Viva Energy Clyde Western Area Remediation Project - Stage 1

2 Durham Street, Rosehill, NSW

Site Audit Report

June 2020

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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

Acronym	Description
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
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
IMWs	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

Acronym	Description
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
MHF	Major Hazard Facility
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 Walls
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
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

Acronym	Description
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
SuRF	Sustainable Remediation Forum
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	Waste Water Treatment Plant

1. Introduction

1.1 Site audit details

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 Western Area to facilitate future commercial and/or industrial development under the existing land use zoning (IN3 – Heavy Industrial). Remediation is proposed to take place in three stages, the first of which is Stage 1. Figures 1 and 2 from the ERM Stage 1 RAP (**Appendix A**) show the site locality and surrounding features.

Given the scale of remedial works, the Western Area Remediation Project (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 Remedial Action Plan (RAP) was submitted by AECOM in late 2018 (AECOM, 2019). It is the auditor's understanding that Viva Energy is proposing to stage the remediation of the WARP as follows:

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

This Site Audit Report (SAR) has been prepared for the Stage 1 Area of the WARP, the purpose of which is to assess whether the Stage 1 RAP was prepared in a manner consistent with NSW Environment Protection Authority (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).

The review and endorsement of the Stage 1 RAP also forms Consent Conditions (B1 and B3) for SSD 9302 as issued by the Department of Planning, Industry and Environment (7 May 2020). **Table 1** present the site audit details.

Table 1 Site audit details

Site auditor	Mr. Andrew Kohlrusch
NSW EPA site auditor accreditation nº.	0403
NSW EPA site audit statement nº.	043/2127799
Audit category	Statutory
Legal property description	Part Lot 100 in DP 1168951 – as shown in the survey plan presented in Appendix A
Council	City of Parramatta Council
Site area	7 hectares
Site owner	Viva Energy
Current land use	Vacant site
Proposed land use	Commercial and/or industrial

1.2 Purpose of this report

A site audit as defined in Part 1 Section 4 of the CLM Act 1997 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.*

The purpose of the audit is to certify what management remains necessary before the area associated with Stage 1 is suitable for future development in accordance with the zoning classification (IN3 heavy industrial). This has been achieved by assessing whether the Stage 1 RAP was prepared 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). Discussion regarding the regulatory context is present in **Section 1.6**.

1.3 Scope and limitations

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

- ERM (2020d) *Clyde Western Area Remediation Project, Stage 1 - Detailed Remediation Action Plan*, dated 4 June 2020 (the Stage 1 RAP).
- ERM (2020e) *Clyde Western Area Remediation Project, Stage 1 - Remedial Options Analysis*, dated 3 June 2020 (the ROA).
- ERM (2020f) *Clyde Western Area Remediation Project, Stage 1 Air Emission Verification Report*, dated 26 May 2020 (the AEVR).
- DPIE (2020) *Conditions of Consent, Application number SSD 9302 - Part Lot 100, DP1168951, Durham Street, Rosehill*, dated 07 May 2020 (Conditions of Consent).
- Viva Energy (2020) *Clyde Western Area Remediation Project (SSD 9302) - Proposed Staging*, dated 19 May 2020 (the Staging remediation letter).
- ERM (2019) *Remedial Site Investigation, Sampling Analysis and Quality Plan (SAQP)* dated 7 August 2019 (the RSI SAQP).
- 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 (2020c) *Clyde Terminal – Quarter 4 (2019) Groundwater Monitoring Report*, dated 7 February 2020 (the GME).
- AECOM (2019) *Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan*, dated 21 January 2019 (the Conceptual RAP).

- ERM (2019b) *Clyde Western Area Remediation Project – Risk Assessment Methodology*, dated 9 October 2019.
- AECOM (2018) *Site Target Investigation*, dated 14 September 2018 (the TSI).
- ERM (2018) *PFAS Conceptual Site Model and Flux Assessment Report*, dated December 2018 (the PFAS CSM).

The outcome of the review of the key aforementioned documents associated with the characterisation and planning for remediation was presented in interim audit advice letters (IAAs). Copies of relevant IAAs, as well as the consultant's response (where relevant) are presented in **Appendix B** of this SAR.

1.4 Proposed and permitted land uses

The Stage 1 Area is zoned IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011. Any permissible use allowed under the sites zoning (with consent), includes:

- *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*.

1.5 Site visit

The auditor has conducted a series of site visits, the latest of which was on 27 April 2020. During this site visit, the auditor observed the features of the Stage 1 Area and discussed with Viva the work that was being planned for the forthcoming remediation and the drainage decommissioning works.

All above ground structures had recently been demolished. The site surface largely comprised bitumen and concrete sealed surfaces. The site sloped gently towards Duck River to the south. There were some depressions owing to either removal of some infrastructure or associated with the pipetracks and/or drainage network. No water was noted in any of the depressions.

There was no storage of chemicals. A disturbed area associated with the recent excavation of soil associated with the remedial trials that had been completed a few months earlier was visible in the northern portion of Stage 1.

1.6 Regulatory context

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 DP41324, Lot 2 DP224288, Lot 1 DP383675, Lot 101 DP809340 and, Lot 100 DP1168951 (which includes the WARP) as contaminated land under the CLM Act (Declaration Number 20131110).

1.6.1 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.

1.6.2 Conditions of Consent SSD 9302

The NSW Government Department of Planning, Industry and Environment (DPIE) issued on 7 May 2020, Consent Conditions for the remediation of contaminated soils and management of contaminated groundwater to enable future commercial and industrial land uses. Conditions Consent 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).* [1]*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*

[1] The NSW EPA has updated this guideline in May 2020.

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.*

1.6.3 Clyde Western Area Remediation Project (SSD-9302) – Proposed Staging

Consent Conditions related to the remediation of the WARP have been issued on 7 May 2020 by NSW DPIE as discussed in **Section 1.6.2**. Condition B1 of the Conditions of Consent state that a detailed RAP is to be reviewed prior to the commencement of preparation works.

