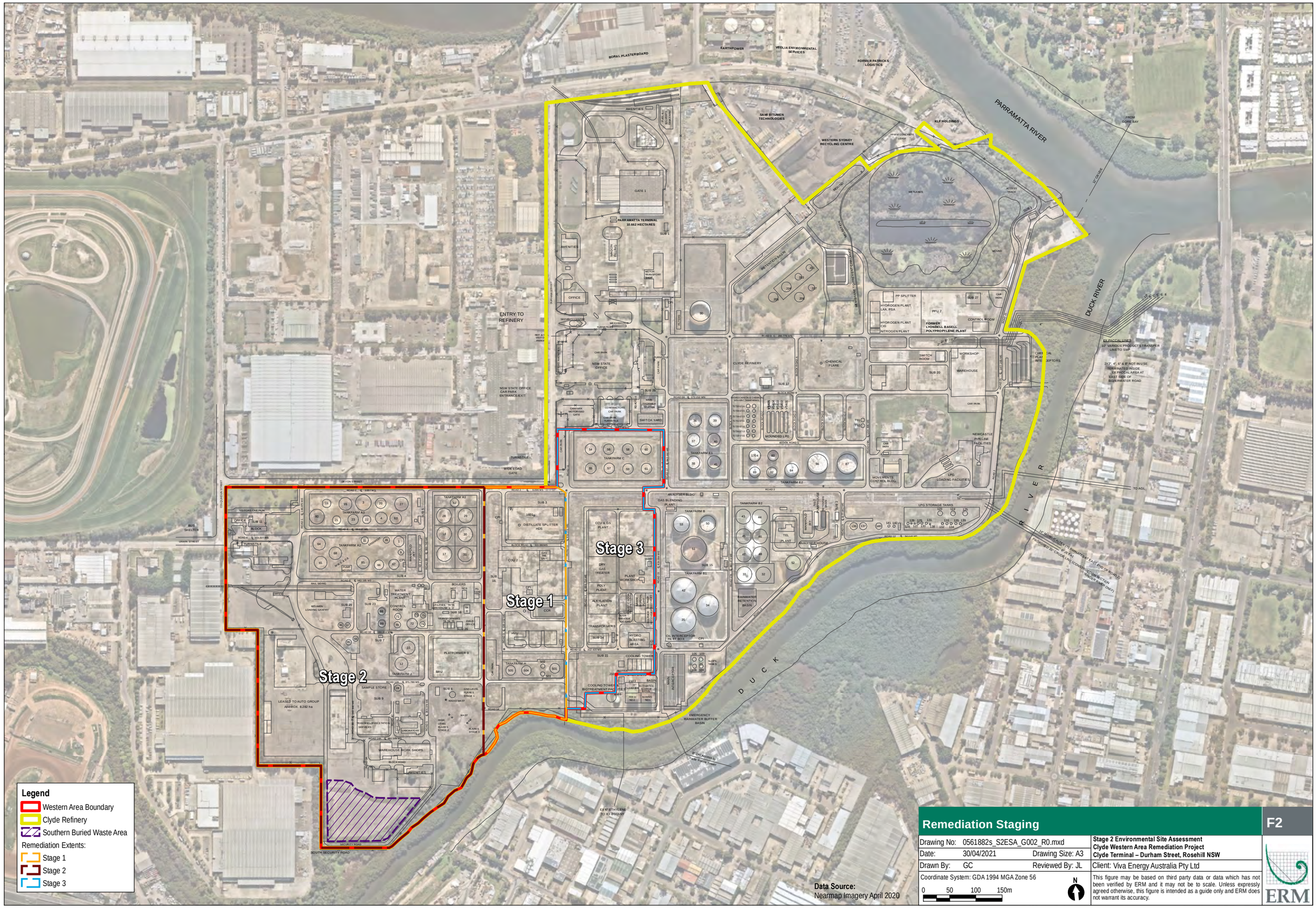
Source:
Nearmap Imagery April 2020
Locality: Esri, OpenStreetMap 2019

Site Location

F1

Drawing No:	0561882s_S2ESA_G001_R0.mxd		**Stage 2 Environmental Site Assessment** **Clyde Western Area Remediation Project** **Clyde Terminal – Durham Street, Rosehill NSW**
Date:	30/03/2021	Drawing Size: A4	
Drawn By:	GC	Reviewed By: JL	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		N	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Remediation Staging

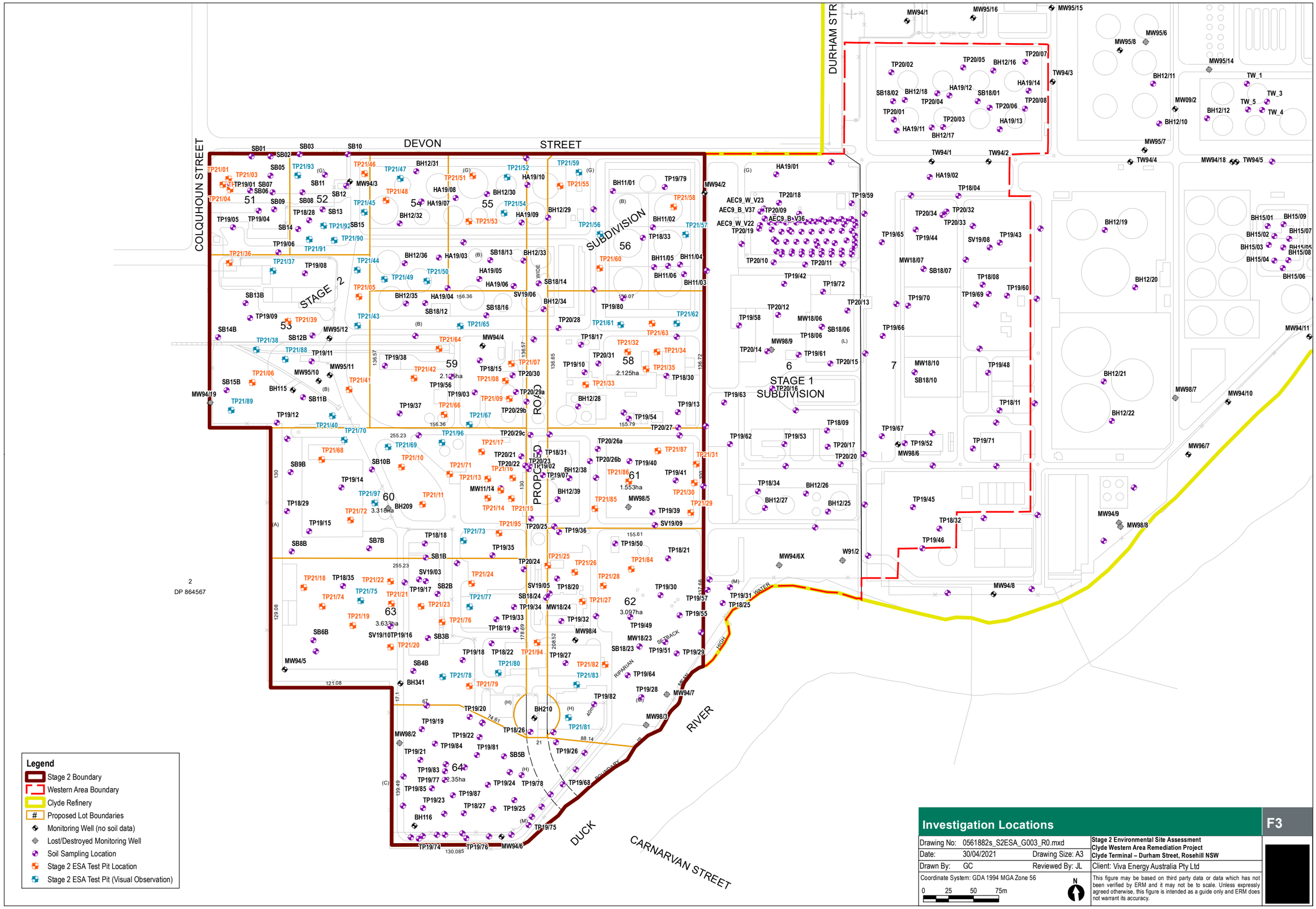
F2

Drawing No: 0561882s_S2ESA_G002_R0.mxd		Stage 2 Environmental Site Assessment Clyde Western Area Remediation Project Clyde Terminal – Durham Street, Rosehill NSW
Date: 30/04/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: JL	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

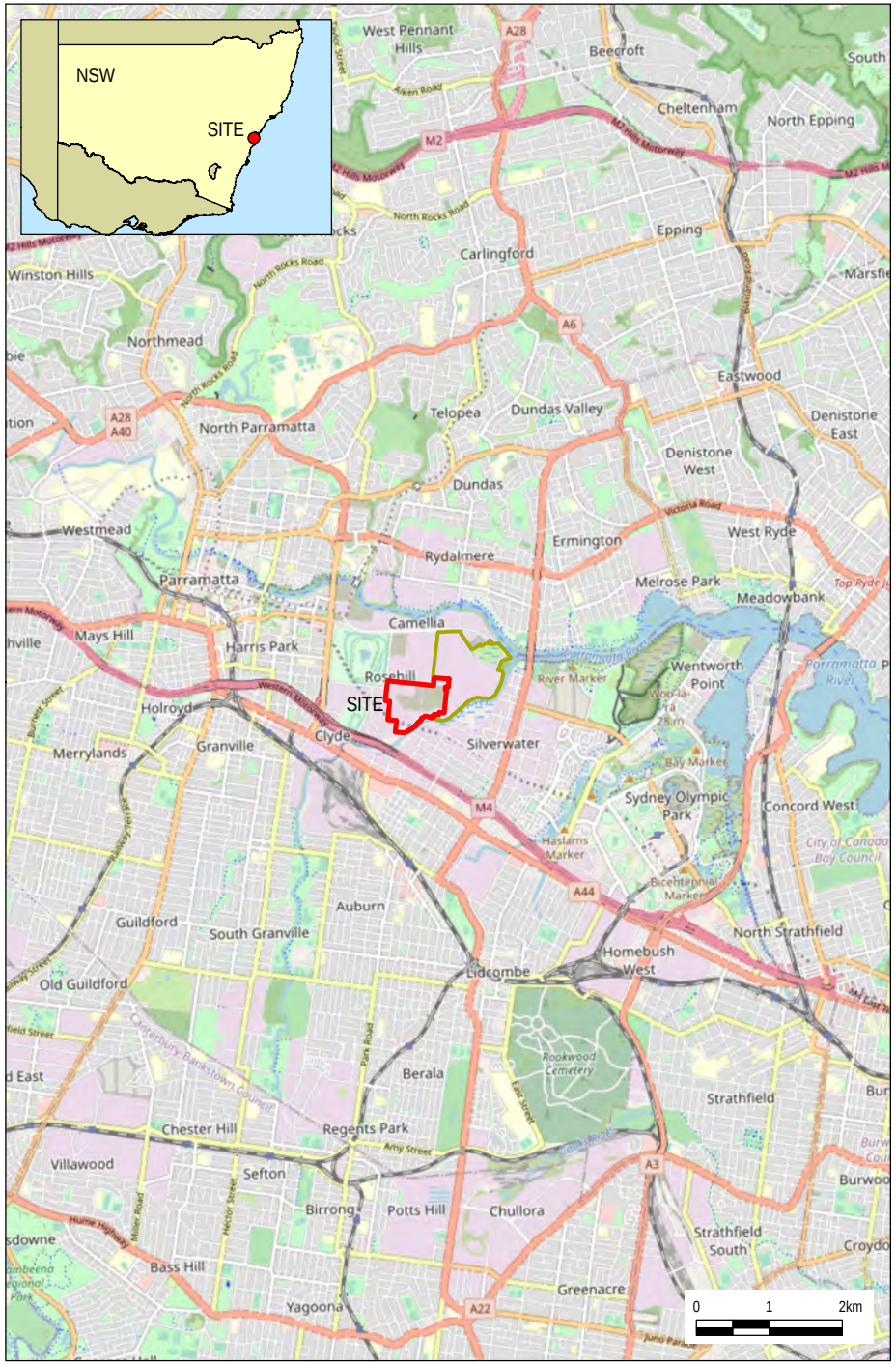
0 50 100 150m

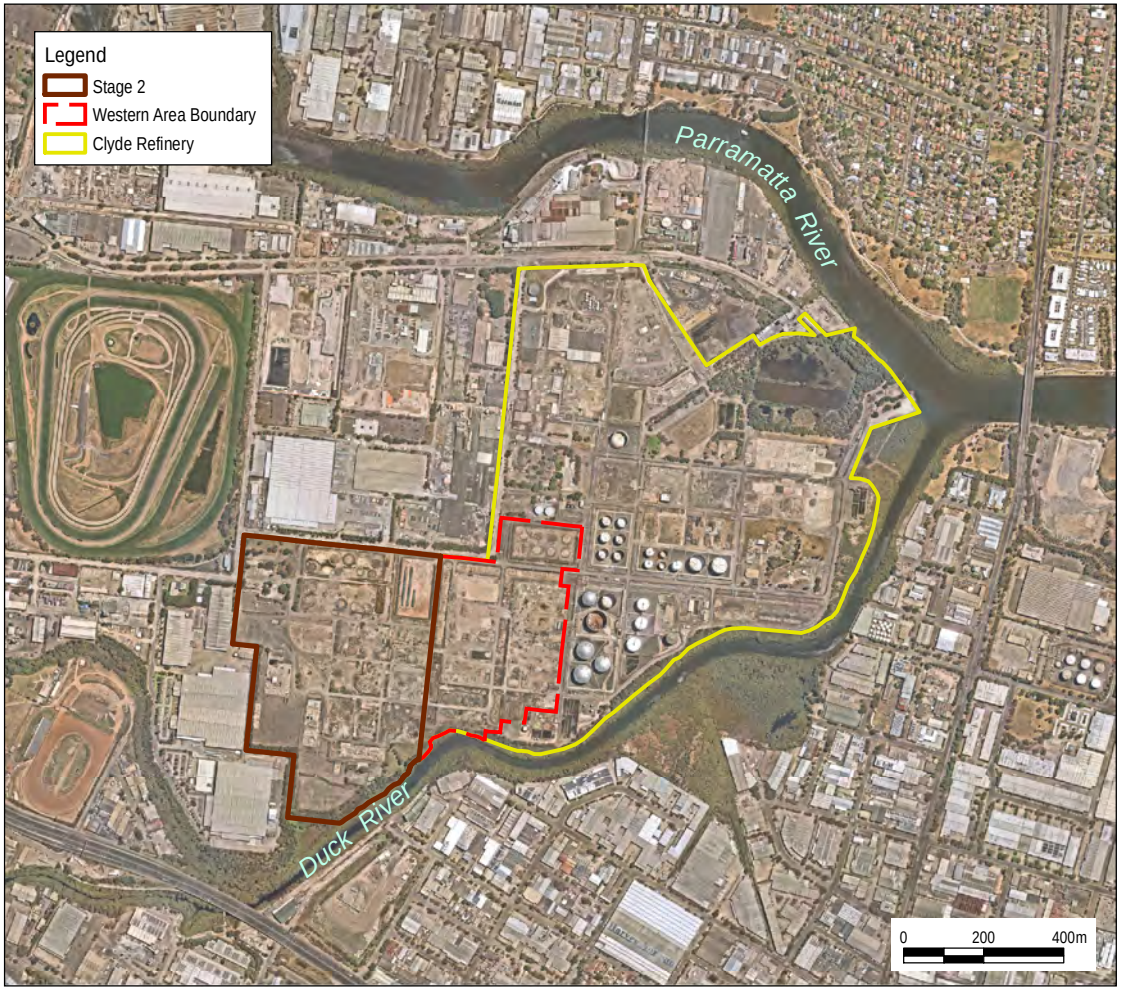
N

ERM


DEVON STREET
COLQUHOUN STREET
DURHAM STR
PROPOSED ROAD
STAGE 2 SUBDIVISION
STAGE 1 SUBDIVISION
DUCK RIVER
CARNARVAN STREET
2
DP 864567
Legend
Stage 2 Boundary
Western Area Boundary
Clyde Refinery
Proposed Lot Boundaries
Monitoring Well (no soil data)
Lost/Destroyed Monitoring Well
Soil Sampling Location
Stage 2 ESA Test Pit Location
Stage 2 ESA Test Pit (Visual Observation)
Investigation Locations
F3
Drawing No: 0561882s_S2ESA_G003_R0.mxd
Date: 30/04/2021
Drawing Size: A3
Drawn By: GC
Reviewed By: JL
Coordinate System: GDA 1994 MGA Zone 56
0 25 50 75m
N
Stage 2 Environmental Site Assessment
Clyde Western Area Remediation Project
Clyde Terminal – Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
[redacted]

Figures - Stage 2 RAP Report





General Area Land Use:
Industrial
General Hydrogeology of Locality:
1. Soil Type:
Residual clay with minor silt and sand
2. Depth to aquifer:
1.0-3.0m bgs

Aquifer Usage:
Not known beneficial onsite extraction
Potentially Sensitive Receptors:
- Parramatta River (north eastern boundary)
- Duck River (southern boundary)

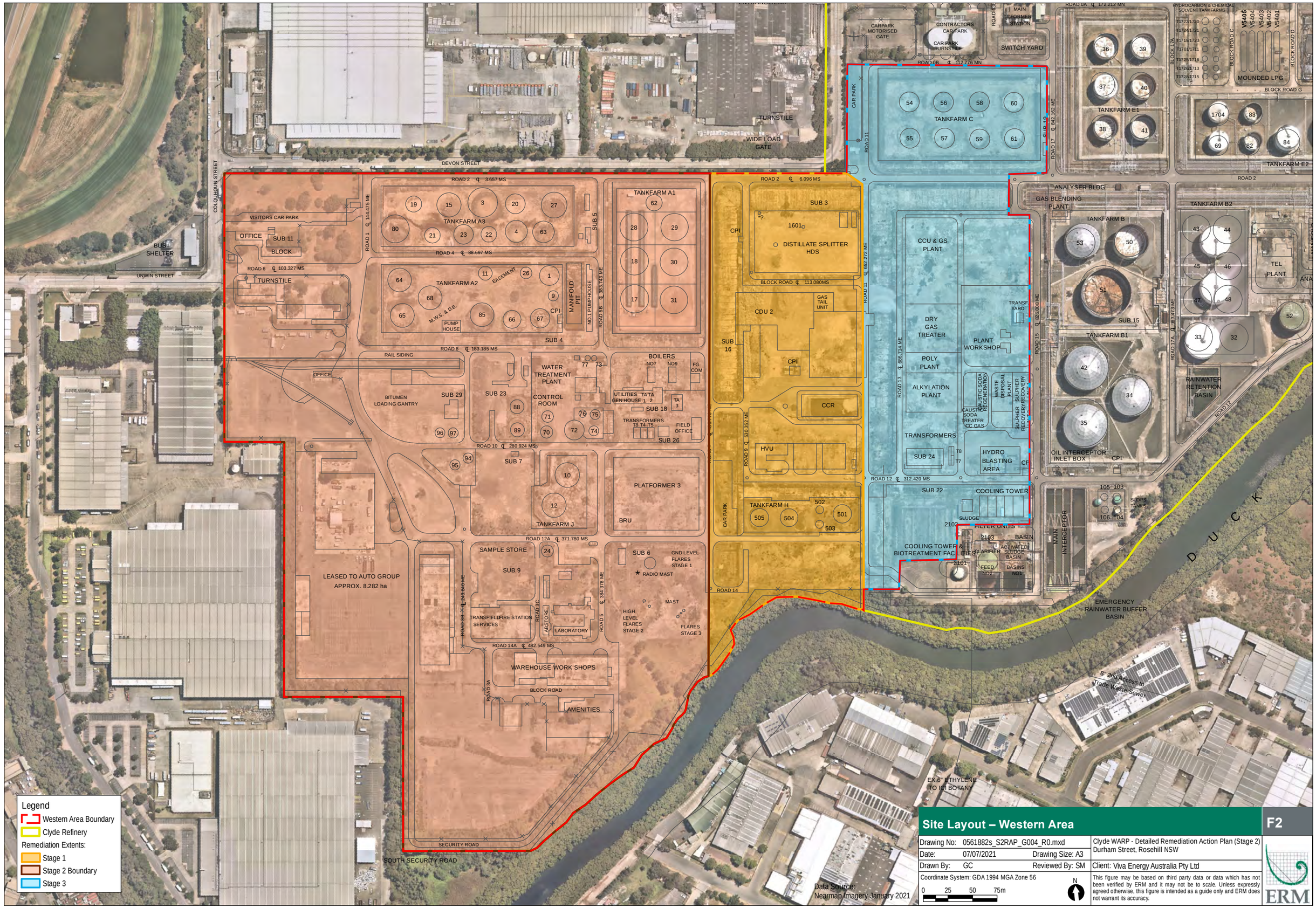
Source:
Nearmap Imagery January 2021
Locality: Esri, OpenStreetMap 2021

Site Locality

F1

Drawing No:	0561882s_S2RAP_G003_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date:	07/07/2021	Drawing Size: A4	
Drawn By:	GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GCS GDA 1994		N	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Site Layout – Western Area

F2

Drawing No: 0561882s_S2RAP_G004_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date: 07/07/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

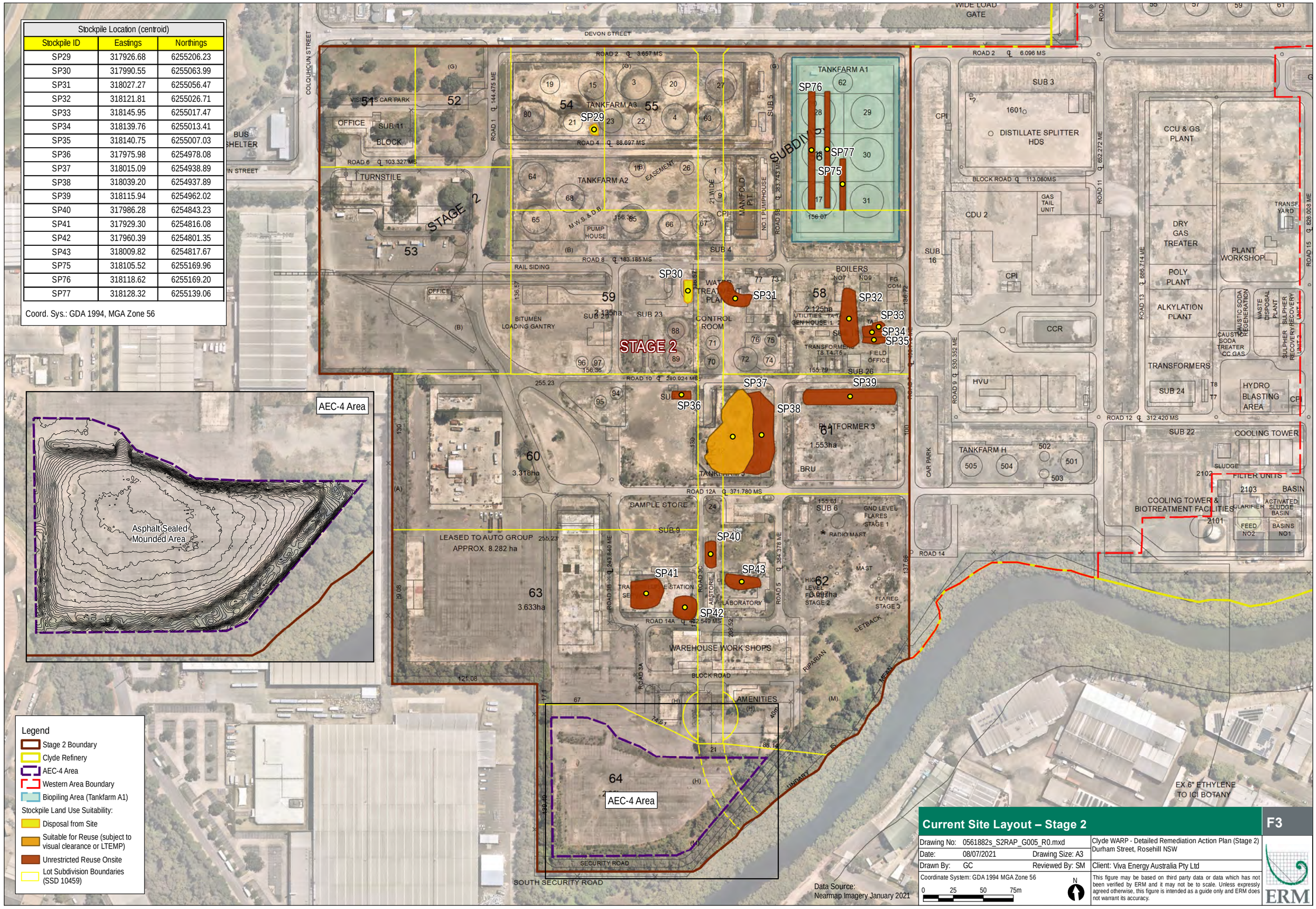
N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Stockpile Location (centroid)		
Stockpile ID	Eastings	Northings
SP29	317926.68	6255206.23
SP30	317990.55	6255063.99
SP31	318027.27	6255056.47
SP32	318121.81	6255026.71
SP33	318145.95	6255017.47
SP34	318139.76	6255013.41
SP35	318140.75	6255007.03
SP36	317975.98	6254978.08
SP37	318015.09	6254938.89
SP38	318039.20	6254937.89
SP39	318115.94	6254962.02
SP40	317986.28	6254843.23
SP41	317929.30	6254816.08
SP42	317960.39	6254801.35
SP43	318009.82	6254817.67
SP75	318105.52	6255169.96
SP76	318118.62	6255169.20
SP77	318128.32	6255139.06

Coord. Sys.: GDA 1994, MGA Zone 56



Current Site Layout – Stage 2

F3

Drawing No: 0561882s_S2RAP_G005_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date: 08/07/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

N

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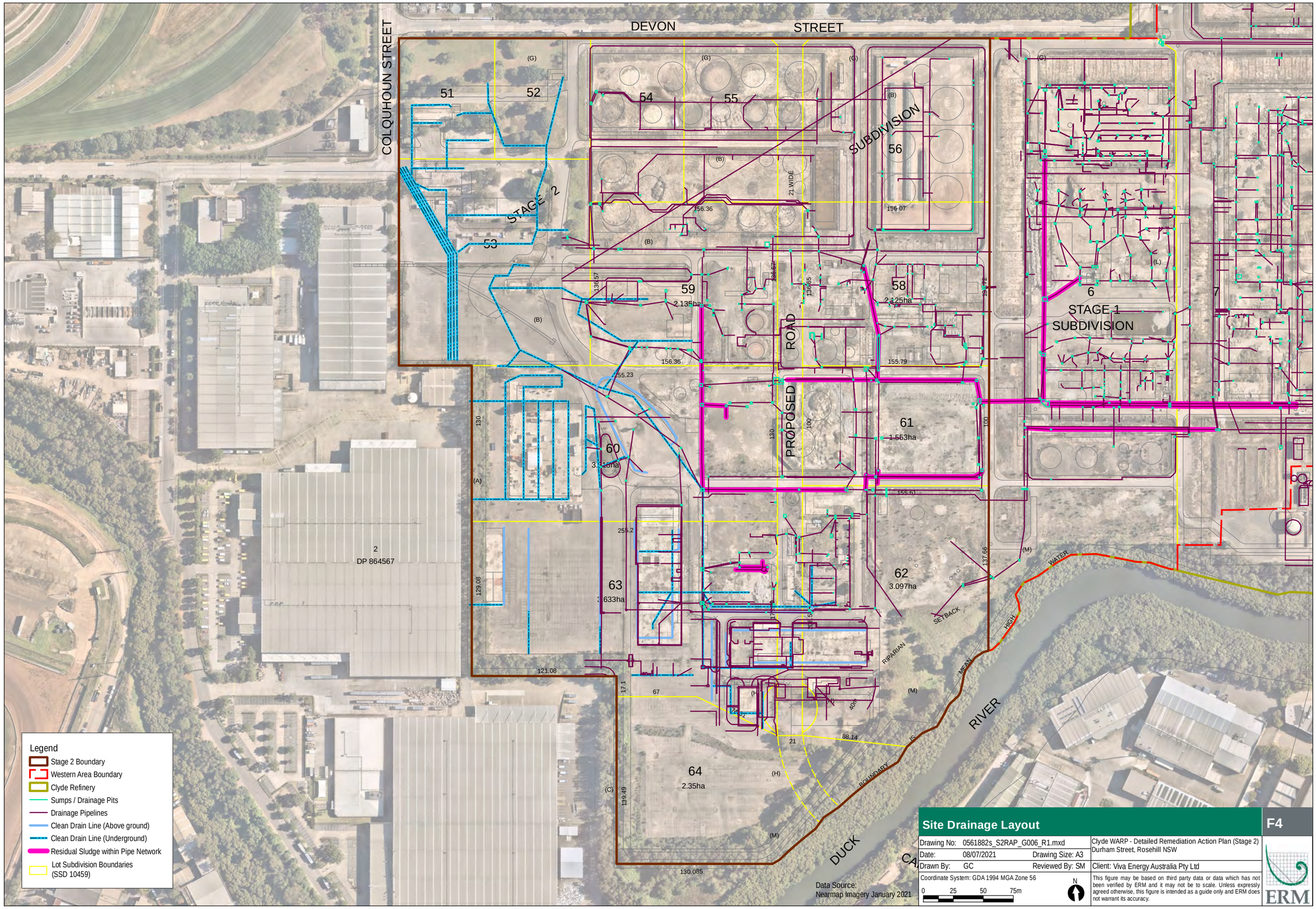
ERM



Site Drainage Layout

F4

Drawing No: 0561882s_S2RAP_G006_R1.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date: 08/07/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

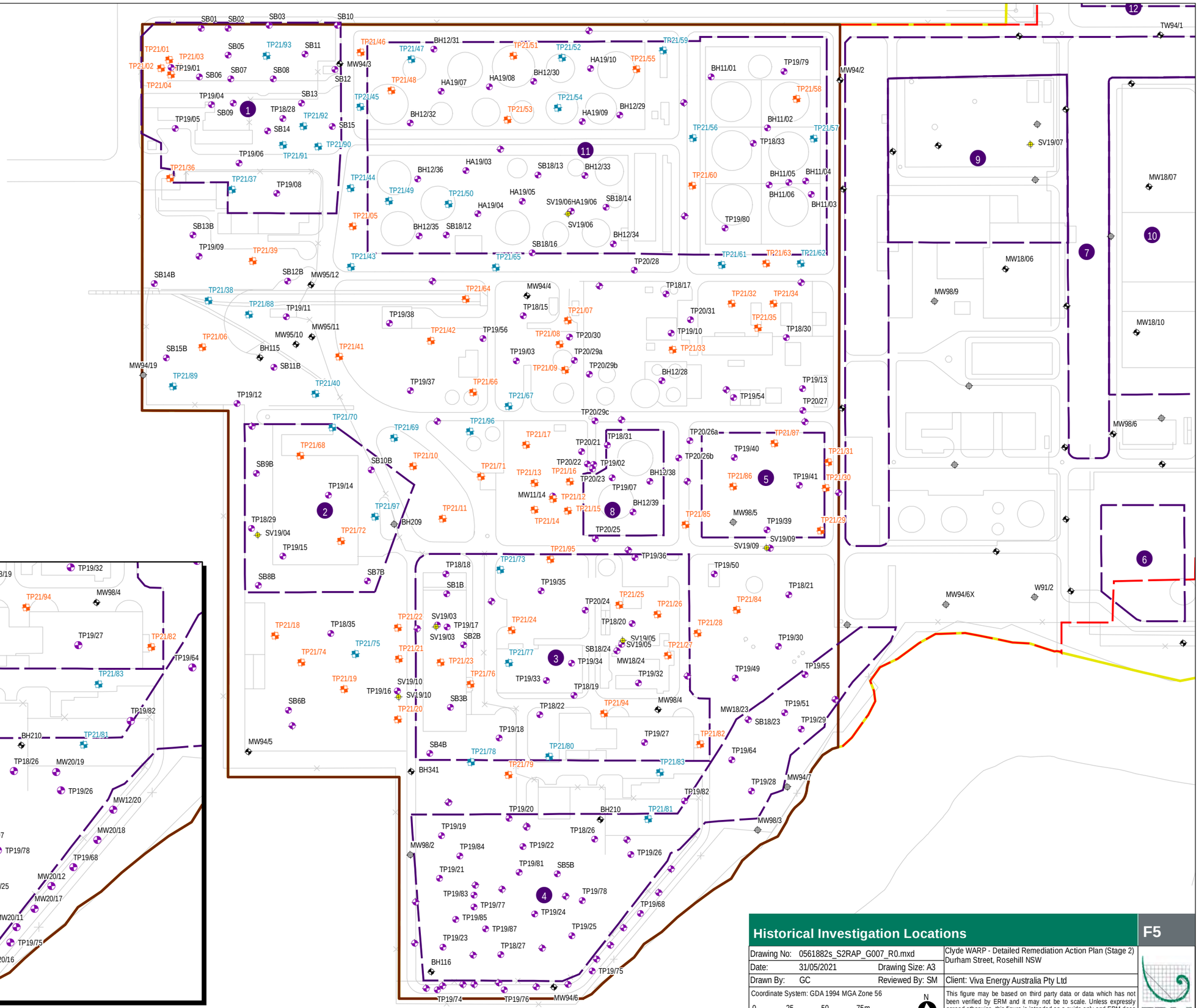
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Legend

- Stage 2
- Western Area Boundary
- Clyde Refinery
- AEC Investigation Areas
- Monitoring Well
- Lost/Destroyed Monitoring Well
- Soil Vapour Well
- Soil Sampling Location
- Test Pit Location
- Test Pit (Visual Observation)

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)



Historical Investigation Locations

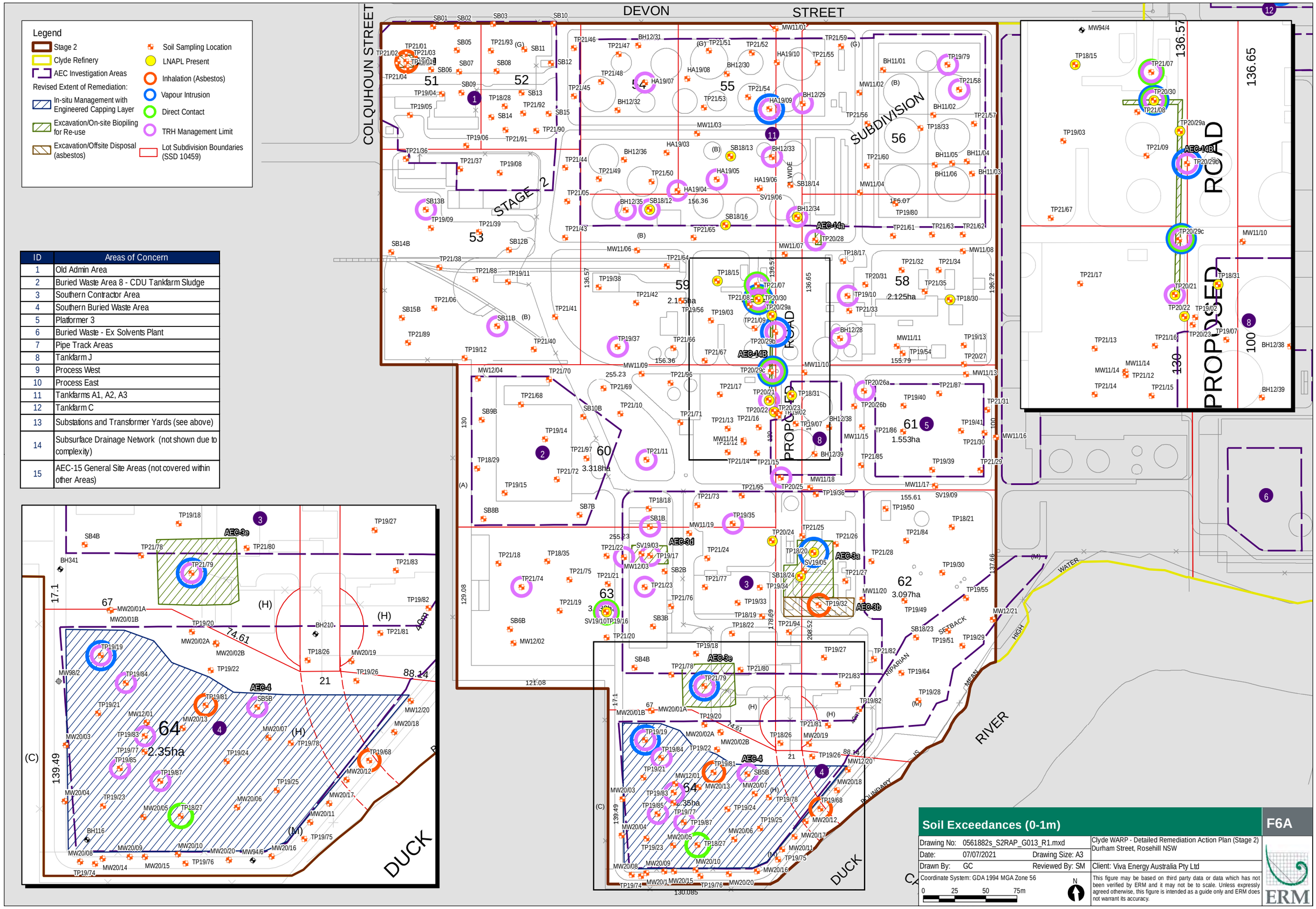
F5

Drawing No: 0561882s_S2RAP_G007_R0.mxd	Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date: 31/05/2021 Drawing Size: A3	
Drawn By: GC Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 25 50 75m

N

ERM



ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Exceedances (0-1m)

F6A

Drawing No:	0561882s_S2RAP_G013_R1.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date:	07/07/2021	Drawing Size: A3	
Drawn By:	GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

N

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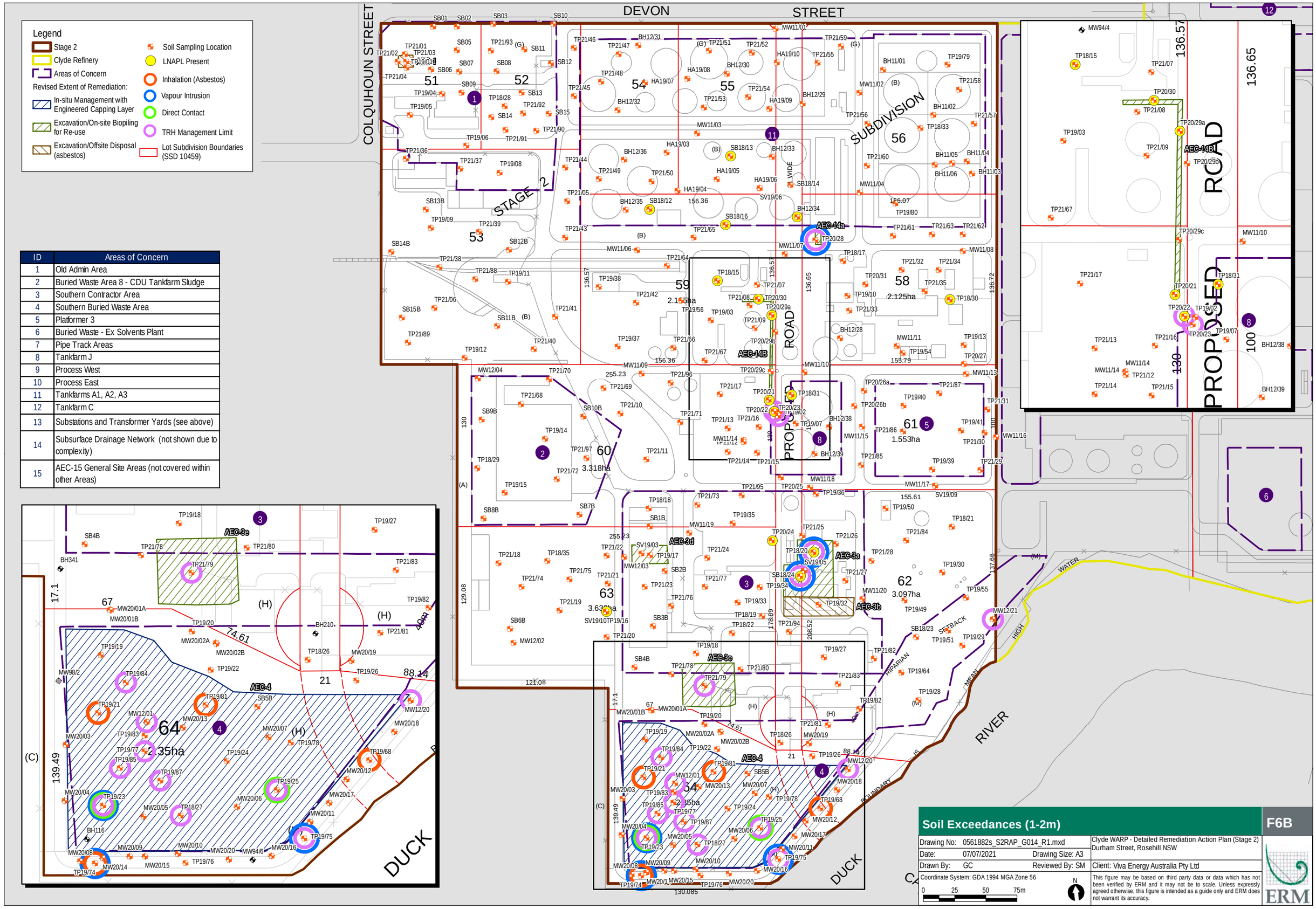
ERM



ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Exceedances (1-2m)

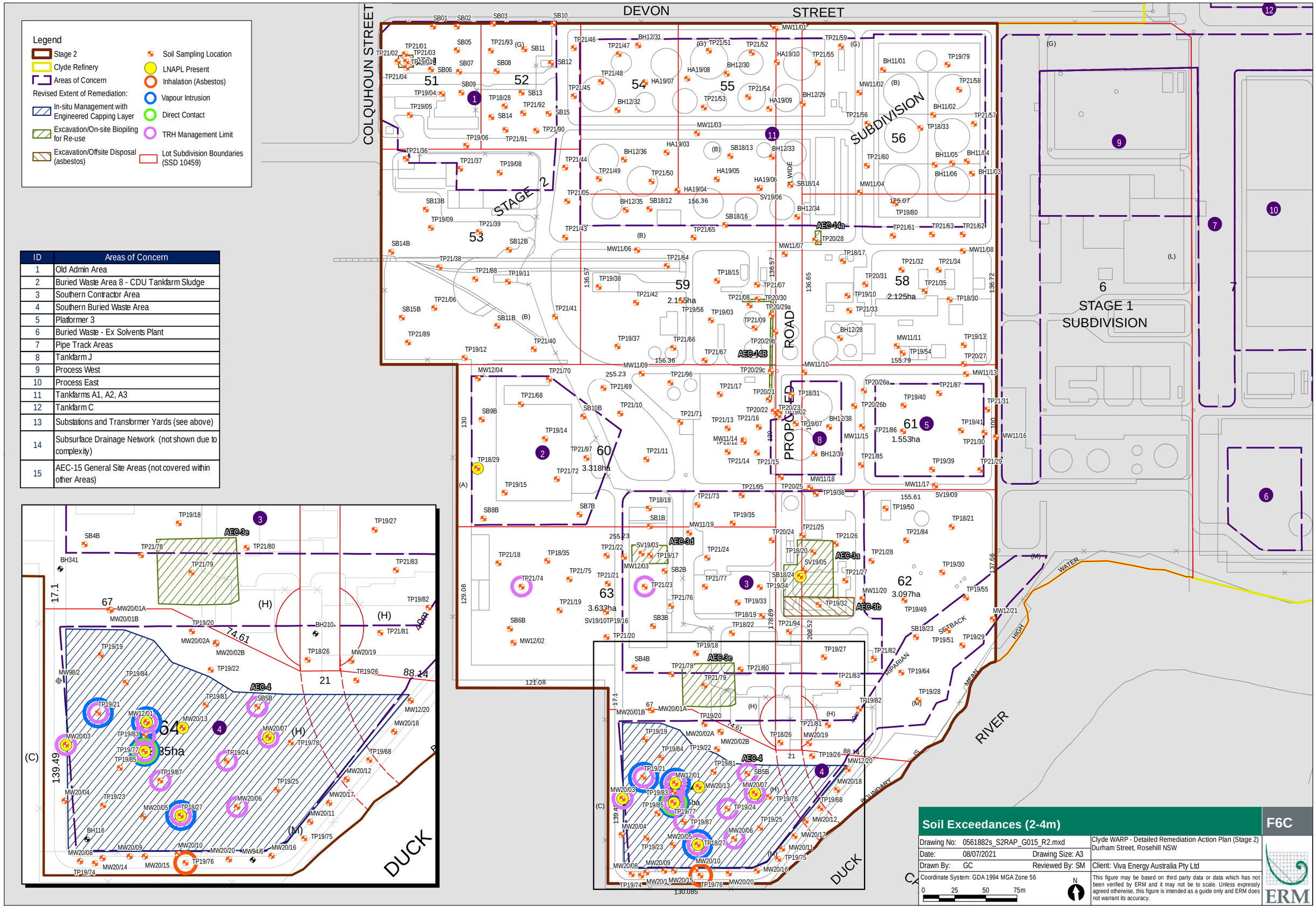
F6B

Drawing No: 0561882s_S2RAP_G014_R1.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date: 07/07/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 25 50 75m

N

ERM



ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Exceedances (2-4m)

F6C

Drawing No: 0561882s_S2RAP_G015_R2.mxd
Date: 08/07/2021 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 25 50 75m

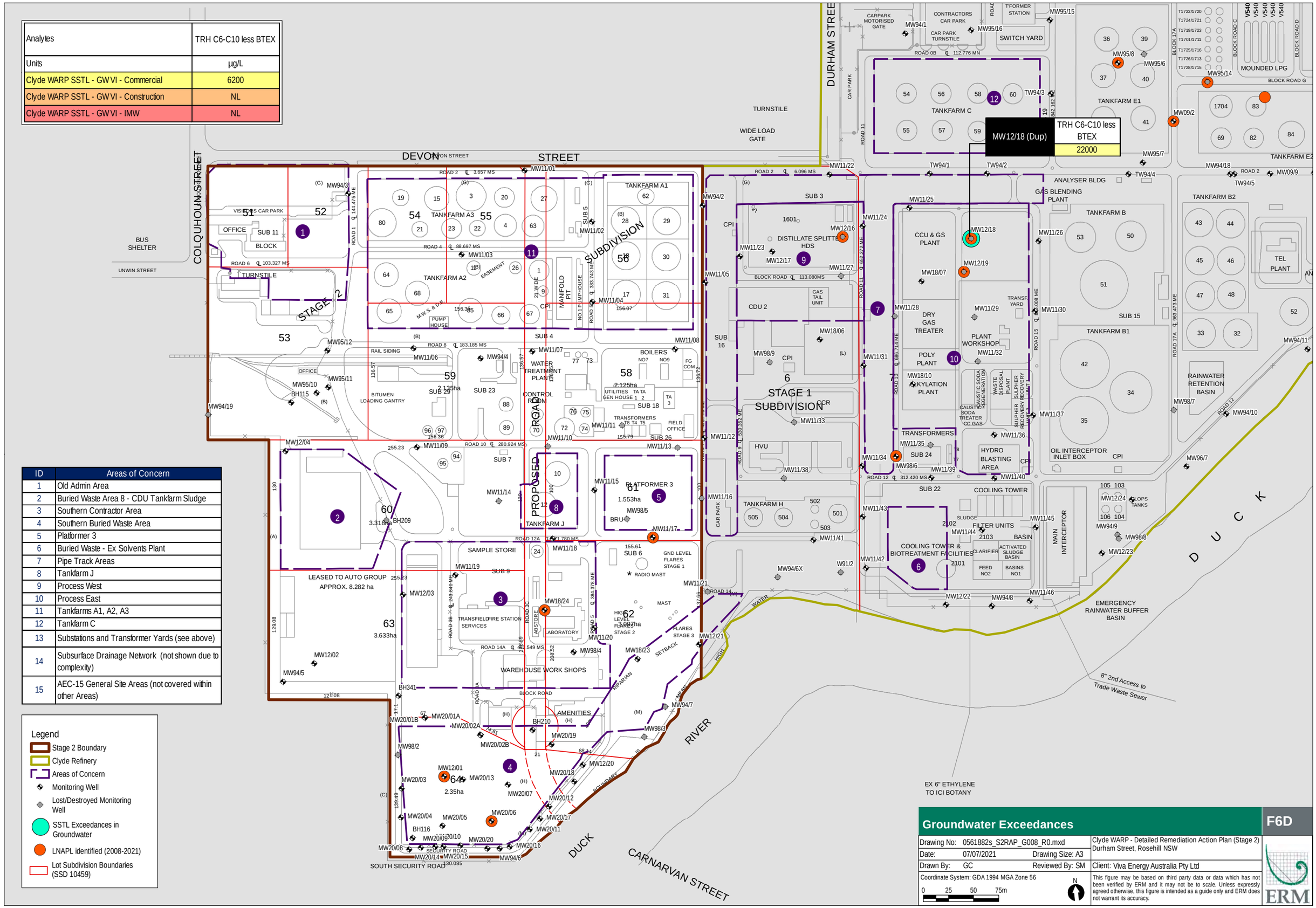
Clyde WARP - Detailed Remediation Action Plan (Stage 2)
Durham Street, Rosehill NSW

Client: Viva Energy Australia Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Analytes	TRH C6-C10 less BTEX
Units	µg/L
Clyde WARP SSTL - GWVI - Commercial	6200
Clyde WARP SSTL - GWVI - Construction	NL
Clyde WARP SSTL - GWVI - IMW	NL



ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Legend

- Stage 2 Boundary
- Clyde Refinery
- Areas of Concern
- Monitoring Well
- Lost/Destroyed Monitoring Well
- SSTL Exceedances in Groundwater
- LNAPL identified (2008-2021)
- Lot Subdivision Boundaries (SSD 10459)

Groundwater Exceedances

F6D

Drawing No:	0561882s_S2RAP_G008_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date:	07/07/2021	Drawing Size: A3	
Drawn By:	GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Analytes	TRH >C8-C10 Aliphatic	Benzene	Naphthalene
Units	mg/m³	ppmv	ppmv
Clyde WARP SSTL - SV VI - Commercial 0.15m	4200	18	14

SV19/07	Naphthalene
	20.5

SV19/05	TRH >C8-C10 Aliphatic	Benzene
	5350	383

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Legend
- Stage 2 Boundary
- Clyde Refinery
- Areas of Concern
- Monitoring Well
- Lost/Destroyed Monitoring Well
- Soil Vapour Well
- Lot Subdivision Boundaries (SSD 10459)

Soil Vapour Exceedances

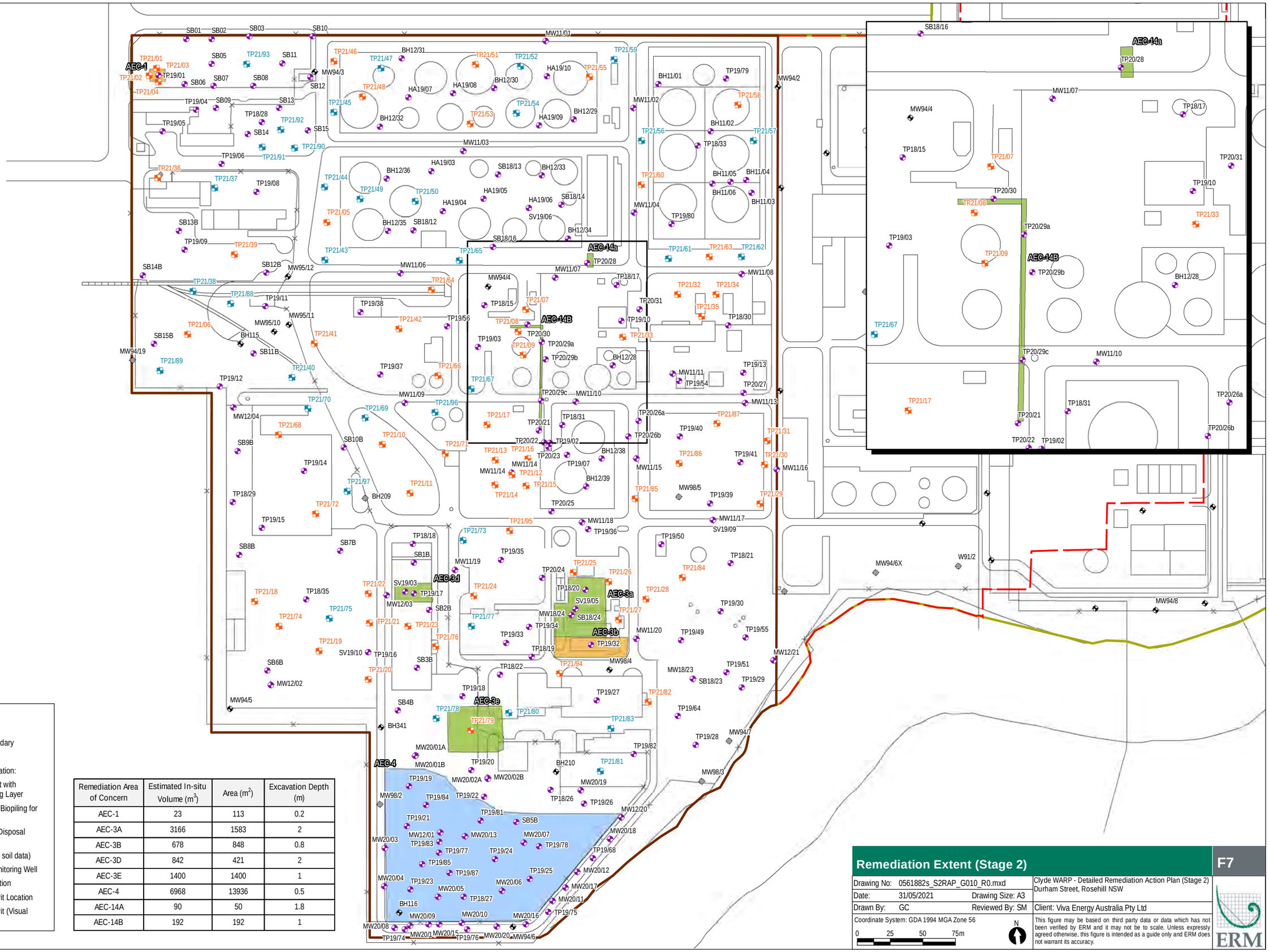
F6E

Drawing No: 0561882s_S2RAP_G009_R0.mxd
Date: 07/07/2021 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 25 50 75m

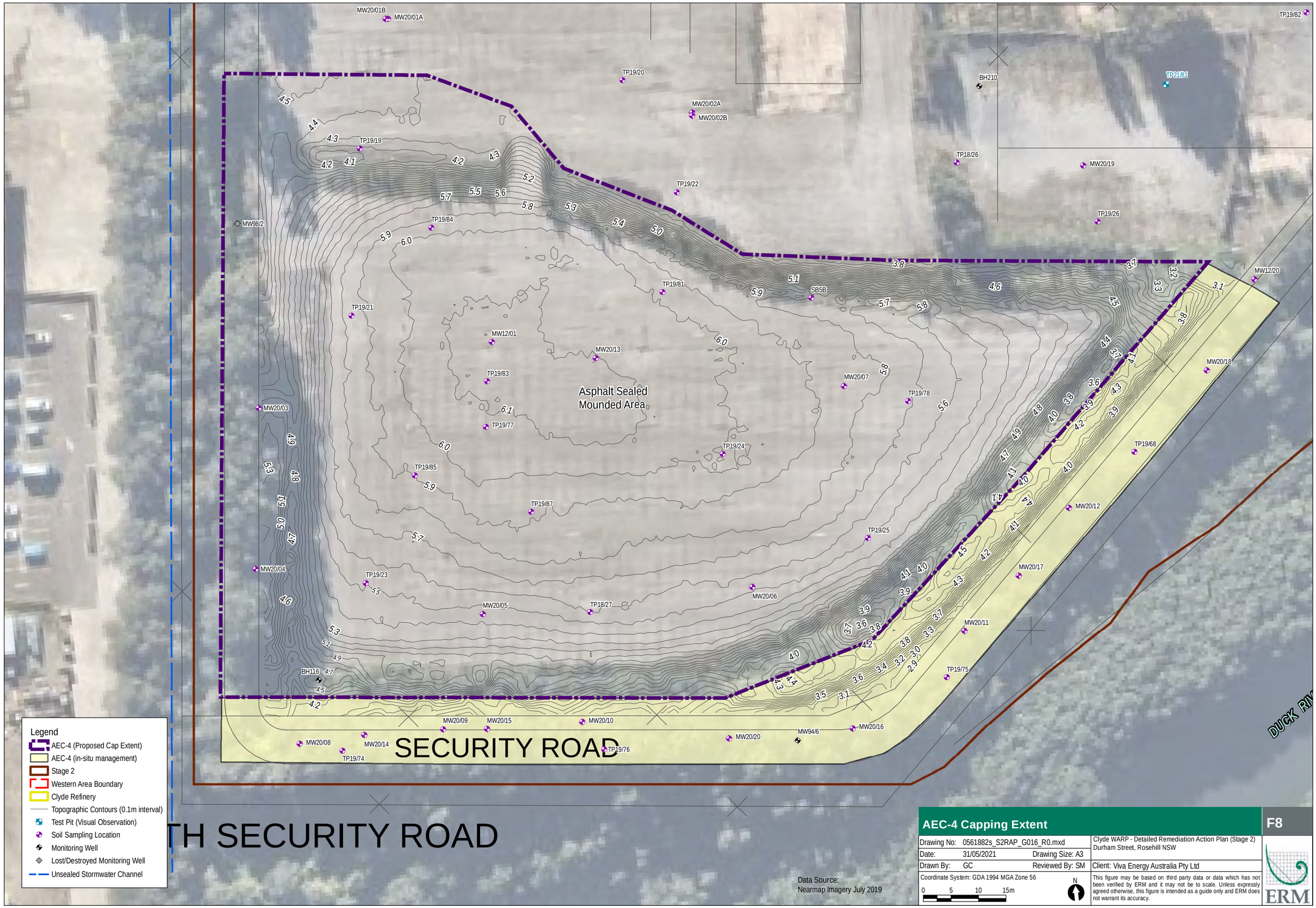
Clyde WARP - Detailed Remediation Action Plan (Stage 2)
Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Remediation Area of Concern	Estimated In-situ Volume (m^3)	Area (m^2)	Excavation Depth (m)
AEC-1	23	113	0.2
AEC-3A	3166	1583	2
AEC-3B	678	848	0.8
AEC-3D	842	421	2
AEC-3E	1400	1400	1
AEC-4	6968	13936	0.5
AEC-14A	90	50	1.8
AEC-14B	192	192	1

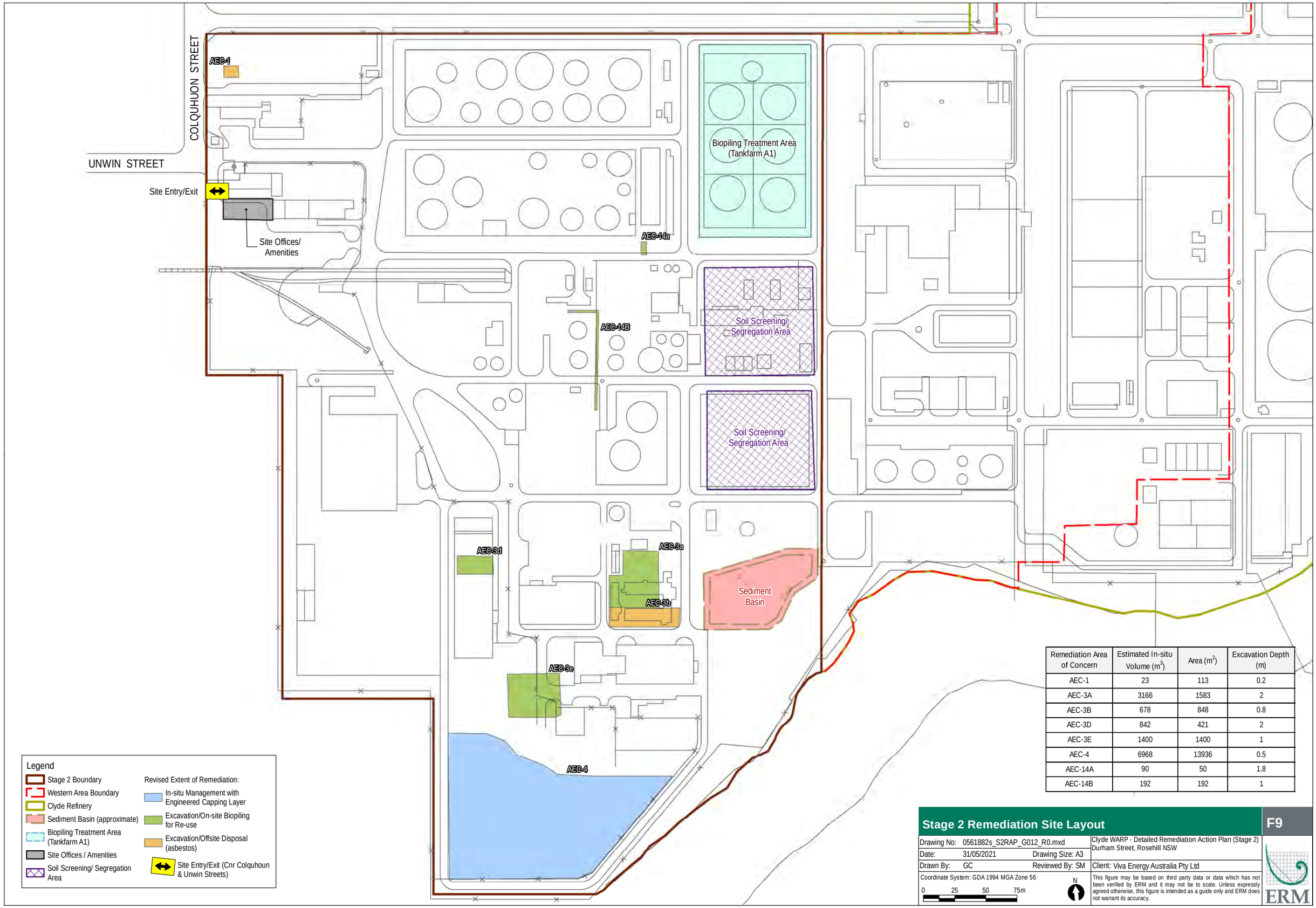


AEC-4 Capping Extent

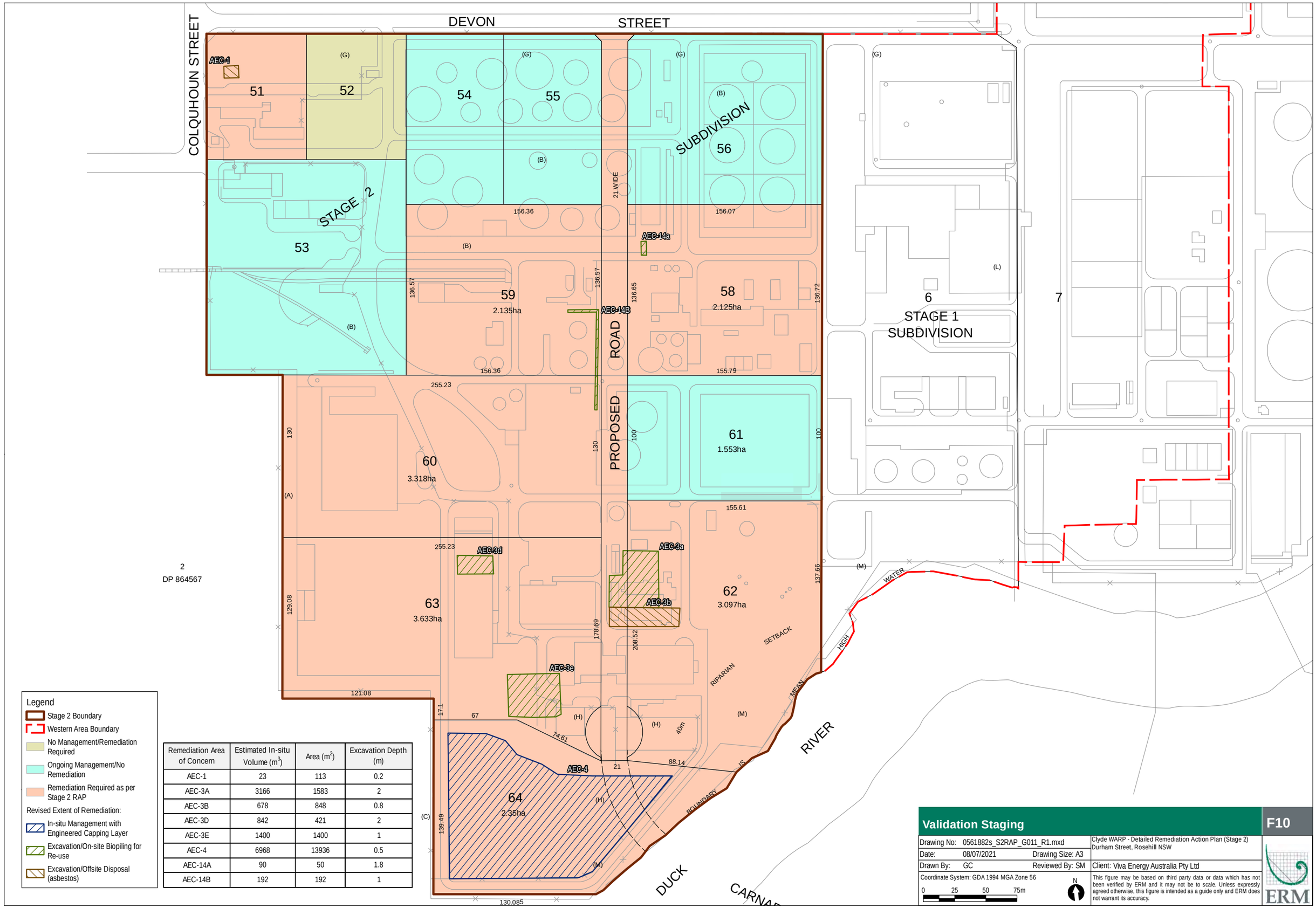
F8

Drawing No: 0561882s_S2RAP_G016_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date: 31/05/2021	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Remediation Area of Concern	Estimated In-situ Volume (m^3)	Area (m^2)	Excavation Depth (m)
AEC-1	23	113	0.2
AEC-3A	3166	1583	2
AEC-3B	678	848	0.8
AEC-3D	842	421	2
AEC-3E	1400	1400	1
AEC-4	6968	13936	0.5
AEC-14A	90	50	1.8
AEC-14B	192	192	1



Legend

- Stage 2 Boundary
- Western Area Boundary
- No Management/Remediation Required
- Ongoing Management/No Remediation
- Remediation Required as per Stage 2 RAP

Revised Extent of Remediation:

- In-situ Management with Engineered Capping Layer
- Excavation/On-site Biopiling for Re-use
- Excavation/Offsite Disposal (asbestos)

Remediation Area of Concern	Estimated In-situ Volume (m^3)	Area (m^2)	Excavation Depth (m)
AEC-1	23	113	0.2
AEC-3A	3166	1583	2
AEC-3B	678	848	0.8
AEC-3D	842	421	2
AEC-3E	1400	1400	1
AEC-4	6968	13936	0.5
AEC-14A	90	50	1.8
AEC-14B	192	192	1

Validation Staging

F10

Drawing No: 0561882s_S2RAP_G011_R1.mxd
Date: 08/07/2021 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

N

Clyde WARP - Detailed Remediation Action Plan (Stage 2)
Durham Street, Rosehill NSW

Client: Viva Energy Australia Pty Ltd

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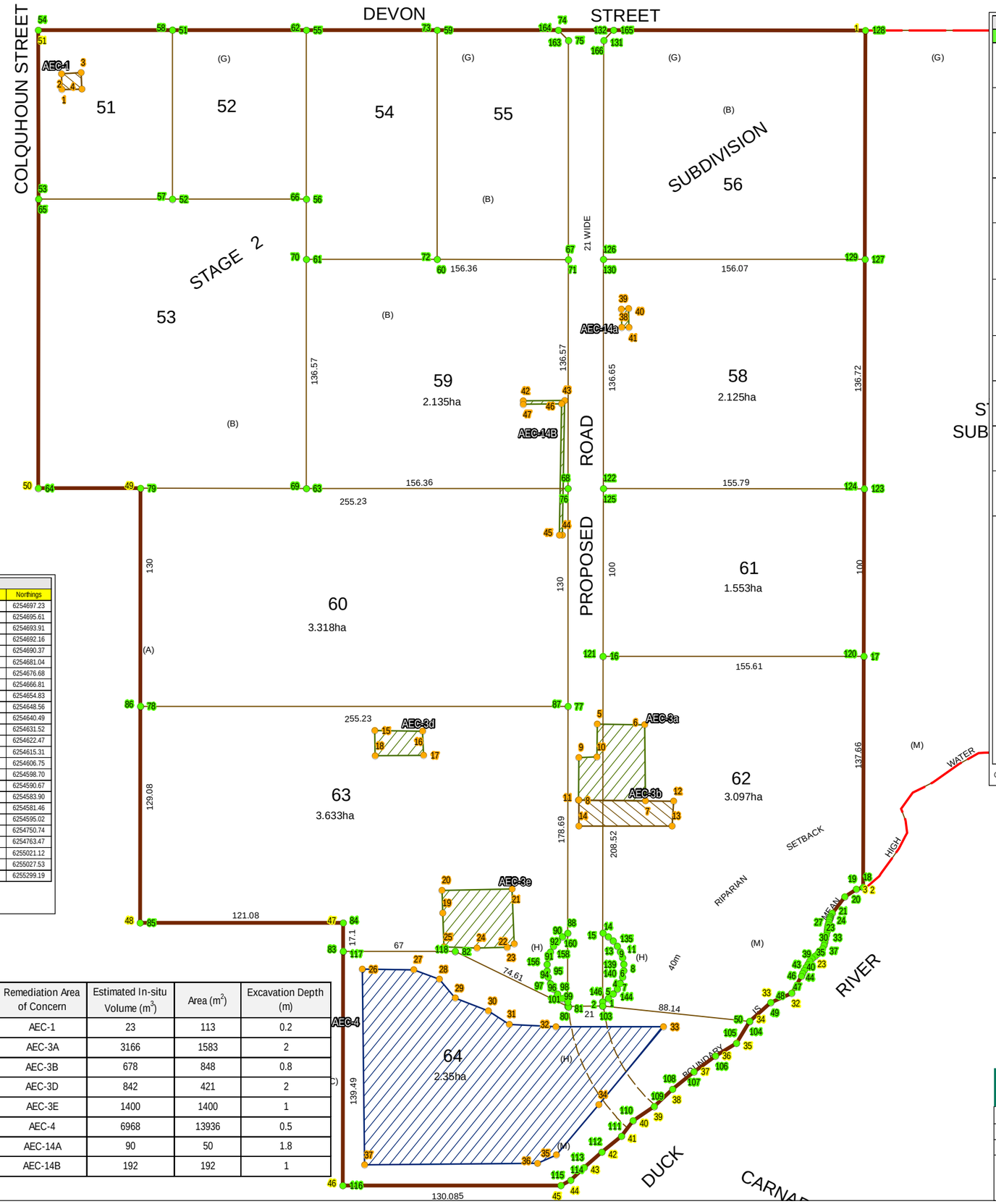
ERM



Stage 2 Boundary					
Point ID	Eastings	Northings	Point ID	Eastings	Northings
1	318196.68	6255247.46	27	318104.15	6254697.23
2	318141.87	6254739.38	28	318102.90	6254695.61
3	318137.61	6254738.63	29	318101.73	6254693.91
4	318130.39	6254734.88	30	318100.65	6254692.16
5	318121.87	6254725.91	31	318099.69	6254690.37
6	318120.73	6254724.09	32	318092.78	6254681.04
7	318120.54	6254723.71	33	318079.87	6254676.68
8	318120.35	6254723.33	34	318066.07	6254666.81
9	318120.16	6254722.95	35	318056.91	6254654.83
10	318119.98	6254722.56	36	318043.74	6254648.56
11	318119.81	6254722.17	37	318030.00	6254640.49
12	318119.29	6254720.83	38	318016.18	6254631.52
13	318118.87	6254719.45	39	318004.07	6254622.47
14	318118.50	6254718.05	40	317990.61	6254615.31
15	318118.12	6254716.65	41	317982.79	6254606.75
16	318117.70	6254715.26	42	317970.15	6254598.70
17	318117.07	6254713.28	43	317958.71	6254590.67
18	318116.45	6254711.26	44	317950.05	6254583.90
19	318115.78	6254709.28	45	317943.80	6254581.46
20	318114.96	6254707.40	46	317814.42	6254595.02
21	318113.93	6254705.68	47	317830.89	6254750.74
22	318112.50	6254704.12	48	317710.48	6254763.47
23	318110.77	6254702.78	49	317737.74	6255021.12
24	318108.91	6254701.53	50	317677.11	6255027.53
25	318107.09	6254700.24	51	317705.68	6255299.19
26	318105.48	6254698.77			

Coord. Sys: GDA 1994, MGA Zone 56

Proposed Lot Boundaries											
Lot	Point ID	Eastings	Northings	Lot	Point ID	Eastings	Northings	Lot	Point ID	Eastings	Northings
51	51	317785.2456	6255290.808	62	1	317979.8816	6254685.258	64	102	317959.4539	6254687.25
	52	317774.7825	6255190.556		2	317980.1351	6254687.647		103	317979.8816	6254685.258
	53	317695.2218	6255198.976		3	317983.6248	6254689.35		104	318066.0658	6254666.807
	54	317705.6809	6255299.19		4	317986.7795	6254691.614		105	318056.9076	6254654.825
52	55	317864.805	6255282.426		5	317989.5098	6254694.375		106	318043.7362	6254648.563
	56	317854.1977	6255182.15		6	317991.7383	6254697.554		107	318030.0003	6254640.491
	57	317774.7825	6255190.556		7	317993.4019	6254701.063		108	318016.1837	6254631.515
	58	317785.2456	6255290.808		8	317994.4535	6254704.801		109	318004.0673	6254622.474
53	63	317836.0633	6255010.716		9	317994.8632	6254708.662		110	317990.6137	6254615.306
	64	317677.1142	6255027.53		10	317994.6194	6254712.537		111	317982.7877	6254606.751
	65	317695.2218	6255198.976		11	317993.7291	6254716.317		112	317970.1503	6254598.7
	66	317854.155	6255182.155		12	317992.2175	6254719.894		113	317958.7133	6254590.672
54	59	317942.4951	6255274.242		13	317990.1274	6254723.166		114	317950.0516	6254583.9
	60	317928.1162	6255138.311		14	317987.518	6254726.041		115	317943.7984	6254581.462
	61	317850.4296	6255146.528		15	317984.4633	6254728.439		116	317814.4204	6254595.015
	62	317864.805	6255282.426		16	318001.8836	6254892.618		117	317829.0942	6254733.735
55	71	318005.9178	6255130.081		17	318156.6336	6254876.248		118	317895.7224	6254726.687
	72	317928.1162	6255138.311		18	318141.8687	6254739.385		119	317959.4072	6254686.8
	73	317942.4951	6255274.242		19	318137.6116	6254738.625	Proposed Road	133	317984.4633	6254728.439
	74	318014.3333	6255266.674		20	318130.3873	6254734.881		134	317987.5236	6254726.045
	75	318019.6691	6255260.078		21	318121.8694	6254725.912		135	317990.1384	6254723.17
56	128	318196.6807	6255247.464		22	318120.7307	6254724.088		136	317992.2332	6254719.898
	129	318182.0238	6255111.602		23	318120.5363	6254723.71		137	317993.7485	6254716.32
	130	318026.8082	6255127.953		24	318120.346	6254723.329		138	317994.6413	6254712.539
	131	318040.5501	6255257.879		25	318120.1608	6254722.946		139	317994.8862	6254708.661
	132	318047.1482	6255263.217		26	318119.9815	6254722.56		140	317994.4762	6254704.797
58	124	318167.3595	6254975.671		27	318119.8071	6254722.173		141	317993.423	6254701.057
	125	318012.435	6254992.059		28	318119.2925	6254720.831		142	317991.7565	6254697.547
	126	318026.8082	6255127.953		29	318118.8732	6254719.451		143	317989.5242	6254694.367
	127	318182.0238	6255111.602		30	318118.5	6254718.047		144	317986.7893	6254691.607
59	67	318005.9178	6255130.081		31	318118.1242	6254716.646		145	317983.6296	6254689.346
	68	317991.5515	6254994.268		32	318117.6992	6254715.262		146	317980.1351	6254687.647
	69	317836.0633	6255010.716		33	318117.069	6254713.278		147	317979.8816	6254685.258
	70	317850.4296	6255146.528		34	318116.4536	6254711.264		148	317959.4539	6254687.25
60	76	317991.5515	6254994.268		35	318115.776	6254709.284		149	317959.3547	6254689.896
	77	317977.8763	6254864.99		36	318114.9588	6254707.4		150	317956.3018	6254692.284
	78	317724.0609	6254891.839		37	318113.9278	6254705.676		151	317953.6933	6254695.151
	79	317737.736	6255021.117		38	318112.4953	6254704.118		152	317951.6032	6254698.415
61	120	318156.6336	6254876.248		39	318110.7673	6254702.779		153	317950.091	6254701.984
	121	318001.8836	6254892.618		40	318108.9106	6254701.528		154	317949.1995	6254705.756
	122	318012.435	6254992.059		41	318107.0912	6254700.235		155	317948.9542	6254709.625
	123	318167.3595	6254975.671		42	318105.4776	6254698.77		156	317949.3619	6254713.479
63	80	317959.4539	6254687.25		43	318104.1492	6254697.232		157	317950.4112	6254717.211
	81	317959.0788	6254687.287		44	318102.8956	6254695.607		158	317952.0721	6254720.713
	82	317895.7224	6254726.687		45	318101.7271	6254693.913		159	317954.2975	6254723.886
	83	317829.0942	6254733.735		46	318100.6534	6254692.164		160	317957.0243	6254726.641
	84	317830.8927	6254750.738		47	318099.6867	6254690.375		161	317960.1749	6254728.899
	85	317710.4825	6254763.475		48	318092.7751	6254681.039		162	317963.66	6254730.595
	86	317724.0609	6254891.839		49	318079.8653	6254676.681		163	318019.6691	6255260.078
	87	317977.8763	6254864.99		50	318066.0658	6254666.807		164	318014.3333	6255266.674
	88	317963.66	6254730.595						165	318047.1482	6255263.217
	89	317960.1749	6254728.899						166	318040.5501	6255257.879
	90	317957.0243	6254726.641								
	91	317954.2975	6254723.886								
	92	317952.0721	6254720.713								
	93	317950.4112	6254717.211								
	94	317949.3619	6254713.479								
	95	317948.9542	6254709.625								
	96	317949.1995	6254705.756								
	97	317950.091	6254701.984								
	98	317951.6032	6254698.415								
	99	317953.6933	6254695.151								
	100	317956.3018	6254692.284								
	101	317959.3547	6254689.896								

Coord. Sys.: GDA 1994, MGA Zone 56

Remediation Extents							
Area	Point ID	Eastings	Northings	Area	Point ID	Eastings	Northings
AEC-1	1	317716.05	6255262.49	AEC-4	26	317839.39	6254721.99
	2	317716.65	6255271.91		27	317869.92	6254718.42
	3	317728.34	6255271.26		28	317884.58	6254711.20
	4	317727.75	6255261.49		29	317892.79	6254699.08
AEC-3a	5	317994.13	6254852.79		30	317911.60	6254689.39
	6	318022.23	6254849.27		31	317923.38	6254680.21
	7	318018.09	6254804.18		32	317950.80	6254675.96
	8	317978.32	6254808.77		33	318014.71	6254669.06
	9	317981.30	6254834.07		34	317971.37	6254626.91
	10	317991.89	6254833.28		35	317943.14	6254599.61
AEC-3b	11	317978.56	6254808.77		36	317931.37	6254595.99
	12	318034.65	6254802.17		37	317828.60	6254605.82
	13	318032.22	6254787.63	AEC-14a	38	318033.37	6255086.54
	14	317976.91	6254793.31		39	318034.30	6255097.41
AEC-3d	15	317861.71	6254862.73		40	318038.68	6255097.10
	16	317889.90	6254859.37		41	318037.75	6255086.06
	17	317889.20	6254844.95		42	317970.39	6255049.05
	18	317860.45	6254847.77		43	317995.05	6255046.71
AEC-3e	19	317890.65	6254750.25		44	317985.35	6254967.01
	20	317891.71	6254763.79		45	317983.46	6254967.15
	21	317933.24	6254760.33		46	317993.02	6255045.00
	22	317931.22	6254727.52		47	317970.24	6255047.18
	23	317926.69	6254726.06				
	24	317908.95	6254727.44				
	25	317889.20	6254730.13				

Coord. Sys.: GDA 1994, MGA Zone 56

Remediation Area of Concern	Estimated In-situ Volume (m^3)	Area (m^2)	Excavation Depth (m)
AEC-1	23	113	0.2
AEC-3A	3166	1583	2
AEC-3B	678	848	0.8
AEC-3D	842	421	2
AEC-3E	1400	1400	1
AEC-4	6968	13936	0.5
AEC-14A	90	50	1.8
AEC-14B	192	192	1

Legend

- Stage 2 Boundary
- Western Area Boundary

Revised Extent of Remediation:

- In-situ Management with Engineered Capping Layer
- Excavation/On-site Biopiling for Re-use
- Excavation/Offsite Disposal (asbestos)

Proposed Lot Boundaries

F11

Drawing No: 0561882s_S2RAP_G017_R0.mxd

Date: 07/07/2021 Drawing Size: A3

Drawn By: GC Reviewed By: SM

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

N

Clyde WARP - Detailed Remediation Action Plan (Stage 2)
Durham Street, Rosehill NSW

Client: Viva Energy Australia Pty Ltd

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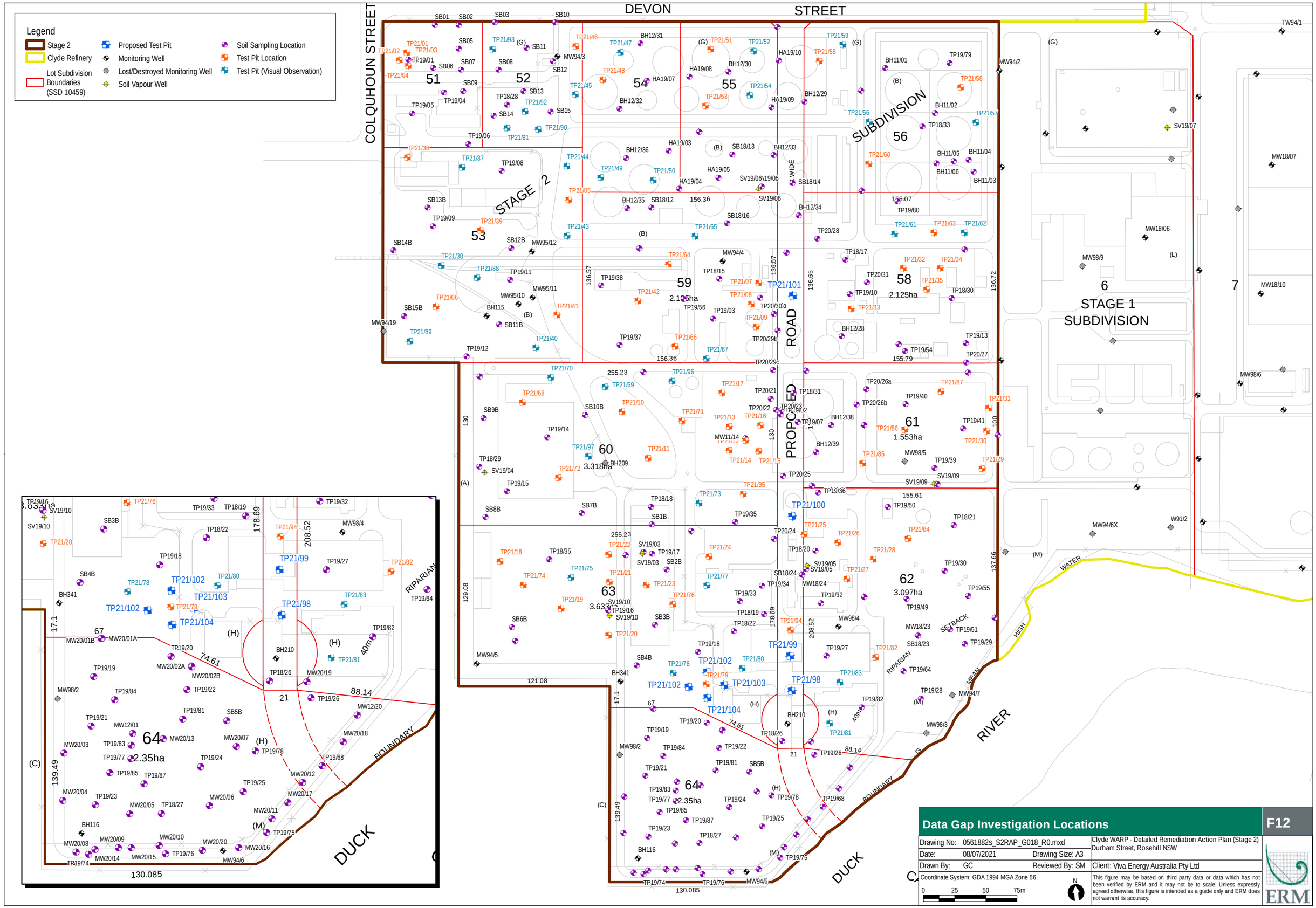
ERM



Data Gap Investigation Locations

F12

Drawing No:	0561882s_S2RAP_G018_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 2) Durham Street, Rosehill NSW
Date:	08/07/2021	Drawing Size: A3	
Drawn By:	GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 25 50 75m

N

ERM

Appendix B Interim Audit Advice Documentation

4 July 2019

Adam Speers
Viva Energy Australia Pty Ltd
Viva Energy Australia Pty Ltd
Level 3 (Suite 2), Governor Macquarie Tower, 1 Farrier Place
Sydney NSW 2000

Our ref: 2127799/IAA02
Your ref:

Dear Adam

Former Clyde Refinery - Western Area
Interim Audit Advice - 02 (Sampling and Quality Plan)

1 Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) has been engaged by Viva Energy Australia Pty. Ltd (Viva Energy) to provide NSW Environment Protection Authority (EPA) accredited Site Auditor services in respect of review of environmental documentation pertaining to the Former Clyde Refinery - Western Area located at 2 Durham Street, Rosehill on the Camellia Peninsula, NSW.

GHD understands that a large part of the south western portion of the former refinery is no longer required for operational purposes. Thus, Viva Energy is proposing to remediate this (Western Area) to facilitate future development under the existing zoning classification (IN3 – Heavy Industrial).

This interim audit advice (IAA) provides comments on the following report:

- ERM (2019), *Clyde Western Remediation Project – Remediation Site Investigation – Sampling and Quality Plan (SAQP)* dated 28 June 2019 (the **SAQP**).

The SAQP has been compared to the requirements of guidelines endorsed by NSW EPA under the *Contaminated Land Management Act 1997*, including but not limited to the NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* and NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme*.

2 Background

Viva Energy operates the Clyde Terminal, where refinery and fuel distribution activities have taken place since the 1920s.

The Terminal operations primarily comprised the receipt and refining of crude oil and finishing product piped from the Gore Bay terminal until cessation of refining activities in 2012. Since the cessation of refining operations in 2012, the site has been utilised as a Terminal, which primarily involves the receipt, storage and distribution of finished petroleum products (ERM, 2019).

The auditor understood that Viva intends to remediate a 40-hectare within the south western portion of the Terminal to enable future commercial / industrial land use. Due to the scale of remedial works, the project was declared State Significant Development (SSD).

A Conceptual Remedial Action Plan (RAP) was prepared by AECOM to support the SSD application under *Part 4 of the Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) for the

remediation project. The key elements and differences between Conceptual RAP and the future Detailed RAP are presented below:

Scope	Conceptual RAP	Detailed RAP
Set remediation goals that ensure the remediated area would be suitable for the proposed use and would pose no unacceptable risk to human health or to the environment.	✓	✓
Identify the necessary approvals and licences required by regulatory authorities.	✓	✓
Provide information on the nature and extent of impact based on the available data.	✓	✓
Preliminary remediation options assessment: Evaluate remedial techniques and/or management measures that are required to reduce risks to acceptable levels for the proposed land use of the Western Area.	✓	Not applicable
Identify remaining nature and extent of impact data gaps, where additional works are required.	✓.	Not applicable
Nature and extent of impact following data gap investigation.	Not applicable	✓
Remediation options assessment: Finalise decision on role of shortlisted remediation techniques (i.e. refinement of relative role of the techniques already shortlisted) and management measures that are required to be implemented to reduce risks to acceptable levels for the proposed land use of the Western Area, protecting human health and the environment.	×	✓
Finalised remediation plan and methodology (Remedial Design). Preparation of a detailed remediation design to inform contractor specification for the remediation.	×	✓
Remedial Site Investigation (RSI) to address identified data gaps and confirm current in-situ remediation volume estimates.	×	✓
Preparation of a Human Health and Ecological Risk Assessment (HHERA) (including the RSI data) to derive risk-based validation criteria for the remedial works to ensure the remediation has been executed to the appropriate standard to mitigate future risk to human health or the environment.	×	✓
Contingency measures should the remediation not succeed at meeting the remediation objectives.	✓.	✓

After a review of the Conceptual RAP, the auditor issued on 22 January 2019 IAA01, which concluded that the Conceptual RAP contained many of the details required for a RAP as outlined in the *Consultant Guidelines*.

However, it was noted in the IAA01 that additional remedial site characterisation and completion of a Human Health and Ecological Risk Assessment (HHERA) would be required prior to finalisation of the Detailed RAP.

The NSW EPA on 6 March 2019 issued a Notification letter, documenting a number of comments and/or requirements regarding the Conceptual RAP.

As recommended in the IAA01, a remedial site investigation (RSI) have been proposed. The SAQP will be discussed in Section 3 of this IAA.

3 SAQP summary

The objectives of the SAQP prepared by ERM were as follows:

- Refinement of LNAPL and TRH vertical and lateral extent of contamination.
- Pre-validation of low risk areas to potentially exclude from remediation and/or management activities.
- Characterisation of the nature and extent of impacts of buried waste areas.
- Characterisation of drainage and subsurface infrastructure.
- Assessing the adequacy of the current on-site wastewater treatment plant (WWTP) for treatment of water/leachate from remediation areas.
- Characterisation of non-petroleum contaminants of potential concern (CoPCs) to determine appropriateness of remediation methodology and/or management.
- Collect data to support the HHERA and development of risk-based Site Specific Target Levels (SSTLs) for remediation.
- Collect data from proposed remediation areas to assist with technical specification development for remediation contractors.

3.1.1 Contaminants of potential concern

ERM based on the scope in the SAQP existing data from historical investigation works. The following table presents the sources:

CoPCs	Sources / impacted area
LNAPL	• Former Process Area East - in the vicinity of the former 'Catalytic Cracker Unit' and 'Gas Stream' Plants, 'Hydro-blasting area' and Substation 24. • Former Process Area west. • Tank Farm J. • Within and south of Tank Farm A1 and A2. • Immediately south of Platformer 3. • Former Autonexus leased area - associated with buried waste. • Within the vicinity of former laboratory area and Substation 9 to the south of the site.

CoPCs	Sources / impacted area
• Total Recoverable Hydrocarbons (TRH) • Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)	ERM stated that the sporadic occurrence and limited extent of impacted soil and groundwater across the site cannot be clearly linked to a specific sources, but rather tend to be co-located with process areas and Tank Farms. Observed conditions do not form a simple plume as might be expected from a subsurface release or single point spill, but reflect a site that has been subject to a number of identified and unidentified release events, which have occurred at various locations, over an extended period of time.
• Polycyclic Aromatic Hydrocarbon (PAHs) • Phenols	Soil exceedances for PAHs, in particular, benzo(a)pyrene (BaP) have been identified generally along the western boundary of the site and were considered attributable to fill materials. Naphthalene concentrations in groundwater have exceeded ecological screening values, but have been delineated to isolated areas, including Process East, Process West, and adjacent Tank Farm A1 and within the former Autonexus leased area.
Polychlorinated Biphenyls (PCBs)	While PCBs have not been identified within soil or groundwater at the site, the potential for the use of PCBs containing transformer oils within former substations and transformer yards is likely based on the site history. Areas of transformer use were distributed across the site. Due to the propensity of PCBs to bind to soil particles, and very low solubility impacts to groundwater from PCBs are considered unlikely.
Per- and poly- fluoroalkyl substances (PFAS)	ERM stated that limited PFAS analysis was carried out across the site. Potential point sources of PFAS impacts included the former location of Tank 24 and the Fire Station. PFAs groundwater concentrations impacts exceeding the current screening levels for off-site recreational users of the Duck River and Ecological direct contact have been reported in the north east portion and along the southern boundary of the site. Due to the highly leachable and persistent nature of PFAS, appropriate characterisation of PFAS in soils will be required to identify restrictions associated with the remediation approach for hydrocarbon based CoPCs.
Metals (lead and hexavalent chromium)	Concentrations of metals in soils have generally been reported below relevant site screening levels, with only elevated concentrations of lead and chromium identified within fill material from buried waste areas toward the south of the site.

CoPCs	Sources / impacted area
	ERM noted that investigation works undertaken in 2014 concluded that the Tetra-Ethyl lead plant was not a significant source and as such TEL is not considered primary CoPC. Concentrations of metals in groundwater have been reported across the site in excess of ecological screening values for lead, copper, nickel and zinc. Concentrations of hexavalent and trivalent chromium have also been reported in isolated portions of the site and are interpreted to be attributed to leaching from historically imported fill material across the wider Camellia Peninsula.
Asbestos	Former buildings and above ground refinery infrastructure containing asbestos have been removed since 2012. Asbestos has been identified in the form of bonded chrysotile asbestos fragments within fill materials in four samples collected across the western area.
Dioxins: polychlorinated dibenzo-para-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and dioxin-like PCBs	Dioxin concentrations were identified in soils associated with the southern Buried Waste Area, which are likely associated with process waste sludge buried from crude oil alkylation processes. Preliminary calculation of Dioxin Toxicity Equivalence Factors (TEF) and screening against relevant US EPA Regional Screening Levels indicated soil concentrations within this area of the site were within one order of magnitude of commercial / industrial criteria.