Viva Energy has entered into an agreement with Downer EDI Works Pty Ltd (Downer) to sell a portion of the Western Area to allow Downer to relocate its asphalt plant. This situation has been brought about by the compulsory acquisition by the NSW Government of Downer's existing asphalt plant.

Viva Energy has subsequently reviewed its approach to remediating the Western Area and intends to conduct the remediation in stages, the first stage being the remediation of a portion of the Western Area that will be sold to and subsequently developed by Downer.

At this juncture Viva Energy is proposing to deliver the Project in three remedial stages (based on geographical portions of the Western Area) and has informed DPIE of its intent (letter of 19 May 2020) as per Condition of Consent A9.

The correspondence to DPIE has stated that all relevant documentation required by the Conditions of Consent for the WARP will be submitted for all stages.

1.7 SAR structure

This SAR documents the audit of the relevant environmental works conducted by the consultants presented in the referenced reports shown in **Section 1.3**. Where the auditor has provided comments on the work completed by the consultants 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	Site history
Section 4	Previous investigations
Section 5	Nature and extent of impacts
Section 6	Remedial options analysis
Section 7	Air emissions verification report
Section 8	Contaminants of potential concern
Section 9	Validation criteria
Section 10	Conceptual site model
Section 11	Stage 1 RAP
Section 12	Data quality indicators

Section 13	Validation sampling analysis and quality plan
Section 14	Other considerations
Section 15	Compliance with regulatory requirements
Section 16	Auditor's opinions and conclusions
Section 17	Disclaimer

1.8 Limitations of this report

The information and opinions given in this SAR are based on reviewing information presented in the documentation referenced in **Section 1.3** 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 17** 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 1 RAP was prepared in accordance with the guidelines made or endorsed by the NSW EPA and complied with relevant Consent Condition required by the DPIE as previously discussed in **Section 1.6**. 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.

1.9 Guidelines used

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

- HEPA, 2020. *PFAS National Environmental Management Plan*, Heads of EPAs Australia and New Zealand (herein referred to as HEPA).
- NSW EPA, 2020. *Contaminated sites: Guidelines for Consultants Reporting on Contaminated sites* (the Consultant Guidelines).
- NSW EPA, 2019. *Assessment and Management of Hazardous Ground Gases* (the Ground Gases Guidelines).
- ANZAST, 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
- CRC CARE, 2018. *CRC for Contamination Assessment and Remediation of the Environment, National Remediation Framework, Guideline on Performing Remediation Options Assessment.*
- NSW EPA, 2017. *Contaminated Land Management: Guidelines for the New South Wales Site Auditor Scheme* (3rd edition) (the Auditor Guidelines).
- NSW EPA, 2016. *Addendum to Waste Classification Guidelines (2014) - Part 1: classifying waste.*
- NSW EPA, 2015a. *Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*.

- 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 NEPM).
- NSW DEC, 2007. *Guidelines for the Assessment and Management of Groundwater Contamination* (the Groundwater Guidelines).
- NSW EPA, 1995. *Sampling Design Guidelines*.
- 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 & NRMMC, 2004. *Guidelines for Drinking Water Quality in Australia, National Health and Medical Research Council and Natural Resource Management Ministerial Council*, Canberra.

2. Site conditions and environmental setting

2.1 Site identification

The following section is based on information from the Stage 1 RAP. The Stage 1 Area is located within the former Process West area and extends from Durham Street in the north to the Duck River at the southern boundary of the WARP. A site location plan and a site layout are provided in Appendix A (Figures 1 and 3 from the Stage 1 RAP).

The site identification information is summarised in Table 2**.**

Table 2 Site location

Site identification:	Stage 1 Area
Site area:	7 hectares
Local Government Authority	City of Parramatta Council
Lot, section and deposit plan (DP):	Part Lot 100 in DP 1168951
Site occupant:	Viva Energy
Current land use:	Vacant site
Proposed land use:	Commercial and/or industrial
Land use zoning:	IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011

2.2 Site description

ERM (2020d) described that the Stage 1 Area, which comprises the Former Process West Area is currently a vacant site. The following was noted by ERM (2020d) during its site inspection completed on 22 January 2020:

- Concrete and bitumen hard standing was present across the vast majority of the Stage 1 Area.
- Aboveground pipework remained within the pipe tracks bordering the west and northern extent of the former Process West footprint.
- Corrugated Plate Interceptor units remain at the ground surface, the location of these interceptors is shown in Appendix A (Figure 4 from ERM 2020d).
- The Central Control Room building has been demolished, leaving an open void with concrete walls and base within the former basement area of approximately 50 metres x 18 metres which extends approximately three metres below the surrounding surface level.
- A large stockpile of building and demolition waste situated in the Western Portion of the Stage 1 Area. This stockpile occupies an approximate footprint of 1,100 m^2 with an average height of two metres (approximately 2,200 m^3).

2.3 Topography and drainage

ERM (2020d) reported that the surface of the Stage 1 Area, included within the Western Area has been reshaped over time with the use of imported fill material, to provide a relatively flat site. Surface water and runoff is directed towards the drainage network, which is comprised of the following:

- Clean water drainage system that discharges direct to the Parramatta and Duck Rivers.

- Accidentally Oil Contaminated (AOC) and a Continually Oil Contaminated (CC) drainage network.

The CC drainage network relevant to the Stage 1 Area is presented in **Appendix A** (Figure 4 from ERM 2020d). The location of the Waste Water Treatment Plant (WWTP) is shown in **Appendix A** (Figure 8 from ERM, 2020d).

A process of drain cleaning of the AOC and CC drainage network was undertaken in 2018 by Ventia Utility Services Pty Ltd (herein referred to as Ventia). The location of cleaned drainage is shown in **Appendix A** (Figure 4 from ERM 2020d). An estimated 2,328 metres of drainage was recorded as cleaned via a process of high pressure jetting and vacuuming between connected drainage pits over a period of three months. ERM (2020d) stated that pits are understood to have been progressively filled with a sand/grout mix following cleaning.

ERM understood that following the cleaning process and backfilling of pits, the drainage from hardstand surfaces within the former Process West Area now drains to surrounding pipe-tracks to the east and west via overland flow, where active drains collect and divert the water to the WWTP.

The AOC and CC drainage systems deliver contaminated water to the on-site wastewater interceptors, where bulk separation of oils takes place. Water from these interceptors is fed into the bio-treater, located in the south-eastern portion of the Western Area. This system treats the wastewater prior to being discharged to the Duck River via licensed discharge points specified by Environmental Protection Licence 570 (mentioned in **Section 1.6**).

ERM (2020d) described that the Duck River is lined with mangroves adjacent to the Western Area, however, was considered a moderately disturbed catchment. As reported by ERM, 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 extends approximately 10 kilometres south to Condell Park, within thr Bankstown LGA where stormwater flows within a series of storm water pipes and open concrete drains.

The downstream extent of the Duck River converges with the Parramatta River at the north-east boundary of the Stage 1 Area. ERM (2020d) 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 (2020d) reported that based on historical intrusive works the average thickness of fill material within the Stage 1 Area is 0.6 metre. Fill material is underlain by high plasticity clay (alluvial sediments) across the majority of the Stage 1 Area.

Localised areas of backfill sand have been identified surrounding subsurface footings and structures to a depth of two metres below ground level (mbgl).

The Acid Sulfate Soil (ASS) Risk Map for Parramatta/Prospect (scale 1:25,000) produced by the Department of Land and Water Conservation (1997) identified the Western Area as having a high probability of ASS in estuarine sediments adjacent to the Duck River. ERM (2020d) stated that no estuarine sediments have been identified within soils during previous intrusive investigations within the Stage 1 Area. Thus ERM (2020d) concluded that given the absence of such sediments across the Stage 1 Area, the probability of encountering ASS or Potential Acid Sulfate Soils (PASS) was considered low.

2.5 Hydrogeology

A summary of the hydrogeology relevant to the Stage 1 Area prepared by ERM (2020d) is present in **Table 3.**

Table 3 Stage 1 Area - Hydrogeology

Data	Results
Groundwater Depth	Groundwater is represented as a shallow unconfined water bearing zone within the fill material at depths between one to three mbgl. Preferential pathways for groundwater flow have been identified within sandy lenses in the fill including anthropogenic structures, such as the on-site storm water drainage network.
Groundwater Flow Direction	The direction of groundwater flow may be subject to fluctuation following rainfall events and localised groundwater mounding, but has generally been established to be towards the Duck River to the south and Parramatta River to the north. The inferred groundwater flow direction based upon recent gauging activities since demolition works in 2016 is towards the Duck River, to the south and south- east.
Hydraulic Gradient	The average hydraulic gradients calculated parallel to groundwater flow direction indicated the hydraulic gradient range between 0.003 m/m along the up gradient portion of the Western Area to 0.011 m/m across the southern portions of the Western Area. ERM concluded that hydraulic gradients were found to increase with proximity to the Duck River.
Hydraulic conductivity	ERM (2020d) stated that the hydraulic conductivity has been established to be low across the large majority of the Western Area, 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. Higher hydraulic conductivity values were reported for wells screened across coarser grained sandy clay soils within the southern portion of the Western Area and are consistent with the more transmissive nature of these geologies. Generally, hydraulic conductivity values increased from a minimum 5×10^{-5} m/day at the up gradient site boundary to up to 4×10^{-2} m/day closer to the southern site boundary due to the presence of sand/silt deposits closer to the Duck River. Historical data demonstrates that the laterally continuous higher hydraulic conductivity lithological units are not expected to be encountered within the Stage 1 Area.

ERM (2020d) stated that the focus of investigation activities and the Conceptual Site Model (CSM) was the assessment of the shallow water bearing unit due to the nature of soil and groundwater contaminant sources within the Stage 1 Area being at or near surface (historical aboveground storage and pipework and near surface drainage).

The presence of fill material underlain by impermeable clay lithology has limited vertical migration of impacts in soil and groundwater to within the surficial shallow water bearing unit. ERM (2020d) stated that the above is supported by soil analytical results indicating that Chemical of Potential Concern (COPC) in soil samples collected from the clay layer (or at depths greater than two metres below ground level (mgbl)) do not exceeded applicable screening criteria.

It was reported by ERM (2020d) that based upon the understanding of geology and hydrogeology at the Stage 1 Area, the lateral migration potential of COPC in groundwater was limited by the low permeability of the lithology, relatively flat hydraulic gradient and low average groundwater velocity. This is supported by the limited extent of impacted groundwater, indicating that, where present, areas of impacted groundwater are relatively stable and do not appear to be migrating.

The auditor considered that the information presented by ERM (2020d) as well as in the background reports (discussed in **Section 1.3**), provided an appropriate description of the Western Area, which includes the Stage 1 Area as well as the local environment setting.

The site description as well as the immediate surrounding land uses reported in the Stage 1 RAP was consistent with the auditor's observations made during his site visits (discussed in **Section 1.5**) and are considered unlikely to affect the contamination status of the site.

The site is zoned as IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011. The auditor notes that the proposed future land use (commercial/industrial) for the Stage 1 Area is in accordance with the Parramatta Council zoning.

The key potential ecological receptor observed within or immediately adjacent to the Stage 1 Area is the Duck River. The auditor notes there is no complete Source – Pathways -Receptors (SPR) Linkage between the Duck River and the Stage 1 Area, as previously discussed in the PFAS Conceptual Site Model and Flux Assessment Report (ERM, 2018).

The auditor notes that an extensive and detailed description of the entire Western Area and environmental condition has been documented in the past 28 years, as further discussed in **Section 3**. The Stage 1 RAP, as well as the previous reports (discussed in **Section 1.3**), provided a detailed summary of site geology and hydrogeology that provides a basis for understanding these elements of the CSM and influences on impacts distribution and mobility.