Note: Extracted from ERM, 2019 - SAQP

3.1.2 Data gap assessment

ERM stated that based on a review of available information, including the current Conceptual Site Model (CSM) and the Conceptual RAP, the following data gaps have been identified, which will be addressed by the RSI.

Data gap / Investigation area	Scope of works
Buried Waste Areas - southern	25 test pits. 16 Test pits will be sampled (two samples per location). Four additional sampling locations will be targeted at specific a LNAPL area identified near the down gradient site boundary. An additional nine locations will be excavated, logged and field screened with no laboratory analysis proposed at this stage to determine the consistency of buried waste material. Samples will only be analysed if material from these test pits is deemed visually inconsistent with surrounding locations.
Tank Farms A1, A2 and A3	Seven test pits; two samples per location (14 samples).

Data gap / Investigation area	Scope of works
Tank Farm C	Two test pits; two samples per location (four samples).
Substation Areas and Transformer Yards (Sub 9, Sub west of former cooling tower, sub 7 and sub 23)	11 test pits; 1 sample per location (11 samples).
Pipe track areas	Seven test pits; two samples per location (14 samples).
Water management investigation	Groundwater influx (recharge rates), including any change with depth (pressure gradients). Groundwater contaminant loading (both physical and chemical). Including any change in water quality and influence of free-phase product. De-watering and treatment throughput requirements (ERM notes that this is also dependent on excavation methodology by contractor). Review and utilise existing slug test data from representative areas of the site. Perform additional slug tests on up to 4 existing groundwater wells, to fill gaps in areas of the site that may be subject to remedial excavation works (such as former process areas). ERM to perform test-pit re-charge test on 6 test-pits, located in representative areas of the site. Collection of water samples of groundwater inflow into excavations at each water management investigation test pit to better understand the groundwater characteristics and determine future treatment requirements.
Soil vapour investigation	Review of soil and groundwater data to determine up to 10 locations for target vapour well installation and sampling.
MNA sampling	Collection of groundwater samples from up to 15 monitoring wells. A minimum of two additional rounds of MNA data (post detailed RAP) is recommended to justify the ongoing justification of MNA as a groundwater management strategy for the site.

Note: Extracted from ERM, 2019 - SAQP

The preliminary CSM presented in the SAQP provided an appropriate framework for identifying the potential sources of contamination and how potential receptors may be exposed, either during or at the completion of the remedial activities.

ERM stated that the exposure pathways identified for human health within the site were both direct and indirect, and consisted of the following:

- Dermal contact, dust inhalation and/or ingestion of contaminated soil, sediment and/or surface water in on-site environments by on-site workers, contractors or intrusive maintenance workers.
- Exposure to vapours derived from hydrocarbon impacted soil and/or sediment in on-site environments.
- Generation and pooling of ground gases to present an explosive hazard.

ERM concluded that although a number of exposure pathways for on-site receptors have been established, the source-pathway-receptor (SPR) linkages were considered incomplete due to current Viva Energy HSE controls. However, under a future commercial / industrial land development scenario, the above-discussed pathways would be considered complete without the implementation of a long term management plan (LTMP) and/or remediation.

Current monitoring of groundwater along the boundary of the site indicated that no off-site migration of impacted groundwater is occurring at levels that could potentially cause risk to the identified environmental/ecological receptors, with the exception of PFAS. ERM noted that the site's contribution of PFAS to the adjoining river systems via discharge from the on-site drainage system is currently unknown due to no available PFAS sampling data and represents a data gap.

4 Auditor review and comments

The auditor acknowledges that the SAQP largely complied with the guidelines identified in Section 1, however, there are some matters presented in Table 1 (attached) that needs to be clarified.

5 Auditor conclusions

It is the auditor's opinion that the SAQP prepared by ERM will largely address the NSW EPA requirements, the data gaps previously identified and will support the HHERA and the Detailed RAP.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely
GHD Pty Ltd

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NSW EPA Accredited Auditor
61+ 447 685 055

Viva Energy

Clyde Western Area Remediation Project

Interim Audit Advice 03

February 2020

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1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (herein referred to as the site auditor) was commissioned by Viva Energy Australia Pty Ltd (herein referred to as Viva Energy) to conduct a site audit associated with the Western Area of the former Clyde refinery located at 2 Durham Street, Rosehill, NSW. A figure showing the Western Area is presented in **Appendix A**.

Viva Energy currently operates the Clyde Terminal. However, the south western portion is no longer required for operational purposes and Viva Energy intends to remediate this area (herein referred to as the Western Area) to facilitate future development of the land under the existing land use zoning (IN3 – Heavy Industrial).

The scope of the site auditor role currently comprises a non-statutory site audit of the contamination assessments commissioned by Viva Energy. It is understood that the objective of the audit will be to certify the Western Area is suitable for future commercial/industrial uses in accordance with applicable guidelines made or endorsed by NSW Environment Protection Authority (EPA) under Section 105 of the *Contaminated Land Management Act 1997* (CLM Act).

1.1 Reports reviewed

This Interim Audit Advice (IAA) provides comments on the following reports prepared by Environmental Resources Management (herein referred to as ERM):

- *Clyde Western Remediation Project, Remediation Site Investigation*, dated 7 February 2020 (herein referred to as the RSI).
- *Clyde Western Area Remediation Project, Human Health and Ecological Risk Assessment,* dated 16 February 2020 (herein referred to as the HHERA).
- *Clyde Terminal – Quarter 4 (2019) Groundwater Monitoring Report*, dated 7 February 2020 (herein referred to as the GME).

The following reports/documents were previously reviewed by the site auditor and (where relevant) IAAs issued. Copies of the IAAs as well as the consultant's responses are shown in **Appendix B**.

- AECOM (2019) *Viva Energy Clyde Western Area Remediation Project, Response to Submissions Report*.
- AECOM (2019) *Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan*, dated 21 January 2019 (herein referred to as the Conceptual RAP).
- ERM (2019a) *Clyde Western Remediation Project, Remediation Site Investigation – Sampling and Quality Plan (SAQP)*, dated 28 June 2019 (herein referred to as the SAQP).
- ERM (2019b) *Clyde Western Area Remediation Project – Risk Assessment Methodology*, dated 9 October 2019.
- DPIE *Draft Conditions of Consent re SSD Application 9302* (issued via email on 11 December 2019).
- AECOM (January 2020) *Viva Energy Clyde Western Area Remediation Project (SSD18_9302)*.

1.2 Relevant guidelines

The information in the RSI and the HHERA has been compared to the requirements of guidelines endorsed by NSW EPA under the *Contaminated Land Management Act 1997*, including but not limited to:

- NSW EPA (2019) *Assessment and Management of Hazardous Ground Gases. Contaminated Land Guidelines* (herein referred to as the Ground Gases Guidelines).
- Heads of Environment Protection Authority (2018). *PFAS National Environmental Management Plan* (herein referred to as the NEMP).
- ANZAST (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
- NSW EPA (2017) *Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition)* (herein referred to as the Auditor Guidelines).
- NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* (herein referred to as the Consultant Guidelines).
- National Health and Medical Research Council (2011) *Australian Drinking Water Guidelines ADWG* (updated August 2018).
- NEPM (1999) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as updated 2013 (herein referred to as the NEPM):
  - Schedule B4: Guideline on site-specific Health Risk Assessment Methodology;
  - Schedule B5: Guideline on Ecological Risk Assessment;
  - Schedule B7: Guideline on the Framework for Risk-based Assessment of;
  - Groundwater Contamination.
- Environmental Health Risk Assessment: *Guidelines for Assessing Human Health Risks from Environmental Hazards, Department of Health and Ageing and enHealth Council, Commonwealth of Australia* (enHealth, 2012).

1.3 Limitations of this IAA

All information and opinions given in this IAA are based on reviewing the information presented in the documentation referenced in **Section 1.1** and other supporting information provided by the client and it's consultants. The site auditor has not carried out any independent investigations about the condition of the site. The audit has been based on the limitations presented in **Section 7** of this IAA.

The site auditor assumes no responsibility or liability for any errors or omissions in the information provided in the reports reviewed or that the consultant did not confer any reliance on the statements to the site auditor.

The purpose of this IAA is to assess whether the RSI and HHERA issued by ERM have been completed in a manner consistent with NSW EPA made or endorsed guidelines. In addition, the auditor, taking into account the information that has been collected during the numerous investigations that have been completed at the Western Area, has also provided comments on issues raised in the Department of Planning, Infrastructure and Environment (DPIE) regarding air toxics and the means by which they can be managed, including use of an emissions control enclosure.

This IAA relates to below ground contamination (soil, groundwater, soil vapour) at the Western Area as well as identified or potential off-site impacts to surface water, groundwater or soil

vapour and the receptors that may be exposed to these media. The site auditor noted no other warranties, expressed or implied, are made.

No evaluation of geotechnical issues or any other issues associated with the Western Area has been made.

2. Regulatory requirements

Following the announcement of the closure of the former Clyde Refinery, on 22 June 2012, the NSW EPA issued a Preliminary Investigation Order to Viva Energy under the CLM Act requesting reports on environmental contamination.

Following receipt of a number of reports, in June 2016, the NSW EPA declared the Lot 398 DP41324, Lot 2 DP224288, Lot 1 DP383675, Lot 101 DP809340 and, Lot 100 DP1168951 (which includes the Western Area) as contaminated land under the CLM Act (Declaration Number 20131110).

It is the auditor's understanding that at the present, there is no Voluntary Management Proposal (VMP) for any area of the former Clyde Refinery, including the Western Area.

2.1 NSW Environment Protection Licence

The Western Area operates under NSW Environment Protection Licence (EPL) number 570, issued under the *Protection of Environment Operations Act 1997* (NSW) (POEO Act). This licence authorises and regulates the carrying out of waste processing and chemical storage.

2.2 Development application and consent

2.2.1 Development application

The preparation and execution of the Remediation Project (remedial works to occur in the Western Area) is integrated with the NSW development consent process. The scale of the proposed remedial works means that under the requirements of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act), the Environmental Planning and Assessment Regulation 2000 (NSW) (EP&A Regulation) and the State Environmental Planning Policy 55 - Remediation of Land (SEPP 55), State Environmental Planning Policy (State and Regional Development), the Remediation Project will require development consent from the NSW Minister for Planning to proceed and the application for development consent will be managed by the Department of Planning, Industry and Environment (DPIE) (AECOM, 2019).

On 27 September 2017 Viva Energy submitted a State Significant Development (SSD) Call In request for the Remediation Project to the DPIE. On 20 April 2018, an order was published in the NSW Government Gazette declaring the Remediation Project as a SSD (ref nº 2018-1291).

AECOM in 2018 prepared a Conceptual Remedial Action Plan (RAP) to support SSD application. AECOM stated that the Conceptual RAP would be updated to a Detailed RAP following further detailed investigations within the Western Area and receipt of relevant conditions of consent if the SSD application is granted consent.

As required by the EP&A Act, the SSD application for the Remediation Project was accompanied by an Environmental Impact Statement (EIS). The contents of the EIS had been informed by the requirements of the EP&A Act, the EP&A Regulation and the contents of the Secretary's Environmental Assessment Requirements (SEARs), as well as consultation with relevant government agencies and the community.

In order to request SEARs, on 1 May 2018 Viva Energy submitted a Preliminary Environmental Assessment (PEA, AECOM, 2018c) to DPIE. The PEA provided an overview of the Remediation Project as well as the site condition, a review of relevant legislation and policies and, an assessment of the potential environmental impacts associated with the Remediation

Project. The DPIE used the PEA to consult with a number of government agencies and stakeholders including the NSW EPA and the City of Parramatta Council (Parramatta Council).

The environmental assessments within the EIS were based on requirements of the SEARs and evaluated the potential impacts resulting from the remedial design in the Conceptual RAP. The Conceptual RAP was appended to Appendix C of the EIS for the Remediation Project as part of the SSD application.

Since lodgement of the EIS with DPIE, the application has been exhibited and Viva Energy has responded to the various submissions that have subsequently been issued by the appropriate regulatory authorities. These responses are documented within the Response to Submissions Report (RtS) for the Remediation Project issued by Viva Energy on 21 October 2019. The RtS presents some minor design changes, additional environmental assessments and additional clarifications and justification for the proposed project.

2.2.2 Consent conditions

Following consideration of information in the RtS, DPIE issued on 11 December 2019 the draft of conditions of consent (herein referred to as the draft conditions) for the Western Area Remediation Project. Key elements highlighted in the draft conditions in relation to contaminated land management include preparation (and approval) of documents such as a detailed remedial action plan, a long term management plan, an air emissions verification report, an air quality management plan and a groundwater monitoring and management plan. It is the auditor's understanding that once the development consent is granted, the Detailed RAP will include relevant site management plans to be implemented during remedial works

While most of these conditions are common to (and consistent with) the general requirements by which ARAs dictate contaminated land management, the draft conditions have a number of expectations in relation to air quality assessment and management. The key draft conditions in relation to this matter are:

B11 The Applicant must install and operate equipment in line with best practice to ensure the development complies with relevant air quality criteria, limits and monitoring requirements as specified in the EPL for the development.

B12 The Applicant must ensure the development does not cause or permit the emission of any offensive odour (as defined in the POEO Act) from the boundary of the Western Area.

B14 Prior to the commencement of preparation works, the Applicant must prepare an Air Emissions Verification Report (AEVR) to the satisfaction of the EPA and the Planning Secretary. The AEVR must:

(a) *be prepared by a suitably qualified and experienced person(s);*

(b) *be approved by the EPA and the Planning Secretary, prior to the commencement of preparation works;*

(c) *detail the final selected remediation methodologies;*

(d) *detail the emission controls and management measures for each final remediation method and remediation activities, including but not limited to:*

  (i) *excavation and material classification;*

  (ii) *material handling, stockpiling and storage;*

  (iii) *processing and treatment;*

  (iv) *material transport; and*

  (v) *validated materials.*

(e) *benchmark the final emission control and management measures with best practice process design and emission control;*

(f) *include robust justification for any part of the remediation process that is not proposed to be conducted in an emission control enclosure (ECE).*

B15 *The Applicant must ensure all contaminated material on site is handled, processed, treated and stored inside an ECE, unless otherwise agreed with the EPA. Any request to* vary the requirement for an ECE, must consider, but not be limited to:

a) the outcomes of the Detailed RAP required by condition B1, supporting remedial site investigations and the AEVR required by condition B14;

b) the potential for emissions of principal toxic air pollutants and odorous compounds;

c) the waste classification of the material proposed to be managed outside of *an ECE*

Viva Energy has commented on the draft conditions of consent and recommended a number of changes, particularly to Conditions B14 and B15.

In addition to the comments on the scope of work that has been presented in the RSI and HHERA, the auditor has presented comments in this interim audit advice on these draft conditions, taking into account the data that has been generated in the investigations undertaken in the Western Area.

3. Background

3.1 Land use

AECOM in it's Conceptual RAP described that the site was originally included as part of an 850 acre land grant by the Crown to John Macarthur. In 1908, a parcel of 140 acres of land was transferred to the Commonwealth Oil Corporation (COC). The COC struck financial difficulties and went into receivership. In 1913 the land was then acquired from COC by John Fell and Co. The new owner began purchasing crude oil to refine at Clyde and refining commenced in 1926.

In 1928, Shell Refining Pty Ltd took over as owner and operator of the site. Shell purchased an additional seven acres of land and a further 150 acres in June 1930. The duration of the first stage of expansion of the site was from 1929 to 1939 with the purchase and construction of new equipment and buildings, increasing the crude product intake to approximately 250 tonnes/day by 1934.

The former Clyde Refinery operations primarily comprised the receipt and refining of crude oil and finishing product piped from the Gore Bay Terminal until cessation of refining activities in 2012. Since the completion of refining operations, the former Clyde Refinery has been partially utilised as a terminal (herein known as the Clyde Terminal), which primarily involves the receipt, storage and distribution of finished petroleum products.

3.2 The Clyde Terminal

Since the cessation of refining operations in 2012, the Clyde Terminal continues to receive finished petroleum products from the Gore Bay Terminal via the existing product transfer pipeline, and distributes the products by separate pipelines from the Clyde Terminal to the adjacent Parramatta Terminal. A figure showing the Clyde Terminal location is presented in **Appendix A**.

3.3 The Western Area

Following completion of the Clyde Terminal Conversion Project (SSD 5147), the Western Area is no longer required for operational purposes. Given the identified presence of contaminated soil in the Western Area, remediation is to take place to enable future commercial and/or industrial land use. A figure showing the location of the Western Area is presented in **Appendix A**.

The site auditor notes that the site has been investigated and/or monitored over the last 27 years. From 2004, all reports have been submitted either, in full or in summary to the NSW EPA via the annual reporting process.

The site auditor considered that the list of the reports shown in **Table 1** are those which provided key relevant information about the Western Area.

Table 1 Summary of reports related to Western Area

Author	Title of document	Relevance to the project
ERM, 2010	Soil and Groundwater Management Plan: Shell Clyde Refinery & Parramatta Terminal, Durham Street, Rosehill, NSW.	General information on LNAPL behaviour in the Western Area.

Author	Title of document	Relevance to the project
ERM, 2011	Tank T92 Release Investigation, Shell Clyde Refinery, Durham Street, Rosehill, NSW.	General information on LNAPL behaviour in the Western Area.
ERM, 2012	Environmental Conditions Summary Report Shell Clyde Refinery, Durham Street, Rosehill, NSW 2142.	Works in response to Preliminary Investigation Order.
ERM, 2012	Stage 1 And 2 Environmental Site Assessment, Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill, NSW 2142.	General information on soil contamination and LNAPL in the Western Area.
ERM, 2012	Phase II Environmental Site Assessment, Shell Clyde Refinery and Parramatta Terminal, Lot 101 DP 809340, Durham Street, Rosehill, NSW 2142.	General information on LNAPL in the Western Area.
ERM, 2012	Supplementary Information to The Environmental Conditions Summary Report, Shell Clyde Refinery.	General information on LNAPL in the Western Area.
ERM, 2013	Groundwater Monitoring Events Report, Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill NSW 2142.	General information on LNAPL in the Western Area has informed this Conceptual RAP and the 3D modelling process/report.
ERM, 2014	Annual Progress Report (2013) Shell Clyde Terminal Durham Street Rosehill NSW 2142.	General information on LNAPL in the Western Area.
ERM, 2016	Groundwater Monitoring Events and Annual Summary – Clyde and Parramatta Terminal.	General information on LNAPL in the Western Area.
ERM, 2017	Groundwater Monitoring Event – Clyde and Parramatta Terminal.	General information on LNAPL in the Western Area.
ERM, 2018	AutoNexus Environmental Site Assessment.	Assessment locations from this investigation provided additional characterisation for the CSM.
AECOM, 2018	Viva Energy Clyde Western Area Remediation Project – 3D Modelling of Hydrocarbon Impacts.	Characterisation work on the distribution of hydrocarbons in the Western Area.
AECOM, 2018	Western Area, Targeted Site Investigation.	A number of identified data gaps were addressed. Assessment locations from this investigation provided additional characterisation for the CSM.

In addition to the aforementioned reports, the auditor notes that a Conceptual RAP was prepared by AECOM in 2019, as part of the SSD application. Further discussion regarding the Conceptual RAP, RSI and HHERA is presented in **Section 4**.

4. Summary of documents previously reviewed by the site auditor

4.1 Conceptual RAP

A Conceptual RAP has been prepared by AECOM (AECOM, 2019) to support the SSD application under Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) for the Remediation Project.

Following review of historical datasets, AECOM concluded in the Conceptual RAP that the following Chemicals of Potential Concern (COPCs) are relevant within the Western Area:

- Total Petroleum/Recoverable Hydrocarbons (TPH/TRH).
- Benzene, Toluene, Ethyl-benzene, and Xylenes compounds (BTEX).
- Heavy metals.
- Polycyclic Aromatic Hydrocarbons (PAHs).
- Phenols.
- Dioxins.
- Polychlorinated Biphenyls (PCBs).
- Tetraethyl lead.
- Per- and polyfluoroalkyl substances (PFAS).

It was also noted by AECOM that there are areas of buried waste and/or leaded sludges within the Western Area that had not been investigated for asbestos containing materials (ACM).

The proposed remedial works presented in the Conceptual RAP were to address petroleum hydrocarbon contaminated soils. It was noted by AECOM that based on the stability of the groundwater plumes and LNAPL characterisation, the remedial works need only focus on the excavation of hydrocarbon impacted soils for treatment.

AECOM considered that groundwater remediation was not required based on existing groundwater monitoring data, which indicated that dissolved phase plumes (benzene and TRH F1 and TRH F2) in the Western Area were stable, and do not pose a potential risk to human health or ecological receptors. It was also noted in the Conceptual RAP that administrative measures such as restriction on groundwater abstraction would be implemented.

Furthermore, AECOM considered in it's Conceptual RAP that the Natural Source Zone Depletion (NSZD) of the LNAPL, and subsequent natural attenuation of the dissolved phase, is likely to continue to reduce the mass of hydrocarbons within the Western Area over time.

4.1.1 Remedial areas

The areas of concern that were the focus of the Conceptual RAP are listed in **Table 2**. The auditor considered that the selection of these areas was appropriate given the soil and groundwater data that had been previously collected in the Western Area.

Table 2 Areas of environmental concern

ID	Description
AEC-1	Old Administration Area
AEC-2	Buried Waste Area 8 – CDU tank farm sludge
AEC-3	Southern Contractor Area

ID	Description
AEC-4	Southern Buried Waste Area
AEC-5	Platformer 3
AEC-6	Buried Waste – Ex Solvents Plant
AEC-7	Pipe Track Areas
AEC-8	Tank farm J
AEC-9	Process West
AEC-10	Process East
AEC-11	Tank farms A1, A2, A3
AEC-12	Tank farm C
AEC-13	Substation Areas and Transformer Yards
AEC-14	Subsurface drainage network
AEC-15/General site area	Other areas within the Western Area

4.1.2 Remedial objectives

The remediation objectives presented in the Conceptual RAP were as follows:

- Remediate soil and manage groundwater of the Western Area to enable the land to be used for commercial/industrial purposes.
- Ensure that any remediation process adheres to all applicable regulatory requirements.

Remedial methodologies

The Conceptual RAP considered a wide range of treatment options. The outcome of this assessment concluded that bioremediation of petroleum contaminated soils (mainly via biopiling) would play a key role. Other technologies had been assessed as suitable included landfarming, in-area soil mixing, stabilisation and thermal desorption.

AECOM stated that where it is not practicable to remediate non-petroleum contaminated soils that are not suitable for bioremediation, stabilisation or thermal desorption would be considered, noting that stakeholder support and post-remediation management measures would need to be formalised under this approach.

Off-site disposal to landfill of untreated soils was also evaluated and would typically be considered when soils are not suitable to bioremediate for on-site reuse or when on-site management is not practicable.

AECOM noted that it is highly likely that the remediation would result in a net loss of soil and as such, the import of additional soils, Virgin Excavated Natural Material (VENM) and/or material approved under an NSW EPA approved Resource Recovery Exemption for backfill would be required.

Estimated volume

AECOM stated that the volume of contaminated soils to be remediated had yet to be finalised. However, initial estimates for the soil remediation works include approximately 90,000 m^3 from impacted remedial areas and 10,000 m^3 that may need to be excavated during the removal of the drainage network, resulting in an estimated in-situ total of 100,000 m^3.

AECOM stated that it was proposed that contaminated soils from other Viva Energy sites (approximately 5,000 m^3) could be imported to the Western Area to be remediated as part of the Remediation Project. This would result in an overall remediation volume of approximately 105,000 m^3.

Long-term environmental management plan

The Conceptual RAP proposed that at the completion of the remedial works, a Long Term Environmental Management Plan (LTEMP) would be prepared for the Western Area to appropriately manage residual contaminated soil and/or groundwater impacts remaining after active remediation.

The LTEMP would include a Groundwater Monitoring Plan (GMP), which would detail groundwater monitoring requirements for the Western Area to confirm that natural attenuation processes are occurring for dissolved phase hydrocarbons in the Western Area.

Identified data gaps

After review of the available dataset, AECOM concluded that the following data gaps would need to be addressed prior to completion of the Remedial Options Assessment (ROA) and the Detailed RAP:

- An RSI to address identified data gaps.
- An HHERA including the RSI data to derive Site-Specific Target Levels (SSTLs) to confirm the remediation extent and potential remediation volumes and to support the development of management plans and work procedures.

After a review of the Conceptual RAP (AECOM, 2019), the site auditor issued on 22 January 2019 IAA01, which concluded that the Conceptual RAP prepared by AECOM contained many of the key elements for a RAP as outlined in the Consultant Guidelines.

However, the auditor noted that prior to preparation of a Detailed RAP, a remedial site investigation aimed at collecting data in relation specifically to remedial actions (such as soil types, amenability to bioremediation or stabilisation) and addressing the data gaps noted by AECOM in the Conceptual RAP would be required. In addition, the auditor noted that a HHERA may be necessary to establish site specific target levels and assist in defining the extent of soils requiring remediation (that would be presented in the Detailed RAP).

The auditor acknowledged that following completion of the remedial works, an LTEMP would be required to document the presence of residual contaminated soil and groundwater that may need to be managed and the scope of groundwater monitoring necessary to assess natural attenuation of dissolved phase hydrocarbons.

4.2 The RSI SAQP

The auditor considered that the Western Area has been subjected to a sufficient range of investigations to identify the key chemicals of concern and the areas in which they are present. The site soil, groundwater and soil vapour data had been evaluated by AECOM in preparing it's Conceptual RAP (2019). The auditor considered that the Conceptual RAP contained many of the key elements as required by NSW EPA Consultant Guidelines (as articulated in IAA01).

The auditor agreed with AECOM (2019) that two key reports would be required prior to preparation of a Detailed RAP, a Remedial Site Investigation (RSI) and (if necessary) a HHERA. The RSI was not required to gain a better understanding of the nature and extent of contamination, but rather it was needed to collect data to assist selecting the most appropriate remedial method for each of the identified areas of concern (refer to **Table 2**) and to establish final volumes for soil remediation. In addition, some of the RSI tasks were to collect information relevant to questions posed by the NSW EPA following review and comment on the EIS (AECOM, 2019).

ERM stated in its SAQP that the overall objective of the RSI was to address remaining data gaps and collect information relevant to questions raised by the NSW EPA and remedial contractors for incorporation into the Detailed RAP. The key objectives of the RSI were as follows:

- Refinement of vertical and lateral extent of remediation/ management required.
- Potential pre-validation of low risk areas to potentially exclude from remediation and/or management.
- Further characterisation of buried waste areas (nature and extent of impacts).
- Drainage and subsurface infrastructure characterisation (confirm contamination status; validate volumes and types of backfill surrounding subsurface drainage).
- Further characterisation of non-petroleum COPCs to determine appropriateness of remediation methodology/ management.
- Further collection of data to support HHERA and development of SSTLs for remediation.
- Collection of data from remediation areas to assist with technical specification development for remediation contractors.

The auditor acknowledged that one of the tasks was to collect additional information on the WWTP, but it is the understanding that this information has been provided in the interim to DPIE.

The SAQP had been prepared to document the data quality objectives (DQO), scope of work and methodology for the RSI. The specific tasks for the RSI were as follows:

- Sampling of potential sources of previously identified soil and groundwater contamination:
  - Former above ground Tank farms A2, A3, A1 and C.
  - Former petroleum transfer areas and above/below ground pipelines – pipe track areas and the on-site drainage network currently represent sources of uncertainty for remediation volumes and potential risk given no targeted investigations of these sources to date.
  - Former landfilling and on-site placement/burial of sludge and other wastes. The nature and extent of some of these areas had not been defined and requires further delineation.
  - Non-petroleum COPCs from former site uses, including the former epoxy resins plant, fire station, and substation and transformer areas.
- Characterisation of the drainage and subsurface infrastructure to determine the potential requirements for site remediation of subsurface infrastructure including the potential for on-site reuse or off-site disposal.
- Further sampling of buried waste material (in the south western portion of the Western Area) to assess the nature and extent of contamination and the potential suitability of various onsite management/remediation options.
- Delineation of the potential extent of ACM and the affect its presence may have on potential remedial strategies.
- Collection of additional data on the physical properties of soils requiring remediation to provide such information to remediation contractors tendering on remediation works.

4.3 The HHERA methodology

Prior to preparation of the HHERA, a HHERA letter was issued by ERM based on the results of the Tier 1 screening (comparison to default NSW EPA endorsed investigation or screening levels – e.g. NEPM), which took into consideration historical datasets and the RSI findings. The purpose of the HHERA letter was to describe the proposed methods to generate the HHERA.

The nominated exposure scenarios to be assessed in the HHERA were:

- Direct contact or ingestion of impacted soils by future on-site intrusive maintenance works (IMWs) or construction worker undertaking earth works for carcinogenic PAHs, TRH>C10-C34, lead and hexavalent chromium.
- Inhalation of vapours by future on-site worker in indoor or outdoor air for benzene, naphthalene and TRH F1.
- Potential exposure by off-site aquatic ecological receptors via leaching of contaminated soil to shallow groundwater, migration via groundwater and surface water discharge for PFOS – indirect ecological receptor exposures through bioaccumulation in the food chain and toluene, ethylbenzene, naphthalene, cadmium, lead, chromium, copper, nickel and zinc – direct exposures toxicity of aquatic receptors.

Regarding the off-site aquatic risk assessment, ERM noted that the HHERA would provide a semi-quantitative assessment based on presenting a more detailed understanding of the migration potential from site groundwater to the adjacent Duck River.

ERM noted that an understanding of groundwater discharge to the Duck River had been developed in the PFAS Conceptual Model and Flux Assessment (ERM, 2018).

For all other aforementioned COPCs (non-PFAS) the HHERA would provide a semi-quantitative assessment.

It was stated by ERM that the following scenarios would not be assessed in the HHERA:

- Inhalation of dusts or potential fibres from isolated soils during excavation by current and future on-site intrusive maintenance or construction workers undertaking earthworks. Given that the SSTLs of potential exposures to asbestos is not supported in the NEPM (1999). Screening levels are sufficient for informing remediation and future site management decisions, as well as for implementation of Environmental Management Plans (EMP).
- Potential explosive hazards due to the generation and pooling gases from LNAPL and impacted soils for on-site intrusive maintenance or construction workers undertaking earthworks. Given that, the potential for isolated acute explosive hazards related to NAPL is complex and not likely to be refined from further risk assessment modelling.

On 4 July 2019 the auditor issued IAA02 following review of the proposed SAQP. It was the auditor's opinion that the scope of works presented in the SAQP would address the data gaps previous identified, thus supporting the preparation of the HHERA and the Detailed RAP.

It was the auditor's opinion that the HHERA letter largely contained essential elements for preparation of an HHERA as per NSW EPA made or endorsed guidelines.

5. Auditor review – RSI, GME and HHERA

5.1 The RSI

The following scope of works was undertaken by ERM:

- Completion of 80 additional test pits to a maximum depth of 4.8 metres below ground level (mbgl) to characterise soils in specific areas. **Appendix A** presents a figure showing the location of the additional test pits.
- Drilling of 16 additional boreholes to a maximum depth of 2.2 mbgl, including tank farms areas A2, A3, C and sections of pipe track areas. **Appendix A** presents a figure showing the location of the additional boreholes.
- Assessment of groundwater influx, including any change with depth.
- Groundwater contaminant loading (both physical and chemical), including any change in water quality and influence of free-phase product to aid in the assessment of de-watering and treatment throughput requirements.
- Installation and sampling of eight soil vapour bores to a maximum depth of 1 mbgl. **Appendix A** presents a figure showing the location of the additional vapour bores.
- Collection of field measurements and groundwater samples from 15 monitoring wells for assessment of potential MNA conditions.
- Summary of groundwater characterisation, based on the historical and the 2019 GME results.
- Interpretation of the collected data set and refinement of the CSM.

In the RSI, ERM collected data to assess the risk of contamination to sensitive on-site and off-site human health and ecological receptors resulting from the Areas of Environmental Concern (AECs) in the Western Area, as summarised in **Table 2** and shown in the ERM figure in **Appendix A**.

Based on field observations and analytical data collected during previous investigations as well as the RSI, ERM concluded the following in relation to the objectives of the RSI:

Refinement of vertical and lateral extent of remediation/ management required

The distribution, nature and extent of contamination identified within the site was consistent with previous investigations. Soil that had concentrations of COPCs exceeding Tier 1 screening values as well as residual LNAPL (generally related to petroleum hydrocarbons in soils) were identified to a depth of 2.0 mbgl within the vicinity of former storage and/or process infrastructure. Contaminated fill was also identified to a depth of approximately 4.0 mbgl within the southern waste burial area (AEC-4).

LNAPL CSM

The lateral and vertical extent of residual LNAPL was consistent with historical investigations undertaken within the Western Area.

ERM considered that the migration potential of LNAPL is negligible based on the following lines of evidence:

- Ongoing primary sources of residual LNAPL have been removed. This, in combination with a flat hydraulic gradient and low hydraulic conductivity limit the migration potential of residual LNAPL in the subsurface.

- While the configuration of LNAPL impacted areas has been modified over time through the addition of monitoring wells, residual LNAPL has not been identified in monitoring wells down-gradient of residual impacts over the course of monitoring since 2008.
- Residual LNAPL was generally present within fill material or discontinuous sandy lenses at the level of groundwater. Vertical migration of COPCs does not appear to be significant, based on analytical results of soil samples collected from within the low permeability clay layer and of groundwater samples collected from deeper monitoring wells.
- Dissolved phase groundwater impacts associated with residual LNAPL appeared to be generally stable (in nature and extent) and limited to on-site areas, with no indication of off-site migration.

Potential pre-validation of low risk areas to potentially exclude from remediation and/or management

ERM concluded that the low risk areas are limited to AEC-1 (Old Admin Area) and AEC-13 (Substation Areas). However, ERM noted he presence of shallow ACM identified within isolated portions of these AECs during the investigation. ERM stated that these portions of the site will not require further assessment as part of the subsequent Tier 2 HHERA. However, asbestos remediation and/or management will be required.

Characterisation of buried waste areas

Test pitting within AEC-4 was terminated in fill at a depth of 4.0 mbgl in several test pits and as such, the potential for deeper fill materials may require consideration. However, ERM stated that on the basis of the data from the RSI and previous investigations, the lateral extent of AEC-4 had been suitably delineated.

Drainage and subsurface infrastructure characterisation

ERM noted that fill materials underlying pipe tacks extend to a depth of 0.1 to 0.2 metres. ERM noted that fill materials located around drainage / pipe-track infrastructure may act as a preferential pathway for site contamination. Results of collected soil samples recorded concentrations of COPCs below the adopted Tier 1 screening criteria.

ERM concluded that on the basis of the extensive nature of the drainage network an unexpected findings protocol should be implemented during future excavation and removal of the subsurface drainage network. This will allow appropriate management and assessment of isolated soil impacts during remediation and sub-grade infrastructure removal.

Characterisation of non-petroleum COPCs to confirm the remediation methodology/ management

Asbestos was identified in the form of ACM fragments at isolated locations throughout the site, largely associated with demolished former infrastructure. ACM fragments were identified on soils within AEC-4 along with fibres at variable depths. This finding was consistent with historically documented waste burial activities within the southwestern area.

The extent of identified asbestos identified during the RSI and historical investigations is presented in a figure in **Appendix A**.

Heavy metals generally recorded at concentrations less than the adopted assessment criteria (Tier 1 screening) with the exception of one isolated sample in AEC-11, which marginally exceeded the assessment criteria for lead. Historical results have also identified the presence of hexavalent chromium results associated with buried waste within AEC-4.

Dioxins - were recorded at concentrations below than limit of reporting (LOR) and/or the adopted assessment criteria.

PFAS ASLP leachate and excavation water samples identified PFAS within localised areas. A figure showing these locations is presented in **Appendix A**.

Concentrations of PFAS in ASLP samples were below adopted screening criteria for current and future on-site receptors. Although concentrations of PFAS, specifically PFOS, were reported at some individual locations exceeding off-site ecological criteria, the potential for risk to off-site receptors was considered acceptable based on previous mass flux modelling undertaken by ERM.

Collect data to support HHERA and development of risk-based Site Specific Target Levels (SSTLs) for remediation

ERM considered that data from the RSI as well as historical data was sufficient for the purposes of developing a HHERA to refine the understanding of potential risks to identified human health and sensitive ecological receptors and to aid in the development of SSTLs and remedial end-points.

Data from likely remediation areas to assist with technical specification development for remediation contractors

ERM has recently completed a series of field and lab-scale remediation trials for the Western Area to assess the feasibility and effectiveness of various soil remediation methods in targeted areas of the site.

The remediation trials included some direct air quality measurement during excavation and soil-turning activities to assess the impact to air quality in and around remedial excavations for both on and off-site receptors. ERM conducted trials for the following remedial options:

- Ex-situ Biopiling – Excavation and treatment of 2 x 100 m^3 stockpiles.
- Ex-situ Landfarming – Excavation and treatment of 2 x 100 m^3 and 3 x 10 m^3 stockpiles of material representing different soil types and petroleum hydrocarbon concentrations.
- Ex-situ Stabilisation – Laboratory based trials to inform potential for offsite disposal.
- Ex-situ Thermal treatment - Collection of laboratory parameters to inform potential energy and material handling requirements.

Air quality data collected from the remediation trial activities included the following:

- Monitoring conditions, including site operations, and prevailing weather during each event.
- Laboratory data for VOC emission characterisation: Concentration, variability, speciation, and attenuation with distance from the excavation.

ERM stated that the data may facilitate estimates of VOC emission flux and observed levels of attenuation with distance from the excavation operations. The data will be used in the Air Emissions Verification Report (AEVR) to support the means by which air quality will be managed during remedial works.

The methodology and results of the trials, including air quality monitoring, will be summarised within a Remediation Trials Summary Report. This report will be factual in nature and will form an addendum to a Contractor Technical Specification, which would be provided to tendering remediation contractors.

Information presented from the remediation trials will be subject to a more detailed interpretation in the context of the ROA report and Air Emissions Verification Report (AEVR) report, which are

currently in preparation by ERM. The scope of how the data will be used in each of these reports is outlined below.

- Remedial Options Assessment (ROA):

  Assessment of the technical effectiveness, potential timeframes, complexity and relative cost of implementing each remedial method for specific remediation areas within the Western Area.

- Air Emissions Verification Report (AEVR):

  Assessment of air emission potential for the selected remedial approaches, including principal air toxics and odour. The report will provide a description and review of existing monitoring data, inclusive of soil gas, VOC/odour emission flux, and ambient air quality monitoring collected from remediation trials. This assessment will also consider data previously presented in the EIS / Air Quality Impact Assessment (AQIA), Response to Submissions (RtS)) and existing operational air quality monitoring surveys and will align with any future condition of consent (if required).

Groundwater monitored natural attenuation results

ERM stated that Mann-Kendall statistical analysis of benzene, TRH C6-C9 and TRH C10-C36 fractions have been undertaken routinely as part of the annual groundwater report to assess stability of groundwater concentrations over time. Stable to decreasing trends in concentrations of these dissolved phase COPCs have been reported since the majority of monitoring wells were installed across the Western Area (2007 to 2019).

A review of the Monitored Natural Attenuation (MNA) parameters collected to date indicated evidence of natural attenuation processes, including lower sulphate concentrations coupled with generally elevated ferrous iron concentrations observed historically within groundwater contaminated suggest that microbial degradation of petroleum hydrocarbons may be occurring within the Western Area.

However, given the limited temporal and spatial extent of the available dataset for MNA parameters, it is considered that additional rounds of groundwater monitoring data will be required to enable a thorough assessment of groundwater MNA processes to be undertaken. The auditor noted that GMEs would occur during and after completion of the remedial works.

Groundwater results

In 2019, ERM conducted a groundwater monitoring program comprising the collection of groundwater samples from 32 wells located across the Western Area associated with key areas of concern (as defined in **Table 2** of this IAA). Sample locations are shown in ERM Figure presented in **Appendix A**. The findings of the monitoring program were consistent with those of groundwater monitoring events conducted for more than 10 years. Key outcomes in relation to potential human health risks were:

- LNAPL was only identified in two wells, with a maximum measured thickness of 0.324 metres.
- No samples recorded concentrations of dissolved phase hydrocarbons greater than health screening levels that could give rise to vapour intrusion risks during the remedial works.
- Trends of benzene and volatile hydrocarbons (C6-C9) were demonstrated to be stable to decreasing.

Further commentary on the groundwater monitoring is presented in **Section 5.2** of this IAA.

Refined CSM

The refined CSM is presented in the HHERA section (**Section 5.3** of this IAA).

It is the auditor's opinion that the information presented by ERM in its RSI report provided an appropriate description of the Western Area setting and the immediate surrounding properties. Surrounding land uses reported were consistent with the observations made by the auditor during site inspections.

The Western Area's land use zone is IN3 – Heavy Industrial under the Parramatta Local Environmental Plan 2011.

The auditor considers that appropriate DQIs were used adequately to assess field procedures and analytical results. The DQI are considered to comply with relevant guidelines and to be adequate to ensure the integrity of the data set used to assess the data gaps identified in the Western Area. The sampling plan was considered appropriate and was designed based on the ERM CSM where specific point sources of contamination were not identified (previously discussed in the SAQP section).

The data validation procedure employed for the assessment of field and laboratory QC/QC data indicated that the reported analytical results were representative of soil and groundwater conditions at the sample locations, and that the overall quality of the analytical data produced is acceptably reliable for the purpose of this additional investigation.

The auditor acknowledged that the RSI presented a detailed description of the Western Area geology and hydrogeology that provided a robust basis for understanding these elements of the CSM and influences on the contaminant distribution and mobility.

The auditor noted that the Western Area has been assessed in the past 11 years and approximately 103 test pits were excavated, 83 boreholes were drilled and more than 580 soil samples were collected, which provided a confident level of information to characterise the Western Area.

It is the auditor's opinion that the environmental assessments undertaken by ERM largely followed the endorsed SAQP and the guidelines mentioned in **Section 1.2**, providing sufficient information to portray the characterisation of the site and to assist the preparation of the HHERA and the Detailed RAP.

5.2 The Q4 2019 GME

The Q4 2019 GME of the Clyde Terminal, including the Western Area was conducted between 19 and 26 November 2019. The information contained within the Q4 2019 GME will be incorporated into the Annual Progress Report (APR), which will be supplied by 31 March 2020 to the NSW EPA in accordance with the conditions of the site's EPL (570). The APR will summarise relevant soil and groundwater data and investigation activities completed during 2019. Commentary in this IAA is on the scope and results relevant to the Western Area.

The objectives of the Q4 2019 GME included the following:

- Assess the potential presence of residual light non-aqueous phase liquid (LNAPL) in the Western Area and manage if required.
- Monitor the groundwater quality in the Western Area and the boundary of the facility to evaluate the potential for off-site migration of free and dissolved phase contaminants.

Data in relation to remedial planning and/or management in the Western Area to meet these objectives included:

- Targeted collection of Monitored Natural Attenuation (MNA) parameters within the Western Area to assess the natural capacity for bio-degradation of petroleum hydrocarbons in groundwater as part of the RSI scope (discussed in **Section 5.1**).
- Collection of groundwater data (metals and PFAS) from areas of elevated ASLP leachate concentrations identified during the RSI to inform remedial planning (discussed in **Section 5.1**).

The scope of the GME included:

- Gauging of 32 monitoring wells for depth to groundwater and identification of potential non-aqueous phase liquid (NAPL).
- Collection of no purge groundwater samples, following a minimum equilibration period of 24 hours from 28 monitoring wells.
- Collection of quality assurance and quality control (QA/QC) samples, comprising 6 intra- and 3 inter laboratory duplicates, 5 rinsate blanks, 6 trip blanks and 6 trip spikes for BTEXN, TRH fractions, metals, PFAS an MNA (trip blanks and trip spikes were analysed only for BTEXN and TRH fractions).

A figure showing the groundwater monitoring wells location and groundwater samples exceedances of the adopted criteria is presented in **Appendix A**.

ERM concluded the following:

- Groundwater flow was consistent with previous GMEs and is generally to the north east, east and southeast towards the Duck and Parramatta Rivers.
- LNAPL was recorded in the Western Area in only two monitoring wells MW18/24 (0.324 m) and MW12/01 (less than 3 mm). The thickness of LNAPL was generally consistent with measurements in previous events, with the exception of MW18/24, located in the Western Area (Former Laboratory Area), this well was however only installed in 2018.
- Limited number of the samples recorded concentrations of dissolved phase hydrocarbons greater than health screening levels.
- The extent of the dissolved phase hydrocarbons contamination was stable, well characterised in the context of the current land use and the monitoring well network was considered suitable to assess potential changes in environmental conditions as well as source/pathway/receptor linkage.
- Trends of benzene and volatile hydrocarbons (C6-C9) were demonstrated to be stable to decreasing.
- Marine GIL exceedances were recorded in a groundwater sample collected from well MW12/03 for benzene, ethylbenzene and naphthalene.
- Recreational water quality criteria for PFOS + PFHxS were exceeded in groundwater collected from monitoring wells in the following areas:
  - Within the former fire training area.
  - Nearby Former AFFF foam storage Tank 24, in the Western Area (MW11/18).
- Ecological direct toxicity trigger values were exceeded for PFOS in the following areas:
  - Former fire training area.
  - Eastern site boundary (MW94/12).
- Concentrations of heavy metals in groundwater that exceeded the relevant marine water quality trigger levels (ANZST 2018) were deemed to be representative of ambient conditions as there are no consistent patterns or association with areas of concern.

- Decreasing dissolved phase petroleum hydrocarbons associated with indicators that microbial mediated petroleum hydrocarbon degradation may be occurring (via a combination of sulfate and ferric iron reduction) were indicated by groundwater data. These lines of evidence were consistent with those previously reported during the Q2 2019 GME.

The auditor considered that the GME carried out by ERM in 2019 was sufficient to characterise the groundwater quality in the Western Area and any association with identified areas of concern. The data collected allowed characterisation of risk to be made, an evaluation of concentration trends and generated data that could be incorporated into the RSI and HHERA.

The data validation procedure adopted for the assessment of field and laboratory QC/QC data indicated that the reported analytical results were representative of groundwater conditions at the sample locations, and that the overall quality of the analytical data produced was acceptably reliable for the purpose of this GME.

Overall, the auditor acknowledged that data collected during the GME was consistent with previous monitoring events, demonstrated that there are not widespread impacts to groundwater quality from the former site uses and that risks of exposure to chemicals in groundwater are generally low and acceptable.

The auditor notes that the Conceptual Remedial Action Plan did not advocate the need to remediate groundwater to control or manage human health exposure and the results of the 2019 GME support this position. It is the auditor's understanding that it is anticipated that groundwater data collected as part of the GME program will be utilised in remediation planning and in support of any ongoing long-term management requirements.

5.3 The HHERA

5.3.1 Objectives

ERM stated that the HHERA provided an assessment of risk and derived SSTLs based on the results of the Tier 1 screening and updated CSM from the RSI.

The auditor notes that Tier 1 screening criteria are default investigation or screening levels made or endorsed by the NSW EPA (largely adopted from Schedule B1 of the NEPM). The NEPM investigation and screening levels (HILs and HSLs respectively) are based on risk assessments that consider the three key pathways of exposure, inhalation, ingestion and dermal absorption. Investigation levels in the NEPM are relevant to non-volatile chemicals (such as heavy metals). It is important to note that the NEPM states *Exceeding a HIL means 'further investigation needed', not 'risk is present, clean-up required"*. Therefore, if chemical concentrations are less than HILs, no further action is necessary.

The HSLs apply to petroleum hydrocarbons, in particular those that are volatile. They were developed for the critical soil vapour exposure pathway. Similar to the HILs, if HSLs are exceeded, a Tier 2 or human health risk assessment should be conducted that allows site specific conditions and activities to be considered.

The objectives of the HHERA were as follows:

- Assess whether the on-site soil and groundwater impacts in the Western Area pose a risk to human health or ecological receptors under the proposed future land use scenario.
- Assess whether the impacts pose a risk to off-site human health or ecological receptors based on the current land use.

- Develop SSTLs for remedial works.

5.3.2 Tier 2 exposure assessment

Following a comparison of all available site data to the Tier 1 HSLs or HILs, ERM identified the following chemicals that needed to be considered as part of the HHERA:

- Carcinogenic PAHs.
- TRH >C10-C34.
- Hexavalent chromium.
- Lead.
- Benzene, naphthalene, and TRH.

5.3.3 Migration pathways

The identified migration pathways for COPCs in soil, groundwater or soil vapours assessed in the RSI Tier 1 screening were:

- Leaching of soil impact or surface spills on hardstanding to shallow groundwater or via runoff to the surface water drainage network.
- Lateral migration of contaminants in groundwater.
- Off-site groundwater migration and discharge to the neighbouring surface water bodies;
- Vapour intrusion of petroleum hydrocarbon contaminated groundwater or LNAPL to indoor or outdoor environments.
- Dust entrainment of impacted soils exposed during excavation.

5.3.4 Exposure pathways (sources)

ERM stated that the following potential exposure pathways or sources assessed in the Tier 1 screening were:

- Inhalation of dusts or potential asbestos fibres from impacted soils during excavation.
- Direct contact or ingestion of impacted soils, groundwater or surface water drainage during intrusive maintenance works or sampling works.
- Inhalation of vapours by on site workers from hydrocarbon impacted soil, groundwater and/or LNAPL in indoor or outdoor air.
- Potential acute hazards during intrusive works and/or in future buildings due to the generation and pooling of ground gases from LNAPL and impacted soil/ groundwater.

Additionally, the following potential exposure pathways for off-site receptors were assessed in the RSI Tier 1 screening, specific to PFAS impacts were:

- Direct exposure to impacted surface water within the Duck and Parramatta Rivers.
- Indirect human health exposure via consumption of seafood containing PFAS caught recreationally from Duck River.
- Indirect ecological exposure via consumption of PFAS containing biota (bioaccumulation).

Potential exposure pathways for off-site commercial/industrial workers were:

- Inhalation of dusts or potential asbestos fibres from contaminated soils during excavation after dilution during ambient air transport.

- Inhalation of vapours by on site workers from hydrocarbons contaminated soil, groundwater and/or LNAPL in outdoor air after dilution during ambient air transport.

5.3.5 Receptors

Human health receptors

ERM stated that the human receptors identified within the CSM that may be exposed to the identified COPCs in soil and groundwater include the following:

- Current and future on-site and off-site commercial/ industrial workers in both indoor and outdoor settings.
- Current and future on-site intrusive maintenance workers or construction workers undertaking earthworks consistent with the development and maintenance of slab-on-grade warehouse development.
- Off-site recreational users of the Duck and Parramatta River Systems.
- Recreational anglers who potentially consume seafood potentially contaminated with PFAS caught in the Duck River / Parramatta River downstream from the site.

Beneficial groundwater users (potable or non-potable) were not considered a potential receptor given the absence of registered extraction bores down gradient of the Western Area, poor natural background quality of groundwater and likely low yields.

In addition, ERM stated that current on-site employees and contractors are subject to Viva Energy Health, Safety & Environment (HSE) controls restricting on-site workers potential exposures to residual soil contamination. Potential complete exposure pathways were therefore considered managed and exposure risks to these current on-site workers were not directly assessed in the HHERA. They were however discussed as being present for completeness.

Ecological receptors (on-site)

ERM stated that on-site ecological receptors were considered to have limited environmental value given it is a highly modified environment and that they likely future commercial/industrial scenario will comprise large slab-on-grade warehouses.

Ecological receptors (off-site)

The Duck River, bordering the Western Area to the south, and the Parramatta River that adjoins the Duck River to the north-east are the closest ecological receptors.

Owing to the estuarine characteristics of these areas, ERM adopted the ecological screening guidelines for a slightly to moderately disturbed ecosystem as defined in ANZG (2018).

In addition, the EIS identified the presence of Green and Golden Bell Frog as Vulnerable or Endangered flora and fauna, which have been identified 100 metres to the north of the Western Area. However, given the distance required for contaminated sources to migrate from the Western Area to the habitat, it was not considered there was a complete exposure pathway to the Green and Golden Bell Frog.

A copy of the refined CSM is presented in **Appendix C**.

5.3.6 Source-Pathway-Receptor (SPR) linkages

The following SPR linkages were considered incomplete due to current Viva Energy HSE controls, which restrict exposure of on-site workers to contaminant sources under the following scenarios:

- Direct contact exposure pathways for on-site workers and intrusive maintenance workers. This includes potential pathways via ingestion of soils and dusts and dermal contact with impacted soils, groundwater and LNAPL including the generation and pooling of ground gases, particularly during ground disturbance activities.
- Contractors/visitors who may be exposed to contaminated groundwater, including groundwater sampling.
- Indirect pathways such as inhalation of vapours derived from groundwater impacts, hydrocarbons contaminated soils and LNAPL have previously been considered by Viva Energy to be incomplete.

Viva Energy continually monitors air quality where works are being undertaken and responds to reported gas leaks or odours of unknown origin. These scenarios would be complete without the implementation of a long-term management plan and/or remediation.

The following scenarios weren't assessed in the HHERA, as further risk assessment is not considered to change the existing conclusions and management considerations:

- Inhalation of dusts or potential asbestos fibres from isolated ACM contaminated soils during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.
- Potential acute hazards due to the generation and pooling of ground gases from LNAPL and contaminated soil/ groundwater on-site intrusive maintenance workers or construction workers undertaking earthworks.

The use of further site-specific risk assessment in the HHERA of potential exposures to asbestos is not supported in the NEPM (2013). Rather, ERM stated that remediation and future site management decisions should be made through implementation of Environmental Management Plans.

Risk categorisation of site-specific of methane in soil gas was undertaken for methane and carbon dioxide concentrations in accordance with the NSW EPA ground gas guidance. Only AEC-3 was identified with a risk categorisation (low risk) which requires management and/or remediation decisions for the development of enclosed spaces. Given there was no ground gas data for AEC-4, as a precaution consideration of hazardous ground gases in future management and/or remediation decisions.

Future management decisions are needed for LNAPL including remedial decisions to remove LNAPL as well as the consideration for implementation of Environmental Management Plans.

ERM stated that while the on-site ecological receptors were considered to have limited value under the current and future land use, the RSI did screen site soil data for ecological risks. The exceedances indicated the need to consider design and planning of future landscape areas.

ERM derived SSTLs for the following – vapour inhalation risks were based on measured soil vapour data and not soil or groundwater data:

- Direct contact or ingestion of impacted soils by future on-site intrusive maintenance workers (IMWs) or construction workers undertaking earthworks for the following AECs and COPCs:
  - AEC-3: carcinogenic PAHs, TRH >C10-C34.
  - AEC-4: carcinogenic PAHs, TRH >C10-C34 and hexavalent chromium.
  - AEC-11: lead.
  - AEC-15: TRH >C10-C34.

- Inhalation of vapours by future on site workers in indoor or outdoor air for Areas and COPCs:
  - AEC-3: benzene, naphthalene, and TRH C6-C10 (less BTEX).
  - AEC-4: benzene, naphthalene, and TRH C6-C10 (less BTEX).
  - AEC-9: benzene, and TRH C6-C10 (less BTEX).
  - AEC-10: TRH C6-C10 (less BTEX).
  - AEC-12: TRH C6-C10 (less BTEX).

The conclusions of the HHERA are summarised in **Table 3**. It should be noted that for lead and hexavalent chromium, the risk driver is direct contact or ingestion of soils, not vapour inhalation. For volatile chemicals (such as benzene) vapour inhalation risks at all AECs for intrusive maintenance workers were considered to be unlikely or within acceptable levels – this scenario would apply for workers during remedial works. The potential vapour risks to future on-site workers in indoor or outdoor air was based on the presence of future buildings only.

A figure showing the AECs and the respective SSTLs is presented in **Appendix A**.

Table 3 Risk assessment conclusions

AEC	Direct contact or ingestion of impacted soils by future on-site intrusive maintenance or construction workers undertaking earthworks	Inhalation of vapours by future on site workers in indoor or outdoor air
AEC-1	No potential risk identified	No potential risk identified
AEC-2	No potential risk identified	No potential risk identified
AEC-3	Potential risk - Carcinogenic PAHs and TR) >C10-C34	Potential risk -Benzene, naphthalene, and TRH C6-C10 (less BTEX)
AEC-4	Potential risk - Carcinogenic PAHs, TRH >C10-C34 and hexavalent chromium	Potential risk - Benzene, naphthalene, and TRH C6-C10 (less BTEX)
AEC-5	No potential risk identified	No potential risk identified
AEC-6	No potential risk identified	No potential risk identified
AEC-7	No potential risk identified	No potential risk identified
AEC-8	No potential risk identified	No potential risk identified
AEC-9	No potential risk identified	Potential risk - Benzene, and TRH C6-C10 (less BTEX)
AEC-10	No potential risk identified	Potential risk - TRH C6-C10 (less BTEX)
AEC-11	Potential risk – Lead	No potential risk identified
AEC-12	No potential risk identified	Potential risk - TRH C6-C10 (less BTEX)
AEC-13	No potential risk identified	No potential risk identified
AEC-14	No potential risk identified	No potential risk identified
AEC-15/General Site Area	Potential risk - TRH >C10-C34	No potential risk identified

The auditor considers that the methodology and guidelines adopted by ERM in preparing the HHERA were appropriate. It is the auditor's opinion that the information presented in the HHERA took into consideration the historical dataset as well as the most recent information presented in the RSI.

ERM identified the relevant COPCs based on the findings of the Tier 1 screening, assigned appropriate screening levels, reviewed and evaluated the available data.

Relevant exposure scenarios were identified for the Western Area based on the refined CSM and considered the current and proposed future land use scenarios – in relation to both on site and off site receptors.

It is the auditor's understanding that the residual LNAPL as well as the dissolved phase plumes do not pose an unacceptable human health and ecological risk to the current and future on and off-site receptors. Exposure to these contaminant sources could be managed through a long term site management plan.

Although asbestos can pose a potential risk to the maintenance workers during the remedial activities this issue can be managed by long management plans at the completion of the audit and in the interim via Viva Energy HSE protocols.

The risk assessment demonstrated that the key exposure risk related to the presence of volatiles is inhalation in a future development scenario where buildings are constructed. This exposure scenario will drive the need for remediation. No inhalation risks were identified owing to the presence of heavy metals.

No unacceptable risks (for any exposure scenario, including vapour inhalation) were identified for a construction worker scenario. This scenario would be akin to remediation workers. ERM stated that as there were no unacceptable risks to on-site workers, the risk to off-site workers would be less.

The auditor considers that the the data gaps previoulsy noted by AECOM in the Conceptual RAP have been apropriately addressed. There has been sufficient assessment of the key exposure pathways both on and off site and combined with the Remedial Options Assessment and the Air Emissions Verification Report, the auditor considers that a Detailed RAP can be prepared.

6. Auditor conclusions

This interim audit advice was prepared following the review of a Remedial Site Investigation and a Human Health and Ecological Risk Assessment, both of which were conducted by ERM. In reviewing the documents, the auditor took into account guidelines made or endorsed by NSW EPA and draft conditions of consent issued by DPIE in relation to air quality assessment and management (as listed in **Section 2.2.2** of this IAA).

6.1 Remedial Site Investigation

The auditor considered that the scope of work of the RSI was completed in a manner consistent with NSW EPA made or endorsed guidelines. The RSI met its key objectives of obtaining data to:

- Better define the volumes of contaminated soil that need remediation.
- Allow preparation of a human health risk assessment.

The groundwater sampling across the Western Area as part of the RSI confirmed findings of previous groundwater monitoring events, in particular that the data did not identify hydrocarbons in groundwater at concentrations that could pose an inhalation risk.

6.2 Human Health Risk Assessment

The HHERA was based on all previously collected data, including the groundwater sampling program completed in 2019. A comprehensive assessment of the chemicals of concern and all realistic pathways by which on and off site receptors could be exposed identified only one scenario that presented a potential risk of inhalation of volatile chemicals – vapour intrusion into future buildings. Vapour risk was only identified for benzene, naphthalene and TRH. No vapour risks are associated with the presence of heavy metals in soils.

No unacceptable risks (for any exposure scenario, including vapour inhalation) were identified for a construction worker scenario. This scenario would be akin to remediation workers. ERM stated that as there were no unacceptable risks to on-site workers, therefore the risk to off-site workers would be less.

The risk assessment demonstrated that the key exposure risk related to the presence of volatiles is inhalation in a future development scenario where buildings are constructed. This exposure scenario will drive the need for remediation.

6.3 Detailed RAP and air quality management

It is the auditor's opinion that in conjunction with the findings of HHERA and the forthcoming Air Emissions Verification Report (AEVR) and Remedial Options Assessment Report (ROA), there is sufficient information to prepare a Detailed Remedial Action Plan. This should be prepared as per the Consultant Guidelines and the Auditor Guidelines and other relevant NSW EPA guidelines or technical advice.

The current remediation trials being conducted by ERM will be used to detail the locations, volumes and manner in which remediation is to take place, including commentary on health and safety considerations (and relevant monitoring) for all site workers. The AEVR will provide VOC emission flux calculations and model observed levels of attenuation of chemicals with distance from the excavation operations.

On the basis of the information presented in the RSI and HHERA, the auditor does not consider there to be a need during the remedial works for an emissions control enclosure. The data that supports this statement are:

- As stated in the Conceptual RAP, no groundwater remediation is necessary.
- Groundwater sampling in the Western Area has not identified any volatile chemicals at concentrations that could pose an inhalation risk during remedial works.
- The heavy metals (hexavalent chromium and lead) that have been found in isolated areas within the Western Area are not volatile and the HHERA identified that these chemicals only pose an ingestion or dermal absorption risk.
- For intrusive maintenance workers, the HHERA demonstrated there is no increased risk of exposure via inhalation of volatile chemicals. This scenario would be relevant to site workers during remedial works.
- Increased risk of inhalation of volatiles was identified in the HHERA as only applicable to future commercial workers where buildings are constructed.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely

GHD

Andrew Kohlrusch

NSW EPA Accredited Auditor
61+ 447 685 055

7. Disclaimer

This IAA has been prepared in accordance with relevant provisions of the *Environment Protection Act 1997*. The IAA represents the auditor's opinion of the reports listed in **Section 1.1**of this IAA.

This IAA:

- Has been prepared by Andrew Kohlrusch and his support team as indicated in the appropriate sections of this Report ("GHD") for Viva Energy Australia Pty Ltd ("Viva Energy").
- May be used and relied on by Viva Energy.
- May be used by and provided to the NSW EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the EP Act 1997.
- May be provided to other third parties but such third parties use of or reliance on the IAA is at their sole risk, as this IAA must not be relied on by any person other than those listed above without the prior written consent of GHD.
- GHD and its servants, employees and officers (including the Auditor) otherwise expressly disclaim responsibility to any person other than Viva Energy arising from or in connection with this IAA.
- To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the IAA are excluded unless they are expressly stated to apply in this IAA.

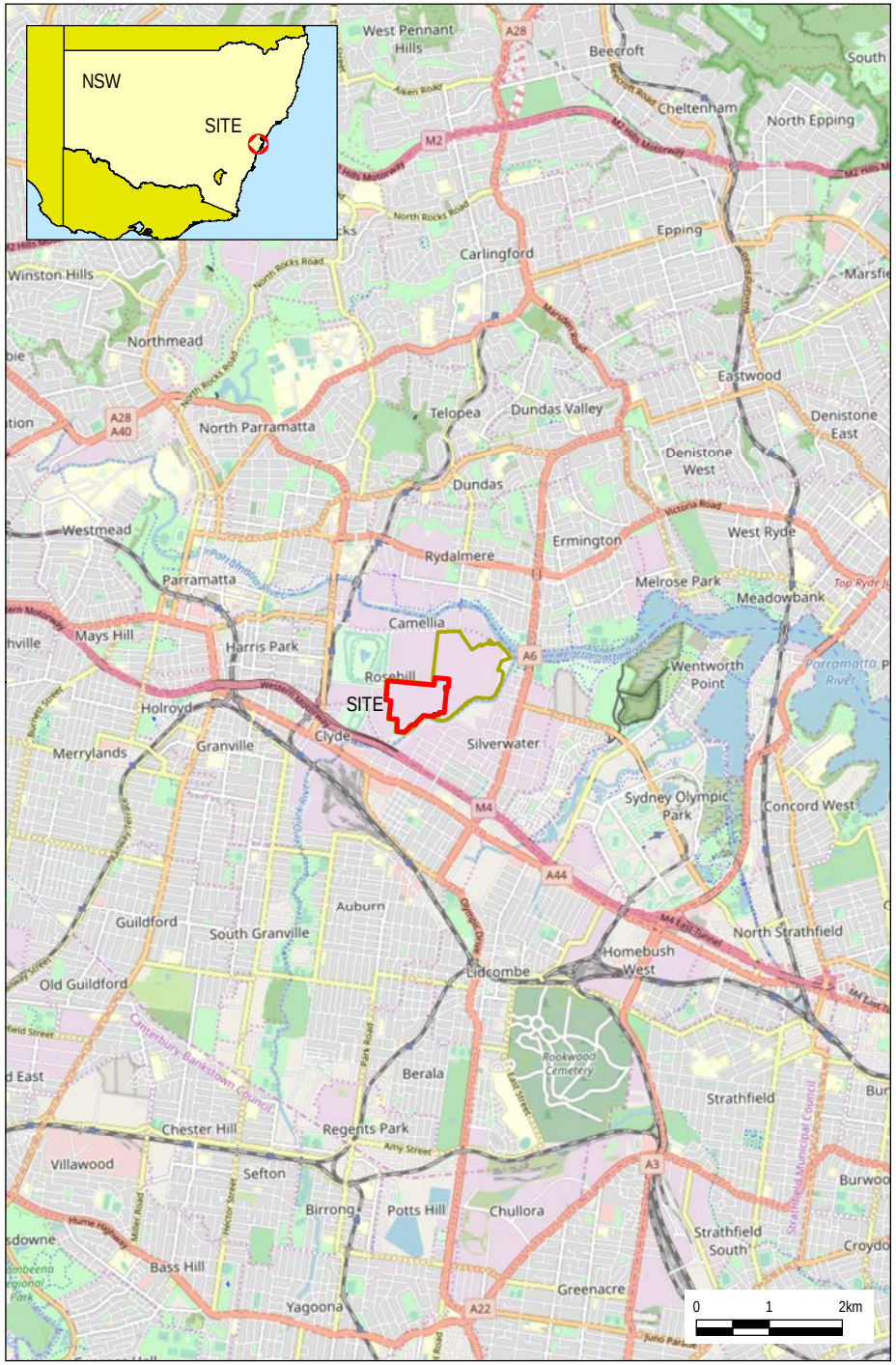
The services undertaken by the auditor, his team and GHD in connection with preparing this IAA:

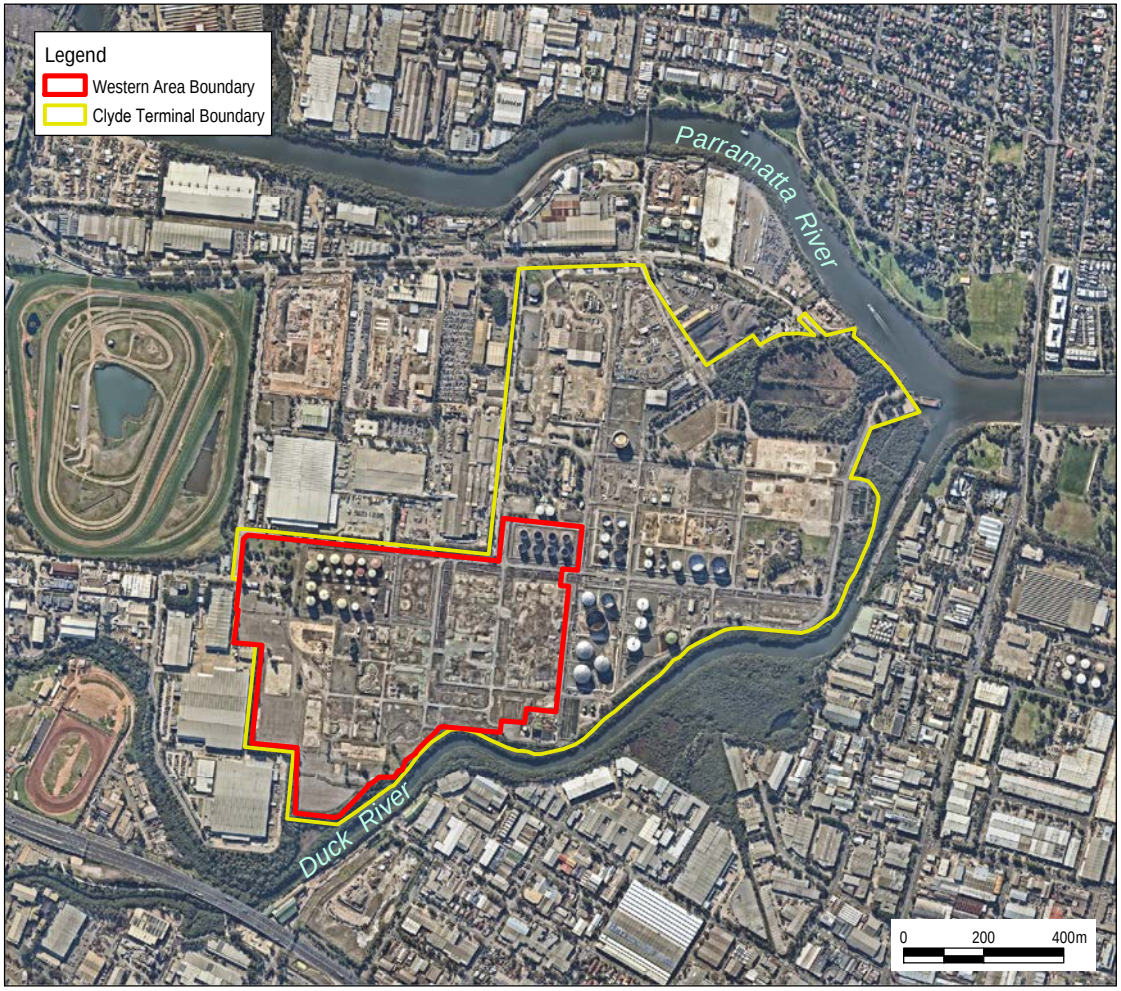
- Were undertaken in accordance with current profession practice and by reference to relevant guidelines made or approved by the NSW EPA.
- The opinions, conclusions and any recommendations in this IAA are based on assumptions made by the auditor, his team and GHD when undertaking services and preparing the IAA ("Assumptions"), as specified throughout this IAA.
- GHD and the auditor expressly disclaim responsibility for any error in, or omission from, this IAA arising from or in connection with any of the assumptions being incorrect.
- Subject to the paragraphs in this section of the IAA, the opinions, conclusions and any recommendations in this IAA are based on conditions encountered and information reviewed at the time of preparation of this IAA and are relevant until such times as the service station conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this IAA arising from or in connection with those opinions, conclusions and any recommendations.
- The auditor and GHD have prepared this IAA on the basis of information provided by ERM and others who provided information to GHD (including Government authorities), which the auditor and GHD have not independently verified or checked ("Unverified Information") beyond the agreed scope of work.
- The auditor and GHD expressly disclaim responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

- This IAA and Site should be read in full and no excerpts are taken to be representative of the findings of this Report.
- The opinions, conclusions and any recommendations in this IAA are based on information obtained from, and testing (if undertaken as specified in this IAA) undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the service station at other than these locations.
  Site conditions at other parts of the service station may be different from the service station conditions found at the specific sampling points.
- Although reasonable care has been used to assess the extent to which the data collected from site is representative of the overall site condition and its beneficial uses, investigations undertaken in respect of this IAA are constrained by the particular service station conditions as discussed in this IAA. As a result, not all relevant site features and conditions may have been identified in this IAA.
- Site conditions (including any the presence of hazardous substances and/or service station contamination) may change after the date of this IAA. The auditor and GHD expressly disclaim responsibility:
  1. Arising from, or in connection with, any change to the site conditions.
  2. To update this IAA if the site conditions change.
- These Disclaimers should be read in conjunction with the entire IAA and no excerpts are taken to be representative of the findings of this IAA.

Appendices

Appendix A Figures





General Area Land Use:
Industrial
General Hydrogeology of Locality:
1. Soil Type:
Residual clay with minor silt and sand
2. Depth to aquifer:
0.5-2.5m bgs

Aquifer Usage:
Not known beneficial onsite extraction
Potentially Sensitive Receptors:
- Parramatta River (north eastern boundary)
- Duck River (southern boundary)

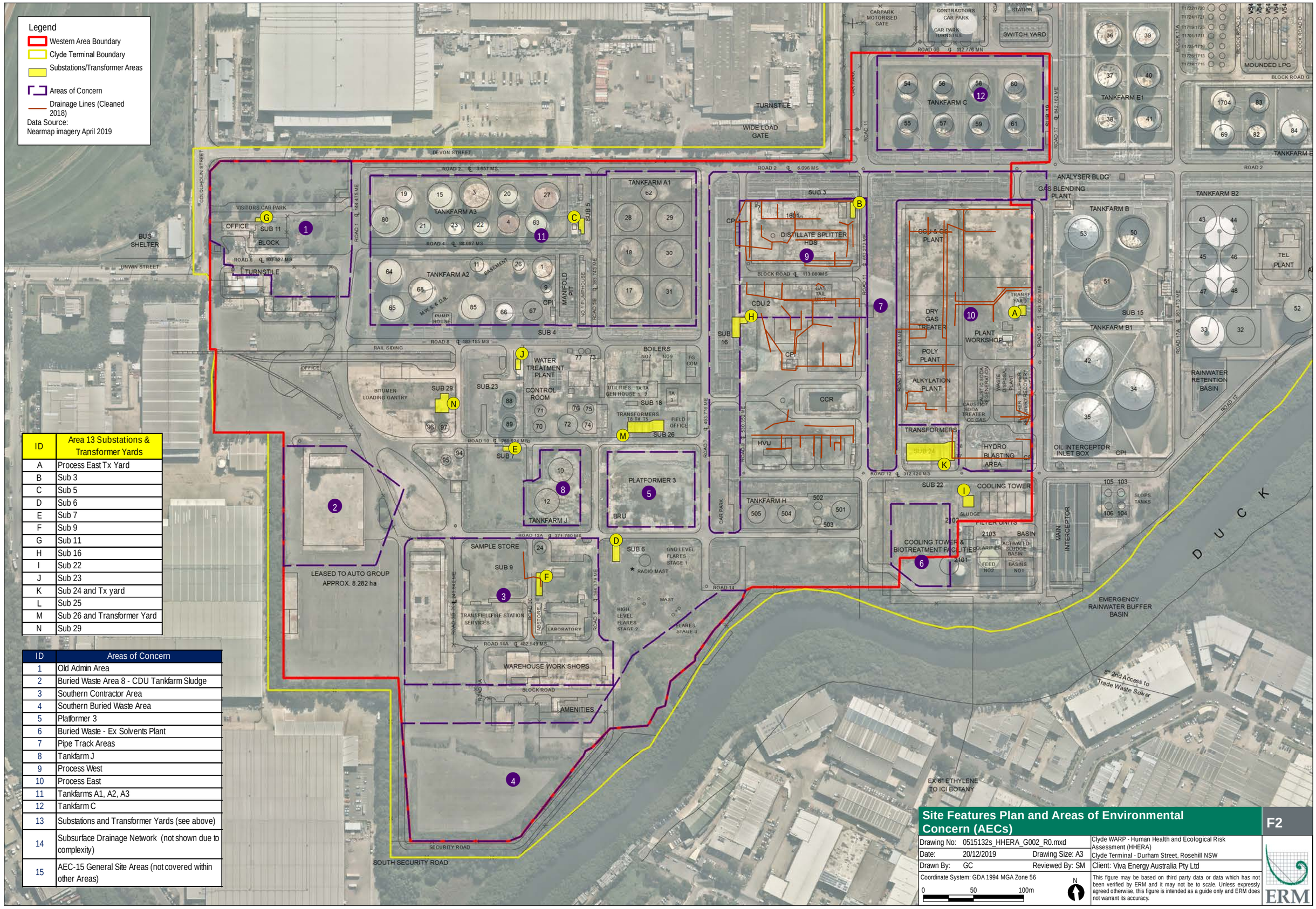
Source:
Nearmap Imagery July 2019
Locality: Esri, OpenStreetMap 2019

Site Location

F1

Drawing No:	0515132s_HHERA_G001_R0.mxd		Clyde WARP - Human Health and Ecological Risk Assessment (HHERA) Clyde Terminal - Durham Street, Rosehill NSW
Date:	20/12/2019	Drawing Size: A4	
Drawn By:	GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		N	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
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K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
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ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Site Features Plan and Areas of Environmental Concern (AECs)

F2

Drawing No: 0515132s_HHERA_G002_R0.mxd

Date: 20/12/2019 Drawing Size: A3

Drawn By: GC Reviewed By: SM

Coordinate System: GDA 1994 MGA Zone 56

0 50 100m

N

Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)
Clyde Terminal - Durham Street, Rosehill NSW

Client: Viva Energy Australia Pty Ltd

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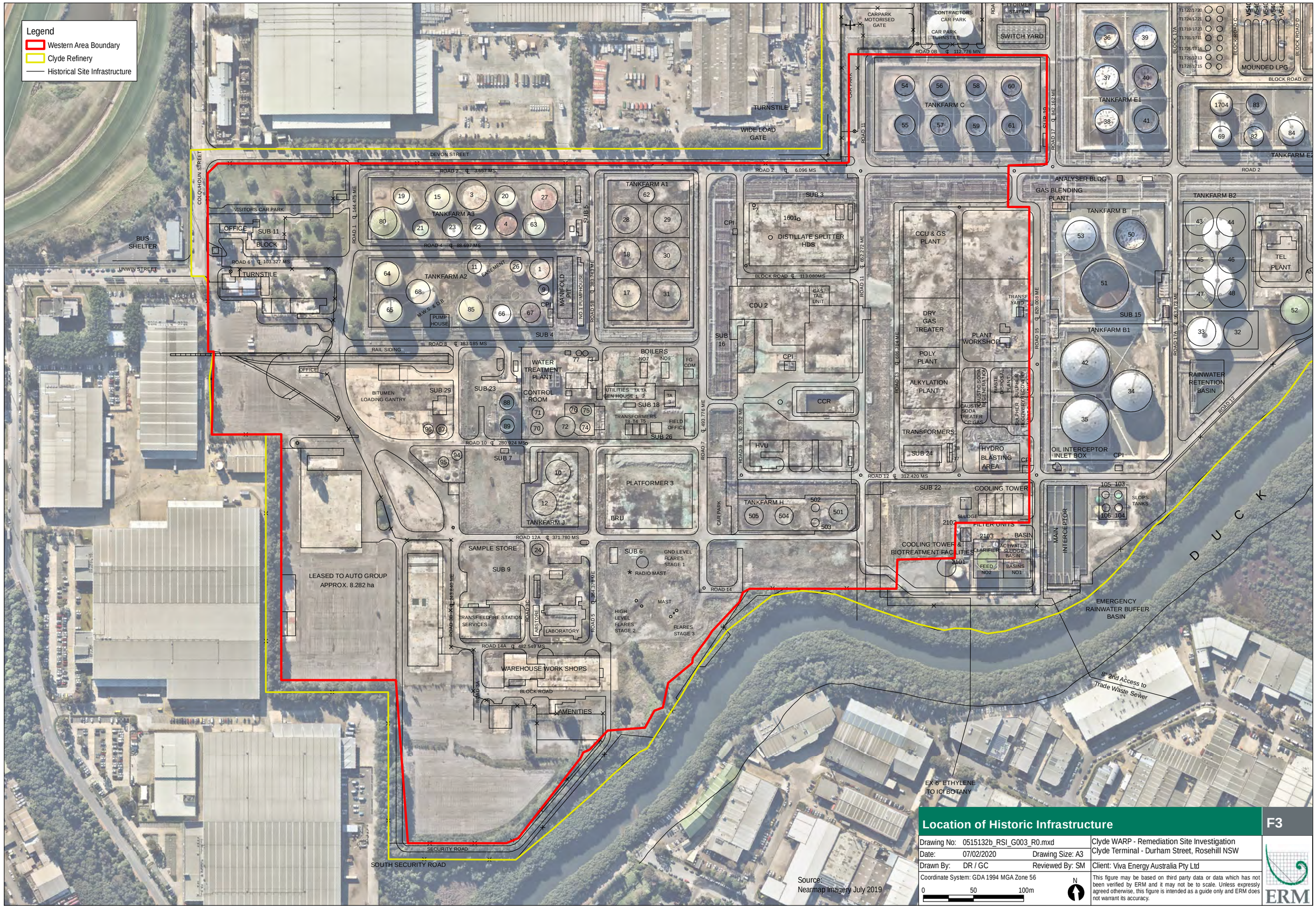
ERM

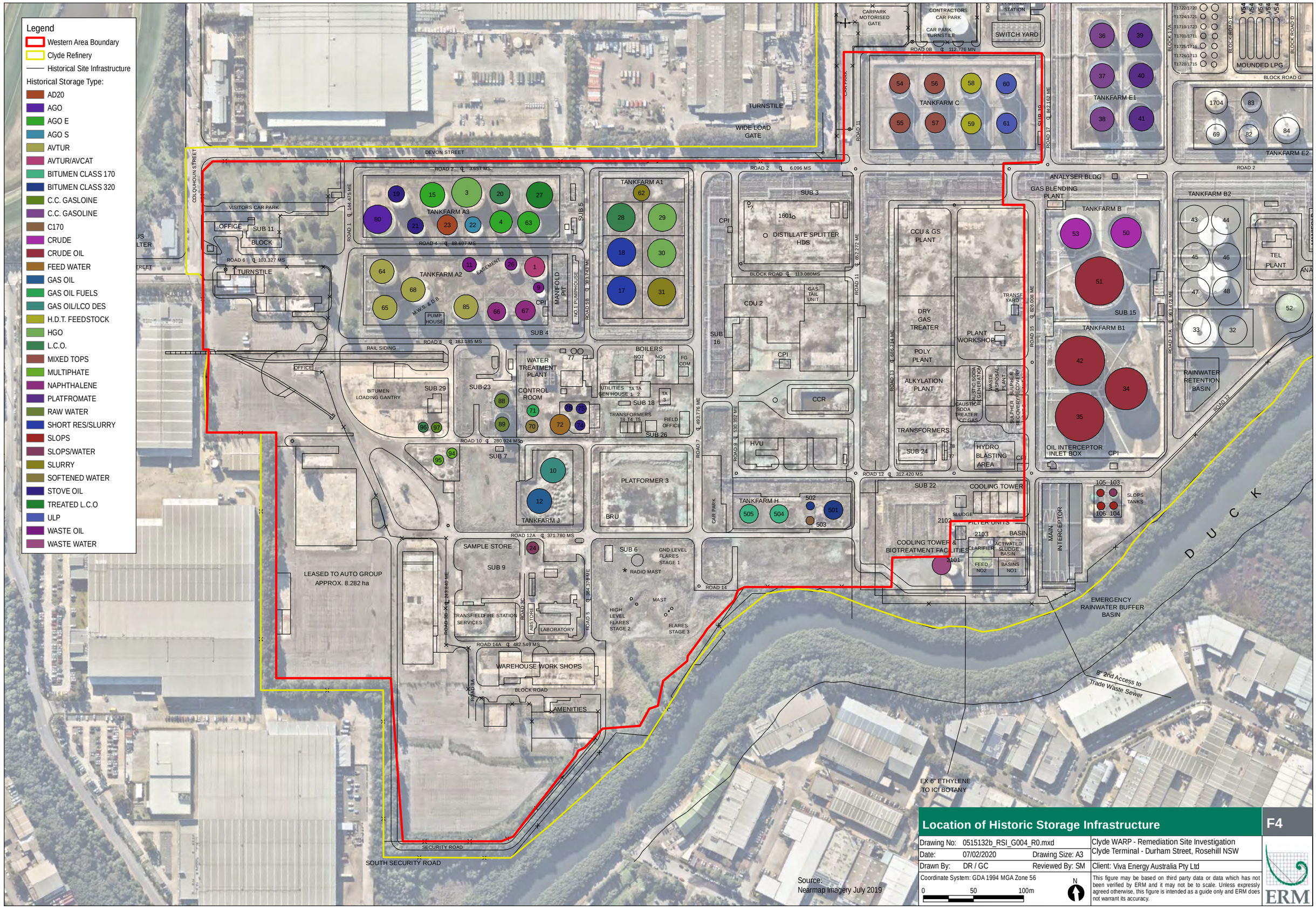


Location of Historic Infrastructure

F3

Drawing No:	0515132b_RSI_G003_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date:	07/02/2020	Drawing Size: A3	
Drawn By:	DR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



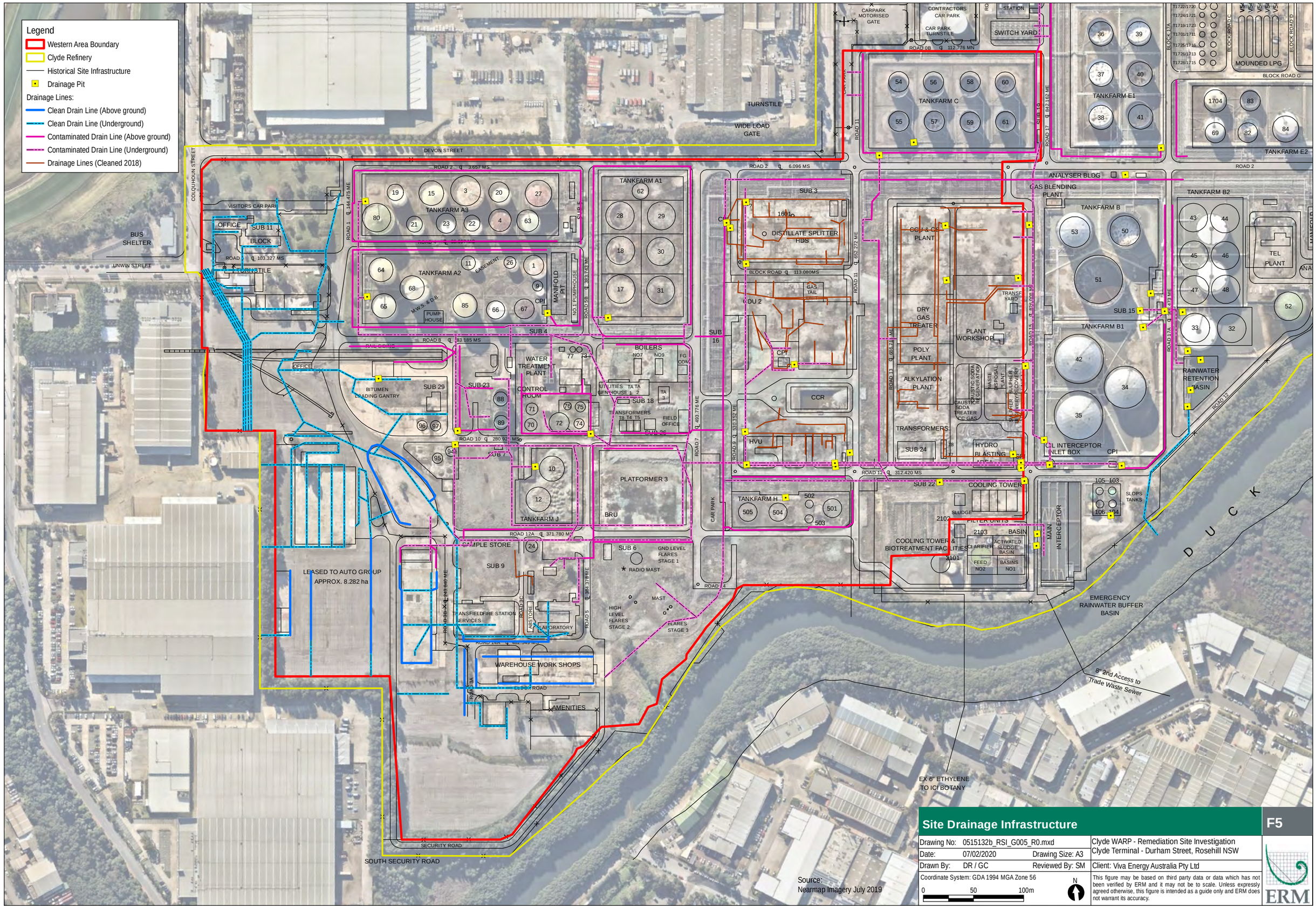
Source:
Nearmap Imagery July 2019

Location of Historic Storage Infrastructure

F4

Drawing No: 0515132b_RSI_G004_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: DR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56 0 50 100m N		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Source:
Nearmap Imagery July 2019

Site Drainage Infrastructure

F5

Drawing No: 0515132b_RSI_G005_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: DR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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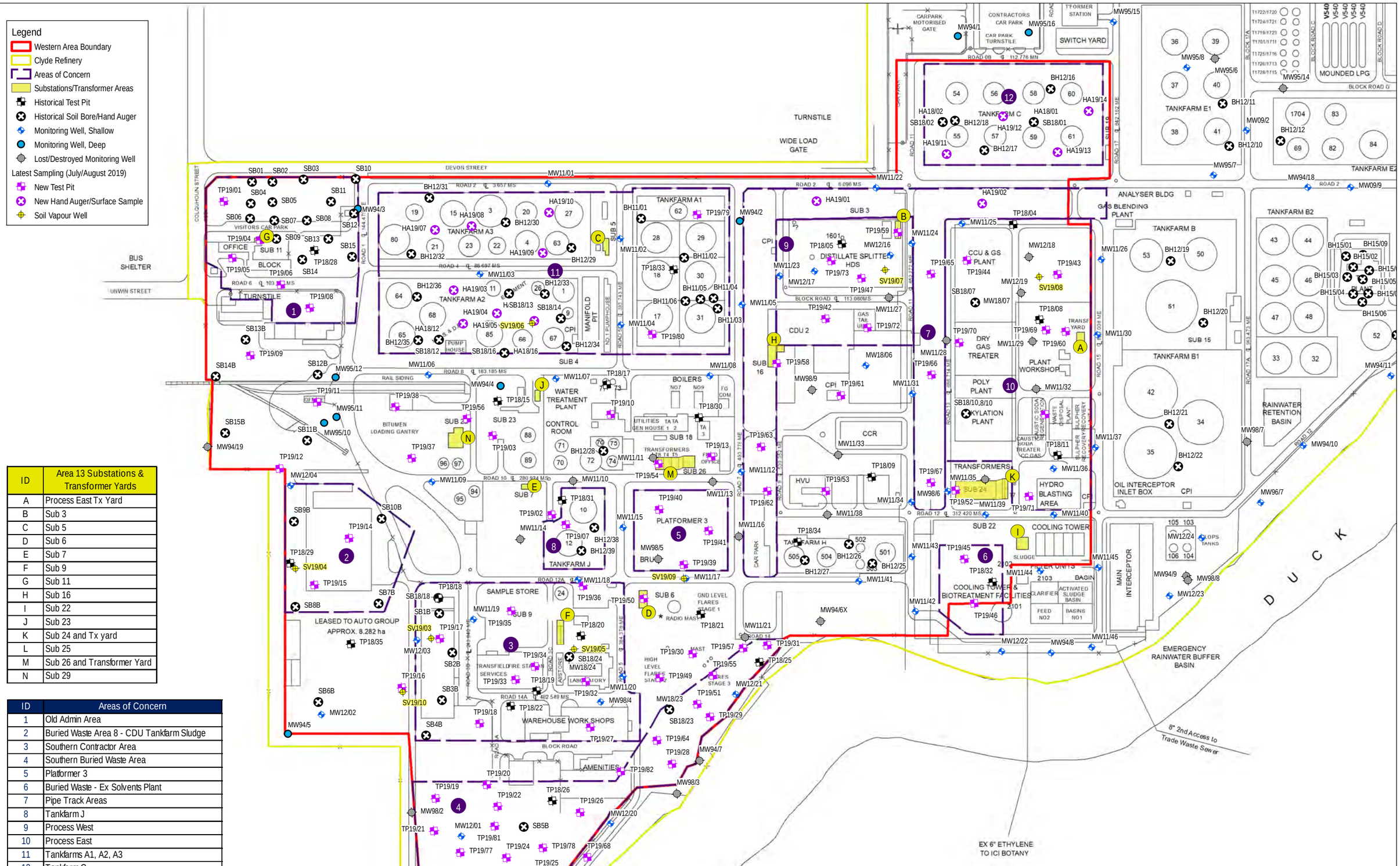
ERM



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C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
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J	Sub 23
K	Sub 24 and Tx yard
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N	Sub 29

ID	Areas of Concern
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2	Buried Waste Area 8 - CDU Tankfarm Sludge
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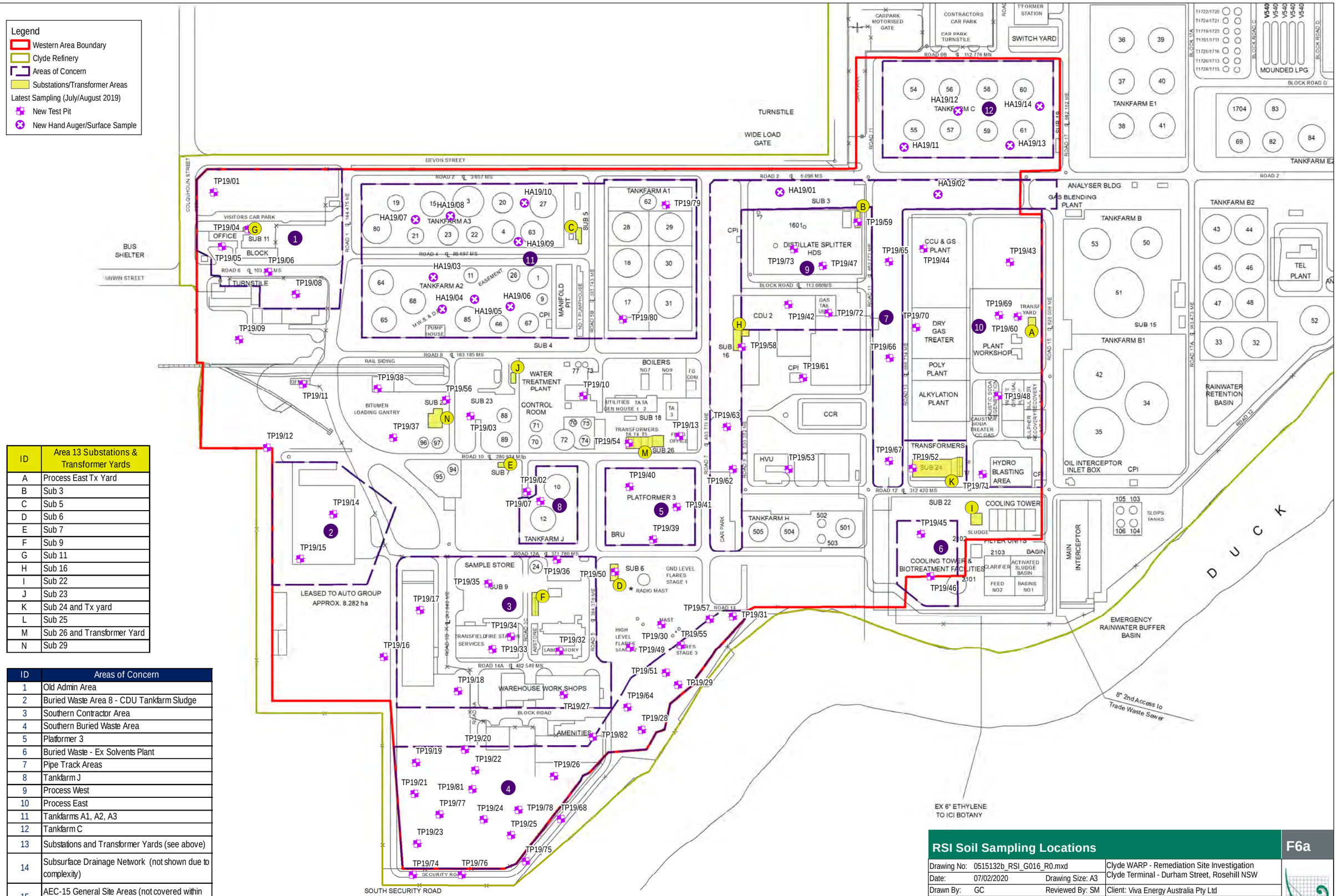
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Current and Historical Soil Sampling Locations

F6

Drawing No: 0515132b_RSI_G006_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56 0 50 100m N		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



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14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

RSI Soil Sampling Locations

F6a

Drawing No: 0515132b_RSI_G016_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56 0 50 100m N		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Legend

- Western Area Boundary
- Clyde Refinery
- Substations/Transformer Areas
- Areas of Concern
- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- 0.324 Maximum LNAPL Thickness (m)

Notes:
* LNAPL / water interface unable to be accurately determined in MW12/01 due to highly viscous nature of LNAPL.