The auditor considered that the information provided by ERM in its Stage 1 RAP was sufficient and largely in accordance with the Schedule B2 of the ASC NEPM and the Consultant Guidelines.

3. Site History

3.1 Land use

AECOM in its Conceptual RAP (AECOM, 2019) 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 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 Clyde Terminal location is presented in **Appendix A** (Figures 1 and 2 from ERM 2020d).

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** (Figures 1 and 2 from ERM 2020d).

3.4 Stage 1 Area

The Stage 1 Area comprises Part Lot 100, DP1168951 at Durham Street, Rosehill. The location of Stage 1 Area is shown in **Appendix A** (Figure 2 from ERM, 2020d).

ERM (2020d) reported that the plant decommissioning, decontamination and above grade demolition activities of the majority of above-ground infrastructure, including the Stage 1 Area was completed between 2012 and 2016.

Demolition of the final remaining above ground infrastructure (Western Tank farm, Tank farm C and remaining pipe track areas) is being completed during early 2020.

Within the boundaries of the Stage 1 Area, the following features associated with former refining operations existed and operated since approximately 1960 prior to demolition. These features are shown in **Appendix A** (Figure 3 from ERM 2020d):

- Former Process West – Aboveground fuel processing infrastructure including a Distillate splitter unit, crude oil distillate units, Central Control Room.
- Tank Farm H – formerly containing Aboveground Storage Tanks (ASTs) 501 – 505, formerly storing various grades of bitumen and wash oil.
- Minor electricity substation units (Sub 3 and Sub 16).
- Drainage infrastructure and associated oil-water interceptor units.

Further discussion about the areas of environmental concern (AEC) is discussed in **Sections 4 and 11**.

The auditor considered that the site's primary historical usage which had the potential to result in soil and groundwater contamination was the storage and manipulation of petroleum hydrocarbons, the substation units and the local drainage and associated oil-water interceptor units.

The auditor noted that the majority of the former infrastructure within Stage 1 Area was aboveground, including the drainage infrastructure, Tank farm and Former Process West, which is expected to have mitigated soil and groundwater impacts.

4. Previous investigations

4.1 Western Area

ERM (2020d) reported that since 1991 investigations across the Clyde Terminal have been conducted. The outcomes from the assessments presented in **Table 4** are relevant to the WARP and were utilised during the development of the Conceptual RAP (AECOM, 2019) and the RSI (ERM, 2020a).

Table 4 Historical reports - WARP

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.

Date	Activities
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. 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.

Date	Activities
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.

Date	Activities
	Lot 101 Detailed Site Investigation conducted by ERM in August/September 2014. GME (Q3 2014) conducted by ERM in September 2014. 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.

4.2 Stage 1 Area

A summary of relevant investigation data which has informed the preparation of the Stage 1 RAP is provided within **Table 5** with details on the relevant investigations presented in the following sections.

ERM (2020a) reported that 17 groundwater monitoring wells, 17 test pits, four soil bores and one soil vapour well within the Stage 1 area have been sampled as part of these investigations and has assisted in the preparation of the Stage 1 RAP. The location of soil, groundwater and soil vapour investigation locations is shown in **Appendix A** (Figure 5 from ERM 2020d).

Table 5 Historical reports – Stage 1 Area

Author	Year	Scope of works	Investigation locations completed	Comments
Coffey	1991	Boundary groundwater monitoring well installation program.	One monitoring well within Stage 1 Area (W91/2).	General information on site geology to inform CSM and the Stage 1 RAP.
Groundwater Technology	1994	Groundwater monitoring well installation.	One monitoring well within Stage 1 Area (MW94/6X).	General information on site geology to inform CSM and the Stage 1 RAP.
Woodward Clyde	1998	Groundwater monitoring well installation.	One monitoring Well within Stage 1 Area (MW98/9).	General information on site geology to inform CSM and the Stage 1 RAP.
ERM	2008 to 2019	Groundwater Monitoring Events. Monitoring of available monitoring wells for compliance purposes.	Various.	General information on LNAPL, dissolved phase COPC concentrations and trends in groundwater. Hydrogeological information was used in the refinement of the CSM and in the Stage 1 RAP.
ERM	2012	Stage 1 and 2 Environmental Site Assessment.	Three soil bores (Tank Farm H). 13 Groundwater monitoring wells.	General information on LNAPL. The site characterisation was used in the refinement of the CSM and in the Stage 1 RAP.
AECOM	2018	Targeted Site Investigation (TSI).	One monitoring well. Four test pits.	General information on LNAPL. The site characterisation was used in the refinement of the CSM and in the Stage 1 RAP.

4.2.1 ERM (2020a) – Remediation site investigation (RSI)

The scope of works undertaken as part of the RSI, undertaken across the WARP, including the Stage 1 Area comprised excavating an additional 80 test pits to a maximum depth of 4.8 mbgl to characterise soils in specific areas where data gaps were identified as outlined in the SAQP RSI.

ERM reported that the objective of the RSI was to collect data to assess the risk of contamination to sensitive on and off-site human and ecological receptors resulting from the AECs as presented in **Table 6**.

ERM stated that AEC-9 and portions of AEC-7, AEC-13, AEC-14 and AEC-15 are situated within the Stage 1 Area. Details regarding the extent, targeted COPC and specific objectives of investigation for each AECs was provided within the RSI report.

Table 6 Summary of AEC

Identification	Description
AEC-1	Old Administration Area
AEC-2	Buried Waste Area 8 – CDU tank farm sludge
AEC-3	Southern Contractor Area
AEC-4	Southern Buried Waste Area
AEC-5	Platformer 3
AEC-6	Buried Waste – Ex Solvents Plant
AEC-7[2]	**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**

ERM's conclusions regarding the specific objectives of the RSI (for the entire WARP and not just the Stage 1 Area) are presented in **Table 7**.

[2] **Bold** – AECs within Stage 1 Area.

Table 7 Resolution of Data gaps

Objective	Comment
Refine the nature and extent of petroleum hydrocarbon impacts and LNAPL	ERM based on the information collected as part of previous investigations and the RSI considered to have collected sufficient data to characterise the nature and extent of impacts requiring remediation within the WARP as further discussed in **Section 5**.
Potential pre-validation of low risk areas to potentially exclude from remediation and / or management	ERM (2020d) stated that based on the results of the RSI and historical investigations low risk areas were limited to AEC-1 (Old Admin Area) and AEC-13 (Substation Areas). Asbestos containing materials (ACM) were identified on or near the surface within isolated areas of these AECs. These portions of the site did not require further assessment as part of the subsequent Tier 2 HHERA. However, ERM stated that remediation or management of these identified impacts will be required.
Further characterisation of buried waste areas (nature and extent of impacts).	ERM (2020d) reported that test pitting within AEC-4 was terminated in fill at a depth of 4.0 mbgl in several location and as such the potential for deeper fill materials may require consideration. However, ERM based on the results of this RSI and previous investigations considered that the lateral extent of AEC-4 was suitably delineated.
Drainage and subsurface infrastructure characterisation.	ERM (2020d) reported that fill materials underlying pipe tacks were identified to be generally shallow, extending to a depth of approximately 0.1 to 0.2 metre. ERM stated that results of soil samples returned concentrations of COPC less than the adopted Tier 1 screening criteria. On the basis of the extensive nature of the drainage network, ERM (2020d) recommended that an unexpected finds protocol should 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 site specific target levels (SSTLs) and remedial end points.

Objective	Comment
Further characterisation of non-petroleum COPC to confirm the remediation methodology/ management.	ERM (2020d) reported the following: Asbestos – was identified in the form of ACM fragments at isolated locations throughout the site, associated with demolished former infrastructure. ERM noted that the presence of ACM identified during investigations was limited to shallow fill materials and surface soils in localised areas. Soils within AEC-4 were identified 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 Western Area. The extent of identified asbestos identified during the RSI and historical investigations is shown in **Appendix A** (Figure 11 from ERM 2020d). Heavy metals – laboratory analysis of collected soil samples returned concentrations of all heavy metals less than the adopted assessment criteria with the exception of one isolated sample located within AEC 11, which exceeded the assessment criteria for lead. Historical results have also identified the presence of total chromium results above adopted criteria associated with buried waste within AEC-4. Dioxins – were reported less than Limit of Reporting (LOR) and/or the adopted assessment criteria. 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 - ASLP leachate 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 was 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.

4.3 ERM (2020b) – Human health and ecological risk assessment

The HHERA was developed to provide to the Western Area 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 (ERM 2020a). The specific objectives of the HHERA were as follows:

- To assess whether the on-site soil and groundwater impacts in the WARP can pose a potential risk to human or ecological receptors under the proposed future land use scenario
- To assess whether the identified on-site impacts can pose a potential risk to off-site human or ecological receptors based on the current land use
- To develop SSTLs for remedial works

ERM (2020b) reported that based on the results of the Tier 1 screening and updated CSM from the RSI, the HHERA conducted further exposure assessment and derived SSTLs for:

- 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 COPC:
  - AEC-3 - carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs), Total Recoverable Hydrocarbons (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 the following AECs and COPC:
  - AEC-3 - benzene, naphthalene, and TRH C6-C10 (less BTEX)
  - AEC-4 - benzene, naphthalene, and TRH C6-C10 (less BTEX)
  - **AEC-9**[3] - benzene, and TRH C6-C10 (less BTEX)
  - AEC-10 - TRH C6-C10 (less BTEX)
  - AEC-12 - TRH C6-C10 (less BTEX)

ERM reported that Tier 1 screening of groundwater along the boundary of the Western Area 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 / ecological receptors.

ERM (2020b) stated that the exposure pathway was considered incomplete and no risk to the potential off-site receptors was identified from COPC in groundwater. Similarly, screening for PFAS and metals from soil leachate and groundwater in the Western Area were not considered to represent a risk to off-site receptors. Overall, the Tier 1 assessment of dissolved phase groundwater impacts did not identify contamination in the Western Area that warranted further assessment or management related to potential risks to on-site and off-site receptors from groundwater migration.

[3] **Bold** font indicates AECs within Stage 1 Area.

It was noted by ERM (2020b) that the following scenarios considered representative of potential risk were not further assessed in the HHERA, as further risk assessment was not considered to change the existing conclusions and management considerations:

- *Inhalation of dusts or potential asbestos fibres from soils containing asbestos during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.*
- *Potential acute hazards to future on-site intrusive maintenance workers or construction workers undertaking earthworks from the pooling of hazardous ground gases associated with LNAPL and impacted soil/ groundwater.*

ERM (2020b) reported that in accordance with SSD approval for the WARP, future on-site intrusive works and construction exposures should be managed via the REMP and its sub-plans, incorporating safety procedures for management of asbestos and ground gases during excavation.

The RSI (ERM, 2020a) identified the presence of methane in soil vapour and/or concentrations of TRH C6-C10 and TRH C10-16 in exceedance of the CCME (2008) hazard screening level (1,400 mg/kg and 5,200 mg/kg, respectively) in AEC-2, AEC-3, AEC-4, AEC-5, **AEC-9**, AEC-10 and AEC-11. ERM stated that management of ground gas generation during future intrusive works was warranted within these areas. Areas AEC-6, AEC-8, AEC-12, and **AEC-15** have identified isolated areas with LNAPL. While the soil data did not have levels of TRH C6-C10 and TRH C10-16 in exceedance of the CCME (2008) hazard screening level, these areas are still conservatively identified for management of intrusive works for ground gas concerns.