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15	AEC-15 General Site Areas (not covered within other Areas)

Groundwater Monitoring Locations and LNAPL Occurrences (2008-2019)

F7

Drawing No: 0515132b_RSI_G007_R1.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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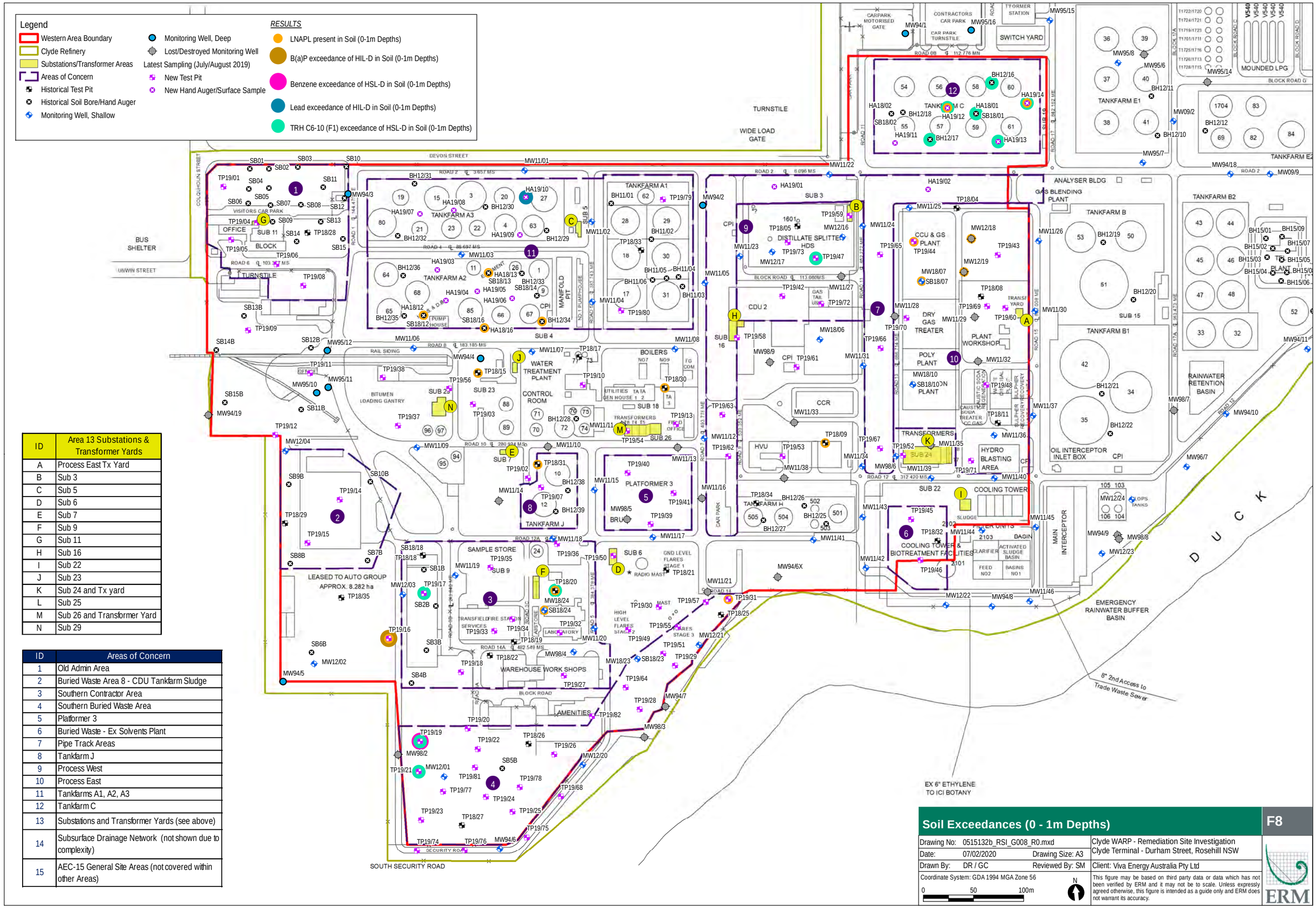
ERM



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12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Exceedances (0 - 1m Depths)

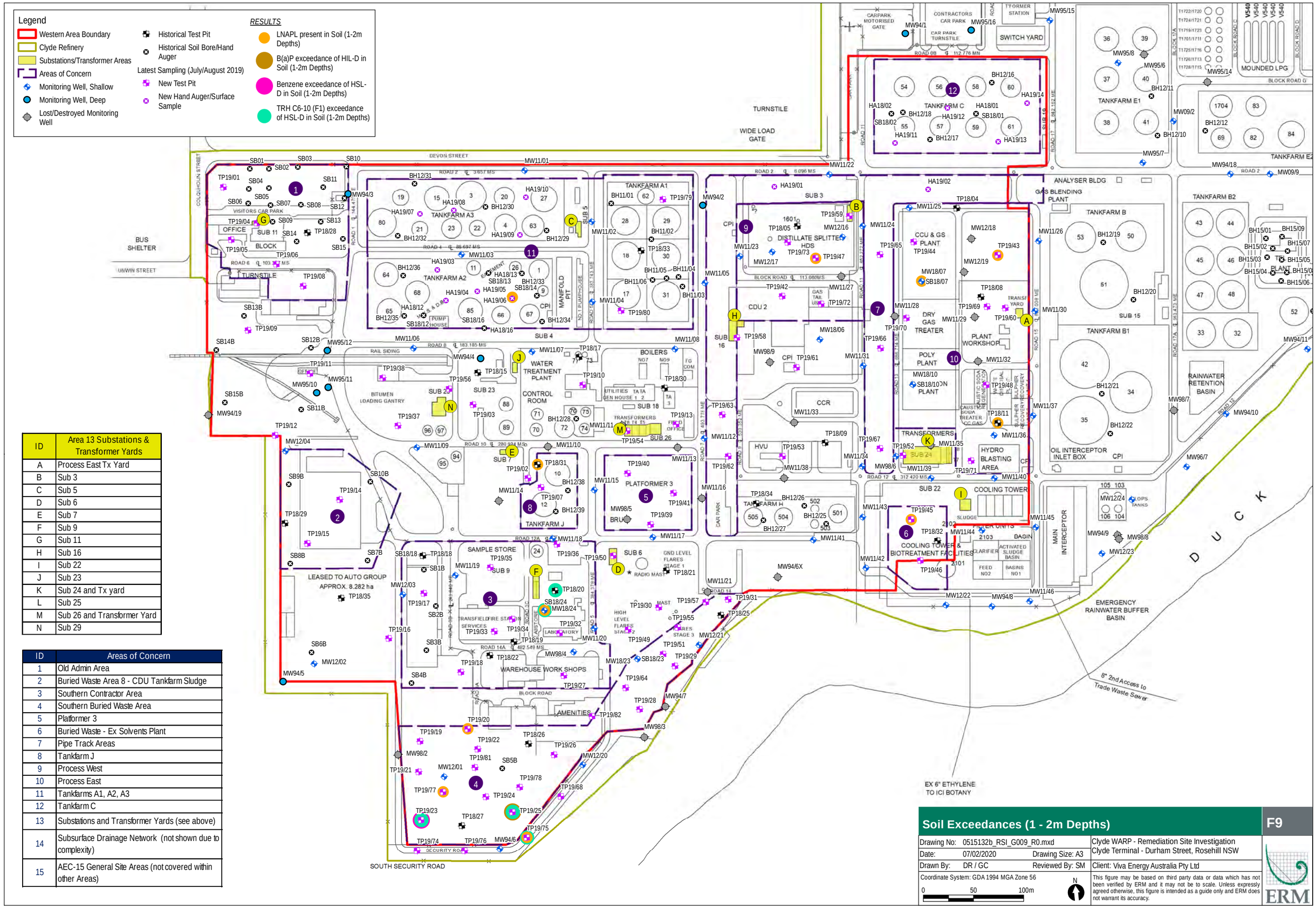
F8

Drawing No: 0515132b_RSI_G008_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: DR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM



ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Exceedances (1 - 2m Depths)

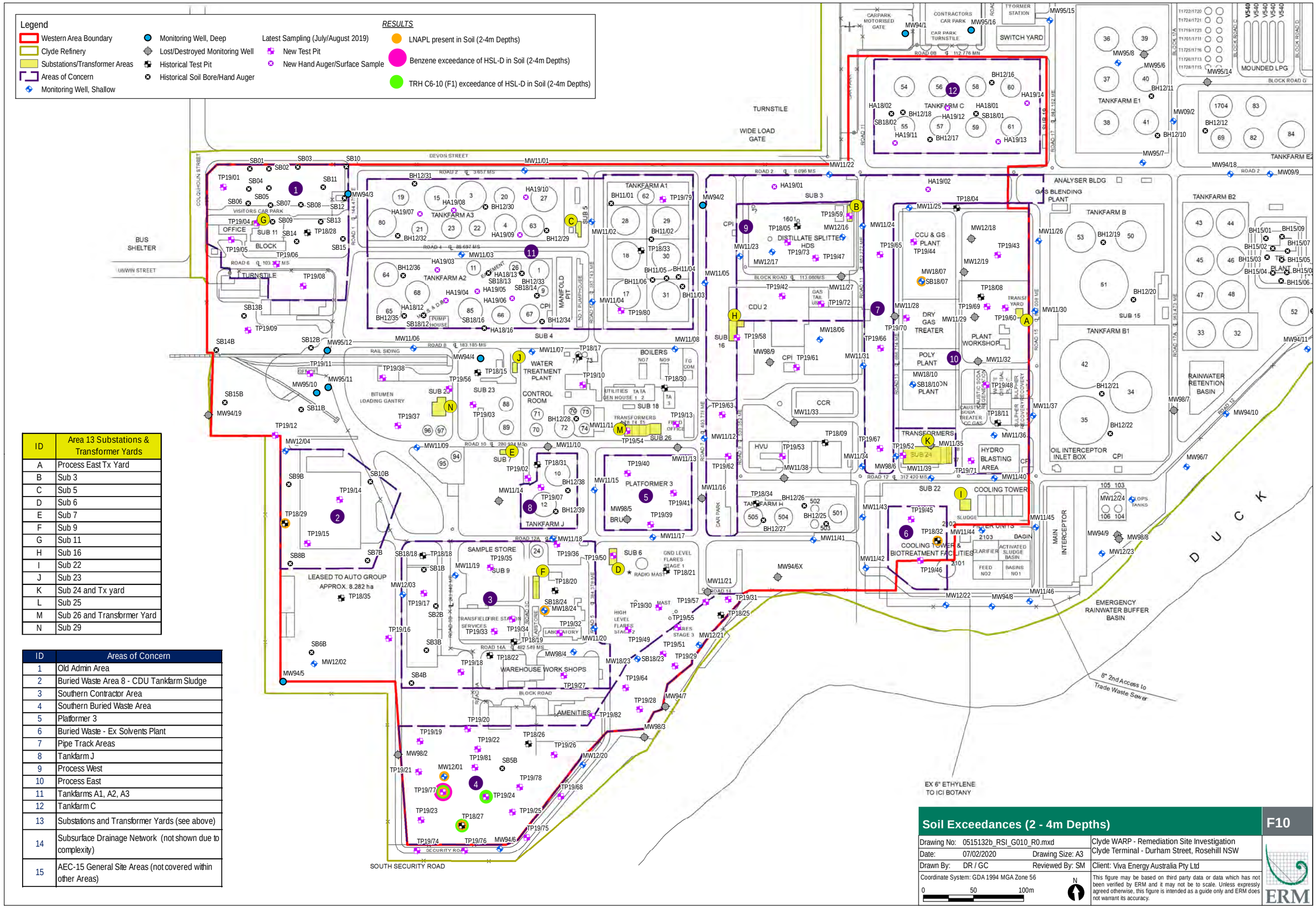
F9

Drawing No: 0515132b_RSI_G009_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: DR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM



ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Exceedances (2 - 4m Depths)

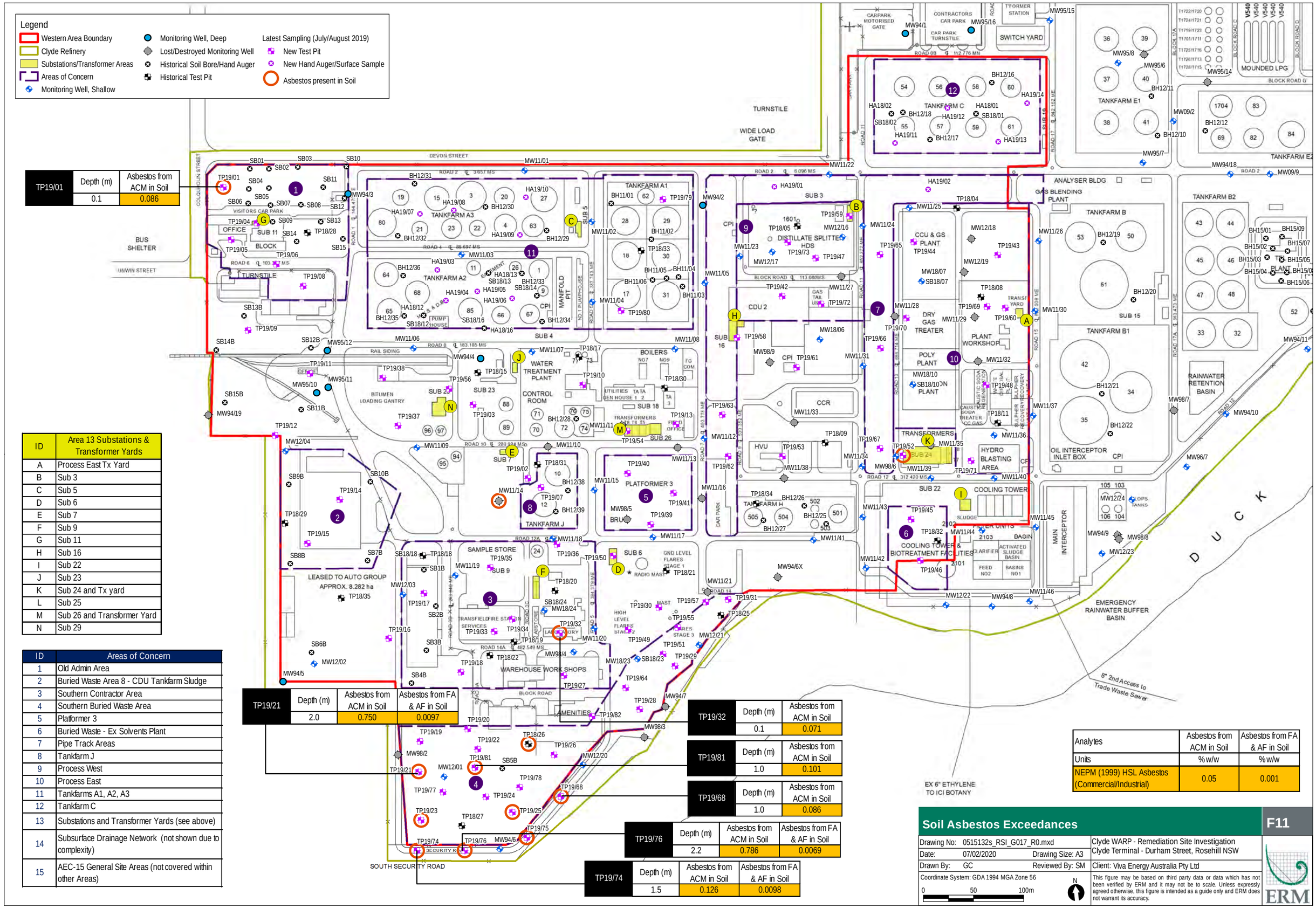
F10

Drawing No: 0515132b_RSI_G010_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: DR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM



TP19/01	Depth (m)	Asbestos from ACM in Soil
	0.1	0.086

ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

TP19/21	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.0	0.750	0.0097

TP19/32	Depth (m)	Asbestos from ACM in Soil
	0.1	0.071

TP19/81	Depth (m)	Asbestos from ACM in Soil
	1.0	0.101

TP19/68	Depth (m)	Asbestos from ACM in Soil
	1.0	0.086

TP19/76	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.2	0.786	0.0069

TP19/74	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	1.5	0.126	0.0098

Analytes	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
Units	%w/w	%w/w
NEPM (1999) HSL Asbestos (Commercial/Industrial)	0.05	0.001

Soil Asbestos Exceedances

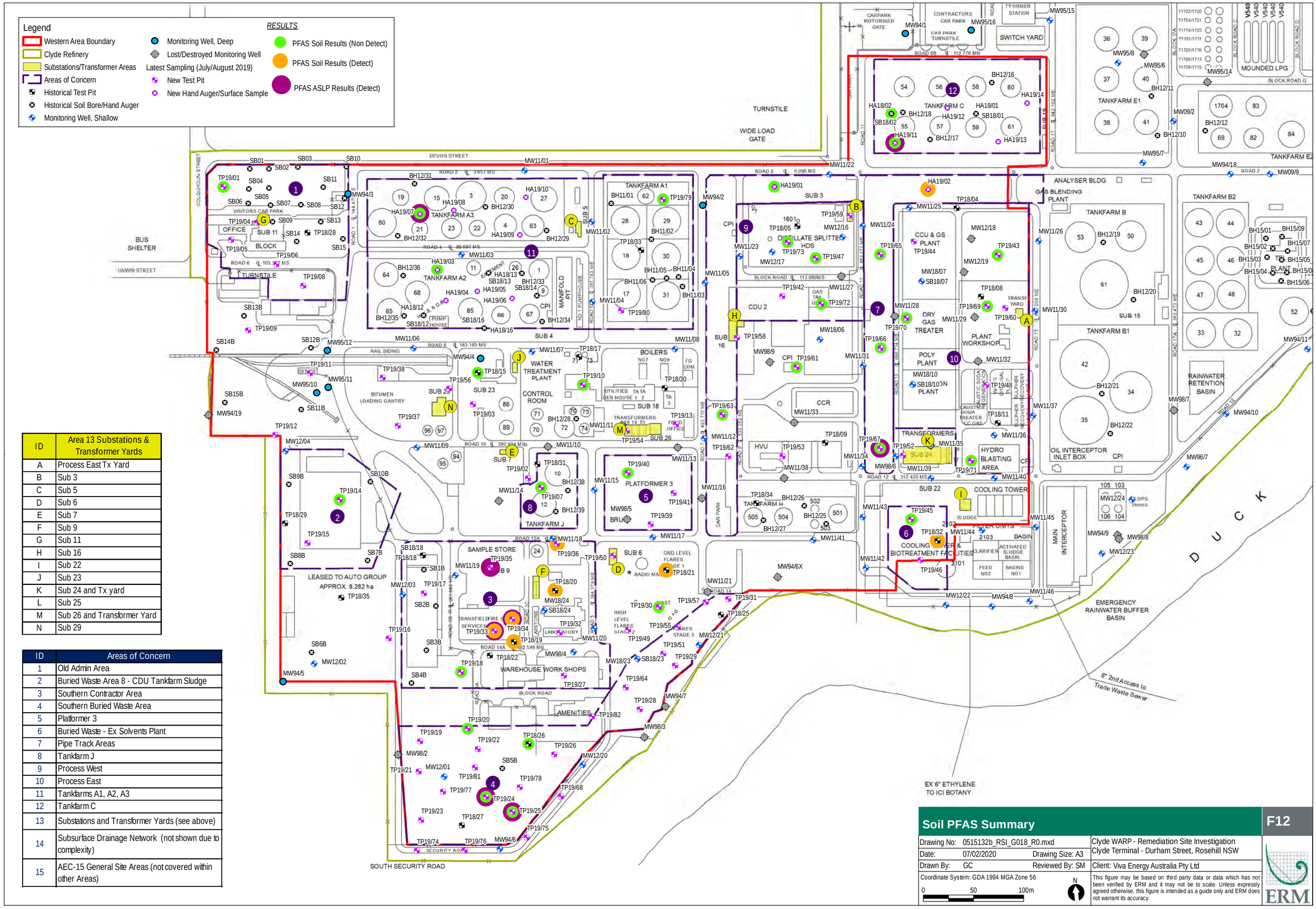
F11

Drawing No: 0515132s_RSI_G017_R0.mxd
Date: 07/02/2020 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 50 100m
N

Clyde WARP - Remediation Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil PFAS Summary

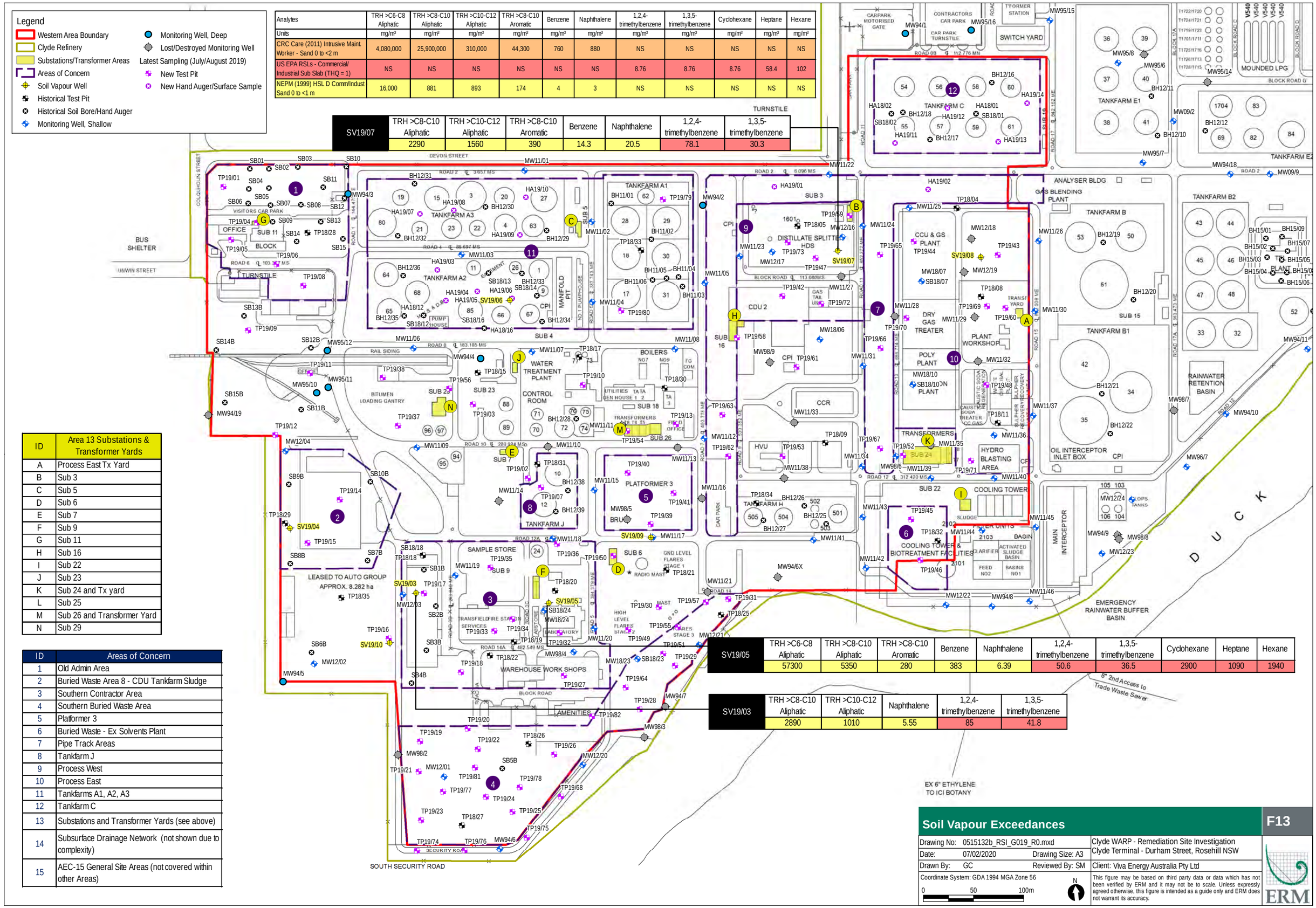
F12

Drawing No: 0515132b_RSI_G018_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 07/02/2020	Drawing Size: A3	
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM



Analytes	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C8-C10 Aromatic	Benzene	Naphthalene	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	Cyclohexane	Heptane	Hexane
Units	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m	4,080,000	25,900,000	310,000	44,300	760	880	NS	NS	NS	NS	NS
US EPA RSLs - Commercial/ Industrial Sub Slab (THQ = 1)	NS	NS	NS	NS	NS	NS	8.76	8.76	8.76	58.4	102
NEPM (1999) HSL D Comm/Indust Sand 0 to <1 m	16,000	881	893	174	4	3	NS	NS	NS	NS	NS

SV19/07	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C8-C10 Aromatic	Benzene	Naphthalene	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene
	2290	1560	390	14.3	20.5	78.1	30.3

SV19/05	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C8-C10 Aromatic	Benzene	Naphthalene	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	Cyclohexane	Heptane	Hexane
	57300	5350	280	383	6.39	50.6	36.5	2900	1090	1940

SV19/03	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	Naphthalene	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene
	2890	1010	5.55	85	41.8

ID	Area 13 Substations & Transformer Yards
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K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
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3	Southern Contractor Area
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5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Vapour Exceedances

F13

Drawing No: 0515132b_RSI_G019_R0.mxd
Date: 07/02/2020 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 50 100m
N

Clyde WARP - Remediation Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
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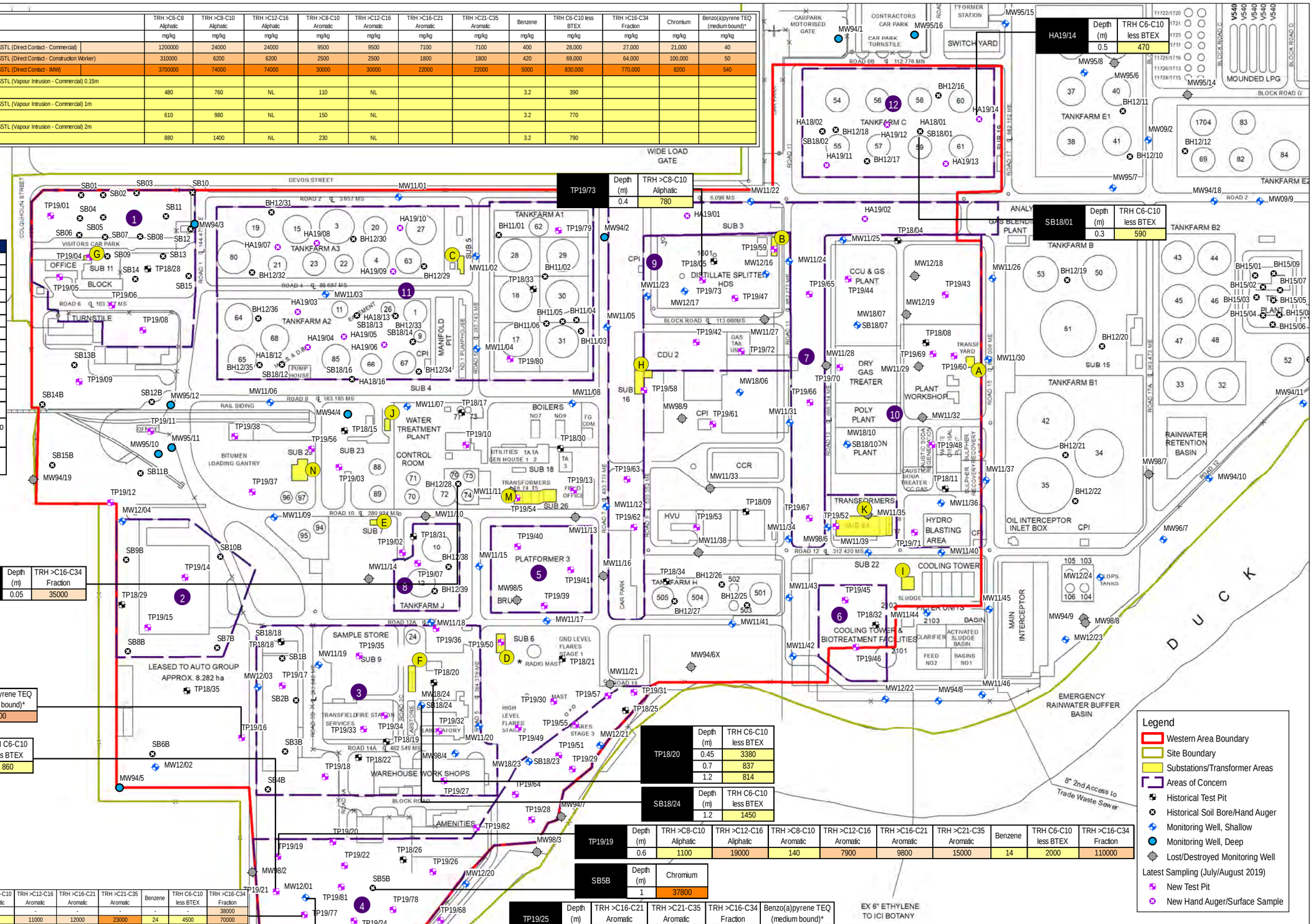
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Analytes	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction	Chromium	Benzo(a)pyrene TEQ (medium bound)*
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Clyde WARP SSTL (Direct Contact - Commercial)	1200000	24000	24000	9500	9500	7100	7100	400	28,000	27,000	21,000	40
Clyde WARP SSTL (Direct Contact - Construction Worker)	310000	6200	6200	2500	2500	1800	1800	420	69,000	64,000	100,000	50
Clyde WARP SSTL (Direct Contact - IMW)	3700000	74000	74000	30000	30000	22000	22000	5000	830,000	770,000	8200	540
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m												
0-0.99m	480	760	NL	110	NL			3.2	390			
Clyde WARP SSTL (Vapour Intrusion - Commercial) 1m												
1-1.99m	610	980	NL	150	NL			3.2	770			
Clyde WARP SSTL (Vapour Intrusion - Commercial) 2m												
2-6m	880	1400	NL	230	NL			3.2	790			



BH12/28	Depth (m)	TRH >C16-C34 Fraction
	0.05	35000

TP19/16	Depth (m)	TRH >C16-C34 Fraction	Benzo(a)pyrene TEQ (medium bound)*
	0.8	47000	300

TP19/21	Depth (m)	TRH C6-C10 less BTEX
	2.8	860

TP19/73	Depth (m)	TRH >C8-C10 Aliphatic
	0.4	780

HA19/14	Depth (m)	TRH C6-C10 less BTEX
	0.5	470

SB18/01	Depth (m)	TRH C6-C10 less BTEX
	0.3	590

TP18/20	Depth (m)	TRH C6-C10 less BTEX
	0.45	3380
	0.7	837
	1.2	814

SB18/24	Depth (m)	TRH C6-C10 less BTEX
	1.2	1450

TP19/19	Depth (m)	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	0.6	1100	19000	140	7900	9800	15000	14	2000	110000

SB5B	Depth (m)	Chromium
	1	37800

TP19/25	Depth (m)	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	TRH >C16-C34 Fraction	Benzo(a)pyrene TEQ (medium bound)*
	1.3	4500	13000	58000	59

TP18/27	Depth (m)	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.2	-	48200
	1.8	-	34800
	3	504	-

TP19/77	Depth (m)	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.5	-	-	-	-	-	-	-	-	-	38000
	4	1000	2300	27000	550	11000	12000	23000	24	4500	70000
(D01)	1.5	-	-	-	-	-	-	-	-	-	28000
(T01)	1.5	-	-	-	-	-	-	-	-	-	49300

TP19/23	Depth (m)	TRH >C8-C10 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	1.5	140	3200	10000	32000	3.8	-	41000
(D01)	1.5	-	-	-	-	-	-	34000
(T01)	1.5	-	-	-	-	12.3	479	73400

MW12/01	Depth (m)	TRH C6-C10 less BTEX	TRH >C16-C34 Fraction
	2	510	61000

TP19/75	Depth (m)	TRH C6-C10 less BTEX
	1.5	580

Legend

- Western Area Boundary
- Site Boundary
- Substations/Transformer Areas
- Areas of Concern
- Historical Test Pit
- Historical Soil Bore/Hand Auger
- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well

Latest Sampling (July/August 2019)

- New Test Pit
- New Hand Auger/Surface Sample

Soil Exceedances

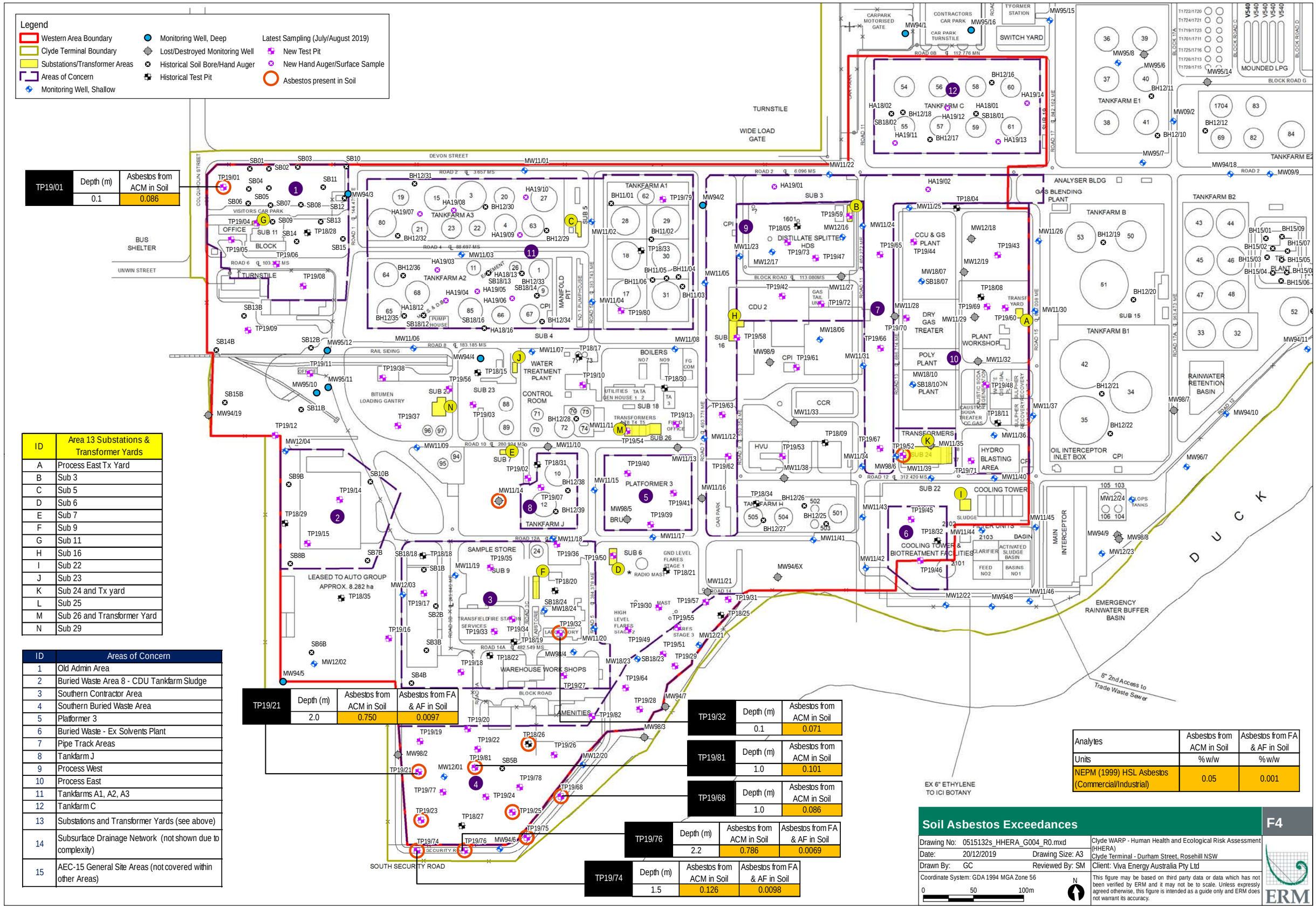
F3

Drawing No: 0515132s_HHERA_G003_R0.mxd	Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)
Date: 15/01/2020 Drawing Size: A3	Clyde Terminal - Durham Street, Rosehill NSW
Drawn By: GC Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM



TP19/01	Depth (m)	Asbestos from ACM in Soil
	0.1	0.086

ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

TP19/21	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.0	0.750	0.0097

TP19/32	Depth (m)	Asbestos from ACM in Soil
	0.1	0.071

TP19/81	Depth (m)	Asbestos from ACM in Soil
	1.0	0.101

TP19/68	Depth (m)	Asbestos from ACM in Soil
	1.0	0.086

TP19/76	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	2.2	0.786	0.0069

TP19/74	Depth (m)	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
	1.5	0.126	0.0098

Analytes	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
Units	%w/w	%w/w
NEPM (1999) HSL Asbestos (Commercial/Industrial)	0.05	0.001

Soil Asbestos Exceedances

F4

Drawing No: 0515132s_HHERA_G004_R0.mxd	Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)
Date: 20/12/2019 Drawing Size: A3	Clyde Terminal - Durham Street, Rosehill NSW
Drawn By: GC Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM

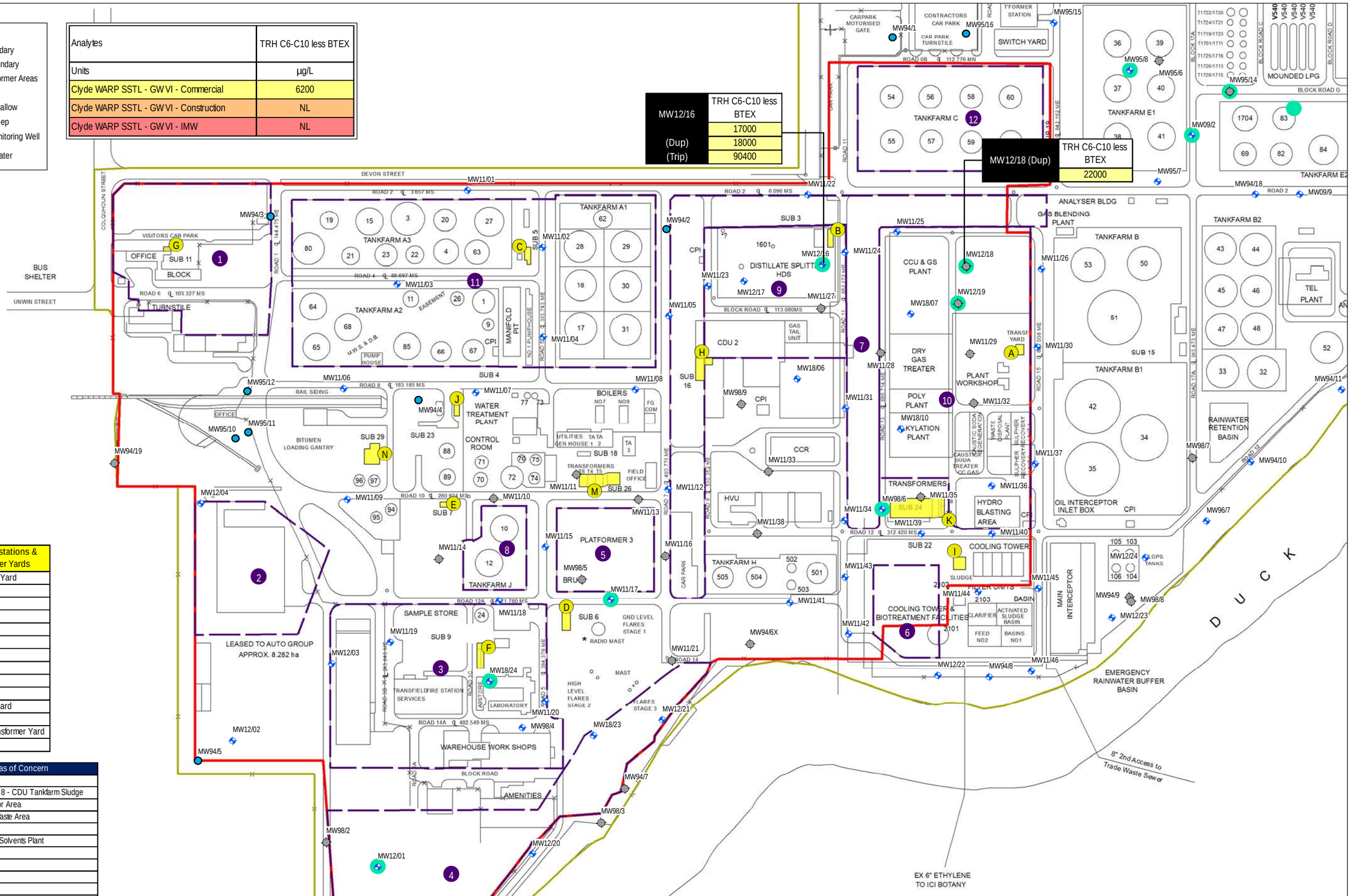
Legend

- Western Area Boundary
- Clyde Terminal Boundary
- Substations/Transformer Areas
- Areas of Concern
- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- LNAPL in Groundwater

Analytes	TRH C6-C10 less BTEX
Units	µg/L
Clyde WARP SSTL - GW VI - Commercial	6200
Clyde WARP SSTL - GW VI - Construction	NL
Clyde WARP SSTL - GW VI - IMW	NL

MW12/16	TRH C6-C10 less BTEX
	17000
(Dup)	18000
(Trip)	90400

MW12/18 (Dup)	TRH C6-C10 less BTEX
	22000



ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
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ID	Areas of Concern
1	Old Admin Area
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9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Groundwater SSTL Exceedances

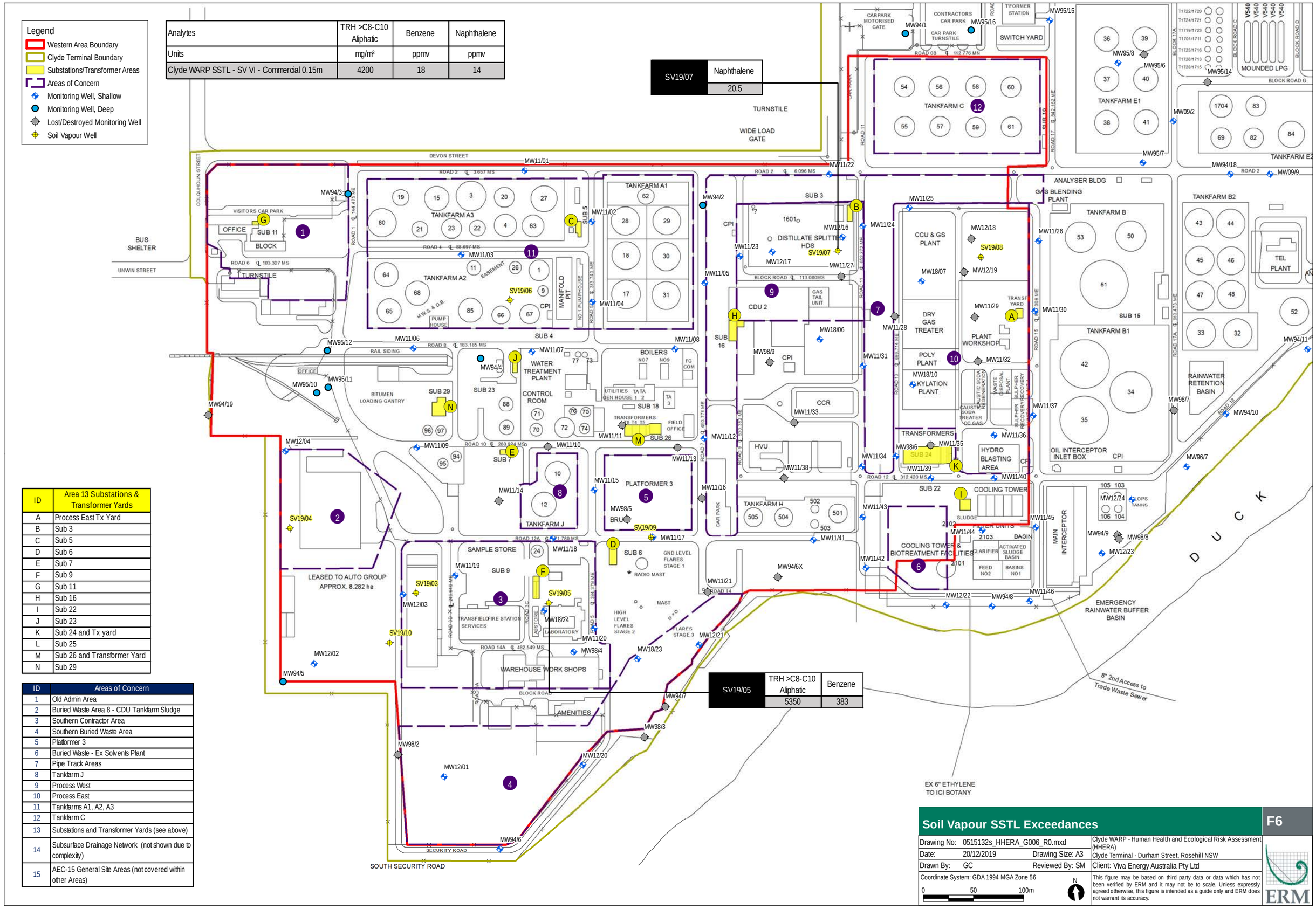
F5

Drawing No: 0515132s_HHERA_G005_R0.mxd		Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)
Date: 20/12/2019	Drawing Size: A3	Clyde Terminal - Durham Street, Rosehill NSW
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 50 100m

N

ERM



Analytes	TRH >C8-C10 Aliphatic	Benzene	Naphthalene
Units	mg/m³	ppmv	ppmv
Clyde WARP SSTL - SV VI - Commercial 0.15m	4200	18	14

ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

ID	Areas of Concern
1	Old Admin Area
2	Buried Waste Area 8 - CDU Tankfarm Sludge
3	Southern Contractor Area
4	Southern Buried Waste Area
5	Platformer 3
6	Buried Waste - Ex Solvents Plant
7	Pipe Track Areas
8	Tankfarm J
9	Process West
10	Process East
11	Tankfarms A1, A2, A3
12	Tankfarm C
13	Substations and Transformer Yards (see above)
14	Subsurface Drainage Network (not shown due to complexity)
15	AEC-15 General Site Areas (not covered within other Areas)

Soil Vapour SSTL Exceedances

F6

Drawing No: 0515132s_HHERA_G006_R0.mxd		Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)
Date: 20/12/2019	Drawing Size: A3	Clyde Terminal - Durham Street, Rosehill NSW
Drawn By: GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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ERM

Appendix B Interim Audit Advice Documentation

Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan

2 Durham Street, Rosehill, NSW

Interim Audit Advice 01

22 January 2019

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Glossary

Abbreviation	Definition
ACM	Asbestos Containing Material
BaP	Benzo(a)Pyrene
AF	Asbestos Fines
AHD	Australian Height Datum
ANZG	Australian and New Zealand Guidelines
AST	Aboveground Storage Tank
Auditor	Accredited Contaminated Site Auditor under *NSW Contaminated Land Management Act 1997*
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CLM Act	*Contaminated Land Management Act 1997*
COPC	Contaminants of Potential Concern
CRC-CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
CSM	Conceptual Site Model
DA	Development Application
DP	Deposit Plan
EPA	Environment Protection Authority
EIL	Ecological Investigation Level
ESA	Environmental Site Assessment
ESL	Ecological Screening Level
GIL	Groundwater Investigation Level
GME	Groundwater Monitoring Event
HHERA	Human Health and Ecological Risk Assessment
HIL D	Health Investigation Level for Commercial/Industrial Land Use
HQ	Hazard Quotient
HSL D	Health Screening Level for Commercial/Industrial Land Use
km	kilometre
LNAPL	Light Non-Aqueous Phase Liquids
LOR	Limit of Reporting
m	metre
mbgl	metres below ground level
mg/kg	milligrams per kilogram
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
OEH	Office of Environment and Heritage
OCP	Organochlorine Pesticide

Abbreviation	Definition
OPP	Organophosphorus Pesticide
PFAS	Per- and Poly-Fluoroalkyl Substances
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
ppm	Parts per Million
PQL	Practical Quantitation Limit
RAP	Remedial Action Plan
SOP	Standard Operating Procedure
SWL	Standing Water Level
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
µg/L	Micrograms per Litre
UPSS	Underground Petroleum Storage System
UST	Underground Storage Tank
VOC	Volatile Organic Compound
VHC	Volatile Halogenated Compound
WHO	World Health Organization

1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) was engaged by Viva Energy Australia Pty. Ltd (Viva Energy) to conduct an audit of the Conceptual Remedial Action Plan (the Conceptual RAP) related to the Former Clyde Refinery - Western Area located at 2 Durham Street, Rosehill on the Camellia Peninsula, NSW. The Western Area is shown in **Appendix A** (Figures 3-1 and 3-2 from the Conceptual RAP).

It is the auditor's understanding that Viva Energy currently operates the Clyde Terminal on part of the site but, a large part of the former refinery in the south-western portion of the terminal is no longer required for operational purposes. Thus, Viva Energy is proposing to remediate the Western Area to facilitate future development of the land under the existing zoning classification (IN3 – Heavy Industrial) (The Remediation Project).

A Conceptual Remedial Action Plan (RAP) has been prepared by AECOM to support the State Significant Development (SSD) application under Part 4 of the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act) for the Remediation Project. It is the auditor's understanding that the Conceptual RAP will be updated to a Detailed RAP following additional remedial site characterisation and completion of a Human Health and Ecological Risk Assessment (HHERA).

This interim audit advice includes a review of the following document prepared by AECOM:

- *Viva Energy Clyde Western Area Remediation Project, Appendix C: Conceptual Remedial Action Plan, version C dated* 19 December 2018

The purpose of this audit advice is to assess whether the Conceptual RAP was prepared in a manner consistent with NSW Environment Protection Authority (EPA) made or endorsed guidelines to render the Western Area suitable for a future development in accordance with the zoning classification (IN3 heavy industrial).These guidelines include, but are not limited to the Guidelines for Consultants Reporting on Contaminated Sites (the Consultant Guidelines) and the Guidelines for the NSW Site Auditor 3rd Scheme (the Auditor Guidelines).

2. Objectives

The remediation objectives described by AECOM in the Conceptual RAP are to:

- *Remediate the soil and manage groundwater to allow the Western Area to be used for commercial/industrial purposes, thereby reducing potential human health and/or environmental risks.*
- *Ensure that any remediation process can limit or eliminate possible adverse effects on human health or ecological receptors. A particular focus will be to ensure that the drainage system is designed to adequately support both the remediation program and the post-remediation period.*

3. Site history

3.1 Land use

AECOM described in the Conceptual RAP the following site history summary:

- 1816: The site was originally included as part of an 850-acre land grant by the Crown to John Macarthur. In 1908, a parcel of 140 acres of land, was transferred to the Commonwealth Oil Corporation (COC). The COC struck financial difficulties and went into receivership
- 1913: The land was then acquired from COC by John Fell and Co. The new owner began purchasing crude oil to refine at Clyde and refining commenced in 1926
- 1928: Shell Refining Pty Ltd (Shell) took over as owner and operator of the Clyde Refinery. Shell purchased an additional seven acres of land and a further 150 acres in June 1930. The first stage of expansion of the refinery ran from 1929 to 1939 with the purchase and construction of new equipment and buildings, increasing the crude product intake to approximately 250 tonnes/day by 1934
- The refinery was used for drumming imported hydrocarbon products during the World War II when crude product supplies were unavailable. Following the resolution of the conflict in 1945, crude oil was once again available and refining operations at the Site recommenced
- 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 and also commissioning a lubricating oil plant, introduction of a chemical and hydrocarbon solvents plant
- 1991, a new propylene unit and platformer unit were commissioned, and in 1994, the mounded LPG storage facility was built
- 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

Appendix A (Figure 3-2 from the Conceptual RAP) presents a map of the site, project area and Western area.

3.2 The Clyde Terminal

Since the cessation of refining operations in late 2012, the Clyde Terminal has been in operation and is used for the receipt, storage and distribution of finished petroleum products.

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.

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

- gasoline (unleaded 91, 95 and 98)

- diesel (AGO)
- jet fuel

3.3 Western Area

It was stated by AECOM that following completion of the Clyde Terminal Conversion Project (SSD 5147), the Western Area will no longer be required for operational purposes. The far western/south-western part of the Western Area was leased to a third party but has now been vacated. **Appendix A** (Figure 3-3 from the Conceptual RAP) shows the boundary of the Western Area. AECOM described the following status of assets/activities in the Western Area:

- The north-west corner contains operational and redundant tank farm assets (within Tank Farms A2 and A3)
- The north-eastern corner contains operational and redundant tank farm assets (within Tank Farm C)
- There is also above ground pipework still in-situ in parts of the Western Area. Existing tanks, pipework, and associated above ground infrastructure will be decommissioned and removed prior to remediation (with the exception of the assets that would serve the Project, i.e. bunds, pipes, equipment in the Wastewater Treatment Plant (WWTP) area, etc.).
- There is above and below ground drainage infrastructure still in-situ across the Western Area. The drainage system would be addressed as part of the remediation scope.

Additionally, the Environmental Condition Summary Report (ERM, August 2012) identifies eight areas within the Western Area where anecdotal information has suggested potential locations of buried waste, as shows **Appendix A** (Figures 9-1 and 9-2 from the Conceptual RAP).

Appendix A (Figure 5-1 from the Conceptual RAP) shows the locations of the tanks and the fuel that was historically stored.

4. Regulatory requirements

Following the announcement of the closure of the Clyde Refinery, on 22 June 2012, the NSW EPA issued a Preliminary Investigation Order to Viva Energy under the CLM Act requesting reports on environmental contamination. This preliminary investigation nominated a number of contaminants potentially affecting the site (further discussed in **Section 6** of this IAA).

Following receipt of a number of reports, in June 2016, the NSW EPA declared the Lot 398 DP41324, Lot 2 DP224288, Lot 1 DP383675, Lot 101 DP809340 and, Lot 100 DP1168951 (which included the Western area) as contaminated land under the CLM Act (Declaration Number 20131110).

It is the auditor's understanding that at the present, there is no Voluntary Management Proposal for any area of the site.

4.1 NSW Environment Protection Licence

The Western Area operates under NSW Environment Protection Licence (EPL 570) issued under the Protection of Environment Operations Act 1997 (NSW) (POEO Act). This licence authorises and regulates the carrying out of two scheduled activities: 1 - Waste processing; and 2 - Chemical storage.

The 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 and Part Lot 100 DP1168951 (that includes the Western Area).

4.2 Department of Planning and Environment (DPE)

As discussed in the Conceptual RAP, the scale of the remedial works means that under the requirements of the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act), the Environmental Planning and Assessment Regulation 2000 (NSW) (EP&A Regulation) and State Environmental Planning Policy 55 - Remediation of Land (SEPP 55), the Remediation Project will require development consent from the DPE in order to proceed.

Viva Energy on 27 September 2017 submitted a SSD Call in Request for the Remediation Project to the NSW Department of Planning and Environment (DPE). On 20 April 2018, an order was published in the NSW Government Gazette declaring the Remediation Project as a SSD (ref no 2018-1291).

To be granted development consent, the SSD application for the Remediation Project must be accompanied by an Environmental Impact Statement (EIS). The contents of the EIS have been informed by the requirements of the EP&A Act, the EP&A Regulation and the contents of the Secretary's Environmental Assessment Requirements (SEARs), including consultation with relevant government agencies and the community.

In order to request SEARs Viva Energy submitted a Preliminary Environmental Assessment (PEA, AECOM, 2018c) to DPE on 1 May 2018. The PEA provided an overview of the Remediation Project as well as the site condition, a review of relevant legislation and policy and, an assessment of the likely potential environmental impacts associated with the Remediation Project. DPE used the PEA to consult with a number of government agencies and stakeholders including the NSW EPA and the City of Parramatta Council (Parramatta Council).

The environmental assessments within the EIS were based on requirements of the SEARs and have assessed the potential impacts resulting from the remediation design within the Conceptual RAP. The Conceptual RAP will be appended to the EIS for the Remediation Project and will form part of the SSD application.

Post development consent, it is proposed that the Conceptual RAP and the conditions of consent would be incorporated into the final remedial design. This final design will be documented within the Detailed RAP (final RAP).

4.3 NSW EPA

The NSW EPA issued a letter (DOC18/972926 SSD 9302) on 17 December 2018 in reply to an email issued by Viva Energy on 10 December 2018 requesting the NSW EPA make a submission in relation to the draft Environmental Impact Statement (EIA) for the Remediation Project. The EPA noted in its letter that the documents submitted did not includ the draft Human Health Risk Assessment. The NSW EPA stated that whilst it appears that the draft EIS has addressed the rehabilitation activities and the potential risks with information outlined in the EPA's letters dated 1 June 2018, the NSW EPA could not provide a compressive response at this time. It was recommended by the NSW EPA that:

- *On-going groundwater monitoring will be undertaken to confirm the rate of natural source zone depletion of the LNAPL, and the rate of natural attenuation of dissolved phase hydrocarbons*
- *If the preferred natural attenuation processes are not making substantial progress within a reasonable timeframe, then one or more alternative remediation technologies to treat the LNAPL and dissolved phase hydrocarbon impacted groundwater will be introduced*

5. Previous environmental works

The site has been investigated and/or monitored over the last 26 years. From 2004, all reports have been submitted either, in full or in summary to the NSW EPA, via the annual reporting process (environmental authorisation). In 2008, a Conceptual Site Model (CSM) was prepared to provide a robust understanding of the site. Further discussion of this CSM is presented in **Section 7**. Since then, a program of both routine and non-routine Environmental Site Assessments (ESAs) has continued including closing data gaps and the routine groundwater-monitoring program.

All previous investigations undertaken at the site are listed in **Appendix C.** A number of the reports presented in **Appendix C** provided key information for the preparation of the Conceptual RAP. A summary of these reports shows in **Table 1**.

Table 1 Summary of reports related to remediation

Author	Title	Relevance to the Conceptual RAP
ERM, 2010	Soil and Groundwater Management Plan: Shell Clyde Refinery & Parramatta Terminal, Durham Street, Rosehill, NSW	General information on LNAPL behaviour at the site has informed this Conceptual RAP
ERM, 2011	Tank T92 Release Investigation, Shell Clyde Refinery, Durham Street, Rosehill, NSW	General information on LNAPL behaviour at the site has informed this Conceptual RAP
ERM, 2012	Environmental Conditions Summary Report Shell Clyde Refinery, Durham Street, Rosehill, NSW 2142	Works in response to Preliminary Investigation Order
ERM, 2012	Stage 1 And 2 Environmental Site Assessment, Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill, NSW 2142	General information on soil contamination and LNAPL at the Site has informed this Conceptual RAP
ERM, 2012	Phase II Environmental Site Assessment, Shell Clyde Refinery and Parramatta Terminal, Lot 101 DP 809340, Durham Street, Rosehill, NSW 2142	General information on LNAPL at the Site has informed this Conceptual RAP
ERM, 2012	Supplementary Information To The Environmental Conditions Summary Report, Shell Clyde Refinery	General information on LNAPL at the Site has informed this Conceptual RAP

Author	Title	Relevance to the Conceptual RAP
ERM, 2013	Groundwater Monitoring Events Report, Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill NSW 2142	General information on LNAPL at the Site has informed this Conceptual RAP and the 3D modelling process/report
ERM, 2014	Annual Progress Report (2013) Shell Clyde Terminal Durham Street Rosehill NSW 2142	General information on LNAPL at the site has informed this Conceptual RAP
ERM, 2016	Groundwater Monitoring Events and Annual Summary – Clyde and Parramatta Terminal	General information on LNAPL at the Site has informed this Conceptual RAP
ERM, 2017	Groundwater Monitoring Event – Clyde and Parramatta Terminal	General information on LNAPL at the Site has informed this Conceptual RAP
ERM, 2018	AutoNexus Environmental Site Assessment	Assessment locations from this investigation provided additional characterisation for the CSM
AECOM, 2018	Viva Energy Clyde Western Area Remediation Project – 3D Modelling of Hydrocarbon Impacts	Characterisation work on the distribution of hydrocarbons in the Western Area.
AECOM, 2018	Western Area, Targeted Site Investigation	A number of identified data gaps were addressed. Assessment locations from this investigation provided additional characterisation for the CSM

6. Chemicals of potential concern

The current understanding of the nature and extent of the impacts within the Western Area is based on investigation works which have conducted between 1991 and 2018. The Chemicals of Potential Concern (COPCs) that have been identified in the Western Area considered by AECOM are:

- Total petroleum Hydrocarbons/ Total Recoverable Hydrocarbons (TRH/TPH), including LNAPL
- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)
- Heavy metals, including hexavalent chromium
- Tetraethyl lead
- Polycyclic Aromatic Hydrocarbon (PAHs)
- Phenols
- Polychlorinated Biphenyl (PCBs)
- Dioxins
- Per- and Poly-Fluoroalkyl Substances (PFAs)
- Asbestos

7. Conceptual site model

AECOM presented a CSM that was developed for the Western Area based on the historic dataset. **Table 2** shows a summary of this CSM. The CSM will be updated following completion of the remediation investigation and the HHERA and incorporated into the Detailed RAP. **Appendix A** (Figure 8-6 from the Conceptual RAP) presents a figure illustrating the CSM.

Table 2 Summary of CSM

Site aspect	Details
Zoning and current land use	• Site: IN3 Heavy Industrial • Surrounding land use is commercial and industrial with the exception of the Duck River located on the southern Western area boundary and down gradient of groundwater flow direction
Potential sources of contamination	• Former Underground Petroleum Storage System (UPSS) • Former landfilling and on-site placement/burial of sludges and other wastes • Potential use of fill material of unknown origin • Impacts from neighbouring industrial / commercial properties
Geology	• 0 to 1 metre: Fill (gravelly sand, coarse and blue metal) • 2 to 5 metres: Silty clay, Clayey silt • > 5 metres: Sand clay
Aquifer Hydrogeological Parameters: Depth, Flow and Water Quality.	• Groundwater was observed in the silty clay at depths of between 1.3 and 3.0 metres bgs • Based on current and historic measurements the flow southeast towards Duck River at a gradient of 0.017 • Seepage velocity was estimated at $3{,}4 \times 10^{-3}$ m/year • Assessment at limited wells indicated a large variability in TDS, with values ranging from 1,442 mg/L to 16,185 mg/L
Influences on Groundwater Conditions at the Site and nearest Surface Receptor	• Surface water runoff is managed via the on-site stormwater and drainage network • Subsurface infrastructure remains in place in the Western Area, which greatly influences groundwater flow creating obstructions and preferential pathways • Deep groundwater is expected to be confined or semi-confined by the stiff clay underlying the Western Area • Groundwater flow is towards Duck River
Nature of Soil Impacts	Soil impacts were identified within hotspots across the Western Area throughout the soil profile

Site aspect	Details				
Nature of LNAPL impacts	Soil impacts have been identified in various areas across the Western Area throughout the soil profile as shows **Appendix A** (Figures 8-1 to 8-3 from the Conceptual RAP)				
Nature of Dissolved phases impacts	Dissolved phase hydrocarbon impacts in groundwater have been identified in various areas as illustrated in **Appendix A** (Figure 8-4 from the Conceptual RAP)				
Nature of Vapour Impacts	Studies conducted by AECOM on the potential for soils to liberate volatile chemicals identified the following characteristics: • Measured odour concentrations ranged from 166 odour units (OU) to 11,600 OU • Odour concentrations (and calculated flux rates) were typically higher on excavated material • There was no apparent decrease in the odour concentrations measured on “aged” material, which had been excavated, and left to air for a period of time				
Potential Transport Mechanisms and Exposure Pathways	• Leaching of soil contaminants into groundwater • Lateral migration of hydrocarbons in groundwater • Direct dermal contact or ingestion of contaminants in soil and/or groundwater • Vapour inhalation from the volatilisation of soil or groundwater impacts to indoor and outdoor air • Migration of groundwater into Duck River				
Potential Receptors (Current)	On-site Ecological None	Off-site Ecological Duck River and Wetlands	On-site Human Commercial and Intrusive	Off-site Human Commercial and Intrusive	Off-site Residents None
Summary of Complete and Potentially S>P>R Exposure Pathways	The CSM presented in the Conceptual RAP was preliminary and will need to be updated following the remedial characterisation work and incorporation of the relevant results of the HHERA and preparation of the final RAP				

8. Tier 1 screening assessment

It was stated by AECOM that historical soil and groundwater data from the Western Area have been considered in the context of the current regulatory framework. In evaluating the need for remediation and/or management the soil and groundwater data set has been compared to current Tier 1 screening values (as listed in the NEPM or other NSW EPA made or endorsed investigation levels). Where Tier 1 screening levels have been exceeded, AECOM will be prepared a HHERA. The results of which will be presented within the Detailed RAP.

The Tier 1 screening levels adopted by AECOM in the Conceptual RAP were:

8.1 Human health commercial/industrial receptor

- Soil health screening levels for vapour intrusion HSL D – Sand (NEPC, 2013)
- Soil health screening levels for direct contact HSL D (CRC CARE, 2011)
- Soil health investigation levels for direct contact /ingestion HIL D (NEPC, 2013)
- Groundwater health screening levels for vapour intrusion HSL D – Sand (NEPC, 2013)
- Site specific modified HSLs have been generated for the vapour pathway using the extension model (CRC Care, 2011) and assuming the same soil type as used in the soil screening (sand). These values have not been rounded and, therefore in some instances the modelled values for 1 to 2 metres are slightly higher than the generic values from CRC Care, 2011

8.2 Human health intrusive maintenance worker

- Soil direct contact/ingestion HSL D - Sand (CRC CARE, 2011)
- Soil vapour inhalation HSL D - Sand (CRC CARE, 2011)
- Soil direct contact/ingestion HIL D (NEPC, 2013)
- Groundwater health screening levels for vapour intrusion HSL D (CRC CARE, 2011)

8.3 Human health users of the Duck River

Guidelines for Managing Risks in Recreational Waters Source (NHMRC, 2008).

8.4 Ecological receptors commercial/industrial end use

- Ecological screening levels (ESLs) for commercial/industrial receptors, coarse soil (for TRH Fractions, BTEX, benzo(a)pyrene) (NEPC, 2013)
- Ecological investigation levels (EILs) for commercial/industrial receptors (for naphthalene, arsenic, and DDT) (NEPC, 2013)
- Freshwater for a moderately disturbed system (generally 95% species protection with the exception of bio accumulative compounds) (ANZG 2018)
- Marine for a moderately disturbed system (generally 95% species protection with the exception of bio accumulative compounds) (ANZG 2018)

8.5 Management limits commercial/industrial end use

Management Limits for TPH Fractions F1 - F4, coarse soil, commercial/industrial scenario (NEPC, 2013).

8.6 PFAS and dioxins specific assessment

Specific assessment of PFAS and dioxins will be part of the HHERA.

9. Remedial action plan

9.1 Overview

The key focus of the Conceptual RAP is the remediation of petroleum hydrocarbon impacts in soils. In addition, other COPCs that are present in areas which warrant remediation and subject to other considerations (e.g. significance of concentration, material/leaching characteristics) will be treated and/or managed by the proposed technologies or appropriate off-site disposal.

LNAPL has been historically detected across the Western Area, as shown in **Appendix A** (Figure 8-4 from the Conceptual RAP). It was reported in the Conceptual RAP that LNAPL would be removed to the extent practicable. Further groundwater remediation was considered by AECOM unlikely based on existing groundwater monitoring data, which indicated that the petroleum hydrocarbon dissolved plumes are stable and not posing potential risks to human health or ecological receptors. Furthermore, AECOM stated that the Natural Source Zone Depletion (NSZD) of the LNAPL and subsequent natural attenuation is likely to continue to reduce the mass of petroleum hydrocarbon within the Western Area over time.

Appendix A presents figures showing soil and groundwater locations where LNAPL, soil and groundwater samples exceeded the adopted assessment criteria (Figures 8-1 to 8-5 from the Conceptual RAP).

9.2 Remedial approach

Preliminary estimates are that 90,000 m^3 of impacted soils are presented in the contaminated areas and 10,000 m^3 of impacted soils are likely to be excavated during the removal of the drainage network. It was proposed that contaminated soils from other Viva Energy sites (approximately 5,000 m^3) would be imported to the Western Area to be remediated as part of the Remediation Project. This would result in an overall remediation volume of approximately 105,000 m^3. AECOM stated that the volume of contaminated soil to be remediated is yet to be finalised, and will be presented in the Detailed RAP.

The Conceptual RAP has considered a wide range of treatment options. The outcome of this assessment has concluded that bioremediation of petroleum impacted soils would be the principal approach. Other technologies which have been assessed as suitable, include landfarming, in-area soil mixing, stabilisation and thermal desorption. **Appendix A** (Figure 15-1 from the Conceptual RAP) shows the proposed remediation layout. **Table 3** presents the proposed remediation options.

Where it is not practicable to remediate non-petroleum contaminated soils, which are not suitable for bioremediation, stabilisation or thermal desorption, then on-site management would be considered. AECOM stated that the stakeholder support and the post remediation management measures would need to be formalised under this approach.

Off-site disposal to landfill of untreated soils was also considered and would typically be the selected approach if soils are not suitable to be incorporated into the bioremediation process or where on-site management is not practicable.

Table 3 Summary of remediation options

Remediation Technology	Applicable COPCs	Unsuitable COPCs*
Landfarming	• TPH • BTEX, and other volatile COPCs	• Heavy metals • PFAS • Asbestos • Pesticides • Dioxins • PCBs
In area soil mixing		
Biopiling		
Direct Thermal Desorption (with consideration of potential stack emissions)		• Heavy metals • PFAS • Asbestos
Stabilisation		-

Note: *COPCs which cannot be remediated through the above options, will be removed off-site or managed on-site.

AECOM reported that the Detailed RAP will further assess the suitability of the selected remediation technologies to appropriately remediate those contaminated soils which require remediation and with consideration of additional analytical data obtained across the Western Area (including other COPCs) and based on the findings of completed bench scale trials and/or pilot trials.

9.3 Unexpected findings

The Conceptual RAP acknowledged that changes to the remedial program can be affected by a number of variables (e.g. relating to ecology, heritage, local stakeholders, HSSE, etc.). Potential scenarios that could change the remedial program and proposed actions/responses are presented in **Table 4**. The management of these issues would be detailed within a series of Management Plans that would be produced alongside the Detailed RAP.

Table 4 Managing unexpected conditions

Scenario	Actions required
Highly impacted soils (beyond the concentrations, lateral extent/depths, or volumes anticipated) or different contaminants not previously identified are encountered	Work in the vicinity of the soils should be suspended until the environmental consultant can further assess the impacted soils/materials and the associated risks. Once the assessment is completed, a decision on changes to the remediation approach should be issued for review by the Auditor prior to implementation
Large volumes of contaminated water (i.e. dissolved phase or LNAPL) is identified during the Project	Work in the vicinity of the contaminated water should be suspended until the environmental consultant can further assess the impacted groundwater and the associated risks Once the assessment is completed, a decision on any changes to the remediation approach should be issued for review by the auditor prior to implementation
Excessive vapours emanating from excavated and stockpiled soil or excavation pits	Work should be suspended (cessation of all excavation works and the movement of stockpiles) until the environmental consultant (in conjunction with air quality lead) can instruct on how best to proceed regarding safe management of vapours Once the assessment is completed, a decision on any changes to the remediation approach should be issued for review by the auditor prior to implementation
Asbestos material (beyond that anticipated) is encountered	Work should be suspended and asbestos material removed by a suitably qualified contractor, in accordance with WorkCover regulations. Alternatively on-site management could be considered
Soil proposed for off-site disposal fails to meet “General Solid Waste” soil classification criteria under the Waste Classification Guidelines, NSW EPA 2014	Conduct toxicity characteristics leaching procedure (TCLP) of contaminants exceeding General and/or Restricted Solid Waste, and/or Hazardous Waste classification to assess the leachable concentration and class of waste. If waste soil still fails criteria then on-site remediation (or on-site management) methods should be considered in the first instance

Scenario	Actions required
Non-hydrocarbon impacted soils are not suitable for treatment using the technologies detailed herein	If non-hydrocarbon impacted soils are identified in the DSI which do not present an unacceptable risk to human health and/or the environment, the material/impacted area would be managed on-site with the implementation of a LTEMP and/or off-site disposal
In the event that the WWTP is not available for a period of time.	To ensure the works are not delayed, two lined treatment ponds would be constructed (each with a capacity of 5,000 m^3). These ponds would be located immediately west of the WWTP infrastructure, and would remain in place for the duration of the Project

9.4 Contingency measures

The following contingency measures were considered by AECOM in the Conceptual RAP:

- Modification of biopiling setup: Should turning biopile be ineffective, thermal enhancement (involving the injection of hot steam into the biopile through the ventilation system) may be considered to enhance the remediation process.
- On-site management may be appropriate as long as administrative measures are put in place to ensure the cap would not be compromised during a later development. On-site management is most useful where it is not practicable to remediate soils such as where soils are not suitable for bioremediation or thermal desorption/stabilisation (such as areas of buried sludges, where other contaminants may be prevalent such as lead, etc.)
- Off-site disposal (untreated soils): Off-site disposal of untreated soils to landfill would typically be considered when soils are not suitable for the selected remediation techniques or where on-site management is not practicable or desirable. However, in certain circumstances the cost benefit of disposal versus treatment (particularly if there are multiple analytes to treat) would be considered

Both on-site management and off-site disposal have been considered in the context of contingency measures in the instance that the selected remedial methods are not effective or appropriate for all soils that require remediation. However, in certain instances, utilisation of these two options may be required or may be considered as appropriate in lieu of these selected methods.

9.5 Validation strategy

The validation strategy will be presented in the Detailed RAP.

10. Auditor comments

The outcome of the auditor's review of the initial version of the Conceptual RAP was presented through email (dated 10 December 2018). A copy of the email as well as the AECOM's response is presented in **Appendix B** of this IAA. The following commentary is presented on the key elements of the Conceptual RAP.

10.1 Site conditions & environmental setting

The auditor considered that the information presented by AECOM provided an appropriate description of the site setting and the surrounding properties. Surrounding land uses reported in the Conceptual RAP were consistent with the auditor's observations made during the site visit carried out on 9 November 2018.

The Western Area is located within an IN3 zoning (heavy industrial). The auditor considered that the Duck River located 300 metres to the south and the wetlands 500 metres distant from the site are the most "sensitive" receptors (concerning potential ecological risks) surrounding the site.

The auditor noted that an extensive description of the entire site and environmental condition was provided since 1992 and therefore, the auditor considered that the information presented in the Conceptual RAP was sufficient and generally followed the ASC NEPM 2013 Schedule B2.

The Conceptual RAP, based on previous reports, presented a comprehensive description of site geology and hydrogeology that provided a reasonable basis for understanding these elements of the CSM and influences on the contaminant distribution and mobility.

10.2 Site history

In the auditor's opinion, the site history provided a comprehensive indicator of current and past activities with the primary potential for contamination being the refinery operation, buried wastes, storage of a range chemicals and asbestos in fill. The findings of the assessments conducted prior to remediation confirmed that the soils and groundwater contamination was attributed to activities associated with the refinery operation.

It is the auditor's understanding that an additional remediation characterisation will be carried out before the finalisation of the Detailed RAP with a key aim being characterisation of the presence of asbestos and buried waste areas.

10.3 Chemicals of potential concern

The auditor considered that based on the site history, the suite of analytes selected for the site characterisation and consideration for remediation and/or management was appropriate.

10.4 Tier 1 assessment

The auditor considered that AECOM presented appropriate investigation levels for the Western Area soil, and groundwater, taking into account the soil profile, the CSM, as well as the future proposed land use scenario (industrial/commercial) and council zoning (heavy industrial).

The exposure scenarios for soil investigation and screening levels were in accordance with Schedule B1 and B7 of the NEPM.

The auditor noted that the AECOM also considered the management limits referred to in s.2.9 and Table 1B(7) of Schedule B1 of the NEPM.

AECOM in response to the auditor email (10 December 2018) (**Appendix B**) stated that further assessment of PFAS impact is currently being completed by ERM, and it will be incorporated in the Detailed RAP. In addition, PFAS will be screened and considered by AECOM in the HHERA.

It is the auditor's understanding that the off-site migration of contamination will be discussed in the HHERA.

10.5 Conceptual site model

The CSM presented in the Conceptual RAP and outlined on **Section 7** of this IAA provided an appropriate framework for identifying the potential sources of contamination and how potential receptors may be exposed, either during or at the completion of the remedial activities.

The auditor considered that based on the information provided, the likely complete and potentially complete pathways between the known or potential sources and receptors will be incorporated in the Detailed RAP.

AECOM stated that the current CSM presented by ERM in the Q4 2017 GME and 2017 Annual Progress Report provided details of PFAS groundwater monitoring data and assessment against current ecological screening levels. Further assessment of PFAS as well as a specific CSM for PFAS impact is currently being completed by ERM, and it will be incorporated in the Detailed RAP. In addition, all COPCs will be screened and considered by AECOM in the HHERA. The relevant results of which will be incorporated into the Detailed RAP.

10.6 Remedial action plan

The auditor considered that the Conceptual RAP has sufficient information on the nature and extent of the contaminations and the risks that may be posed to human and/or the environment.

The auditor considered that the sustainability of the proposed remediation methodologies overall were appropriately considered by AECOM in terms of achieving a balance between the benefits and effects of undertaking the option. However, it should be noted that the document prepared by AECOM is still a Conceptual RAP and more detailed information should be provided in the Detailed RAP.

It is the auditor's opinion that the proposed landfarming methodology demonstrated adequate safeguards for the protection of human health and the environment for a Conceptual RAP version. It is the auditor understanding that the potential for uncontrolled emissions of, for example, volatile organic compounds, leachates and odours and any other adverse effects from treatment will be discussed in the Detailed RAP to ensure compliance with the POEO Act and other relevant regulatory requirements.

It is the auditor's understanding that groundwater accumulated during the excavations will be analysed and the decision on whether it is suitable for directing to the biotreater/Waste Water Treatment Plant (WWTP) will be managed accordingly.

The Conceptual RAP acknowledges that additional information, including more detailed design of the final selected remedial options, will need to be incorporated into the Detailed RAP. The list of the contingency measures and the proposed activities are a suitable acknowledgment of potential changes that could be faced in a remedial program. The auditor recommends that the

Detailed RAP incorporates a risk assessment approach to identify project risks and appropriate mitigation steps and responsibilities.

The auditor understood that more information regarding waste management will be presented in the Detailed RAP.

10.7 Long term environmental management plan

An LTEMP should be prepared to provide a management framework for the Western Area. The LTEMP would be a working document for site users who may need to undertake intrusive works at the Western Area.

11. Compliance with EPA Consultant Guidelines

Table 5 compares the components as required in the Consultant Guidelines to the information in the Conceptual RAP.

Table 5 Conceptual RAP and Consultants Guidelines summary

Consultant Guidelines	Conceptual RAP	Auditor comments
Executive summary	Executive summary	An executive summary was presented, including background, site setting and conditions, remediation overview, remediation objectives, remediation approach and conclusions
Scope of work	Section 1	A detailed scope of works was presented, including objectives, actions, planning and regulatory context
Site identification	Section 3	A summary of site identification (Lot and DP) as well as a site map were presented
Site history	Sections 4 and 5	A summary of history of remediation activities or assessment that were relevant to the Remediation Project was presented in Section 4. A detailed site history including the Western Area as well as the former Clyde Refinery area was presented in the RAP
Site condition and surrounding environmental	Section 5	A description of the off-site land use was presented in Section 5.3. In addition, a chronological list of site uses, including a review of aerial photographs was discussed in the RAP
Field quality assurance/quality control (QA/QC)	-	Not applicable, but should be incorporated into the Validation section in the Detailed RAP

Consultant Guidelines	Conceptual RAP	Auditor comments
Laboratory quality assurance/quality control (QA/QC)	-	Not applicable, but should be incorporated into the Validation section in the Detailed RAP
Assessment criteria	Section 8	The auditor noticed that although, a Tier 1 screening assessment was presented in Section 6 of the RAP, this assessment only included hydrocarbons compounds A summary of the CSM of the Western Area was provided in Section 7 of this IAA. However, it is the auditor's understanding that a final CSM will be presented in the Detailed RAP
Site characterisation	Section 5.8	A detailed site characterisation was presented in Section 5.8 of the RAP, including: • Inventory of chemicals and wastes associated with site use and their on-site storage location • Possible contaminant sources (and potential off-site effects) • Chemical inventory and storage tanks • COPCs • Site layout plans showing present and past industrial processes • Site topography • Surface water condition • Flood potential and • Local geology, hydrogeology and hydrology
Remedial action plan	Sections 10, 11 and 12	The Conceptual RAP presented a series of potential remediation approaches that could be applicable for the Western Area, details of which were presented in Table 3 of this IAA. As previously outlined in

Consultant Guidelines	Conceptual RAP	Auditor comments
		this IAA, selection of remedial activities will be presented in the Detailed RAP
Conclusions and recommendations	Section 14	Conclusions were presented in Section 14 of the RAP. As previously outlined in this IAA, final conclusions and recommendations will be presented in the Detailed RAP

12. Auditor conclusions

Based on the information presented in the Conceptual RAP, it is the auditor's opinion that it contains many of the details required for a RAP as outlined in the Guidelines for Consultants Reporting on Contaminated Sites (August 2011, NSW Office of Environment and Heritage). A Detailed RAP will be presented based on the historical analytical results and the additional remediation characterisation, the HHERA and other relevant documents.

It is the auditor's opinion that following completion of the soil remediation works, a program of groundwater monitoring should be conducted to confirm that natural processes will facilitate the degradation of dissolved phase hydrocarbons in the Western Area and that LNAPL remains stable. If non-petroleum groundwater COPCs exceed the risk based groundwater criteria to be derived in the HHERA, then assessment for these COPCs should also be monitored.

Therefore, a Groundwater Monitoring Plan (GMP) should be prepared to detail these works. The GMP would be included in the LTEMP to be prepared for the Western Area.

The auditor noted that the GMP was also recommended by NSW EPA in its letter DOC18/972926 SSD 9302 sent to Viva Energy on 17 December 2018 as discussed in **Section 4.3** of this IAA.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

13. Disclaimer

This Interim Audit Advice (IAA) has been prepared in accordance with relevant provisions of the CLM Act 1997. The IAA represents the auditor's opinion of the suitability and appropriateness of the reports listed in **Section 5** of this IAA to demonstrate that the Conceptual RAP have been prepared in accordance with the NSW EPA guidelines, based on the condition of the site at the date the site document was prepared.

This IAA:

- Has been prepared by Andrew Kohlrusch and his support team as indicated in the appropriate sections of this report ("GHD") for Viva Energy.
- May be used and relied on by Viva Energy.
- May be used by and provided to the NSW EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the EP Act 1997.
- May be provided to other third parties but such third parties use of or reliance on the report is at their sole risk, as this IAA must not be relied on by any person other than those listed above without the prior written consent of GHD.
- GHD and its servants, employees and officers (including the auditor) otherwise expressly disclaim responsibility to any person other than Viva Energy arising from or in connection with this IAA.
- To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the IAA are excluded unless they are expressly stated to apply in this IAA.

The services undertaken by the auditor, his team and GHD in connection with preparing this IAA:

- Were undertaken in accordance with current profession practice and by reference to relevant guidelines made or approved by the NSW EPA.
- The opinions, conclusions and any recommendations in this report are based on assumptions made by the auditor, his team and GHD when undertaking services and preparing the IAA ("Assumptions"), as specified throughout this IAA.
- GHD and the auditor expressly disclaim responsibility for any error in, or omission from, this IAA arising from or in connection with any of the Assumptions being incorrect.
- Subject to the paragraphs in this section of the IAA, the opinions, conclusions and any recommendations in this IAA are based on conditions encountered and information reviewed at the time of preparation of this IAA and are relevant until such times as the service station conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this IAA arising from or in connection with those opinions, conclusions and any recommendations.
- The auditor and GHD have prepared this IAA on the basis of information provided by AECOM and others who provided information to GHD (including Government authorities), which the auditor and GHD have not independently verified or checked ("Unverified Information") beyond the agreed scope of work.

- The auditor and GHD expressly disclaim responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the IAA, which were caused or contributed to by errors in, or omissions from, the Unverified Information.
- The opinions, conclusions and any recommendations in this IAA are based on information obtained from, and testing (if undertaken as specified in this IAA) undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the service station at other than these locations.
- Although reasonable care has been used to assess the extent to which the data collected from site is representative of the overall site condition and its beneficial uses, investigations undertaken in respect of this IAA are constrained by the particular service station conditions as discussed in this IAA. As a result, not all relevant site features and conditions may have been identified in this IAA.
- Site conditions (including any the presence of hazardous substances and/or service station contamination) may change after the date of this IAA. The auditor and GHD expressly disclaim responsibility:
    1. Arising from, or in connection with, any change to the site conditions.
    2. To update this IAA if the site conditions change.
- These Disclaimers should be read in conjunction with the entire IAA and no excerpts are taken to be representative of the findings of this IAA.