ERM (2020b) stated that with the exception of AEC-4, a 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 (NSW EPA, 2019) for potential ground gas related risks in indoor air spaces. Of the areas with ground gas measurement, only AEC-3 was identified with a risk categorisation high enough ("low risk") which, per the guidance, requires consideration of hazardous ground gases in future management and/or remediation decisions for the development of enclosed spaces. ERM concluded that for AEC-4, consideration of hazardous ground gases in future management and / or remediation decisions for the development of enclosed spaces is necessary.

ERM (2020b) reported that while on-site ecological receptors were considered to have limited value under the current and future land use, the RSI (ERM, 2020a) identified COPC concentrations in site soils exceeding Ecological Investigation Levels / Ecological Screening Levels (EILs/ESLs) that were indicative of the need for consideration within future site management, particularly for design and planning of landscape areas in AEC-1, AEC-2, AEC-3, AEC-4, AEC-8, **AEC-9** and AEC-10.

ERM (2020b) stated that the human health risk assessment was conducted following the ASC NEPM (NEPC 2013) to assess risks to potential future workers from direct soil contact exposure and vapour migration and to derive SSTLs.

The risk assessment concluded that potential risks to off-site adjacent receptors were unlikely. The summary of potential risks for on-site receptors is presented in **Table 8**.

Table 8 HHERA conclusions

Area	Soil - direct contact risk			Commercial – VI[4]	Asbestos	LNAPL[5]
	Commercial worker	Construction worker	IMW			
AEC-1	✓[6]	✓	✓	✓	×[7]	✓
AEC-2	✓	✓	✓	✓	✓	×
AEC-3	× carcinogenic PAHs	✓	✓	× benzene naphthalene TRH C6-C10 less BTEX TRH C8-12 (aliphatic)	×	×
AEC-4	× TRH C10-C34 carcinogenic PAHs	× hexavalent chromium	✓	× Benzene TRH C6-C10	×	×
AEC-5	✓	✓	✓	✓	✓	×
AEC-6	✓	✓	✓	✓	×	×
AEC-7[8]	✓	✓	✓	✓	✓	✓
AEC-8	✓	✓	✓	✓	✓	×
AEC-9	✓	✓	✓	× Naphthalene TRH C8-C12 (aliphatic and aromatic) TRH C10 – C16 (aromatic)	✓	×
AEC-10	✓	✓	✓	✓	✓	×
AEC-11	✓	✓	✓	✓	✓	×

4 Potential vapour intrusion risks assume the presence of future buildings.

5 Consideration of the management of LNAPL is warranted separately to potential health risks.

6 ✓Indicates potential risks are unlikely or within acceptable levels.

7 × Indicates a potential risk or need for remediation and / or management.

8 Dark grey Indicates AECs within Stage 1 Area.

Area	Soil - direct contact risk			Commercial – VI[4]	Asbestos	LNAPL[5]
	Commercial worker	Construction worker	IMW			
AEC-12	× TRH C6- C16 TRH C8- C12 Aromatic	✓	✓	× TRH C6-C12 (Aliphatic) TRH C8-C16 Aromatic TRH C6-C10 (unspecified) Benzene	✓	×
AEC-13	✓	✓	✓	✓	×	✓
AEC-14	✓	✓	✓	✓	✓	✓
AEC-15	✓	✓	✓	✓	×	×

4.4 ERM (2020c) – Quarter 4 (2019) groundwater monitoring event

ERM (2020c) stated that the Quarter 4 Groundwater Monitoring Event (Q4 2019 GME) represented the baseline understanding of groundwater conditions within the Western Area at the time of Stage 1 RAP preparation. The Q4 2019 GME made the following conclusions regarding groundwater conditions within the Western Area, which includes the Stage 1 Area:

- The direction of groundwater flow was consistent with previous GMEs and generally flows to the south east towards the Duck River.
- LNAPL observed within the monitoring well network was considered to be consistent in spatial extent with previous GMEs. LNAPL was identified at two locations (MW18/24, MW12/01) within the Western Area at a maximum thickness of 0.324 metre. ERM concluded that the occurrence of LNAPL within these wells was consistent with historical data and has been laterally delineated to on-site environments via monitoring of down gradient wells.
- Detected concentrations of dissolved phase COPC were below the adopted criteria, with the exception of groundwater collected from MW12/03 (AEC-3), in which the recreational water quality criteria for benzene and marine water criteria for ethylbenzene and naphthalene were exceeded.
- Stable to decreasing trends were reported for benzene and TRH C6-C9 in groundwater collected at all monitoring wells sampled across the Western Area.
- The nature and extent of LNAPL and dissolved phase hydrocarbon impacts were 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 linkages.
- Decreasing concentration trends of dissolved phase petroleum hydrocarbon COPC coupled with indicators that microbially mediated natural attenuation of petroleum hydrocarbons in groundwater may be occurring, via sulphate and ferric iron reduction.

- Concentrations of heavy metals exceeded adopted ecological screening criteria for copper, lead, mercury, nickel and zinc. ERM reported that the distribution of metals exceedances did not appear to be confined to a particular portion of the Western Area, and were considered likely to be related to regional background water quality associated with imported fill materials.

ERM stated that based on the current dataset for PFAS in groundwater within the Western Area, ecological exceedances for PFOS were consistent with the findings of previous sampling events and were not considered to change the existing findings of the CSM and mass flux assessment previously undertaken (ERM, 2018).

Historical reports - Overview

It is the auditor's opinion that the previous reports provided sufficient evidence that the primary historical use of fuel storage at the site resulted in contamination of soil and groundwater. The COPC identified for the characterisation of the site is consistent with the documented historical use.

The auditor noted that the investigations of the Western Area over the past 11 years comprised installation and sampling of 103 monitoring wells and excavation of 83 test pits. More than 580 soil samples have been collected and analysed providing a reliable level of information to characterise the area.