Appendices

Appendix A Figures

FIGURE 3-1 - SITE LOCATION MAP

KEY

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

AECOM

0 250 500 m

imagery © Nearmap 2017

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Figure 3-1 Site Location Map

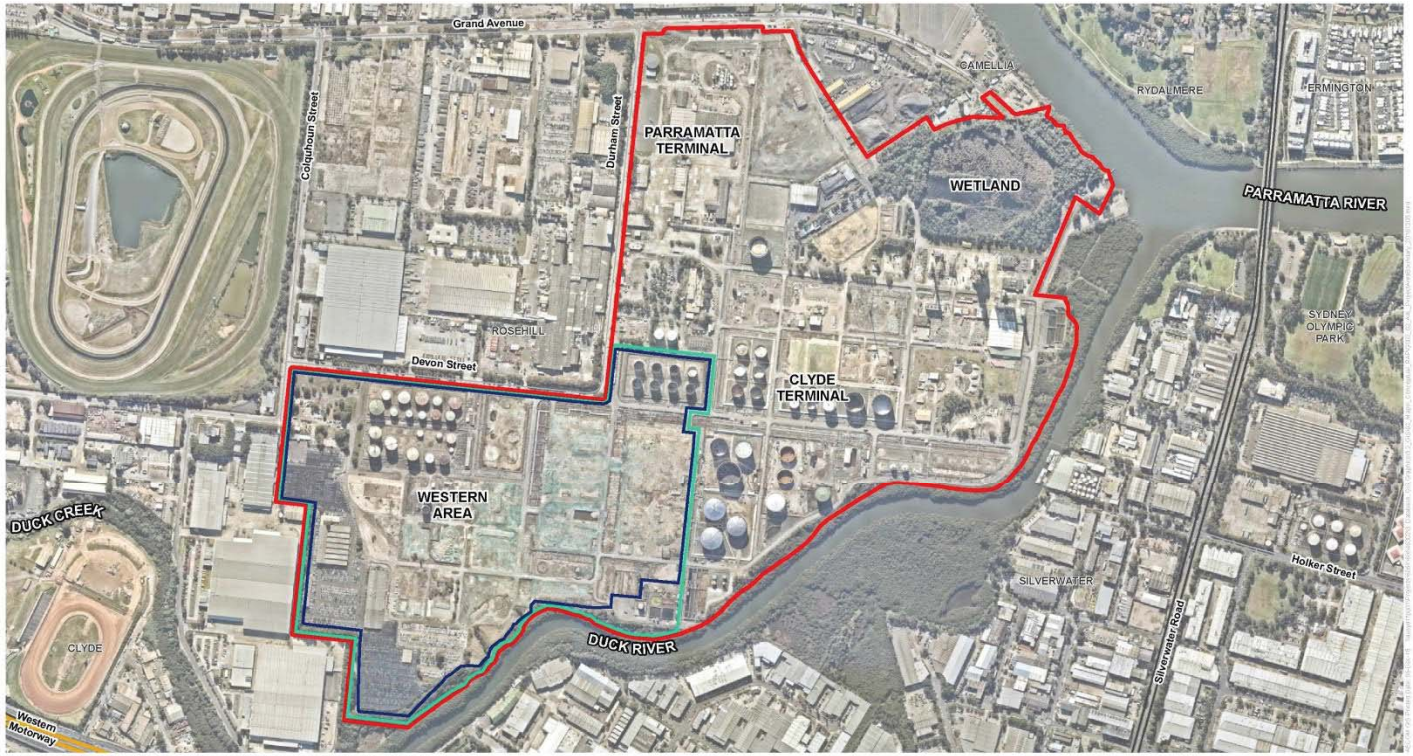

FIGURE 3-2 - SITE, PROJECT AREA AND WESTERN AREA MAP

KEY

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

AECOM

0 100 200 300 m

Imagery © Nearmap 2017

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Figure 3-2 Site, Project Area and Western Area map

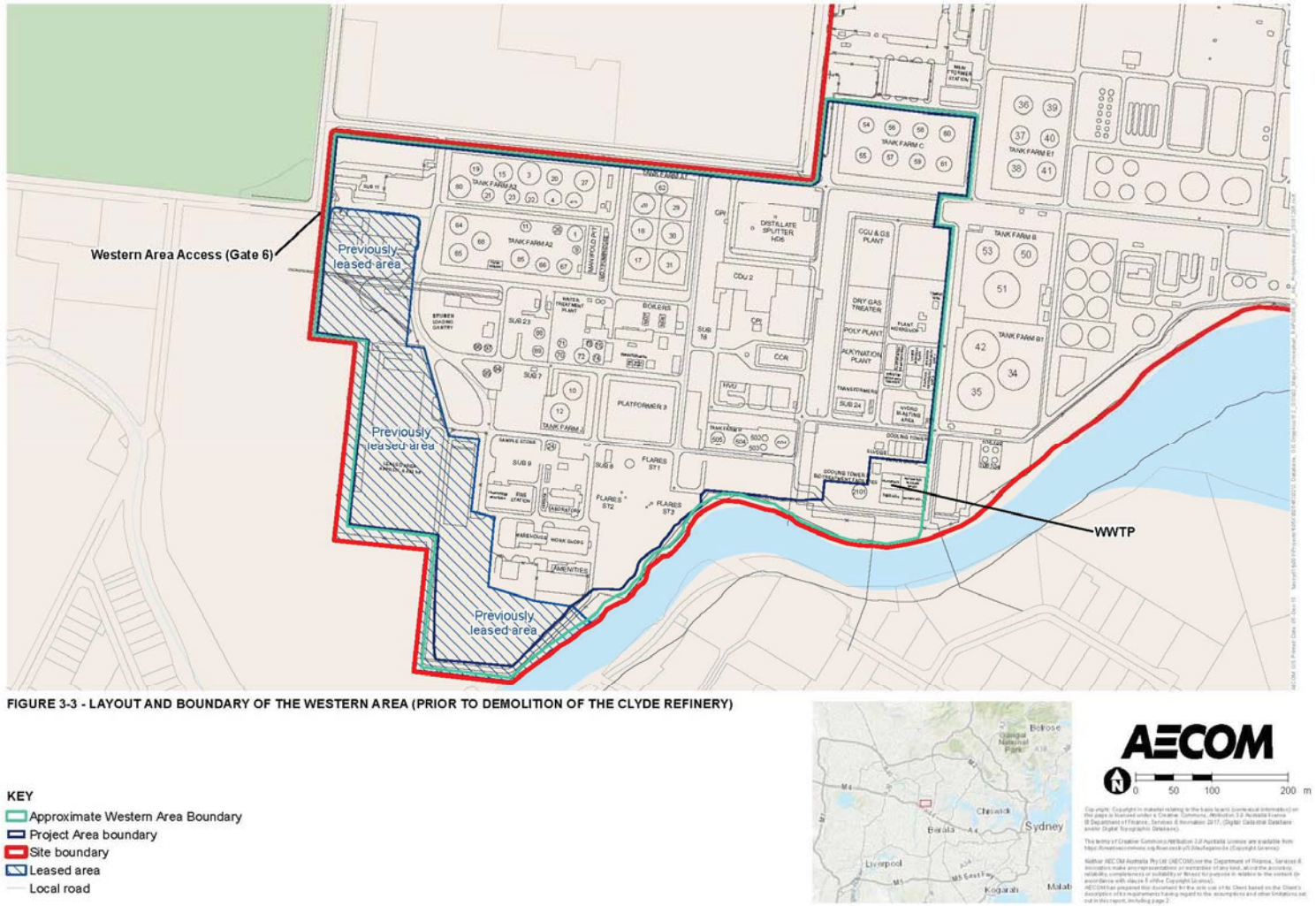

Figure 3-3 Layout and Boundary of the Western Area (prior to demolition of the Clyde Refinery)

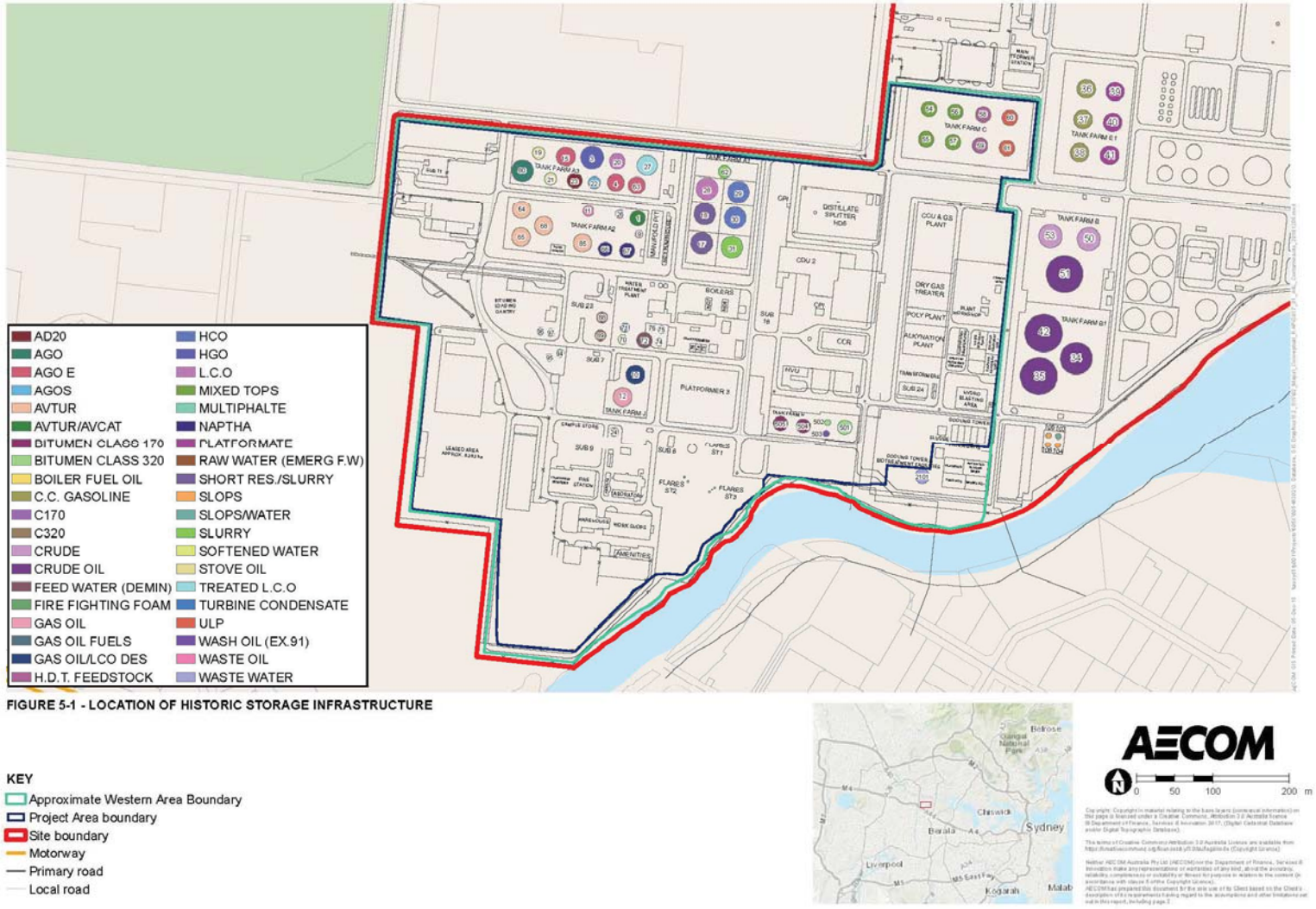

FIGURE 5-1 - LOCATION OF HISTORIC STORAGE INFRASTRUCTURE

Figure 5-1 Location of Historic Storage Infrastructure

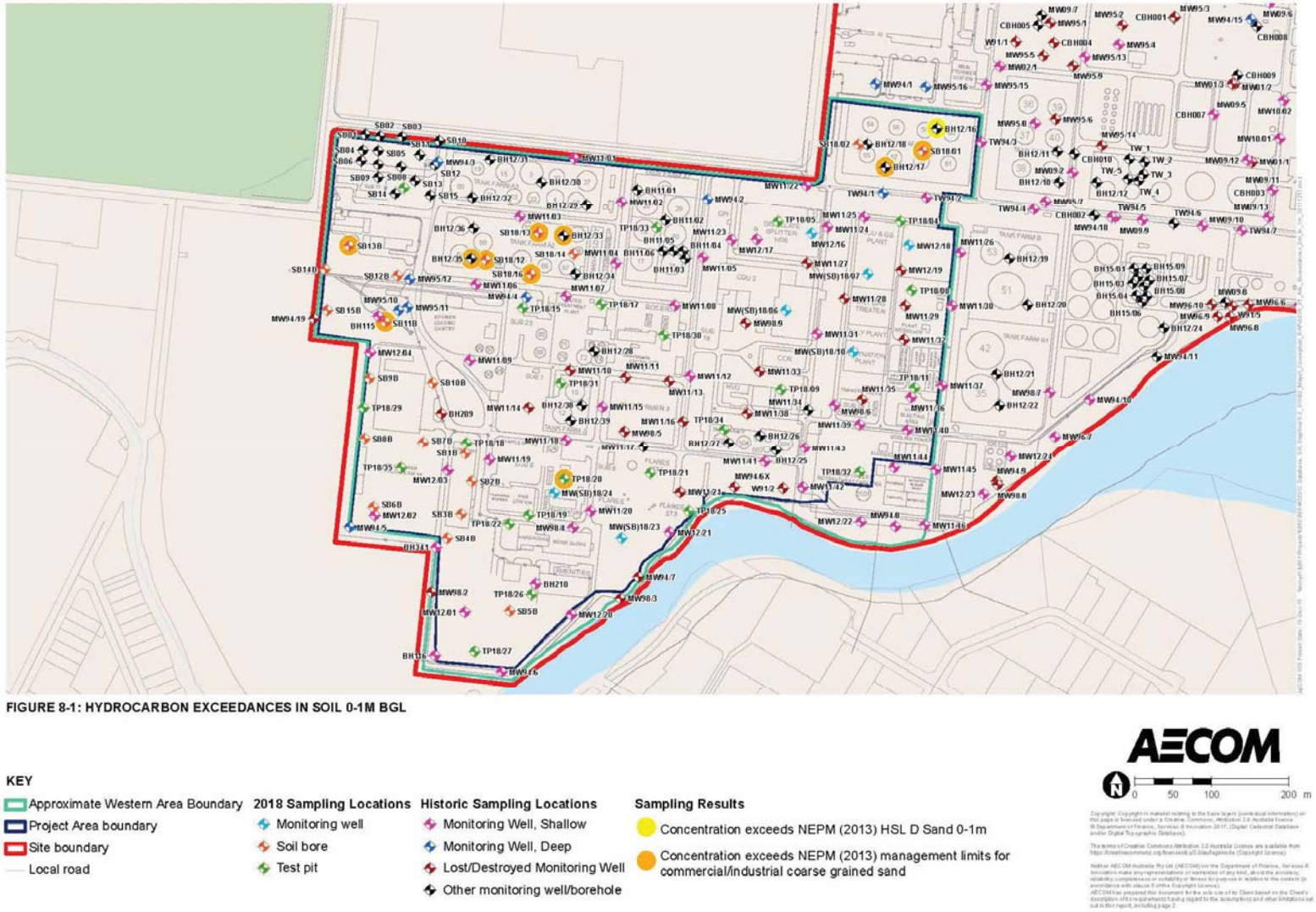

Figure 8-1 Hydrocarbon Impacts in Soil: 0-1 metre below ground level

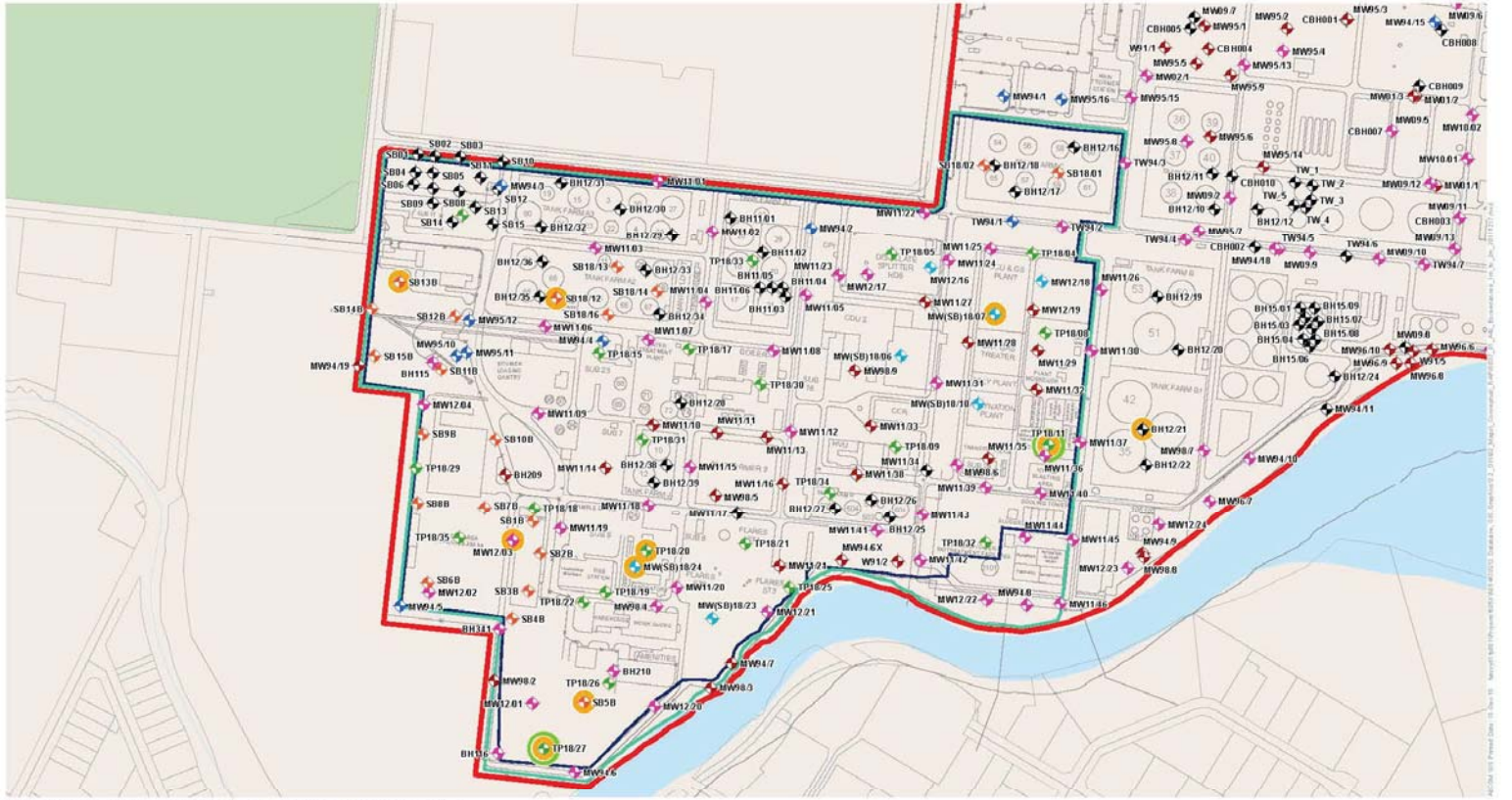

FIGURE 8-2: HYDROCARBON EXCEEDANCES IN SOIL 1-2M BGL

KEY

- Approximate Western Area Boundary
- Project Area boundary
- Site boundary
- Local road

2018 Sampling Locations

- Monitoring well
- Soil bore
- Test pit

Historic Sampling Locations

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

Sampling Results

- Concentration exceeds NEPM (2013) management limits for commercial/industrial coarse grained sand
- Concentration exceeds NEPM (2013) HSL D Direct Contact

AECOM

0 50 100 200 m

Figure 8-2 Hydrocarbon Impacts in Soil: 1-2 metres below ground level

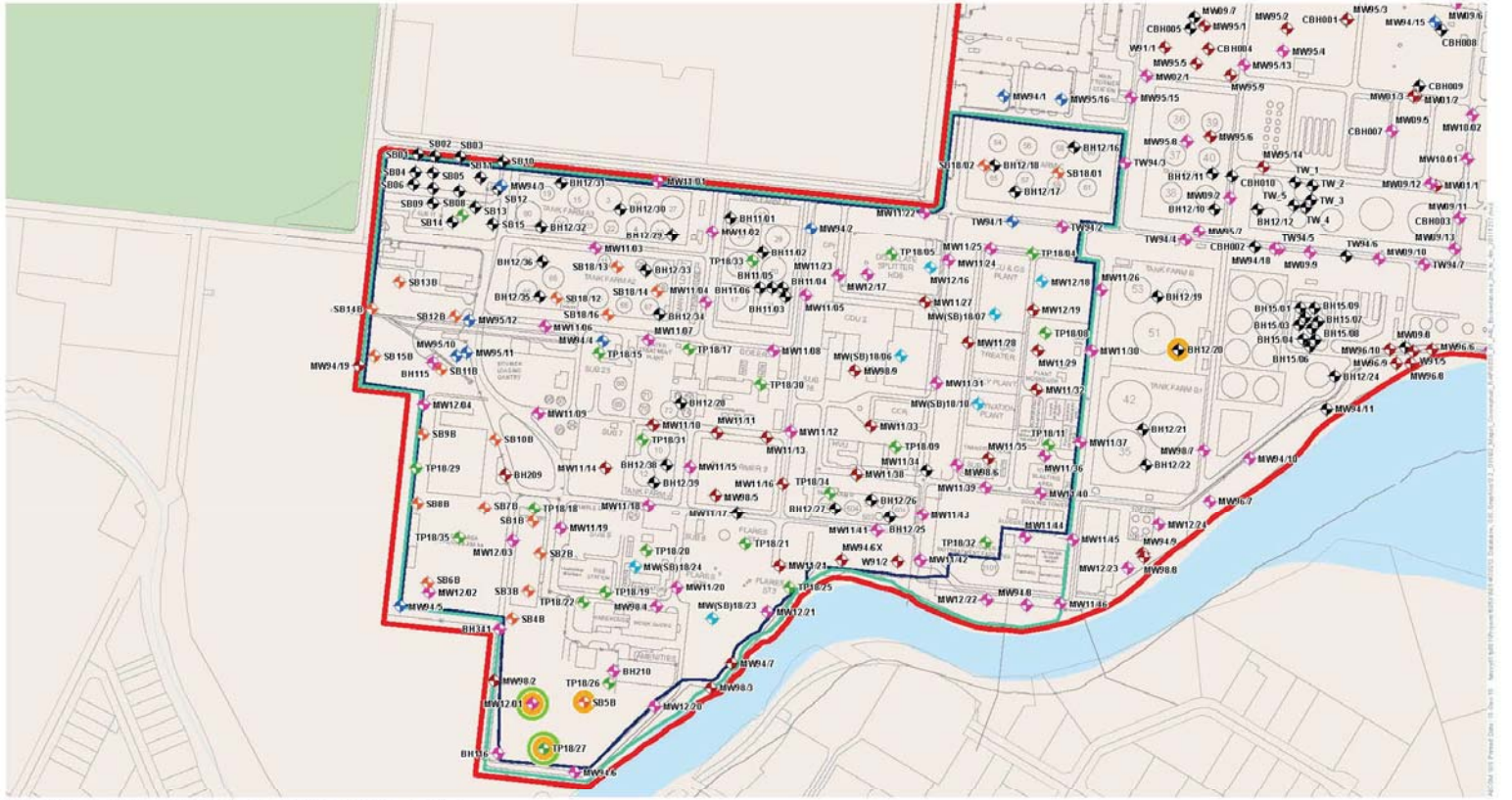

FIGURE 8-3: HYDROCARBON EXCEEDANCES IN SOIL 2-4M BGL

KEY

- Approximate Western Area Boundary
- Project Area boundary
- Site boundary
- Local road

2018 Sampling Locations

- Monitoring well
- Soil bore
- Test pit

Historic Sampling Locations

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

Sampling Results

- Concentration exceeds NEPM (2013) management limits for commercial/industrial coarse grained sand
- Concentration exceeds NEPM (2013) HSL D Direct Contact

AECOM

0 50 100 200 m

Figure 8-3 Hydrocarbon Impacts in Soil: 2-4 metres below ground level

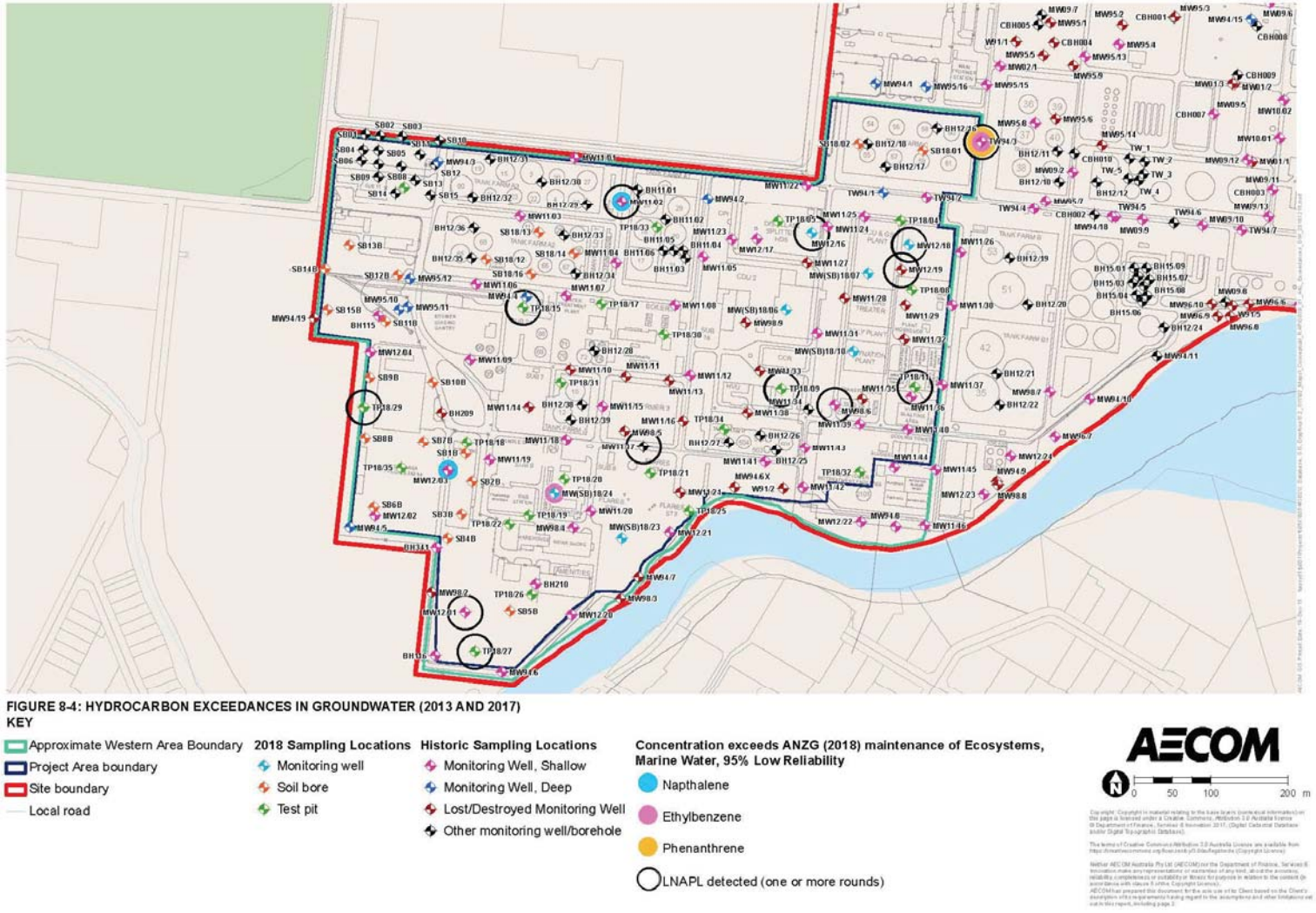

Figure 8-4 Hydrocarbon Exceedances in Groundwater (2013 and 2017)

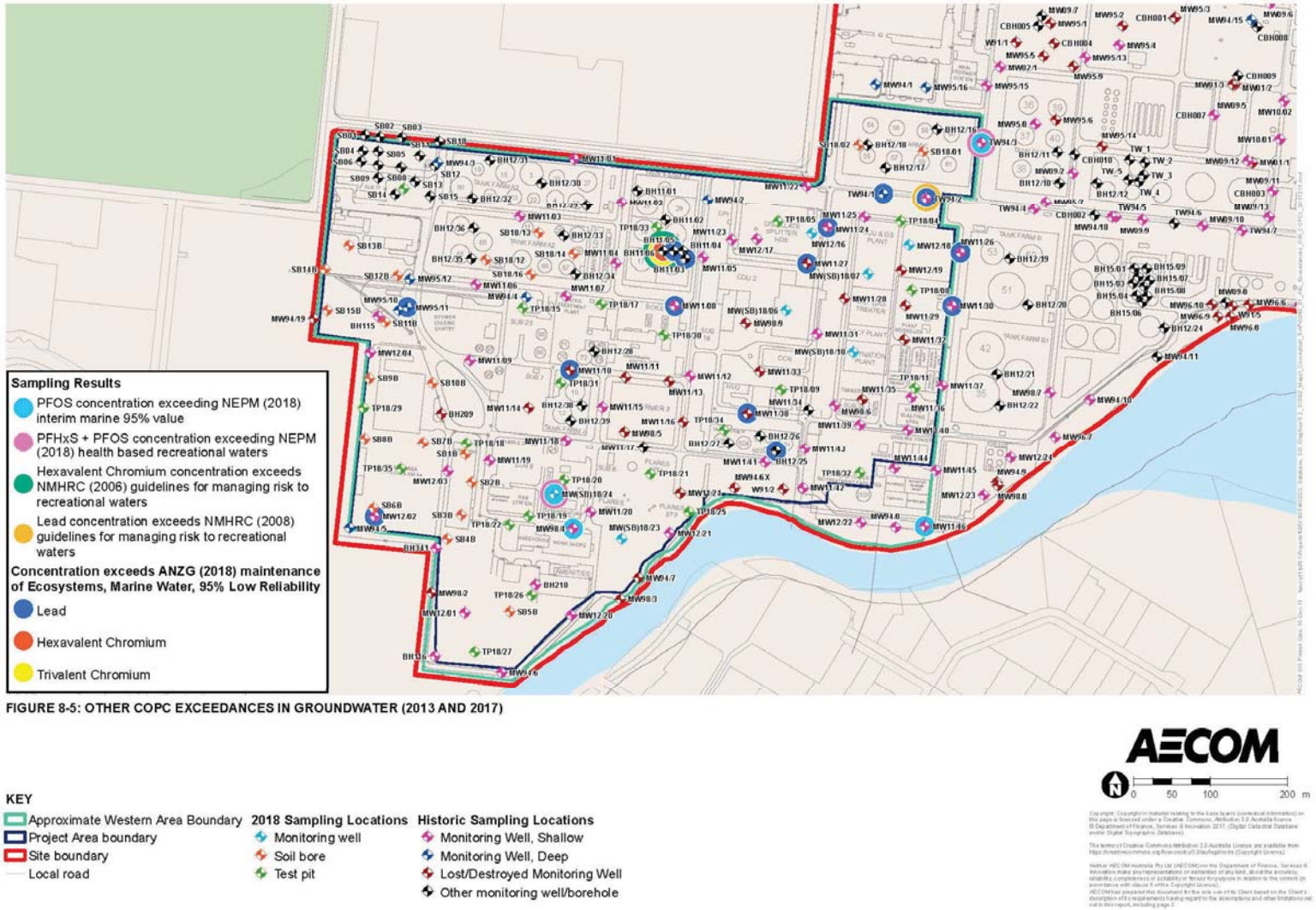

FIGURE 8-5: OTHER COPC EXCEEDANCES IN GROUNDWATER (2013 AND 2017)

Figure 8-5 Other COPC Exceedances in Groundwater (2013 and 2017)

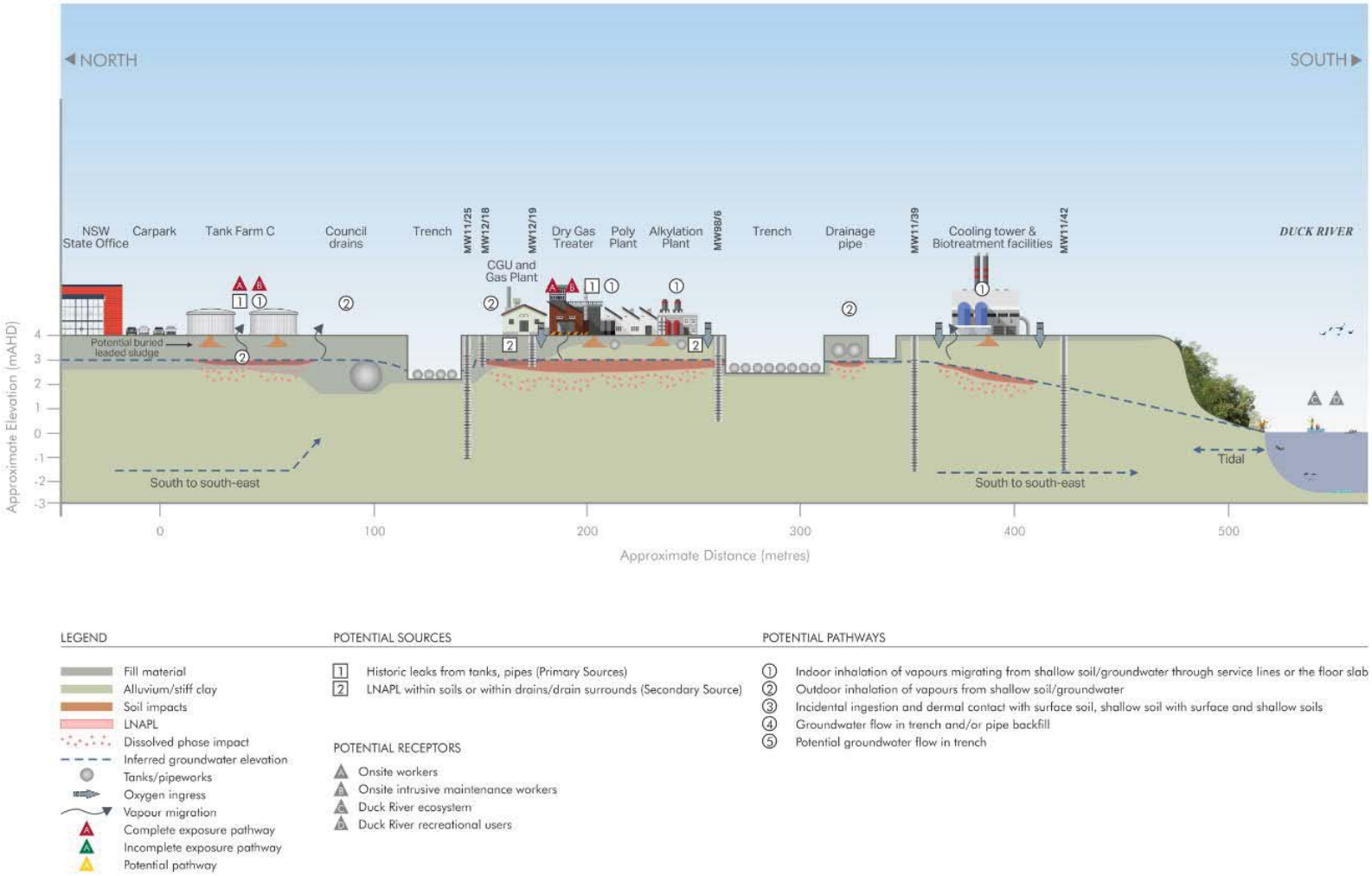

Figure 8-6 Conceptual Site Model

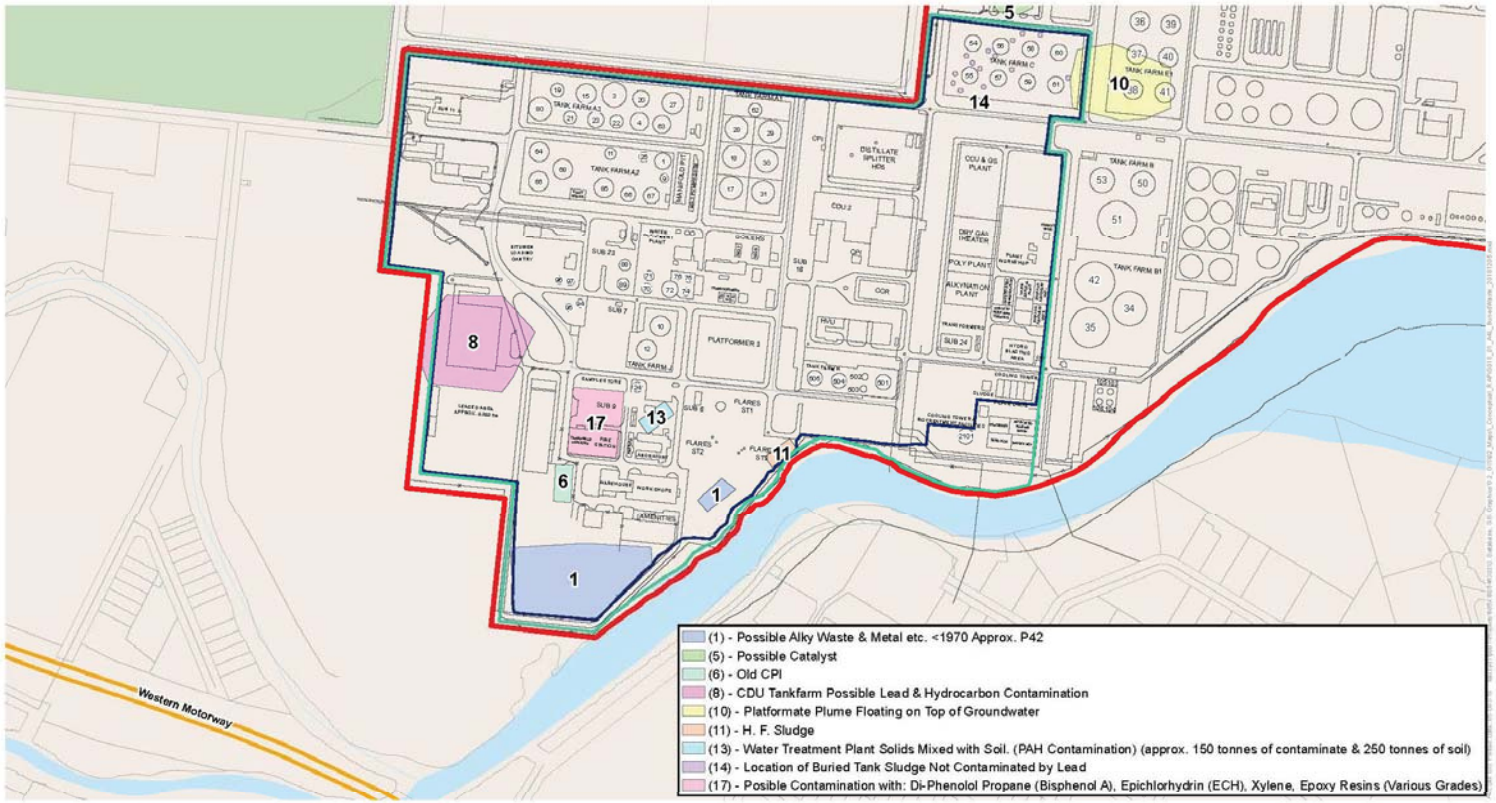

FIGURE 9-1 - HISTORIC BURIED WASTE LOCATIONS

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

AECOM

0 50 100 200 m

Figure 9-1 Historic buried waste locations

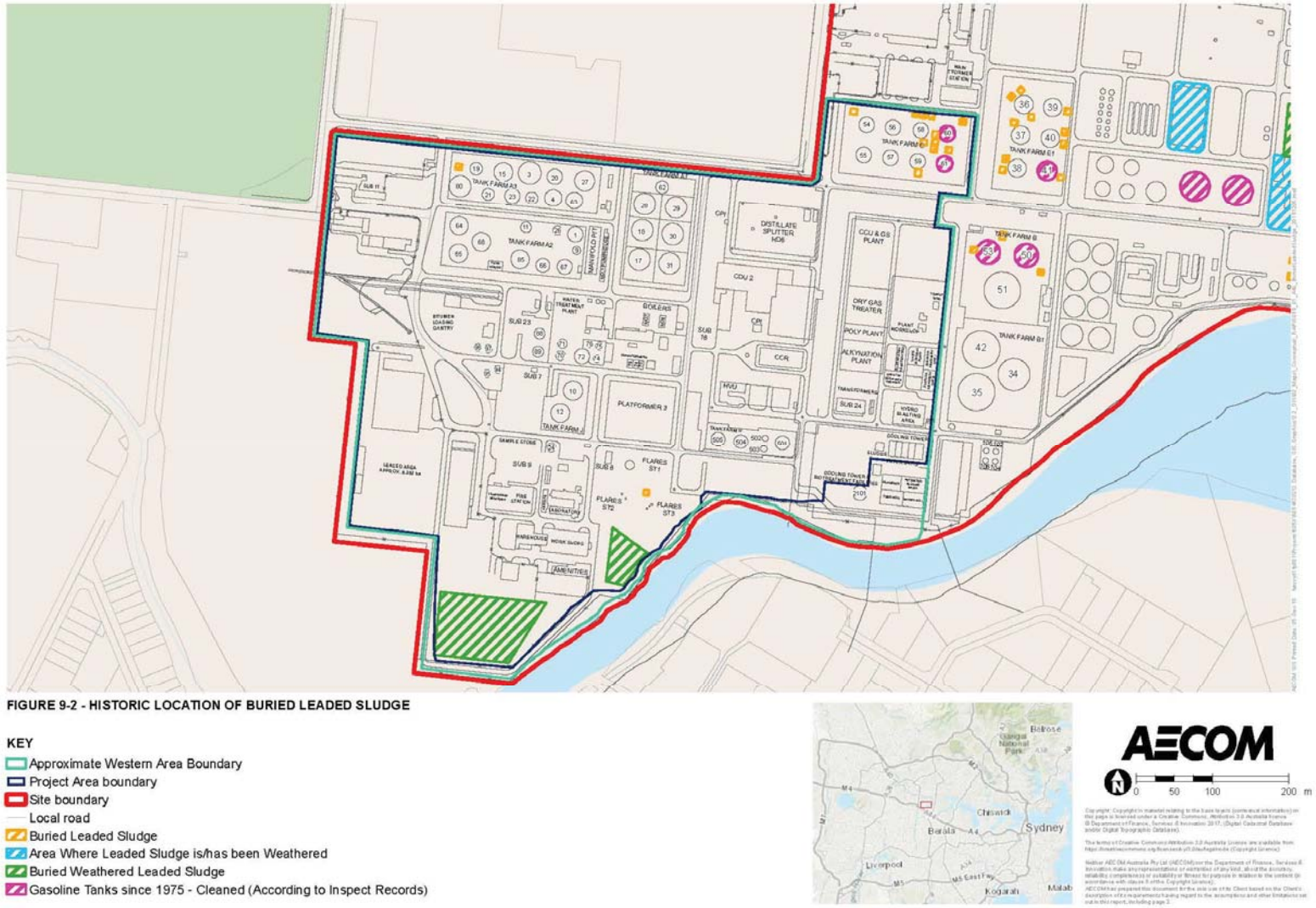

Figure 9-2 Historic location of buried leaded sludge

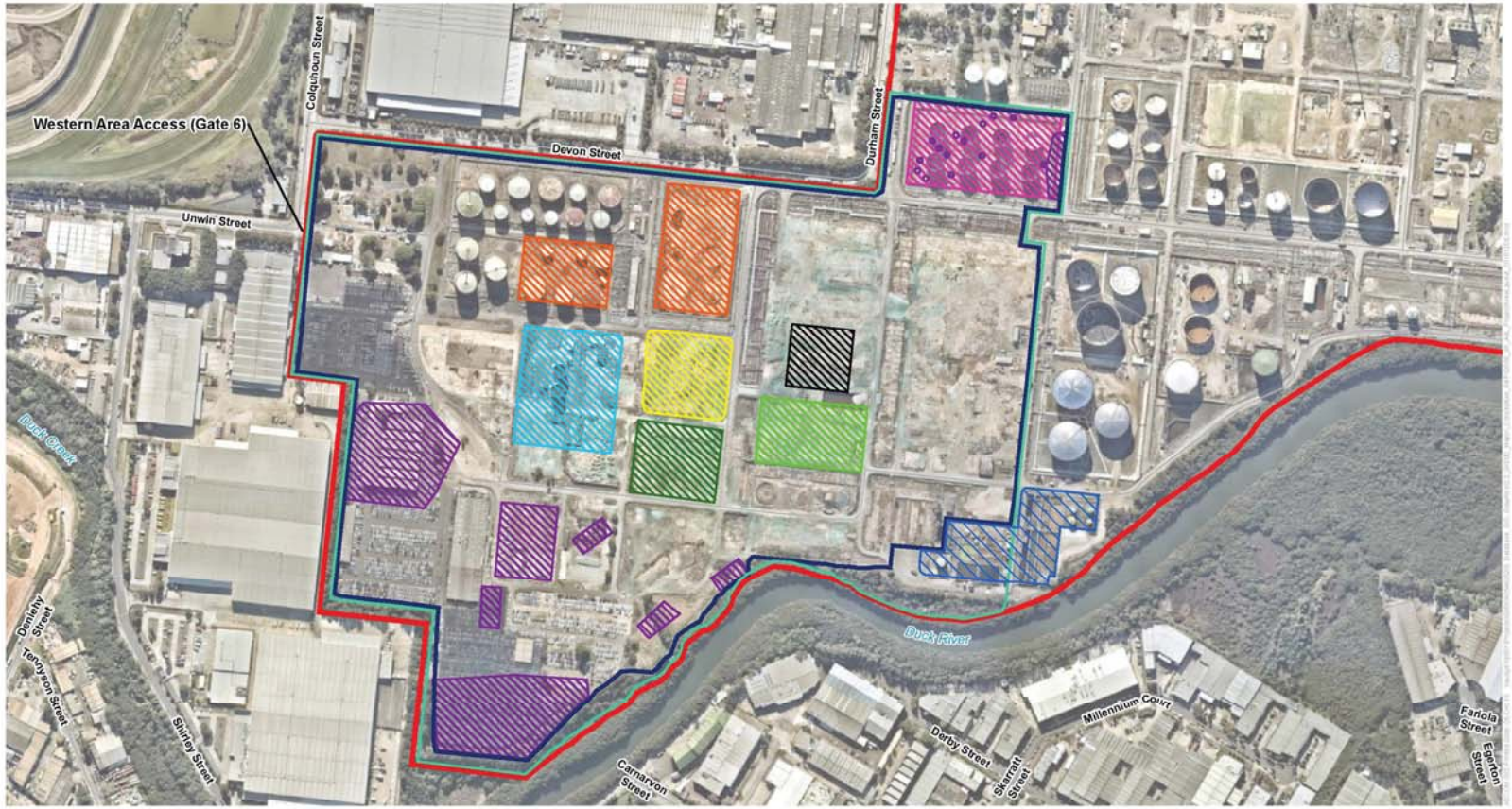

FIGURE 15-1 - WESTERN AREA PROPOSED REMEDIATION LAYOUT

KEY

- Site boundary
- Project Area boundary
- Western Area boundary
- Waste Water Treatment Plant (WWTP)
- Local road

Potential Location of Remediation Technologies

- Biopiling
- In-area soil mixing / landfarming excavation
- Landfarming
- Stabilisation
- Thermal desorption
- Waste proccessing area
- Contingency treated stockpile area
- On-site management (buried waste)

Note: Project Area boundary along the southern border is indicative only and will be refined during detailed design to exclude the tree management zone.

AECOM

0 50 100 200 m

Figure 15-1 Project Area Proposed Remediation Layout

Appendix B Interim Audit Advice documents

Daniela Balbachevsky

From: Andrew Kohlrusch
Sent: Monday, 10 December 2018 4:04 PM
To: Rolfe, Andrew; Erica.Salazar@vivaenergy.com.au; Adam Speers (InTouch); Gavin.Barnes@vivaenergy.com.au; Miles, William
Cc: Daniela Balbachevsky
Subject: Comments on Conceptual RAP V2

CompleteRepository: 2127799
Description: Viva Clyde Audit
JobNo: 27799
OperatingCentre: 21
RepoEmail: 2127799@ghd.com
RepoType: Job

Hi team,

Daniela and I have reviewed the latest version of the Conceptual RAP in relation to comments made by GHD on 23 November 2018 on the initial version of the document. We have also considered in preparing these comments, the key elements that should be incorporated into an RAP prepared in a manner that is consistent with guidelines made or endorsed by the NSW EPA.

It is our opinion that greater detail needs to be presented in the conceptual RAP in relation to the following comments prior to its inclusion in the EIS:

Chemicals of potential Concern (COPCs)

- It would be clearer (and more accurate) to add asbestos as a COPC (section 5.11).

Conceptual Site Model (CSM)

- Although Figure 8-6 illustrated the CSM for the site, a more robust CSM including the complete exposure pathways should be provided. As a guide, the Targeted Site Investigation (TSI) report presented a CSM (Section 6) that could be used in the Conceptual RAP after appropriate revision.

- The CSM presented in the TSI report identified the Duck River as an off-site ecological receptor. Therefore, the Conceptual RAP should present discussion regarding this receptor, especially as high concentrations of lead, dioxins and PFAS (up to 1.8 ug/L) in groundwater samples collect in the monitoring wells located close to the river.

- Given that dioxins have been identified in soils on site, commentary on whether a site-specific assessment of exposure to all PCBs (including dioxin-like PCBs) and dioxins (as per NEPM requirements) is necessary.

Adopted assessment criteria

- Based on the following: *"The vertical extent of impact is typically within the uppermost three metres, which typically comprises fill, silty gravels or silty clays. Exceedances of the ESL Commercial/Industrial (coarse soil) criteria are typically shallower than 1 m in the north-west corner of the Project Area and exceedances of the Management Limits (coarse soils) are typically present in the upper 2 metres in the Tank Farm A2 area*".

  - The above information should be clearly shown on cross sections with annotated data.
  - The information provided in Figures 8-1 to 8-3 is different to above described.

Remediation

- Confirmation is required on whether all previous data have been used in the calculations of the extent and volume of impacted material that warrants remediation with appropriate modificatoin to figures and tables presented in the Conceptual RAP.

- The Conceptual RAP needs to show areas of contamination requiring remediation, calculations and assessment/action levels used in the calculations. Figure 15-1 only shows areas where remediation may take place.

- The Conceptual RAP needs to discuss management of PFAS affected groundwater and/or soils.

- Although the purpose of the remediation is to remove the potential risk associated with petroleum hydrocarbon present in soil, it is necessary to consider that these 100,000 m^3 are also contaminated by other COCPs (i.e. PFAS, heavy metals, PAHs – benzo(a)pyrene and dioxins). The document should be include a table that lists each remedial option with comments on the applicability of each to the various COPCs – PCBs limited for example.

- The following statement was presented in the executive summary "*in areas where contamination remains and cannot be practicable* ….". It is necessary to clarify why some areas maybe cannot be remedied.

- The following statement was presented *"The requirements relating to remediation or management of buried waste areas would also be confirmed as the investigations proceed."* It will be necessary to clarify if this investigations still being carried out and how the outcomes could affect the Conceptual RAP.

Groundwater

- The groundwater is impacted by a series of chemicals besides petroleum hydrocarbons. Clarification is required on whether the site Wastewater treatment plant (WWTP) is designed to treat all COPCs (including heavy metals, PFAS, PCBs and dioxins).

- Lines of Evidence are required to support the statement that the LNAPL plume is stable and does not pose human health or ecological risks. The groundwater modelling presented in the TSI report could be used to support this statement.

Figures

- A figure showing the areas where the contaminated soils will be removed is required.

- A figure showing the areas impacted by PFAS, dioxins and asbestos (soil and groundwater) is required.

- Figures 8-1 to 8-3 from the Conceptual RAP are different to the corresponding figures presented in the TSI report (Figures 8 to 10).

- Based on Figure 8-5 the following points need to be clarified:

  - What are the adopted criteria that have been exceeded?

  - Naphthalene is a petroleum hydrocarbon. However, it was reported in Figure 8-5 as a non-petroleum COPCs.

Tables

- **Soil**

  - A revision of the adopted criterion is necessary. It is not clear why HIL A&B and HSL A&B have been nominated.

- **Groundwater**

  - The assessment criteria for PFAS was not presented in the tables.

  - Clarify why HSL D for sand 0-2 metres was not presented in the tables

To expedite a quick turnaround on these matters and to allow us sufficient time to finalise our interim audit advice, we recommend a meeting to discuss these matters. GHD is available this Wednesday from 10:30
Regards

andrew

Andrew Kohlrusch | A GHD Principal
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Viva Energy Clyde Western Area Remediation Project

Change Log Memo – Site Auditor Review of Conceptual RAP (finalised following meeting with Site Auditor on 12 December 2018 and to be included in the Site Auditor Interim Advice Letter)

Ref.	Site Auditor comment	AECOM Response
	Chemicals of potential Concern (COPCs) • It would be clearer (and more accurate) to add asbestos as a COPC (section 5.11).	Agreed – text has been added to **Section 5.11**.
	Conceptual Site Model (CSM) • Although Figure 8-6 illustrated the CSM for the site, a more robust CSM including the complete exposure pathways should be provided. As a guide, the Targeted Site Investigation (TSI) report presented a CSM (Section 6) that could be used in the Conceptual RAP after appropriate revision.	Agreed - the table has been added to **Section 8.4** and modified.
	• The CSM presented in the TSI report identified the Duck River as an off-site ecological receptor. Therefore, the Conceptual RAP should present discussion regarding this receptor, especially as high concentrations of lead, dioxins and PFAS (up to 1.8 ug/L) in groundwater samples collect in the monitoring wells located close to the river.	The current CSM as presented by ERM in the Q4 2017 GME and 2017 Annual Progress Report provides details of PFAS groundwater monitoring data and assessment against current ecological screening levels. Further assessment of PFAS and development of the CSM specific to PFAS impacts is currently being completed by ERM and this will be incorporated in the Detailed RAP. All CoPCs will be screened and considered in the full HHERA. Text has been added to **Section 9.4**.
	• Given that dioxins have been identified in soils on site, commentary on whether a site-specific assessment of exposure to all PCBs (including dioxin-like PCBs) and dioxins (as per NEPM requirements) is necessary.	The text in **Section 9.6** has been clarified that all CoPCs will be screened and considered in the full HHERA/Detailed RAP.

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	Adopted assessment criteria • Based on the following: "*The vertical extent of impact is typically within the uppermost three metres, which typically comprises fill, silty gravels or silty clays. Exceedances of the ESL Commercial/Industrial (coarse soil) criteria are typically shallower than 1 m in the north-west corner of the Project Area and exceedances of the Management Limits (coarse soils) are typically present in the upper 2 metres in the Tank Farm A2 area*". ▪ The above information should be clearly shown on cross sections with annotated data. ▪ The information provided in Figures 8-1 to 8-3 is different to above described.	Not required at this conceptual stage. Will be provided in the Detailed RAP adopting the site-specific validation criteria and in defining the Remediation Extent. The RAP figures has been amended to show exceedances only and the **Section 9.2.1** text updated accordingly.

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	Remediation	
	• Confirmation is required on whether all previous data have been used in the calculations of the extent and volume of impacted material that warrants remediation with appropriate modification to figures and tables presented in the Conceptual RAP.	All available data (including the TSI completed in February this year) was included in the 3D modelling report which estimated the remediation volumes. Refer to the 3D report for further information. Clarification has been added to **Section 12.1**.
	• The Conceptual RAP needs to show areas of contamination requiring remediation, calculations and assessment/action levels used in the calculations. Figure 15-1 only shows areas where remediation may take place.	Not required for a conceptual plan. The 3D modelling report shows areas of hydrocarbon impacts based on current data sets. The Remediation Extent will be detailed in Detailed RAP based on adopting the site-specific validation criteria (post HHERA).
	• The Conceptual RAP needs to discuss management of PFAS affected groundwater and/or soils.	Further assessment of PFAS and development of the CSM specific to PFAS impacts (based on the ongoing ERM work) will be undertaken and will be incorporated into the Detailed RAP. This information will assist in confirming if PFAS impacted material needs to be managed during the remediation works. Text has been added to **Section 9.4.**
	• Although the purpose of the remediation is to remove the potential risk associated with petroleum hydrocarbon present in soil, it is necessary to consider that these 100,000 m3 are also contaminated by other COCPs (i.e. PFAS, heavy metals, PAHs – benzo(a)pyrene and dioxins). The document should be include a table that lists each remedial option with comments on the applicability of each to the various COPCs – PCBs limited for example.	Agreed – a high level summary table has been added to **Section 12.9** (new section).
	• The following statement was presented in the executive summary "in areas where contamination remains and cannot be practicable ….". It is necessary to clarify why some areas maybe cannot be remedied.	The text in the Executive Summary has been amended to include preparation of area-specific risk assessments to assess residual impacts (as per paragraph 4 in **Section 10.2**) and, if required, assessment of other COPCs based on their individual characteristics. Wording has been added to the Conclusions.
	• The following statement was presented "*The requirements relating to remediation or management of buried waste areas would also be confirmed as the investigations proceed*." It will be necessary to clarify if this investigations still being carried out and how the outcomes could affect the Conceptual RAP.	It is envisaged that identified buried waste areas will be assessed as part of the Remedial Investigation (RI). The wording in **Section 10.2** has been amended to reflect this. We confirm that there are currently no ongoing investigations and there is no data is pending for Conceptual RAP completion.

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	Groundwater • The groundwater is impacted by a series of chemicals besides petroleum hydrocarbons. Clarification is required on whether the site Wastewater treatment plant (WWTP) is designed to treat all COPCs (including heavy metals, PFAS, PCBs and dioxins). • Lines of Evidence are required to support the statement that the LNAPL plume is stable and does not pose human health or ecological risks. The groundwater modelling presented in the TSI report could be used to support this statement.	Text has been added to **Section 12.11** to confirm that testing of accumulated groundwater in excavations will be an important part of its management and will determine whether it is suitable for directing to the biotreater/WWTP for treatment or whether it requires separate management. Text has been clarified in **Section 7.2.2** based on the TSI and recent ERM groundwater monitoring reports. Also refer to the Q4 2017 GME and 2017 Annual Progress Report which provides discussion on LNAPL stability as part of CSM.
	Figures • A figure showing the areas where the contaminated soils will be removed is required. • A figure showing the areas impacted by PFAS, dioxins and asbestos (soil and groundwater) is required. • Figures 8-1 to 8-3 from the Conceptual RAP are different to the corresponding figures presented in the TSI report (Figures 8 to 10). • Based on Figure 8-5 the following points need to be clarified: ▪ What are the adopted criteria that have been exceeded? ▪ Naphthalene is a petroleum hydrocarbon. However, it was reported in Figure 8-5 as a non-petroleum COPCs.	As above, not required for conceptual plan. To be added for the RI stage once more analytical data and better site coverage has been achieved. The RAP figures have been amended to show exceedances only. The groundwater criteria has been added to the legend. The Figure 8-5 title will be changed to “Other COPCs”.

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	Tables • Soil ▪ A revision of the adopted criterion is necessary. It is not clear why HIL A&B and HSL A&B have been nominated. • Groundwater ▪ The assessment criteria for PFAS was not presented in the tables. ▪ Clarify why HSL D for sand 0-2 metres was not presented in the tables	HIL/HSL A and B has been removed from the tables. Groundwater note has been removed The PFAS criteria has been added to the summary table. This is explained at the top of Table 8-2, Section 8.2.1: *"Values used:* ***1-2 m**: Generic HSLs for groundwater have not been developed where groundwater is shallower than 2 mbgs. This is primarily due to the potential for a direct contact pathway to also be present. Groundwater in the Project Area has been observed as shallow as 1 m depth. It is assumed that a receptor will not come into direct contact with groundwater at 1 m depth (as assumed maximum direct contact depth deemed to be 0.5 mbgs)."* Section 8.2.4 already confirms that a 95% level of protection has been adopted as Duck River is considered a moderately disturbed system.

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Revision A.

Appendix C Summary of environmental works

Date	Reports
1992	Geotechnical model developed by Coffey Partners International Pty Ltd. Ten groundwater wells were 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	ESA conducted by Groundwater Technology in June
1995	Environmental Site Assessment (ESA) conducted by Groundwater Technology in March in the old chemical plant and Tank Farm E1
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
2002	Pollution Reduction Program Remedial Action Plan produced by Shell Engineering Pty Ltd in July
2003	• 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
2004	Remedial Action Plan (Phase Separated Hydrocarbon (PSH) removal trial) conducted by C.M. Jewell & Associates
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 prepared 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

Date	Reports
	• PSH removal trial assessment in the central part of Site completed by ERM • Factual GME (GME 9) conducted by ERM for the 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 • PSHs assessment for CSM2 conducted by ERM. CSM2 is located east and immediately north of the Project Area • Tank Farm E2 (Tank 83) alkylate release investigation conducted by ERM • Factual groundwater monitoring report (GME10) conducted by ERM for the Clyde Refinery and Parramatta Terminal • Factual groundwater monitoring report (GME11) conducted by ERM for the Clyde Refinery and Parramatta Terminal • Underground storage tank pit validation for the AutoNexus site conducted by ERM
2010	• Quarter 1 to 2 (2010) GME - Clyde Refinery, ERM • Hexavalent chromium investigation Clyde Refinery and Parramatta Terminal reported by ERM • Shell Clyde Refinery Soil and Groundwater Management Plan prepared by ERM • Shell Clyde Refinery Soil and Groundwater Management Plan third party review by Environ
2011	• Tank T92 release investigation at the Shell Clyde Refinery reported by ERM • Quarter 1 to 4 GMEs conducted by ERM for the Clyde Refinery • Stage 1 and 2 ESA conducted by ERM, for the Shell Clyde Refinery and Parramatta Terminal (CSM Sub Area 3 Investigation) • Phase 1 ESA conducted by ERM, for the Clyde Refinery – Lot 101 DP809340
2012	• Tank 30 release investigation conducted by ERM, for the Clyde Refinery and Parramatta Terminal • Quarter 1 to 4 GMEs conducted by ERM, for the Clyde Refinery • Environmental Conditions Summary (ECS) reported by ERM, for the Shell Clyde Refinery • Stage 1 and 2 ESA conducted by ERM, for the Shell Clyde Refinery and Parramatta Terminal • Phase II ESA conducted by ERM, for the Shell Clyde Refinery and Parramatta Terminal Lot 101 DP 809340 • Supplementary information to the ECS reported by ERM
2013	Quarter 1 to 4 GMEs conducted by ERM, for the Clyde Refinery

Date	Reports
2014	• Quarter 1 to 4 GMEs conducted by ERM for the Clyde Refinery • Annual progress report (2013) provided by ERM, for the Shell Clyde Terminal • Detailed Site Investigation (DSI) conducted by ERM for the Clyde Terminal Lot 101 DP809340 • Refinery Property Remediation Program, preliminary concept and budget costing presentation
2015	• Shallow soil assessment and lead dust survey conducted by ERM, for the Tetraethyl Lead Plant at the Clyde Terminal
2016	• Quarter 1 to 4 GMEs conducted by ERM, for the Clyde Refinery • Demolition spoil assessment reported by Coffey, for the Clyde Refinery • Annual progress report (2015) provided by ERM, for the Shell Clyde Terminal • Tank Lot 101 DSI, reported by ERM, for the Clyde Refinery • Tank Farm B2 investigation, reported by ERM, for the Clyde Refinery • Clyde Condition Report and Environmental Management Plan prepared by ERM, for the Clyde Refinery • Letter detailing fire-fighting foam deluge systems and uses prepared by Viva Energy. • Clyde Soil and Groundwater Management Plan prepared by ERM
2017	• Annual progress report, prepared by ERM, for the Clyde Refinery • GMEs conducted by ERM, for the Clyde Refinery • Liberty Industrial Viva Bio Summary (soil biopile works)
2018	• Targeted Site Investigation (TSI), Viva Energy Clyde Western Area Remediation Project, conducted by AECOM • 3D modelling of hydrocarbon impacts report prepared by AECOM • PEA prepared by AECOM • GMEs conducted by ERM, for the Clyde Refiner • AutoNexus ESA prepared by ERM

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Document Status" 2127799 Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan – 2 Durham Street, Rosehill, NSW – Interim Audit Advice 01".

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Final	D. Balbachevsky	A. Kohlrusch		A. Kohlrusch		22/01/2019

4 July 2019

Adam Speers
Viva Energy Australia Pty Ltd
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Our ref: 2127799/IAA02
Your ref:

Dear Adam

Former Clyde Refinery - Western Area
Interim Audit Advice - 02 (Sampling and Quality Plan)

1 Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) has been engaged by Viva Energy Australia Pty. Ltd (Viva Energy) to provide NSW Environment Protection Authority (EPA) accredited Site Auditor services in respect of review of environmental documentation pertaining to the Former Clyde Refinery - Western Area located at 2 Durham Street, Rosehill on the Camellia Peninsula, NSW.

GHD understands that a large part of the south western portion of the former refinery is no longer required for operational purposes. Thus, Viva Energy is proposing to remediate this (Western Area) to facilitate future development under the existing zoning classification (IN3 – Heavy Industrial).

This interim audit advice (IAA) provides comments on the following report:

- ERM (2019), *Clyde Western Remediation Project – Remediation Site Investigation – Sampling and Quality Plan (SAQP)* dated 28 June 2019 (the **SAQP**).

The SAQP has been compared to the requirements of guidelines endorsed by NSW EPA under the *Contaminated Land Management Act 1997*, including but not limited to the NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* and NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme*.

2 Background

Viva Energy operates the Clyde Terminal, where refinery and fuel distribution activities have taken place since the 1920s.

The Terminal operations primarily comprised the receipt and refining of crude oil and finishing product piped from the Gore Bay terminal until cessation of refining activities in 2012. Since the cessation of refining operations in 2012, the site has been utilised as a Terminal, which primarily involves the receipt, storage and distribution of finished petroleum products (ERM, 2019).

The auditor understood that Viva intends to remediate a 40-hectare within the south western portion of the Terminal to enable future commercial / industrial land use. Due to the scale of remedial works, the project was declared State Significant Development (SSD).

A Conceptual Remedial Action Plan (RAP) was prepared by AECOM to support the SSD application under *Part 4 of the Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) for the

remediation project. The key elements and differences between Conceptual RAP and the future Detailed RAP are presented below:

Scope	Conceptual RAP	Detailed RAP
Set remediation goals that ensure the remediated area would be suitable for the proposed use and would pose no unacceptable risk to human health or to the environment.	✓	✓
Identify the necessary approvals and licences required by regulatory authorities.	✓	✓
Provide information on the nature and extent of impact based on the available data.	✓	✓
Preliminary remediation options assessment: Evaluate remedial techniques and/or management measures that are required to reduce risks to acceptable levels for the proposed land use of the Western Area.	✓	Not applicable
Identify remaining nature and extent of impact data gaps, where additional works are required.	✓.	Not applicable
Nature and extent of impact following data gap investigation.	Not applicable	✓
Remediation options assessment: Finalise decision on role of shortlisted remediation techniques (i.e. refinement of relative role of the techniques already shortlisted) and management measures that are required to be implemented to reduce risks to acceptable levels for the proposed land use of the Western Area, protecting human health and the environment.	×	✓
Finalised remediation plan and methodology (Remedial Design). Preparation of a detailed remediation design to inform contractor specification for the remediation.	×	✓
Remedial Site Investigation (RSI) to address identified data gaps and confirm current in-situ remediation volume estimates.	×	✓
Preparation of a Human Health and Ecological Risk Assessment (HHERA) (including the RSI data) to derive risk-based validation criteria for the remedial works to ensure the remediation has been executed to the appropriate standard to mitigate future risk to human health or the environment.	×	✓
Contingency measures should the remediation not succeed at meeting the remediation objectives.	✓.	✓

After a review of the Conceptual RAP, the auditor issued on 22 January 2019 IAA01, which concluded that the Conceptual RAP contained many of the details required for a RAP as outlined in the *Consultant Guidelines*.

However, it was noted in the IAA01 that additional remedial site characterisation and completion of a Human Health and Ecological Risk Assessment (HHERA) would be required prior to finalisation of the Detailed RAP.

The NSW EPA on 6 March 2019 issued a Notification letter, documenting a number of comments and/or requirements regarding the Conceptual RAP.

As recommended in the IAA01, a remedial site investigation (RSI) have been proposed. The SAQP will be discussed in Section 3 of this IAA.

3 SAQP summary

The objectives of the SAQP prepared by ERM were as follows:

- Refinement of LNAPL and TRH vertical and lateral extent of contamination.
- Pre-validation of low risk areas to potentially exclude from remediation and/or management activities.
- Characterisation of the nature and extent of impacts of buried waste areas.
- Characterisation of drainage and subsurface infrastructure.
- Assessing the adequacy of the current on-site wastewater treatment plant (WWTP) for treatment of water/leachate from remediation areas.
- Characterisation of non-petroleum contaminants of potential concern (CoPCs) to determine appropriateness of remediation methodology and/or management.
- Collect data to support the HHERA and development of risk-based Site Specific Target Levels (SSTLs) for remediation.
- Collect data from proposed remediation areas to assist with technical specification development for remediation contractors.

3.1.1 Contaminants of potential concern

ERM based on the scope in the SAQP existing data from historical investigation works. The following table presents the sources:

CoPCs	Sources / impacted area
LNAPL	• Former Process Area East - in the vicinity of the former 'Catalytic Cracker Unit' and 'Gas Stream' Plants, 'Hydro-blasting area' and Substation 24. • Former Process Area west. • Tank Farm J. • Within and south of Tank Farm A1 and A2. • Immediately south of Platformer 3. • Former Autonexus leased area - associated with buried waste. • Within the vicinity of former laboratory area and Substation 9 to the south of the site.

CoPCs	Sources / impacted area
• Total Recoverable Hydrocarbons (TRH) • Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)	ERM stated that the sporadic occurrence and limited extent of impacted soil and groundwater across the site cannot be clearly linked to a specific sources, but rather tend to be co-located with process areas and Tank Farms. Observed conditions do not form a simple plume as might be expected from a subsurface release or single point spill, but reflect a site that has been subject to a number of identified and unidentified release events, which have occurred at various locations, over an extended period of time.
• Polycyclic Aromatic Hydrocarbon (PAHs) • Phenols	Soil exceedances for PAHs, in particular, benzo(a)pyrene (BaP) have been identified generally along the western boundary of the site and were considered attributable to fill materials. Naphthalene concentrations in groundwater have exceeded ecological screening values, but have been delineated to isolated areas, including Process East, Process West, and adjacent Tank Farm A1 and within the former Autonexus leased area.
Polychlorinated Biphenyls (PCBs)	While PCBs have not been identified within soil or groundwater at the site, the potential for the use of PCBs containing transformer oils within former substations and transformer yards is likely based on the site history. Areas of transformer use were distributed across the site. Due to the propensity of PCBs to bind to soil particles, and very low solubility impacts to groundwater from PCBs are considered unlikely.
Per- and poly- fluoroalkyl substances (PFAS)	ERM stated that limited PFAS analysis was carried out across the site. Potential point sources of PFAS impacts included the former location of Tank 24 and the Fire Station. PFAs groundwater concentrations impacts exceeding the current screening levels for off-site recreational users of the Duck River and Ecological direct contact have been reported in the north east portion and along the southern boundary of the site. Due to the highly leachable and persistent nature of PFAS, appropriate characterisation of PFAS in soils will be required to identify restrictions associated with the remediation approach for hydrocarbon based CoPCs.
Metals (lead and hexavalent chromium)	Concentrations of metals in soils have generally been reported below relevant site screening levels, with only elevated concentrations of lead and chromium identified within fill material from buried waste areas toward the south of the site.

CoPCs	Sources / impacted area
	ERM noted that investigation works undertaken in 2014 concluded that the Tetra-Ethyl lead plant was not a significant source and as such TEL is not considered primary CoPC. Concentrations of metals in groundwater have been reported across the site in excess of ecological screening values for lead, copper, nickel and zinc. Concentrations of hexavalent and trivalent chromium have also been reported in isolated portions of the site and are interpreted to be attributed to leaching from historically imported fill material across the wider Camellia Peninsula.
Asbestos	Former buildings and above ground refinery infrastructure containing asbestos have been removed since 2012. Asbestos has been identified in the form of bonded chrysotile asbestos fragments within fill materials in four samples collected across the western area.
Dioxins: polychlorinated dibenzo-para-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and dioxin-like PCBs	Dioxin concentrations were identified in soils associated with the southern Buried Waste Area, which are likely associated with process waste sludge buried from crude oil alkylation processes. Preliminary calculation of Dioxin Toxicity Equivalence Factors (TEF) and screening against relevant US EPA Regional Screening Levels indicated soil concentrations within this area of the site were within one order of magnitude of commercial / industrial criteria.

Note: Extracted from ERM, 2019 - SAQP

3.1.2 Data gap assessment

ERM stated that based on a review of available information, including the current Conceptual Site Model (CSM) and the Conceptual RAP, the following data gaps have been identified, which will be addressed by the RSI.

Data gap / Investigation area	Scope of works
Buried Waste Areas - southern	25 test pits. 16 Test pits will be sampled (two samples per location). Four additional sampling locations will be targeted at specific a LNAPL area identified near the down gradient site boundary. An additional nine locations will be excavated, logged and field screened with no laboratory analysis proposed at this stage to determine the consistency of buried waste material. Samples will only be analysed if material from these test pits is deemed visually inconsistent with surrounding locations.
Tank Farms A1, A2 and A3	Seven test pits; two samples per location (14 samples).

Data gap / Investigation area	Scope of works
Tank Farm C	Two test pits; two samples per location (four samples).
Substation Areas and Transformer Yards (Sub 9, Sub west of former cooling tower, sub 7 and sub 23)	11 test pits; 1 sample per location (11 samples).
Pipe track areas	Seven test pits; two samples per location (14 samples).
Water management investigation	Groundwater influx (recharge rates), including any change with depth (pressure gradients). Groundwater contaminant loading (both physical and chemical). Including any change in water quality and influence of free-phase product. De-watering and treatment throughput requirements (ERM notes that this is also dependent on excavation methodology by contractor). Review and utilise existing slug test data from representative areas of the site. Perform additional slug tests on up to 4 existing groundwater wells, to fill gaps in areas of the site that may be subject to remedial excavation works (such as former process areas). ERM to perform test-pit re-charge test on 6 test-pits, located in representative areas of the site. Collection of water samples of groundwater inflow into excavations at each water management investigation test pit to better understand the groundwater characteristics and determine future treatment requirements.
Soil vapour investigation	Review of soil and groundwater data to determine up to 10 locations for target vapour well installation and sampling.
MNA sampling	Collection of groundwater samples from up to 15 monitoring wells. A minimum of two additional rounds of MNA data (post detailed RAP) is recommended to justify the ongoing justification of MNA as a groundwater management strategy for the site.

Note: Extracted from ERM, 2019 - SAQP

The preliminary CSM presented in the SAQP provided an appropriate framework for identifying the potential sources of contamination and how potential receptors may be exposed, either during or at the completion of the remedial activities.

ERM stated that the exposure pathways identified for human health within the site were both direct and indirect, and consisted of the following:

- Dermal contact, dust inhalation and/or ingestion of contaminated soil, sediment and/or surface water in on-site environments by on-site workers, contractors or intrusive maintenance workers.
- Exposure to vapours derived from hydrocarbon impacted soil and/or sediment in on-site environments.
- Generation and pooling of ground gases to present an explosive hazard.

ERM concluded that although a number of exposure pathways for on-site receptors have been established, the source-pathway-receptor (SPR) linkages were considered incomplete due to current Viva Energy HSE controls. However, under a future commercial / industrial land development scenario, the above-discussed pathways would be considered complete without the implementation of a long term management plan (LTMP) and/or remediation.

Current monitoring of groundwater along the boundary of the site indicated that no off-site migration of impacted groundwater is occurring at levels that could potentially cause risk to the identified environmental/ecological receptors, with the exception of PFAS. ERM noted that the site's contribution of PFAS to the adjoining river systems via discharge from the on-site drainage system is currently unknown due to no available PFAS sampling data and represents a data gap.

4 Auditor review and comments

The auditor acknowledges that the SAQP largely complied with the guidelines identified in Section 1, however, there are some matters presented in Table 1 (attached) that needs to be clarified.

5 Auditor conclusions

It is the auditor's opinion that the SAQP prepared by ERM will largely address the NSW EPA requirements, the data gaps previously identified and will support the HHERA and the Detailed RAP.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely
GHD Pty Ltd

Andrew Kohlrusch
NSW EPA Accredited Auditor
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Appendix C CSM

Table 7.1 Tier 2 CSM Summary

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-1 Old Administration Area	Primary source areas within AEC-1 included former administration buildings and the former substation (11) which has been decommissioned / removed. Potential sources of contamination are considered to be limited to on-site burial of fill materials. CoPCs assessed included: ■ TRH C6-C40 ■ Metals ■ PAH ■ Phenols ■ Asbestos (fill) PFAS (groundwater only)	Soil ■ Asbestos (ACM)	■ Inhalation of dusts or potential asbestos fibres from isolated ACM impacted soils (TP19/01) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-2 Buried Waste Area 8 – CDU tank farm sludge	Primary sources within AEC-2 include buried waste materials associated within the CDU tank farm sludge that at the time of this RSI remain in-situ. CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PAH ■ Phenols.	Soil ■ LNAPL	■ No exceedances of tier 1 screening criteria are noted for this AEC; ■ Based on the observed presence of LNAPL within the soil profile at TP18/29 within this AEC, aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-3 Southern Contractor Area	Potential historical sources of impacts which have been decommissioned / removed from AEC-3 included: ■ sample store; ■ laboratory; ■ storage and handling of AFFF products around the former location of Tank 24 and the Former Fire Station area; ■ contractor warehouse; ■ workshop area; ■ Epoxy resins Plant Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PAH ■ Phenols ■ VOC/SVOC. ■ Asbestos Specific to the Epoxy resins plant area: ■ Epichlorohydrin ■ bisphenol-a (BPA) ■ SVOC, VOC. Specific to the Fire Station area: ■ PFAS	<u>Soil</u> ■ LNAPL ■ TRH C6-C10 (F1) ■ Asbestos (ACM) ■ Carcinogenic PAHs <u>Groundwater</u> ■ LNAPL <u>Soil Vapour</u> Former contractor warehouse (SV19/03) ■ TRH >C8-C10 Aliphatic; ■ TRH >C10-C12 Aliphatic; ■ Naphthalene; ■ Methane Former Laboratory Area (SV19/05) ■ TRH >C6-C8 Aliphatic; ■ TRH >C8-C10 Aliphatic; ■ TRH >C8-C10 Aromatic; ■ Benzene; ■ Naphthalene; and ■ Methane	■ Inhalation of vapours from hydrocarbon impacted soil, groundwater and LNAPL by future on site commercial workers in indoor air; ■ Inhalation of dusts or potential asbestos fibres from isolated ACM in soils (TP19/32) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Direct contact or ingestion of soils impacted with carcinogenic PAHs (TP19/16) or TRH C16-C34 fractions by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater within this AEC, and elevated LEL/ methane readings in soil vapour there is potential for pooling of ground gases within future excavations in the former contractor warehouse and laboratory areas. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-4 Southern Buried Waste Area	Primary sources within AEC-4 include buried waste materials that at the time of this RSI remain in-situ. CoPCs assessed included: ■ LNAPL ■ TRH ■ C6-C40 ■ BTEXN ■ Metals ■ PAH ■ Phenols ■ SVOC ■ pH (associated with acids) ■ Dioxins ■ PFAS ■ Asbestos	Soil ■ LNAPL ■ TRH C6-C40 ■ Benzene ■ Asbestos (ACM and fibres within fill) ■ Metals (hexavalent chromium) Groundwater ■ LNAPL	■ Indoor inhalation of vapours by future commercial/industrial workers (benzene, TRH C6-C10 (F1) fractions) from LNAPL and hydrocarbon impacted soil; ■ Inhalation of dusts or potential asbestos fibres from ACM and asbestos fibres in soils during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Direct contact or ingestion of impacted soils (TRH >C10-C16 (F2) Fraction, TRH >C16-C34 Fraction, carcinogenic PAHs, hexavalent chromium), by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this AEC.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-5 Platformer 3	■ Primary sources areas within AEC-5 (platformer 3) have been decommissioned / removed. ■ Secondary sources include subsurface soils/groundwater containing LNAPL CoPCs assessed included: ■ LNAPL ■ TRH ■ C6-C40 ■ BTEXN ■ Metals ■ PAH ■ Phenols	Groundwater ■ LNAPL	■ No exceedances of tier 1 screening criteria are noted for this AEC; Based on the observed presence of LNAPL within groundwater at MW/11/17 within this AEC, aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-6 Buried Waste – Ex Solvents Plant	■ Primary sources within AEC-6 include the former cooling tower and bio-treatment facility and buried waste materials associated that at the time of this RSI remain in-situ. ■ Secondary sources include subsurface soils containing LNAPL CoPCs assessed included: ■ LNAPL ■ TRH ■ C6-C40 ■ BTEXN ■ Metals ■ VOC	Soil ■ LNAPL ■ Asbestos (potential ACM in adjacent stockpiles)	■ Inhalation of dusts or potential asbestos fibres from isolated ACM impacted stockpiles within this AEC during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the isolated presence of LNAPL within the soil profile at TP18/32 within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-7 Pipe Track Areas	■ Secondary sources within AEC-7 include former surface spills from transfer of product within pipework during former refinery operation, some disused pipe track infrastructure that at the time of this RSI remained in-situ. CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PAH ■ Phenols ■ SVOCs ■ pH (associated with acids) ■ dioxins ■ PFAS	■ No COPCs exceeding adopted tier 1 screening criteria	■ No potential SPR linkages were identified during the investigation	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-8 Tank farm J	■ Primary sources areas within AEC-8 included former fuel storage infrastructure, which has been decommissioned / removed. ■ Secondary sources include subsurface soils containing LNAPL CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ PFAS	Soil ■ LNAPL	■ Based on the isolated presence of LNAPL within the soil profile at TP18/31 within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this area.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-9 Process West	■ Primary sources areas within AEC-9 included former fuel processing infrastructure, which has been decommissioned / removed . ■ Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PCB ■ PFAS ■ Dioxins	Soil ■ LNAPL ■ TRH C6-C10 (F1) ■ naphthalene Groundwater ■ LNAPL ■ TRH C6-C10 (F1) ■ naphthalene Soil Vapour ■ TRH >C8-C10 Aliphatic fractions; ■ TRH >C8-C10 Aromatic fractions; and ■ naphthalene.	■ Indoor inhalation of vapours by future on site commercial workers from hydrocarbon impacted soil, groundwater and LNAPL; ■ Based on the observed presence of LNAPL within soil and groundwater within this AEC (MW12/16, TP19/47), the potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-10 Process East	■ Primary sources areas within AEC-10 included former fuel processing infrastructure which has been decommissioned / removed ■ Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PCB ■ PFAS ■ Dioxins	Soil ■ LNAPL Groundwater ■ LNAPL ■ TRH C6-C10 (F1) – associated with LNAPL	■ Indoor inhalation of vapours by future on site commercial workers from LNAPL; ■ Based on the observed presence of LNAPL within soil and groundwater within this AEC, the potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified.
AEC-11 Tank farms A1, A2, A3	■ Primary sources areas within AEC-11 included fuel storage infrastructure, which at the time of this RSI remain onsite. ■ Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PCB ■ PFAS ■ Dioxins	Soil ■ LNAPL	■ Based on the observed presence of LNAPL within soil within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-12 Tank farm C	■ Primary sources areas within AEC-12 included fuel storage infrastructure, which at the time of his RSI remain onsite. ■ Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PCB ■ PFAS ■ Dioxins	Soil ■ LNAPL ■ TRH C6-C10 (F1)	■ Inhalation of vapours (TRH C6-C10 (F1) fractions) by future on site workers from hydrocarbon impacted soil, groundwater and LNAPL in indoor air; ■ Based on the observed presence of LNAPL within soil within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified.
AEC-13 Substation Areas and Transformer Yards	■ Primary sources areas within AEC-13 include former substation infrastructure, which has been decommissioned / removed. Substation areas assessed include substation and transformer footprints, as identified on Figure 6. ■ Substations 9 and 23 were unable to be sampled due to their ongoing operation at the time of the investigation. CoPCs assessed included: ■ BTEXN ■ Metals ■ PCB	Soil ■ Asbestos (fill)	■ Inhalation of dusts or potential asbestos fibres from disturbance of isolated ACM impacted soils (TP19/52) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks	■ No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-14 Subsurface drainage network	■ Primary sources areas within AEC-14 include subsurface drainage infrastructure, which at the time of this RSI remains in-situ. ■ Secondary sources include subsurface soils containing LNAPL and surface materials potentially impacted with PFAS CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PAH ■ Phenols ■ SVOC ■ pH (associated with acids) ■ Dioxins ■ PFAS ■ Asbestos	■ No COPCs exceeding adopted tier 1 screening criteria	■ Based on field observations and results of the RSI and previous investigations, no potentially complete pathways have been identified	■ No potentially complete SPR linkages to ecological receptors identified.
AEC-15 General Site Areas (not covered within other AECs)	■ Primary sources areas within AEC-15 include a range of former processing and fuel storage infrastructure, which has been removed. ■ Secondary sources include subsurface soils containing LNAPL CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ Metals ■ PAH ■ Phenols ■ Asbestos (fill)	Soil ■ LNAPL ■ Asbestos (ACM in fill)	■ Potential acute hazards from the pooling of hazardous ground gases from LNAPL and impacted soil by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Inhalation of dusts or potential asbestos fibres from isolated ACM in soils (MW11/14) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.	■ No potentially complete SPR linkages to ecological receptors identified.

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Document Status - Final

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft	D Balbachevsky	A Kohlrusch	-	A Kohlrusch		14/02/2020
Final	D Balbachevsky	A Kohlrusch	-			

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24 June 2021

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Clyde Western Area Remediation Project – Stage 2 Area, Interim Audit Advice (IAA) 14 – Review of Stage 2 Air Emission Verification Report

Dear Adam

1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) was commissioned by Viva Energy Australia Pty Ltd (Viva Energy) to conduct an environmental site audit of the Western Area of the former Clyde Refinery (the Western Area Remediation Project or WARP). The WARP is located at Durham Street, Rosehill, on the Camellia Peninsula. Viva Energy is in the process of delivering the WARP to facilitate future commercial and/or industrial development under the existing land use zoning (IN3 – Heavy Industrial).

This interim audit advice (IAA) letter has been prepared following a review of the following report prepared by Environmental Resources Management Australia Pty Ltd (ERM):

– Clyde Western Area Remediation Project, Stage 2 Air Emission Verification Report, dated 11 June 2021 (the **Stage 2 AEVR**).

The Stage 2 AEVR is a requirement of Condition of Consent B15 for SSD 9302 for the WARP as issued by the Department of Planning, Industry and Environment (7 May 2020). In brief, the Stage 2 AEVR presents an evaluation of the contaminants of concern that are to be remediated in Stage 2 of the WARP (see Section 2), the potential for the release of chemicals that could affect air quality during remedial works and what measures are needed to manage and monitor the presence of chemicals liberated into the atmosphere during remedial works.

In reviewing the Stage 2 AEVR, the auditor also considered information and findings presented in the following documents:

– ERM (2020a). Clyde Western Area Remediation Project, Human Health and Ecological Risk Assessment, dated 16 February 2020 (**the HHERA**).
– ERM (2020c). Clyde Western Remediation Project, Air Emissions Verification Report, dated 17 July 2020 (the **Stage 1 AEVR**).
– ERM (2021a). Clyde Western Area Remediation Project – Supplementary Site Assessment – Southern Buried Waste Area (AEC-4), dated 07 June 2021 (the **AEC-4 ESA**).
– ERM (2021b). Clyde Western Area Remediation Project – Stage 2 Environmental Site Assessment, dated 30 April 2021 (draft) (the **Stage 2 DSI**).

A draft version of the Stage 2 AEVR, dated 24 May 2021, had been earlier reviewed by the auditor, who issued comments in an audit project tracking sheet. A copy of this tracking sheet will be incorporated in the

Stage 2 RAP Site Audit Report (SAR) that will be issued to meet condition B15 of the State Significant Development (SSD 9302).

The purpose of this audit advice is to comment on whether the Stage 2 AEVR (where relevant) was prepared in a manner consistent with NSW Environment Protection Authority (EPA) made or endorsed guidelines. The EPA guidelines include the NSW EPA (2020) *Guidelines for Consultants Reporting on Contaminated Sites* (the Consultant Guidelines) and the NSW EPA (2017) *Guidelines for the NSW Site Auditor 3rd Scheme* (the Auditor Guidelines).

2. Background information

2.1 Remediation stages

The remedial works and subsequent validation program for the WARP are proposed to be completed in three stages as follows:

- Stage 1 – Former Process West
- Stage 2 – Former Utilities and Movements
- Stage 3 – Former Process East

The WARP and remediation Stages are shown in **Figure 1** (extracted from the Stage 2 DSI).

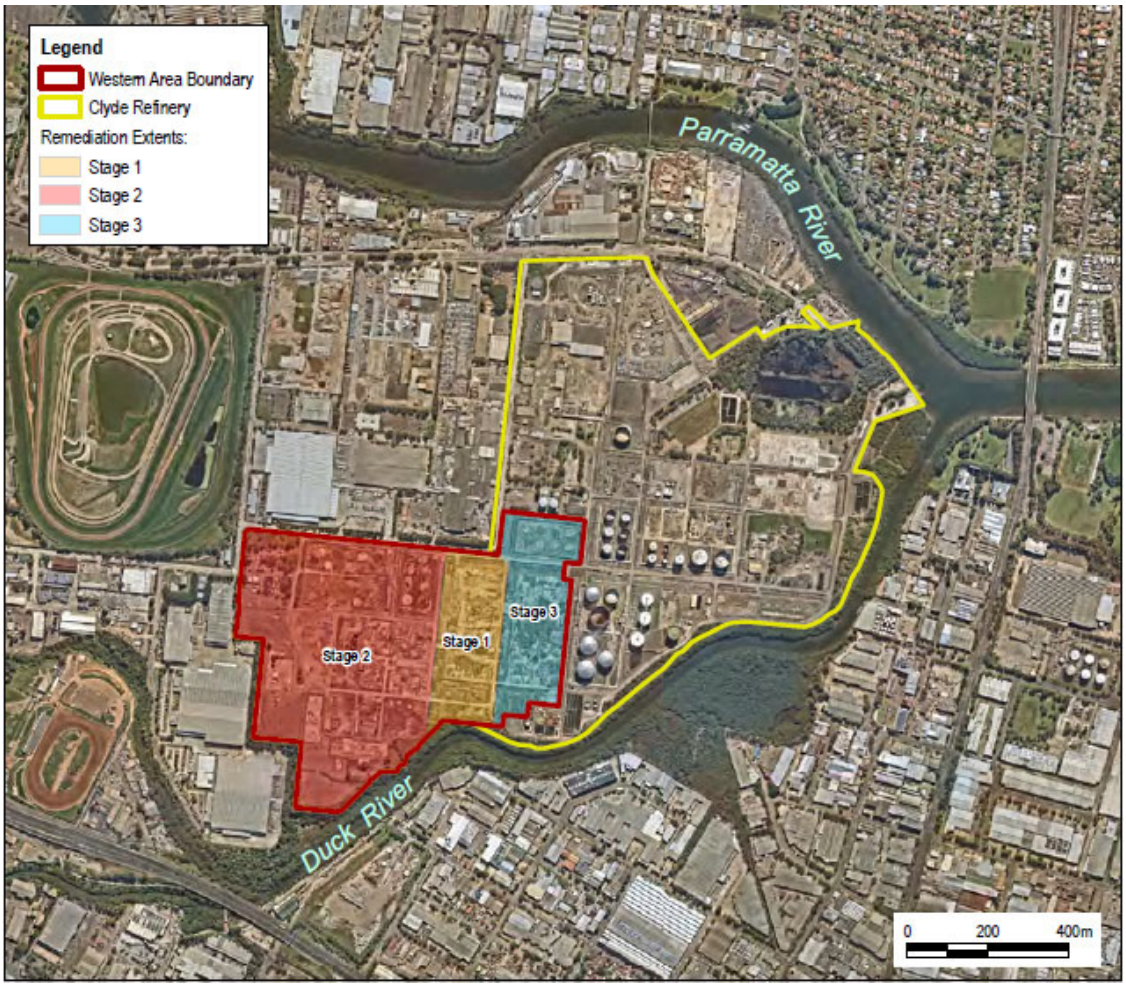

Figure 1 WARP and Remediation Stages Areas

The auditor notes that the staged remediation approach was accepted by the NSW Department Planning Industry and Environment (DPIE) on 3 June 2020 as follows:

– *The Department notes Viva Energy Australia proposes to remediate the Western Area in three stages and would submit management plans required in the development consent for each stage of the remediation works. These include but are not limited to the Detailed Remediation Action Plan, Air Emissions Verification Report and Remediation Environmental Management Plan.*
– *The Department also notes the Site Audit Reports, Statements and Validation Reports would be delivered in three stages. The Department has carefully reviewed the Staging Plan and is satisfied with the proposed approach. Accordingly, the Planning Secretary has approved the Staging Plan, dated 19 May 2020.*

2.2 Stage 1 Area remediation

The Stage 1 remedial works and subsequent validation program were carried out under ERM supervision between October 2020 and February 2021.

The Stage 1 Area remediation comprised the excavation of approximately 4,763 m^3 of shallow soils (generally to a depth of 1.5 metre below ground level) impacted by petroleum hydrocarbons and LNAPL from the Area of Environmental Concern (AEC) 9 – as outlined in the Stage 1 RAP. **Figure 2** extracted from the Stage 1 RAP shows the Stage 1 Area and AEC-9.

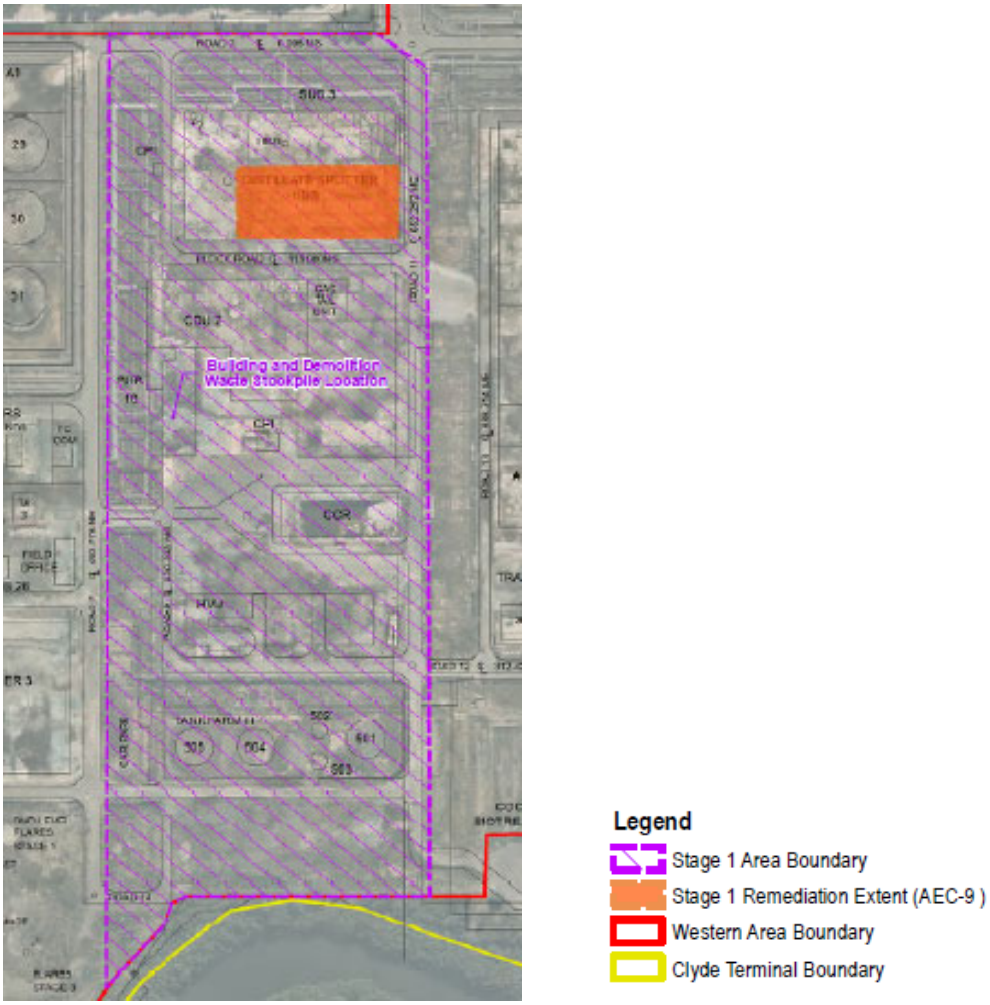

Figure 2 Stage 1 Area and AEC-9

Stockpiles of material from the AEC-9 excavation were characterised for on-site re-use or on-site treatment via biopiling on the adjacent Stage 2 Area. ERM completed validation sampling of the walls and base of the excavation areas before the area was backfilling in accordance with the Stage 1 RAP. An estimated volume of 12 022 tonnes of Virgin Excavated Natural Material (VENM) was imported to backfill the AEC-9 excavation.

Approximately 51% of excavated soils from AEC-9 required on-site treatment. Active biopiling of these materials was carried out over nine weeks under supervision of ERM. During the biopiling and as part of the Stage 1 Area remediation, ambient air quality and soil vapour extraction (SVE) emission monitoring events were completed by ERM as per the Stage 1 AEVR to meet the Conditions of Consent B15 of SSD 9302. The information was issued to the NSW EPA on a weekly basis, the key findings of which are discussed in the following section of this interim audit advice.

The auditor issued Site Audit Statement (SAS) no 043/2127799 on 18 February 2021, attesting the suitability of the Stage 1 Area for commercial/industrial land uses subject to compliance with a passive Long-Term Environmental Management Plan (LTEMP). Currently, the Stage 1 Area is under development by Downer EDI Works Pty Ltd (Downer).

2.3 Review of Stage 1 AEVR data

During the remedial works conducted in Stage 1 Area, the following data was collected as part of the monitoring program presented in the Air Emissions Verification Report (submitted to DPIE in accordance with the SSD 9302 conditions of consent B15).

The auditor considered the nature of the contaminants encountered during the Stage 1 Area remedial works and those that are likely to be encountered during Stage 2 Area remedial works in evaluating the appropriateness of the Stage 2 AEVR. In addition, the auditor notes that ERM during the preparation of the Stage 2 AEVR has considered the NSW EPA comments following review of Stage 1 AEVR in Notification DOC20/444311-5 dated 3 July 2020, as well as the Responses to the NSW EPA – Stage 1 AEVR prepared by ERM, dated 15 July 2020.

Photo-ionisation Detector (PID) monitoring

This monitoring provided real-time information on the VOC emissions during soil handling works and relevant response measures. The application of these measures was documented within an Air Quality Performance Report (AQPR) submitted each week to the NSW EPA during the Stage 1 remedial works. The following was noted regarding the PID monitoring:

– PID measurements were below 1 ppm for much of the works, and were highest between 19 and 23 of October 2020, with maximum daily work area concentrations ranging between approximately 3 ppm and 7 ppm during this period.

Boundary VOC monitoring

Boundary monitoring was undertaken to provide assurance of the efficacy of PID monitoring in gauging potential off-site air ambient VOC impacts. The following was noted regarding the boundary VOC monitoring:

– Of the 64 TO-15 analytes reported by the laboratory, results above the Limit of Reporting (LOR) were limited to toluene, xylenes, 1,2,4-trimethylbenzene and naphthalene. Detections above the LOR were all than less than the respective screening criteria. In addition, the maximum toluene detection, was significantly higher than the corresponding at-source sample and ERM attributed this measurement to be indicative of an external toluene source and not associated with the Stage 1 Area remedial works.

Biopile Soil Vapour Extraction (SVE) system monitoring

Air quality monitoring at the biopiles was undertaken in accordance with the Stage 1 AEVR and the Environment Protection Licence (EPL) requirements. This task included daily monitoring of exhaust concentrations (Monday to Friday) and weekly reporting of monitoring data and operational data. The following was noted with regard the system operation:

- Inlet concentrations were observed to decrease rapidly in the first week of treatment, prior to a more progressive decrease across the duration of the biopile treatment program.
- Treatment capacity was observed to be consistent with breakthrough estimates. Change out of carbon filter media in the lead vessel was not required, nor was implementation of a contingency vessel.
- VOC concentrations at the outlet of the lead vessel were less than or equal to 0.1 ppm for the duration of the biopile treatment program, demonstrating there was no breakthrough of VOCs from the lead to the lag vessel.
- VOC concentrations at the EPL discharge points were less than or equal to 0.1 ppm for the duration of the biopile treatment program.
- Ambient VOC concentrations in close proximity to the biopile covers were indicative of negligible fugitive VOC emissions from the covered biopiles. This situation was observed irrespective of the operating condition of the SVE system, as demonstrated by the monitoring conducted during the Christmas shutdown period – which was not dissimilar to measurements made during system operation.

Based on the summary of Stage 1 AEVR results, the auditor considers that the air emission monitoring conducted during the Stage 1 Area remediation largely followed the Stage 1 AEVR report and EPL requirements. Air emissions of VOCs associated with the Stage 1 Area contamination (which is similar in type – long chain hydrocarbons – and magnitude to the contamination in the Stage 2 Area) were less than the nominated respective screening criteria during excavation and biopiling and did not warrant implementation of any contingency measures.

3. Auditor review and commentary

3.1 Stage 2 Remediation – Proposed works

The Stage 2 Area covers an area of approximately 28 hectares and is situated within the former utilities and movements areas.

Based on the HHERA (ERM, 2020a) and most recent assessment results from the AEC-4 ESA (ERM, 2021a) and Stage 2 DSI (ERM, 2021b), refinement of the Stage 2 remediation approach has demonstrated that the volume and extent of remedial areas will be less than initially presented in the EIS. Remediation for the Stage 2 Area will take place at a number of discrete areas of concern, namely AEC-1, AEC-2, AEC-3a, AEC-3b, AEC-3c, AEC-3d, AEC-4, AEC-5, AEC-8, AEC-11 and portions of AEC-7, AEC-13, AEC-14a, AEC-14b, and AEC-15.

Three different remediation methods have been selected for the AECs as follows:

1. Excavation and off-site disposal of asbestos-containing material (ACM) impacted soils from AEC-1 and AEC-3b, comprising 0.3% of the Stage 2 Area.
2. Excavation and on-site treatment (biopiling) of petroleum hydrocarbon and LNAPL impacted shallow soils from AEC-3a, AEC-3d, AEC-3e, AEC-14a, and AEC14b using a similar remediation approach applied in Stage 1. Excavation would occur sequentially across these AEC's, which together only comprise 1.3% of the Stage 2 Area. The auditor notes that the proposed excavation volume and extent is similar in scale to that completed for the Stage 1 Area.
3. Construction of an engineered capping layer at AEC-4 to a maximum depth of 0.5 m below existing grade, comprising approximately 5% of the Stage 2 Area.

Based on the HHERA and updated CSM that included data from the Stage 2 DSI and AEC-4 ESA, the following AECs, namely 2, 3c, 5, 8, 11 and part of AECs-7, 13 and 15 will have residual petroleum hydrocarbons and LNAPL impacts in groundwater managed through long term environmental management plans (LTEMPs).

The AECs included within Stage 2 Area that requires remediation are presented in **Figure 3** (from the Stage 2 RAP).

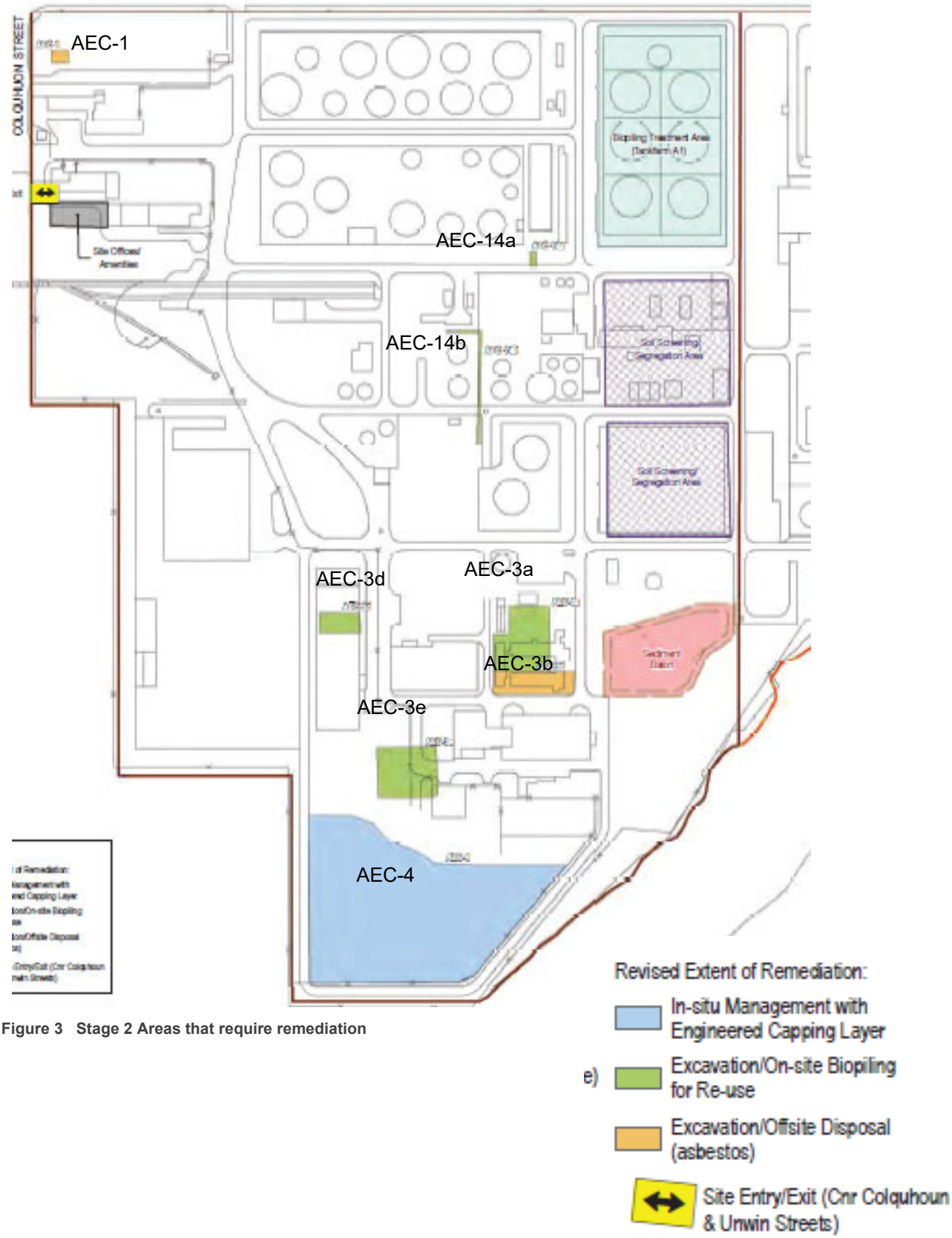

Figure 3 Stage 2 Areas that require remediation

3.2 Stage 2 AEVR review

The Stage 2 AEVR discussed the factors that need to be considered in relation to air emission management during the Stage 2 Area remediation. In preparing the Stage 2 AEVR, ERM took into consideration the results of monitoring of volatile chemicals conducted during remedial works of petroleum hydrocarbon impacted material and subsequent biopiling of the Stage 1 Area (specifically at AEC-09).

3.2.1 Air emission characterisation

Based on the review of data presented in the Stage 2 AEVR, the auditor concurs that the contamination in Stage 2 Area is similar to the hydrocarbons remediated in the Stage 1 Area, the key VOCs in the Stage 2 Area being:

- Ethylbenzene
- Xylenes
- Trimethylbenzenes
- Naphthalene

The auditor notes that although benzene concentrations were detected in-situ in soil vapour, soil and groundwater samples in Stage 2, benzene was not detected in ambient air measurements in the immediate vicinity of either excavation, stockpiling or biopiling operations during Stage 1 remedial works. It would be expected that this situation will also occur during Stage 2 remedial works given the types and concentrations of chemicals of concern.

Hydrocarbon odours similar in nature to diesel oil were noted during the excavation process during Stage 1 remedial works. However, these odours were not observed beyond 165 metres from the excavation. The auditor notes that the potential for odours will need to be managed as part of the Stage 2 operations as per the Stage 2 RAP.

In regards of ACM removal within AEC-1 and AEC-3b, the auditor notes that impacted soils are to be removed in accordance with the SafeWork NSW Code of Practice for asbestos removal.

3.2.2 Air emission control review

A range of emission controls was considered based on those identified in best practice references and the factors associated with the remediation of each AEC (the maximum extent where active remediation will take place being 1 580 m^2 at AEC-3a, less than the area at AEC-9 remediated in Stage 1 Area – including the depth of excavation (maximum depth of two metres and average of 1.3 metres), the proposed progressive excavations work, and the extensive data set of monitoring results from the Stage 1 Area remediation. Other factors that were considered included the proximity to other receptors, duration and intensity of the proposed activity, as well as the practicality with which contingency measures can be implemented and managed during the Stage 2 Area remediation.

Taking all these factors into account, ERM concluded that no emission control system is required for the Stage 2 remedial works. ERM did recommend suitable air quality management protocols to monitor performance indicators to demonstrate that the nominated emission controls are being operated effectively and that nominated trigger concentrations for the identified VOCs are not exceeded.

4. Conclusions

The auditor considered that key, relevant aspects of Condition of Consent B15 of SSD 9302 have been taken into account in preparing the Stage 2 AEVR. The auditor concurred that the evaluation of the types (and concentrations) of chemicals that might be presented in soils that are to be remediated was completed in a manner consistent with the requirements of the AEVR and standard industry practice. ERM's assessment of the type of chemicals, extent of the AECs, proposed progressive excavation by AECs, and robust data obtained from the Stage 1 Area remediation demonstrate that the air emissions management protocols that have been nominated are appropriate.

The auditor considers that the air quality management protocols considered by ERM in the Stage 2 AEVR are sufficient to monitor and control air emissions during the remediation of the Stage 2 Area.

Nevertheless, the auditor notes that ERM during the preparation of the Stage 2 AEVR has considered the NSW EPA comments following review of Stage 1 AEVR in Notification DOC20/444311-5 dated 3 July 2020, as well as the Responses to the NSW EPA – Stage 1 AEVR prepared by ERM, dated 15 July 2020.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely

Andrew Kohlrusch
NSW EPA and WA DWER accredited site auditor

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Our ref: 2127799/IAA15

22 July 2021

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Sydney NSW 2000

Clyde Western Area Remediation Project, Stage 2 Area - Interim Audit Advice (IAA) 15 – Review of Groundwater Monitoring and Management Plan

Dear Adam,

1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) was commissioned by Viva Energy Australia Pty Ltd (Viva Energy) to conduct an environmental site audit of the Western Area of the former Clyde Refinery. Environmental site investigations have identified that remediation of contaminated soils is required. The Western Area is located on the Camellia Peninsula at Durham Street, Rosehill, NSW.

As part of this audit, the auditor has reviewed the following reports:

– AECOM (2021). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan Groundwater Monitoring and Management Plan*, dated 21 July 2021 (the **GMP**).
– ERM (2021c). *Clyde Western Area Remediation Project - Groundwater Monitoring Program*, dated 14 July 2021 (the **GWMP**).

The review of the GMP is a condition of SSD 9302 (B22) which states in part that *prior to commencement of remediation works, the Applicant must prepare a GMP… to the satisfaction of the Site Auditor.* The auditor notes that the GWMP prepared by ERM is an attachment of the GMP where the scope of groundwater works and its rationale is discussed. Therefore, this report was also reviewed by the auditor.

In reviewing the document, the auditor also considered the information presented in the following documents:

– ERM (2021a). *Clyde Terminal – Quarter 4 (2019) Groundwater Monitoring Report*, dated 24 March 2021 (the **2021 Q4 GME**).
– ERM (2021b). *Clyde Western Area Remediation Project – Stage 2 Detailed Remediation Plan*, dated 9 July 2021 (the **Stage 2 RAP**).
– ERM (2020a). *Clyde Western Remediation Project, Remediation Site Investigation*, dated 7 February 2020 (the **RSI**).
– ERM (2020b). *Clyde Western Area Remediation Project, Human Health and Ecological Risk Assessment*, dated 16 February 2020 (the **HHERA**).
– DPIE[1] (2020). *Development Consent, File: SSD 9302*, dated 7 May 2020.

[1] DPIE - Department of Planning, Industry and Environment

– AECOM (2019). *Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan*, dated 21 January 2019 (the **Conceptual RAP**).

The purpose of this audit advice is to assess whether the GMP (including the GWMP) were prepared in a manner consistent with NSW Environment Protection Authority (EPA) made or endorsed guidelines. These guidelines included the NSW EPA (2020) *Guidelines for Consultants Reporting on Contaminated Sites* (the Consultant Guidelines), NSW (DEC) *Guidelines for the assessment and management of groundwater contamination* (the Groundwater Guidelines) and the NSW EPA (2017) *Guidelines for the NSW Site Auditor 3rd Scheme (the Auditor Guidelines*).

2. Background

Viva Energy intends to remediate the Western Area to facilitate future commercial and/or industrial development under the existing land use zoning (IN3 – Heavy Industrial).

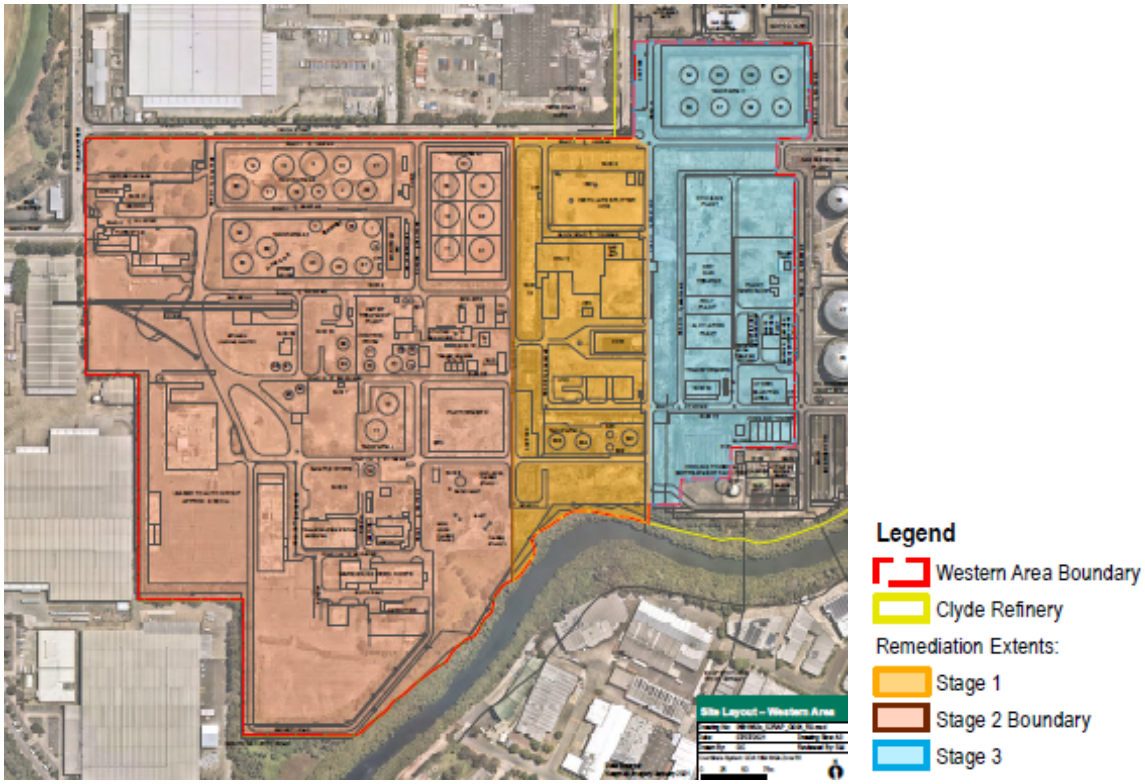
Development Consent issued by DPIE – SSD 9302 dated 7 May 2020, states that a detailed Remedial Action Plan (RAP) and associated Remediation Environmental Management Plan (REMP) must be prepared prior to the commencement of remedial works. The consent conditions also permit staging of works and Viva has issued a staging letter to DPIE for the following three stages:

– Stage 1 - Former Process West

– Stage 2 - Former Utilities, Movements and Southern Buried Waste Area

– Stage 3 - Former Process East

A figure showing the three stages extracted from the Stage 2 RAP is presented below.



The GWMP, presented as Attachment A of the GMP, was prepared to meet Development Consent condition B22, specifically:

- *B22(b) include a program to monitor groundwater levels and quality during remediation works and following demobilisation.*
- *B22(d) detail ongoing monitoring following demobilisation, to verify that natural attenuation of groundwater contamination is occurring over time.*
- *B22(e) include trigger levels for investigating potential adverse impacts to the Duck River, including triggers for indicating if further remediation of groundwater is required.*
- *B22(f) outline contingency actions to be implemented if monitoring indicates that natural attenuation is not occurring, or groundwater is having an adverse impact on the Duck River.*
- *B22(g) monitor the effectiveness of management measures and contingency actions for reducing impacts.*
- *B22(h) procedures for reporting changes to groundwater conditions that have the potential to create unacceptable risks to the Duck River.*

3. Auditor review

The auditor noted that the GWMP largely addressed Development Consent B22, as summarised in the Table 1.

Table 1 Summary of GMP – Attachment A - GWMP

SSD Condition	Definition	Section of GMP – Attachment GWMP	Auditor comments
B22(b)	Include a program to monitor groundwater levels and quality during remediation works and following demobilisation	Section 3	The auditor noted that two groundwater monitoring programs were developed by ERM, as requested by the DPIE, as follows: **During remediation work** - This groundwater monitoring plan is a sub-plan of the REMP and has been prepared to demonstrate that remediation activities have no adverse effects on the quality of the local groundwater or in the Duck River. Contingency measures were included as part of this GWMP. **Post remediation works** - This groundwater monitoring program is to form (if required, depending on the proposed sub division of the Stage 2 Area into separate lots) a sub-plan of the Long-Term Monitoring Management Plan (LTEMP) and was prepared to demonstrate that the mass of Contaminants of Potential Concern (CoPC) based on groundwater testing from the selected sentinel wells is stable to decreasing, as a result of natural attenuation processes and removal of the primary source of impact. The auditor notes that current concentrations of CoPC detected in groundwater as well as the presence of LNAPL have been demonstrated to not pose unacceptable risks to on or off-site receptors, as previously discussed in the HHERA (ERM, 2020b). The refined CSM as well as a summary of the Tier 2 risk assessment were presented in the GWMP, supporting the

SSD Condition	Definition	Section of GMP – Attachment GWMP	Auditor comments
			selected CoPC, location of monitoring wells and the sampling frequency.
B22(d)	Detail ongoing monitoring following demobilisation, to verify that natural attenuation of groundwater contamination is occurring over time	Section 3.5 and Table 2, Appendix B	The auditor noted that the groundwater monitoring plan, following remedial and validation works incorporates the monitoring wells within the areas proposed for remediation as well as those located along the site boundaries (the selected sentinel wells), the relevant CoPC for the site, which included MNA parameters, frequency of sampling and rationale for the selection of monitoring wells and analytical parameters. The auditor notes that the GWMP for ongoing monitoring (where relevant) will be part of the LTEMP and can be reviewed (if necessary) based on the validation results.
B22(e)	Include trigger levels for investigating potential adverse impacts to the Duck River, including triggers for indicating if further remediation of groundwater is required	Section 3.3	Groundwater trigger levels (for vapour intrusion) were developed as part of the HHERA and are presented in Appendix C. It is noted that the DQOs list as a decision rule the use of statistical means of evaluating the data collected as part of the monitoring program. This assessment along with evaluating of mass flux will be used to establish whether remediation of groundwater is necessary, considering potential risks to receptors. Triggers levels for ecological assessment (95% marine protection) were also presented in the GWMP in Appendix C.
B22 (f)	Outline contingency actions to be implemented if monitoring indicates that natural attenuation is not occurring, or groundwater is having an adverse impact on the Duck River	Section 3.7	A protocol to assess unexpected findings in groundwater (e.g. mobilisation of LNAPL or an increase in CoPC concentration in groundwater) was discussed in Section 3.7. The auditor noted that if any of the triggers are exceeded, additional actions such as active short-term remediation solutions, including multiphase vacuum extraction (MPVE) and/or chemical in situ oxidation (ISCO) could be considered.
B22(g)	Monitor the effectiveness of management measures and contingency actions for reducing impacts	Section 3.5 and 3.7	Groundwater monitoring is proposed during and after remediation: around excavation areas and along the down gradient site boundary.
B22(h)	Procedures for reporting changes to groundwater conditions that have the potential to create unacceptable risks to the Duck River.	Section 3.6	The auditor notes that any non-compliance (i.e. exceeding the monitoring limits that may present risks to receptors) should be reported to NSW DPIE, along with corrective actions according to the procedure provided in Section 6.4 of the REMP.

4. Conclusions

The auditor considered that the GMP, including the GWMP that forms the attachment, were prepared contains the key elements of a monitoring program as listed in the Consultant Guidelines (NSW EPA, 2020) and largely meet Development Consent condition B22 as presented in Table 1.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely

GHD Pty Ltd

Andrew Kohlrusch
NSW EPA Accredited Auditor
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Our ref: 21/27799/IAA16

22 July 2021

Adam Speers
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Sydney NSW 2000

Western Area Remediation Project - Interim Audit Advice 16 - Review of Stage 2 Detailed Remediation Action Plan (RAP)

Dear Adam

1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) was commissioned by Viva Energy Australia Pty Ltd (Viva Energy) to conduct an environmental site audit of the Western Area of the former Clyde Refinery (Western Area Remediation Project or WARP). The WARP is located at Durham Street, Rosehill on the Camellia Peninsula. Viva Energy intends to remediate the WARP to facilitate future commercial and/or industrial development under the existing land use zoning (IN3 – Heavy Industrial).

Given the scale of remedial works, the WARP was declared State Significant Development (SSD 9302, dated 7 May 2020) and as such, to assess the potential environmental impacts from remediation, an Environmental Impact Statement (EIS) containing a Conceptual Remedial Action Plan (RAP) (AECOM,2019) were prepared by AECOM.

The SSD 9302 states that a detailed RAP and associated Remediation Environmental Management Plan (REMP) must be prepared prior to the commencement of remedial works. The consent conditions also permit staging of works and Viva Energy has issued a staging letter to DPIE for the following three stages:

– Stage 1 – Former Process West
– Stage 2 – Former Utilities, Movements and Southern Buried Waste Area
– Stage 3 – Former Process East

The review and endorsement of the Stage 2 RAP by an auditor forms Consent Conditions B1 and B3 for SSD 9302.

A figure showing the staged remediation areas (extracted from the Stage 2 RAP) is presented in Figure 1 below.

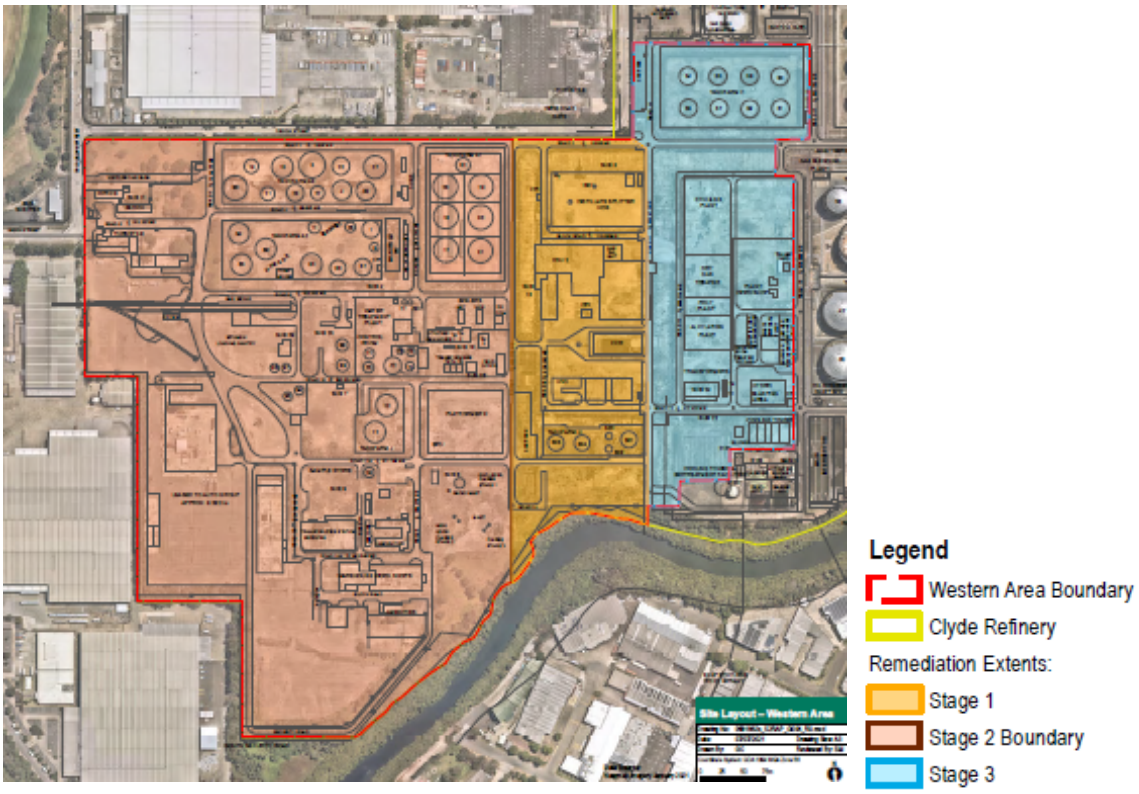

Figure 1 *Staged remediation areas (extracted from Stage 2 RAP).*

2. Stage 2 - Former Utilities, Movements and Southern Buried Waste Area

As part of this audit, the auditor has reviewed the following report prepared by Environmental Resources Management (ERM):

– ERM (2021). *Clyde Western Area Remediation Project, Stage 2 - Detailed Remediation Action Plan*, dated 9 July 2021 (the **Stage 2 RAP**).

The Stage 2 Area covers approximately 28.07 hectares and is situated within the former ulitilities, movements and tankfarm areas. It is the auditor's understanding that the Stage 2 Area is to be subdivided for redevelopment under SSD 10459, as per the survey plan presented in Attachment A.

The Stage 2 RAP provides details on how the area will be remediated to render this portion of the WARP suitable for a future commercial/industrial land uses in accordance with the existing zoning classification. Details of the approximate areas of these proposed subdivision boundaries and proposed remedial options for each are shown in Table 1.

Table 1 *Stage 2 Area - Proposed subdivision areas, AECs and remediation/management summary*

Lot ID	Area (Ha)	AECs[1]	Is remediation or management required?
51	0.806	AEC-1	Yes, remediation is required as per the Stage 2 RAP – Asbestos.
52	0.806	Not applicable	No management or remediation required.

[1] Areas of environmental concern (AEC)

Lot ID	Area (Ha)	AECs[1]	Is remediation or management required?
53	2.755	Not applicable	Yes, for ongoing management. No active remediation is required.
54	1.067	Not applicable	Yes, for ongoing management. No active remediation is required.
55	1.067	Not applicable	Yes, for ongoing management. No active remediation is required.
56	2.133	Not applicable	Yes, for ongoing management. No active remediation is required.
58	2.125	AEC-14a	Yes, remediation is required as per the Stage 2 RAP – Petroleum hydrocarbons.
59	2.135	AEC-14b	Yes, remediation is required as per the Stage 2 RAP – Petroleum hydrocarbons.
60	3.318	AEC-14b	Yes, remediation is required as per the Stage 2 RAP – Petroleum hydrocarbons.
61	1.553	Not applicable	Yes, for ongoing management. No active remediation is required.
62	3.097	AEC-3a and AEC-3b	Yes, remediation is required as per the Stage 2 RAP – Asbestos (AEC-3b) and petroleum hydrocarbons (AEC-3a).
63	3.633	AEC-3d and AEC-3d	Yes, remediation is required as per the Stage 2 RAP – Petroleum hydrocarbons.
64	2.35	AEC-4	Yes, in-situ management with engineered capping layer is required.
Proposed Road	3.35	Not applicable	Yes, remediation is required as per the Stage 2 RAP – Asbestos (AEC-3b) and petroleum hydrocarbons (if necessary).

Given the nature of the works undertaken in the WARP to date (Stage 1 Area), the auditor also considered the following documents as background information relevant to this audit:

- AECOM (2019). *Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan*, dated 21 January 2019 (the Conceptual RAP).
- ERM (2020a). *Clyde Western Remediation Project, Remediation Site Investigation*, dated 7 February 2020 (the RSI).
- ERM (2020b). *Clyde Western Area Remediation Project, Human Health and Ecological Risk Assessment*, dated 16 February 2020 (the HHERA).
- ERM (2021a). *Clyde Western Area Remediation Project – Quarter 4 (2020) Groundwater Monitoring Event*, dated 24 March 2021 (the 2020 GME).
- ERM (2021b). *Clyde Western Area Remediation Project – Stage 2 Drainage Decommissioning Validation Report*, dated 17 June 2021 (the Stage 2 Drainage).
- ERM (2021c). *Clyde Western Area Remediation Project – Stage 2 Environmental Site Assessment*, dated 17 June 2021 (the Stage 2 ESA).
- ERM (2021d). *Clyde Western Area Remediation Project – Supplementary Site Assessment – Southern Buried Waste Area (AEC-4)*, dated 07 June 2021 (the AEC-4 ESA).
- ERM (2021e). *Clyde Western Area Remediation Project – Remediation Options Analysis (AEC-4)*, dated 07 June 2021 (the AEC-4 ROA).
- ERM (2021f). *Clyde Western Area Remediation Project, Stage 2 Stockpile Validation Report*, dated 17 June 2021 (the Stockpile Validation).
- ERM (2021g). *Clyde Western Area Remediation Project, Stage 2 Air Emissions Verification Report*, dated 11 June 2021 (the Stage 2 AEVR).

– ERM (2021h). *Clyde Western Area Remediation Project*, Groundwater Monitoring Program – Stage 2, dated 14 July 2021.
– AECOM (2021). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan Groundwater Monitoring and Management Plan,* dated 21 July 2021.

It should be noted that the auditor has reviewed all the aforementioned documents and provided comments in interim audit advice letters or in a site audit tracking sheet.

3. Auditor review

3.1 General

The purpose of this IAA is to document the review of the Stage 2 RAP and evaluate whether it was prepared in a manner consistent with NSW EPA made or endorsed guidelines. These guidelines include the NSW EPA (2020) *Guidelines for Consultants Reporting on Contaminated Sites* (the Consultant Guidelines) and the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme 3rd Edition* (the Auditor Guidelines). A draft version of the Stage 2 RAP (dated 31 May 2021) had been reviewed by the auditor, who issued comments in a site audit tracking sheet. The site audit tracking sheet and IAAs will be included in the Site Audit Report (SAR).

The Stage 2 RAP included the key elements of the Conceptual RAP (AECOM, 2019) and incorporated additional site characterisation obtained for the Stage 2 Area by ERM during 2020 and 2021. A list of the relevant reports that formed the basis of the Stage 2 RAP is presented in Section 2 of this IAA.

The evaluation of data that has been collected in the Stage 2 Area identified that the key drivers for remediation were as follows:

– indoor inhalation of vapours by future on site commercial workers from hydrocarbon impacted soil and LNAPL trapped within soil.
– direct contact with contaminated soils (PAHs, TRH C10-C40 and hexavalent chromium) by future on-site commercial workers and construction workers undertaking intrusive works.
– inhalation of asbestos fibres by future on site commercial workers, construction workers and intrusive maintenance workers from bonded asbestos fibres liberated during future excavation works or exposed at the ground surface.
– potential acute hazards within future indoor settings where potential for hazardous ground gas accumulation (specifically methane) from LNAPL trapped within soils source areas within the soil profile has been identified (AEC-3A and AEC-3D).

3.2 Soil remediation

The proposed methodologies selected for remediation of contaminated soil within the Stage 2 Area are as follows:

1. Excavation and on-site bio-piling (hydrocarbon impacted areas).
2. Excavation and off-site disposal of soils (for asbestos impacted soils or as a contingency measure).
3. On-site management under a constructed engineered cap (specific approach to AEC-4).
4. On-site management with management control outlined within a Long-Term Environmental Management Plan (LTEMP) (direct contact risks and residual LNAPL).

A summary of AECs within the Stage 2 Area that require remediation or management via LTEMP, the remedial strategy, depth of remediation and estimated volume of impacted material is presented in Table 2.

Table 2 Impacted areas, depth of remediation, estimated volume of impacted material and remediation strategy

AEC	Impacted area (m^2)	Remediation depth (m bgl)	Remediation volume (m^3)	Remedial methodology
AEC-1	113	0.2	23	**Asbestos removal** - Excavation and off-site disposal of soils - asbestos impacted soils or as a contingency measure.
AEC-3A	1,583	2	3,166	**Bio-piling** - Excavation and on-site bio-piling - hydrocarbon impacted areas.
AEC-3B	78	1	78	**Asbestos removal** - Excavation and off-site disposal of soils - asbestos impacted soils or as a contingency measure.
AEC-3D	421	2	842	**Bio-piling** - Excavation and on-site bio-piling - hydrocarbon impacted areas.
AEC-3E	1,400	1	1,400	**Bio-piling** - Excavation and on-site bio-piling - hydrocarbon impacted areas.
AEC-4	13,396	0.5	6,968[2]	**Engineered cap** - On-site management under a constructed engineered cap.
AEC-14A	50	1.8	90	**Bio-piling** - Excavation and on-site bio-piling - hydrocarbon impacted areas.
AEC-14B	192	1	192	**Bio-piling** - Excavation and on-Site bio-piling - hydrocarbon impacted areas.
AEC-2 AEC-3C AEC-5 AEC-8 AEC-11 AEC-14 AEC-15	Not applicable	Not applicable	Not applicable	**LTEMP** - On-site management with management controls outlined within an LTEMP - direct contact risks and residual LNAPL.

The biopiling of hydrocarbon contaminated soil will follow the method successfully used to treat soil contaminated with similar chemicals in the Stage 1 Area. The auditor notes that a detailed design for capping construction at AEC-4 is required to meet the objectives outlined in the Stage 2 RAP ro allow physical separation and minimisation of water infiltration. It is the auditor's understanding that the detailed cap design and associated validation approach will be reviewed by the auditor to supplement the Stage 2 RAP.

3.3 Groundwater management

The auditor notes that given the current assessment that hydrocarbon concentrations in groundwater are stable to decreasing (ERM, 2021a), it is expected that the remedial works will enhance the current natural attenuation processes to reduce residual groundwater impacts over time. Groundwater conditions will be managed via an LTEMP. The LTEMP will incorporate a groundwater monitoring program and protocols for managing LNAPL if encountered during future construction activities.

3.4 Validation program

The validation-sampling program prepared by ERM is based on a systematic sampling pattern for each excavation that will be created to remove the contaminated soil. The sampling pattern will allow collection of data that will be used to evaluate the suitability of the materials to remain on site and demonstrate the success of the remediation. Sampling densities have also been nominated to characterise soils for off-site disposal (e.g. asbestos impacted material) or demonstrate the efficacy of the material treated during the

[2] AEC-4 excavation volume refers to anticipated volume of uncontaminated surface material required to be re-worked for capping construction.

biopiling and whether such material can be reused on-site. The auditor considered that the validation and characterisation sampling strategy is appropriate.

The auditor noted that decommissioning of redundant pipework has been completed. The protocols for validating the effectiveness of the decommissioning program, along with any confirmatory sampling by ERM were discussed in the Stage 2 Drainage (ERM, 2021b). Any uncertainty in relation to the locations of the pipes and/or ability to effectively decommission the pipes will be recorded in the LTEMP.

3.5 Environmental management

The remediation scope discussed in the Stage 2 RAP will be implemented in accordance with the overarching Remediation Environmental Management Plan (REMP) for the WARP. The REMP includes the following sub-plans, and relevant contractor work method statements to ensure compliance with the consent conditions of the SSD 9302 and other relevant legislative requirements:

- Soil and Water Management Plan.
- Groundwater Monitoring and Management Plan.
- Air Quality and Odour Management Plan.
- Waste Management Plan.
- Traffic Management Plan.

The auditor reviewed the Stage 2 AEVR (ERM, 2021g) as per Condition of Consent B15 of SSD 9302. IAA14 dated 24/06/2021 was issued supporting the AEVR for the Stage 2 Area.

The auditor reviewed the GMP (AECOM, 2021) – including the GWMP as an attachment –as per Condition of Consent B22 of SSD 9302. IAA15 dated 22/07/2021 was issued supporting the groundwater monitoring plan for the Stage 2 Area.

4. Conclusions

The auditor considers that the Stage 2 RAP prepared by ERM largely followed the requirements of the relevant guidelines listed in Section 1 of this IAA. The Stage 2 RAP considered a series of robust investigations, including two remedial option assessments, an AEVR and the observations and monitoring conducted during the remediation of the Stage 1 Area.

The auditor considers that following remedial and validation works discussed in the Stage 2 RAP, the Stage 2 Area will be suitable for the proposed future use (commercial and/or industrial) in accordance with permissible land uses subject to implementation LTEMPs (where relevant).

This letter should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely

GHD Pty Ltd

Andrew Kohlrusch
NSW EPA Accredited Auditor
0447 685 055

Encl. Attachment A

Attachment A – Survey plans

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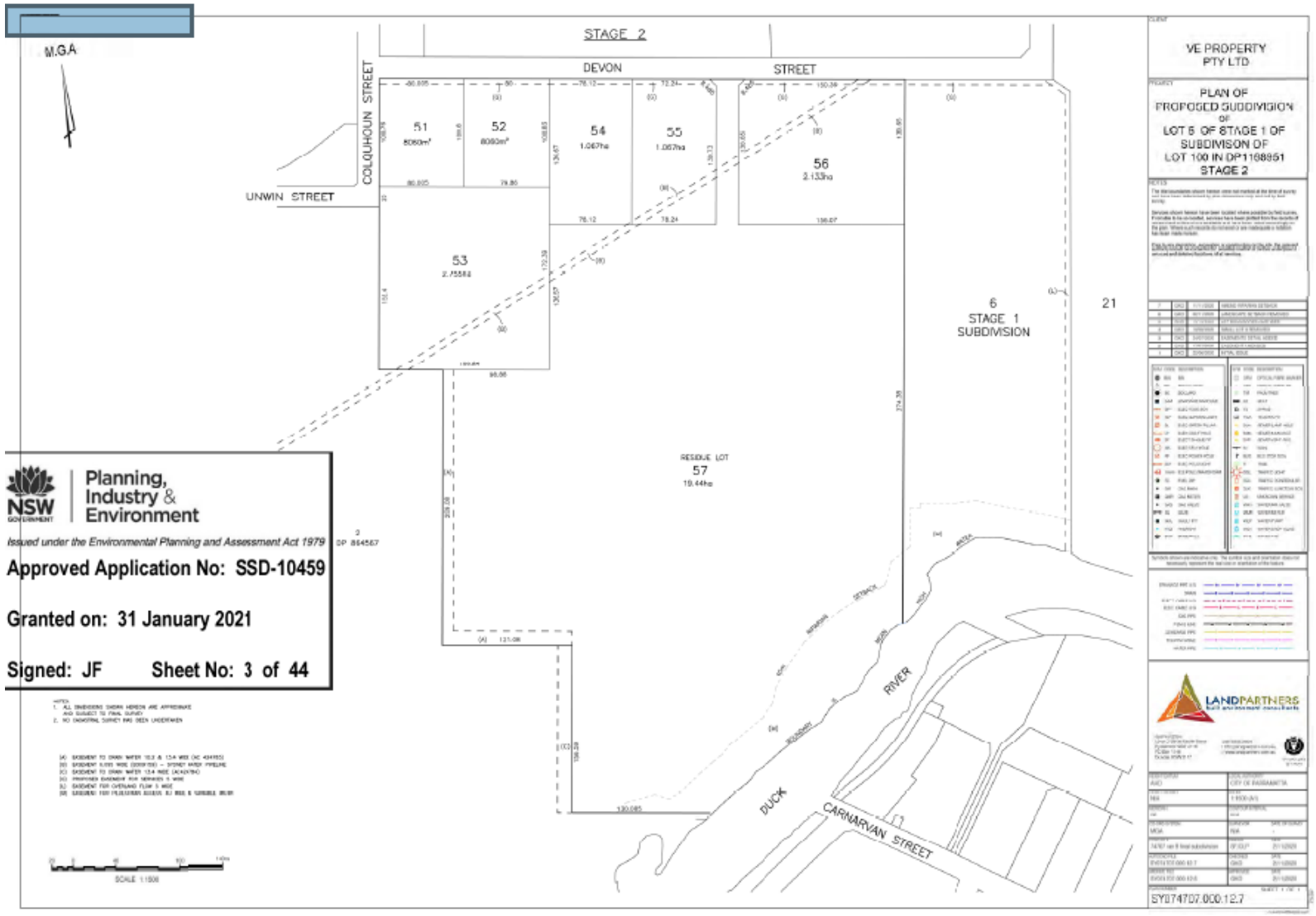


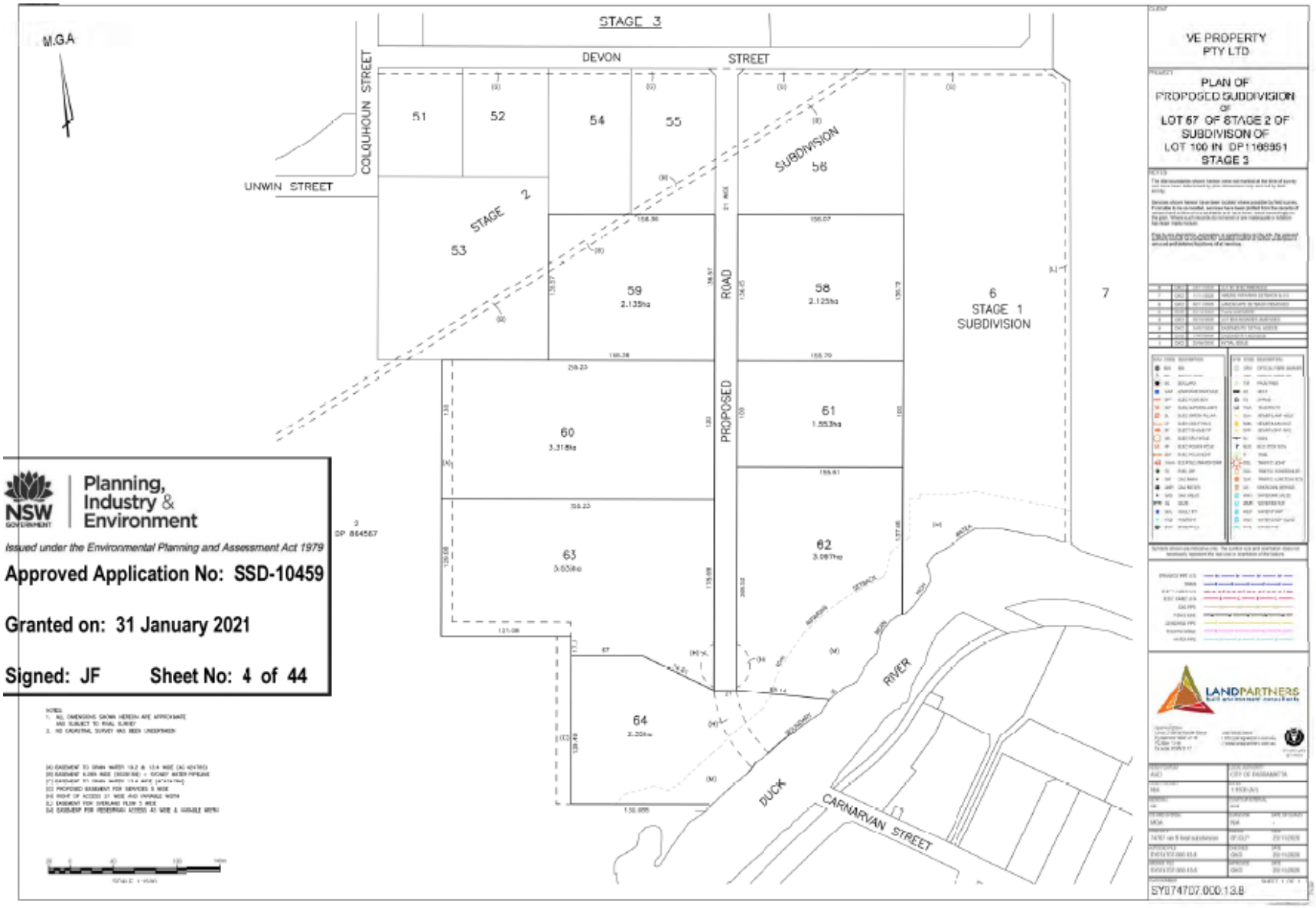
Planning, Industry & Environment

Issued under the Environmental Planning and Assessment Act 1979

Approved Application No: SSD-10459

Granted on: 31 January 2021

Signed: JF Sheet No: 3 of 44


STAGE 3
DEVON STREET
COLQUHOUN STREET
UNWIN STREET
M.G.A
51
52
54
55
56
SUBDIVISION
STAGE 2
53
59
2.135ha
58
2.125ha
PROPOSED ROAD
6
STAGE 1
SUBDIVISION
7
60
3.318ha
61
1.553ha
63
3.608ha
62
3.087ha
64
2.224ha
DP 864567
DUCK RIVER
CARNARVAN STREET
VE PROPERTY PTY LTD
PLAN OF PROPOSED SUBDIVISION OF LOT 67 OF STAGE 2 OF SUBDIVISION OF LOT 100 IN DP1169951 STAGE 3
LANDPARTNERS
SY0747D7.000.13.B
Planning, Industry & Environment
NSW GOVERNMENT
Issued under the Environmental Planning and Assessment Act 1979
Approved Application No: SSD-10459
Granted on: 31 January 2021
Signed: JF
Sheet No: 4 of 44

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Our ref: 2127799/IAA17

22 July 2021

Viva Energy Australia Pty Ltd
Adam Speers
Level 31 (Suite 2), Governor Macquarie Tower, 1 Farrer Place
Sydney NSW 2000

Western Area Remediation Project - Interim Audit Advice 17 - Review of Remediation Environmental Management Plan (REMP) and associated sub-plans

Dear Adam,

1. Introduction

Andrew Kohlrusch of GHD Pty Ltd (the auditor) was commissioned by Viva Energy Australia Pty Ltd (Viva Energy) to conduct an environmental site audit of the Western Area of the former Clyde refinery (referred to as the Western Area Remediation Project or WARP). The Western Area is located at Durham Street, Rosehill on the Camellia Peninsula. Viva Energy intends to remediate the WARP to facilitate future commercial and/or industrial development. The remedial works and subsequent validation program for the WARP are proposed to be completed in three different stages as follows:

- Stage 1 – Former Process West
- Stage 2 – Former Utilities, Movements and Southern Buried Waste Area
- Stage 3 – Former Process East

The three stages areas are illustrated in Figure 1 extracted from the Stage 2 RAP.

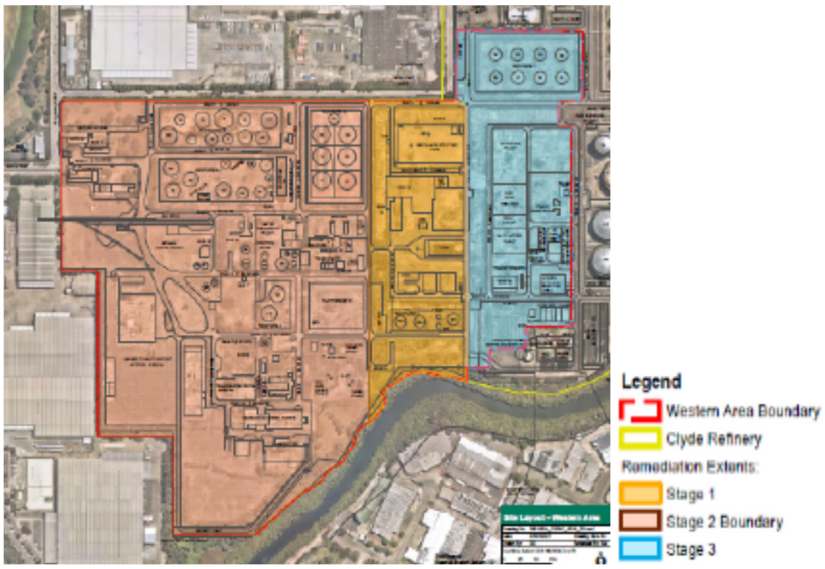

Figure 1 Staged remediation areas (extracted from Stage 2 RAP)

The Department of Planning, Industry and Environment (DPIE) issued conditions of consent in relation to the WARP (SSD 9302 dated 7 May 2020). Condition of Consent C2 requires that a Remediation Environmental Management Plan (REMP) be prepared prior to commencement of remedial works. The REMP is to include the following sub plans:

- Air Quality Management Plan (Condition of Consent B17)
- Soil and Water Management Plan (Condition of Consent B20)
- Groundwater Monitoring and Management Plan (Condition of Consent B22)
- Waste Management Plan (Condition of Consent B31)
- Traffic Management Plan (Condition of Consent B33)

Condition of consent C2 also requires the auditor to issue an interim audit advice endorsing the environmental management measures outlined in the REMP.

The purpose of this audit advice is to comment on whether the REMP and associated sub-plans (where relevant) were prepared in a manner consistent with NSW Environment Protection Authority (EPA) made or endorsed guidelines and the requirements of relevant Conditions of Consent outlined in SSD 9302.

2. Auditor review and commentary

In preparing this interim audit advice, the following reports prepared by Environmental Resources Management (ERM), Viva Energy and AECOM have been reviewed:

- Viva Energy (2021). *Stage 2 Remediation Environmental Management Plan - Clyde Western Area Remediation Project*, dated 21 July 2021 (the **REMP**).
- ERM (2021). *Clyde Western Area Remediation Project - Groundwater Monitoring Program*, dated 14 July 2021 (the **GWMP** – included as Attachment A within the GMP).
- AECOM (2021a). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan – Groundwater Monitoring and Management Plan*, dated 21 July 2021 (the **GMP**).
- AECOM (2021b). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan - Soil and Water Management Plan*, dated 21 July 2021 (the **SWMP**).
- AECOM (2021c). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan - Traffic Management Plan*, dated 21 July 2021 (the **TMP**).
- AECOM (2021d). *Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan – Waste Management Plan*, dated 21 July 2021 (the **WMP**).
- AECOM (2021e). Clyde Western Area Remediation Project – Stage 2 Remediation Environmental Management Plan - Air Quality Management Plan, dated 21 July 2021 (the **AQMP**).

The proposed methods selected for remediation of contaminated soil within the Stage 2 Area are as follows:

- Excavation and on-site bio-piling (hydrocarbon impacted areas)
- Excavation and off-site disposal of soils (for asbestos impacted soils or as a contingency measure)
- On-site management under a constructed engineered cap (specific approach to AEC-4).
- On-site management with management control outlined within a Long-Term Environmental Management Plan (LTEMP) (direct contact risks and residual LNAPL)

Protocols for the nominated remedial approaches in the Stage 2 Area are presented in *Clyde Western Area Remediation Project, Stage 2 - Detailed Remediation Action Plan*, dated 9 July 2021 (the **Stage 2 RAP**).

The auditor has reviewed the Stage 2 RAP and issued on 22 July 2021, IAA16 stating that the Stage 2 RAP prepared by ERM is suitable for the purposes of remediating contaminated soils to render the site suitable for commercial/industrial land use.

The REMP and associated sub-plans provide a framework for environmental management during remediation of the Stage 2 Area. An evaluation of the key elements of the REMP and the associated sub-plans is presented in Table 1.

Table 1 Stage 2 Area – REMP and associated sub-plans evaluation

Document name	Auditor commentary
REMP	The REMP clearly states the requirements for its preparation (Condition of Consent C1 of SSD 9302). The roles, responsibilities, authority of all key personnel are presented. The document contains stakeholder communication and complaint handling and resolution protocols. Appropriate steps are articulated on emergency response. As per Condition of Consent C2(c) plans are included for the management of air quality, soil and water, groundwater monitoring, waste, and traffic.
AQMP	The AQMP was considered by the auditor to have taken appropriate consideration of the activities that are to be conducted as part of the remedial works planned for the Stage 2 Area. Of particular importance is that the AQMP is based on the results of an Air Emissions Verification Report prepared by ERM (*Clyde Western Area Remediation Project, Stage 2 Air Emission Verification Report*, dated 11 June 2021). The Stage 2 AEVR considered the comprehensive data set derived during monitoring of air emissions of various activities completed and work areas during remediation of Stage 1 Area. The auditor issued IAA14 on 24 June 2021 following review of the Stage 2 AEVR. The IAA concurred with ERM's conclusions regarding the types of emission controls and monitoring necessary for the Stage 2 remedial works.
SWMP	The SWMP includes a comprehensive assessment of where (and what type of) activities will take place during Stage 2 remediation and how soil and water will be managed. Appropriate mitigation and management measures have been detailed for each key aspect of soil and water management along with the monitoring and reporting requirements and corrective actions. The auditor notes that groundwater (if encountered) during excavation at AEC-3A, AEC-3D and AEC-14A will be temporarily stored, classified and disposed off-site.
GMP	The auditor considered that the GMP, including the GWMP that forms the attachment, were prepared contains the key elements of a monitoring program as listed in the Consultant Guidelines (NSW EPA, 2020) and largely meet Development Consent condition B22 as presented in IAA15 dated 22 July 2021.
WMP	The WMP details the activities that could generate waste during the Stage 2 remedial works including preparation works, the remediation of the contaminated soils. A waste management hierarchy was presented which had the overarching aims of minimising the generation of waste and ensuring that waste was managed as per the Protection of the *Environment Operations Act 1997*. The WMP identified the waste streams likely to be generated during Stage 2 remediation and how they need to be identified/tracked, stored and managed and off-site disposed. Mitigation and management measures were detailed for each key waste stream. Appropriate monitoring and reporting requirements and corrective actions were articulated.
TMP	The auditor noted that the REMP contains a TMP that includes the requirements as per Condition of Consent B33.

3. Conclusions

The auditor considered that the REMP and associated sub-plans largely contain the elements as required by the Condition of Consent C1 (and relevant referenced Condition of Consent). The plans included appropriate identification of the specific activities that will take place during the Stage 2 remedial works and environmental aspects that need to be managed.

The protocols listed in the plans for the management and mitigation of environmental impacts are considered to be consistent either with NSW EPA made or endorsed guidelines or with appropriate and responsible industry practice. The monitoring programs will provide confidence that the mitigation and management actions will protect the environment and the corrective actions (if required) are appropriate.

This report should be regarded as interim advice to the overall review and site audit process and should not be considered a Site Audit Statement under the CLM Act, 1997. This interim audit advice letter will subsequently be referred to and provided as an Annex to the final Site Audit Statement and Site Audit Report.

Sincerely

GHD Pty Ltd
Andrew Kohlrusch

NSW EPA Accredited Auditor

Appendix C Tables

Tables - SSTLs

COPC	Soil									
	Direct Contact (mg/kg)			VI (mg/kg)						Management Limits (mg/kg)
	Commercial	IMW	Construction	Commercial (0.15mbgl)	Commercial (1 mbgl)	Commercial (>2-4mbgl)	Commercial (>4mbgl)	IMW	Construction	
Benzene	400	15000	1200	3.2	3.2	3.2	3.2	NL	NL	-
Naphthalene	9800	810000	67000	NL	NL	NL	NL	NL	NL	-
Benzo(a)pyrene TEQ	40	3000	200	-	-	-	-	-	-	-
Total Chromium[a]	21000	100,000	8200							
Chromium VI	3600	17000	1400	-	-	-	-	-	-	-
TRH C6-C10 (less BTEX)	28000	830000	69000	600	770	NL	NL	NL	NL	-
TRH C6-C10	-	-	-	-	-	-	-	-	-	700
TRH C10-C16 (less N)	17000	540000	45000	NL	NL	NL	NL	NL	NL	-
TRH C10-C16	-	-	-	-	-	-	-	-	-	1000
TRH C16-C34	27000	770000	64000	-	-	-	-	-	-	3500
TRH C34-C40	27000	770000	64000	-	-	-	-	-	-	10000
TPH (EC5-6) aliphatic	1200000	3700000	310000	-	-	-	-	-	-	-
TPH (>EC6-8) aliphatic	1200000	3700000	310000	480	610	880	1400	NL	NL	-
TPH (>EC8-10) aliphatic	24000	740000	62000	760	980	1400	2200	NL	NL	-
TPH (>EC10-12) aliphatic	24000	740000	62000	430	600	980	1800	NL	NL	-
TPH (>EC12-16) aliphatic	24000	740000	62000	4300	8300	17000	33000	NL	NL	-
TPH (>EC16-21) aliphatic	470000	4400000	370000	-	-	-	-	-	-	-
TPH (>EC21-34) aliphatic	470000	4400000	370000	-	-	-	-	-	-	-
TPH (>34) aliphatic	4700000	44000000	3700000	-	-	-	-	-	-	-
TPH (>EC8-10) aromatic	9500	300000	25000	110	150	230	420	NL	NL	-
TPH (>EC10-12) aromatic	9500	300000	25000	280	430	750	1400	NL	NL	-
TPH (>EC12-16) aromatic	9500	300000	25000	430	2800	5100	9800	NL	NL	-
TPH (>EC16-21) aromatic	7100	220000	18000	-	-	-	-	-	-	-
TPH (>EC21-34) aromatic	7100	220000	18000	-	-	-	-	-	-	-
TPH (>34) aromatic	7100	220000	18000	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-										
Trimethylbenzene, 1,3,5-										
Cyclohexane										
Heptane, N-										
Hexane, N-										
Isooctane										
Propene										

a - Assumes Total chromium is 17% Hexavalent chromium

Tables - Stockpile validation

				BTEX						Naphthalene						TRH NEPM (2013)							Inorganics		Metals							
				Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene	TRH >C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction	Moisture Content (dried @ 103°C)	Moisture Content (dried @ 40°C)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				0.1	0.1	0.1	0.1	0.2	0.3	0.5	20	20	50	50	50	20	20	50	50	100	100	100	1	1	2	0.4	5	5	5	0.1	5	5
Clyde WARP SSTL (Direct Contact - Commercial)				400						9800							28000		17000	27000		27000					21000					
Clyde WARP SSTL (Direct Contact - Construction Worker)				1200						67000							69000		45000	64000		64000					8200					
Clyde WARP SSTL (Direct Contact - IMW)				15000						810000							830000		540000	770000		770000					100000					
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																																
1-1.99m				3.2						NL							770		NL													
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																																
2-3.99m				3.2						NL							NL		NL													
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																																
0-0.99m				3.2						NL							600		NL													
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)				NL						NL							NL		NL													
Clyde WARP SSTL (Vapour Intrusion - IMW)				NL						NL							NL		NL													
NEPM (1999) HIL D - Commercial/Industrial																									3000	900		240000	1500	730	6000	400000
NEPM (1999) HSL D Comm/Indust - Asbestos																																
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																700		1000		3500		10000										
Field_ID	**Location_Code**	**Sampled_Date_Time**	**Lab_Report_Number**																													
SP32-1	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	9.6	-	12	0.5	51	40	180	1.4	27	280
SP32-10	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	80	<50	80	<20	<20	<50	<50	130	130	<100	7.7	-	-	-	-	-	-	-	-	-
SP32-2	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	69	<50	69	<20	<20	<50	<50	<100	<100	<100	11	-	-	-	-	-	-	-	-	-
SP32-3	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	80	79	159	<20	<20	<50	<50	130	130	<100	6.2	-	9.9	0.5	33	32	85	0.9	20	290
SP32-4	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	5.4	-	-	-	-	-	-	-	-	-
SP32-5	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	78	100	178	<20	<20	<50	<50	150	260	110	12	-	160	<0.4	79	32	180	1.1	64	570
SP32-6	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	63	<50	63	<20	<20	<50	<50	<100	<100	<100	10	-	-	-	-	-	-	-	-	-
SP32-7	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	51	51	<20	<20	<50	<50	<100	<100	<100	6.8	-	58	0.6	66	53	190	2.4	62	530
SP32-8	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	12	-	-	-	-	-	-	-	-	-
SP32-9	SP32	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	76	72	148	<20	<20	<50	<50	130	130	<100	7.2	-	21	0.5	60	45	150	0.8	36	420
DUP1-20201119	SP33	19/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	7	-	14	0.5	65	55	120	1.5	32	330
SP33-1	SP33	19/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	110	120	230	<20	<20	<50	<50	190	190	<100	8	-	20	0.7	56	60	140	6.9	57	760
SP33-2	SP33	19/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	72	600	59	731	<20	<20	90	90	910	1320	320	11	-	-	-	-	-	-	-	-	-
SP33-3	SP33	19/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	72	60	132	<20	<20	<50	<50	110	110	<100	6.5	-	5.5	0.6	21	17	130	0.3	5.4	390
TRIP 1 -20201119	SP33	19/11/2020	ES2041429	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100	<50	<10	<10	<50	<50	<100	<50	<100	-	6.5	6	<1	27	26	59	1.4	12	129
DUP2-20201120	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	120	100	220	<20	<20	<50	<50	190	190	<100	3.4	-	3.4	<0.4	12	7.5	9.1	0.3	6.7	48
DUP3-20201120	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	3.2	-	2.4	<0.4	8.7	7.1	8.8	0.3	6.4	36
SP37-1	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	2.8	-	5	<0.4	7.8	5.4	6.8	0.6	5.3	34
SP37-10	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	2.4	-	-	-	-	-	-	-	-	-
SP37-11	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	4.9	-	2.2	<0.4	8.7	8.6	9.2	0.4	5.4	38
SP37-12	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	340	120	460	<20	<20	<50	<50	540	540	<100	13	-	-	-	-	-	-	-	-	-
SP37-13	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	300	88	388	<20	<20	<50	<50	350	350	<100	8.3	-	12	<0.4	73	44	81	0.2	50	170
SP37-14	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	210	<50	210	<20	<20	<50	<50	240	240	<100	12	-	-	-	-	-	-	-	-	-
SP37-15	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	25	170	91	286	<20	<20	<50	<50	220	220	<100	6.7	-	7.8	0.8	41	240	400	0.2	41	2300
SP37-16	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	55	<50	55	<20	<20	<50	<50	<100	<100	<100	3.9	-	-	-	-	-	-	-	-	-
SP37-17	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	33	440	310	783	<20	<20	51	51	650	941	240	11	-	6.9	0.5	340	77	110	0.8	120	1200
SP37-18	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	380	<50	380	<20	<20	<50	<50	530	710	180	11	-	-	-	-	-	-	-	-	-
SP37-19	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	3	-	2.3	<0.4	7.8	8.7	6.9	0.4	<5	35
SP37-2	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	3.5	-	-	-	-	-	-	-	-	-
SP37-20	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	110	<50	110	<20	<20	<50	<50	190	190	<100	5	-	-	-	-	-	-	-	-	-
SP37-21	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	64	56	120	<20	<20	<50	<50	<100	<100	<100	5.4	-	2.3	<0.4	9.6	6.2	7.6	0.5	6.3	41
SP37-22	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	3.5	-	-	-	-	-	-	-	-	-
SP37-3	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	3.5	-	2.3	<0.4	7.3	5.9	7.1	0.7	<5	30
SP37-4	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	5	-	-	-	-	-	-	-	-	-
SP37-5	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	140	120	260	<20	<20	<50	<50	230	230	<100	3	-	3	<0.4	20	16	19	0.9	14	68
SP37-6	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	90	<50	90	<20	<20	<50	<50	180	180	<100	1.4	-	-	-	-	-	-	-	-	-
SP37-7	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	56	<50	56	<20	<20	<50	<50	<100	<100	<100	2.8	-	2.9	<0.4	8.7	5.7	6.7	1.4	5.2	30
SP37-8	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	2.9	-	-	-	-	-	-	-	-	-
SP37-9	SP37	20/11/2020	758441	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	3.2	-	2.3	<0.4	5.5	6.6	6.2	0.6	<5	25
TRIP 2-20201120	SP37	20/11/2020	ES2041429	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100	<50	<10	<10	<50	<50	<100	<50	<100	-	3	<5	<1	8	8	10	0.3	6	51
Statistical Summary																																
Number of Results				40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	38	2	23	23	23	23	23	23	23	23
Number of Detects				0	0	0	0	0	0	0	0	3	22	14	23	0	0	2	2	17	17	4	38	2	22	9	23	23	23	23	20	23
Minimum Concentration				<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<10	<20	<50	<50	<50	<10	<10	<50	<50	<100	<50	<100	1.4	3	2.2	<0.4	5.5	5.4	6.2	0.2	<5	25
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	25	55	51	51	ND	ND	51	51	110	110	110	1.4	3	2.2	0.5	5.5	5.4	6.2	0.2	5.2	25
Maximum Concentration				<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<20	72	600	310	783	<20	<20	90	90	910	1320	320	13	6.5	160	<1	340	240	400	6.9	120	2300
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	72	600	310	783	ND	ND	90	90	910	1320	320	13	6.5	160	0.8	340	240	400	6.9	120	2300
Average Concentration				0.053	0.06	0.06	0.06	0.11	0.16	0.25	9.8	13	105	53	142	9.8	9.8	27	27	156	179	66	6.5		16	0.37	44	35	84	1.1	26	339
Median Concentration				0.05	0.05	0.05	0.05	0.1	0.15	0.25	10	10	59.5	25	59.5	10	10	25	25	50	50	50	5.8	4.75	5.5	0.2	21	17	59	0.7	12	129
Standard Deviation				0.011	0.044	0.044	0.044	0.033	0.022	0	1.1	11	131	52	183	1.1	1.1	11	11	191	265	55	3.4		34	0.2	69	50	96	1.4	29	519
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

				PAH/Phenols																						PSD						
				Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(a)pyrene TEQ (half LOR)	Benzo(a)pyrene TEQ (LOR)	Benzo(a)pyrene TEQ (zero)	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(b&j)fluoranthene	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	PAHs (Sum of total)	<63 Micron	>2000 Micron	1000-2000 Micron	125-250 Micron	250-500 Micron	500-1000 Micron	63-125 Micron
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%W/W	%W/W	%W/W	%W/W	%W/W	%W/W	%W/W
EQL				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Clyde WARP SSTL (Direct Contact - Commercial)														40																		
Clyde WARP SSTL (Direct Contact - Construction Worker)														200																		
Clyde WARP SSTL (Direct Contact - IMW)														3000																		
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																																
1-1.99m																																
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																																
2-3.99m																																
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																																
0-0.99m																																
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)																																
Clyde WARP SSTL (Vapour Intrusion - IMW)																																
NEPM (1999) HIL D - Commercial/Industrial																									4000							
NEPM (1999) HSL D Comm/Indust - Asbestos																																
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																																
Field_ID	**Location_Code**	**Sampled_Date_Time**	**Lab_Report_Number**																													
SP32-1	SP32	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	31	16	15	15	16	5.5
SP32-10	SP32	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP32-2	SP32	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP32-3	SP32	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.9	32	15	11	17	18	3.7
SP32-4	SP32	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP32-5	SP32	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.1	46	13	11	12	12	4.6
SP32-6	SP32	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP32-7	SP32	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6.5	29	14	17	13	16	5.2
SP32-8	SP32	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP32-9	SP32	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9.1	42	12	9.3	13	11	4.5
DUP1-20201119	SP33	19/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
SP33-1	SP33	19/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
SP33-2	SP33	19/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP33-3	SP33	19/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	31	23	10	12	19	4.1
TRIP 1 -20201119	SP33	19/11/2020	ES2041429	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
DUP2-20201120	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
DUP3-20201120	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
SP37-1	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.5	10	8.2	13	21	34	5
SP37-10	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-11	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9.5	29	5.9	14	20	21	1.1
SP37-12	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-13	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	21	32	12	12	9.6	12	1.7
SP37-14	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-15	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	25	27	5	17	13	12	2.3
SP37-16	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-17	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.5	42	11	12	11	14	6.5
SP37-18	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-19	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	12	20	6	16	17	26	4
SP37-2	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-20	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-21	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3	21	7.2	18	25	23	3.1
SP37-22	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-3	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6.2	21	8.4	13	24	27	1.9
SP37-4	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-5	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	17	17	5.6	13	23	21	3.5
SP37-6	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-7	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	13	19	8.1	13	19	27	0.5
SP37-8	SP37	20/11/2020	758441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SP37-9	SP37	20/11/2020	758441	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6	32	5.7	14	17	21	4.5
TRIP 2-20201120	SP37	20/11/2020	ES2041429	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
Statistical Summary																																
Number of Results				23	23	23	23	23	2	2	2	21	21	21	23	23	23	23	23	23	23	23	23	23	23	17	17	17	17	17	17	17
Number of Detects				0	0	0	0	0	2	2	0	0	21	21	0	0	0	0	0	0	0	0	0	0	0	17	17	17	17	17	17	17
Minimum Concentration				<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	10	5	9.3	9.6	11	0.5
Minimum Detect				ND	ND	ND	ND	ND	0.6	1.2	ND	ND	1.2	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	10	5	9.3	9.6	11	0.5
Maximum Concentration				<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	25	46	23	18	25	34	6.5
Maximum Detect				ND	ND	ND	ND	ND	0.6	1.2	ND	ND	1.2	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	25	46	23	18	25	34	6.5
Average Concentration				0.25	0.25	0.25	0.25	0.25				0.25	1.2	0.6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	8.6	28	10	13	17	19	3.6
Median Concentration				0.25	0.25	0.25	0.25	0.25	0.6	1.2	0.25	0.25	1.2	0.6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	6.5	29	8.4	13	17	19	4
Standard Deviation				0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.1	9.6	4.8	2.5	4.8	6.5	1.7
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sieved Asbestos %w/w Calculations

			Material Retained on Sieve		Material Passed through Sieve						
Sample ID	**Lab Report**	**Sieve Date**	**% Asb Content**	**Bonded ACM Weight (g)**	**Weight of AF/FA (g)**	**Weight of Soil Sample (g)**	**Soil Volume (L)**	**Soil Density (kg/L)**	**%w/w Asb in Soil**	**Applicable Criteria (w/w)**	**Suitable for onsite use?**
SP32-1	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-2	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-3	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-4	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-5	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-6	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-7	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-8	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-9	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP32-10	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP33-1	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP33-2	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP33-3	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-1	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-2	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-3	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-4	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-5	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-6	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-7	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-8	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-9	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-10	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-11	758441-AID	20-Nov-20	15	4.05	nd	--	11	1.8	**0.0031**	0.050%	✓
SP37-12	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-13	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-14	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-15	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-16	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-17	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-18	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-19	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-20	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-21	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓
SP37-22	-	20-Nov-20	-	-	-	-	11	-	-	Visual	✓

nd = Not Detected above Laboratory detection limits; -- = Not Required

			Lab Report Number	758441	758441		758441	758441		758441	758441	
			Field ID	SP33-3	DUP1-20201119	**RPD**	SP37-1	DUP2-20201120	**RPD**	SP37-10	DUP3-20201120	**RPD**
			Sampled Date/Time	19/11/2020	19/11/2020		20/11/2020	20/11/2020		20/11/2020	20/11/2020	
Chem_Group	**ChemName**	**Units**	**EQL**									
BTEX	Benzene	mg/kg	0.1 : 0.2 (Interlab)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Toluene	mg/kg	0.1 : 0.5 (Interlab)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Ethylbenzene	mg/kg	0.1 : 0.5 (Interlab)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Xylene (o)	mg/kg	0.1 : 0.5 (Interlab)	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Xylene (m & p)	mg/kg	0.2 : 0.5 (Interlab)	<0.2	<0.2	0	<0.2	<0.2	0	<0.2	<0.2	0
	Xylene Total	mg/kg	0.3 : 0.5 (Interlab)	<0.3	<0.3	0	<0.3	<0.3	0	<0.3	<0.3	0
Naphthalene	Naphthalene	mg/kg	0.5 : 1 (Interlab)	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Naphthalene	mg/kg	0.5 : 1 (Interlab)	<0.5	<0.5	0	<0.5	<0.5	0			
ne												
TRH NEPM (1999)	TRH >C6-C9 Fraction	mg/kg	20	<20	<20	0	<20	<20	0	<20	<20	0
	TRH >C10-C14 Fraction	mg/kg	20 : 50 (Interlab)	<20	<20	0	<20	<20	0	<20	<20	0
	TRH >C15-C28 Fraction	mg/kg	50 : 100 (Interlab)	**72**	**<50**	**36**	**<50**	**120**	**82**	<50	<50	0
	TRH >C29-C36 Fraction	mg/kg	50 : 100 (Interlab)	60	<50	18	**<50**	**100**	**67**	<50	<50	0
	TRH >C10-C36 Fraction	mg/kg	50	**132**	**<50**	**90**	**<50**	**220**	**126**	<50	<50	0
M (1999)												
TRH NEPM (2013)	TRH C6-C10 Fraction	mg/kg	20 : 10 (Interlab)	<20	<20	0	<20	<20	0	<20	<20	0
	TRH C6-C10 less BTEX	mg/kg	20 : 10 (Interlab)	<20	<20	0	<20	<20	0	<20	<20	0
	TRH >C10-C16 Fraction	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
	TRH >C10-C16 Fraction less N	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
	TRH >C16-C34 Fraction	mg/kg	100	110	<100	10	**<100**	**190**	**62**	<100	<100	0
	TRH >C10-C40 Fraction	mg/kg	100 : 50 (Interlab)	110	<100	10	**<100**	**190**	**62**	<100	<100	0
	TRH >C34-C40 Fraction	mg/kg	100	<100	<100	0	<100	<100	0	<100	<100	0
M (2013)												
Inorganics	Moisture Content (dried @ 103°C)	%	1	6.5	7	7	2.8	3.4	19	2.4	3.2	29
Metals	Arsenic	mg/kg	2 : 5 (Interlab)	**5.5**	**14**	**87**	**5**	**3.4**	**38**			
	Cadmium	mg/kg	0.4 : 1 (Interlab)	0.6	0.5	18	<0.4	<0.4	0			
	Chromium	mg/kg	5 : 2 (Interlab)	**21**	**65**	**102**	**7.8**	**12**	**42**			
	Copper	mg/kg	5	**17**	**55**	**106**	**5.4**	**7.5**	**33**			
	Lead	mg/kg	5	130	120	8	6.8	9.1	29			
	Mercury	mg/kg	0.1	**0.3**	**1.5**	**133**	**0.6**	**0.3**	**67**			
	Nickel	mg/kg	5 : 2 (Interlab)	**5.4**	**32**	**142**	5.3	6.7	23			
	Zinc	mg/kg	5	390	330	17	**34**	**48**	**34**			
PAH/Phenols	Acenaphthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Acenaphthylene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Benz(a)anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Benzo(a) pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Benzo(a)pyrene TEQ (lower bound)*	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Benzo(a)pyrene TEQ (upper bound)*	mg/kg	0.5	1.2	1.2	0	1.2	1.2	0			
	Benzo(a)pyrene TEQ (medium bound)*	mg/kg	0.5	0.6	0.6	0	0.6	0.6	0			
	Benzo(b&j)fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Benzo(g,h,i)perylene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Benzo(k)fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Chrysene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Dibenz(a,h)anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Fluorene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Phenanthrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	Pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			
	PAHs (Sum of total)	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0			

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 30 (1-10 x EQL); 30 (10-30 x EQL); 30 (> 30 x EQL))
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

			Lab Report Number	758441	ES2041429		758441	ES2041429	
			Field ID	SP33-3	TRIP 1 -20201119	**RPD**	SP37-1	TRIP 2-20201120	**RPD**
			Sampled Date/Time	19/11/2020	19/11/2020		20/11/2020	20/11/2020	
Chem_Group	**ChemName**	**Units**	**EQL**						
BTEX	Benzene	mg/kg	0.1 : 0.2 (Interlab)	<0.1	<0.2	0	<0.1	<0.2	0
	Toluene	mg/kg	0.1 : 0.5 (Interlab)	<0.1	<0.5	0	<0.1	<0.5	0
	Ethylbenzene	mg/kg	0.1 : 0.5 (Interlab)	<0.1	<0.5	0	<0.1	<0.5	0
	Xylene (o)	mg/kg	0.1 : 0.5 (Interlab)	<0.1	<0.5	0	<0.1	<0.5	0
	Xylene (m & p)	mg/kg	0.2 : 0.5 (Interlab)	<0.2	<0.5	0	<0.2	<0.5	0
	Xylene Total	mg/kg	0.3 : 0.5 (Interlab)	<0.3	<0.5	0	<0.3	<0.5	0
Naphthalene	Naphthalene	mg/kg	0.5 : 1 (Interlab)	<0.5	<0.5	0	<0.5	<0.5	0
	Naphthalene	mg/kg	0.5 : 1 (Interlab)	<0.5	<0.5	0	<0.5	<0.5	0
ıe									
TRH NEPM (1999)	TRH >C6-C9 Fraction	mg/kg	20	<20			<20		
	TRH >C10-C14 Fraction	mg/kg	20 : 50 (Interlab)	<20	<50	0	<20	<50	0
	TRH >C15-C28 Fraction	mg/kg	50 : 100 (Interlab)	72	<100	0	<50	<100	0
	TRH >C29-C36 Fraction	mg/kg	50 : 100 (Interlab)	60	<100	0	<50	<100	0
	TRH >C10-C36 Fraction	mg/kg	50	**132**	**<50**	**90**	<50	<50	0
ı (1999)									
TRH NEPM (2013)	TRH C6-C10 Fraction	mg/kg	20 : 10 (Interlab)	<20	<10	0	<20	<10	0
	TRH C6-C10 less BTEX	mg/kg	20 : 10 (Interlab)	<20	<10	0	<20	<10	0
	TRH >C10-C16 Fraction	mg/kg	50	<50	<50	0	<50	<50	0
	TRH >C10-C16 Fraction less N	mg/kg	50	<50	<50	0	<50	<50	0
	TRH >C16-C34 Fraction	mg/kg	100	110	<100	10	<100	<100	0
	TRH >C10-C40 Fraction	mg/kg	100 : 50 (Interlab)	**110**	**<50**	**75**	<100	<50	0
	TRH >C34-C40 Fraction	mg/kg	100	<100	<100	0	<100	<100	0
ı (2013)									
Inorganics	Moisture Content (dried @ 103°C)	%	1	6.5			2.8		
Metals	Arsenic	mg/kg	2 : 5 (Interlab)	5.5	6	9	5	<5	0
	Cadmium	mg/kg	0.4 : 1 (Interlab)	0.6	<1	0	<0.4	<1	0
	Chromium	mg/kg	5 : 2 (Interlab)	21	27	25	7.8	8	3
	Copper	mg/kg	5	**17**	**26**	**42**	**5.4**	**8**	**39**
	Lead	mg/kg	5	**130**	**59**	**75**	**6.8**	**10**	**38**
	Mercury	mg/kg	0.1	**0.3**	**1.4**	**129**	**0.6**	**0.3**	**67**
	Nickel	mg/kg	5 : 2 (Interlab)	**5.4**	**12**	**76**	5.3	6	12
	Zinc	mg/kg	5	**390**	**129**	**101**	**34**	**51**	**40**
PAH/Phenols	Acenaphthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Acenaphthylene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Benz(a)anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(a) pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(a)pyrene TEQ (lower bound)*	mg/kg	0.5	<0.5			<0.5		
	Benzo(a)pyrene TEQ (upper bound)*	mg/kg	0.5	1.2			1.2		
	Benzo(a)pyrene TEQ (medium bound)*	mg/kg	0.5	0.6			0.6		
	Benzo(b&j)fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(g,h,i)perylene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(k)fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Chrysene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Dibenz(a,h)anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Fluorene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Phenanthrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	Pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
	PAHs (Sum of total)	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 30 (1-10 x EQL); 3(
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratori

Contents

Trip Spike Recoveries (70% - 130% is acceptable)

SID	SDG	Lab_Report_Number	Matrix_Type	SampleCode	Field_ID	Method_Name	Compound	Trip_Spike_Result	Trip_Spike_Control	Result_Units	Spike_Recovery_%	Acceptable	Result_Type
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Benzene	NA	NA	NA	95	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Ethylbenzene	NA	NA	NA	90	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	m&p-Xylenes	NA	NA	NA	89	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Naphthalene	NA	NA	NA	110	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	o-Xylene	NA	NA	NA	88	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Toluene	NA	NA	NA	97	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	TRH C6-C10	NA	NA	NA	93	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	TRH C6-C9	NA	NA	NA	95	Y	REG
96	20 Nov 2020	758441	soil	S20-No37910	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Xylenes - Total	NA	NA	NA	88	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Benzene	NA	NA	NA	100	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Ethylbenzene	NA	NA	NA	95	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	m&p-Xylenes	NA	NA	NA	94	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Naphthalene	NA	NA	NA	86	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	o-Xylene	NA	NA	NA	94	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Toluene	NA	NA	NA	99	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	TRH C6-C10	NA	NA	NA	99	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	TRH C6-C9	NA	NA	NA	100	Y	REG
96	20 Nov 2020	758441	soil	S20-No37923	TRIP SPIKE	LTM-ORG-2010 TRH C6-C40	Xylenes - Total	NA	NA	NA	94	Y	REG

Field Blanks (soil)
Filter: Lab_Report_Number in('758441')

Lab Report Number	758441	758441
Field ID	TRIP BLANK	TRIP BLANK
Sampled_Date/Time	19/11/2020	20/11/2020
Sample Type	Trip_B	Trip_B

Chem_Group	**ChemName**	**Units**	**EQL**		
BTEX	Benzene	mg/kg	0.1	<0.1	<0.1
	Toluene	mg/kg	0.1	<0.1	<0.1
	Ethylbenzene	mg/kg	0.1	<0.1	<0.1
	Xylene (o)	mg/kg	0.1	<0.1	<0.1
	Xylene (m & p)	mg/kg	0.2	<0.2	<0.2
	Xylene Total	mg/kg	0.3	<0.3	<0.3
Inorganics	Moisture Content (dried @ 103°C)	%	1		
Metals	Arsenic	mg/kg	2		
	Cadmium	mg/kg	0.4		
	Chromium	mg/kg	5		
	Copper	mg/kg	5		
	Lead	mg/kg	5		
	Mercury	mg/kg	0.1		
	Nickel	mg/kg	5		
	Zinc	mg/kg	5		
Naphthalene	Naphthalene	mg/kg	0.5	<0.5	<0.5
PAH/Phenols	Acenaphthene	mg/kg	0.5		
	Acenaphthylene	mg/kg	0.5		
	Anthracene	mg/kg	0.5		
	Benz(a)anthracene	mg/kg	0.5		
	Benzo(a) pyrene	mg/kg	0.5		
	Benzo(a)pyrene TEQ (lower bound)*	mg/kg	0.5		
	Benzo(a)pyrene TEQ (upper bound)*	mg/kg	0.5		
	Benzo(a)pyrene TEQ (medium bound)*	mg/kg	0.5		
	Benzo(b&j)fluoranthene	mg/kg	0.5		
	Benzo(g,h,i)perylene	mg/kg	0.5		
	Benzo(k)fluoranthene	mg/kg	0.5		
	Chrysene	mg/kg	0.5		
	Dibenz(a,h)anthracene	mg/kg	0.5		
	Fluoranthene	mg/kg	0.5		
	Fluorene	mg/kg	0.5		
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5		
	Phenanthrene	mg/kg	0.5		
	Pyrene	mg/kg	0.5		
	PAHs (Sum of total)	mg/kg	0.5		
Prep-Preparation for Biota Ana	Weight of Sample Prepared	g			
PSD	<63 Micron	%W/W	0.1		
	>2000 Micron	%W/W	0.1		
	1000-2000 Micron	%W/W	0.1		
	125-250 Micron	%W/W	0.1		
	250-500 Micron	%W/W	0.1		
	500-1000 Micron	%W/W	0.1		
	63-125 Micron	%W/W	0.1		
TRH NEPM (1999)	TRH >C6-C9 Fraction	mg/kg	1	<20	<20
	TRH >C10-C14 Fraction	mg/kg	20		
	TRH >C15-C28 Fraction	mg/kg	50		
	TRH >C29-C36 Fraction	mg/kg	50		
	TRH >C10-C36 Fraction	mg/kg	50		
TRH NEPM (2013)	TRH C6-C10 Fraction	mg/kg	1	<20	<20
	TRH C6-C10 less BTEX	mg/kg	20	<20	<20
	TRH >C10-C16 Fraction	mg/kg	50		
	TRH >C10-C16 Fraction less N	mg/kg	50		
	TRH >C16-C34 Fraction	mg/kg	100		
	TRH >C10-C40 Fraction	mg/kg	100		
	TRH >C34-C40 Fraction	mg/kg	100		

Tables - Drainage validation

COPC	Soil										
	Direct Contact (mg/kg)			VI (mg/kg)						CCME (2008) Acute Risk	NEPM Management Limits (mg/kg)
	Commercial	IMW	Construction	Commercial (0.15mbgl)	Commercial (1 mbgl)	Commercial (>2-4mbgl)	Commercial (>4mbgl)	IMW	Construction		
Benzene	400	15000	1200	3.2	3.2	3.2	3.2	NL	NL	-	-
Naphthalene	9800	810000	67000	NL	NL	NL	NL	NL	NL	-	-
Benzo(a)pyrene TEQ	40	3000	200	-	-	-	-	-	-	-	-
Total Chromium[a]	21000	100,000	8200							-	
Chromium VI	3600	17000	1400	-	-	-	-	-	-	-	-
TRH C6-C10 (less BTEX)	28000	830000	69000	600	770	NL	NL	NL	NL	-	-
TRH C6-C10	-	-	-	-	-	-	-	-	-	1400	700
TRH C10-C16 (less N)	17000	540000	45000	NL	NL	NL	NL	NL	NL	-	-
TRH C10-C16	-	-	-	-	-	-	-	-	-	5200	1000
TRH C16-C34	27000	770000	64000	-	-	-	-	-	-	NL	3500
TRH C34-C40	27000	770000	64000	-	-	-	-	-	-	NL	10000
TPH (EC5-6) aliphatic	1200000	3700000	310000	-	-	-	-	-	-	-	-
TPH (>EC6-8) aliphatic	1200000	3700000	310000	480	610	880	1400	NL	NL	-	-
TPH (>EC8-10) aliphatic	24000	740000	62000	760	980	1400	2200	NL	NL	-	-
TPH (>EC10-12) aliphatic	24000	740000	62000	430	600	980	1800	NL	NL	-	-
TPH (>EC12-16) aliphatic	24000	740000	62000	4300	8300	17000	33000	NL	NL	-	-
TPH (>EC16-21) aliphatic	470000	4400000	370000	-	-	-	-	-	-	-	-
TPH (>EC21-34) aliphatic	470000	4400000	370000	-	-	-	-	-	-	-	-
TPH (>34) aliphatic	4700000	44000000	3700000	-	-	-	-	-	-	-	-
TPH (>EC8-10) aromatic	9500	300000	25000	110	150	230	420	NL	NL	-	-
TPH (>EC10-12) aromatic	9500	300000	25000	280	430	750	1400	NL	NL	-	-
TPH (>EC12-16) aromatic	9500	300000	25000	430	2800	5100	9800	NL	NL	-	-
TPH (>EC16-21) aromatic	7100	220000	18000	-	-	-	-	-	-	-	-
TPH (>EC21-34) aromatic	7100	220000	18000	-	-	-	-	-	-	-	-
TPH (>34) aromatic	7100	220000	18000	-	-	-	-	-	-	-	-

a - Assumes Total chromium is 17% Hexavalent chromium

ERM

						TRH NEPM (1999)				TRH NEPM (2013)								TRH Ali & Aro												
						TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH >C6-C9 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C16-C21 Aliphatic	TRH >C21-C35 Aliphatic	TRH >C5-C7 (Benzene) Aromatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						20	50	50	50	20	20	20	50	50	100	100	100	10	10	10	10	10	10	0.1	0.1	1	10	10	10	10
Clyde WARP SSTL (Direct Contact - Commercial)												28000		17000	27000		27000	1200000	24000	24000	24000	470000	470000			9500	9500	9500	7100	7100
Clyde WARP SSTL (Direct Contact - Construction Worker)												69000		45000	64000		64000	310000	62000	62000	62000	370000	370000			25000	25000	25000	18000	18000
Clyde WARP SSTL (Direct Contact - IMW)												830000		540000	770000		770000	3700000	740000	740000	740000	4400000	4400000			300000	300000	300000	220000	220000
Clyde WARP SSTL (Vapour Intrusion - Commercial) <1m																														
0-0.99m												600		NL				480	760	430	4300					110	280	430		
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																														
1-1.99m												770		NL				610	980	600	8300					150	430	2800		
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)												NL		NL				NL	NL	NL	NL					NL	NL	NL		
Clyde WARP SSTL (Vapour Intrusion - IMW)												NL		NL				NL	NL	NL	NL					NL	NL	NL	NL	NL
NEPM (1999) Management Limits - Commercial/Industrial (coarse)											700		1000		3500		10000													
Field_ID	**Location_Code**	**Sample_Type**	**Sample_Depth_Range**	**Lab_Report_Number**	**Sampled_Date**																									
TP20/21_0.8	TP20/21	Normal	0.7-0.9	744949	16/09/2020	880	2200	410	3490	<200	<200	<200	1500	1500	1900	3630	230	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/22_1.5	TP20/22	Normal	1.4-1.6	744949	16/09/2020	3100	5500	1700	10,300	<200	<200	<200	4900	4900	4900	10,900	1100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/23_1.5	TP20/23	Normal	1.4-1.6	744949	17/09/2020	1500	5400	1300	8200	<200	<200	<200	2700	2700	5300	8750	750	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/24_1.0	TP20/24	Normal	0.9-1	748112	29/09/2020	<20	<50	<50	<50	<20	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/25_0.7	TP20/25	Normal	0.7-0.8	749375	6/10/2020	1300	1600	68	2968	190	470	470	1900	1900	890	2790	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/26A_0.7	TP20/26a	Normal	0.6-0.7	749375	6/10/2020	330	6800	2300	9430	<20	<20	<20	640	640	8200	9680	840	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/27_0.45	TP20/27	Normal	0.35-0.45	749375	6/10/2020	<20	<50	<50	<50	<20	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/28_1.55	TP20/28	Normal	1.45-1.55	751224 & 752837	16/10/2020	2400	620	130	3150	470	1700	1700	2300	2300	460	2760	<100	<10	91	1800	2100	350	300	<0.1	<0.1	<1	300	610	240	410
TP20/29A_0.8	TP20/29a	Normal	0.7-0.8	751224 & 752837	16/10/2020	340	1300	250	1890	36	81	81	710	709.3	1100	1960	150	140	160	370	1700	1400	1100	<0.2	<0.2	5.7	170	990	1500	2000
TP20/29B_0.5	TP20/29b	Normal	0.5-0.6	751224 & 752837	16/10/2020	1600	6000	1200	8800	760	1100	1100	3100	3079	5500	9120	520	29	130	510	1600	520	200	<0.1	<0.1	1.6	31	200	160	160
TP20/29C_0.5	TP20/29c	Normal	0.4-0.5	751224 & 752837	16/10/2020	3600	2500	180	6280	830	1800	1800	4000	3987	1200	5200	<100	120	270	1000	1700	960	1300	<0.2	<0.2	6.7	290	1000	2500	11,000
TP20/30_0.5	TP20/30	Normal	0.4-0.5	751224	16/10/2020	3100	13,000	9100	25,200	1000	1600	1600	4100	4100	19,000	27,600	4500	-	-	-	-	-	-	-	-	-	-	-	-	-
TP20/31_0.55	TP20/31	Normal	0.45-0.55	751224	16/10/2020	240	2400	1600	4240	<20	<20	<20	600	600	3300	4820	920	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical Summary																														
Number of Results						13	13	13	13	13	13	13	13	13	13	13	13	4	4	4	4	4	4	4	4	4	4	4	4	4
Number of Detects						11	11	11	11	6	6	6	11	11	11	11	8	3	4	4	4	4	4	0	0	3	4	4	4	4
Minimum Concentration						<20	<50	<50	<50	<20	<20	<20	<50	<50	<100	<100	<100	<10	91	370	1600	350	200	<0.1	<0.1	<1	31	200	160	160
Minimum Detect						240	620	68	1890	36	81	81	600	600	460	1960	150	29	91	370	1600	350	200	ND	ND	1.6	31	200	160	160
Maximum Concentration						3600	13000	9100	25200	1000	1800	1800	4900	4900	19000	27600	4500	140	270	1800	2100	1400	1300	<0.2	<0.2	6.7	300	1000	2500	11000
Maximum Detect						3600	13000	9100	25200	1000	1800	1800	4900	4900	19000	27600	4500	140	270	1800	2100	1400	1300	ND	ND	6.7	300	1000	2500	11000
Average Concentration						1416	3644	1407	6461	279	545	545	2038	2036	3988	6716	712	74	163	920	1775	808	725	0.075	0.075	3.6	198	700	1100	3393
Median Concentration						1300	2400	410	4240	100	100	100	1900	1900	1900	4820	230	74.5	145	755	1700	740	700	0.075	0.075	3.65	230	800	870	1205
Standard Deviation						1272	3646	2437	6607	359	724	724	1636	1634	5180	7248	1202	66	77	646	222	471	556	0.029	0.029	3	126	380	1117	5137
Number of Guideline Exceedances						0	0	0	0	0	4	4	8	0	5	0	0	0	0	2	0	0	0	0	0	0	1	2	0	1
Number of Guideline Exceedances(Detects Only)						0	0	0	0	0	4	4	8	0	5	0	0	0	0	2	0	0	0	0	0	0	1	2	0	1