SAQP comments

The auditor acknowledged that the SAQP prepared by ERM in 2019 documented the data quality objectives (DQOs), the scope of work and the methodology for the RSI and broadly addressed the previous data gaps documented by AECOM in its TSI (AECOM, 2018) and Conceptual RAP (AECOM, 2019).

It is the auditor's opinion that the sampling plan was prepared based on a CSM that took into consideration all historical data. The RSI SAQP had been reviewed by the auditor, the outcome of which was presented in IAA02 issued on 4 July 2019.

RSI comments

The RSI was reviewed by the auditor, the results of which were documented in IAA03, issued in February 2020.

The auditor considered that the RSI presented appropriate DQIs to assess field procedures and analytical results. The DQIs demonstrated suitable accuracy and precision of the field and laboratory program used to assess the data gaps identified in the WARP.

The validation procedure adopted in the RSI for the evaluation of field and laboratory QA/QC data indicated that the reported analytical results were representative of the soil and groundwater conditions and the quality of the analytical data produced was acceptable as reliable for characterisation of the WARP area.

It is the auditor's opinion that the RSI carried out by ERM largely followed the endorsed SAQP and the relevant guidelines made or endorsed by EPA, providing sufficient information to portray the characterisation of the WARP and assist in the preparation of the HHERA and a Detailed RAP.

The auditor acknowledged that the distribution of the sampling used to characterise the extent of contamination within the WARP was sufficient to identify and characterise the extent of the AECs. However, as noted by the auditor in IAA04 issued on 5 May 2020, given the size of the Stage 1 area (seven hectares) and the number of soil sampling sites within Stage 1 Area, it would be prudent to include as part of the validation program, a series of sampling points in areas where data is scarce.

Q4 2019 GME comments

The Q4 2019 GME was reviewed by the auditor, the results of which were documented in IAA03, issued in February 2020.

The auditor considered that the Q4 2019 GME conducted by ERM was sufficient to characterise the quality of groundwater in the WARP. The collected data were used in the assessment of concentration trends and incorporated into the HHERA.

Overall, the auditor recognised that the data collected during the Q4 2019 GME was consistent with previous monitoring events, demonstrated that the risks of exposure to chemicals in groundwater are generally low and acceptable.

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 noted that the findings of the 2019 GME supported AECOM's position in its Conceptual RAP (AECOM, 2018) that active remediation of groundwater was not required to control or manage exposure to human health.

HHERA comments

The auditor notes that the review of the HHERA was documented in IAA03 issued in February 2020.

The auditor considered that the methodology and guidelines adopted by ERM in preparing the HHERA were appropriate and in accordance with the ASC NEPM.

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.

The auditor considered that ERM identified the relevant COPC 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 WARP based on the refined CSM and considered the current and proposed future land use scenarios - in relation to both on and off-site receptors.

It is the auditor's understanding that the residual LNAPL, as well as the dissolved phase plumes groundwater, do not pose an unacceptable human and ecological risk to the current and future on and off-site receptors. Exposure to these contaminant sources will be managed through a long-term site management plan (LTMP).

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.

Although asbestos (in the form of ACM) can pose a potential risk to IMW during the remedial activities, exposure can be managed by long management plans and in the interim via Viva Energy HSE protocols.

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.

Regarding potential risks within the Stage 1 Area, the auditor notes that the risk driver is vapour intrusion for future commercial works related with exceedances of naphthalene, TRH C8-C12 (aliphatic and aromatic), TRH C10 - C16 (aromatic) within AEC 9. Potential for asbestos occurrence was noted within AECs 13 and 15. LNAPL management will also be required for AEC 15. As noted by ERM in its HHERA, asbestos occurrence and LNAPL does not pose a potential risk to future commercial receptors and will be managed through either an LTMP or Viva Energy HSE protocols.

A copy of interim advice letters, as well as the responses where relevant, are presented in Appendix B of this SAR.

5. Nature and extent of impacts

The locations of soil, groundwater and soil vapour investigation locations within Stage 1 are shown in **Appendix A** (Figure 5 from ERM 2020d). Site plans showing the extent of soil and groundwater impacts exceeding relevant assessment criteria are provided in **Appendix A** (Figures 6A - soil, Figure 6B – Groundwater and Figure 6C - soil vapour from ERM 2020d).

5.1 Soil

5.1.1 Field observations

ERM (2020d) stated that the headspace screening using a calibrated PID recorded a maximum concentration of 1,141 ppm at TP19/47 at a depth of 1.2 m bgl. Similar PID results (>1000 ppm) were identified within black stained sandy fill material identified during remediation trials, conducted within the AEC-9 footprint. ERM described that this fill was identified to a maximum depth of approximately 1.5 mbgl around subsurface infrastructure and footings.

ERM reported that outside of the AEC-9 portion of the Stage 1 Area, LNAPL was observed within the soil profile at a depth of approximately 1 mbgl at TP18/09. Impacts were described as a free phase liquid collapsing the walls of the test pit. Soil samples were collected of this impacted material, which returned PID screening values of 99.1 ppm.

5.1.2 Analytical results

ERM (2020d) stated that COPC concentrations in soil samples collected within the Stage 1 Area were reported below the relevant remediation criteria (commercial worker - vapour intrusion SSTL), with the exception of the following soil samples:

- TP19/73 at 0.4 mbgl): Exceeded the relevant commercial worker for vapour intrusion SSTL for TRH C8-C10 aliphatic fractions.
- TP19/47 at 0.3 mbgl: Exceeded the relevant commercial worker for vapour intrusion SSTL for TRH C10-C12 aliphatic and aromatic fractions and TRH C12-C16 aromatic fractions.
- TP19/42 at 0.3 mbgl and TP19/47 at 0.4 mbgl - Exceeded NEPM TRH management limits for TRH C10-C16 fractions.

ERM (2020d) stated that while LNAPL was identified within the soil profile at TP18/09 at a depth of 1 mbgl, COPC concentrations were reported below adopted SSTLs which is consistent with highly weathered, non-volatile LNAPL within this localised portion of the Stage 1 Area.