ERM

						BTEXN							PAH																				
						Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Pyrene	PAHs (Sum of total)
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						0.1	0.1	0.1	0.1	0.2	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Clyde WARP SSTL (Direct Contact - Commercial)						400						9800								40										9800			
Clyde WARP SSTL (Direct Contact - Construction Worker)						1200						67000								200										67000			
Clyde WARP SSTL (Direct Contact - IMW)						15000						810000								3000										810000			
Clyde WARP SSTL (Vapour Intrusion - Commercial) <1m																																	
0-0.99m						3.2						NL																		NL			
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																																	
1-1.99m						3.2						NL																		NL			
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)						NL						NL																		NL			
Clyde WARP SSTL (Vapour Intrusion - IMW)						NL						NL																		NL			
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																																	
Field_ID	**Location_Code**	**Sample_Type**	**Sample_Depth_Range**	**Lab_Report_Number**	**Sampled_Date**																												
TP20/21_0.8	TP20/21	Normal	0.7-0.9	744949	16/09/2020	<1	<1	<1	<1	<2	<3	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TP20/22_1.5	TP20/22	Normal	1.4-1.6	744949	16/09/2020	<1	<1	<1	<1	<2	<3	<5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	2.6	<0.5	0.7	3	1.2	9.9
TP20/23_1.5	TP20/23	Normal	1.4-1.6	744949	17/09/2020	<1	<1	<1	<1	<2	<3	<5	0.7	0.8	2.2	4.4	0.7	1.3	1.9	1.6	<0.5	<0.5	0.7	6.8	<0.5	3.4	2.7	<0.5	0.7	4.8	8.2	36.1
TP20/24_1.0	TP20/24	Normal	0.9-1	748112	29/09/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TP20/25_0.7	TP20/25	Normal	0.7-0.8	749375	6/10/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	1.5	2.2	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	4.3	<0.5	3.5	2.1	<0.5	14.3
TP20/26A_0.7	TP20/26a	Normal	0.6-0.7	749375	6/10/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	0.8	<0.5	1.7	9.5	8.7	12	12	12	2.8	3.9	2.3	19	1.6	2.4	1.4	1	<0.5	7.6	12	74.7
TP20/27_0.45	TP20/27	Normal	0.35-0.45	749375	6/10/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TP20/28_1.55	TP20/28	Normal	1.45-1.55	751224 & 752837	16/10/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	0.6	<0.5	1.7	<0.5	<0.5	2.8
TP20/29A_0.8	TP20/29a	Normal	0.7-0.8	751224 & 752837	16/10/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	0.7	1.8	0.7	1.6	0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	4.5	<0.5	0.5	9.8	1	21.2
TP20/29B_0.5	TP20/29b	Normal	0.5-0.6	751224 & 752837	16/10/2020	<1	<1	3.1	<1	<2	<3	21	5.3	2.4	5.4	7	4.6	7.3	7.3	7.3	2.5	1.6	0.9	11	1.4	2.9	16	0.9	7.5	51	13	133.4
TP20/29C_0.5	TP20/29c	Normal	0.4-0.5	751224 & 752837	16/10/2020	<1	<1	<1	<1	<2	<3	13	0.9	0.6	<0.5	0.6	<0.5	<0.5	1.2	0.7	<0.5	<0.5	<0.5	1	<0.5	<0.5	2.4	<0.5	8.2	4.4	0.9	19
TP20/30_0.5	TP20/30	Normal	0.4-0.5	751224	16/10/2020	0.3	0.1	0.2	<0.1	0.6	0.6	<0.5	15	3.6	40	250	100	220	220	220	75	30	44	220	77	37	58	31	4.1	250	120	1354.7
TP20/31_0.55	TP20/31	Normal	0.45-0.55	751224	16/10/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	0.7	0.7	0.8	1.4	1.1	<0.5	0.6	<0.5	0.7	<0.5	0.6	<0.5	<0.5	<0.5	0.6	0.8	4.7
Statistical Summary																																	
Number of Results						13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Number of Detects						1	1	2	0	1	1	3	8	7	5	7	5	5	13	13	3	4	4	10	3	5	9	3	8	9	8	10
Minimum Concentration						<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Minimum Detect						0.3	0.1	0.2	ND	0.6	0.6	0.7	0.7	0.6	1.6	0.5	0.7	0.8	1.2	0.6	2.5	0.6	0.7	0.5	1.4	0.6	0.6	0.9	0.5	0.6	0.8	2.8
Maximum Concentration						<1	<1	3.1	<1	<2	<3	21	15	3.6	40	250	100	220	220	220	75	30	44	220	77	37	58	31	8.2	250	120	1354.7
Maximum Detect						0.3	0.1	3.1	ND	0.6	0.6	21	15	3.6	40	250	100	220	220	220	75	30	44	220	77	37	58	31	8.2	250	120	1354.7
Average Concentration						0.24	0.23	0.43	0.22	0.48	0.7	3.4	2.2	0.95	4.1	21	9	19	19	19	6.4	3	3.9	20	6.3	3.7	7.2	2.7	2.2	26	12	129
Median Concentration						0.05	0.05	0.05	0.05	0.1	0.15	0.25	0.8	0.6	0.25	0.5	0.25	0.25	1.2	0.6	0.25	0.25	0.25	0.7	0.25	0.25	2.4	0.25	0.7	3	0.9	14.3
Standard Deviation						0.22	0.23	0.83	0.23	0.45	0.67	6.3	4.1	1.1	11	69	27	61	60	60	21	8.2	12	60	21	10	16	8.5	2.8	69	33	370
Number of Guideline Exceedances						0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)						0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

							TRH NEPM (1999)					TRH NEPM (2013)							TRH Aliphatic / Aromatic Split													BTEXN						
							TRH >C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C16-C21 Aliphatic	TRH >C21-C35 Aliphatic	TRH >C5-C7 (Benzene) Aromatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene
							mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL							20	20	50	50	50	20	20	50	50	100	100	100	10	10	10	10	10	10	0.1	0.1	1	10	10	10	10	0.1	0.1	0.1	0.1	0.2	0.3	0.5
Clyde WARP SSTL (Direct Contact - Construction Worker)													69000		45000	64000		64000	310000	62000	62000	62000	370000	370000			25000	25000	25000	18000	18000	1200						67000
Clyde WARP SSTL (Direct Contact - IMW)													830000		540000	770000		770000	3700000	740000	740000	740000	4400000	4400000			300000	300000	300000	220000	220000	15000						810000
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m 2-3.99m								NL		NL									880	1400	980	17000					230	750	5100			3.2						NL
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)								NL		NL									NL	NL	NL	NL					NL	NL	NL			NL						NL
Clyde WARP SSTL (Vapour Intrusion - IMW)								NL		NL									NL	NL	NL	NL					NL	NL	NL	NL	NL	NL						NL
NEPM (1999) Management Limits - Commercial/Industrial (coarse)												700		1000		3500		10000																				
Lab_Report_Number	**Field_ID**	**Location_Code**	**Sample_Type**	**Location_Type**	**Sample_Depth_Range**	**Sampled_Date**																																
743424	10_P3_NAPL	10_P3	Normal	Drainage Sludge	>2 - 4 m	10/09/2020	96	2000	7000	2500	13,000	250	240	2900	602	7800	7500	1500	<10	<10	190	620	650	890	<0.1	<0.1	<1	120	1400	1900	5000	<0.1	0.4	0.9	1.1	4.7	5.8	18
748112	D5D610-1	16D610-1	Normal	Drainage Sludge	>2 - 4 m	1/10/2020	280	9700	100,000	36,000	145,700	610	530	19,000	18,955	120,000	160,000	21,000	<40	140	1	1	1	1	<0.1	18	27	1	1	1	1	<1	48	9	7.2	20	28	45
748112	15D610-2	15D610-2	Normal	Drainage Sludge	>2 - 4 m	1/10/2020	300	<2000	20,000	8000	28,000	620	560	<2500	<2500	24,000	32,100	8100	<40	160	1	1	1	1	<0.4	4.3	<4	1	1	1	1	<0.5	44	3.1	3.8	11	15	19
749375	10D1070-2	10D1070-2	Normal	Drainage Sludge	>2 - 4 m	7/10/2020	110	16,000	85,000	36,000	137,000	260	240	26,000	25,987	96,000	152,000	30,000	<20	160	1600	8100	8500	12,000	<0.2	3.4	26	<10	14,000	20,000	61,000	<0.1	5.4	1.6	4.3	13	17	13
749375	14D920-3 4	14D920-3 4	Normal	Drainage Sludge	>2 - 4 m	7/10/2020	110	19,000	72,000	35,000	126,000	300	280	24,000	23,986	86,000	143,000	33,000	<50	260	1000	5700	6000	14,000	<0.5	<0.5	30	<10	10,000	16,000	68,000	<0.1	0.5	1.5	3.3	11	14	14
750747	11D1070-1	11D1070-1	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	<400	5000	25,000	5400	35,400	<400	<400	7500	7461	27,000	37,200	2700	<200	<200	1100	2300	3800	6100	<2	120	49	640	5900	7000	9200	<2	120	9.2	10	29	39	39
750747	11D460-3	11D460-3	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	27	2500	23,000	7700	33,200	49	47	6000	5997	25,000	35,500	4500	<10	29	<100	2500	2800	4300	<0.1	0.5	1.3	<100	5100	8600	24,000	<0.1	0.5	0.1	0.4	0.8	1.2	3
750747	9D610-1	9D610-1	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	130	1000	4900	2600	8500	190	160	1500	1500	6400	9500	1600	<50	81	210	910	1200	2600	<0.5	27	<5	<10	370	800	2400	<0.5	27	<0.5	<0.5	1.5	1.5	<2.5
750747	9D610-3	9D610-3	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	25	13,000	47,000	570	60,570	55	55	30,000	30,000	31,000	61,240	240	<10	36	1300	19,000	20,000	3400	<0.1	0.5	1.8	670	24,000	17,000	2300	<0.1	0.5	<0.1	<0.1	<0.2	<0.3	<0.5
Statistical Summary																																						
Number of Results							9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Number of Detects							8	8	9	9	9	8	8	8	8	9	9	9	0	7	8	9	9	9	0	7	6	5	9	9	9	0	9	7	7	8	8	7
Minimum Concentration							25	1000	4900	570	8500	49	47	1500	602	6400	7500	240	<10	<10	1	1	1	1	<0.1	<0.1	<1	1	1	1	1	<0.1	0.4	<0.1	<0.1	<0.2	<0.3	<0.5
Minimum Detect							25	1000	4900	570	8500	49	47	1500	602	6400	7500	240	ND	29	1	1	1	1	ND	0.5	1.3	1	1	1	1	ND	0.4	0.1	0.4	0.8	1.2	3
Maximum Concentration							<400	19000	100000	36000	145700	620	560	30000	30000	120000	160000	33000	<200	260	1600	19000	20000	14000	<2	120	49	670	24000	20000	68000	<2	120	9.2	10	29	39	45
Maximum Detect							300	19000	100000	36000	145700	620	560	30000	30000	120000	160000	33000	ND	260	1600	19000	20000	14000	ND	120	49	670	24000	20000	68000	ND	120	9.2	10	29	39	45
Average Concentration							142	7689	42656	14863	65263	282	257	13128	12860	47022	70893	11404	24	108	606	4348	4772	4810	0.22	19	16	166	6752	7922	19100	0.25	27	2.9	3.4	10	14	17
Median Concentration							110	5000	25000	7700	35400	250	240	7500	7461	27000	37200	4500	20	100	210	2300	2800	3400	0.1	3.4	2.5	5	5100	7000	5000	0.05	5.4	1.5	3.3	11	14	14
Standard Deviation							99	6940	35124	15790	55440	208	182	11546	11818	41990	62741	13026	30	81	636	6141	6397	5081	0.3	39	18	280	8098	7963	26829	0.32	40	3.7	3.4	9.7	13	16
Number of Guideline Exceedances							0	0	0	0	0	0	0	9	0	9	0	3	0	0	4	1	0	0	0	0	0	0	4	1	3	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)							0	0	0	0	0	0	0	8	0	9	0	3	0	0	4	1	0	0	0	0	0	0	4	1	3	0	0	0	0	0	0	0

							PAH																																								
							Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Pyrene	PAHs (Sum of total)	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,4-dimethylphenol	2,4-dinitrophenol	2,6-dichlorophenol	2-chlorophenol	2-methylphenol	2-nitrophenol	3-&4-methylphenol	4,6-Dinitro-2-methylphenol	4,6-Dinitro-o-cyclohexyl phenol	4-chloro-3-methylphenol	4-nitrophenol	Dinoseb	Pentachlorophenol	Phenol	tetrachlorophenols	Phenols (Total Halogenated)	Total Non-Halogenated Phenol
							mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL							0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	0.5	0.5	5	0.5	0.5	0.2	1	0.4	5	20	1	5	20	1	0.5	10	1	20
Clyde WARP SSTL (Direct Contact - Construction Worker)														200									67000																								
Clyde WARP SSTL (Direct Contact - IMW)														3000									810000																								
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m 2-3.99m																							NL																								
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)																							NL																								
Clyde WARP SSTL (Vapour Intrusion - IMW)																							NL																								
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																																															
Lab_Report_Number	**Field_ID**	**Location_Code**	**Sample_Type**	**Location_Type**	**Sample_Depth_Range**	**Sampled_Date**																																									
743424	10_P3_NAPL	10_P3	Normal	Drainage Sludge	>2 - 4 m	10/09/2020	85	31	82	220	140	56	56	56	<100	39	<100	300	26	46	210	12	110	620	340	556.6	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
748112	D5D610-1	16D610-1	Normal	Drainage Sludge	>2 - 4 m	1/10/2020	51	14	58	130	87	130	130	130	27	25	30	190	17	19	93	7.5	75	240	190	1253.5	<1	<1	<0.5	<1	<5	<0.5	<0.5	<0.5	<1	<1	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
748112	15D610-2	15D610-2	Normal	Drainage Sludge	>2 - 4 m	1/10/2020	20	3.4	8.4	7.9	5.6	8.3	8.3	8.3	5.1	5.2	2.9	14	0.8	6.6	21	0.9	30	33	12	176.8	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
749375	10D1070-2	10D1070-2	Normal	Drainage Sludge	>2 - 4 m	7/10/2020	54	26	49	97	140	180	180	180	39	35	55	200	18	35	130	9.5	150	540	230	1807.5	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
749375	14D920-3 4	14D920-3 4	Normal	Drainage Sludge	>2 - 4 m	7/10/2020	46	14	26	57	74	98	98	98	26	18	34	130	10	22	87	4.2	91	340	140	1119.2	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
750747	11D1070-1	11D1070-1	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	<0.5	2.8	6.8	6	3.6	5.2	5.2	5.2	2.6	0.9	1.4	6.7	0.5	13	23	<0.5	44	60	15	186.3	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	1.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
750747	11D460-3	11D460-3	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	7.3	2	6.5	28	25	36	36	36	15	9	12	46	4.9	6.4	23	1.9	8.5	84	36	315.5	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
750747	9D610-1	9D610-1	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	0.6	<0.5	1.1	1	<0.5	4.9	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
750747	9D610-3	9D610-3	Normal	Drainage Sludge	>2 - 4 m	15/10/2020	26	12	18	1.5	0.8	1	1.6	1.3	<0.5	<0.5	<0.5	3.3	<0.5	14	110	<0.5	4.5	300	39	529.1	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
Statistical Summary																																															
Number of Results							9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Number of Detects							8	8	8	8	8	8	9	9	6	7	6	9	7	8	9	6	9	9	8	9	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	0.6	<0.5	1.1	1	<0.5	4.9	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
Minimum Detect							1.6	2	6.5	1.5	0.8	1	1.2	0.6	2.6	0.9	1.4	0.6	0.5	6.4	0.6	0.9	1.1	1	12	4.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration							85	31	82	220	140	180	180	180	<100	39	<100	300	26	46	210	12	150	620	340	1807.5	<1	<1	<0.5	<1	<5	<0.5	<0.5	<0.5	<1	1.4	<5	<20	<1	<5	<20	<1	<0.5	<10	<1	<20
Maximum Detect							85	31	82	220	140	180	180	180	39	39	55	300	26	46	210	12	150	620	340	1807.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration							32	12	28	61	53	57	57	57	18	15	21	99	8.6	18	78	4.1	57	246	111	661	0.5	0.5	0.25	0.28	2.5	0.25	0.25	0.12	0.5	0.37	2.5	10	0.5	2.5	10	0.5	0.25	5	0.5	10
Median Concentration							26	12	18	28	25	36	36	36	15	9	12	46	4.9	14	87	1.9	44	240	39	529.1	0.5	0.5	0.25	0.25	2.5	0.25	0.25	0.1	0.5	0.2	2.5	10	0.5	2.5	10	0.5	0.25	5	0.5	10
Standard Deviation							29	11	28	75	59	65	65	65	18	15	22	110	9.6	15	68	4.5	53	225	120	603	0	0	0	0.083	0	0	0	0.05	0	0.4	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Pipe Details									Gas Testing - Upstream Pit (Pre-Cleaning)					Gas Testing - Downstream Pit (Pre-Cleaning)					Gas Testing - Upstream Pit (Post-Cleaning)					Gas Testing - Downstream Pit (Post-Cleaning)				
Pipe ID ("CDLD Area_Pipe Number")	Upstream Pit ID	Downstream Pit ID	Key Plan Area	x Co-Ords	Y Co-Ords	Date/time completed	Pipe Type	Other - Pipe Type	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%
17D200-1	17-P1	17-P2	17	151.0316536	-33.82824507	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D200-2	17-P1	17-P2	17	151.0317284	-33.82825491	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D300-1	17-P2	17-P1	17	151.0316608	-33.82825433	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D300-2	17-P3	17-P1	17	151.0316536	-33.8282817	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D300-2a	NA	17-P3	17	151.0316635	-33.82860821	27/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17D380-1	17-P3	17-P4	17	151.031863	-33.82860733	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D380-2	NA	17-P3	17	151.0316216	-33.82860201	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D380-3	18-P2	17-P4	17	151.031839	-33.82861886	27/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D200-1	NA	14-P2	14	151.0317567	-33.82898108	28/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D200-2	NA	14-P2	14	151.0317618	-33.82899805	28/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D300-2	14-P1	14-P2	14	151.031651	-33.82900208	28/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D300-4	14-P3	14-P2	14	151.0317645	-33.82900254	28/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D200-1	17-P1	17-P2	17	151.0317106	-33.82825274	28/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D200-2	Na	17-P2	17	151.0317471	-33.82825533	28/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P6300D-2	P6-3 (Cannot	P6-1	6	151.0316287	-33.82970067	31/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P6D300-1	NA	P6-1	6	151.0315446	-33.82968093	31/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D200-3	NA	14-P5	14	151.0322232	-33.82907429	31/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D200-4	NA	14-P5	14	151.0322639	-33.82907412	31/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D230-1	14-P1	14-P12	14	151.0314974	-33.82924138	31/08/2020	steel		0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D230-1a	14-P1	14-P12	14	151.0314879	-33.82922147	31/08/2020	other	Concrete ditch drain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D300-5	14-P3 (unabl	14-P5	14	151.0321608	-33.82907789	31/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D300-6	14-P4	14-P5	14	151.0322203	-33.82905388	31/08/2020	steel		0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D300-8	14-P13	14-P12	14	151.0315057	-33.8292625	31/08/2020	steel		0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D300-8a	14-P13	14-P12	14	151.0315506	-33.82924528	31/08/2020	other	Concrete ditch drain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D300-9	14-P15 (Unable to locate pit)	14-P13	14	151.0318848	-33.82934846	31/08/2020	other	Concrete ditch drain	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D375-1	14-P13	P6-2	14	151.0316057	-33.82965264	31/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18D150-1	NA	18D150-1	18	151.0331703	-33.82875096	1/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D230-2	14-P5A (filled	14D230-2	14	151.0325616	-33.82887425	2/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D300-16	14-P7	14D300-16	14	151.0327969	-33.82885632	2/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D150-1	NA	15D150-1	15	151.0331332	-33.8290307	2/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15D150-2	15P2	15D150-2	15	151.0330957	-33.82903477	2/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D150-3	15P3	15D150-3	15	151.0329525	-33.82907609	2/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D380-3 new	17-P4	17D380-3	17	151.0325799	-33.8287015	2/09/2020	steel		0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18D380-4	18-P8 (not located/uncovered yet)	18D380-4	18	151.0325863	-33.82869358	2/09/2020	steel		NA	NA	NA	NA	NA	0.1	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D150-1a	14-P11	14D150-1a	14	151.0326264	-33.82919654	3/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D300-7	14-P8	14D300-7	14	151.0325352	-33.82909168	3/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D460-1	14-P10	14D460-1	14	151.0326041	-33.82911951	3/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D460-2	15P9 (unable to locate pit)	14D460-2	14	151.0326731	-33.82921556	3/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14D300-7a	NA	14-P9	14	151.0325707	-33.82910065	8/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
14D920-1 and 14D920-2	14-P6	14-P9	14	151.0325717	-33.82909399	8/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0.8	0	0	0	0	0
14D150-3a	NA	14-P21a	14	151.032495	-33.82952276	9/09/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	Na	Na	NA	NA	0	0	0	0	0	0
14D300-15	14-P21a	14-P21	14	151.031964	-33.82891834	9/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14D380-3	NA	14-P21a	14	151.0325124	-33.82954527	9/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
10 D380-2	10-P5	10-P4	10	151.0326748	-33.82991927	11/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10D300-1a	NA	10-P4	10	151.0326459	-33.82994496	11/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
10D380-3	10-P6	10-P7	10	151.0329107	-33.82984836	11/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10D380-4	10-P7	10-P8	10	151.033068	-33.82989064	11/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10D150-2	NA	10-P18	10	151.0324247	-33.83042264	14/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
10D230-1a	NA	10-P13	10	151.0338417	-33.82986336	15/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D300-10	P11	P10	15	151.0334628	-33.82916326	15/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D300-11	15-P12	15-P11	15	151.0334732	-33.82914952	15/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D300-12	15-P13	15-P12	15	151.0334611	-33.82910149	15/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D300-13	15-P14 (could not uncover- under stockpile of rubble)	15-P13	15	151.0335134	-33.82913237	15/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D300-9	NA	15-P11	15	151.0334486	-33.82917391	15/09/2020	other	PVC	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0
15D100-10	NA	15-P24	15	151.0339093	-33.829067	16/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D100-6a	NA	15-P25	15	151.0340289	-33.82913866	16/09/2020	steel		NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D100-7	15-P26	15-P25	15	151.0340124	-33.82912416	16/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D150-4	NA	15P22	15	151.0335245	-33.82890703	16/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D150-5	15-P23	15-P24	15	151.0338876	-33.82905828	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D150-6	16-P7	15-P24	15	151.0339313	-33.82904348	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D150-7	NA	15-P25	15	151.0340242	-33.8291263	16/09/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D300-14	15-P15 (unable to uncover pit under rubble)	15-P21	15	151.0333885	-33.8290136	16/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
15D300-15	18-P8	15-P21	15	151.0333847	-33.82899479	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D100-2a	16-P1	16-P4	16	151.0342978	-33.82928178	16/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-1	16P2	16P4	16	151.0343133	-33.82927587	16/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-3	16-P5	16-P4	16	151.0342641	-33.8292713	16/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D200-1	16-P8b	16-P8a	16	151.0341707	-33.82895405	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-1	16-P87	16-P8a	16	151.0341577	-33.82896075	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-1a	NA	16-P8a	16	151.0341667	-33.82895996	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-2	19-P1	16-P8a	16	151.0341719	-33.82894177	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-10	16-P13	16-P14	16	151.0344662	-33.82905736	17/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-4	16P6	16P5	16	151.0341064	-33.82925618	17/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-5	16-P8b	16-P10	16	151.0343756	-33.82897706	17/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-9	16-P12 (unable to locate)	16-P13	16	151.0344573	-33.82906549	17/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0
16D230-1	16-P5	16-P7	16	151.0340807	-33.82911419	17/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-5	16-P8b	16-P10	16	151.0343756	-33.82897706	21/09/2020 0:28	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D150-11	16P14	16P10	16	151.0344468	-33.82897769	21/09/2020 0:28	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-3	16P21	16P20	16	151.0350384	-33.82977812	24/09/2020 5:39	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D380-1	NA (channel)	16P20	16	151.0350386	-33.82975989	24/09/2020 5:39	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11D300-1	11P2	15P29	15	151.0339967	-33.82975725	24/09/2020 5:39	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11D300-2	NA	15P29	15	151.0340053	-33.82973021	24/09/2020 5:39	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0
15D300-20	15P29	15P30	15	151.0335645	-33.82963399	24/09/2020 5:39	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15D300-22	NA	15P31	15	151.0334965	-33.82959518	24/09/2020 5:39	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0
15D300-21	15-P31	15-P30	15	151.0335174	-33.82960666	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D200-5	16P31	16P30	16	151.0341403	-33.82941141	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D200-4	16P30	16P29	16	151.0342135	-33.82943882	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D200-3	16P28	16P29	16	151.0343534	-33.82945633	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-4	16P21	16P22	16	151.0347848	-33.82980624	24/09/2020 5:40	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18D300-2	CPI 18	18-P	18	151.0336091	-33.82852427	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18D300-1	NA	18-P1	18	151.0336497	-33.82851178	24/09/2020 5:40	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0
18D250-1	NA	18-P1	18	151.0335412	-33.82851748	24/09/2020 5:40	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0
19D300-1	19-P2	19-P3	19	151.0342795	-33.82868763	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19D200-4	NA	19-P3	19	151.0342779	-33.82869153	24/09/2020 5:41	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17D150-1	17-P10	17-P8	17	151.032469	-33.8285104	24/09/2020 5:41	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D230-3	19P1a	16P17	16	151.0350338	-33.82908623	24/09/2020 5:41			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-a	NA (channel)	16P18	16	151.0351672	-33.82923526	24/09/2020 5:41	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D300-b	NA	16P18	16	151.0351766	-33.82923136	24/09/2020 5:41	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16D230-5	16P19	16P20	16	151.0350203	-33.82975624	24/09/2020 5:41	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ventia Comments (do not print)

Pipe Details	Post Cleaning Conditions				Validation										
Pipe ID ("CDLD Area_Pipe Number")	Cleaning Process Notes (optional)	Flush Water/ CCTV/visual Observations	Other - Flush Water/ CCTV/visual Observations	Visual Observations Comment	Contingency Actions Required? (as per SAQP)	Contingencies Implemented	Contingency additional notes	Compromised Pipework Identified?	If Yes Specify	Further Validation/ Decommissioning Action Required	Length of Compromsied Pipe	Number of Test Pits Required as per SAQP	Number of Test Pits Completed	Reasons for not meeting requirements (if applicable)	Pits backfilled?
17D200-1	Unable to flush	no visual evidence of contamination or residual hydrocarbon sludges			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to jet; pipe capped at on end in 17-P1 and jetter unable to fit in upstream pit 17-P2 due to pit setup (concrete overflow) To attempt breaking the concrete overflow tomorrow 28/8	No		No					Yes
17D200-2		no visual evidence of contamination or residual hydrocarbon sludges		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Could not jet pipe due to drain setup (concrete overflow in the middle of drain)- not enough space to fit jetter To attempt breaking concrete overflow for jetter access tomorrow 28/8	No		No					Yes
17D300-1		no visual evidence of contamination or residual hydrocarbon sludges		Slightly grey water	yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
17D300-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
17D300-2a	Pipe not on maps	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
17D380-1	HC Odours during jetting (max VOC of 12ppm)	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted six rounds of flushing	No		No					Yes
17D380-2	Pipe not on maps	no visual evidence of contamination or residual hydrocarbon sludges		Clear water, stained glass	yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
17D380-3		no visual evidence of contamination or residual hydrocarbon sludges		Grey water, potentially mixing with sediments	No - validation criteria met	-	-	No		No					Yes
14D200-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
14D200-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D300-2		no visual evidence of contamination or residual hydrocarbon sludges		Glass stained from tar on hose	No - validation criteria met	-	-	No		No					Yes
14D300-4		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
17D200-1		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No		No					Yes
17D200-2	Unable to clean pipe, pipe appears to be concreted in	no visual evidence of contamination or residual hydrocarbon sludges		Photo of water dripping out of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe, pipe appears to be filled with concrete with a few leaks, however water coming out of pipe appears to be clean	No		No					Yes
P6300D-2	Could not locate upstream pit P6-3, potentially does not exist	no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown due to soil sediments in drain	yes	conduct additional round of flushing	Conducted three runs of flushing	No		No					Yes
P6D300-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
14D200-3		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met			No		No					Yes
14D200-4	Jetter went in ~1m	no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown	yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D230-1	Unable to jet from this pipe from this pit, potential blockage	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean fully; potential blockage, pipe jetter unable to move through pipe, stuck at half a metre but jetter water coming back out clean	No		no					Yes
14D230-1a		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
14D300-5	Unable to locate upstream pit 14-P3	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D300-6		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D300-8	Unable to clean pipe, jetter stuck at 1m, pipe filled with rocks	-			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Potentially blocked drain. Attempted flushing from upstream pit, jetter unable to move through pipe as it was filled with rocks, water from jetter coing back out (not collapsed or broken)	No		No					Yes
14D300-8a	Ditch drain	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D300-9	Jetter went in ~5m roughly to where 14-P15 should be (unable to locate P15)	no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown turbid water due to soil sediments in drain	yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
14D375-1		no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown due to soil sediments in drain	yes	conduct additional round of flushing	Conducted five rounds of flushing	No		No					Yes
18D150-1	Jetter initially went in 18m then went in to 25m; water that wasn't from jetter started to gush out.	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
14D230-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
14D300-16		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
15D150-1	Jetter went in ~15m, Water initially brownish (potentially rust)	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
15D150-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
15D150-3		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No		No					Yes
17D380-3 new	Max VOC of 50ppm during cleaning	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
18D380-4	Max VOCs of 20ppm during cleaning	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted five rounds of flushing	No		No					Yes
14D150-1a					yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D300-7					yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D460-1					yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
14D460-2					yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D300-7a	Pipe not on map	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D920-1 and 14D920-2	Roughly 35 tonnes of water used (two and a half truck loads), max VOC reading of 112ppm during flushing	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted over 20 rounds of flushing	No		No					Yes
14D150-3a		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No		No					Yes
14D300-15		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No		No					Yes
14D380-3		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No		No					Yes
10 D380-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
10D300-1a	Pipe not on maps	no visual evidence of contamination or residual hydrocarbon sludges		Slight brown water due to soil sediments in pipe	yes	conduct additional round of flushing	Conducted three rounds of flushing	No		No					Yes
10D380-3		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No		No					Yes
10D380-4		no visual evidence of contamination or residual hydrocarbon sludges		Slightly cloudy	yes	conduct additional round of flushing	Conducted five rounds of flushing	No	-	No					Yes
10D150-2		no visual evidence of contamination or residual hydrocarbon sludges		Water coming out of pipe clear	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Conducted two rounds of flushing and water was coming out clean, jetter only extended 1m, potentially blocked with rocks, no evidence of hydrocarbons (no odours, no VOCs, no staining)	No	-	no					Yes
10D230-1a		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted five rounds of flushing	No	-	No					Yes
15D300-10		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
15D300-11		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
15D300-12		no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown due to soil sediments	yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
15D300-13		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
15D300-9		no visual evidence of contamination or residual hydrocarbon sludges		Brown water- mixing with soil sediments at the end of this pipe	yes	conduct additional round of flushing	Conducted six rounds of flushing, very short line, brown water due to soil sediments at the end of pipe but no visual signs of hydrocarbon contamination	No	-	No					Yes
15D100-10		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes
15D100-6a	Pipe not on map, extends ~5m	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
15D100-7		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
15D150-4	Shallow pipe, just underneath ballast rock leading to ditch drain	other	Photo of pipe leading to ditch drain	Pipe opens up towards the end	yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
15D150-5		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
15D150-6		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
15D150-7		no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown due to soil sediments	yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
15D300-14		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes
15D300-15		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
16D100-2a		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
16D150-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
16D150-3		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
16D200-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D300-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted six rounds of flushing	No	-	No					Yes
16D300-1a	Pipe not on map	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
16D300-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D150-10		no visual evidence of contamination or residual hydrocarbon sludges		Slight brown tinge due to rusty pipe	yes	conduct additional round of flushing	Conducted 3 rounds of flushing	No	-	No					Yes
16D150-4		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted 3 rounds of flushing	No	-	No					Yes
16D150-5		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D150-9		no visual evidence of contamination or residual hydrocarbon sludges		Slight brown tinge due to rust in pipes	yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D230-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D150-5		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D150-11		no visual evidence of contamination or residual hydrocarbon sludges		Photo not taken	yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
16D300-3		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D380-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
11D300-1		no visual evidence of contamination or residual hydrocarbon sludges		Slightly brown due to soil sediments in upstream pit	yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
11D300-2		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
15D300-20		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes
15D300-22		no visual evidence of contamination or residual hydrocarbon sludges		Slightly reddish due to potential rust in pipe	yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
15D300-21		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
16D200-5		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes
16D200-4		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes
16D200-3		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes
16D300-4		no_visual_evidence_of_contamina		Slightly brown due to mixing with soil sediments in upstream pit	yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
18D300-2		no visual evidence of contamination or residual hydrocarbon sludges		Slightly cloudy	yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
18D300-1		no visual evidence of contamination or residual hydrocarbon sludges		Slightly cloudy	yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
18D250-1	Unable to clean line fully as pipe bends 120 degrees, jetter can't get around bend, only cleaned straight line (~15m)	no visual evidence of contamination or residual hydrocarbon sludges		Slightly grey	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Only first 15m of line able to be cleaned (straight line, no bends), jetter unable to go through bends	No	-	No					Yes
19D300-1		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
19D200-4		no visual evidence of contamination or residual hydrocarbon sludges		Slightly cloudy	yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
17D150-1		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes
16D230-3		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D300-a	Pipe not on maps				yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes
16D300-b	Pipe not on map	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes
16D230-5		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes

Pipe Details									Gas Testing - Upstream Pit (Pre-Cleaning)					Gas Testing - Downstream Pit (Pre-Cleaning)					Gas Testing - Upstream Pit (Post-Cleaning)					Gas Testing - Downstream Pit (Post-Cleaning)					Post Cleaning Conditions				Validation											Ventia Comments (do not print)
Pipe ID ("CDLD Area_Pipe Number")	Upstream Pit ID	Downstream Pit ID	Key Plan Area	x Co-Ords	Y Co-Ords	Date/time completed	Pipe Type	Other - Pipe Type	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	Cleaning Process Notes (optional)	Flush Water/ CCTV/visual Observations	Other - Flush Water/ CCTV/visual Observations	Visual Observations Comment	Contingency Actions Required? (as per SAQP)	Contingencies Implemented	Contingency additional notes	Compromised Pipework Identified?	If Yes Specify	Further Validation/ Decommissioning Action Required	Length of Compromsied Pipe	Number of Test Pits Required as per SAQP	Number of Test Pits Completed	Reasons for not meeting requirements (if applicable)	Pits backfilled?	
18D300-3	CPI 18	18-P5	18	151.0336106	-33.82865888	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes	
18D300-4	18P6	18-P5	18	151.0336567	-33.82866873	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
15D300-17	15P28	18-P7	18	151.0336747	-33.82880091	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges		Slight brown tinge due to soil sediments in pit	yes	conduct additional round of flushing	Conducted six rounds of flushing	No	-	No					Yes	
18D380-5	18-P7	18-P8	18	151.0333827	-33.82877116	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted seven rounds of flushing	No	-	No					Yes	
19D380-1	19-P2	19-P1	19	151.0341275	-33.82885447	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted seven rounds of flushing	No	-	No					Yes	
18D380-6	18-P7	19-P1	19	151.0341516	-33.82886034	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted 7 rounds of flushing	No	-	No					Yes	
16D150-26	16-P33 (unable to locate)	16-P31	16	151.0341411	-33.82887124	25/09/2020 5:47	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges		No Photo taken	No - validation criteria met	-	-	No	-	No					Yes	
16D230-4	NA (channel)	19P1a	19	151.0350608	-33.8289732	25/09/2020 5:48	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes	
6D230-3	6-P5	NA	6	151.0321434	-33.83061492	28/09/2020 2:48	steel		NA	NA	NA	NA	NA	0		0	0	0	NA	NA	NA	NA	NA	0		0	0	0	VOC reading of 20ppm when cleaning, water running out of pipe was clear but when jetted the line water turned black and sludgy	no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted 10 rounds of flushing	No	-	No					Yes	
9D150-2	9-P26	9-P27	9	151.032878	-33.83115057	28/09/2020 4:22	other	PVC	NA	MA	NA	NA	NA	0	0	0	0	0	NA	MA	NA	NA	NA	0	0	0	0	0	Unable to clean pipe, jetter does not extend past ~0.5m	other		Photo of pipe and pits	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as jetter cannot move through pit. Getting stuck at 0.5m, potentially blocked as jetter water runs back out of pipe (no hole within pipe where water is lost)	No	-	no					Yes	
9D150-2a	NA	9-P27	9	151.0328668	-33.83114948	28/09/2020 4:22	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Pipe not on maps, unable to jet pipe	other		Photo of pipe and pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to jet pipe, potentially blocked- water comes back out of it (no hole within pipe where water is lost)	No	-	no					Yes	
9D230-2	9-P16	9-P17	9	151.0331387	-33.83094873	28/09/2020 5:26	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted five rounds of flushing	No	-	No					Yes	
9D230-3	9-P21	9-P170	9	151.0331563	-33.83097518	28/09/2020 5:26	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
9D230-1	9-P16	9-P15	9	151.0330491	-33.83088021	28/09/2020 5:26	steel		00	0	0	0	0	0	0	0	0	0	00	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges		Slightly cloudy	No - validation criteria met	-	-	No	-	No					Yes	
9D150-3	9-P29	9-P18	9	151.0331802	-33.83094341	29/09/2020 2:03	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
9D230-4	9-P18	9-P13	9	151.0331726	-33.83090435	29/09/2020 2:03	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes	
9D250-1	9-P5	9-P15	9	151.0330103	-33.83088541	29/09/2020 2:03	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
9D100-1	NA	9-P6	9	151.0330505	-33.83075855	29/09/2020 2:03	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes	
9D150-4	9-P30	9-P29	9	151.0331497	-33.8310595	29/09/2020 2:08	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes	
9D230-5	9-P14	9-P13 (unable to locate)	9	151.0334412	-33.83073625	29/09/2020 5:25	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes	
9D100-8	NA	9-P14	9	151.0336353	-33.830823	29/09/2020 5:25	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
9D150-8	9-P10 (does not appear to be a pit)	9-P9	9	151.0334241	-33.83077435	29/09/2020 5:25	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes	
9D150-9a	9-P12 (does not appear to be a pit)	9-P14	9	151.0336083	-33.83083361	29/09/2020 5:25	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
9D150-7	9-P9	9-P7	9	151.0334433	-33.83073709	29/09/2020 5:25	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes	
9D150-6	9-P8	9-P7	9	151.0334433	-33.83073709	29/09/2020 5:25	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	No					Yes	
12D150-3	NA	12-P5 (sewer man hole)	12	151.0338702	-33.83066651	2/10/2020 5:30	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean				yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Did not clean as pit was a sewer manhole, strong sewer odours, no evidence of hydrocarbons (odours, VOCs, staining on walls)	No	-	No					Yes	
12D150-1	NA	12-P4 (not a pit/ unable to locate pit)	12	151.0338149	-33.83157507	2/10/2020 5:30	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe	yes	Excavate and remove affected pipe and surrounding soils	No pit, Unable to clean pipe, very shallow ~50mm bgl, to be removed, no evidence of hydrocarbons	No	-	No					Yes	Validated
15D300-a	15P38	15P37	15	151.0340478	-33.82895665	2/10/2020 5:30	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges		Unable to take sample, took Photo of jetter water coming out	yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes	
12D150-9	12-P9 (unable to locate)	12-P13	12	151.0351393	-33.83130228	2/10/2020 5:31	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		NO Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as jetter couldn't not be put fully through pipe (only extends 0.5m), potentially blocked, however no evidence of hydrocarbon contamination (no odours, no VOCs)	No	-	No					Yes	
12D150-8	12-P12	12-P13	12	151.035167	-33.8312421	2/10/2020 5:31	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to send jetter fully through pipe, stuck at 1m potentially blocked, jetter water coming back (not collapsed/broken)	No	-	No					Yes	
12D150-7	NA	12-P12	12	151.034838	-33.83137554	2/10/2020 5:31	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to put jetter through pipe	other		Photo of exposed pipe pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to jet pipe- potentially blocked, pipe exposed but unable to tell if it is broken, however no evidence of hydrocarbons (no odours, no VOCs)	No	-	no					Yes	
12D230-2	NA	12-P10	12	151.0345695	-33.83141933	2/10/2020 5:31	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Jetter only went in 1m but water was clean	no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	no					Yes	
12D230-1	NA	12-P10	12	151.0345747	-33.83143405	2/10/2020 5:31	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			No - validation criteria met	-	-	No	-	no					Yes	
9D460-6	10-P17	9-P4	9	151.0336699	-33.83059766	13/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Max VOCreading of 20ppm when cleaning	no visual evidence of contamination or residual hydrocarbon sludges		Unable to collect water sample due to access isues	yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
15D300-16	NA	15P28	15	151.0336967	-33.82902593	13/10/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to fully clean	other		No Photo taken	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetted five times, jetter getting stuck at 1m, potentially blocked, water coming out clean	No	-	No					Yes	
12D 460-1	12-P6	9-P4	12	151.0336261	-33.83061429	13/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges		Unable to grab a sample due to access issues	yes	conduct additional round of flushing	Conducted five rounds of flushing	No	-	No					Yes	
9D300-3	NA	12-P2	12	151.0338432	-33.83063056	13/10/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
11D380-1	11-P11	12-P8	11	151.0348648	-33.8307339	14/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted three rounds of flushing	No	-	No					Yes	
11D380-c	11-P7	11-P11c	11	151.0349143	-33.83008192	15/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted two rounds of flushing	No	-	No					Yes	
11D380-b	11-P11b	11-Pc	11	151.0349383	-33.83014604	15/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean full length of pipe (1m off)	no visual evidence of contamination or residual hydrocarbon sludges			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Conducted five rounds of flushing, potentially block 1m away from upstream pit, jetter water coming back clean	No	-	No					Yes	
11D380-a	11-P11a	11-P11b	11	151.0349042	-33.83034322	15/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pit and pipe not on maps, unsure of layout and depths	no visual evidence of contamination or residual hydrocarbon sludges			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Conducted six rounds of flushing, unable to clean assumed length (2m away from assumed pit) of pipe as pipe potentially drops to lower pit, length of pipe covered by jetter was cleaned though	No	-	No					Yes	
11D380-2	11-P9	11-P11	11	151.0348826	-33.83058135	15/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean full length of pipe	no visual evidence of contamination or residual hydrocarbon sludges			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to flush entire line, jetter got through to upstream pit once but was unable to get through after that, potentially blocked, but water was coming back out clean	No	-	No					Yes	
11D460-2	NA	11-P5	15	151.0339776	-33.83023669	15/10/2020	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Pipe is in wrong alignment than what is shown on maps; instead of running east west it runs north south	no visual evidence of contamination or residual hydrocarbon sludges		Slightly cloudy	yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
10D460-4	10-P11	11-P3	10	151.0339333	-33.83054954	15/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted four rounds of flushing	No	-	No					Yes	
11D460-1	11-P5	11-P4	11	151.0338733	-33.83055558	15/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges			yes	conduct additional round of flushing	Conducted seven rounds of flushing	No	-	No					Yes	
10D380-1	10-P3	10-P4	10	151.0325902	-33.82990045	11/09/2020	steel		0.5	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0		no visual evidence of contamination or residual hydrocarbon sludges		Slightly grey	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetter unable to go fully through pipe due to potential blockage (only goes in roughly 4m out of 10m), water coming out of upstream pit, potential blockage on rock and hardened tar pieces	No		No - Include in Long Term Management Plan					Yes	Validated
9D150-2b	NA	9-P27	9	151.0328713	-33.83114286	28/09/2020 4:22	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Not on maps	other		Photo of pipe and pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to jet pipe, jetter not moving through pipe but jetter water comes back out (no hole within pipe where water is lost)	No	-	No - Include in Long Term Management Plan					Yes	
15D610-1	18-P7	15-P37	15	151.0340356	-33.82893879	2/10/2020 5:31	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	HC odours when cleaning, max VOC reading of 10pmm	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe, flushed 10 times, planks of wood and concrete pieces stuck at bottom of pit (unable to remove from pit, too narrow and deep).	No	-	No - Include in Long Term Management Plan					Yes	Unable to clean, presence of rubble in line, jetter got stuck
16D610-1	16P32	11P2	16	151.0340437	-33.82984031	2/10/2020 5:31	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean	other		Photo of tarry material	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Conducted 10 rounds of flushing, tarry material getting pulled out of pipes very similar to 9-P (similar consistency and viscosity), took a sample of material from jetter hose (ID: 16D610-1)	No	-	No - Include in Long Term Management Plan					Yes	Unable to clean, presence of rubble in line, jetter got stuck
11D1070-2	11-P2	11-P7	11	151.0341003	-33.82973013	13/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean	other		No Photo taken	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Adopted five flush method, black tarry material encountered however unable to sample due to access issues (deep but narrow pit)	No	-	No - Include results from closest pipe in Long Term Management Plan					Yes	
15D610-2	15P37	16P32	15	151.0340953	-33.82950105	2/10/2020 5:30	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean	other		No Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to fully clean pipe, jetter stuck at 5m, potentially blocked on tar /black sandy sediment, sampled hardened tar (stuck in vac truck hose) (sample ID:15D610-2)	No	-	No - Include results in Long Term Management Plan					Yes	
10D1070-1	10-P1	10-P3	10	151.0324299	-33.8297461	6/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean, lots of tar/sludge in pipe, max VOC readings of 98ppm while flushing	other		Photo of pit with black viscous tarry material	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Flushed 20+ times, unable to clean pipe, sampled tarry material pulled from pipe on the 10/9/20 (sample ID: 10-P3)	No	-	No - Include results in Long Term Management Plan					Yes	
14D920-3 and 14D920-4	14-P11	10-P1	14	151.0324686	-33.82961509	6/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean pipe, lots of tarry material, max VOC reading of 86 ppm when flushing	other		Sample of black viscous tarry material	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Flushed 20+ times unable to clean pipe, lots of black tarry material (similar to 10-P3) being pulled up by jetter - sampled (sample ID: 14D920-3,4)	No	-	No - Include results in Long Term Management Plan					Yes	
10D920-1	10-P1	10-P12	10	151.0331947	-33.82972393	7/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean pipe, jetter does not extend full length only about 3/4 of the pipe length	other		Photo of hardened tar piece	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Adopted nominal five flushes when tar was encountered, tarry material was more hard and and not as viscous as previously encountered- unable to collect a sample of material, jetter was getting stuck on this material 3/4 of the way along the pipe	No	-	No - Include results in Long Term Management Plan					Yes	
11D1070-1 and 10D920-2	11-P2	10-P12	11	151.0340271	-33.82982954	7/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean pipe, max VOC reading of 90 ppm when cleaning	other		Photo of hardened tar	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Tar observed-adopted five flush method, unable to fully clean, jetter pulling out hardened tar and sediment pieces and vac truck hose getting blocked, sampled (ID: 11D1070-1)	No	-	No - Include results in Long Term Management Plan					Yes	
10D1070-2	9-P1	10-P3	9	151.0324747	-33.82987266	7/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean	other		Photo of pit, full of black tarry material	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe, adopted five flushes method when tarry material was observed, similar consistency to material from 10-P3, sampled (ID: 10D1070-2)	No	-	No - Include results in Long Term Management Plan					Yes	
11D1070-2	11-P2	11-P7	11	151.0349534	-33.82993151	8/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean pipe, HC odours when flushing, max VOC reading of 57ppm when cleaning	other		Photo of tarry material in pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to fully clean, black tarry sludge material observed , adopted five flush method , unable to collect sample due to access issues	No	-	No - Include results in Long Term Management Plan					Yes	
11D1070-3	11-P8	11-P7	11	151.034947	-33.82989928	8/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean, HC odours when jetting	other		Photo of tarry material on jetter hose	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to fully clean pipe, tarry material observed - adopted five flushes method, unable to sample material due to access issues.	No	-	No - Include results in Long Term Management Plan					Yes	
9D610-3 and 9D610-2	9-P2	9-P4	9	151.033631	-33.83058165	13/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean, max of 54ppm when cleaning.	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Adopted five flush method, lots of black sludge within pipes, unable to fully clean pipe, sampled sludge (sample ID: 9D610-3)	No	-	No - Include results in Long Term Management Plan					Yes	
9D610-1	9-P1	9-P2	9	151.0330165	-33.83055269	13/10/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean pipe, max VOC reading of 37ppmvwhen cleaning	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Adopted five flush method, black silty sludge material in pipes, unable to fully clean pipe, sampled material (Sample ID: 9D610-1)	No	-	No - Include results in Long Term Management Plan					Yes	
11D460-3	11-P10 (unable to locate)	11-P3	11	151.0339922	-33.8305318	19/10/2020	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to fully clean pipe, max VOC reading of 35ppm when cleaning	other		Photo of tar in pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to fully clean pipe, adopted five flush method due to amount of tar being pulled out of line, sampled tar (ID: 11D460-3)	No		No - Include results in Long Term Management Plan					Yes	
17D100-1	17-P1	17-P2	17	151.0317339	-33.82828081	27/08/2020	other	Pipe does not exist	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No		No - Unable to be located/ Inaccessible					Yes	
14D300-1	NA	14-P1	14	151.0315877	-33.82890321	28/08/2020	other	Pipe does not exist	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		no visual evidence of contamination or residual hydrocarbon sludges		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No		No - Unable to be located/ Inaccessible					Yes	
14D300-3	NA	14-P1	14	151.0315908	-33.82890493	28/08/2020	other	Pipe does not exist	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		no visual evidence of contamination or residual hydrocarbon sludges		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No		No - Unable to be located/ Inaccessible					Yes	
14D300-3a	NA	14-P1	14	151.0316854	-33.82896834	28/08/2020	other	Does not exist	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		-			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No		No - Unable to be located/ Inaccessible					Yes	
14D380-1	NA	14-P1	14	151.0314899	-33.82897484	28/08/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean - pipe runs through pit	other	Photo of pipe running through pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe - pipe was enclosed and running through pit	No		No - Unable to be located/ Inaccessible					Yes	
14D300-8	14-P12	14-P13	14	151.0318564	-33.82932985	31/08/2020	other	Could not locate pipe	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Could not uncover pipe, attempted further excavation of pit/ using gurney to jet the pit	other		Photo of pit- only ditch drain (14D300-8a) was able to be reached as shown in Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No		No - Unable to be located/ Inaccessible					Yes	
14D200-5	14-P6	14D200-5	14	151.0326337	-33.82888129	2/09/2020	steel		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- down pipe	no visual evidence of contamination or residual hydrocarbon sludges	Photo of down pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Downwards enclosed pipe- unable to clean	No		No - Unable to be located/ Inaccessible					Yes	
15D100-2	NA	15D100-2	15	151.032934	-33.82904411	2/09/2020	steel		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean pipe	other	Photo of pit filled with rubble		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to uncover pipe due to size and amount of rubble (concrete blocks/bricks) in pit, unable to excavate out rubble due to size/depth of pit	No		No - Unable to be located/ Inaccessible					Yes	
15D230-1	15P4 (Could	15D230-1	15	151.0329306	-33.8290947	2/09/2020	steel		NA	NA	NA	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to jet pipe due to pit being too deep and concrete blocks at the bottom blocking jetter	other	Photo of pit and pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to jet pipe due to concrete block in pit hindering jetter, unable to remove block with excavator	No		No - Unable to be located/ Inaccessible					Yes	
18D100-1	NA	18D100-1	18	151.0332319	-33.82872133	2/09/2020	steel		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		no visual evidence of contamination or residual hydrocarbon sludges	Photo of.pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to reach pipe without being in pit due to depth of pit	No		No - Unable to be located/ Inaccessible					Yes	
15D100-1	NA	15D100-1	15	151.0330245	-33.82902182	3/09/2020	other	Unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean, unable to locate pipe				yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pipe	No		No - Unable to be located/ Inaccessible					Yes	
15D100-3	15P7 (could not locate pit)	15D100-3	15	151.0329084	-33.82915597	3/09/2020	other	Could not locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean, unable to locate pipe		Area where pits and pipe were supposed to be according to maps		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pits and pipe	No		No - Unable to be located/ Inaccessible					Yes	
15D230-2	15P9	15P10	15	151.031946	-33.82995144	4/09/2020	other	Could not uncover pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Location of pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to uncover pit/ pipe	No		No - Unable to be located/ Inaccessible					Yes	
14D300-10	14-P15 (Unable to locate pit)	14-P16 (Unable to locate pit)	14	151.031885	-33.82936883	8/09/2020	other	Unable to uncover pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other	Photo of pit location	Pits potentially concreted over	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to uncover pit and pipe- potentially concreted over	No		No - Unable to be located/ Inaccessible					Yes	
14D300-11	14-P16 (Unable to locate pit)	14-P17 (Unable to locate pit)	14	151.0320422	-33.82936518	8/09/2020	other	Unable to uncove pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of location of pits	Pits concreted over	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to uncover pit and pipe- potentially concreted over	No		No - Unable to be located/ Inaccessible					Yes	
14D300-12	14-P17 (Unable to locate pit)	14-P18 (Unable to locate pit)	14	151.0322187	-33.82939649	8/09/2020	other	unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of location of pit	Appears to be concreted over	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pipe and pits- concreted over	No		No - Unable to be located/ Inaccessible					Yes	
14D300-13	14-P18 (Unable to locate pit)	14-P19 (Unable to locate pit)	14	151.0322452	-33.82939431	8/09/2020	other	Could not uncover pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of pit location	Pit is concreted over	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to uncover pipe and pits- pits concreted over	No		No - Unable to be located/ Inaccessible					Yes	
14D380-2	14-P21a	14-P20 (unable to locate pit)	14	151.0324856	-33.82950872	9/09/2020	other	Unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of pit	Pit appears to be filled with hardened tar material- unable to gurney down to pipes but visible dents made with crowbar	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clear material in pit to access pipe	No		No - Unable to be located/ Inaccessible					Yes	
10D150-4	NA	10-P	10	151.0331545	-33.83001449	14/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- down pipe	other	Photo of pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Downwards enclosed pipe- unable to clean	No	-	No - Unable to be located/ Inaccessible					Yes	
10D150-6	10-P16 (unable to uncover under stockpile)	10-P17	10	151.0337388	-33.8304941	15/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- down pipe	other	Photo of pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Cannot clean- downwards pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
10D230-2	NA	10-P12	10	151.0331859	-33.82971575	15/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- enclosed downwards pipe	other	Photo of pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Enclosed downwards pipe- unable to clean	No	-	No - Unable to be located/ Inaccessible					Yes	
15D100-10a	NA	15-P24	15	151.0339147	-33.82906322	16/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean pipe- pipe bent downwards and unable to fit jetter through	other	Photo of pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Cannot clean due to pipe being bent downwards	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-2	NA	NA (neutralising	15	151.0336982	-33.82910262	16/09/2020	other	PVC	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- pipe inaccessible	other	Photo of neutralising pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to gain safe access to clean pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-3	15-P17 (does not appear to be a pit - pipe put in clay)	15-P16 (shallow pit)	15	151.0336387	-33.82918174	16/09/2020	other	PVC	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean, potential pipe blockage	other	Photo of pit		yes	Excavate and remove affected pipe and surrounding soils	Pipe blocked, jetter getting stuck	No	To remove shallow pipe, ~200mm bgl	No - Unable to be located/ Inaccessible					Yes	Unable to clean, no clear access point

Pipe Details									Gas Testing - Upstream Pit (Pre-Cleaning)					Gas Testing - Downstream Pit (Pre-Cleaning)					Gas Testing - Upstream Pit (Post-Cleaning)					Gas Testing - Downstream Pit (Post-Cleaning)					Post Cleaning Conditions				Validation											Ventia Comments (do not print)
Pipe ID ("CDLD Area_Pipe Number")	**Upstream Pit ID**	**Downstream Pit ID**	**Key Plan Area**	**x Co-Ords**	**Y Co-Ords**	**Date/time completed**	**Pipe Type**	**Other - Pipe Type**	**VOC (ppm) - limit 100ppm**	**H2S (ppm) - limit 10ppm**	**CH4 (%) - record only**	**CO2 (%)**	**LEL (%) - limit 0.5%**	**VOC (ppm) - limit 100ppm**	**H2S (ppm) - limit 10ppm**	**CH4 (%) - record only**	**CO2 (%)**	**LEL (%) - limit 0.5%**	**VOC (ppm) - limit 100ppm**	**H2S (ppm) - limit 10ppm**	**CH4 (%) - record only**	**CO2 (%)**	**LEL (%) - limit 0.5%**	**VOC (ppm) - limit 100ppm**	**H2S (ppm) - limit 10ppm**	**CH4 (%) - record only**	**CO2 (%)**	**LEL (%) - limit 0.5%**	**Cleaning Process Notes (optional)**	**Flush Water/ CCTV/visual Observations**	**Other - Flush Water/ CCTV/visual Observations**	**Visual Observations Comment**	**Contingency Actions Required? (as per SAQP)**	**Contingencies Implemented**	**Contingency additional notes**	**Compromised Pipework Identified?**	**If Yes Specify**	**Further Validation/ Decommissioning Action Required**	**Length of Compromsied Pipe**	**Number of Test Pits Required as per SAQP**	**Number of Test Pits Completed**	**Reasons for not meeting requirements (if applicable)**	**Pits backfilled?**	
15D300-4	15-P16 (not a pit, but an inspection point)	NA (open neutralising pit)	15	151.0336657	-33.82907693	16/09/2020	other	PVC	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other	Photo of pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to get safe access to clean pipes	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-5	15-P18 (inspection point, not a pit)	15-P19 (unable to uncover pit, concreted in)	15	151.0336365	-33.82902307	16/09/2020	other	Unable to locate pipe	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean, unable to locate pipe	other	Photo of pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Cannot clean pipe- unable to locate pipe or pits	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-6	NA	15-P19 (concreted in)	15	151.0341656	-33.82899164	16/09/2020	other	Unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other	Photo of pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe -unable to uncover pit and pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-7	15P20 (unable to uncover pit under rubble)	15P18 (inspection point, not a pit)	15	151.0336329	-33.82906373	16/09/2020	other	unable to locate pipe	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of inspection point		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pits on either side are inaccessible	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-8	15-P15 (unable to locate pit)	15-P20 (unable to locate pit)	15	151.0334552	-33.82902995	16/09/2020	other	Unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of pit location under rubble		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Cannot clean - unable to uncover pit and pipe under rubble	No	-	No - Unable to be located/ Inaccessible					Yes	
16D100-1	NA	16P4	16	151.034273	-33.82926594	17/09/2020	other	Pipe does not exist	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		other	Photo of pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-8	16P11	16P12 (unable to locate pit)	16	151.0344105	-33.82928581	17/09/2020	other	Unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of supposed pit location		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean-unable to locate pit and pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-14	16P17	16P18	16	151.0350787	-33.82923199	24/09/2020 5:39	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean - does not appear to be a pipe	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Did not clean- does not appear to be a pipe, instead a square enclosed concrete culvert that only extends 0.5m where jetter got stuck, according to maps pipe is supposed to extend to upstream pit 16P17 but pipe outlet was not found in upstream pit 16P17- potentially does not exist	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-a	NA(channel)	16P18	16	151.0351702	-33.82922994	24/09/2020 5:39	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pipe not on maps, unable to clean	other		Photo of pipe and pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Enclosed pipe pipe running through pit - unable to clean	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-18	NA	15P29	15	151.0339953	-33.82973868	24/09/2020 5:39	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe- pipe was enclosed and running through pit	No	-	No - Unable to be located/ Inaccessible					Yes	
16D250-1	16P27 (under rubble stockpile)	16P26 (under rubble stockpile)	16	151.0344571	-33.82946748	24/09/2020 5:40	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as line and pits were located under rubble stockpile	No	-	No - Unable to be located/ Inaccessible					Yes	
16D250-2	16P27 (under rubble stockpile)	16P28 (under rubble stockpile)	16	151.0343954	-33.82945939	24/09/2020 5:40	other	Unknown- unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of rubble stockpile over line	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pipe and pits located under rubble stockpile	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-17	NA	16P39	16	151.0348823	-33.82960386	24/09/2020 5:40	other	Unknown- unable to locate or does not exist	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Strong sewer odour	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe - cannot locate it in pit under rubble or it does not exist	No	-	No - Unable to be located/ Inaccessible					Yes	
18D100-2	NA	18-P1	18	151.0335356	-33.82851756	24/09/2020 5:40	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean- enclosed downwards pipe	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe- downwards enclosed pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
19D200-5	19-P2	19-P3	19	151.0342519	-33.82871043	24/09/2020 5:40	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to put jetter into pipe due to access issues; narrow but deep pit (~3m)	No	-	No - Unable to be located/ Inaccessible					Yes	
17D150-2	NA	17-P8	17	151.0324394	-33.82850025	24/09/2020 5:41	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean, downwards enclosed pipe	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe- unable to fit jetter in enclosed pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
17D200-3	17-P13 (unable to locate)	NA	17	151.0324133	-33.82873562	24/09/2020 5:41	other	Unknown- unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Location of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pit and pipes	No	-	No - Unable to be located/ Inaccessible					Yes	
18D100-3	17-P6 (unable to locate)	17-P11 (unable to locate)	17	151.0323755	-33.82872602	24/09/2020 5:41	other	Unknown- unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Location of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pipe and pits (same pipe line branches into pits 17-P7, 17-P11, 17-P12 too)	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-18	16P35 (located under rubble stockpile)	16P34 (located under rubble stockpile)	16	151.0346492	-33.82945277	24/09/2020 5:41	other	Unknown- unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of rubble stockpile over line	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe - pipe and pit under rubble stockpile	No	-	No - Unable to be located/ Inaccessible					Yes	
16D200-2	16P26 (located under rubble stockpile)	16P34 (located under rubble stockpile)	16	151.0346466	-33.8294542	24/09/2020 5:41	other	Unknown- unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe location	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pipe and pits were unable to be located	No	-	No - Unable to be located/ Inaccessible					Yes	
16D230-6	16P26 (under rubble stockpile)	16P25 (under rubble stockpile)	16	151.0346797	-33.8293402	24/09/2020 5:41	other	Unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe location	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe - pit and pipe both located under large rubble stockpile	No	-	No - Unable to be located/ Inaccessible					Yes	
16D100-2	NA	16P24	16	151.0345212	-33.8293029	24/09/2020 5:41	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean pipe- pipe entry crushed	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as there is no safe access to pipe, ~400 mbgl	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-15	16P25 (under rubble stockpile)	16P24	16	151.0345189	-33.82927906	24/09/2020 5:41	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetter unable to go through pipe- no access to pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
18D230-1a	NA	18-P4	18	151.0332646	-33.82866081	24/09/2020 5:41	other	Pipe could not be located	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of location of pit (under tank bund wall)	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pit and pipe under tank bund wall	No	-	No - Unable to be located/ Inaccessible					Yes	
16D300-c	NA (channel)	16P18	16	151.0350773	-33.82922562	24/09/2020 5:41	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean, pipe not on maps	other		Photo of riser	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe-it is a riser	No	-	No - Unable to be located/ Inaccessible					Yes	
16D300-2a	NA	19-P1	19	151.0339591	-33.82946752	25/09/2020 5:47	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Pipe not on maps, does not extend past 0.5m	other		Photo of pipe location	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe fully, only extends 0.5m, pipe not on maps potentially old decommissioned pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
16D300-6	16P32 (unable to uncover)	16P30	16	151.0339591	-33.82946752	25/09/2020 5:47	other	Pipe does jot exist	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe did not exist in pit - unable to clean	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-24	15P33	15P32	15	151.0335234	-33.82936648	25/09/2020 5:47	other	Unknown -pipe non existent	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean as pit has no pipes	other		Photo of skinny pit with not pipe outlets	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as no pipe outlets found in pit	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-23	NA	15P32	15	151.0335234	-33.82936648	25/09/2020 5:47	other	UNKNOWN -pipe does not exist	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean as pit has no pipes	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pit has no pipes	No	-	No - Unable to be located/ Inaccessible					Yes	
15D230-1a	15P35	15P36	15	151.0335522	-33.82935282	25/09/2020 5:47	other	Unknown-pipe does not exist	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean pipe as pit has no pipes	other		Photo of pit with no pipes	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as it does not exist in pit	No	-	No - Unable to be located/ Inaccessible					Yes	
6D230-2	NA	6-P5	6	151.0321416	-33.83056325	28/09/2020 2:48	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to fully jet pipe, jetter getting stuck at ~0.5m , potential blockage, however no evidence of hydrocarbons (no odours, no VOCs)	No	-	No - Unable to be located/ Inaccessible					Yes	
6D150-1	NA	6-P5	6	151.0321395	-33.83058353	28/09/2020 2:48	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean, downwards enclosed pipe	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as it was a downwards enclosed pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
9D150-1	9-P23	9-P24	9	151.0329279	-33.83101994	28/09/2020 4:08	other	Unable to see pipe, appears to be concreted in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean pipe- filled with concrete	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pipe appeared to be filled with concrete	No	-	No - Unable to be located/ Inaccessible					Yes	
9D100-4	NA	9-P32 (not a drainage pit)	9	151.0331403	-33.8310849	29/09/2020 2:03	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pits uncovered were not drainage pits (cable pits), could not locate pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
9D100-3	9-P32 (not a drainage pit)	9-P28 (not a drainage pit)	9	151.0331374	-33.83108456	29/09/2020 2:03	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pits uncovered are not drainage pits, cable pits	No	-	No - Unable to be located/ Inaccessible					Yes	
9D250-2	9-P2	9-P5	9	151.0329849	-33.83088574	29/09/2020 2:03	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean	other		Photo of downwards enclosed pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pipe outlets in both pits inaccessible. 9-P2 (downwards enclosed pipe) and 9-P5 (only valve in pit)	No	-	No - Unable to be located/ Inaccessible					Yes	
9D100-2	9-P20 (not a drainage pit)	9-P28 (not a drainage pit)	9	151.0331522	-33.83094186	29/09/2020 2:03	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pit- has cables	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe- pits uncovered are not drainage pipes and have cables in them, unable to locate pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
9D150-5	9-P31	9-P30	9	151.0334638	-33.83108293	29/09/2020 4:17	other	Pipe does not exist	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean as pipe does not exist	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist in pit	No	-	No - Unable to be located/ Inaccessible					Yes	
9D230-6	NA	9-P14	9	151.0336256	-33.83083667	29/09/2020 5:25	other	Does not exist	Na	NA	NA	NA	NA	NA	NA	NA	NA	NA	Na	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist	No	-	No - Unable to be located/ Inaccessible					Yes	
9D100-7	NA	9-P13 (inaccessible)	9	151.0335023	-33.83077959	29/09/2020 5:25	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to safely access pit for cleaning	No	-	No - Unable to be located/ Inaccessible					Yes	
9D100-6	NA	9-P13 (inaccessible)	9	151.0334936	-33.83078168	29/09/2020 5:25	other	Unable to see pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to safely access pit	No	-	No - Unable to be located/ Inaccessible					Yes	
9D150-9	9-P12	9-P10 (does not appear to be a pit)	9	151.033526	-33.83079618	29/09/2020 5:25	terracotta		0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean				yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as unable to gain safe access to pipe	no	-	No - Unable to be located/ Inaccessible					Yes	
9D300-1	NA	P-10a	9	151.0336546	-33.83082363	29/09/2020 5:35	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pit as pit contains cables and tap outlet	No	-	No - Unable to be located/ Inaccessible					Yes	
10D150-5	NA	10-p19 (unable to locate pit)	10	151.0330959	-33.82971806	30/09/2020 0:12	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pit and pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
17D200-4	NA	17-P14 (unable to locate pit)	17	151.0324167	-33.82836526	30/09/2020 2:13	other	Unknown - unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Location of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pit and pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
20D100-2 through to 20D100-11 (entire network of tank farm pipes)	NA	NA	20	151.0345914	-33.82878025	30/09/2020 22:16	other	Unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of tank farm	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean as pipes were unable to be located	No	-	No - Unable to be located/ Inaccessible					Yes	
20D200-4	NA	20-P1 (could not locate)	20	151.0345502	-33.82882128	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate	No	-	No - Unable to be located/ Inaccessible					Yes	
12D300-1	NA	12-P1	12	151.033777	-33.83081047	2/10/2020 5:30	other	Nonexistent	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Did not clean as pipe does not exist	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-b	NA	15P37	15	151.0340452	-33.82895049	2/10/2020 5:31	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean pipe, downwards enclosed pipe	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pipe is a downwards enclosed pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
12D150-2	NA	12-P4 (not a pit/ unable to locate)	12	151.0338251	-33.83157235	2/10/2020 5:31	other	Does not exist/ unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pipe or it does not exist	No	-	No - Unable to be located/ Inaccessible					Yes	
9D150-10	NA	9-P5	9	151.0330303	-33.83059912	12/10/2020	other	Unknown, does not exist	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- pipe does not exist	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe does not exist, unable to clean	No	-	No - Unable to be located/ Inaccessible					Yes	
9D100-5	NA	NA	9	151.0331816	-33.83109462	12/10/2020	other	UNKNOWN- unable to locate pipe	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Location of pipes	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pipe as there are no accessible entry points (no pits)	No	-	No - Unable to be located/ Inaccessible					Yes	
12D150-5,6,10,11	NA	NA	12	151.0342005	-33.83064983	13/10/2020	other	Unknown - unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Location of pipes	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean line of pipes as unable to locate pipes- no acces points/pits	No	-	No - Unable to be located/ Inaccessible					Yes	
11D230-1	NA	11-P2	11	151.0338924	-33.82982313	13/10/2020	other	Pipe does not exist	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No Photo taken	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean as pipe does not exist in pit	No	-	No - Unable to be located/ Inaccessible					Yes	
15D300-19	NA	NA	15	151.0340998	-33.82972514	13/10/2020	other	UNKNOWN- unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe location	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to locate pipes as no access point or pits, unable to clean	No	-	No - Unable to be located/ Inaccessible					Yes	
16D100-2	NA	16P24	16	151.034595	-33.82948466	13/10/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe location	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to gain safe access to clean pipe, pipe entry also appears crushed	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-16,21,22	NA	NA	16	151.0346088	-33.82935268	13/10/2020	other	Unknown- unable to locate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipes as they are located under large rubble stockpile	No	-	No - Unable to be located/ Inaccessible					Yes	
11D150-c	NA	11-P11	11	151.0348774	-33.83058617	15/10/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe, capped with concrete	No	-	No - Unable to be located/ Inaccessible					Yes	
11D230-2	11-P9 (unable to locate)	11-P8	11	151.0349174	-33.83007517	15/10/2020	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as it's an enclosed downwards pipe	No	-	No - Unable to be located/ Inaccessible					Yes	
16D150-9	16P34 (under rubble stockpile)	16P37 (under rubble stockpile)	16	151.0346553	-33.82940192	21/10/2020	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe as pipe and pit as all were located under rubble stockpile	No		No - Unable to be located/ Inaccessible					Yes	
18D250-1	NA	18D250-1	18	151.0331829	-33.82878042	1/09/2020	steel		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Jetter got ~3m into pipe before reaching clay	other	Photo of pipe with clay	Clay pieces visible on jetter, no signs of hydrocarbon contamination on clay	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetter reached clay	Yes	Potential collapsed pipe	No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and therefore it was deemed unnecessary for test pitting.					Yes	
16D150-24	16P42	16P43	16	151.0348461	-33.82976144	24/09/2020 5:40	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	Excavate and remove affected pipe and surrounding soils	Shallow terracotta pipe (~200mm bgl), appears to be cracked, to potentially remove	Yes	Shallow terracotta pipe (~200mm bgl), appears to be cracked, to potentially remove	No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-20	16P40	16P36	16	151.0348412	-33.82938697	24/09/2020 5:40	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe entry appears cracked and pipe is slanted downwards, unable to clean	Yes	Appears cracked/ slanted downwards, to potentially test pit or remove (~300-400mm bgl)	No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	Unable to clean, no clear access point
16D100-4	16P40	16P41	16	151.0349978	-33.82968202	24/09/2020 5:41	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean pipe, pipe appears to be broken	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe, pipe appears to be broken	Yes		No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	
16D100-5	NA	16P41	16	151.0349963	-33.82968344	24/09/2020 5:41	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe and pit appear to be damaged/cracked	Yes		No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	
16D100-3	NA	16P41	16	151.0350157	-33.82968336	24/09/2020 5:41	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Did not clean pipe, pit and pipe appears to be cracked and broken - do not want to send jetter through a potentially broken pipe in case it gets stuck	Yes		No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	
9D100-9	NA	9-P33	9	151.0335931	-33.83114139	29/09/2020 4:20	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe appears to be compromised just under surface, do not want to jet in case it gets stuck	Yes	Very shallow pipe ~100m bgl, to potentially remove	No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	Pipe compromised, <300mm BGL, no test pit required
9D300-2	9-P12 (- does not appear to be a pit)	NA	9	151.0336516	-33.83082271	29/09/2020 5:31	terracotta		NA	Na	NA	NA	NA	NA	NA	NA	NA	NA	NA	Na	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Shallow terracotta pipe in clay, does not appear to be a pipe	Yes	Pipe appears to be broken but is a shallow pipe, to potentially be removed	No - Whilst pipe appears to be compromised there is no evidence of hydrocarbons (no odours, no staining, no VOCs) and terracotta pipes were not utilised for hydrocarbons and therefore it was deemed unnecessary for test pitting.					Yes	Pipe compromised, <300mm BGL, no test pit required
15D100-4	15P7 (canno	15D100-4	15	151.0330859	-33.82914889	3/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to fully flush and clean, jetter getting stuck		Photo of pit	Pieces of pipe can be found at the bottom of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Flushed 3 times but jetter getting stuck ~0.5m, unable to clean pipe, potentially collapsed	Yes	Pieces of steel can be found at the bottom of pit (potentially from pipe)	Yes - characterise surrounding soils	20m	2	1 - TP20/30	Half of the line was located under former building footings	Yes	

Pipe Details									Gas Testing - Upstream Pit (Pre-Cleaning)					Gas Testing - Downstream Pit (Pre-Cleaning)					Gas Testing - Upstream Pit (Post-Cleaning)					Gas Testing - Downstream Pit (Post-Cleaning)					Post Cleaning Conditions				Validation											Ventia Comments (do not print)
Pipe ID ("CDLD Area_Pipe Number")	Upstream Pit ID	Downstream Pit ID	Key Plan Area	x Co-Ords	Y Co-Ords	Date/time completed	Pipe Type	Other - Pipe Type	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	VOC (ppm) - limit 100ppm	H2S (ppm) - limit 10ppm	CH4 (%) - record only	CO2 (%)	LEL (%) - limit 0.5%	Cleaning Process Notes (optional)	Flush Water/ CCTV/visual Observations	Other - Flush Water/ CCTV/visual Observations	Visual Observations Comment	Contingency Actions Required? (as per SAQP)	Contingencies Implemented	Contingency additional notes	Compromised Pipework Identified?	If Yes Specify	Further Validation/ Decommissioning Action Required	Length of Compromsied Pipe	Number of Test Pits Required as per SAQP	Number of Test Pits Completed	Reasons for not meeting requirements (if applicable)	Pits backfilled?	
15D100-5	NA	15D100-5	15	151.0331798	-33.8292045	3/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to fully flush and clean. Max VOC reading of 20ppm when cleaning, strong hydrocarbon odour, Jetter only goes in ~4m (getting stuck)		Photo of the hole in the former building wall through to the ground to the pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Flushed 6 times but jetter getting stuck at ~4m, potentially collapsed pipe	Yes	Potentially collapsed pipe - a hole in the ground is visable	Yes - characterise surrounding soils	38m	4	3 - TP20/29a, TP20/29b, TP20/29c	Part of the line was under former building footings and therefore inaccessible	Yes	
10D230-1	10P-14 (unable to uncover)	10-P13	10	151.0338081	-33.82980477	14/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	0	0	0	0	0	0		other	Photo of piipe	clay that jetter pulled out	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Conducted eight rounds of flushing, jetter was pulling out clay-potentially collapsed pipe	Yes	Jetter pulling out clay	Yes - characterise surrounding soils	19m	2	2 - TP20/26a, TP20/26b	NA	Yes	
10D300-1	NA	10-P8	10	151.0330721	-33.82988226	14/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		other	Photo of jetter	Clay on jetter	yes	conduct additional round of flushing	Pipe appears to be collapsed, jetter pulling out clay and on,y extended ~5m (supposed to extend 10-15)	Yes	Appears to be collapsed- jetter pulling out clay	Yes - characterise surrounding soils	20m	2	1 - TP20/21	Due to access issues; the line was located under rubble stockpile and cable trays	Yes	
10D460-2	10-P10 (unable to uncover- under stockpile	10-P9	10	151.0331335	-33.82999324	14/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other			yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe- collapsed pipe	Yes	Pipe collapsed as we were jetting pipe, jetter was pulling out clay	Yes - characterise surrounding soils	10m	1	1 - TP20/23	NA	Yes	
10D460-3	10-P10 (unable to uncover under stockpile)	10-P11	10	151.0330926	-33.8304441	14/09/2020	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to fully clean- jetter pulling out chunks of clay into pit	other	No Photo		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Conducted four rounds of flushing and jetter was pulling out clay	Yes	Potentially a collapsed pipe	Yes - characterise surrounding soils	30m	3	1 - TP20/25	More than 2/3 of the line was located under rubble stockpile in tank farm J	Yes	
15D100-6	15-P27 (unable to uncover under stockpile)	15-P25	15	151.0340197	-33.82913707	16/09/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- pipe potentially broken	other	Photo of pipe		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetter getting stuck and pulling out clay,	Yes	Potentially broken due to clay content	Yes - characterise surrounding soils	6m	1	1 - TP20/31	NA	Yes	
16D230-2	16-P7	15-P25	15	151.0340327	-33.82911532	16/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		other	Photo of pipe/pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetter pulling out clay and silt from pipe, jetter only going ~2m, did not reach next pit (16-P7)	Yes	Potential broken pipe- clay and silt being pulled out of pipe	Yes - characterise surrounding soils	10m	1	0	Unable to test pit due to access issues and presence of rubble/roadbase stockpile	Yes	
18D300-5	18-P6	18-P7	18	151.0336414	-33.82877748	25/09/2020 5:47	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean, pipe was breaking as we started jetting	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe was breaking as started to jet, jetter unable to move more than 0.5 m in pipe	Yes	Broken pipe ~1.5-2 m bgl	Yes - characterise surrounding soils	8m	1	1 - TP20/28	NA	Yes	
9D230-1a	NA	9-P15	9	151.0329481	-33.83089023	29/09/2020 2:03	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Pipe not on maps, jetter went in ~2m and got stuck, unable to clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Jetter got stuck in pipe, collapsed pipe	Yes	Collapsed pipe- had to dig a tes pit to remove jetter from pipe	Yes - characterise surrounding soils	Pipe isn't on maps, unsure how long it extends	-	1 - TP20/24	NA	Yes	
10D460-1	10-P8	10-P9	10	151.0331195	-33.82992606	29/09/2020 23:53	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean, HC odours when jetting	other		No Photo	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	jetter pulled out clay, potentially a collapsed pipe	Yes	Collapsed pipe as jetter was getting stuck and pulled out clay	Yes - characterise surrounding soils	8m	1	1 - TP20/22	NA	Yes	
15D300-1	NA	15-P6 (appear to be a very shallow pit)	15	151.0336086	-33.82919792	16/09/2020	other	PVC	NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean, pipe is crushed	other	Photo of pipe		yes	excavate and remove affected pipe and surrounding soils	Cannot clean, pipe entry crushed	Yes	Pipe entry appears to be crushed- to potentially remove as it is a very shallow pipe ~200mm bgl	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Unable to clean, no clear access point
16D150-12	16-P14	16-P15	16	151.0345586	-33.82898917	17/09/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean- hole in pipe to surface, soil sediments at surface being sucked into pipe	other	Photo of hole in the surface created by the jetter and the upstream pit		yes	Excavate and remove affected pipe and surrounding soils	Unable to fully clean pipe due to hole in pipe- water from jetter shot out through hole	Yes	Hole in pipe- to dig out, very shallow pipe ~ 200mm bgl	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-13	16-P16	16-P15	16	151.0346115	-33.82899227	17/09/2020	steel		0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean- jetter stuck in pipe	other	Photo of hole dug to remove jetter		yes	Excavate and remove affected pipe and surrounding soils	Jetter stuck in pipe, unable to clean, had to dig hole in pipe to remove jetter	Yes	Pipe broken, to dig out, shallow pipe ~ 300mm bgl	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-6	16-P10	16-P9	16	151.0344151	-33.82904361	17/09/2020	terracotta		0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other	No Photo		yes	Excavate and remove affected pipe and surrounding soils	Unable to clean, pipe potentially crushed, jetter getting stuck	Yes	Pipe potentially crushed, to remove, shallow pipe ~ 300mm bgl	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-7	16-P9	16-P8 (unable to locate)	16	151.0344151	-33.82906419	17/09/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean, pipe crushed	other	Photo of pit		yes	Excavate and remove affected pipe and surrounding soils	Pipe crushed, jetter getting stuck	Yes	Pipe crushed, to remove, shallow pipe ~ 300m bgl	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-7	16-P9	16-P8 (unable tc	16	151.0344151	-33.82906419	21/09/2020 0:28	steel		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	0	0	0	0	0	Unable to clean, pipe crushed	other	Photo of pit		yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Pipe crushed, jetter getting stuck	Yes	Pipe crushed, to revisit with test pitting/ripping out, shallow pipe ~ 0.3m	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-23	16P40	16P42	16	151.0348578	-33.82975041	24/09/2020 5:41	terracotta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to clean	other		Photo of pipe	yes	Excavate and remove affected pipe and surrounding soils	Unable to clean pipe as it appears to be broken	Yes	To potentially excavate, shallow pipe ~300mm bgl	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
16D150-25	11P1 (unable to locate)	16P43	16	151.0341012	-33.82972749	13/10/2020	terracotta		NA	NA	NA	NA	NA	0	0	0	0	0	Na	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	Excavate and remove affected pipe and surrounding soils	Pipe appears to be crushed in pit, unable to clean	Yes	Shallow pipe (~300mm bgl), to excavte as part of future works	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	Pipe compromised, <300mm BGL, no test pit required
12D380-1	12-P7	12-P8	12	151.0348813	-33.83074036	13/10/2020	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean pipe	other		Photo of pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe , jetter getting stuck at 10m and pulling clay and sand	Yes	Jetter pulling out clay and potential backfill sand, potentially collapsed	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	
11D460-4	11-P10 (unable to locate)	11-P8	11	151.0349199	-33.83009001	15/10/2020	concrete		NA	NA	NA	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	BA	NA	NA	NA	NA	Unable to clean	other		Photo of jetter hose covered in clay and pit	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Unable to clean pipe, jetter pulling out clay	Yes	Jetter pulling out clay potentially a collapsed pipe	Yes - potenital hydrocarbons in soil. Additional Investigation required to characterise soils					Yes	
14D230-1	14-P12	14-P1	14	151.0315148	-33.82900799	28/08/2020	steel		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Lots of black tar/sludge in pipe.	other		Thin black LNAPL film, very grey water	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Completed eight rounds of flushing for an hour. Pipe potentially still has tar. Water coming out dark. To reasses at 14-P12	No	Tar left in pipe, Potential blockage; pipe supposed to extend to Pit 14-P12 which is roughly 25-30 m away but jetter only went in ~18-20m. To reasses at 14-P12.	Yes - verify pipe has been grouted					Yes	Concreted Compromised line, also had a large amount of material
16D300-5	16P22	16P23	16	151.0347875	-33.82979685	24/09/2020 5:40	concrete		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unable to fully clean	other		Photo of pipe	yes	impractical to complete further flushing - Document conditions and limitations for LTEMP	Flushed four times but jetter is veering off pipeline, potentially collapsed	Yes	To potentially test pit	Yes- characterise surrounding soils	10m	1	1 - TP20/27	NA	Yes	
19D200-2	19-P4	19-P5	19	151.0345828	-33.82873172	24/09/2020 5:40	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other	No photo		yes	Excavate and remove affected pipe and surrounding soils	Pipe line just under tank bund wall, to be removed during future works	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
20D200-2	20-P5	20-P6	10	151.0352416	-33.82821267	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	Excavate and remove affected pipe and surrounding soils	To remove as part of future tank bund excavations	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
20D200-1	20-P3	20-P4	20	151.0353008	-33.82787744	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	Excavate and remove affected pipe and surrounding soils	To remove as part of future tank bund excavations	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
19D200-1	19-P7	19-P6	20	151.0351879	-33.8285521	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	Excavate and remove affected pipe and surrounding soils	To remove as part of future tank bund excavations	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
19D200-3	19-P8	19-P9	10	151.0341431	-33.82825148	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other			yes	Excavate and remove affected pipe and surrounding soils	To remove as part of future tank bund excavations	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
20D100-1	NA	20-P2	20	151.034264	-33.82745754	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	Excavate and remove affected pipe and surrounding soils	To be removed as part of tank bund excavation	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
20D200-3	20-P7	20-P8	20	151.0341866	-33.82794931	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other			yes	Excavate and remove affected pipe and surrounding soils	To remove as part of future tank bund excavations	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required
19D200-2	19-P4	19-P5	19	151.0345927	-33.8287927	30/09/2020 22:16	other	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Unable to clean	other		No photo	yes	Excavate and remove affected pipe and surrounding soils	To remove as part of future tank bund excavations	No	-	Yes- verify pipe has been removed				No access to pipe	Yes	Connecting pits unable to be located, no access to pipe, pipe level <300mm BGL, no test pit required

Tables - ROA Report

The following table summarises the assessment of relevant remedial technologies for CoPCs within AEC -4.

Technology	Matrix	Effectiveness	Timeframe	Health & Safety	Complexity	Sustainability	Relative Costs	Relative Score
		● Effective ● Limited ● Ineffective	● <1 year ● 1-5 Years ● >5 Years	● Few concerns ● Mod concerns ● Many concerns	● Low ● Moderate ● High	● Above Average ● Average ● Below Average	● Low cost ● Mod Cost ● High Cost	● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
Excavation and Off-site Disposal ■ Removal of contaminated soils to the extent feasible with multiple options to treat or dispose of contaminants	**Soil**	■ Offsite disposal of soil material will effectively remediate onsite contamination. ■ Material to be disposed of to landfill licenced to receive Restricted Solid Waste/ Special Waste (asbestos)	■ Remediation can be undertaken within short timeframes.	■ Health and safety concerns associated with the excavation, handling, transport and disposal of contaminated materials. ■ NSW EPA position on air emissions/quality and related health effects. ■ AEC4 is positioned close to adjacent land users on the site boundary.	Moderate complexity of excavation due to the following site-specific considerations: ■ Excavations will be >3m deep and extend beyond the water table; ■ Dewatering, management of wastewater and Potential Acid Sulfate Soils in close proximity to the Duck River will be required; ■ Increased chance of environmental incidents and mobilisation of contaminants during works; ■ Excavations to be undertaken under asbestos conditions and may require the use of an Odour Control Enclosure (OCE) to manage contaminated materials. ■	■ Low sustainability due to due to the high volume of trucks movement and use of landfill resources.	■ Estimated total fee of approximately $32,000,000 for site establishment and remedial works including excavation and offsite disposal of waste at $640/m^3 ■ Due to the high volumes of material requiring disposal as restricted / hazardous waste, high costs due to trucking and waste levies. ■ Requirements for emissions control enclosures for excavation and handling areas.	■ 1.8
In-situ Immobilisation including Stabilisation ■ Physical and chemical form of various contaminants would strongly influence the selection of specific immobilisation approach. ■ Could include pH control, adding bonding agents, oxidising or reducing reactions.	**Soil**	■ Application of amendments can significantly decrease the mobility, toxicity and bioavailability various contaminants in soil and groundwater ■ Due to heterogeneous nature of fill materials consideration during design must consider mechanisms to ensure all contamination is effectively bound within stabilising matrix. ■ Where contaminants are immobilised through potentially reversible reactions, a change in geochemical conditions in the subsurface could remobilise contaminants. ■ Remediation trial data suggests solidification/stabilisation immobilisation for treatment of material from AEC-4 can be effective.	■ Relatively short timeframe for stabilisation to be undertaken (i.e. less than 90 days from initial treatment) however excavation, sorting and screening where required) can result in moderate timeframes for remediation being required.	■ Significant onsite equipment is required resulting in potential safety concerns associated with movement of machinery equipment within the Site. ■ It is however the opinion of ERM that these considerations can be appropriately managed via existing onsite safety permitting requirements. ■ NSW EPA position on air emissions/quality and related health effect if immobilisation completed as ex-situ method.	■ Based on the delineation and non-mobile nature of contamination within AEC-4 stabilisation may be overly complex for management of identified impact as mitigation of off mobilisation is not required. ■ Implementation of approach is considerate moderately complex due to the heterogeneous nature of subsurface fill materials. ■ Approach will require validation measures to demonstrate all contaminated materials have been bound within stabilising matrix. ■ Where material is proposed to be placed below the groundwater table, additional assessment may be required to assess potential long term leachability.	■ Limited infrastructure / power generation required	■ Estimated total fee of approximately $8,000,000 for site establishment and remedial works based on a treatment rate of $160/m^3 ■ Moderate costs for implementation of approach, however ongoing monitoring may be required to demonstrate effectiveness.	■ 1.6

Technology	Matrix	Effectiveness	Timeframe	Health & Safety	Complexity	Sustainability	Relative Costs	Relative Score
		● Effective ● Limited ● Ineffective	● <1 year ● 1-5 Years ● >5 Years	● Few concerns ● Mod concerns ● Many concerns	● Low ● Moderate ● High	● Above Average ● Average ● Below Average	● Low cost ● Mod Cost ● High Cost	● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
In-Situ Thermal Treatment ■ The injection of energy into the subsurface to mobilize and recover volatile and semi-volatile organic contaminants	**Soil**	■ Destroys a broad range of hydrocarbons quickly and thoroughly ■ Calorific values of materials assessed within the ERM (2020) RSI indicate the material is significantly heterogeneous and therefore the effectiveness of the approach will vary (and may be unreliable) depending on the composition of materials. ■ Co-mingled asbestos will not be destroyed and will require ongoing management.	■ Remedial targets can be achieved within a relatively short timeframe, however project planning and equipment procurement can result in extensive lead times. ■ Due to the heterogeneous nature of materials and associated calorific values, timeframes may vary depending on underlying materials.	■ Health and Safety concerns due to site disturbance, high heat or voltage exist. ■ Requires significant infrastructure to be installed within the Site that will require safety planning. ■ Due to the presence of asbestos within the soil matrix, concerns relating to the release of asbestos fines / fibres during handling and treatment.	■ Significant design requirements for development of appropriate system.	■ High energy usage. ■ In-situ thermal requires significant infrastructure to be installed within the site and therefore High equipment costs	■ Estimated total fee of approximately $34,000,000 for site establishment and remedial works based on a treatment rate of approximately $650/m^3 ■ In-situ thermal treatment can be expensive to deploy and operate and typically requires vapour extraction to remove vapours produced	■ 2.5
Ex-Situ Thermal Treatment ■ Excavation of material and treatment either on-site or offsite to mobilize and recover volatile and semi-volatile organic contaminants. ■ Off-site thermal treatment would involve shipping / transport to a licenced treatment facility potentially interstate)	**Soil**	■ Destroys a broad range of hydrocarbons quickly and thoroughly ■ Ex-situ approach enables screening and sorting of material prior to treatment, however this may require a significant time frame and to be undertaken within an emission control enclosure where concentrations of volatile contaminants pose a risk from air borne emissions / odour. ■ ERM notes the presence of asbestos within primary remedial areas (AEC-4) that may impact the appropriateness of thermal treatment. Co-mingled asbestos will not be destroyed and will require ongoing management regardless of treated hydrocarbon contaminants. ■ Compromised geotechnical properties post thermal treatment.	■ Due to the heterogeneous nature of materials and associated calorific values, significant time may be required to sort / screen and blend materials prior to thermal treatment. ■ Remedial targets can be achieved within a relatively short timeframe, however project planning and equipment procurement can result in extensive lead times.	■ Health and Safety concerns due to site disturbance, high heat or voltage exist. ■ Due to the presence of asbestos within the soil matrix, concerns relating to the release of asbestos fines / fibres during handling and treatment. ■ NSW EPA position on air emissions/quality and related health effects.	■ Ex-situ screening, sorting and blending may require significant site infrastructure including emissions control enclosures and site management controls associated with air emissions, odour and surface water management. ■ Ex-situ on-site treatment via thermal also requires consideration of use/placement/management of treated soils that may not be geotechnically suitable. ■ The presence of asbestos in the fill materials will potentially inhibit thermal treatment options offsite.	■ Significant costs associated with enclosures for the treatment / handling of materials [prior to treatment. ■ High energy usage. ■ High equipment costs	■ Onsite - Estimated total fee of approximately $27,500,000 for site establishment and remedial works based on a treatment rate of approximately $520/m^3 ■ Off-Site - Estimated total fee of approximately $36,500,000 for site establishment and remedial works based on a treatment rate of approximately $725/m^3	■ 2.5

Technology	Matrix	Effectiveness	Timeframe	Health & Safety	Complexity	Sustainability	Relative Costs	Relative Score
		● Effective ● Limited ● Ineffective	● <1 year ● 1-5 Years ● >5 Years	● Few concerns ● Mod concerns ● Many concerns	● Low ● Moderate ● High	● Above Average ● Average ● Below Average	● Low cost ● Mod Cost ● High Cost	● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
<u>Engineered Capping Layer and Ongoing Management</u> ■ Remediation would involve retaining impacted materials in-situ and construction of a constructed / engineered capping layer with no requirement for a liner at the base of waste material. ■ Engineered capping layer to restrict potential direct contact with contaminated soils ■ Capped materials would be managed under Site / Environmental Management Plans including requirements for ongoing monitoring, trigger / action levels to prevent future offsite impacts.	**Soil**	■ Investigations within the site have indicated that contamination within AEC-4 is delineated, immobilew and is unlikely to pose a risk of harm to adjacent ecological receptors through migration in groundwater. ■ Construction of a capping layer would mitigate the potential for contact for onsite workers through reducing the potential for incidental contact. ■ Following construction of the capping layer, land use planning for the Site should consider uses such as car parking or slab on grade building structures where services are not located to minimise the potential for damage to the constructed capping layer. The implementation of ongoing controls (including management of potential vapour intrusion risks) will provide further mitigation of risk to identified receptors. ■ Occurrence of PFAS in low concentrations in soils and leachate within buried waste area supports the adoption of on-site containment and reduction of surface infiltration for protection of off-site receptors, as recommended by the PFAS NEMP (HEPA, 2020).	■ Remedial / site management works can be undertaken within a short timeframe, however negotiation with DPIE / council and future land holders may be required to confirm ongoing management requirements are appropriate	■ Where material is retained –in-situ there are low health and safety concerns as materials handling will be minimised. ■ Health and safety concerns to future site users will be managed under an ongoing site management plan.	■ Low complexity associated with implementation, however strategy will require ongoing monitoring plans to be developed with defined trigger levels, action items etc. ■ Ongoing groundwater monitoring may be required to ensure potential changes to groundwater conditions (and potential mobilisation of contamination) are identified as soon as practicable ■ All management plans will require endorsement by NSW EPA accredited auditor and DPIE. ■ Restrictions on the use of the land will be required to ensure the long-term integrity of the capping layer and potential vapour intrusion risks are mitigated.	■ Limited resources required	■ Estimated total fee of approximately $1,500,000 for site establishment and construction of an engineered capping layer based on a capping rate of $110/m^2 (cost do not include land forming or other site preparation works) ■ Strategy will require ongoing monitoring plans to be developed and implemented with defined trigger levels, action items etc. All management plans will require endorsement by NSW EPA accredited auditor and DPIE	■ 1.3

Note: Estimated remediation costings are preliminary only and do not include consulting fees, consultation with stakeholders, additional required approvals / permits, land forming / additional civil works etc.

Tables- AEC-4 ESA Report

Location ID	Location Type	Site Location	Rationale	Groundwater Montioring Well Installation						Hydaulic Data					Notes
				Proposed Drilling Depth (m BGL)	Drilling Depth Comments	Drilling Method	Proposed Well Screen Interval (m BGML)	Well Surface Completion	Well Development	Slug Test	Static Logger (Tidal Influence)	Survey	Groundwater Gauging	Groundwater Sampling	
MW20/01A	New Monitoring Well (shallow)	Transect 1 - upgradient	Upgradient groundwater characterisation (shallow)	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Flush	1	1	-	1	1	1	-
MW20/01B	New Monitoring Well (deep)	Transect 1 - upgradient	Upgradient groundwater characterisation (deep). Establish depth to bedrock and hydraulic conductivity data to support to support future decisions regarding upgradient cutoff wall	10	To depth of rock	Direct Push/ Solid Flight Auger	7 - 10m	Flush	1	1	-	1	1	1	-
MW20/02A	New Monitoring Well (shallow)	Transect 1 - upgradient	Upgradient groundwater characterisation (shallow)	2	-	Direct Push/ Solid Flight Auger	2 - 5m	Flush	1	1	1	1	1	1	Confirm no tidal influence on groundwater
MW20/02B	New Monitoring Well (deep)	Transect 1 - upgradient	Upgradient groundwater characterisation (deep). Establish depth to bedrock and hydraulic conductivity data to support to support future decisions regarding upgradient cutoff wall	10	To depth of rock	Direct Push/ Solid Flight Auger	7 - 10m	Flush	1	1	-	1	1	1	-
MW20/03	New Monitoring Well (shallow)	Transect 2 - Source Area (north)	Vertical and lateral delineation of buried waste impact, groundwater characterisation in northern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/04	New Monitoring Well (shallow)	Transect 3 - Source Area (south)	Vertical and lateral delineation of buried waste impact, groundwater characterisation in northern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/05	New Monitoring Well (shallow)	Transect 3 - Source Area (south)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	1	1	1	1	Confirm no tidal influence on groundwater
MW20/06	New Monitoring Well (shallow)	Transect 3 - Source Area (south)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/07	New Monitoring Well (shallow)	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/08	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	1	1	1	1	Confirm no tidal influence on groundwater
MW20/09	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/10	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/11	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/12	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/13	New Monitoring Well (shallow)	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in northern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/14	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	1	1	1	1	Confirm no tidal influence on groundwater
MW20/15	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/16	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/17	New Monitoring Well (shallow)	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	1	1	1	1	Confirm no tidal influence on groundwater
MW20/18	New Monitoring Well (shallow)	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in northern portion of source area	5	To natural soils underlying fill	Direct Push/ Solid Flight Auger	2 - 5m	Monument	1	1	-	1	1	1	-
MW20/19	New Monitoring Well (shallow)	Transect 1 - upgradient	Upgradient groundwater characterisation	5	-	Direct Push/ Solid Flight Auger	2 - 5m	Flush	1	1	-	1	1	1	-
BH341	Existing Monitoring Well (Shallow)	Transect 1 - upgradient	Upgradient groundwater characterisation	-	-	-	-	-	1	1	-	1	1	1	Redevelop 'BH series' wells as these have silted up due to infrequent sampling since install in 2010
BH210	Existing Monitoring Well (Shallow)	Transect 1 - upgradient	Upgradient groundwater characterisation	-	-	-	-	-	1	1	-	1	1	1	Redevelop 'BH series' wells as these have silted up due to infrequent sampling since install in 2010
MW12/01	Existing Monitoring Well (Shallow)	Transect 2 - Source Area (north)	Investigate the nature and extent of groundwater impacts associated with buried waste	-	-	-	-	-	-	-	-	-	1	-	Well has had LNAPL present since 2012. no slug testing or sampling proposed
MW12/20	Existing Monitoring Well (Shallow)	Transect 4 - Downgradient Boundary	Investigate the nature and extent of groundwater impacts associated with buried waste	-	-	-	-	-	-	-	-	-	1	1	Slug Testing previously conducted in 2019
BH116	Existing Monitoring Well (Shallow)	Transect 3 - Source Area (south)	Investigate the nature and extent of groundwater impacts associated with buried waste	-	-	-	-	-	1	1	-	1	1	1	Redevelop 'BH series' wells as these have silted up due to infrequent sampling since install in 2010
MW94/6	Existing Monitoring Well (Shallow)	Transect 4 - Downgradient Boundary	Investigate the nature and extent of groundwater impacts associated with buried waste	-	-	-	-	-	-	1	-	1	1	1	-
			SUM TOTAL	102	-	-	-	-	**24**	**25**	**5**	**25**	**27**	**26**	

Location ID	Location Type	Area ID	Site Location	Rationale	Lab Analysis (Soils)									Notes
					TRH, BTEXN	TRH Silica Gel Clean-up	Hexavalent Chromium	PAH	Asbestos Quantification (%w/w)	Asbestos (presence/absence)	ASS/PASS Screen (pH Ox, pH fox)	ASS / PASS (CRS Suite)	QAQC - Trip Spike/ Blank TRH C6-C10, BTEXN	
MW20/01A	Monitoring Well (shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation (shallow)	-	-	-	-	-	-	1	1	-	ASS/PASS sampling of natural soil
MW20/01B	Monitoring Well	4	Transect 1 - upgradient	Upgradient groundwater characterisation (deep). Establish depth to bedrock and hydraulic conductivity data to support to support future decisions regarding upgradient cutoff wall	-	-	-	-	-	-	1	1	-	ASS/PASS sampling of natural soil at depth
MW20/02A	Monitoring Well (shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation (shallow)	-	-	-	-	-	-	1	1	-	ASS/PASS sampling of natural soil
MW20/02B	Monitoring Well	4	Transect 1 - upgradient	Upgradient groundwater characterisation (deep). Establish depth to bedrock and hydraulic conductivity data to support to support future decisions regarding upgradient cutoff wall	-	-	-	-	-	-	1	1	-	ASS/PASS sampling of natural soil at depth
MW20/03	Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical and lateral delineation of buried waste impact, groundwater characterisation in northern portion of source area	2	2	2	2	-	-	-	-	1	Sample of fill and underlying natural soils
MW20/04	Monitoring Well (shallow)	4	Transect 3 - Source Area (south)	Vertical and lateral delineation of buried waste impact, groundwater characterisation in northern portion of source area	2	2	2	2	-	-	-	-	1	Sample of fill and underlying natural soils
MW20/05	Monitoring Well (shallow)	4	Transect 3 - Source Area (south)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	1	1	1	1	-	-	-	-	-	Sample of underlying natural soils to achieve vertical delineation
MW20/06	Monitoring Well (shallow)	4	Transect 3 - Source Area (south)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	1	1	1	1	-	-	-	-	-	Sample of underlying natural soils to achieve vertical delineation
MW20/07	Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	1	1	1	1	-	-	1	1	-	Sample of underlying natural soils to achieve vertical delineation
MW20/08	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/09	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/10	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	1	1	-	ASS/PASS sampling of natural soil
MW20/11	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/12	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/13	Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in northern portion of source area	1	1	1	1	-	-	1	1	-	Sample of underlying natural soils to achieve vertical delineation. ASS/PASS sampling of natural soil
MW20/14	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/15	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/16	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/17	Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	-	-	-	-	-	-	-	-	-	
MW20/18	Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in northern portion of source area										
MW20/19	Monitoring Well (shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation	-	-	-	-	-	-	-	-	-	-
Total Primary Samples					**8**	**8**	**8**	**8**	**0**	**0**	**7**	**7**	**2**	
QAQC - Field Duplicates (10%)					**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	
QAQC - Interlab Duplicates (5%)					**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	

Location ID	Location Type	Area ID	Site Location	Rationale	Lab Analysis - Water					
					TRH, BTEXN	TRH Silica Gel Clean-up	Hexavalent Chromium (ultra trace)	PAHs	QAQC - Trip Spike/ Blank TRH C6-C10, BTEXN	Notes
MW20/01A	New Monitoring Well (shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation	1	1	1	1	-	
MW20/01B	New Monitoring Well (deep)	4	Transect 1 - upgradient	Upgradient groundwater characterisation (deep). Establish depth to bedrock and hydraulic conductivity data to support to support future decisions regarding upgradient cutoff wall	1	1	1	1	-	
MW20/02A	New Monitoring Well (shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation	1	1	1	1	-	
MW20/02B	New Monitoring Well (deep)	4	Transect 1 - upgradient	Upgradient groundwater characterisation (deep). Establish depth to bedrock and hydraulic conductivity data to support to support future decisions regarding upgradient cutoff wall	1	1	1	1	-	
MW20/03	New Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical and lateral delineation of buried waste impact, groundwater characterisation in northern portion of source area	1	1	1	1	1	
MW20/04	New Monitoring Well (shallow)	4	Transect 3 - Source Area (south)	Vertical and lateral delineation of buried waste impact, groundwater characterisation in northern portion of source area	1	1	1	1	1	
MW20/05	New Monitoring Well (shallow)	4	Transect 3 - Source Area (south)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	1	1	1	1	-	
MW20/06	New Monitoring Well (shallow)	4	Transect 3 - Source Area (south)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	1	1	1	1	-	
MW20/07	New Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in southern portion of source area	1	1	1	1	-	
MW20/08	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/09	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/10	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/11	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/12	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/13	New Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Vertical delineation of buried waste impact, groundwater characterisation in northern portion of source area	1	1	1	1	-	
MW20/14	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/15	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/16	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/17	New Monitoring Well (shallow)	4	Transect 4 - Downgradient Boundary	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/18	New Monitoring Well (shallow)	4	Transect 2 - Source Area (north)	Downgradient boundary groundwater delineation, increase downgradient monitoring coverage	1	1	1	1	-	
MW20/19	New Monitoring Well (shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation	1	1	1	1	-	
BH341	Existing Monitoring Well (Shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation	1	1	1	1	-	
BH210	Existing Monitoring Well (Shallow)	4	Transect 1 - upgradient	Upgradient groundwater characterisation	1	1	1	1	1	
MW12/01	Existing Monitoring Well (Shallow)	4	Transect 2 - Source Area (north)	Investigate the nature and extent of groundwater impacts associated with buried waste	-	-	-	-	-	Gauge only - LNAPL present
MW12/20	Existing Monitoring Well (Shallow)	4	Transect 4 - Downgradient Boundary	Investigate the nature and extent of groundwater impacts associated with buried waste	1	1	1	1	-	
BH116	Existing Monitoring Well (Shallow)	4	Transect 3 - Source Area (south)	Investigate the nature and extent of groundwater impacts associated with buried waste	1	1	1	1	-	
MW94/6	Existing Monitoring Well (Shallow)	4	Transect 4 - Downgradient Boundary	Investigate the nature and extent of groundwater impacts associated with buried waste	1	1	1	1	-	
				Total Primary Samples	**26**	**26**	**26**	**26**	**3**	
				QAQC - Field Duplicates (10%)	**3**	**3**	**3**	**3**	-	
				QAQC - Interlab Duplicates (5%)	**2**	**2**	**2**	**2**	-	

Well ID	Gauging Date	Monitoring round	TOC Elevation (mAHD)	Total Measured Depth (mbTOC)	Depth to LNAPL (mbTOC)	Depth to Water (mbTOC)	LNAPL Thickness (m)	Corrected Depth to Water (mbTOC)	Corrected Water Elevation (mAHD)	Well Condition/Comments
BH116	21/07/2020	GME	4.391	3.995	-	1.636	-	1.636	2.755	
BH116	28/07/2020	Slug Test (pre)	4.391	3.995	-	1.217	-	1.217	3.174	
BH116	14/08/2020	Slug Test (post)	4.391	3.995	-	1.397	-	1.397	2.994	
BH210	20/07/2020	GME	3.758	6.910	-	1.049	-	1.049	2.709	
BH210	28/07/2020	Slug Test (pre)	3.758	6.910	-	0.954	-	0.954	2.804	
BH210	14/08/2020	Slug Test (post)	3.758	6.910	-	1.9	-	1.9	1.858	
MW12/20	21/07/2020	GME	2.94	3.670	-	1.683	-	1.683	1.257	
MW12/01	20/07/2020	GME	6.04	-	2.048	-	-	-	-	LNAPL Present - depth to water unable to be determined due to NAPL vicosity
MW20/01A	20/07/2020	GME	4.537	4.900	-	1.761	-	1.761	2.776	
MW20/01A	28/07/2020	Slug Test (pre)	4.412	4.900	-	1.572	-	1.572	2.84	
MW20/01A	14/08/2020	Slug Test (post)	4.412	4.900	-	1.63	-	1.63	2.782	
MW20/01B	20/07/2020	GME	4.54	9.973	-	1.684	-	1.684	2.856	
MW20/01B	28/07/2020	Slug Test (pre)	4.472	9.973	-	1.59	-	1.59	2.882	
MW20/01B	14/08/2020	Slug Test (post)	4.472	9.973	-	1.583	-	1.583	2.889	
MW20/02A	20/07/2020	GME	4.018	4.891	-	1.196	-	1.196	2.822	
MW20/02A	28/07/2020	Slug Test (post)	4.018	4.891	-	1.124	-	1.124	2.894	
MW20/02A	14/08/2020	Slug Test (post)	4.018	4.891	-	1.139	-	1.139	2.879	
MW20/02B	20/07/2020	GME	3.979	7.881	-	1.095	-	1.095	2.884	
MW20/02B	28/07/2020	Slug Test (pre)	3.979	7.881	-	0.98	-	0.98	2.999	
MW20/02B	14/08/2020	Slug Test (post)	3.979	7.881	-	0.963	-	0.963	3.016	
MW20/03	21/07/2020	GME	5.93	5.861	-	3.201	-	3.201	2.729	
MW20/03	28/07/2020	Slug Test (pre)	5.93	5.861	-	3.001	-	3.001	2.929	
MW20/03	14/08/2020	Slug Test (post)	5.93	5.861	-	3.158	-	3.158	2.772	
MW20/04	21/07/2020	GME	6.215	8.981	-	4.962	-	4.962	1.253	
MW20/04	28/07/2020	Slug Test (pre)	6.215	8.981	-	4.614	-	4.614	1.601	
MW20/04	14/08/2020	Slug Test (post)	6.215	8.981	-	4.351	-	4.351	1.864	
MW20/05	21/07/2020	GME	5.382	4.901	-	3.282	-	3.282	2.1	
MW20/05	28/07/2020	Slug Test (pre)	5.382	4.901	-	2.53	-	2.53	2.852	
MW20/05	14/08/2020	Slug Test (post)	5.382	4.901	-	2.237	-	2.237	3.145	
MW20/06	21/07/2020	GME	5.477	5.803	-	3.419	-	3.419	2.058	
MW20/06	28/07/2020	Slug Test (pre)	-	-	-	-	-	-	-	LNAPL present in well, depth not gauged
MW20/06	14/08/2020	Slug Test (post)	5.477	5.803	3.200	4.46	1.260	4.46	1.017	LNAPL present, oil-water interface potentially unreliable due to NAPL viscosity
MW20/07	21/07/2020	GME	5.725	5.843	-	3.57	-	3.57	2.155	
MW20/07	28/07/2020	Slug Test (pre)	5.725	5.843	-	3.57	-	3.57	2.155	
MW20/07	14/08/2020	Slug Test (post)	5.725	5.843	-	3.551	-	3.551	2.174	
MW20/08	20/07/2020	GME	4.876	5.980	-	3.203	-	3.203	1.673	
MW20/08	14/08/2020	Slug Test (post)	4.876	5.980	-	2.759	-	2.759	2.117	
MW20/09	20/07/2020	GME	4.864	5.926	-	4.142	-	4.142	0.722	
MW20/09	28/07/2020	Slug Test (pre)	4.864	5.926	-	3.877	-	3.877	0.987	
MW20/09	14/08/2020	Slug Test (post)	4.864	5.926	-	2.764	-	2.764	2.1	
MW20/10	20/07/2020	GME	4.697	5.941	-	2.592	-	2.592	2.105	
MW20/10	28/07/2020	Slug Test (pre)	4.697	5.941	-	2.443	-	2.443	2.254	
MW20/10	14/08/2020	Slug Test (post)	4.697	5.941	-	2.41	-	2.41	2.287	
MW20/11	20/07/2020	GME	3.949	5.977	-	3.077	-	3.077	0.872	
MW20/11	28/07/2020	Slug Test (pre)	3.949	5.977	-	3.703	-	3.703	0.246	
MW20/11	14/08/2020	Slug Test (post)	3.949	5.977	-	2.881	-	2.881	1.068	
MW20/12	20/07/2020	GME	4.368	5.961	-	3	-	3	1.368	
MW20/12	28/07/2020	Slug Test (pre)	4.368	5.961	-	2.721	-	2.721	1.647	
MW20/12	14/08/2020	Slug Test (post)	4.368	5.961	-	2.789	-	2.789	1.579	
MW20/13	21/07/2020	GME	6.016	5.867	-	2.985	-	2.985	3.031	
MW20/13	28/07/2020	Slug Test (pre)	6.016	5.867	-	2.934	-	2.934	3.082	
MW20/13	14/08/2020	Slug Test (post)	6.016	5.867	-	2.992	-	2.992	3.024	
MW20/14	20/07/2020	GME	4.81	5.912	-	2.712	-	2.712	2.098	
MW20/14	28/07/2020	Slug Test (pre)	4.81	5.912	-	1.611	-	1.611	3.199	
MW20/14	14/08/2020	Slug Test (post)	4.81	5.912	-	1.955	-	1.955	2.855	
MW20/15	20/07/2020	GME	4.825	6.032	-	4.185	-	4.185	0.64	
MW20/15	28/07/2020	Slug Test (pre)	4.825	6.032	-	3.789	-	3.789	1.036	
MW20/15	14/08/2020	Slug Test (post)	4.825	6.032	-	3.266	-	3.266	1.559	
MW20/16	20/07/2020	GME	3.482	5.955	-	3.484	-	3.484	-0.002	
MW20/16	28/07/2020	Slug Test (pre)	3.482	5.955	-	2.893	-	2.893	0.589	
MW20/16	14/08/2020	Slug Test (post)	3.482	5.955	-	2.215	-	2.215	1.267	
MW20/17	20/07/2020	GME	4.051	5.875	-	3.193	-	3.193	0.858	
MW20/17	28/07/2020	Slug Test (pre)	4.051	5.875	-	2.909	-	2.909	1.142	
MW20/17	14/08/2020	Slug Test (post)	4.051	5.875	-	2.982	-	2.982	1.069	
MW20/18	21/07/2020	GME	3.629	5.996	-	2.706	-	2.706	0.923	
MW20/18	28/07/2020	Slug Test (pre)	3.629	5.996	-	2.342	-	2.342	1.287	
MW20/18	14/08/2020	Slug Test (post)	3.629	5.996	-	2.576	-	2.576	1.053	
MW20/19	20/07/2020	GME	3.315	4.978	-	1.902	-	1.902	1.413	
MW20/19	28/07/2020	Slug Test (pre)	3.315	4.978	-	0.09	-	0.09	3.225	
MW20/19	14/08/2020	Slug Test (post)	3.315	4.978	-	0.566	-	0.566	2.749	
MW20/20	20/07/2020	GME	4.077	5.954	-	-	-	-	-	Dry or sitting on hydrosleeve at 5.212m
MW20/20	28/07/2020	Slug Test (pre)	4.077	5.954	-	2.755	-	2.755	1.322	
MW20/20	14/08/2020	Slug Test (post)	4.077	5.954	-	2.246	-	2.246	1.831	
MW94/6	20/07/2020	GME	3.669	5.070	-	3.828	-	3.828	-0.159	
MW94/6	28/07/2020	Slug Test (pre)	3.669	5.070	-	2.787	-	2.787	0.882	
MW94/6	14/08/2020	Slug Test (post)	3.669	5.070	-	2.983	-	2.983	0.686	

Notes:
TOC=Top of Casing
BTOC=Below Top of Casing
mDatum=Site Height Datum
m=Meters
NA - Not Available

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Well ID	Sample Date	Purge Volume (L)	TEMP (°C)	pH	EC (µScm-1)	DO (mg/L)	Eh (mV)	Comments
BH210	20/07/2020	-	21.1	5.19	11,457	1	102.3	Turbid, orange, no odour
MW20/01A	20/07/2020	-	22.5	6.38	19,422	0.52	-10.9	Brown, muddy, no odour
MW20/01B	20/07/2020	-	22.5	7.26	7779	0.09	-84.6	Slightly turbid, muddy at bottom, no odour
MW20/02A	20/07/2020	-	22.2	5.51	15,104	3.58	73.7	Slightly turbid, no odour, turned blue in NaOH preserved bottle
MW20/02B	20/07/2020	-	22.2	5.98	26,250	0.65	-13.4	Turbid, cloudy, red-brown
MW20/03	21/07/2020	-	17.7	7.06	12,089	0.58	-89	Bailer used due to little water in hydrosleeve. Clear, slighty turbid, slight hydrocarbon odour, sheen
MW20/04	21/07/2020	-	19	6.3	10,580	1.08	50.4	Bailer used due to little water in hydrosleeve. Clear, no odour
MW20/05	21/07/2020	-	22.8	7.09	24,984	0.65	-58.1	Bailer used due to little water in hydrosleeve. Clear, turned blue in NaOH preserved bottle
MW20/06	21/07/2020	-	22.2	7.74	4880	0.53	-115.4	Bailer used due to little water in hydrosleeve. Light brown, strong hydrocarbon odour, sheen, small black globules of LNAPL
MW20/07	21/07/2020	-	22.6	7.66	2694	1.19	7.9	Bailer used due to little water in hydrosleeve. Slightly turbid, light brown, strong hydrocarbon odour, LNAPL present
MW20/08	20/07/2020	-	18.8	6.3	16,945	2.4	80.5	Clear, no odour
MW20/09	20/07/2020	-	18.5	6.25	16,121	2.66	93.5	Clear, no odour
MW20/10	20/07/2020	-	18.1	5.84	10,978	1.25	66.1	Orange tinge, almost clear, acetone-like odour
MW20/11	20/07/2020	-	17.4	6.37	19,257	0.98	10.4	Turbid, brown, sediment in bottom of hydrosleeve, slight odour
MW20/12	20/07/2020	-	18.4	6.54	13,798	0.75	-68.4	Clear above brown sediment, no odour
MW20/13	21/07/2020	-	21.8	7.09	17,293	0.53	-98	Slightly turbid, mostly clear, strong hydrocarbon odour, sheen, black globules of LNAPL present
MW20/14	20/07/2020	-	18.4	6.93	2711	1.53	21.1	Slight yellow tinge, clear, no odour
MW20/15	20/07/2020	-	18.5	5.91	20,674	4.04	99	Clear, no odour
MW20/16	20/07/2020	-	17.9	6.57	18,649	0.92	33.7	Slightly turbid, yellow tinge, no odour
MW20/17	20/07/2020	-	18.3	5.71	18,635	0.55	128.1	Turbid, brown, no odour
MW20/18	21/07/2020	-	16.5	7.42	4380	1.48	52.9	Clear, slight yellow tinge, no odour
MW20/19	20/07/2020	-	20.4	6.74	20,009	3.6	93	Clear, no odour
MW20/20	20/07/2020	-	18.6	5.72	29,196	1.16	55.7	Turbid, brown, no odour
MW94/6	20/07/2020	-	17.7	6.57	10,957	1.19	-70.1	Clear, no odour, turned blue in NaOH preserved bottle

Notes:

Pre	Pre Purging	Eh	Redox
Post	Post Purging	mV	millivolts
DO	Dissolved Oxygen	L	Litres
mg/L	milligrams per litre		
EC	Electrical Conductivity		
μScm^{-1}	microsiemens per centimetre		

Field Staff:
Amy Dorrington, Peter Brouwer

					BTEX							Naphthalene	TRH NEPM (2011)					TRH NEPM (2013)							TRH Silica Gel Cleanup								
					Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene	TRH >C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction	TRH >C10-C14 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C10-C40 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36	TRH >C34-C40 Silica Gel Cleanup	TRH >C10-C16 Fraction SG less Naphthalene
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.5	20	20	50	50	50	20	20	50	50	100	100	100	50	50	100	50	100	100	100	100	50
Clyde WARP SSTL (Direct Contact - Commercial)					400							9800							28000		17000	27000		27000									
Clyde WARP SSTL (Direct Contact - Construction Worker)					1200							67000							69000		45000	64000		64000									
Clyde WARP SSTL (Direct Contact - IMW)					15000							810000							830000		540000	770000		770000									
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m																																	
4-6m					3.2							NL							NL		NL	NL		NL									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																																	
1-1.99m					3.2							NL							770		NL	NL		NL									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																																	
2-3.99m					3.2							NL							NL		NL	NL		NL									
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																																	
0-0.99m					3.2							NL							600		NL	NL		NL									
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)					NL							NL							NL		NL	NL		NL									
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																										1000				3500		10000	
Field_ID	**Location_Code**	**Sample_Type**	**Sample_Depth_Range**	**Sampled_Date_Time**																													
MW20/03_0.8	MW20/03	Normal	0.7-0.9	13/07/2020	<0.1	<0.1	<0.1	0.3	2.2	2.5	-	<0.5	<20	59	100	56	215	<20	<20	<50	<50	<100	<100	<100	<50	<50	<100	-	<100	<100	<100	<100	-
MW20/03_3.0	MW20/03	Normal	2.9-3.1	13/07/2020	0.3	0.2	3.9	1	2.5	3.5	-	5 - 9.1	350	2600	5200	1600	9400	620	610	2800	2790.9	2200	5340	340	2100	2400	6800	-	3700	1500	1000	220	-
MW20/03_6.0	MW20/03	Normal	5.9-6.1	13/07/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	330	970	<50	1300	35	35	520	520	240	760	<100	<50	<50	<100	-	<100	<100	<100	<100	-
MW20/04_1.0	MW20/04	Normal	0.9-1.1	13/07/2020	<0.1	<0.1	<0.1	0.2	2.2	2.4	-	<0.5	<20	<20	150	<50	150	<20	<20	<50	<50	190	190	<100	<50	<50	<100	-	<100	100	<100	<100	-
MW20/04_3.5	MW20/04	Normal	3.4-3.6	13/07/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	52	<50	52	24	24	<50	<50	<100	<100	<100	390	590	3040	-	1700	560	950	270	-
MW20/04_4.5	MW20/04	Normal	4.4-4.6	13/07/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	<50	<50	<100	-	<100	<100	<100	<100	-
MW20/05_3.5	MW20/05	Normal	3.4-3.6	13/07/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	20	160	110	290	<20	<20	<50	<50	160	160	<100	<50	<50	<100	-	<100	120	<100	<100	-
MW20/06_6.0	MW20/06	Normal	5.8-6	14/07/2020	<1	5.2	1.3	2	4	6	-	3.2 - 8.9	<200	2200	14,000	1600	17,800	<200	<200	4400	4391.1	9800	14,990	790	1500	2400	9900	-	6600	3700	1800	330	-
MW20/07_6.0	MW20/07	Normal	5.8-6	14/07/2020	<0.1	0.6	0.9	1.4	5.7	7.1	-	1.5 - 7.6	470	820	2200	710	3730	970	960	940	932.4	890	1990	160	550	590	2090	-	1100	340	440	<100	-
D01_20200714	MW20/13	Field_D	4.5-4.7	14/07/2020	<0.1	0.8	1.1	1.1	2	3.1	-	1 - 6.1	120	310	620	220	1150	230	230	360	353.9	100	460	<100	240	220	820	-	400	120	180	<100	-
MW20/13_6.0	MW20/13	Normal	5.8-6	14/07/2020	<0.1	<0.1	0.2	0.2	0.3	0.4	-	<0.5 - 2	<20	94	350	<50	444	49	48	170	168	190	360	<100	64	110	234	-	170	<100	<100	<100	-
T01_20200714	MW20/13	Interlab_D	5.8-6	14/07/2020	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	1 - 3.3	55	520	1480	540	2540	79	79	820	820	1570	2690	300	250	490	1670	1830	1010	1100	410	240	490
MW20/17_3.0	MW20/17	Normal	2.9-3.1	9/07/2020	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	190	4000	340	4530	<20	<20	580	580	2900	3920	440	150	480	2780	-	2400	1200	230	240	-
Statistical Summary																																	
Number of Results					13	13	13	13	13	13	1	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	1	13	13	13	13	1
Number of Detects					1	4	5	7	7	7	0	6	4	10	12	8	12	7	7	8	8	10	10	5	8	8	8	1	8	9	7	5	1
Minimum Concentration					<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.2	<0.5	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	<50	<50	<100	1830	<100	<100	<100	<100	490
Minimum Detect					0.3	0.2	0.2	0.2	0.3	0.4	ND	1	55	20	52	56	52	24	24	170	168	100	160	160	64	110	234	1830	170	100	180	220	490
Maximum Concentration					<1	5.2	3.9	2	5.7	7.1	<0.2	9.1	470	2600	14000	1600	17800	970	960	4400	4391.1	9800	14990	790	2100	2400	9900	1830	6600	3700	1800	330	490
Maximum Detect					0.3	5.2	3.9	2	5.7	7.1	ND	9.1	470	2600	14000	1600	17800	970	960	4400	4391.1	9800	14990	790	2100	2400	9900	1830	6600	3700	1800	330	490
Average Concentration					0.11	0.57	0.62	0.52	1.5	2		2	90	552	2254	408	3202	166	164	824	822	1415	2385	187	413	570	2122		1333	688	408	131	
Median Concentration					0.05	0.05	0.05	0.2	0.3	0.4	0.1	0.25	10	190	620	110	1150	35	35	360	353.9	190	460	50	150	220	820	1830	400	120	180	50	490
Standard Deviation					0.14	1.4	1.1	0.64	1.8	2.4		2.5	149	858	3889	573	5133	295	291	1313	1310	2688	4151	226	649	843	3036		1941	1038	535	109	
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13	0	0	0	0	0	2	0	0	0	1	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13	0	0	0	0	0	2	0	0	0	1	0	0	0

					Inorganics	Metals	PAH/Phenols																			
					Moisture Content (dried @ 103°C)	Chromium (hexavalent)	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	PAHs (Sum of total)
					%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Clyde WARP SSTL (Direct Contact - Commercial)						3600								40											
Clyde WARP SSTL (Direct Contact - Construction Worker)						1400								200											
Clyde WARP SSTL (Direct Contact - IMW)						17000								3000											
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m																									
4-6m																									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																									
1-1.99m																									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																									
2-3.99m																									
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																									
0-0.99m																									
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)																									
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																									
Field_ID	**Location_Code**	**Sample_Type**	**Sample_Depth_Range**	**Sampled_Date_Time**																					
MW20/03_0.8	MW20/03	Normal	0.7-0.9	13/07/2020	9.3	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MW20/03_3.0	MW20/03	Normal	2.9-3.1	13/07/2020	21	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	1.4	<1	7.2
MW20/03_6.0	MW20/03	Normal	5.9-6.1	13/07/2020	22	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1
MW20/04_1.0	MW20/04	Normal	0.9-1.1	13/07/2020	8.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MW20/04_3.5	MW20/04	Normal	3.4-3.6	13/07/2020	22	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MW20/04_4.5	MW20/04	Normal	4.4-4.6	13/07/2020	20	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MW20/05_3.5	MW20/05	Normal	3.4-3.6	13/07/2020	10	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MW20/06_6.0	MW20/06	Normal	5.8-6	14/07/2020	20	<1	1.2	0.6	2	5.2	2.8	4.5	4.5	4.5	2.2	1.5	0.7	10	0.7	2.4	4.4	0.5	12	8.3	57.7
MW20/07_6.0	MW20/07	Normal	5.8-6	14/07/2020	25	<1	0.6	<0.5	1.3	1.9	0.5	0.7	1.4	1	<0.5	<0.5	<0.5	2.6	<0.5	1.4	2.9	<0.5	10	3.6	26.3
D01_20200714	MW20/13	Field_D	4.5-4.7	14/07/2020	21	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1
MW20/13_6.0	MW20/13	Normal	5.8-6	14/07/2020	18	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
T01_20200714	MW20/13	Interlab_D	5.8-6	14/07/2020	20.8	<0.5	0.6	<0.5	<0.5	0.6	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	0.7	1.2	<0.5	3.3	1.8	12.1
MW20/17_3.0	MW20/17	Normal	2.9-3.1	9/07/2020	27	<1	<0.5	<0.5	0.5	1.4	1.9	3	3	3	0.8	1.8	1.3	1.3	0.6	2.2	<0.5	1.5	1.6	2.6	17.5
Statistical Summary																									
Number of Results					13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Number of Detects					13	0	3	1	3	4	3	3	13	13	2	2	2	4	2	4	4	2	5	4	6
Minimum Concentration					8.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Minimum Detect					8.5	ND	0.6	0.6	0.5	0.6	0.5	0.7	1.2	0.6	0.8	1.5	0.7	0.6	0.6	0.7	0.8	0.5	1.4	1.8	1
Maximum Concentration					27	<1	1.2	0.6	2	5.2	2.8	4.5	4.5	4.5	2.2	1.8	1.3	10	0.7	2.4	4.4	1.5	12	8.3	57.7
Maximum Detect					27	ND	1.2	0.6	2	5.2	2.8	4.5	4.5	4.5	2.2	1.8	1.3	10	0.7	2.4	4.4	1.5	12	8.3	57.7
Average Concentration					19	0.48	0.38	0.28	0.48	0.87	0.59	0.82	1.6	1.1	0.44	0.47	0.37	1.3	0.31	0.69	0.89	0.37	2.3	1.5	9.5
Median Concentration					20.8	0.5	0.25	0.25	0.25	0.25	0.25	0.25	1.2	0.6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5
Standard Deviation					5.9	0.069	0.28	0.097	0.54	1.4	0.8	1.3	1	1.2	0.55	0.53	0.31	2.7	0.15	0.79	1.3	0.35	4	2.3	17
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					ASS		Chromium Reducible Sulfur							SPOCAS										
					pH (Fox)	Reaction Rate	acidity - Chromium Reducible Sulfur (a-22B)	acidity - Net Acid Soluble Sulfur (a-20J)	HCl Extractable Sulfur (20Be)	Net Acid Soluble Sulfur (20Ie)	sulfidic - Net Acid Soluble Sulfur (s-20J)	Acid Neutralising Capacity - acidity (a-ANCbt)	HCl Extractable Sulfur Correction Factor	Acid Neutralising Capacity	ANC Fineness Factor	Chromium Reducible Sulfur	KCl Extractable Sulfur	Liming Rate	Net Acidity (acidity units)	Net Acidity (sulfur units)	pH KCl	sulfidic - Titratable Actual Acidity	sulfidic-Acid Neutral	Titratable Actual Acidity
					pH units	COMMENT	MOL H+/T	MOL H+/T	%	%	%	MOL H+/T	FACTOR	% CaCO3	FACTOR	%S	%	kg CaCO3/t	mole H+/t	%S	pH Units	%S	%S	mole H+/t
EQL					0.1		3	10	0.02	0.02	0.02	2	1	0.01		0.005	0.02	1	10	0.02	0.1	0.003	0.02	2
NSW ASSMAC 1998 Action Criteria >1000T disturbed (Fine texture soils)																			62	0.03				
NSW ASSMAC 1998 Action Criteria >1000T disturbed (Medium texture soils)																			36	0.03				
Field_ID	**Location_Code**	**Sample_Type**	**Sample_Depth_Range**	**Sampled_Date_Time**																				
MW20/01A_3.5	MW20/01A	Normal	3.4-3.5	14/07/2020	3.5	4	15	-	-	-	-	-	2	-	1.5	0.024	-	1.6	21	0.03	5.7	0.009	-	5.8
MW20/01B_6.0	MW20/01B	Normal	5.9-6.1	15/07/2020	6.6	4	4.9	-	-	-	-	95	2	0.47	1.5	0.008	-	<1	<10	<0.02	7.4	<0.003	0.15	<2
MW20/02A_2.5	MW20/02A	Normal	2.5-2.7	15/07/2020	3.9	4	3.4	21	0.07	0.05	0.03	-	2	-	1.5	0.005	0.02	140	1800	2.9	4.1	2.9	-	1800
MW20/02B_3.0	MW20/02B	Normal	2.9-3.1	15/07/2020	4.1	4	<3	26	0.11	0.06	0.04	-	2	-	1.5	<0.005	0.05	93	1200	2	4.4	1.9	-	1200
MW20/07_6.0	MW20/07	Normal	5.8-6	14/07/2020	4.6	4	93	-	-	-	-	190	2	0.97	1.5	0.15	-	<1	<10	<0.02	7.5	<0.003	0.31	<2
MW20/10_2.0	MW20/10	Normal	1.9-2.1	8/07/2020	2.8	4	280	-	-	-	-	180	2	0.9	1.5	0.45	-	12	160	0.26	6.7	<0.003	0.29	<2
MW20/13_4.5	MW20/13	Normal	4.5-4.7	14/07/2020	6.9	4	80	-	-	-	-	700	2	3.5	1.5	0.13	-	<1	<10	<0.02	8.8	<0.003	1.1	<2
Statistical Summary																								
Number of Results					7	7	7	2	2	2	2	4	7	4	7	7	2	7	7	7	7	7	4	7
Number of Detects					7	7	6	2	2	2	2	4	7	4	7	6	2	4	4	4	7	3	4	3
Minimum Concentration					2.8	4	<3	21	0.07	0.05	0.03	95	2	0.47	1.5	<0.005	0.02	<1	<10	<0.02	4.1	<0.003	0.15	<2
Minimum Detect					2.8	4	3.4	21	0.07	0.05	0.03	95	2	0.47	1.5	0.005	0.02	1.6	21	0.03	4.1	0.009	0.15	5.8
Maximum Concentration					6.9	4	280	26	0.11	0.06	0.04	700	2	3.5	1.5	0.45	0.05	140	1800	2.9	8.8	2.9	1.1	1800
Maximum Detect					6.9	4	280	26	0.11	0.06	0.04	700	2	3.5	1.5	0.45	0.05	140	1800	2.9	8.8	2.9	1.1	1800
Average Concentration					4.6	4	68					291	2	1.5	1.5	0.11		35	457	0.75	6.4	0.69	0.46	430
Median Concentration					4.1	4	15	23.5	0.09	0.055	0.035	185	2	0.935	1.5	0.024	0.035	1.6	21	0.03	6.7	0.0015	0.3	1
Standard Deviation					1.6	0	101					276	0	1.4	0	0.16		57	736	1.2	1.7	1.2	0.43	751
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					Extraneous Material				PSD						
					Extraneous Material	>2mm Fraction	<2mm Fraction	Analysed Material	<63 Micron	>2000 Micron	1000-2000 Micron	125-250 Micron	250-500 Micron	500-1000 Micron	63-125 Micron
					%	G	G	%	%W/W	%W/W	%W/W	%W/W	%W/W	%W/W	%W/W
EQL					0.1	0.005	0.005	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Field_ID	**Location_Code**	**Sample_Type**	**Sample_Depth_Range**	**Sampled_Date_Time**											
MW20/01A_3.5	MW20/01A	Normal	3.4-3.5	14/07/2020	<0.1	<0.005	66	100	-	-	-	-	-	-	-
MW20/01B_0.5	MW20/01B	Normal	4.-0.6	14/07/2020	-	-	-	-	13	34	10	16	9.5	10	7.5
MW20/01B_09.0	MW20/01B	Normal	8.8-9.0	14/07/2020	-	-	-	-	77	3.7	2.2	6.1	2.1	1.5	7.2
MW20/01B_2.0	MW20/01B	Normal	1.9-2.1	14/07/2020	-	-	-	-	31	0.3	1.4	24	0.2	1.7	41
MW20/01B_5.0	MW20/01B	Normal	4.9-5.1	14/07/2020	-	-	-	-	40	18	24	5.2	1.9	2.2	8.6
MW20/01B_6.0	MW20/01B	Normal	5.9-6.1	15/07/2020	9.3	5.7	55	91	-	-	-	-	-	-	-
MW20/02A_2.5	MW20/02A	Normal	2.5-2.7	15/07/2020	<0.1	<0.005	71	100	-	-	-	-	-	-	-
MW20/02B_2.0	MW20/02B	Normal	1.9-2.1	15/07/2020	-	-	-	-	59	12	3.7	7.7	7.6	4.7	5.4
MW20/02B_3.0	MW20/02B	Normal	2.9-3.1	15/07/2020	1.2	0.77	65	99	-	-	-	-	-	-	-
MW20/02B_4.5	MW20/02B	Normal	4.4-4.6	15/07/2020	-	-	-	-	28	0.1	1.2	27	1.3	1.3	41
MW20/02B_9.0	MW20/02B	Normal	8.8-9.0	15/07/2020	-	-	-	-	60	9.1	2.3	11	2.4	2.8	13
MW20/07_6.0	MW20/07	Normal	5.8-6	14/07/2020	<0.1	<0.005	56	100	-	-	-	-	-	-	-
MW20/10_2.0	MW20/10	Normal	1.9-2.1	8/07/2020	5.3	3.1	55	95	-	-	-	-	-	-	-
MW20/13_4.5	MW20/13	Normal	4.5-4.7	14/07/2020	11	7.7	62	89	-	-	-	-	-	-	-
MW20/19_2.5	MW20/19	Normal	2.4-5.6	15/07/2020	-	-	-	-	91	3.5	0.9	1.8	1.3	0.3	1.7
MW20/19_4.0	MW20/19	Normal	3.9-4.1	15/07/2020	-	-	-	-	76	4.2	1.2	8.4	3.5	1.8	5.1
Statistical Summary															
Number of Results					7	7	7	7	9	9	9	9	9	9	9
Number of Detects					4	4	7	7	9	9	9	9	9	9	9
Minimum Concentration					<0.1	<0.005	55	89	13	0.1	0.9	1.8	0.2	0.3	1.7
Minimum Detect					1.2	0.77	55	89	13	0.1	0.9	1.8	0.2	0.3	1.7
Maximum Concentration					11	7.7	71	100	91	34	24	27	9.5	10	41
Maximum Detect					11	7.7	71	100	91	34	24	27	9.5	10	41
Average Concentration					3.9	2.5	61	96	53	9.4	5.2	12	3.3	2.9	15
Median Concentration					1.2	0.77	62	99	59	4.2	2.2	8.4	2.1	1.8	7.5
Standard Deviation					4.7	3.1	6.3	4.7	26	11	7.6	8.7	3.1	2.9	15
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0

					BTEX						Naphthalene							TRH NEPM (2013)						
					Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene	TRH >C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C15-C36 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					1	1	1	1	2	1	0.05	20	50	100		50	50	20	20	50	50	100	100	100
ANZG (2018) TV - Marine (Slightly To Moderately Disturbed)					700[#1]	180[#2]	80	350[#2]	275[#2]		70[#1]													
Clyde WARP SSTL - GW VI - Commercial					5000						13000								6200		NL			
Clyde WARP SSTL - GW VI - Construction					NL						NL							-	NL	-	NL	-		-
Clyde WARP SSTL - GW VI - IMW					NL						NL							-	NL	-	NL	-		-
NEPM (2013) - Marine Water					500						50													
NEPM (2013) - Recreational					10	8000	3000			6000														
NHMRC (2008) Recreational Water - Health					10	8000	3000			6000														
Location_Code	**Field_ID**	**Sampled_Date_Time**	**Transect**	**Sample_Type**																				
BH210	BH210	20/07/2020	1 - Upgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	710	<100	-	<100	710	<20	<20	120	120	<100	120	<100
BH210	D01_20200720	20/07/2020	1 - Upgradient	Field_D	<1	<1	<1	<1	<2	<3	<1	<20	580	<100	-	<100	580	<20	<20	<50	<50	<100	<100	<100
MW20/01A	MW20/01A	20/07/2020	1 - Upgradient	Normal	<1	<1	<1	2	3	5	<10 - 2	<20	100	1600	-	500	2200	30	30	280	280	1800	2280	200
MW20/01B	MW20/01B	20/07/2020	1 - Upgradient	Normal	<1	<1	1	3	5	8	<10 - 3	50	<50	<100	-	<100	<100	80	70	<50	<50	<100	<100	<100
MW20/02A	MW20/02A	20/07/2020	1 - Upgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	420	<100	-	<100	420	<20	<20	410	410	<100	410	<100
MW20/02B	MW20/02B	20/07/2020	1 - Upgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	100	100	<20	<20	<50	<50	<100	<100	<100
MW20/19	MW20/19	20/07/2020	1 - Upgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	500	500	<20	<20	<50	<50	300	500	200
MW20/03	MW20/03	21/07/2020	2 - Source	Normal	14	<1	6	8	3	11	<1	330	3600	9400	-	1600	14,600	610	580	5100	5100	8600	14,500	800
MW20/07	MW20/07	21/07/2020	2 - Source	Normal	4	7	3	6	14	19	20 - 25	170	5500	14,000	-	4300	23,800	330	300	7300	7280	15,000	25,100	2800
MW20/13	MW20/13	21/07/2020	2 - Source	Normal	42	25	56	68	95	160	50 - 57	710	1700	4800	-	400	6900	1100	810	2100	2050	4300	6600	200
BH116	BH116	21/07/2020	3 - Source	Normal	<1	<1	<1	<1	<2	<3	<2	<20	7400	35,000	-	41,000	83,400	<20	<20	13,000	13,000	48,000	80,000	19,000
MW20/04	MW20/04	21/07/2020	3 - Source	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	<100	<100	<20	<20	<50	<50	<100	<100	<100
MW20/05	MW20/05	21/07/2020	3 - Source	Normal	4	6	2	2	4	6	<10 - 2	<20	430	1600	-	100	2130	<20	<20	690	690	1400	2090	<100
MW20/06	MW20/06	21/07/2020	3 - Source	Normal	2	10	1	1	<2	<3	<10 - 65	60	21,000	16,000	-	3900	40,900	130	120	22,000	22,000	8200	33,400	3200
MW12/20	MW12/20	21/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	<100	<100	<20	<20	<50	<50	<100	<100	<100
MW20/08	MW20/08	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	<100	<100	<20	<20	<50	<50	<100	<100	<100
MW20/09	MW20/09	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	410	300	-	1900	2610	<20	<20	410	410	1600	2710	700
MW20/10	MW20/10	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	30	460	1100	-	400	1960	30	30	610	610	1000	1810	200
MW20/11	MW20/11	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	150	1300	-	700	2150	<20	<20	160	160	1000	1560	400
MW20/12	D02_20200720	20/07/2020	4 - Downgradient	Field_D	<1	<1	<1	<1	<2	<3	<1	<20	<50	300	-	100	400	<20	<20	50	50	300	350	<100
MW20/12	MW20/12	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	180	800	-	400	1380	<20	<20	140	140	1000	1240	100
MW20/14	MW20/14	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	1100	-	200	1300	<20	<20	<50	<50	800	800	<100
MW20/15	MW20/15	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	1900	1900	<20	<20	<50	<50	1300	2000	700
MW20/16	MW20/16	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	<100	<100	<20	<20	<50	<50	<100	<100	<100
MW20/17	MW20/17	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	160	1700	-	600	2460	<20	<20	330	330	1900	2630	400
MW20/18	D01_20200721	21/07/2020	4 - Downgradient	Field_D	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	<100	<100	<20	<20	<50	<50	<100	<100	<100
MW20/18	MW20/18	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	-	<100	<100	<20	<20	<50	<50	<100	<100	<100
MW20/20	MW20/20	20/07/2020	4 - Downgradient	Normal	<1	<1	<1	<1	<2	<3	<1	<20	3400	800	-	100	4300	<20	<20	3200	3200	600	3800	<100
MW94/6	MW94/6	20/07/2020	4 - Downgradient	Normal	<1	<1	2	4	12	16	<1	20	<50	<100	-	<100	<100	30	<20	<50	<50	<100	<100	<100
Statistical Summary																								
Number of Results					29	29	29	29	29	29	29	29	29	29	0	29	29	29	29	29	29	29	29	29
Number of Detects					5	4	7	8	7	7	6	7	16	15	0	18	21	8	7	16	16	17	19	13
Minimum Concentration					<1	<1	<1	<1	<2	<3	<1	<20	<50	<100	99999	<100	<100	<20	<20	<50	<50	<100	<100	<100
Minimum Detect					2	6	1	1	3	5	20	20	100	300	ND	100	100	30	30	50	50	300	120	100
Maximum Concentration					42	25	56	68	95	160	65	710	21000	35000	0	41000	83400	1100	810	22000	22000	48000	80000	19000
Maximum Detect					42	25	56	68	95	160	65	710	21000	35000	ND	41000	83400	1100	810	22000	22000	48000	80000	19000
Average Concentration					2.7	2.1	2.8	3.6	5.4	8.9	4.6	55	1604	3121		2043	6728	88	74	1939	1936	3369	6290	1024
Median Concentration					0.5	0.5	0.5	0.5	1	1.5	0.5	10	150	300		100	1300	10	10	120	120	600	800	50
Standard Deviation					8	5	10	13	18	29	12	142	4142	7367		7572	17114	231	184	4779	4778	9213	16150	3540
Number of Guideline Exceedances					2	0	0	0	0	0	2	0	0	0	0	0	0	29	0	29	29	29	0	29
Number of Guideline Exceedances(Detects Only)					2	0	0	0	0	0	2	0	0	0	0	0	0	29	0	29	29	29	0	29

Env Stds Comments

#1:Moderate Reliability

#2:Unknown level of species protection; Unknown Reliability

#3:High Reliability

#4:Very high Reliability

#5:Low Reliability

					TRH Silica Gel Cleanup							Metals			PAH/Phenols															
					TRH >C10-C14 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36 Silica Gel Cleanup	TRH >C34-C40 Silica Gel Cleanup	Chromium (Filtered)	Chromium (hexavalent) (Filtered)	Chromium (Trivalent) (Filtered)	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	PAHs (Sum of total)
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					50	50	50	100	100	50	100	1	0.5	5	0.05	0.05	0.05	0.05	0.01	1	0.05	1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2
ANZG (2018) TV - Marine (Slightly To Moderately Disturbed)																	0.01[#2]		0.1[#2]						1[#2]			0.6[#2]		
Clyde WARP SSTL - GW VI - Commercial																														
Clyde WARP SSTL - GW VI - Construction													-																	
Clyde WARP SSTL - GW VI - IMW													-																	
NEPM (2013) - Marine Water													4.4	27																
NEPM (2013) - Recreational													500																	
NHMRC (2008) Recreational Water - Health													500						0.1											
Location_Code	**Field_ID**	**Sampled_Date_Time**	**Transect**	**Sample_Type**																										
BH210	BH210	20/07/2020	1 - Upgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BH210	D01_20200720	20/07/2020	1 - Upgradient	Field_D	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/01A	MW20/01A	20/07/2020	1 - Upgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<1	<0.5	<5	<1	<1	<1	1	1	1	1	<1	2	1	1	<1	1	1	1	13
MW20/01B	MW20/01B	20/07/2020	1 - Upgradient	Normal	<50	<50	<100	<100	<100	<100	<100	1	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	3
MW20/02A	MW20/02A	20/07/2020	1 - Upgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/02B	MW20/02B	20/07/2020	1 - Upgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/19	MW20/19	20/07/2020	1 - Upgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/03	MW20/03	21/07/2020	2 - Source	Normal	940	2000	3640	2400	1800	300	<100	<2	<0.5	<5	3	6	1	<1	<1	<1	<1	<1	<1	<1	1	4	<1	6	1	22
MW20/07	MW20/07	21/07/2020	2 - Source	Normal	1700	2900	8100	4600	5000	1800	1100	<2	3.1	<5	5	1	9	15	5	3	<2	3	19	2	8	17	1	69	24	206
MW20/13	MW20/13	21/07/2020	2 - Source	Normal	<50	<50	<100	<100	<100	<100	<100	<2	1	<5	2	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	3	<1	2	<1	66
BH116	BH116	21/07/2020	3 - Source	Normal	5200	9400	22,800	4600	6000	13,000	11,000	<2	0.7	<5	<2	3	<2	4	3	6	4	<2	6	<2	10	<2	3	7	10	56
MW20/04	MW20/04	21/07/2020	3 - Source	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/05	MW20/05	21/07/2020	3 - Source	Normal	<50	<50	<100	<100	<100	<100	<100	1	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	3
MW20/06	MW20/06	21/07/2020	3 - Source	Normal	11,000	15,000	22,700	11,000	4800	700	700	<2	3.8	<5	20	7	5	4	3	1	<2	<1	8	1	2	38	<1	59	9	222
MW12/20	MW12/20	21/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/08	MW20/08	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	0.6	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/09	MW20/09	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/10	MW20/10	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/11	MW20/11	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	0.7	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/12	D02_20200720	20/07/2020	4 - Downgradient	Field_D	<50	<50	<100	<100	<100	<100	<100	<2	0.6	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/12	MW20/12	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	0.6	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/14	MW20/14	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/15	MW20/15	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	0.9	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/16	MW20/16	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	1.3	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/17	MW20/17	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/18	D01_20200721	21/07/2020	4 - Downgradient	Field_D	<50	<50	<100	<100	<100	<100	<100	<2	0.7	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/18	MW20/18	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW20/20	MW20/20	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW94/6	MW94/6	20/07/2020	4 - Downgradient	Normal	<50	<50	<100	<100	<100	<100	<100	<2	0.7	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Statistical Summary

Number of Results	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Number of Detects	4	4	4	4	4	4	3	3	13	0	4	5	3	4	4	4	2	1	4	3	5	4	3	7	5	8
Minimum Concentration	<50	<50	<100	<100	<100	<100	<100	<1	<0.5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Minimum Detect	940	2000	3640	2400	1800	300	700	1	0.6	ND	2	1	1	1	1	1	1	3	2	1	1	3	1	1	1	3
Maximum Concentration	11000	15000	22800	11000	6000	13000	11000	2	3.8	<5	20	7	9	15	5	6	4	3	19	2	10	38	3	69	24	222
Maximum Detect	11000	15000	22800	11000	6000	13000	11000	2	3.8	ND	20	7	9	15	5	6	4	3	19	2	10	38	3	69	24	222
Average Concentration	671	1032	2017	822	650	588	486	1	0.68	2.5	1.5	1.1	0.98	1.3	0.84	0.81	0.67	0.6	1.6	0.6	1.2	2.6	0.62	5.4	2	21
Median Concentration	25	25	50	50	50	50	50	1	0.25	2.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Standard Deviation	2226	3245	5964	2311	1638	2412	2035	0.21	0.83	0	3.7	1.6	1.8	2.8	1	1.1	0.66	0.47	3.7	0.31	2.2	7.5	0.48	16	4.8	56
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	29	0	29	0	0	0	0	0	5	0	0	29	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	4	0	0	0	0	0	5	0	0	7	0	0

Env Stds Comments

#1:Moderate Reliability

#2:Unknown level of species protection; Unknown Reliability

#3:High Reliability

#4:Very high Reliability

#5:Low Reliability

Tables - Stage 2 ESA Report

Existing Sampling density - Stage 2 Subdivisions						NSW Sampling Guideline Recommendation Table A - Sampling density				Desired/Achieved Sampling Density					
Subdivision	Area (m2)	Area (ha)	Existing soil sampling points	Sample Locations/ ha	Existing Circular Hotspot Radius (m)	Sample Points	Eq. Sample Density	Circular Hotspot Diameter (m)	Additional sampling proposed?	Proposed new sampling points	Sampling points achieved during Stage 2 ESA	Total Sampling Points	Revised Sample Location/ ha	Revised Circular Hotspot Radius (m)*	Rationale/ Comments on Sample Density
51	8100	0.81	10	12.3	15.8	19	23.8	15.8	Y	**4**	**4**	14	17.3	13.4	Extra locations to confirm localised extent of asbestos at TP19/01 (AEC-1). Density of sampling completed is considered appropriate based on site use for administration, car park and inert impacts fill materials identified during previous investigations. Asbestos considered limited to former demolished building footprint
52	8100	0.81	9	11.1	16.7	19	23.8	19.2	Y	**6**	**6**	15	18.5	12.9	Density of sampling increased based on potential for validation as suitable for commercial/ industrial land use without a LTEMP.
53	27100	2.71	14	5.2	30.5	35	31.5	30.5	Y	**12**	**12**	26	9.6	18.3	Propose new locations for spatial coverage out of heavy trafficked areas. Proposed sampling density considered appropriate given past land use limited to asphalt carpark area, potential contaminant sources limited to historical UST (validated and removed 2009) and thin layer of fill underlying asphalt. Existing sample locations include 9 soil sample locations + 4 wells + UST validation (1).
54	10100	1.01	6	5.9	22.8	21	21.0	25.0	Y	**4**	**4**	10	9.9	17.7	Tank bund area - uniform contaminant distribution expected from any historical spills. Calculated Hotspot size is appropriate for management of residual hydrocarbons under LTEMP (20m buffer).
55	11000	1.1	9	8.2	19.4	21	21.0	19.4	Y	**4**	**4**	13	11.8	16.2	Tank bund area - uniform contaminant distribution expected from any historical spills. Calculated Hotspot size is appropriate for management of residual hydrocarbons under LTEMP (20m buffer).
56	21300	2.13	11	5.2	24.5	30	15.0	24.5	Y	**6**	**6**	17	8.0	19.7	Tank bund area - uniform contaminant distribution expected from any historical spills. Calculated Hotspot diameter is appropriate for management of residual hydrocarbons under LTEMP (20m buffer). Some limitations to sample placement due to areas inundated with water and location of biopiles within former tankfarm area.
58	21250	2.125	12	5.6	23.4	30	15.0	23.4	Y	**7**	**7**	19	8.9	18.6	Data gaps Identified from Stage 2 Drainage validation: - numerous shallow compromised pipes suspected not to have contained hydrocarbon product were identified in footprint of former water treatment infrastructure, confirm no soil impacts requiring remediation or management for RAP
59	21350	2.135	12	5.6	23.46	30	15.0	23.46	Y	**8**	**8**	20	9.4	18.17	Lateral delineation of hydrocarbon impacts identified to backfill sands identified from drainage validation test pits (TP20/30, TP220/29a and b)
60	33180	3.318	9	2.7	33.77	40	13.3	33.77	Y	**17**	**17**	26	7.8	19.87	Increased systematic spatial coverage. 3 x locations to increase spatial coverage (no known sources of impact in these areas). Up to 5 x locations to determine requirement for remediation/management of asbestos identified at AEC-15a (single ACM fragment identified at MW11/14 in 2011)
61	15530	1.553	10	6.4	21.63	6	60.0	21.63	Y	**6**	**6**	16	10.3	17.33	Data gaps Identified from Stage 2 Drainage validation: Compromised pipe identified (11D460-4) but surrounding soil not characterised to determine requirement for management/ remediation
62	30970	3.097	21	6.8	21.36	40	13.3	21.36	Y	**8**	**8**	29	9.4	18.18	Increased systematic spatial coverage. Confirm lateral and vertical extent of remediation required at AEC-3a (hydrocarbons)
63	36630	3.663	22	6.0	22.69	45	12.9	22.69	Y	**14**	**14**	36	9.8	17.74	Increased systematic spatial coverage. Lateral delineation of remediation and management required (AEC-3c and AEC-3d)
64	23500	2.35	46	19.6	12.57	35	14.0	18.18	N	**0**	**0**	46	19.6	12.57	AEC-4: considered sufficiently characterised for purposes of the RAP (above sample design guidelines)
Road Alignmen	12075	1.2075	15	12.4	15.58	21	21.0	15.78	Y	**1**	**1**	16	13.3	15.28	
STAGE 2	280185	28.0185	206	7.4						97		303.0	10.81	19.16	
STAGE 1	70000	7	40	5.7	-	-	-	-	-	0		40.0	5.7	23.27	

* Hotspot radius calculated using Visual Sample Plan 7. Based on number of sample locations and sample area per lot and systematic triangular grid spacing between samples. Hotspot diameter is the smallest circular hotspot that can be detected with 95% probability

NSW Sampling Guideline Recommendation - Table A

Size of the site (hectare) 1 hectare = 10,000 m²	Number of sampling points recommended	Equivalent sampling density (points/hectare)	Diameter of the hot spot that can be detected with 95% confidence (metre)
0.05	5	100.0	11.8
0.1	6	60.0	15.2
0.2	7	35.0	19.9
0.3	9	30.0	21.5
0.4	11	27.5	22.5
0.5	13	26.0	23.1
0.6	15	25.0	23.6
0.7	17	24.3	23.9
0.8	19	23.8	24.2
0.9	20	22.2	25.0
1.0	21	21.0	25.7
1.5	25	16.7	28.9
2.0	30	15.0	30.5
2.5	35	14.0	31.5
3.0	40	13.3	32.4
3.5	45	12.9	32.9
4.0	50	12.5	33.4
4.5	52	11.6	34.6
5.0	55	11.0	35.6

Location ID	Location Type	Expected Target Depth (m) *(See Notes)*	Proposed Lot ID	Sampling Rationale	Concrete Hardstand	Total Number of Samples	Lab Analysis (Soils)								
							TRH, BTEXN	TRH, BTEXN, PAH	TRH/ BTEXN/ PAH/ Phenols/ metals	Speciated Cr *(See notes)*	TRH Speciation - CWG Fractions *(See Notes)*	TRH C10-C40 Silica Gel Clean-up *(See Notes)*	Asbestos ID *(See Notes)*	Asbestos Quantification (%w/w) *(See notes)*	QAQC - Trip Spike/ Blank TRH C6-C10, BTEXN
TP21/01	Test Pit	1	51	Laterally delineate asbestos impacts identified in AEC-1 (TP19/01)	N	2							1	2	
TP21/02	Test Pit	1	51	Laterally delineate asbestos impacts identified in AEC-1 (TP19/01)	N	2							1	2	
TP21/03	Test Pit	1	51	Laterally delineate asbestos impacts identified in AEC-1 (TP19/01)	N	2							1	2	
TP21/04	Test Pit	1	51	Laterally delineate asbestos impacts identified in AEC-1 (TP19/01)	N	2							1	2	
TP21/05	Test Pit	2	53	Spatial coverage - increase lot specific sample density	N	2	1		1			2			
TP21/06	Test Pit	2	53	Spatial coverage - increase lot specific sample density	N	2	1		1			2			
TP21/07	Test Pit	2	59	Confirmation of width of service trench and confinement of hydrocarbon impacts exceeding SSTLs (TP20/30) from compromised pipe to backfill sand	Y	2		2				2			
TP21/08	Test Pit	2	59	Confirmation of width of service trench and confinement of hydrocarbon impacts exceeding SSTLs (TP20/30) from compromised pipe to backfill sand	Possible	2		2				2			
TP21/09	Test Pit	2	59	Confirmation of width of service trench and confinement of hydrocarbon impacts exceeding SSTLs (TP20/30) from compromised pipe to backfill sand	Possible	2		2				2			
TP21/10	Test Pit	2	60	Spatial coverage - increase lot specific sample density	N	2	1		1			2			
TP21/11	Test Pit	2	60	Spatial coverage - increase lot specific sample density	N	2	1		1			2			
TP21/12	Test Pit	2	60	Confirm requirement for asbestos management/remediation at AEC-15a (single ACM fragment found at MW11/14)	Possible - gravel at surface	2							1	2	
TP21/13	Test Pit	2	60	Lateral delineation of asbestos impact at AEC-15a	Possible - gravel at surface	2							1	2	
TP21/14	Test Pit	2	60	Lateral delineation of asbestos impact at AEC-15a	Possible - gravel at surface	2							1	2	
TP21/15	Test Pit	2	60	Lateral delineation of asbestos impact at AEC-15a	Possible - gravel at surface	2							1	2	
TP21/16	Test Pit	2	60	Lateral delineation of asbestos impact at AEC-15a	Possible - gravel at surface	2							1	2	
TP21/17	Test Pit	2	60	Spatial coverage - increase lot specific sample density	Possible - gravel at surface	2	1		1			2			
TP21/18	Test Pit	2	63	Spatial coverage - increase lot specific sample density	N - Asphalt	2	1		1			2			
TP21/19	Test Pit	2	63	Spatial coverage - increase lot specific sample density. Lateral delineation of AEC-3c	N - Asphalt	2	1		1			2			
TP21/20	Test Pit	2	63	Spatial coverage - increase lot specific sample density. Lateral delineation of AEC-3d/ AEC-3c	N - Asphalt	2	1		1			2			
TP21/21	Test Pit	2	63	Spatial coverage - increase lot specific sample density. Lateral delineation of AEC-3d/ AEC-3c	N - Asphalt	2	1		1			2			
TP21/22	Test Pit	2	63	Spatial coverage - increase lot specific sample density. Lateral delineation of AEC-3d	N - Asphalt	2	1		1			2			
TP21/23	Test Pit	2	63	Spatial coverage - increase lot specific sample density. Lateral delineation of AEC-3d/ AEC-3c	Y	2	1		1			2			
TP21/24	Test Pit	2	63	Spatial coverage - increase lot specific sample density. Lateral delineation of AEC-3c	N	2	1		1			2			
TP21/25	Test Pit	2	62	Spatial coverage Lateral delineation of hydrocarbon imapcts requiring remediation at AEC-3a	N	2	2					2			
TP21/26	Test Pit	2	62	Spatial coverage Lateral delineation of hydrocarbon imapcts requiring remediation at AEC-3a	N	2	2					2			
TP21/27	Test Pit	2	62	Spatial coverage Lateral delineation of hydrocarbon imapcts requiring remediation at AEC-3a	Possible	2	2					2			
TP21/28	Test Pit	2	62	Spatial coverage Lateral delineation of hydrocarbon imapcts requiring remediation at AEC-3a	N	2	2					2			
TP21/29	Test Pit	2	61	Compromised pipe (11D-380-2): Address Stage 2 Drainage Validation Data Gap	Y	2		2				2			
TP21/30	Test Pit	2	61	Compromised pipe (11D-380-2): Address Stage 2 Drainage Validation Data Gap	Y	2		2				2			
TP21/31	Test Pit	2	61	Compromised pipe (11D-380-2): Address Stage 2 Drainage Validation Data Gap	Y	2		2				2			
TP21/32	Test Pit	2	58	Drainage validation data gap: Potentially compromised pipe data gap, characterise backfill material	Y	2		2				2			
TP21/33	Test Pit	2	58	Drainage validation data gap: Potentially compromised pipe data gap, characterise backfill material	Y	2		2				2			
TP21/34	Test Pit	2	58	Drainage validation data gap: Potentially compromised pipe data gap, characterise backfill material	Y	2		2				2			
TP21/35	Test Pit	2	58	Drainage validation data gap: Potentially compromised pipe data gap, characterise backfill material	Y	2		2				2			
TP21/36	Test Pit	2	53	Spatial Coverage - increase lot-specific density	Y	2	1		1			2			
TP21/37	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density	Y	0									
TP21/38	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density		0									
TP21/39	Test Pit	2	53	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/40	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density	N	0									
TP21/41	Test Pit	2	53	Spatial Coverage - increase lot-specific density	N	2	1		1			2			
TP21/42	Test Pit	2	59	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/43	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density		0									
TP21/44	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density	N	0									
TP21/45	Test Pit (Visual Observation)	2	52	Spatial Coverage - increase lot-specific density		0									
TP21/46	Test Pit	2	52	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/47	Test Pit (Visual Observation)	2	54	Spatial Coverage - increase lot-specific density		0									
TP21/48	Test Pit	2	54	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/49	Test Pit (Visual Observation)	2	54	Spatial Coverage - increase lot-specific density		0									
TP21/50	Test Pit (Visual Observation)	2	54	Spatial Coverage - increase lot-specific density		0									
TP21/51	Test Pit	2	55	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/52	Test Pit (Visual Observation)	2	55	Spatial Coverage - increase lot-specific density		0									
TP21/53	Test Pit	2	55	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/54	Test Pit (Visual Observation)	2	55	Spatial Coverage - increase lot-specific density		0									
TP21/55	Test Pit	2	56	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/56	Test Pit (Visual Observation)	2	56	Spatial Coverage - increase lot-specific density		0									
TP21/57	Test Pit (Visual Observation)	2	56	Spatial Coverage - increase lot-specific density		0									
TP21/58	Test Pit	2	56	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/59	Test Pit (Visual Observation)	2	56	Spatial Coverage - increase lot-specific density		0									
TP21/60	Test Pit	2	56	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/61	Test Pit (Visual Observation)	2	58	Spatial Coverage - increase lot-specific density		0									
TP21/62	Test Pit (Visual Observation)	2	58	Spatial Coverage - increase lot-specific density		0									
TP21/63	Test Pit	2	58	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/64	Test Pit	2	59	Spatial Coverage - increase lot-specific density	possible	2	1		1			2			
TP21/65	Test Pit (Visual Observation)	2	59	Spatial Coverage - increase lot-specific density	possible	0									
TP21/66	Test Pit	2	59	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/67	Test Pit (Visual Observation)	2	59	Spatial Coverage - increase lot-specific density		0									
TP21/68	Test Pit	2	60	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/69	Test Pit (Visual Observation)	2	60	Spatial Coverage - increase lot-specific density		0									
TP21/70	Test Pit (Visual Observation)	2	60	Spatial Coverage - increase lot-specific density		0									
TP21/71	Test Pit	2	60	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/72	Test Pit	2	60	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/73	Test Pit (Visual Observation)	2	60	Spatial Coverage - increase lot-specific density		0									
TP21/74	Test Pit	2	63	Spatial Coverage - increase lot-specific density	N	2	1		1			2			
TP21/75	Test Pit (Visual Observation)	2	63	Spatial Coverage - increase lot-specific density	N	0									
TP21/76	Test Pit	2	63	Spatial Coverage - increase lot-specific density	Y	2	1		1			2			
TP21/77	Test Pit (Visual Observation)	2	63	Spatial Coverage - increase lot-specific density	Y	0									
TP21/78	Test Pit (Visual Observation)	2	63	Spatial Coverage - increase lot-specific density		0									
TP21/79	Test Pit	2	63	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/80	Test Pit (Visual Observation)	2	63	Spatial Coverage - increase lot-specific density		0									
TP21/81	Test Pit (Visual Observation)	2	62	Spatial Coverage - increase lot-specific density		0									
TP21/82	Test Pit	2	62	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/83	Test Pit (Visual Observation)	2	62	Spatial Coverage - increase lot-specific density		0									
TP21/84	Test Pit	2	62	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/85	Test Pit	2	61	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/86	Test Pit	2	61	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/87	Test Pit	2	61	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/88	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density		0									
TP21/89	Test Pit (Visual Observation)	2	53	Spatial Coverage - increase lot-specific density		0									
TP21/90	Test Pit (Visual Observation)	2	52	Spatial Coverage - increase lot-specific density		0									
TP21/91	Test Pit (Visual Observation)	2	52	Spatial Coverage - increase lot-specific density		0									
TP21/92	Test Pit (Visual Observation)	2	52	Spatial Coverage - increase lot-specific density		0									
TP21/93	Test Pit (Visual Observation)	2	52	Spatial Coverage - increase lot-specific density		0									
TP21/94	Test Pit	2	Proposed Roadway	Spatial Coverage		2	1		1			2			
TP21/95	Test Pit	2	60	Spatial Coverage - increase lot-specific density		2	1		1			2			
TP21/96	Test Pit (Visual Observation)	2	60	Spatial Coverage - increase lot-specific density		0									
TP21/97	Test Pit (Visual Observation)	2	60	Spatial Coverage - increase lot-specific density		0									

Notes:
Visual Observation Test Pits to be logged, PID screened, sampled and photographed as per regular test pits. Samples will be analysed if the presence of visible contamination is noted (LNAPL, heavy staining, elevated PID readings (>100pm) demolition rubble including ACM

Total Primary Samples		124	**47**	**20**	**39**	**0**	**0**	**106**	**9**	**18**	**20**
QAQC - Field Duplicates (10%)		13	**5**	**2**	**4**	**0**	**0**	**11**	**1**	**0**	**0**
QAQC - Interlab Duplicates (5%)		7	**3**	**1**	**2**	**0**	**0**	**6**	**1**	**0**	**0**
Notes						10% of samples analysed for metals will require Speciated Cr analysis	Allowance for all samples in tank farm areas plus 10% of remaining samples	All samples		Only where visual ACM suspected. Assume 10% total soil samples will require analysis	1 x TS, 1 x TB, 10 days (20 total)

					BTEX							Naphthalene	TRH NEPM (1999)					
					Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene	TRH C6-C9 Fraction	TRH >C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.5	20	20	20	50	50	50
Clyde WARP SSTL (Direct Contact - Commercial)					400							9800						
Clyde WARP SSTL (Direct Contact - Construction Worker)					1200							67000						
Clyde WARP SSTL (Direct Contact - IMW)					15000							810000						
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m																		
4-6m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																		
1-1.99m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																		
2-3.99m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																		
0-0.99m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)					NL							NL						
Clyde WARP SSTL (Vapour Intrusion - IMW)					NL							NL						
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																		
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision No.**														
TP21/05-0.7	TP21/05	0.7	779521	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	480	310	790
TP21/05-1.0	TP21/05	1	779521	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/06-0.3	TP21/06	0.3	779521	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	83	77	160
TP21/06-0.8	TP21/06	0.8	779521	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/07_0.5	TP21/07	0.5	779866	59	0.2	0.1	0.3	0.1	0.7	0.9	-	3.8 - 4.7	56	56	2800	9400	5800	18,000
TP21/07_1.5	TP21/07	1.5	779866	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	31	210	250	491
TP21/08_1.1	TP21/08	1.1	779866	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 0.9	<20	<20	210	1200	690	2100
TP21/08_1.5	TP21/08	1.5	779866	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1	<20	<20	<20	<50	58	58
TP21/09_1.0	TP21/09	1	779866	59	<0.1	<0.1	0.1	<0.1	0.3	<0.3	-	<0.5 - 1.2	27	27	30	360	330	720
TP21/09_1.6	TP21/09	1.6	779866	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	29	29	590	200	65	855
TP21/09_2.2	TP21/09	2.2	779866	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	78	95	173
TP21/10-0.5	TP21/10	0.5	779521	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	130	170	300
TP21/10-1.2	TP21/10	1.2	779521	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/11-0.5	TP21/11	0.5	779521	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	3800	2700	6500
TP21/11-2.0	TP21/11	2	779521	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/16_2.0	TP21/16	2	780097	60	<0.1	<0.1	0.2	0.4	0.3	0.6	-	2.5	-	<20	61	<50	<50	61
TP21/17_1.0	TP21/17	1	780097	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	39	150	84	273
TP21/17_2.2	TP21/17	2.2	780097	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/18-0.6	TP21/18	0.6	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	150	170	320
TP21/18-2.2	TP21/18	2.2	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/19-0.5	TP21/19	0.5	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	870	680	1550
TP21/19-3.0	TP21/19	3	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	510	450	960
TP21/20-0.6	TP21/20	0.6	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	190	150	340
TP21/20-1.0	TP21/20	1	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	51	51
TP21/21-0.5	TP21/21	0.5	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	65	1400	790	2255
TP21/21-1.0	TP21/21	1	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	63	<50	63
DUP01_210308	TP21/22	0.2	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/22-0.2	TP21/22	0.2	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TRIP01_210308	TP21/22	0.2	ES2108618	63	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	-	<10	-	-	-	-
TP21/22-1.0	TP21/22	1	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/23-0.2	TP21/23	0.2	779521	63	<1	<1	<1	<1	<2	<3	-	49 - 64	-	<200	2100	720	140	2960
TP21/23-3.1	TP21/23	3.1	779521	63	<0.1	<0.1	0.3	0.7	1.9	2.6	-	14 - 22	-	26	1500	500	86	2086
TP21/24-0.5	TP21/24	0.5	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	54	<50	54
TP21/24-1.5	TP21/24	1.5	779521	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	120	180	<50	300
TP21/25_0.1	TP21/25	0.1	780097	62	<0.1	0.2	<0.1	0.2	0.4	0.6	-	<0.5	-	<20	<20	450	320	770
TP21/25_1.0	TP21/25	1	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	390	220	610
DUP04_210311	TP21/26	0.6	780097	62	<0.1	0.2	<0.1	0.2	0.8	1	-	<0.5	-	<20	<20	<50	<50	<50
TP21/26_0.6	TP21/26	0.6	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TRIP04_210311	TP21/26	0.6	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	23	180	150	353
TP21/26_1.1	TP21/26	1.1	780097	62	<0.1	<0.1	0.3	<0.1	1	1	-	<0.5	-	38	27	<50	<50	<50
TP21/27_0.3	TP21/27	0.3	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/27_0.8	TP21/27	0.8	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/28_0.2	TP21/28	0.2	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/28_2.0	TP21/28	2	780097	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/29-0.7	TP21/29	0.7	779521	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	35	<50	<50	<50
TP21/29-1.7	TP21/29	1.7	779521	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/30-1.0	TP21/30	1	779521	54	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	250	100	350
TP21/30-2.1	TP21/30	2.1	779521	54	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	130	61	191
DUP02_210309	TP21/31	0.9	779521	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/31-0.9	TP21/31	0.9	779521	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TRIP02_210309	TP21/31	0.9	ES2108618	61	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	-	<10	-	-	-	-
TP21/31-2.0	TP21/31	2	779521	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/32_1.0	TP21/32	1	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	<50	<50	<50
TP21/33_0.5	TP21/33	0.5	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	220	230	450
TP21/33_1.4	TP21/33	1.4	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	86	71	157
TP21/34_0.4	TP21/34	0.4	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	87	96	183
TP21/34_0.6	TP21/34	0.6	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	50	350	220	620
TP21/32_0.3	TP21/35	0.3	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	200	930	280	1410
TP21/35_0.6	TP21/35	0.6	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	<50	57	57
DUP03_210310	TP21/35	1	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	<50	<50	<50
TP21/35_1.0	TP21/35	1	779866	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<20	<50	<50	<50
TRIP03_210310	TP21/35	1	ES2108829	58	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	-	<10	<50	<100	<100	<50
TP21/36_0.5	TP21/36	0.5	782194	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/36_1.5	TP21/36	1.5	782194	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/39_0.3	TP21/39	0.3	782194	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
DUP09_210319	TP21/39	1.2	782194	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/39_1.2	TP21/39	1.2	782194	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TRIP09_210319	TP21/39	1.2	ES2110600	53	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	-	<10	<50	<100	<100	<50
TP21/41_1.0	TP21/41	1	784102	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50

	TRH NEPM (2013)							TRH Aliphatic/Aromatic Split												
Field_ID	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C34-C40 Fraction	TRH >C10-C40 Fraction	TRH >C5-C7 (Benzene) Aromatic	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C16-C21 Aliphatic	TRH >C21-C35 Aliphatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	20	20	50	50	100	100	100	0.1	10	10	10	10	10	10	0.1	1	10	10	10	10
Clyde WARP SSTL (Direct Contact - Commercial)		28000		17000	27000	27000			1200000	24000	24000	24000	470000	470000		9500	9500	9500	7100	7100
Clyde WARP SSTL (Direct Contact - Construction Worker)		69000		45000	64000	64000			310000	62000	62000	62000	370000	370000		25000	25000	25000	18000	18000
Clyde WARP SSTL (Direct Contact - IMW)		830000		540000	770000	770000			3700000	740000	740000	740000	4400000	4400000		300000	300000	300000	220000	220000
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m																				
4-6m		NL		NL					1400	2200	1800	33000				420	1400	9800		
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																				
1-1.99m		770		NL					610	980	600	8300				150	430	2800		
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																				
2-3.99m		NL		NL					880	1400	980	17000				230	750	5100		
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																				
0-0.99m		600		NL					480	760	430	4300				110	280	430		
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)		NL		NL					NL	NL	NL	NL				NL	NL	NL		
Clyde WARP SSTL (Vapour Intrusion - IMW)		NL		NL					NL	NL	NL	NL				NL	NL	NL	NL	NL
NEPM (1999) Management Limits - Commercial/Industrial (coarse)	700		1000		3500	10000														
TP21/05-0.7	<20	<20	<50	<50	650	<100	650	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/05-1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/06-0.3	<20	<20	<50	<50	130	<100	130	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/06-0.8	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/07_0.5	230	230	3900	3896.2	12,000	<100	15,900	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/07_1.5	<20	<20	51	51	390	200	641	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/08_1.1	31	31	380	380	1600	350	2330	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/08_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/09_1.0	39	39	<50	<50	610	190	800	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/09_1.6	95	95	610	610	180	<100	790	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/09_2.2	<20	<20	<50	<50	150	<100	150	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/10-0.5	<20	<20	<50	<50	230	100	330	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/10-1.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/11-0.5	<20	<20	<50	<50	6600	710	7310	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/11-2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/16_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/17_1.0	<20	<20	57	57	200	<100	257	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/17_2.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/18-0.6	<20	<20	<50	<50	240	<100	240	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/18-2.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/19-0.5	<20	<20	63	63	1300	390	1753	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/19-3.0	<20	<20	<50	<50	760	280	1040	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/20-0.6	<20	<20	<50	<50	250	150	400	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/20-1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/21-0.5	34	34	150	150	1600	350	2100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/21-1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP01_210308	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/22-0.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP01_210308	<10	<10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/22-1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/23-0.2	320	320	2100	2036	440	<100	2540	<0.1	<10	120	86	140	49	67	<0.1	12	60	140	46	100
TP21/23-3.1	150	150	1400	1386	310	<100	1710	<0.1	<10	120	42	49	19	16	<0.1	5.4	33	55	18	26
TP21/24-0.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/24-1.5	24	24	170	170	110	<100	280	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/25_0.1	<20	<20	<50	<50	720	210	930	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/25_1.0	<20	<20	<50	<50	560	130	690	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP04_210311	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/26_0.6	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP04_210311	<20	<20	<50	<50	310	110	420	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/26_1.1	74	73	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/27_0.3	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/27_0.8	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/28_0.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/28_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/29-0.7	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/29-1.7	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/30-1.0	<20	<20	<50	<50	270	<100	270	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/30-2.1	<20	<20	<50	<50	150	<100	150	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP02_210309	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/31-0.9	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP02_210309	<10	<10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/31-2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/32_1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/33_0.5	<20	<20	<50	<50	420	<100	420	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/33_1.4	<20	<20	<50	<50	140	<100	140	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/34_0.4	<20	<20	<50	<50	150	<100	150	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/34_0.6	<20	<20	92	92	480	160	732	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/32_0.3	<20	<20	430	430	950	180	1560	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/35_0.6	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP03_210310	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/35_1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP03_210310	<10	<10	<50	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/36_0.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/36_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/39_0.3	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP09_210319	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/39_1.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP09_210319	<10	<10	<50	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/41_1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-

	TRH Silica Gel Cleanup								
Field_ID	TRH >C10-C14 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C29-C36 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C16 Fraction SG less Naphthalene	TRH >C16-C34 Silica Gel Cleanup	TRH >C34-C40 Silica Gel Cleanup	TRH >C10-C40 Silica Gel Cleanup
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	50	100	100	50	50	50	100	100	50
Clyde WARP SSTL (Direct Contact - Commercial)									
Clyde WARP SSTL (Direct Contact - Construction Worker)									
Clyde WARP SSTL (Direct Contact - IMW)									
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m									
4-6m									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m									
1-1.99m									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m									
2-3.99m									
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m									
0-0.99m									
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)									
Clyde WARP SSTL (Vapour Intrusion - IMW)									
NEPM (1999) Management Limits - Commercial/Industrial (coarse)					1000		3500	10,000	
TP21/05-0.7	<50	350	180	530	<50	-	440	<100	-
TP21/05-1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/06-0.3	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/06-0.8	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/07_0.5	2600	5300	1600	9500	3600	-	5800	600	-
TP21/07_1.5	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/08_1.1	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/08_1.5	<50	160	<100	160	<50	-	200	<100	-
TP21/09_1.0	200	<100	<100	200	210	-	<100	<100	-
TP21/09_1.6	520	160	<100	680	530	-	110	<100	-
TP21/09_2.2	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/10-0.5	<50	100	120	220	<50	-	180	<100	-
TP21/10-1.2	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/11-0.5	<50	5500	3400	8900	<50	-	10,000	830	-
TP21/11-2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/16_2.0	<50	<100	<100	<100	<50	-	<100	130	-
TP21/17_1.0	<50	100	<100	100	52	-	140	100	-
TP21/17_2.2	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/18-0.6	<50	<100	<100	<100	<50	-	110	<100	-
TP21/18-2.2	-	-	-	-	-	-	-	-	-
TP21/19-0.5	<50	980	600	1580	73	-	1300	290	-
TP21/19-3.0	<50	470	260	730	<50	-	590	110	-
TP21/20-0.6	<50	130	<100	130	<50	-	150	<100	-
TP21/20-1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/21-0.5	84	1500	780	2364	160	-	1900	320	-
TP21/21-1.0	<50	<100	<100	<100	<50	-	<100	<100	-
DUP01_210308	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/22-0.2	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP01_210308	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/22-1.0	-	-	-	-	-	-	-	-	-
TP21/23-0.2	1100	650	170	1920	1300	-	490	<100	-
TP21/23-3.1	1000	370	<100	1370	1100	-	250	<100	-
TP21/24-0.5	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/24-1.5	<50	150	<100	150	51	-	100	<100	-
TP21/25_0.1	<50	280	160	440	<50	-	400	<100	-
TP21/25_1.0	<50	320	200	520	<50	-	460	110	-
DUP04_210311	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/26_0.6	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP04_210311	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/26_1.1	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/27_0.3	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/27_0.8	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/28_0.2	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/28_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/29-0.7	<50	<100	<100	<100	70	-	<100	<100	-
TP21/29-1.7	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/30-1.0	<50	220	<100	220	<50	-	270	<100	-
TP21/30-2.1	<50	150	<100	150	<50	-	180	<100	-
DUP02_210309	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/31-0.9	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP02_210309	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/31-2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/32_1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/33_0.5	<50	200	160	360	<50	-	320	<100	-
TP21/33_1.4	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/34_0.4	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/34_0.6	<50	200	110	310	57	-	270	<100	-
TP21/32_0.3	180	740	190	1110	360	-	650	<100	-
TP21/35_0.6	<50	<100	<100	<100	<50	-	<100	<100	-
DUP03_210310	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/35_1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP03_210310	-	-	-	-	-	-	-	-	-
TP21/36_0.5	-	-	-	-	-	-	-	-	-
TP21/36_1.5	-	-	-	-	-	-	-	-	-
TP21/39_0.3	-	-	-	-	-	-	-	-	-
DUP09_210319	-	-	-	-	-	-	-	-	-
TP21/39_1.2	-	-	-	-	-	-	-	-	-
TRIP09_210319	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/41_1.0	<50	<100	<100	<100	<50	-	<100	<100	-

Field_ID	Location_Code	Sample_Depth (m)	Lab_Report	Subdivision No.	BTEX							Naphthalene	TRH NEPM (1999)					
					Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene	TRH C6-C9 Fraction	TRH >C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.5	20	20	20	50	50	50
Clyde WARP SSTL (Direct Contact - Commercial)					400							9800						
Clyde WARP SSTL (Direct Contact - Construction Worker)					1200							67000						
Clyde WARP SSTL (Direct Contact - IMW)					15000							810000						
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m																		
4-6m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																		
1-1.99m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																		
2-3.99m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																		
0-0.99m					3.2							NL						
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)					NL							NL						
Clyde WARP SSTL (Vapour Intrusion - IMW)					NL							NL						
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																		
TP21/41_2.0	TP21/41	2	784102	53	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/42_0.2	TP21/42	0.2	780630	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1.5	-	<20	70	3300	1600	5800
DUP05_210315	TP21/42	0.7	780630	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	1.4	-	<20	150	680	190	1300
TP21/42_0.7	TP21/42	0.7	780630	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	29	230	190	530
TRIP05_210315	TP21/42	0.7	ES2109446	59	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	-	<10	<50	140	<100	140
TP21/46_0.2	TP21/46	0.2	782194	52	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/46_0.5	TP21/46	0.5	782194	52	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
DUP11_210330	TP21/48	0.2	784408	54	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	72	72	<50	144
TP21/48_0.2	TP21/48	0.2	784408	54	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	600	510	<50	1110
TRIP 11_210330	TP21/48	0.2	ES2112038	54	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	-	<10	<50	<100	<100	<50
TP21/48_1.5	TP21/48	1.5	784408	54	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	2.1	-	<20	29	91	<50	120
TP21/51_0.5	TP21/51	0.5	784408	55	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	46	64	<50	110
TP21/51_1.5	TP21/51	1.5	784408	55	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/53_0.5	TP21/53	0.5	784408	55	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	48	700	120	868
TP21/53_1.5	TP21/53	1.5	784408	55	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/55_0.6	TP21/55	0.6	784408	56	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	36	420	130	586
TP21/55_1.2	TP21/55	1.2	784408	56	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/58_0.5	TP21/58	0.5	784408	56	<1	<1	<1	<1	<2	<3	-	<1 - 9.2	-	<200	1100	15,000	1100	17,200
TP21/58_1.2	TP21/58	1.2	784408	56	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/60_1.0	TP21/60	1	784102	56	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
DUP10-210329	TP21/60	2	784102	56	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/60_2.0	TP21/60	2	784102	56	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TRIP10_210329	TP21/60	2	ES2111796	56	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	-	<10	-	-	-	-
TP21/63_0.2	TP21/63	0.2	784102	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/63_1.5	TP21/63	1.5	784102	58	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/64_1.0	TP21/64	1	781399	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 0.5	-	<20	1300	4800	750	6850
TP21/64_2.0	TP21/64	2	781399	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	33	<50	<50	<50
DUP06_210316	TP21/66	1	781399	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/66_1.0	TP21/66	1	781399	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TRIP06_210316	TP21/66	1	ES2109923	59	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	-	<10	-	-	-	-
TP21/66_2.0	TP21/66	2	781399	59	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/68_0.7	TP21/68	0.7	781399	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	860	3400	790	5050
TP21/68_1.5	TP21/68	1.5	781399	60	<0.1	<0.1	<0.1	0.1	0.3	0.4	-	6.4	-	<20	290	370	120	780
TP21/71_0.2	TP21/71	0.2	780630	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	21	220	250	560
TP21/71_1.5	TP21/71	1.5	780630	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	60
TP21/72_0.4	TP21/72	0.4	781399	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1	-	<20	960	4600	710	6270
TP21/72_0.9	TP21/72	0.9	781399	60	<0.1	<0.1	0.1	<0.1	<0.2	<0.3	-	12	-	<20	590	1100	310	2000
TP21/74_1	TP21/74	1	780630	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1.2	-	<20	680	4600	910	7800
TP21/74_2.5	TP21/74	2.5	780630	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	1200	3800	280	8300
TP21/76_0.2	TP21/76	0.2	781477	63	<0.5	<0.5	<0.5	<0.5	<1	<1.5	-	22	-	<100	1600	1100	1300	4000
DUP07_210317	TP21/76	2	781477	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/76_2.0	TP21/76	2	781477	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	0.7	-	<20	<20	<50	<50	<50
TRIP07_210317	TP21/76	2	ES2109929	63	<0.2	<0.5	<0.5	0.5	1.8	2.3	2.3	3	-	31	-	-	-	-
TP21/79_0.2	TP21/79	0.2	780630	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 3.7	-	510	4800	5800	2200	15,000
TP21/79_0.2	TP21/79	0.2	782540	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/79_1.0	TP21/79	1	782540	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	1.5	-	26	710	270	250	1230
TP21/79_2.0	TP21/79	2	782540	63	<0.1	<0.1	0.3	<0.1	0.3	<0.3	-	<0.5	-	440	3400	4100	650	8150
TP21/79_2.8	TP21/79	2.8	780630	63	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	78	140	<50	270
TP21/82_0.5	TP21/82	0.5	781477	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/82_1.2	TP21/82	1.2	781477	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	42	600	260	902
TP21/84_0.8	TP21/84	0.8	781475	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	99	5700	3600	9399
TP21/84_2.0	TP21/84	2	781475	62	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/85_0.4	TP21/85	0.4	781475	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	430	250	680
TP21/85_2.0	TP21/85	2	781475	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/86_0.5	TP21/86	0.5	781475	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/86_1.5	TP21/86	1.5	781475	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/87_1.0	TP21/87	1	781475	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	92	<50	92
TP21/87_1.5	TP21/87	1.5	781475	61	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/94_0.2	TP21/94	0.2	781477	Road	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	110	310	420
TP21/94_0.6	TP21/94	0.6	781477	Road	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/95_0.5	TP21/95	0.5	781475	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
DUP08_210318	TP21/95	1	781475	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	<50	<50
TP21/95_1.0	TP21/95	1	781475	60	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	180	850	<50	1030
TRIP08_210318	TP21/95	1	ES2109928	60	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	-	<10	-	-	-	-
Statistical Summary																		
Number of Results					132	132	132	132	132	132	10	132	16	132	126	126	126	126
Number of Detects					1	3	7	7	10	8	1	21	3	9	43	61	53	66
Minimum Concentration					<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.2	<0.5	<20	<10	<20	<50	<50	<50
Minimum Detect					0.2	0.1	0.1	0.1	0.3	0.4	2.3	0.7	27	26	21	54	51	51
Maximum Concentration					<1	<1	<1	<1	<2	<3	2.3	64	56	510	4800	15000	5800	18000
Maximum Detect					0.2	0.2	0.3	0.7	1.9	2.6	2.3	64	56	510	4800	15000	5800	18000
Average Concentration					0.063	0.076	0.083	0.086	0.18	0.24	0.32	1.3	15	20	221	705	263	1229
Median Concentration					0.05	0.05	0.05	0.05	0.1	0.15	0.1	0.25	10	10	10	50	25	57.5
Standard Deviation					0.06	0.078	0.086	0.1	0.27	0.35	0.7	5.6	13	58	656	1925	702	3084
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0

Field_ID	TRH NEPM (2013)							TRH Aliphatic/Aromatic Split												
	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C34-C40 Fraction	TRH >C10-C40 Fraction	TRH >C5-C7 (Benzene) Aromatic	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C16-C21 Aliphatic	TRH >C21-C35 Aliphatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	20	20	50	50	100	100	100	0.1	10	10	10	10	10	10	0.1	1	10	10	10	10
Clyde WARP SSTL (Direct Contact - Commercial)		28000		17000	27000	27000			1200000	24000	24000	24000	470000	470000		9500	9500	9500	7100	7100
Clyde WARP SSTL (Direct Contact - Construction Worker)		69000		45000	64000	64000			310000	62000	62000	62000	370000	370000		25000	25000	25000	18000	18000
Clyde WARP SSTL (Direct Contact - IMW)		830000		540000	770000	770000			3700000	740000	740000	740000	4400000	4400000		300000	300000	300000	220000	220000
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m																				
4-6m		NL		NL					1400	2200	1800	33000				420	1400	9800		
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m																				
1-1.99m		770		NL					610	980	600	8300				150	430	2800		
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m																				
2-3.99m		NL		NL					880	1400	980	17000				230	750	5100		
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m																				
0-0.99m		600		NL					480	760	430	4300				110	280	430		
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)		NL		NL					NL	NL	NL	NL				NL	NL	NL		
Clyde WARP SSTL (Vapour Intrusion - IMW)		NL		NL					NL	NL	NL	NL				NL	NL	NL	NL	NL
NEPM (1999) Management Limits - Commercial/Industrial (coarse)	700		1000		3500	10000														
TP21/41_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/42_0.2	<20	<20	210	210	4500	850	5560	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP05_210315	<20	<20	260	258.6	870	190	1320	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/42_0.7	<20	<20	61	61	370	150	581	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP05_210315	<10	<10	<50	<50	170	<100	170	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/46_0.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/46_0.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP11_210330	<20	<20	92	92	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/48_0.2	<20	<20	890	890	190	<100	1080	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP 11_210330	<10	<10	<50	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/48_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/51_0.5	<20	<20	53	53	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/51_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/53_0.5	<20	<20	210	210	560	150	920	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/53_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/55_0.6	<20	<20	68	68	430	<100	498	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/55_1.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/58_0.5	<200	<200	3400	3390.8	<100	450	3850	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/58_1.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/60_1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP10-210329	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/60_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP10_210329	<10	<10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/63_0.2	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/63_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/64_1.0	68	68	3100	3100	3700	240	7040	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/64_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP06_210316	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/66_1.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP06_210316	<10	<10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/66_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/68_0.7	<20	<20	2100	2100	2900	250	5250	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/68_1.5	24	24	470	463.6	710	<100	1180	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/71_0.2	<20	<20	<50	<50	420	280	700	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/71_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/72_0.4	<20	<20	2100	2100	3800	270	6170	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/72_0.9	<20	<20	1000	988	2100	110	3210	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/74_1	<20	<20	1300	1300	5700	650	7650	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/74_2.5	64	100	1900	1900	3400	170	5470	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/76_0.2	240	240	1600	1578	3700	650	5950	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP07_210317	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/76_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP07_210317	66	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/79_0.2	860	1000	6000	6000	6000	1100	13,100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/79_0.2	-	-	-	-	-	-	-	<0.1	180	320	1100	1800	770	1300	<0.1	15	330	820	550	1200
TP21/79_1.0	45	45	820	818.5	1300	140	2260	<0.1	25	76	140	240	100	200	<0.1	1.7	35	110	67	140
TP21/79_2.0	610	610	5400	5400	3900	620	9920	<0.1	190	220	780	1100	490	780	<0.1	6.8	380	840	480	1000
TP21/79_2.8	<20	<20	100	100	170	<100	270	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/82_0.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/82_1.2	<20	<20	82	82	760	140	982	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/84_0.8	23	23	230	230	8700	920	9850	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/84_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/85_0.4	<20	<20	<50	<50	620	120	740	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/85_2.0	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/86_0.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/86_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/87_1.0	<20	<20	<50	<50	120	<100	120	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/87_1.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/94_0.2	<20	<20	<50	<50	310	320	630	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/94_0.6	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/95_0.5	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP08_210318	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
TP21/95_1.0	<20	<20	370	370	690	<100	1060	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP08_210318	<10	<10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical Summary																				
Number of Results	132	132	126	126	126	126	126	5	5	5	5	5	5	5	5	5	5	5	5	5
Number of Detects	18	18	36	36	55	34	56	0	3	5	5	5	5	5	0	5	5	5	5	5
Minimum Concentration	<10	<10	<50	<50	<100	<100	<50	<0.1	<10	76	42	49	19	16	<0.1	1.7	33	55	18	26
Minimum Detect	23	23	51	51	110	100	120	ND	25	76	42	49	19	16	ND	1.7	33	55	18	26
Maximum Concentration	860	1000	6000	6000	12000	1100	15900	<0.1	190	320	1100	1800	770	1300	<0.1	15	380	840	550	1200
Maximum Detect	860	1000	6000	6000	12000	1100	15900	ND	190	320	1100	1800	770	1300	ND	15	380	840	550	1200
Average Concentration	32	33	345	344	727	126	1141	0.05	81	171	430	666	286	473	0.05	8.2	168	393	232	493
Median Concentration	10	10	25	25	50	50	50	0.05	25	120	140	240	100	200	0.05	6.8	60	140	67	140
Standard Deviation	98	108	953	951	1752	183	2607	0	95	99	481	760	331	554	0	5.3	172	400	260	560
Number of Guideline Exceedances	1	1	13	0	10	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	1	1	13	0	10	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0

Field_ID	TRH Silica Gel Cleanup								
	TRH >C10-C14 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C29-C36 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C16 Fraction SG less Naphthalene	TRH >C16-C34 Silica Gel Cleanup	TRH >C34-C40 Silica Gel Cleanup	TRH >C10-C40 Silica Gel Cleanup
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	50	100	100	50	50	50	100	100	50
Clyde WARP SSTL (Direct Contact - Commercial)									
Clyde WARP SSTL (Direct Contact - Construction Worker)									
Clyde WARP SSTL (Direct Contact - IMW)									
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m									
4-6m									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m									
1-1.99m									
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m									
2-3.99m									
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m									
0-0.99m									
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)									
Clyde WARP SSTL (Vapour Intrusion - IMW)									
NEPM (1999) Management Limits - Commercial/Industrial (coarse)					1000		3500	10,000	
TP21/41_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/42_0.2	55	2600	780	4000	170	-	3200	330	-
DUP05_210315	67	350	<100	520	130	-	380	<100	-
TP21/42_0.7	<50	140	<100	160	<50	-	180	<100	-
TRIP05_210315	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/46_0.2	-	-	-	-	-	-	-	-	-
TP21/46_0.5	-	-	-	-	-	-	-	-	-
DUP11_210330	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/48_0.2	440	350	<100	790	610	-	140	<100	-
TRIP 11_210330	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/48_1.5	59	110	<100	169	100	-	<100	<100	-
TP21/51_0.5	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/51_1.5	-	-	-	-	-	-	-	-	-
TP21/53_0.5	60	600	150	810	210	-	590	150	-
TP21/53_1.5	-	-	-	-	-	-	-	-	-
TP21/55_0.6	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/55_1.2	-	-	-	-	-	-	-	-	-
TP21/58_0.5	640	5400	770	6810	1500	-	5500	350	-
TP21/58_1.2	-	-	-	-	-	-	-	-	-
TP21/60_1.0	-	-	-	-	-	-	-	-	-
DUP10-210329	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/60_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP10_210329	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/63_0.2	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/63_1.5	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/64_1.0	<50	170	<100	170	81	-	160	<100	-
TP21/64_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
DUP06_210316	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/66_1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP06_210316	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/66_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/68_0.7	350	1400	240	1990	850	-	1200	<100	-
TP21/68_1.5	<50	<100	<100	<100	100	-	<100	<100	-
TP21/71_0.2	<50	<100	<100	110	<50	-	160	<100	-
TP21/71_1.5	<50	<100	<100	120	<50	-	<100	<100	-
TP21/72_0.4	100	330	<100	430	210	-	260	<100	-
TP21/72_0.9	120	220	<100	340	240	-	230	<100	-
TP21/74_1	540	3800	700	6400	1100	-	4400	540	-
TP21/74_2.5	850	2900	190	6200	1500	-	2500	150	-
TP21/76_0.2	700	1300	540	2540	910	-	1400	210	-
DUP07_210317	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/76_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP07_210317	<50	<100	<100	<50	<50	<50	<100	<100	<50
TP21/79_0.2	3000	5700	930	11,000	5200	-	6300	1100	-
TP21/79_0.2	-	-	-	-	-	-	-	-	-
TP21/79_1.0	410	1200	270	1880	790	-	950	130	-
TP21/79_2.0	2400	3900	880	7180	5400	-	3300	410	-
TP21/79_2.8	51	120	<100	210	65	-	180	110	-
TP21/82_0.5	<50	140	<100	140	<50	-	150	<100	-
TP21/82_1.2	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/84_0.8	<50	1600	1000	2600	63	-	2500	200	-
TP21/84_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/85_0.4	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/85_2.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/86_0.5	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/86_1.5	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/87_1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/87_1.5	-	-	-	-	-	-	-	-	-
TP21/94_0.2	<50	<100	280	280	<50	-	270	270	-
TP21/94_0.6	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/95_0.5	<50	<100	<100	<100	<50	-	<100	<100	-
DUP08_210318	<50	<100	<100	<100	<50	-	<100	<100	-
TP21/95_1.0	<50	<100	<100	<100	<50	-	<100	<100	-
TRIP08_210318	<50	<100	<100	<50	<50	<50	<100	<100	<50
Statistical Summary									
Number of Results	116	116	116	116	116	9	116	116	9
Number of Detects	23	41	25	45	31	0	43	20	0
Minimum Concentration	<50	<100	<100	<50	<50	<50	<100	<100	<50
Minimum Detect	51	100	110	100	51	ND	100	100	ND
Maximum Concentration	3000	5700	3400	11000	5400	<50	10000	1100	<50
Maximum Detect	3000	5700	3400	11000	5400	ND	10000	1100	ND
Average Concentration	154	466	166	774	249	25	534	97	25
Median Concentration	25	50	50	50	25	25	50	50	25
Standard Deviation	455	1155	388	1988	802	0	1433	149	0
Number of Guideline Exceedances	0	0	0	0	8	0	5	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	8	0	5	0	0

					PAH/Phenols																																							
					2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,4-dimethylphenol	2,4-dinitrophenol	2,6-dichlorophenol	2-chlorophenol	2-methylphenol	2-nitrophenol	3-&4-methylphenol	4,6-Dinitro-2-methylphenol	4,6-Dinitro-o-cyclohexyl phenol	4-chloro-3-methylphenol	4-nitrophenol	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Dinoseb	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Pentachlorophenol	Phenanthrene	Phenol	Pyrene	tetrachlorophenols	Phenols (Total Halogenated)	Total Non-Halogenated Phenol	PAHs (Sum of total)
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					1	1	0.5	0.5	5	0.5	0.5	0.2	1	0.4	5	20	1	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	20	0.5	0.5	0.5	1	0.5	0.5	0.5	10	1	20	0.5
Clyde WARP SSTL (Direct Contact - Commercial)																										40																		
Clyde WARP SSTL (Direct Contact - Construction Worker)																										200																		
Clyde WARP SSTL (Direct Contact - IMW)																										3000																		
NEPM (1999) HIL D - Commercial/Industrial																																				660		240000					4000
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision No.**																																								
TP21/05-0.7	TP21/05	0.7	779521	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	0.6	<0.5	<0.5	<10	<1	<20	0.6
TP21/06-0.3	TP21/06	0.3	779521	53	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/07_0.5	TP21/07	0.5	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6	0.8	14	88	37	83	83	83	27	14	15	97	30	-	18	15	18	-	120	-	50	-	-	-	551.1
TP21/07_1.5	TP21/07	1.5	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	1.7	0.8	1.7	1.8	1.7	0.7	<0.5	<0.5	2	0.6	-	0.7	<0.5	<0.5	-	1.1	-	1.1	-	-	-	8.7
TP21/08_1.1	TP21/08	1.1	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	1.5	8.5	3.6	7.9	7.9	7.9	2.6	1.2	1.4	9	2.8	-	2	1.7	1.3	-	9.5	-	5.9	-	-	-	51.9
TP21/08_1.5	TP21/08	1.5	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	0.9	-	<0.5	-	-	-	0.9
TP21/09_1.0	TP21/09	1	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	4.2	1.6	3.4	3.4	3.4	1.3	0.7	0.7	5.1	1.1	-	0.7	<0.5	0.7	-	1.4	-	2.1	-	-	-	19.6
TP21/09_1.6	TP21/09	1.6	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	1.1	<0.5	-	<0.5	-	<0.5	-	-	-	1.1
TP21/09_2.2	TP21/09	2.2	779866	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.6	0.5	0.6	1.2	0.9	<0.5	<0.5	<0.5	0.7	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	1.8
TP21/10-0.5	TP21/10	0.5	779521	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/11-0.5	TP21/11	0.5	779521	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/17_1.0	TP21/17	1	780097	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/18-0.6	TP21/18	0.6	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	0.6	<0.5	<0.5	<1	<0.5	<0.5	0.6	<10	<1	<20	1.2
TP21/19-0.5	TP21/19	0.5	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	0.6	0.7	0.8	1.4	1.1	<0.5	0.7	<0.5	0.9	<0.5	<20	0.9	<0.5	<0.5	<1	0.6	<0.5	1	<10	<1	<20	5.4
TP21/20-0.6	TP21/20	0.6	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/21-0.5	TP21/21	0.5	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
DUP01_210308	TP21/22	0.2	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/22-0.2	TP21/22	0.2	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TRIP01_210308	TP21/22	0.2	ES2108618	63	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<1	-	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<2	<0.5	<0.5	<0.5	-	-	-	<0.5
TP21/23-0.2	TP21/23	0.2	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	0.6	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	49.6
TP21/23-3.1	TP21/23	3.1	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	22
TP21/24-0.5	TP21/24	0.5	779521	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/25_0.1	TP21/25	0.1	780097	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	1.2	0.7	<0.5	0.6	<0.5	1.2	<0.5	<20	<0.5	<0.5	<0.5	<1	2	<0.5	0.8	<10	<1	<20	5.3
DUP04_210311	TP21/26	0.6	780097	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/26_0.6	TP21/26	0.6	780097	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TRIP04_210311	TP21/26	0.6	780097	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	1.2	0.7	<0.5	<0.5	<0.5	1.2	<0.5	<20	<0.5	<0.5	<0.5	<1	1.9	<0.5	0.6	<10	<1	<20	4.4
TP21/27_0.3	TP21/27	0.3	780097	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/28_0.2	TP21/28	0.2	780097	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/29-0.7	TP21/29	0.7	779521	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/29-1.7	TP21/29	1.7	779521	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/30-1.0	TP21/30	1	779521	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/30-2.1	TP21/30	2.1	779521	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
DUP02_210309	TP21/31	0.9	779521	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/31-0.9	TP21/31	0.9	779521	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TRIP02_210309	TP21/31	0.9	ES2108618	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/31-2.0	TP21/31	2	779521	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/32_1.0	TP21/32	1	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/33_0.5	TP21/33	0.5	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/33_1.4	TP21/33	1.4	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/34_0.4	TP21/34	0.4	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/34_0.6	TP21/34	0.6	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/32_0.3	TP21/35	0.3	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/35_0.6	TP21/35	0.6	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
DUP03_210310	TP21/35	1	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/35_1.0	TP21/35	1	779866	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TRIP03_210310	TP21/35	1	ES2108829	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	-	-	<0.5
TP21/36_0.5	TP21/36	0.5	782194	53	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/39_0.3	TP21/39	0.3	782194	53	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/41_1.0	TP21/41	1	784102	53	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/42_0.2	TP21/42	0.2	780630	59	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	2.1	<0.5	0.7	9.3	8.2	16	16	16	5.3	4	4.8	13	5.6	<20	5.3	1.5	3.4	<1	6.6	<0.5	7.8	<10	1.2	23	79.1
TP21/46_0.2	TP21/46	0.2	782194	52	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
DUP11_210330	TP21/48	0.2	784408	54	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/48_0.2	TP21/48	0.2	784408	54	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TRIP 11_210330	TP21/48	0.2	ES2112038	54	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<1	-	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<2	<0.5	<0.5	<0.5	-	-	-	<0.5

					PAH/Phenols																																							
					2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,4-dimethylphenol	2,4-dinitrophenol	2,6-dichlorophenol	2-chlorophenol	2-methylphenol	2-nitrophenol	3-&4-methylphenol	4,6-Dinitro-2-methylphenol	4,6-Dinitro-o-cyclohexyl phenol	4-chloro-3-methylphenol	4-nitrophenol	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Dinoseb	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Pentachlorophenol	Phenanthrene	Phenol	Pyrene	tetrachlorophenols	Phenols (Total Halogenated)	Total Non-Halogenated Phenol	PAHs (Sum of total)
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					1	1	0.5	0.5	5	0.5	0.5	0.2	1	0.4	5	20	1	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	20	0.5	0.5	0.5	1	0.5	0.5	0.5	10	1	20	0.5
Clyde WARP SSTL (Direct Contact - Commercial)																										40																		
Clyde WARP SSTL (Direct Contact - Construction Worker)																										200																		
Clyde WARP SSTL (Direct Contact - IMW)																										3000																		
NEPM (1999) HIL D - Commercial/Industrial																																				660		240000					4000
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision No.**																																								
TP21/51_0.5	TP21/51	0.5	784408	55	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/53_0.5	TP21/53	0.5	784408	55	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/55_0.6	TP21/55	0.6	784408	56	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	0.7	<0.5	<0.5	<10	<1	<20	0.7
TP21/58_0.5	TP21/58	0.5	784408	56	<2	<2	<1	<1	<5	<1	<1	<1	<2	<2	<5	<20	<2	<5	3.4	<1	1.8	1.2	<1	<1	2.5	1.3	<1	<1	<1	2.1	<1	<20	<1	4.9	<1	<2	12	<1	6.3	<10	<2	<20	31.7
TP21/60_1.0	TP21/60	1	784102	56	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/63_0.2	TP21/63	0.2	784102	58	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/64_1.0	TP21/64	1	781399	59	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	1.4	1.3	1.1	0.7	<0.5	<0.5	1.2	0.7	<0.5	<0.5	<0.5	1.1	<0.5	<20	0.8	4.1	<0.5	<1	7.5	<0.5	1.4	<10	<1	<20	19.9
TP21/66_1.0	TP21/66	1	781399	59	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/68_0.7	TP21/68	0.7	781399	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	0.8	0.6	0.7	1.4	1	<0.5	<0.5	<0.5	1.7	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	1.3	<10	<1	<20	4.4
TP21/71_0.2	TP21/71	0.2	780630	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	1.1	23	<0.5
TP21/72_0.4	TP21/72	0.4	781399	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	4.4	0.8	9.4	14	3	7.1	7.1	7.1	1.9	1.2	2	18	2	<20	8.2	21	1.2	<1	110	<0.5	18	<10	<1	<20	216.1
TP21/74_1	TP21/74	1	780630	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	1.6	6.1	1.5	3.9	3.9	3.9	1.9	0.9	1.3	9	1.3	<20	2.6	2.7	0.8	<1	22	<0.5	5.5	<10	1.3	25	58.4
TP21/76_0.2	TP21/76	0.2	781477	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	0.5	<1	10	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	1.1	<0.5	<1	1.1	2	<0.5	<10	<1	<20	24.2
TP21/79_0.2	TP21/79	0.2	780630	63	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	2.3	0.9	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<20	<0.5	3.9	<0.5	<1	4.1	<0.5	0.5	<10	1.2	24	16
TP21/82_1.2	TP21/82	1.2	781477	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	0.9	<0.5	<0.5	<10	<1	<20	0.9
TP21/84_0.8	TP21/84	0.8	781475	62	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	0.3	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<20	<0.5	<0.5	<0.5	<1	1.1	<0.5	<0.5	<10	<1	<20	1.7
TP21/85_0.4	TP21/85	0.4	781475	61	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/86_0.5	TP21/86	0.5	781475	61	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	0.7	<10	<1	<20	1.3
TP21/87_1.0	TP21/87	1	781475	61	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/94_0.2	TP21/94	0.2	781477	Road	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
TP21/95_0.5	TP21/95	0.5	781475	60	<1	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<1	<0.4	<5	<20	<1	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
Statistical Summary																																												
Number of Results					50	50	50	50	48	50	50	50	50	50	48	48	50	48	75	75	75	75	75	75	75	75	75	75	75	75	48	75	75	75	50	75	50	75	48	48	48	75
Number of Detects					0	0	0	0	0	0	0	2	0	1	0	0	0	0	6	4	7	14	10	10	75	75	7	8	6	17	7	0	10	11	6	0	19	1	16	0	4	4	26
Minimum Concentration					<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.2	<0.5	<0.4	<5	<20	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<20	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<10	<1	<20	<0.5
Minimum Detect					ND	ND	ND	ND	ND	ND	ND	0.3	ND	10	ND	ND	ND	ND	1.4	0.8	0.7	0.6	0.5	0.6	1.2	0.6	0.7	0.6	0.7	0.6	0.6	ND	0.6	0.6	0.7	ND	0.6	2	0.5	ND	1.1	23	0.6
Maximum Concentration					<2	<2	<1	<1	<5	<1	<1	<1	<2	10	<5	<20	<2	<5	4.4	1.3	14	88	37	83	83	83	27	14	15	97	30	<20	18	21	18	<2	120	2	50	<10	<2	25	551.1
Maximum Detect					ND	ND	ND	ND	ND	ND	ND	0.5	ND	10	ND	ND	ND	ND	4.4	1.3	14	88	37	83	83	83	27	14	15	97	30	ND	18	21	18	ND	120	2	50	ND	1.3	25	551.1
Average Concentration					0.5	0.5	0.26	0.26	2.5	0.26	0.26	0.13	0.5	0.42	2.5	10	0.5	2.5	0.45	0.29	0.63	2	0.99	1.9	2.8	2.2	0.77	0.54	0.57	2.4	0.81	10	0.75	0.98	0.57	0.53	4.2	0.29	1.6	5	0.57	11	16
Median Concentration					0.5	0.5	0.25	0.25	2.5	0.25	0.25	0.1	0.5	0.2	2.5	10	0.5	2.5	0.25	0.25	0.25	0.25	0.25	0.25	1.2	0.6	0.25	0.25	0.25	0.25	0.25	10	0.25	0.25	0.25	0.5	0.25	0.25	0.25	5	0.5	10	0.25
Standard Deviation					0.087	0.087	0.035	0.035	0	0.035	0.035	0.087	0.087	1.4	0	0	0.087	0	0.72	0.17	1.9	10	4.3	9.7	9.6	9.7	3.1	1.6	1.8	11	3.5	0	2.3	3	2.1	0.12	19	0.25	6.2	0	0.21	3.8	69
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					Inorganics	Metals							
					Moisture Content (dried @ 103°C)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
					%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					1	2	0.4	5	5	5	0.1	5	5
Clyde WARP SSTL (Direct Contact - Commercial)								21000					
Clyde WARP SSTL (Direct Contact - Construction Worker)								8200					
Clyde WARP SSTL (Direct Contact - IMW)								100000					
NEPM (1999) HIL D - Commercial/Industrial						3000	900		240000	1500	730	6000	400000
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision No.**									
TP21/05-0.7	TP21/05	0.7	779521	60	27	9	<0.4	33	16	48	<0.1	<5	43
TP21/05-1.0	TP21/05	1	779521	60	36	-	-	-	-	-	-	-	-
TP21/06-0.3	TP21/06	0.3	779521	53	15	12	<0.4	26	32	130	<0.1	<5	110
TP21/06-0.8	TP21/06	0.8	779521	53	23	-	-	-	-	-	-	-	-
TP21/07_0.5	TP21/07	0.5	779866	59	27	-	-	-	-	-	-	-	-
TP21/07_1.5	TP21/07	1.5	779866	59	19	-	-	-	-	-	-	-	-
TP21/08_1.1	TP21/08	1.1	779866	59	15	-	-	-	-	-	-	-	-
TP21/08_1.5	TP21/08	1.5	779866	59	21	-	-	-	-	-	-	-	-
TP21/09_1.0	TP21/09	1	779866	59	8.3	-	-	-	-	-	-	-	-
TP21/09_1.6	TP21/09	1.6	779866	59	26	-	-	-	-	-	-	-	-
TP21/09_2.2	TP21/09	2.2	779866	59	20	-	-	-	-	-	-	-	-
TP21/10-0.5	TP21/10	0.5	779521	60	21	7.6	<0.4	37	100	30	<0.1	110	140
TP21/10-1.2	TP21/10	1.2	779521	60	18	-	-	-	-	-	-	-	-
TP21/11-0.5	TP21/11	0.5	779521	60	21	13	<0.4	21	14	14	<0.1	<5	26
TP21/11-2.0	TP21/11	2	779521	60	27	-	-	-	-	-	-	-	-
TP21/16_2.0	TP21/16	2	780097	60	19	-	-	-	-	-	-	-	-
TP21/17_1.0	TP21/17	1	780097	60	16	9.9	<0.4	49	26	54	0.3	17	180
TP21/17_2.2	TP21/17	2.2	780097	60	19	-	-	-	-	-	-	-	-
TP21/18-0.6	TP21/18	0.6	779521	63	56	24	0.4	24	22	58	<0.1	<5	54
TP21/18-2.2	TP21/18	2.2	779521	63	30	-	-	-	-	-	-	-	-
TP21/19-0.5	TP21/19	0.5	779521	63	10	7	<0.4	250	77	69	0.2	170	230
TP21/19-3.0	TP21/19	3	779521	63	25	-	-	-	-	-	-	-	-
TP21/20-0.6	TP21/20	0.6	779521	63	23	7.5	<0.4	<5	8.4	7.7	<0.1	<5	120
TP21/20-1.0	TP21/20	1	779521	63	48	-	-	-	-	-	-	-	-
TP21/21-0.5	TP21/21	0.5	779521	63	50	22	<0.4	250	170	2000	6.3	<5	260
TP21/21-1.0	TP21/21	1	779521	63	27	-	-	-	-	-	-	-	-
DUP01_210308	TP21/22	0.2	779521	63	19	6.5	<0.4	24	88	<5	<0.1	130	78
TP21/22-0.2	TP21/22	0.2	779521	63	18	6.4	<0.4	21	79	5.6	<0.1	130	92
TRIP01_210308	TP21/22	0.2	ES2108618	63	10.9	<5	<1	8	64	<5	<0.1	72	33
TP21/22-1.0	TP21/22	1	779521	63	18	-	-	-	-	-	-	-	-
TP21/23-0.2	TP21/23	0.2	779521	63	18	11	<0.4	23	7.4	21	<0.1	<5	19
TP21/23-3.1	TP21/23	3.1	779521	63	57	21	<0.4	20	16	29	<0.1	<5	16
TP21/24-0.5	TP21/24	0.5	779521	63	56	15	<0.4	12	10	44	0.2	<5	55
TP21/24-1.5	TP21/24	1.5	779521	63	22	-	-	-	-	-	-	-	-
TP21/25_0.1	TP21/25	0.1	780097	62	11	7.2	<0.4	30	76	55	1.6	16	96
TP21/25_1.0	TP21/25	1	780097	62	18	-	-	-	-	-	-	-	-
DUP04_210311	TP21/26	0.6	780097	62	5.4	3.1	0.4	32	71	47	0.2	23	500
TP21/26_0.6	TP21/26	0.6	780097	62	2.6	2	<0.4	8.2	<5	12	<0.1	<5	57
TRIP04_210311	TP21/26	0.6	780097	62	6.8	4.5	<0.4	68	30	79	0.9	13	180
TP21/26_1.1	TP21/26	1.1	780097	62	14	-	-	-	-	-	-	-	-
TP21/27_0.3	TP21/27	0.3	780097	62	9.7	2.6	<0.4	14	12	19	0.9	6.4	69
TP21/27_0.8	TP21/27	0.8	780097	62	18	-	-	-	-	-	-	-	-
TP21/28_0.2	TP21/28	0.2	780097	62	7.5	4.9	<0.4	17	8.9	29	<0.1	<5	170
TP21/28_2.0	TP21/28	2	780097	62	19	-	-	-	-	-	-	-	-
TP21/29-0.7	TP21/29	0.7	779521	61	50	-	-	-	-	-	-	-	-
TP21/29-1.7	TP21/29	1.7	779521	61	25	-	-	-	-	-	-	-	-
TP21/30-1.0	TP21/30	1	779521	54	37	-	-	-	-	-	-	-	-
TP21/30-2.1	TP21/30	2.1	779521	54	19	-	-	-	-	-	-	-	-
DUP02_210309	TP21/31	0.9	779521	61	18	-	-	-	-	-	-	-	-
TP21/31-0.9	TP21/31	0.9	779521	61	31	-	-	-	-	-	-	-	-
TRIP02_210309	TP21/31	0.9	ES2108618	61	16.4	-	-	-	-	-	-	-	-
TP21/31-2.0	TP21/31	2	779521	61	17	-	-	-	-	-	-	-	-
TP21/32_1.0	TP21/32	1	779866	58	16	-	-	-	-	-	-	-	-
TP21/33_0.5	TP21/33	0.5	779866	58	25	-	-	-	-	-	-	-	-
TP21/33_1.4	TP21/33	1.4	779866	58	27	-	-	-	-	-	-	-	-
TP21/34_0.4	TP21/34	0.4	779866	58	8.1	-	-	-	-	-	-	-	-
TP21/34_0.6	TP21/34	0.6	779866	58	14	-	-	-	-	-	-	-	-
TP21/32_0.3	TP21/35	0.3	779866	58	9.1	-	-	-	-	-	-	-	-
TP21/35_0.6	TP21/35	0.6	779866	58	12	-	-	-	-	-	-	-	-
DUP03_210310	TP21/35	1	779866	58	19	-	-	-	-	-	-	-	-
TP21/35_1.0	TP21/35	1	779866	58	22	-	-	-	-	-	-	-	-
TRIP03_210310	TP21/35	1	ES2108829	58	17.6	-	-	-	-	-	-	-	-
TP21/36_0.5	TP21/36	0.5	782194	53	3.5	<2	<0.4	9.8	49	<5	<0.1	42	39
TP21/36_1.5	TP21/36	1.5	782194	53	22	-	-	-	-	-	-	-	-
TP21/39_0.3	TP21/39	0.3	782194	53	12	3	<0.4	19	61	8.6	<0.1	63	65
DUP09_210319	TP21/39	1.2	782194	53	17	-	-	-	-	-	-	-	-
TP21/39_1.2	TP21/39	1.2	782194	53	25	-	-	-	-	-	-	-	-
TRIP09_210319	TP21/39	1.2	ES2110600	53	16.2	-	-	-	-	-	-	-	-
TP21/41_1.0	TP21/41	1	784102	53	24	9.6	<0.4	32	22	33	<0.1	5.6	19
TP21/41_2.0	TP21/41	2	784102	53	16	-	-	-	-	-	-	-	-
TP21/42_0.2	TP21/42	0.2	780630	59	14	38	1.9	410	180	780	19	190	5100
DUP05_210315	TP21/42	0.7	780630	59	20	-	-	-	-	-	-	-	-
TP21/42_0.7	TP21/42	0.7	780630	59	15	-	-	-	-	-	-	-	-
TRIP05_210315	TP21/42	0.7	ES2109446	59	15.7	-	-	-	-	-	-	-	-
TP21/46_0.2	TP21/46	0.2	782194	52	15	6.8	<0.4	62	23	21	<0.1	23	47
TP21/46_0.5	TP21/46	0.5	782194	52	26	-	-	-	-	-	-	-	-
DUP11_210330	TP21/48	0.2	784408	54	18	<2	<0.4	61	75	<5	<0.1	250	91
TP21/48_0.2	TP21/48	0.2	784408	54	18	<2	<0.4	54	68	<5	<0.1	240	88

					Inorganics	Metals							
					Moisture Content (dried @ 103°C)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
					%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					1	2	0.4	5	5	5	0.1	5	5
Clyde WARP SSTL (Direct Contact - Commercial)								21000					
Clyde WARP SSTL (Direct Contact - Construction Worker)								8200					
Clyde WARP SSTL (Direct Contact - IMW)								100000					
NEPM (1999) HIL D - Commercial/Industrial						3000	900		240000	1500	730	6000	400000
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision No.**									
TRIP 11_210330	TP21/48	0.2	ES2112038	54	17.7	<5	<1	20	70	<5	<0.1	189	53
TP21/48_1.5	TP21/48	1.5	784408	54	19	-	-	-	-	-	-	-	-
TP21/51_0.5	TP21/51	0.5	784408	55	13	<2	<0.4	40	70	<5	<0.1	180	81
TP21/51_1.5	TP21/51	1.5	784408	55	17	-	-	-	-	-	-	-	-
TP21/53_0.5	TP21/53	0.5	784408	55	9.9	<2	<0.4	35	110	48	<0.1	140	410
TP21/53_1.5	TP21/53	1.5	784408	55	20	-	-	-	-	-	-	-	-
TP21/55_0.6	TP21/55	0.6	784408	56	19	8.6	<0.4	37	12	19	<0.1	11	28
TP21/55_1.2	TP21/55	1.2	784408	56	17	-	-	-	-	-	-	-	-
TP21/58_0.5	TP21/58	0.5	784408	56	9.2	<2	<0.4	<5	<5	7.2	<0.1	<5	<5
TP21/58_1.2	TP21/58	1.2	784408	56	16	-	-	-	-	-	-	-	-
TP21/60_1.0	TP21/60	1	784102	56	21	9.7	<0.4	37	16	22	<0.1	9.2	29
DUP10-210329	TP21/60	2	784102	56	21	-	-	-	-	-	-	-	-
TP21/60_2.0	TP21/60	2	784102	56	16	-	-	-	-	-	-	-	-
TRIP10_210329	TP21/60	2	ES2111796	56	13.3	-	-	-	-	-	-	-	-
TP21/63_0.2	TP21/63	0.2	784102	58	9.7	3.1	<0.4	19	<5	18	<0.1	5.2	19
TP21/63_1.5	TP21/63	1.5	784102	58	15	-	-	-	-	-	-	-	-
TP21/64_1.0	TP21/64	1	781399	59	24	6.5	<0.4	34	20	22	<0.1	13	39
TP21/64_2.0	TP21/64	2	781399	59	21	-	-	-	-	-	-	-	-
DUP06_210316	TP21/66	1	781399	59	26	-	-	-	-	-	-	-	-
TP21/66_1.0	TP21/66	1	781399	59	26	8.9	<0.4	33	17	22	<0.1	11	22
TRIP06_210316	TP21/66	1	ES2109923	59	27.2	-	-	-	-	-	-	-	-
TP21/66_2.0	TP21/66	2	781399	59	22	-	-	-	-	-	-	-	-
TP21/68_0.7	TP21/68	0.7	781399	60	24	11	<0.4	41	23	25	<0.1	9.3	27
TP21/68_1.5	TP21/68	1.5	781399	60	19	-	-	-	-	-	-	-	-
TP21/71_0.2	TP21/71	0.2	780630	60	12	7.9	0.4	83	100	140	1.6	72	920
TP21/71_1.5	TP21/71	1.5	780630	60	17	-	-	-	-	-	-	-	-
TP21/72_0.4	TP21/72	0.4	781399	60	19	7.6	<0.4	33	9.2	53	<0.1	6.8	13
TP21/72_0.9	TP21/72	0.9	781399	60	19	-	-	-	-	-	-	-	-
TP21/74_1	TP21/74	1	780630	63	21	11	<0.4	910	31	96	0.2	32	180
TP21/74_2.5	TP21/74	2.5	780630	63	36	-	-	-	-	-	-	-	-
TP21/76_0.2	TP21/76	0.2	781477	63	17	3	<0.4	23	32	70	<0.1	32	500
DUP07_210317	TP21/76	2	781477	63	21	-	-	-	-	-	-	-	-
TP21/76_2.0	TP21/76	2	781477	63	23	-	-	-	-	-	-	-	-
TRIP07_210317	TP21/76	2	ES2109929	63	19.4	-	-	-	-	-	-	-	-
TP21/79_0.2	TP21/79	0.2	780630	63	16	6.6	<0.4	29	26	27	<0.1	<5	27
TP21/79_0.2	TP21/79	0.2	782540	63	22	-	-	-	-	-	-	-	-
TP21/79_1.0	TP21/79	1	782540	63	17	-	-	-	-	-	-	-	-
TP21/79_2.0	TP21/79	2	782540	63	19	-	-	-	-	-	-	-	-
TP21/79_2.8	TP21/79	2.8	780630	63	18	-	-	-	-	-	-	-	-
TP21/82_0.5	TP21/82	0.5	781477	62	18	-	-	-	-	-	-	-	-
TP21/82_1.2	TP21/82	1.2	781477	62	23	6.1	<0.4	34	39	97	0.1	<5	190
TP21/84_0.8	TP21/84	0.8	781475	62	9.2	11	<0.4	37	8.2	19	<0.1	8.2	24
TP21/84_2.0	TP21/84	2	781475	62	18	-	-	-	-	-	-	-	-
TP21/85_0.4	TP21/85	0.4	781475	61	15	8.3	<0.4	54	49	100	13	48	1400
TP21/85_2.0	TP21/85	2	781475	61	17	-	-	-	-	-	-	-	-
TP21/86_0.5	TP21/86	0.5	781475	61	15	7.3	1	82	36	140	1.6	39	3700
TP21/86_1.5	TP21/86	1.5	781475	61	18	-	-	-	-	-	-	-	-
TP21/87_1.0	TP21/87	1	781475	61	9.5	2.2	<0.4	23	62	<5	<0.1	95	100
TP21/87_1.5	TP21/87	1.5	781475	61	17	-	-	-	-	-	-	-	-
TP21/94_0.2	TP21/94	0.2	781477	Road	8	<2	<0.4	11	92	<5	<0.1	42	64
TP21/94_0.6	TP21/94	0.6	781477	Road	18	-	-	-	-	-	-	-	-
TP21/95_0.5	TP21/95	0.5	781475	60	17	8.8	<0.4	22	17	19	<0.1	<5	11
DUP08_210318	TP21/95	1	781475	60	18	-	-	-	-	-	-	-	-
TP21/95_1.0	TP21/95	1	781475	60	20	-	-	-	-	-	-	-	-
TRIP08_210318	TP21/95	1	ES2109928	60	18.4	-	-	-	-	-	-	-	-
Statistical Summary													
Number of Results					133	50	50	50	50	50	50	50	50
Number of Detects					133	41	5	48	47	41	14	35	49
Minimum Concentration					2.6	<2	<0.4	<5	<5	<5	<0.1	<5	<5
Minimum Detect					2.6	2	0.4	8	7.4	5.6	0.1	5.2	11
Maximum Concentration					57	38	1.9	910	180	2000	19	250	5100
Maximum Detect					57	38	1.9	910	180	2000	19	250	5100
Average Concentration					20	7.9	0.27	65	45	91	0.96	50	316
Median Concentration					18	7.1	0.2	32	30.5	23.5	0.05	13	67
Standard Deviation					9.4	6.8	0.27	141	41	297	3.3	69	888
Number of Guideline Exceedances					0	0	0	0	0	1	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	1	0	0	0

					SVOC			VOC																													
					1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Total MAH	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2,3-trichloropropane	1,2,4-trimethylbenzene	1,2-dibromoethane	1,2-dichloroethane	1,2-dichloropropane	1,3,5-trimethylbenzene	1,3-dichloropropane	2-butanone (MEK)	4-chlorotoluene	4-methyl-2-pentanone (MIBK)	Acetone	Allyl chloride	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision**																																	
TP21/23-0.2	TP21/23	0.2	779521	63	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	38	<5	<5	<5	15	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
TP21/23-3.1	TP21/23	3.1	779521	63	<0.5	<0.5	<0.5	3.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	12	<0.5	<0.5	<0.5	5.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Statistical Summary																																					
Number of Results					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of Detects					0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration					<0.5	<0.5	<0.5	3.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	12	<0.5	<0.5	<0.5	5.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Minimum Detect					ND	ND	ND	3.4	ND	ND	ND	ND	ND	ND	ND	12	ND	ND	ND	5.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	38	<5	<5	<5	15	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Maximum Detect					ND	ND	ND	3.4	ND	ND	ND	ND	ND	ND	ND	38	ND	ND	ND	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																																					
Median Concentration					1.375	1.375	1.375	2.95	1.375	1.375	1.375	1.375	1.375	1.375	1.375	25	1.375	1.375	1.375	10.2	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375
Standard Deviation																																					
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Iodomethane	Isopropylbenzene	Styrene	TCE	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Trichlorofluoromethane	Vic EPA IWRG 621 CHC (Total)*	Vic EPA IWRG 621 Other CHC (Total)*	Vinyl chloride
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	MG/KG	MG/KG	mg/kg
EQL					0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision**																		
TP21/23-0.2	TP21/23	0.2	779521	63	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
TP21/23-3.1	TP21/23	3.1	779521	63	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Statistical Summary																						
Number of Results					2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of Detects					0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Minimum Concentration					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Minimum Detect					ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Maximum Detect					ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																						
Median Concentration					1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.5	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375
Standard Deviation																						
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					Asbestos											
					Mass of test sample for extraction	Asbestos Detected	Mass ACM	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil	Asbestos Sample Dimensions	AF - Comment	FA- Comment	ACM - Comment	Organic Fibres - Comment	Respirable Fibres - Comment	Synthetic Fibres - Comment
					g	Comment	g	%w/w	%w/w	Comment	Comment	Comment	Comment	Comment	COMMENT	COMMENT
EQL																
NEPM (1999) HSL D Comm/Indust - Asbestos								0.05	0.001							
500g Soil Sample for Asbestos Fines Determination																
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision**												
TP21/01_0.2	TP21/01	0.2	780153	51	573	No	0	0	0	-	-	-	-	Yes	-	-
TP21/01_1.0	TP21/01	1	780153	51	479	No	0	0	0	-	-	-	-	Yes	-	-
TP21/02_0.2	TP21/02	0.2	780153	51	623	No	0	0	0	-	-	-	-	Yes	-	-
TP21/02_0.5	TP21/02	0.5	780153	51	570	No	0	0	0	-	-	-	-	Yes	-	-
TP21/03_0.3	TP21/03	0.3	780153	51	691	No	0	0	0	-	-	-	-	Yes	-	-
TP21/03_1.2	TP21/03	1.2	780153	51	516	No	0	0	0	-	-	-	-	Yes	-	-
TP21/04_0.1	TP21/04	0.1	780153	51	731	No	0	0	0	-	-	-	-	Yes	-	-
TP21/04_0.5	TP21/04	0.5	780153	51	780	Yes	0.013	0.00017	0	-	-	-	Chrysotile	Yes	-	-
TP21/12_0.2	TP21/12	0.2	780097	60	611	No	0	0	0	-	-	-	-	Yes	-	Yes
TP21/12_0.6	TP21/12	0.6	780097	60	504	No	0	0	0	-	-	-	-	Yes	-	-
TP21/13_0.2	TP21/13	0.2	780097	60	616	No	0	0	0	-	-	-	-	Yes	-	Yes
TP21/13_0.8	TP21/13	0.8	780097	60	597	No	0	0	0	-	-	-	-	Yes	-	-
TP21/14_0.1	TP21/14	0.1	780097	60	950	No	0	0	0	-	-	-	-	Yes	-	Yes
TP21/14_0.6	TP21/14	0.6	780097	60	521	No	0	0	0	-	-	-	-	Yes	-	-
TP21/15_0.3	TP21/15	0.3	780097	60	639	No	0	0	0	-	-	-	-	Yes	-	Yes
TP21/15_1.0	TP21/15	1	780097	60	426	No	0	0	0	-	-	-	-	Yes	-	-
TP21/16_0.4	TP21/16	0.4	780097	60	574	No	0	0	0	-	-	-	-	Yes	-	Yes
TP21/16_1.5	TP21/16	1.5	780097	60	546	No	0	0	0	-	-	-	-	Yes	-	-
TP21/19-0.5	TP21/19	0.5	779521	63	953	No	0	0	0	-	-	-	-	Yes	-	-
TP21/92_0.4	TP21/92	0.4	782194	52	548	No	0	0	0	-	-	-	-	Yes	-	-
Suspected ACM Fragments Submitted for Asbestos Identification																
Field_ID	**Location_Code**	**Sample_Depth (m)**	**Lab_Report**	**Subdivision**												
TP21/01_0.2 ACM	TP21/01	0.2	780153	51	4	Yes	4	0.0033	0	140x25x5mm	-	-	Chrysotile	-	-	-
TP21/92_ACM	TP21/92	0.4	782194	52	27	Yes	27	0.0225	0	-	-	-	Chrysotile and amosite	-	-	-

Sieved Asbestos %w/w Calculations

Material Retained on Sieve									
Sample ID	Lab Report	Subdivision No.	% Asb Content	Bonded ACM Weight (g)	Soil Volume (L)	Soil Density (kg/L)	%w/w Asb in Soil	Applicable Criteria (w/w)	Suitable for Commercial Industrial use?
TP21/01_0.2_ACM	780153	51	15	4	10	1.8	**0.0033**	0.05%	Yes
TP21/01_1.0	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/02_0.2	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/02_0.5	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/03_0.3	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/03_1.2	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/04_0.1	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/04_0.5	N/A	51	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/12_0.2	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/12_0.6	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/13_0.2	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/13_0.8	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/14_0.1	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/14_0.6	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/15_0.3	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/15_1.0	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/16_0.4	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/16_1.5	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/19_0.5	N/A	60	-	ND	10	1.8	**ND**	0.05%	Yes
TP21/92_0.4_ACM	782194	52	15	27	10	1.8	**0.0225**	0.05%	Yes

Table 6-1 – Source-Pathway-Receptor Linkage Summary (Stage 2 Area)

The CSM presented below was developed within the ERM (2020) HHERA based on information collected during previous investigations summarised in Section 4.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-1 Old Administration Area	Primary source areas within AEC-1 included former administration buildings and the former substation (11) which has been decommissioned and demolished. Potential sources of contamination are considered to be limited to on-site burial of fill materials. CoPCs assessed included: ■ TRH C6-C40, Metals, PAH, Phenols, Asbestos (fill) ■ PFAS (groundwater only)	Soil ■ Asbestos (ACM)	■ Inhalation of dusts or potential asbestos fibres from isolated ACM impacted soils (TP19/01) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-2 Buried Waste Area 8 – CDU tank farm sludge	Primary sources within AEC-2 include buried waste materials associated within the CDU tank farm sludge that at the time of this RSI remain in-situ. CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols.	Soil ■ LNAPL	■ No exceedances of tier 1 screening criteria are noted for this AEC; ■ Based on the observed presence of LNAPL within the soil profile at TP18/29 within this AEC, aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-3 Southern Contractor Area Including the following sub-areas	Potential historical sources of impacts which have been decommissioned / removed from AEC-3 included: ■ sample store and laboratory area (AEC-3A and 3B);	Soil ■ LNAPL ■ TRH C6-C10 (F1)	■ Inhalation of vapours from hydrocarbon impacted soil, and LNAPL within the soil profile by future on site commercial workers in indoor air (AEC-3A, AEC-3D, AEC-3E);	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
refined based on SPR linkages: ■ AEC-3A (Former Laboratory Area) ■ AEC-3B (Former Laboratory Area – Asbestos impacts) ■ AEC-3C (Former Contactor Warehouse (PAH hotspot)) ■ AEC-3D (Former Contactor Warehouse) ■ AEC-3E (TRH hotspot TP21/79)	■ storage and handling of AFFF products around the former location of Tank 24 and the Former Fire Station area; ■ contractor warehouse (AEC-3D); ■ workshop area; ■ Epoxy resins Plant. Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols, VOC/SVOC, Asbestos Specific to the Epoxy resins plant area: ■ Epichlorohydrin ■ bisphenol-a (BPA) ■ SVOC, VOC. Specific to the Fire Station area: ■ PFAS	■ Asbestos (ACM) ■ Carcinogenic PAHs <u>Groundwater</u> ■ LNAPL <u>Soil Vapour</u> AEC-3D (SV19/03): ■ TRH >C8-C10 Aliphatic; ■ TRH >C10-C12 Aliphatic; ■ Naphthalene; ■ Methane (associated with LNAPL source) AEC-3A (SV19/05): ■ TRH >C6-C8 Aliphatic; ■ TRH >C8-C10 Aliphatic; ■ TRH >C8-C10 Aromatic; ■ Benzene; ■ Naphthalene; and ■ Methane (associated with LNAPL source)	■ Inhalation of dusts or potential asbestos fibres from isolated ACM in soils (AEC-3B - TP19/32) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Direct contact or ingestion of soils impacted with carcinogenic PAHs (AEC-3C - TP19/16) or TRH C16-C34 fractions by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater wells screening LNAPL soil sources within AEC-3A and AEC-3D, soil vapour and ground gas assessment undertaken, elevated LEL/ methane readings in soil vapour there is potential for pooling of ground gases within future excavations. Infiltration of ground gases (methane) into future indoor air spaces is to be addressed via source removal of LNAPL. ■ The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-4 Southern Buried Waste Area	Primary sources within AEC-4 include buried waste materials that at the time of this remain in-situ. CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols, SVOC, pH (associated with acids), Dioxins, PFAS, Asbestos	Soil ■ LNAPL ■ TRH C6-C40 ■ Benzene ■ Asbestos (ACM and fibres within fill) ■ Metals (hexavalent chromium) ■ Carcinogenic PAHs ■ PFAS Groundwater ■ LNAPL	Soil ■ Indoor inhalation of vapours by future commercial/industrial workers (benzene, TRH C6-C10 (F1) fractions) from LNAPL and hydrocarbon impacted soil. ■ Inhalation of dusts or potential asbestos fibres from ACM and fibrous asbestos and asbestos fines within soil in soils during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Direct contact or ingestion of impacted soils (TRH >C10-C16 (F2) Fraction, TRH >C16-C34 Fraction, carcinogenic PAHs, hexavalent chromium), by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers as well in enclosed air spaces in future development of buildings. The potential effects of LNAPL on future buried infrastructure and aesthetics (particularly odour generation) should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this AEC. Groundwater ■ No potentially complete SPR linkages were identified for on-site or off-site human health receptors	No potentially complete SPR linkages to ecological receptors identified. ■ PAHs (including naphthalene, anthracene, benzo(a)pyrene, fluoranthene, phenanthrene) exceeding ecological criteria in groundwater have been identified within the northern portion of AEC-4 but have been laterally delineated to below assessment criteria within the Site. ■ PFAS (specifically PFOS) has been identified in soil and soil leachate samples within the which within the northern portion of AEC-4 and given high solubility may contribute to future offsite groundwater migration. Requires ongoing monitoring as part of the groundwater monitoring program.
AEC-5 Platformer 3	■ Primary sources areas within AEC-5 (platformer 3) have been decommissioned / removed.	Groundwater ■ LNAPL (MW11/17)	■ No exceedances of screening criteria are noted for this AEC; Based on the observed presence of LNAPL within shallow groundwater at MW11/17 within this AEC,	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
	■ Secondary sources include subsurface soils/groundwater containing LNAPL CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols		aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	
AEC-8 Tank farm J	■ Primary sources areas within AEC-8 included former fuel storage infrastructure, which has been decommissioned / removed. ■ Secondary sources include subsurface soils containing LNAPL CoPCs assessed included: ■ TRH C6-C40, BTEXN, PFAS	Soil ■ LNAPL	■ Based on the isolated presence of LNAPL within the soil profile at TP18/31 within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this area.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-11 Tank farms A1, A2, A3	■ Primary sources areas within AEC-11 included fuel storage infrastructure, which at the time of this RSI remain onsite. ■ Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PCB, PFAS, Dioxins	Soil ■ LNAPL	■ Based on the observed presence of LNAPL within soil within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified.
AEC-13 Substation Areas and Transformer Yards	■ Primary sources areas within AEC-13 include former substation infrastructure, which has been decommissioned / removed. Substation areas	Nil	■ No potentially complete SPR linkages to human health receptors identified.	■ No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
	assessed include substation and transformer footprints, as identified on Figure 6 of the RSI Report (ERM, 2020a). ■ Substations 9 and 23 were unable to be sampled due to their ongoing operation at the time of the investigation. CoPCs assessed included: ■ BTEXN, Metals, PCBs, Asbestos			
AEC-14 Subsurface drainage network Including the following sub-areas refined based on SPR linkages: ■ AEC-14A (Compromised Pipe 18D300-5) ■ AEC-14B (Compromised Pipes 15D100-4, 15D100-5)	■ Primary sources areas within AEC-14 include compromised or leaking subsurface drainage infrastructure, which contained hydrocarbon/oily water from product storage and handling areas. ■ Secondary sources include subsurface soils containing LNAPL and surface materials potentially impacted with PFAS CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols, SVOC, pH (associated with acids), Dioxins, PFAS, Asbestos	Soil ■ LNAPL ■ TRH C6-C10 ■ TRH >C10-C12 (Aliphatic) ■ TRH >C12-C16 (Aromatic) ■ Carcinogenic PAHs	■ Indoor inhalation of vapours from volatile TRH fractions (C6-C16) by future on site commercial workers from hydrocarbon impacted soils at: ▪ AEC-14A (TP20/28) ▪ AEC-14B (TP20/29a, TP20/29b, TP20/29c, TP20/30, TP21/07) ■ Direct contact with contaminated soils (carcinogenic PAHs) by future on-site construction workers undertaking intrusive works: ▪ AEC14B (TP20/30, TP21/07) The presence of LNAPL and soils exceeding TRH management limits associated with the drainage network in Stage 2 as shown on Figures 6A-6C requires management under a LTEMP for aesthetic/ odour impacts identified during future works.	■ No potentially complete SPR linkages to ecological receptors identified.
AEC-15 General Site Areas (not covered within other AECs)	■ Primary sources areas within AEC-15 include a range of former processing and fuel storage infrastructure, which has been removed. ■ Secondary sources include subsurface soils containing LNAPL	Soil ■ LNAPL	■ No exceedances of screening criteria are noted for this AEC; The presence of LNAPL of management limit exceedances for TRH fractions as shown on Figures 6A-6C will require management under a LTEMP for aesthetic/ odour impacts potentially encountered during future excavation works.	■ No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
	CoPCs assessed included: ■ BTEXN, TRH C6-C40, Metals, PAH, Phenols, Asbestos (fill)		As identified in the HHERA, inhalation of dusts or potential asbestos fibres from isolated ACM in soils (MW11/14) was conservatively identified as a potential risk based on the presence of asbestos (which was not quantified). Further investigation and quantification in this area was undertaken and it was subsequently found to be compliant with commercial/ industrial criteria (TP21/12).	

1.9.2 Potential Exposure Pathways

Potential exposure pathways associated with the presence of LNAPL in the subsurface within the Stage 2 Area are limited to the following:

- Direct contact or ingestion of impacted soils, groundwater containing LNAPL during future intrusive maintenance works or sampling works;
- Inhalation of vapours by future on site workers from hydrocarbon impacted soil, groundwater and/or LNAPL in indoor air; and
- Potential acute hazards due to the generation and pooling of ground gases from LNAPL and impacted soil/ groundwater.

In addition to the above, potential for aesthetic impacts (soil staining) or generation of odours during future excavation works is relevant to future site occupants conducting intrusive works.

Beneficial groundwater users (potable or non-potable) are not considered a potential receptor given the absence of registered extraction bores down gradient of the Site, poor natural background quality of groundwater and likely low yields.

1.10 Identified Source Pathway Receptor Linkages associated with LNAPL

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
AEC-1 Old Administration Area	No LNAPL sources Identified	■ No LNAPL sources identified based on known historical land use as office space, car park; ■ No secondary sources of LNAPL have been identified in soil or groundwater investigations undertaken.	Nil
AEC-2 Buried Waste Area 8 – CDU tank farm sludge	■ Primary sources within AEC-2 include buried waste materials associated within the CDU tank farm sludge. ■ Secondary sources include subsurface soils/groundwater containing LNAPL	■ LNAPL was identified in soil at TP18/29 (as a visible sheen on soil, with a strong hydrocarbon odour) at a depth of 2.2 – 3m during previous investigations. ■ Results from previous investigations and this RSI returned concentrations of all CoPCs within soil and soil vapour less than the adopted assessment criteria. ■ Based on soil vapour monitoring undertaken, concentrations and flow of hazardous ground gases (methane, carbon dioxide) associated with LNAPL pose a "very low" safety risk in accordance with risk categorisation completed in accordance with the Hazardous Ground Gas Guidance[1]. ■ Based on the lack of an ongoing source and driving head, the significant distance to offsite receptors and lateral delineation achieved via test pitting completed during this RSI, potential migration of LNAPL to offsite receptors from LNAPL within this AEC is considered unlikely.	No exceedances of tier 1 screening criteria were noted for this AEC; ■ Based on the observed presence of LNAPL within the soil profile at TP18/29 within this AEC, aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.
AEC-3 Southern Contractor Area	Potential historical sources of LNAPL impacts which have been decommissioned	Based on the available dataset, the following Tier 1 exceedances are noted: <u>Soil</u>	■ Inhalation of vapours from hydrocarbon impacted soil, groundwater and LNAPL by future on

[1] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
	/ removed from AEC-3 included: ■ laboratory; ■ contractor warehouse; ■ workshop area; Secondary sources include: ■ subsurface soils containing LNAPL	■ TRH C6-C10 (F1) - was reported exceeding the adopted vapour intrusion screening criteria within the former contractor warehouse area (TP19/17 at a depth of 0.5 m bgl) and former laboratory area (TP18/20 and MW18/24, to a depth of 1.2m BGL). An exceedance was also noted at TP21/79 (to a depth of 0.2m, vertically delineated to the upper 1m) ■ Soil analytical results from collected soil samples reported concentrations of TRH Fractions exceeding NEPM management limits to a maximum depth of 1.2m bgl across this AEC. ■ Carcinogenic PAHs (reported as BaP TEQ) and TRH >C16-C34 Fractions exceeded direct contact criteria at a depth of 0.8 m bgl at TP19/16. It is noted that direct contact by current on-site commercial/industrial workers is limited by the presence of hardstanding and overlying fill material. As such, this exposure pathway is limited to direct contact or ingestion of PAHs in soil by intrusive maintenance/ construction workers undertaking earthworks. <u>Groundwater</u> ■ LNAPL has been identified during groundwater monitoring within MW18/24 since December 2018 at a maximum thickness of 0.324m in November 2019. ■ Benzene, ethylbenzene and naphthalene concentrations have been reported exceeding adopted recreational or ecological criteria for offsite receptors in localised monitoring wells (MW12/03 and MW18/24). These groundwater impacts have been delineated to within the site boundary via down gradient wells and are therefore not considered to represent a complete exposure pathway to offsite receptors. <u>Soil Vapour</u> ■ Results of soil vapour assessment exceeded the adopted assessment criteria for volatile petroleum hydrocarbon COPCs. ■ Based on soil vapour monitoring undertaken, concentrations and flow of hazardous ground gases (methane) associated with SV19/03 and SV19/05 pose a “low” safety risk in accordance with risk categorisation completed in accordance with the Hazardous Ground Gas Guidance[2]. As such, consideration of hazardous ground gases in future	site commercial workers in indoor air; ■ Direct contact or ingestion of soils impacted with carcinogenic PAHs (TP19/16) or TRH C16-C34 fractions by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater within this AEC, and elevated LEL/ methane readings in soil vapour there is potential for pooling of ground gases within future excavations in the former contractor warehouse and laboratory areas. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.

[2] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
		management and/or remediation decisions for these areas of the site will be required.	
AEC-4 Southern Buried Waste Area	■ Primary sources of LNAPL within AEC-4 include buried waste materials from former refinery operations. ■ Secondary sources include subsurface soils/groundwater containing LNAPL ■ LNAPL has been identified as being "composed of primarily diesel oil with a minor component of an unresolved complex mixture of higher molecular weight, possibly lube oil"	Soil ■ LNAPL and "sludge materials" were identified at variable depths and locations throughout the fill materials within "Southern Buried Waste Area 1a", located within the south-western portion of the Stage 2 Area, within the former "Autonexus Leased Area". ■ Laboratory analysis of collected soil samples returned concentrations of a range of CoPCs (TRH C6-C40 fractions, Benzene, carcinogenic PAHs (reported as Benzo(a)pyrene TEQ) exceeding the adopted assessment criteria. Groundwater The following key observations are noted regarding groundwater results from the investigation: ■ No exceedances of SSTLs for current and future on-site receptors were reported for contaminants of concern in groundwater. ■ Reported exceedances of off-site ecological criteria were situated within the AEC-4 buried waste area and are directly associated with observation of LNAPL in the soil profile at these well locations noted during well installation. ■ No exceedances of assessment criteria for off-site receptors on the down gradient site boundary bordering Duck River, with a minor exceedance of recreational criteria for benzene and ecological criteria for PAHs noted on the western extent of the AEC-4 area. Dissolved phase groundwater impacts are localised to within the AEC-4 Buried waste area. Dissolved phase groundwater impacts have been delineated to below adopted screening criteria via down gradient monitoring wells, with the exception of benzene exceeding recreational assessment criteria and PAHs exceeding ecological assessment criteria at MW20/03, situated on the western extent of the AEC-4 area adjacent an unlined storm water channel. A risk to offsite receptors at this location is considered unlikely based on the following lines of evidence: ■ direct exposure by recreational receptors to benzene in groundwater is not a likely exposure pathway given no feasible access by recreational users to the storm water channel. The average groundwater discharge concentration for benzene from AEC-4 to the drainage channel could also be expected to be below recreational criteria given no benzene detections bordering the drainage channel in other wells to the south and to the north; ■ contribution of groundwater to overall flows within the drainage channel is considered negligible in the context of contributing flows from the 3 x 910mm concrete drainage pipes from public roadways to the north and would be expected to provide	■ Indoor inhalation of vapours by future commercial/industrial workers (benzene, TRH C6-C10 (F1) fractions) from LNAPL and hydrocarbon impacted soil; ■ Direct contact or ingestion of LNAPL impacted soils (TRH >C10-C16 (F2) Fraction, TRH >C16-C34 Fraction, carcinogenic PAHs), by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers or within future buildings. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this AEC.

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
		further dilution effect prior to discharge to the Duck River. ■ Ecological exceedances of PAHs are considered indicative of a near source impact (immobile NAPL within the soil profile) rather than a down gradient plume of PAHs. The low solubility and high sorption properties of these PAHs restrict their potential to migrate in groundwater flow, as is evident with no detections reported down-gradient of other source areas. Considering this, the exceedances of PAHs at MW20/03 are not considered to indicate a risk to the down-gradient aquatic environment. ■ Light Non-Aqueous Phase Liquids (LNAPL) were also limited to the AEC-4 buried waste mound and therefore does not currently present a risk to off-site receptors. Ongoing stability of LNAPL and dissolved phase impacts is expected based on the following: ▪ The significant time since deposition of waste in AEC-4 (greater than 40 years). The absence of LNAPL or dissolved phase concentrations in down gradient boundary wells suggest that the observed LNAPL is immobile. Ongoing contribution of contaminants to dissolved phase is also low given the weathered nature of the LNAPL source; ▪ The residual nature of LNAPL source and presence of an impermeable asphalt cap over the majority of AEC-4 to limit infiltration do not provide sufficient driving head to allow significant LNAPL migration in the subsurface; ▪ The viscous properties of the product (diesel oil/ lube oil mixture) observed across the buried waste area have a demonstrated tendency to bind to soil particles and these properties are anticipated to inhibit mobility of LNAPL through the soil matrix; ▪ A high proportion of LNAPL mass has been observed to be buried at depths below the water table (phreatic zone) within laterally discontinuous zones of more porous materials (higher sand content) which results in restriction of available pore-space for migration of LNAPL; ▪ No tidal connectivity with the Duck River limits the potential for migration of LNAPL or dissolved phase hydrocarbons to the Duck River.	
AEC-5 Platformer 3	■ Historical primary sources of LNAPL include former Platformer 3 operations. This plant has been decommissioned and removed from the Site. ■ Secondary sources include subsurface	Soil ■ Field observations during soil sampling identified strong hydrocarbon odours and elevated PID readings to a depth of 0.4 m bgl. No evidence of staining, odour or other visual / olfactory indications of contamination were recorded within underlying natural material. ■ Laboratory analysis of collected soil samples were below the adopted assessment criteria Groundwater	■ No exceedances of tier 1 screening criteria are noted for this AEC; ■ Based on the observed presence of LNAPL within groundwater at MW/11/17 within this AEC, aesthetics (odour/staining

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
	soils/groundwater containing LNAPL	■ LNAPL has been identified in monitoring well MW11/17, located immediately south of Platformer 3 during groundwater monitoring events undertaken since March 2013 at a maximum thickness of 0.077m. LNAPL or elevated dissolved phase concentrations have not been detected within monitoring wells situated down gradient of this locations. ■ Concentrations of dissolved phase COPCs in groundwater samples collected from MW11/17 have been reported below adopted assessment criteria, indicating low solubility and volatility of LNAPL. ■ Based on the lack of an ongoing source and driving head, the significant distance to offsite receptors and lateral delineation achieved via test pitting completed during this RSI, potential migration of LNAPL to offsite receptors from LNAPL within this AEC is considered unlikely. <u>Soil Vapour</u> ■ Concentrations of COPCs in soil vapour sample SV19/09, targeted at MW11/17 were not detected above the laboratory LOR or adopted assessment criteria. ■ Hazardous ground gas categorisation was undertaken for methane and carbon dioxide concentrations in accordance with the NSW EPA ground gas guidance (NSW EPA 2019). Based on soil vapour monitoring undertaken, these gases were categorised as having a "very low" safety risk in accordance with of the Ground Gas Guidance[3]. As such, no further management of hazardous ground gases are considered necessary for LNAPL at this location.	encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.
AEC-6 Buried Waste – Ex Solvents Plant	■ Primary sources of LNAPL within AEC-6 include the bio-treatment facility and buried waste materials. ■ Secondary sources include subsurface soils containing LNAPL	■ Fill comprising black shale, bricks with an observed oily sheen and hydrocarbon odour was identified within TP19/45 at a depth of between 1.0 – 1.2m bgl. ERM notes that section of poly-pipe was identified within this material with a sludge like material leaking from the pipe. Concentrations of COPCs within the soil material surrounding the section of pipe were reported by the laboratory below the adopted assessment criteria; ■ LNAPL has historically been identified within soil at TP18/32 at depths between 2 and 4 m bgl; ■ Laboratory analysis of collected soil samples returned concentrations of CoPCs less than the adopted tier 1 assessment criteria; ■ One sample collected from TP19/46 exceeded NEPM TRH management limits (TRH C16-C34 Fractions) at a depth of 0.05 m bgl.	■ Based on the isolated presence of LNAPL within the soil profile at TP18/32 within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed

[3] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
			RAP and/or future Long Term Environmental Management Plans.
AEC-7 Pipe Track Areas	■ Historically, primary sources within AEC-7 include former surface spills from transfer of product within pipework during former refinery operation; ■ Secondary sources include impacted soils containing LNAPL	■ No LNAPL was noted within this AEC during investigation works ■ No exceedances of tier 1 criteria for soil were reported	No potential SPR linkages were identified during the investigation
AEC-8 Tank farm J	■ Historically, primary source areas within AEC-8 included former fuel storage infrastructure which has been decommissioned / removed from the Site. ■ Secondary sources include subsurface soils containing LNAPL	■ PID screening returned a maximum concentration of 2 ppm at a depth of 0.4 m bgl. A hydrocarbon odour was noted at a depth of 0.2 m bgl, ■ No evidence of staining was noted within fill materials. ■ LNAPL was identified within previous investigations at TP18/31 at depths ranging from 0 – 2 m bgl. ■ TRH exceeding NEPM management limits was identified within sol at a depth of 0.4 m bgl	■ No exceedances of tier 1 screening criteria have been noted in soils analysed. ■ Based on the isolated presence of LNAPL within the soil profile at TP18/31 within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this area.
AEC-9 Process West	■ Historically, primary source areas within AEC-9 included former fuel processing infrastructure which has been decommissioned / removed from the Site. ■ Secondary sources include	<u>Soil</u> ■ PID screening returned a maximum concentration of 1141 ppm at TP19/47 at a depth of 1.2 m bgl Hydrocarbons odours were noted to be present throughput the fill profile with staining / black impacted sands being identified at TP19/42 and TP19/47 at a depth of 0.4 – 2.0 m bgl. ■ Laboratory analysis of collected samples identified TRH C6-C10 (F1) exceeding the adopted screening criteria with a reported	■ Based on the observed presence of LNAPL within soil/ and groundwater within this AEC (MW12/16, TP19/47), the potential effects of hydrocarbons on future buried infrastructure and aesthetics should

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
	subsurface soils containing LNAPL	concentration of 300 mg/kg within TP19/47 at depth of 0.3 m bgl. ■ Soil samples collected from TP19/42 and TP19/47 exceeded NEPM management limits for TRH C10-C16 fractions at depths ranging from 0.3 m bgl – 0.4 m bgl. <u>Groundwater</u> ■ LNAPL has been identified within groundwater during previous investigations within monitoring well MW12/16. LNAPL has been measured at a maximum thickness of 0.025m in this well during the Quarter 2 2016 GME. ■ Concentrations of TRH C6-C10 (F1) fractions in groundwater have exceeded adopted HSL-D criteria for vapour intrusion at MW12/16; ■ Concentrations of benzene, ethylbenzene and xylenes have been reported exceeding adopted offsite recreational criteria in monitoring wells MW12/16 and MW11/27 (benzene only) during groundwater sampling undertaken during the last 5 years. Concentrations of naphthalene and metals (including trivalent and hexavalent chromium, lead, nickel, copper, and zinc) have also been reported above adopted ecological criteria. ■ Naphthalene and zinc were identified to exceed the adopted ecological water criteria in ASLP samples collected. ■ Given the large distance between this AEC and the Duck River, and down gradient delineation of the above COPCs to below relevant criteria, SPR linkages with offsite receptors are considered incomplete; <u>Soil Vapour</u> ■ Soil vapour results identified exceedances of the adopted screening criteria for TRH >C8-C10 and TRH >C10-C12 Aliphatic fractions, TRH >C8-C10 Aromatic fractions, Benzene, Naphthalene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene within SV19/07, targeted at LNAPL identified in monitoring well MW12/16. ■ Hazardous ground gas categorisation was undertaken for methane and carbon dioxide concentrations in accordance with the NSW EPA ground gas guidance (NSW EPA 2019). Based on soil vapour monitoring undertaken, these gases were categorised as having a “very low” safety risk in accordance with of the Ground Gas Guidance[4]. As such, no additional management of methane or carbon dioxide gases are considered necessary for LNAPL at this location.	also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.

[4] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
AEC-11 Tank farms A1, A2, A3	■ Historically, primary source areas within AEC-11 included fuel storage infrastructure Secondary sources include subsurface soils containing LNAPL	Soil ■ During investigation works, hydrocarbon odours and staining were noted within several locations to a depth of between 0.6 to 1.5m bgl ■ LNAPL and hydrocarbon sheen has been identified within soil at several locations throughout the area to a depth of 1.5 m bgl. ■ Results of soil sampling identified exceedances of NEPM management limits for TRH C10-C16 and C16-C34 across Tank farm A2 (0.3 to 1.2m bgl), northern extent of Tank farm A1 (0.3m bgl) and the eastern extent of Tank farm A3 (to 0.8m bgl). Soil Vapour ■ Concentrations of COPCs in soil vapour sample SV19/06 were reported below adopted screening criteria. ■ Hazardous ground gas categorisation was undertaken for methane and carbon dioxide concentrations in accordance with the NSW EPA ground gas guidance (NSW EPA 2019). Based on soil vapour monitoring undertaken, these gases were categorised as having a "very low" safety risk in accordance with of the Ground Gas Guidance[5]. As such, further management of hazardous ground gases are considered unlikely to be required for LNAPL at this location.	■ Based on the observed presence of LNAPL within soil and groundwater within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.
AEC-13 Substation Areas and Transformer Yards		■ No LNAPL was noted within this AEC during investigation works No exceedances of tier 1 criteria for soil were reported	■ No exceedances of tier 1 screening criteria have been noted in soils analysed.
AEC-14 Subsurface drainage network	■ Primary sources areas within AEC-14 include compromised or leaking subsurface drainage infrastructure, which contained hydrocarbon/oily water from product storage and handling areas. ■ Secondary sources include subsurface soils containing LNAPL and surface materials potentially impacted with PFAS	■ LNAPL was visibly identified within backfill sand material surrounding sections of compromised pipework within Stage 2 Area (TP20/21, TP20/22, TP20/23, TP20/24, TP20/29A, TP20/30) to a depth of 1.5m BGL. The following exceedances of Tier 1 Criteria for soils were noted: ■ Indoor inhalation of vapours from volatile TRH fractions (C6-C16) by future on site commercial workers from hydrocarbon impacted soils at: ▪ AEC-14A (TP20/28) ▪ AEC-14B (TP20/29a, TP20/29b, TP20/29c, TP20/30, TP21/07) ■ Direct contact with contaminated soils (carcinogenic PAHs) by future on-site construction workers undertaking intrusive works: ▪ AEC14B (TP20/30, TP21/07)	■ Based on field observations and results of the RSI and previous investigations, no potentially complete pathways have been identified

[5] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC	LNAPL Source(s)	Analytical Results Summary	SPR Linkages
		■ The presence of LNAPL and soils exceeding TRH management limits associated with the drainage network in Stage 2 as shown on Figures 6A-6C of the Stage 2 RAP requires management under a LTEMP for aesthetic/ odour impacts identified during future works.	
AEC-15 General Site Areas (not covered within other AECs)		■ LNAPL has been identified in soil and groundwater during previous investigations and this RSI within the central portion the site to the south of AEC-9 (TP18/09) and AEC-11 (TP18/15, TP18/30). ■ Heavily stained soil material was identified to a depth of 0.3m bgl at BH12/28, within the footprint of former tanks 72, 74 and 75, formerly containing boiler fuel oil. Soil concentrations exceeded the criteria for direct contact by commercial workers for TRH C16-34 fractions in this isolated location. ■ Soil sampling identified exceedances of NEPM management limits for TRH C10-C16 and C16-C34 at shallow depths less than 0.5 m bgl. Groundwater ■ No LNAPL has been identified within groundwater monitoring wells installed within AEC15. As reported within routine groundwater monitoring reports, including the Stage 2 Area, concentrations of dissolved phase COPCs have been demonstrated to be stable to decreasing within the wider Stage 2 Area and are limited to on-site environments.	■ Potential acute hazards from the pooling of hazardous ground gases from LNAPL and impacted soil/ groundwater on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Direct contact or ingestion of impacted soils (TRH >C16-C34 Fraction), by on-site intrusive maintenance workers or construction workers undertaking earthworks – Limited to BH12/28.

1.11 Data Gaps Assessment

In accordance with the CRC Care (2015) Guidance, an LNAPL CSM should include information relating to the following parameters:

- LNAPL physical properties data – including density, dynamic viscosity, interfacial tensions, vapour pressure, Henry's law constant
- LNAPL chemical properties – including constituent solubilities and mole fractions, weathering profile and breakdown products; and
- LNAPL mobility and body stability information – LNAPL transmissivity and losses (including Source Zone Natural Attenuation).

The above data sources have not been able to be obtained due to minimal thickness and/or highly viscous LNAPL identified within groundwater monitoring wells within the Stage 2 Area, which have inhibited the ability to obtain sufficient sample volumes for laboratory assessment of chemical and physical properties during investigations undertaken within the Western Area. Similarly, for bail down testing, at least 0.33 m of LNAPL is desirable to obtain useful results (API, 2004).

Anecdotal evidence, including the slow movement of LNAPL from the soil profile into well screens following well installation (often months to years) is suggestive of low transmissivity and provides a limitation to the assessment of physical and chemical properties.

Appendix D Historical Reports

Date	Activities
1992	– Coffey Partners International Pty developed a geotechnical model of the site using information from 150 previous site investigations. – Ten monitoring wells were installed along the south eastern boundary to determine if the migration of contaminants into Duck River was occurring. ANSTO conducted water sampling.
1993	– Groundwater Monitoring Event (GME) conducted by Groundwater Technology in March 1993. – GME conducted by Groundwater Technology in July 1993. – Environmental Site Assessment (ESA) conducted by Coffey (16 boreholes), August 1993. – ESA conducted by Golder (eight boreholes) in November 1993. – ESA conducted by OTEK (three boreholes) in December 1993.
1994	ESA conducted by Coffey (six boreholes) in January 1994.
1995	– ESA conducted by Groundwater Technology in March 1995 in the former chemical plant and Tank Farm E. – ESA conducted by Groundwater Technology in April 1995 near the refuelling facility on the western site boundary.
1997	ESA conducted by OTEK (13 boreholes eastern site boundary).
1998	ESA (test pitting) completed by Coffey in November.
1999	– Sludge pilot conducted by IT (formerly Groundwater Technology) in February 1999. – ESA conducted by IT in May 1999 near the refuelling facility on the western site boundary. – GME conducted by IT in October 1999. – ESA conducted by Woodward Clyde (43 boreholes) in August 1999.
2000	GME conducted by IT in October in 2000.
2001	– GME conducted by IT in February 2001. – ESA conducted by IT in March near the sludge drying area in 2001. – GME conducted by IT in August in 2001.
2002	Pollution Reduction Program and Remedial Action Plan produced by Shell Engineering Pty Ltd in July in 2002.
2003/2004	GME conducted by IT in December 2003 and January 2004.
2004	– Gauging event conducted by IT in February 2004. – Gauging event conducted by IT in April 2004. – Gauging event conducted by IT in May 2004. – GME conducted by IT in July 2004. – Gauging event conducted by IT in August 2004. – Gauging event conducted by IT in September 2004. – Limited ESA conducted by IT in September 2004. – Gauging event conducted by IT in October 2004. – Gauging event conducted by IT in December 2004.
2005	– GME conducted by IT in March 2005. – Gauging event conducted by IT in June 2005. – Gauging event conducted by IT in July 2005.

Date	Activities
	– GME conducted by IT in August-September 2005. – Gauging event conducted by IT in November 2005. – Gauging event conducted by IT in December 2005.
2006	– Gauging event conducted by IT in January 2006. – GME conducted by IT in March 2006. – Gauging event conducted by Coffey in July 2006. – GME conducted by Coffey in September/October 2006. – Gauging event and limited GME conducted by Coffey in December 2006.
2007	GME conducted by HLA ENSR in September 2007.
2008	– Conceptual Site Model and Data Gaps Analysis completed by ERM in October 2008. – GME conducted by ERM Australia in February 2008. – GME conducted by ERM Australia in November 2008.
2009	– ESA Phase Separated Hydrocarbon Assessment (Sub Area CSM2) - ERM April 2009. – GME conducted by ERM Australia in April 2009. – ESA of Tank Farm E2 September 2009. – GME conducted by ERM Australia in November 2009.
2009/2010	ESA Chromium Assessment conducted by ERM November 2009 - January 2010.
2010	– GME (Q1.2010) conducted by ERM Australia in March 2010. – GME (Q2 2010) conducted by ERM Australia in June 2010. – GME (Q3 2010) conducted by ERM in September 2010. – Investigation of Tank 92 release conducted by ERM Australia in October 2010. – GME (Q4 2010) conducted by ERM Australia in November 2010.
2011	– GME (Q1.2011) conducted by ERM Australia in March 2011. – GME (Q2 2011) conducted by ERM Australia in June 2011. – GME (Q3 2011) conducted by ERM in September 2011. – CSM3 ESA conducted by ERM in October/November 2011. – GME (Q4 2011) conducted by ERM Australia in December 2011. – Investigation of Tank 30 release conducted by ERM Australia in December 2011.
2012	– GME (Q1 2012) conducted by ERM Australia in March 2012. – ESA (Lot 1 SPMT and Mobil Tank Farm) Phase 2 conducted in June 2012. – GME (Q2 2012) conducted by ERM Australia in June 2012. – GME (Q3 2012) conducted by ERM in September 2012. – GME (Q4 2012) conducted by ERM in December 2012.
2013	– GME (Q1 2013) conducted by ERM Australia in March 2013. – GME (Q2 2013) conducted by ERM Australia in June 2013. – GME (Q3 2013) conducted by ERM Australia in September 2013. – GME (Q4 2013) conducted by ERM Australia in December 2013.
2014	– GME (Q1 2014) conducted by ERM March 2014. – GME (Q2 2014) conducted by ERM in May 2014. – Lot 101 Detailed Site Investigation conducted by ERM in August/September 2014. – GME (Q3 2014) conducted by ERM in September 2014.

Date	Activities
	– GME (Q4 2014) conducted by ERM in December 2014.
2015	– GME (Q1 2015) conducted by ERM March 2015. – GME (Q2 2015) conducted by ERM in June 2015. – GME (Q4 2015) conducted by ERM in November 2015.
2016	– GME (Q2 2016) conducted by ERM in August 2016. – GME (Q4 2016) conducted by ERM in December 2016.
2017	– GME (Q2 2017) conducted by ERM in May 2017. – GME (Q4 2017) conducted by ERM in December 2017.
2018	– Western Area Targeted Site Investigation (TSI) completed by AECOM in January - March 2018. – GME (Q2 2018) conducted by ERM in June 2018. – PFAS PSI and Conceptual Site Model Fieldworks completed by ERM in August 2018. – GME (Q4 2018) conducted by ERM in December 2018. – Western Area Remediation Project – Environmental Impact Statement (EIS), prepared by AECOM. – Western Area Remediation Project - Conceptual Remediation Action Plan, prepared by AECOM.
2019	– GME (Q2 2019) conducted by ERM in May/June 2019. – Remediation Site Investigation (RSI) conducted by ERM in July and August 2019. Report issued in early 2020. – Human Health and Ecological Risk Assessment (HHERA) developed in late 2019. Report issued in early 2020. – Remediation Options Analysis conducted by ERM in October 2019 to January 2020. – Western Area Remediation Project – Response to Submissions Report, prepared by AECOM.
2020	– Stage 1 Remediation of AEC-9 excavation and Soil Validation. – Stage 1 Drainage Decommissioning Validation Report. – Stage 1 Remedial Action Plan (RAP) – Stage 1 Air Emission Validation Report (AEVR) – Stage 1 Remediation and Validation works – Stage 1 Long-Term Environmental Management Plan (LTEMP) and associate reports/plans

Appendix E Data Quality Objectives

Table 1 DQOs – Stage 2 ESA

Action	Requirements
State the Problem	Define the problem: ERM reported that previous investigations identified soil contamination in excess of SSTLs criteria as a result of historical land-use within the Stage 2 area. ERM reported that the validation approach following completion of remedial works may involve separate validation of portions of the Stage 2 Area not requiring remediation, such that property sale may be undertaken for future 'lots' ahead of more complex remediation areas. ERM reported that while the previously soil sampling density was considered appropriate for the WARP, the signoff of portions of land within subdivided proposed 'lots' has indicated a potential for sample densities and spatial coverage to be insufficient for particular proposed lot areas.
Identify the Decision/Goal of the study	ERM reported that the goal of the study was the collection of additional data, such that the sampling density across the Stage 2 area is sufficient to inform a future detailed Stage 2 RAP that would allow progressive divestment by lots if they were suitable for the proposed commercial/industrial site use without requiring remediation. **Primary study question(s):** • What is the nature and extent (laterally and vertically) of contaminants of concern in soil at the Stage 2 Area? • Where identified, does contamination exceed site specific and relevant screening criteria? • Is the sampling density and data obtained sufficient inform the detailed Stage 2 RAP should the remediation approach involve validation of numerous lots within the Stage 2 Area? **Decision Statement:** ERM reported that information obtained during the Stage 2 ESA will be used to supplement data obtained from historical investigations. The full dataset will be used to inform a future Stage 2 RAP for the area as part of Stage 2 remediation. The decision is whether there is enough suitable site data to inform the Stage 2 RAP.
Identify the Information Inputs	**Media to be sampled:** Soil**.** ERM reported that the identify information needed are as follows: • Existing relevant environmental data • Laboratory methods and LOR are appropriate for the purposes of the investigation and allow appropriate comparison of results against the adopted assessment criteria. • Field procedures and data collection will be consistent with all relevant guidelines made or approved by the NSW EPA and the ERM SAQP • Laboratory testing methods are noted in the laboratory reports.
Define the Boundaries of the Study	**Study area**: The study area is known as the Stage 2 Area within the WARP. **Temporal limits**: The study comprises the investigation completed as part of the Stage 2 ESA scope of works undertaken in March 2021, but assessment of sample density will include all historical data obtained within the Stage 2 area. **Constraints within the study boundaries include**: the location of above or below ground services or infrastructure.
Develop the Analytical Approach (or Decision Rule)	**Specifying the action level:** Individual soil data, along with the maximum, minimum, mean, standard deviation and 95% Upper Confidence Limit (UCL) of the mean concentration (if required) will be compared to the relevant assessment criteria. **Data acceptance limits**: The suitability of analytical data has been be assessed based on acceptable limits for field and laboratory QA/QC samples outlined in relevant guidelines made or endorsed under the CLM Act which includes the ASC NEPM. Where acceptable limits were not met, the field observations relating to the nature of the samples were reviewed in an effort to identify the issue that had given rise to the non-conformance. **Appropriateness of LOR:** Comparison of the LOR to the assessment criteria will be undertaken to confirm that the laboratory LORs are less than the assessment criteria, any exceptions to this will be appropriately noted and justified. **Assessing the sample density:** The sampling density was evaluated during SAQP development. The proposed sampling density aimed to meet the requirements of the Sampling Design Guidelines for each of the proposed lots. Stakeholders including the Site Auditor were consulted on the proposed investigation and sampling density.
Specify the Performance or Acceptance Criteria	Data quality assessment: The acceptable limits on decision errors applied during the review of the results will be based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness (The potential for significant decision errors will be minimised by PARCC in accordance with the ASC NEPM Schedule B (3) - Guidelines on Laboratory Analysis
Optimise the Design for Obtaining Data	The DQOs have been developed based on a review of existing data and discussions with Viva Energy and the Site Auditor. The sampling design was adjusted accordingly based on feedback from project stakeholders. ERM reported that in the event that the findings of the investigation identify issues which require further delineation or further investigation these will be delineated to the extent practicable, the scope of which is subject to approval from Viva Energy.

Table 2 DQOs – AEC-4 ESA

Action	Requirements
State the Problem	Previous investigations within the Stage 2 area have identified soil contamination in excess of risk-based screening criteria as a result of historical land-use within AEC-4. ERM reported that to prepare the Stage 2 RAP and AEC-4 ROA additional characterisation of AEC-4 is necessary.
Identify the Decision/Goal of the study	Based on the remediation objectives, ERM stated that the following decisions must be made: • What is the nature and extent (laterally and vertically) of CoPC in soil at the site? • Where identified, does contamination present a potential risk to human health and/or the environment? • Based on the extent of identified impacts, and the potential pathways to receptors, what remedial/ management actions are required?
Identify the Information Inputs	**Media to be sampled:** Soil and groundwater. ERM reported that the identify information needed are as follows: • Existing relevant environmental data • Laboratory methods and LOR are appropriate for the purposes of the investigation and allow appropriate comparison of results against the adopted assessment criteria. • Field procedures and data collection will be consistent with all relevant guidelines made or approved by the NSW EPA and the ERM SAQP • Laboratory testing methods are noted in the laboratory reports.
Define the Boundaries of the Study	**Study area**: The study area is known as the AEC-4. **Temporal limits**: The study comprises the investigation completed as part of the AEC-4 ESA scope of works between July 2020 and August 2020. **Constraints within the study boundaries include**: the location of above or below ground services or infrastructure.
Develop the Analytical Approach (or Decision Rule)	**Specifying the action level:** Individual soil data, along with the maximum, minimum, mean, standard deviation and 95% Upper Confidence Limit (UCL) of the mean concentration (if required) will be compared to the relevant assessment criteria. **Data acceptance limits**: The suitability of analytical data has been be assessed based on acceptable limits for field and laboratory QA/QC samples outlined in relevant guidelines made or endorsed under the CLM Act which includes the ASC NEPM. Where acceptable limits were not met, the field observations relating to the nature of the samples were reviewed in an effort to identify the issue that had given rise to the non-conformance. **Appropriateness of LOR:** Comparison of the LOR to the assessment criteria will be undertaken to confirm that the laboratory LORs are less than the assessment criteria, any exceptions to this will be appropriately noted and justified. **Assessing the sample density:** The sampling density was evaluated during SAQP development. The proposed sampling density aimed to meet the requirements of the Sampling Design Guidelines for each of the proposed lots. Stakeholders including the Site Auditor were consulted on the proposed investigation and sampling density.
Specify the Performance or Acceptance Criteria	Data quality assessment: The acceptable limits on decision errors applied during the review of the results will be based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness (The potential for significant decision errors will be minimised by PARCC in accordance with the ASC NEPM Schedule B (3) - Guidelines on Laboratory Analysis
Optimise the Design for Obtaining Data	The DQOs have been developed based on a review of existing data and discussions with Viva Energy and the Site Auditor. The sampling design was adjusted accordingly based on feedback from project stakeholders. ERM reported that in the event that the findings of the investigation identify issues which require further delineation or further investigation these will be delineated to the extent practicable, the scope of which is subject to approval from Viva Energy.

Table 3 DQOs – Stage 2 RAP

Action	Requirements
State the Problem	Previous investigations within the Stage 2 area have identified soil contamination in excess of risk-based screening criteria as a result of historical land-use. Therefore, the Stage 2 Area must be remediated to allow future redevelopment in accordance with the land zoning, i.e. commercial/industrial. To demonstrate completion of site remediation works to achieve these objectives, site validation will need to be undertaken in accordance with the Stage 2 RAP to the satisfaction of the auditor.
Identify the Decision/Goal of the study	Based on the remediation objectives, ERM stated that the following decisions must be made: • What is the lateral extent of the AEC-3E hotspot which requires remediation? • Has sufficient soil sampling been conducted in the proposed road area? • Have remediation excavations removed contaminated soil and LNAPL to the extent practicable to remove potential risks to human health and the environment? • Is excavated soil material suitable for on-site re-use, or does it require further treatment (via biopiling) or off-site disposal? • Is imported fill material suitable for use in the Stage 2 Area? • Has the AEC-4 cap been constructed in accordance with the design requirements?
Identify the Information Inputs	ERM reported that the identify information needed are as follows: • Results from previous soil, groundwater and soil vapour sampling during previous investigations and risk assessment undertaken within the HHERA (ERM, 2020b). • Field observations and analytical data collected during Remediation Trials and the Stage 1 remedial works. • Field observations made during remediation works for odours, LNAPL, sheens, discolouration, asbestos and other indicators of potential contamination. • Field screening of soil material during excavation works for volatile organic compounds. • Characterisation of contaminant conditions via visual screening and sampling of soil from excavations and stockpiled material and subsequent field testing and/or laboratory analysis of selected samples. • Assessment criteria as per the Stage 2 RAP. • Confirmation of acceptable data quality by assessment of data quality assurance/quality control by comparison against Data Quality Indicators (DQI).
Define the Boundaries of the Study	• Study area: The Stage 2 Area is approximately 28 ha in size, and comprises of the former Utilities, Movements and Buried Waste Area. • The lateral extent of remediation excavations required is shown on Figure F2 in **Appendix A**. • The vertical extent of remediation will be carried out as per AECs impacts. A summary of the depth is presented in Figure F10 in **Appendix A**. • Temporal limits: The study comprises validation activities to be completed as part of the Stage 2 RAP scope of works, anticipated to be completed throughout Quarter 3 and 4 of 2021. • Constraints within the study boundaries are considered limited to the location and extent of sub-grade footings and associated concrete and footings, which will not be removed as part of • excavation works. The presence of established vegetation within the Riparian corridor represents a constraint to capping works in AEC-4.
Develop the Analytical Approach (or Decision Rule)	**Specifying the action level:** Individual soil data, along with the maximum, minimum, mean, standard deviation and 95% Upper Confidence Limit (UCL) of the mean concentration (if required) will be compared to the relevant assessment criteria. **Data acceptance limits**: The suitability of analytical data has been be assessed based on acceptable limits for field and laboratory QA/QC samples outlined in relevant guidelines made or endorsed under the CLM Act which includes the ASC NEPM. Where acceptable limits were not met, the field observations relating to the nature of the samples were reviewed in an effort to identify the issue that had given rise to the non-conformance. **Appropriateness of LOR:** Comparison of the LOR to the assessment criteria will be undertaken to confirm that the laboratory LORs are less than the assessment criteria, any exceptions to this will be appropriately noted and justified. **Assessing the sample density:** The sampling density was evaluated during SAQP development. The proposed sampling density aimed to meet the requirements of the Sampling Design Guidelines for each of the proposed lots. Stakeholders including the Site Auditor were consulted on the proposed investigation and sampling density.
Specify the Performance or Acceptance Criteria	Data quality assessment: The acceptable limits on decision errors applied during the review of the results will be based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness (The potential for significant decision errors will be minimised by PARCC in accordance with the ASC NEPM Schedule B (3) - Guidelines on Laboratory Analysis
Optimise the Design for Obtaining Data	The DQOs have been developed based on a review of existing data and discussions with Viva Energy and the Site Auditor. The sampling design was adjusted accordingly based on feedback from project stakeholders. ERM reported that in the event that the findings of the investigation identify issues which require further delineation or further investigation these will be delineated to the extent practicable, the scope of which is subject to approval from Viva Energy.

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft	D.Balbachevsky	A. Kohlrusch	DRAFT	A. Kohlrusch	DRAFT	12/08/2021
Final	D.Balbachevsky	A. Kohlrusch		A. Kohlrusch		13/08/2021

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