5.2 Groundwater

ERM (2020d) described the following:

- LNAPL has been identified within groundwater during previous investigations within monitoring well MW12/16. LNAPL has been measured at a maximum thickness of 0.025 metre in this well during the Q2 2016 GME.
- Concentrations of TRH F1 were identified exceeding SSTLs groundwater collected in a single sampling event from MW12/16, undertaken in December 2012.

- Concentrations of benzene, ethylbenzene and xylenes have been reported exceeding adopted off-site recreational criteria in groundwater collected from monitoring wells MW12/16 and benzene in MW11/27 during groundwater sampling carried out during the last five years.
- Concentrations of naphthalene and 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.
- PFOS and TRH C10-C40 fractions were detected at concentrations exceeding the laboratory LOR in ASLP on soils but were less than the assessment criteria in groundwater.
- Down gradient delineation of the above COPC has been demonstrated through monitoring data to being below relevant groundwater criteria.

5.3 Soil vapour

ERM (2020d) stated that soil vapour results identified exceedances of the SSTLs for naphthalene within soil vapour monitoring well SV19/07, which was targeted to assess potential soil vapour concentrations associated with LNAPL in the vicinity of monitoring well MW12/16.

ERM stated that hazardous ground gas assessment was undertaken for methane and carbon dioxide in accordance with the Ground Gases Guidelines (NSW EPA, 2019). Based on soil vapour monitoring results, ERM concluded that these ground gases were categorised as having a very low safety risk. Thus, consideration of hazardous ground gases in future management and/or remediation decisions for the future construction of buildings with enclosed spaces was not warranted by ERM.

The RSI (ERM 2020a) identified the presence of methane in soil vapour and/or concentrations of TRH F1 and TRH F2 in exceedance of the CCME (2008) hazard screening level (1,400 mg/kg and 5,200 mg/kg, respectively) in AEC-9. Management of potential ground gas generation during future intrusive works is warranted within these areas.

The auditor recognises 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 1 Area. These aspects were sufficient to prepare the Stage 1 RAP.

However, as noted by the auditor in IAA04 issued on 5 May 2020, given the size of the Stage 1 area (seven hectares) and the number of sampling locations that have been used to characterise this area, it would be prudent to include as part of the validation program a series of sampling points in areas where there is a paucity of data.

6. Remedial options analysis

ERM (2020e) stated that the scope of works undertaken in the ROA included the following:

- Review of previous investigations/risk assessments undertaken within the site detailing site specific environmental conditions and the nature and extent of contamination within the WARP.
- Definition of remedial goals based on the CSM and LNAPL CSM presented in the RSI (ERM, 2020a) and SSTLs derived in the HHERA (ERM, 2020b).
- Calculation of the required remedial extent and volume of material for each AEC based the risks outlined in the HHERA (ERM, 2020b).
- An assessment of potential remedial options using the criteria of effectiveness, timeframes, health and safety, sustainability, cost and in consideration of NSW EPA regulatory guidance relating to remedial hierarchy.
- An assessment of the preferred remedial strategy for each AEC based upon information presented within the assessment of options.

6.1 Estimated remedial volumes requiring remediation and / or management

ERM (2020e) reported that to aid in the estimation of the volume of material requiring remediation and/or management, fill thicknesses from available borelogs and field density measurements of the encountered materials were utilised to estimate volume and mass of contaminated soil warranting remediation within the site. For Stage 1, the remedial design will entail excavation of contaminated soil in AEC-9 to a depth of approximately 1.5 metres. The total estimated excavation volume is approximately 4,000 m^3.

The table that summarises the assessment of relevant remedial technologies for COPC within each AEC is presented in **Appendix C** (Table 5.1 from ERM, 2020e).

6.2 Preferred remediation and site management approach

In relation to the contaminated soils in Stage 1, ERM (2020e) stated the remedial strategy was selected based on the following considerations:

- On-site treatment (biopiling) and the subsequent on-site reuse of soils was more sustainable approach than off-site disposal other technologies, such as thermal treatment. Additionally, on-site treatment meets the principles of waste minimisation and sustainable development. Following completion of biopiling, the material would either be re-used on-site or disposed off-site to a suitably licensed receiving facility.
- Identified contamination within the WARP does not pose a risk to off-site receptors, as outlined within the HHERA (ERM, 2020b).
- LNAPL in groundwater identified to be degrading, stable and not migrating off-site. Therefore, it was considered by ERM (2020e) suitable for management via Monitored Natural Attenuation (MNA).

Further discussion regarding the remedial trials is discussed within **Section 7** (AEVR) and **Section 12** (the Stage 1 RAP).

It is the auditor's opinion that the ROA was developed in a manner consistent with guidance provided in the CRC CARE (2018) *Guideline on Performing Remediation Options Assessments* taking into account 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.

7. Air emissions verification report – Stage 1

The AEVR provided an assessment of air emission control requirements for the Stage 1 remediation. This was a requirement of Conditions of Consent B15 and B16 of the SSD 9302 Development Consent issued by the DPIE on 7 May 2020.

The AEVR noted that with implementation of a staged remediation approach, it is intended that a separate AEVR (or multiple AEVRs) will be prepared to address future remediation stages.

The AEVR prepared by ERM included the following information:

- The AEVR process, with direct reference to the conditions consent. An evaluation of the presented information against the conditions consent is presented in **Section 15.**
- Description of the Stage 1 remediation, including remediation processes and final selected remediation approach. **Section 12** presents a detailed discussion regarding the Stage 1 Area remediation.
- Characterisation of potential air emissions, including VOCs, odour and principal toxic pollutants.
- Benchmarking of relevant emission controls including a detailed description of controls and management measures for each final remediation method and remediation activities. Further discussed in this section.
- Evaluation of consistency between the proposed Stage 1 remediation and the air quality studies prepared for the EIS and Response to Submissions (RtS) for the WARP. Further discussed in this section.
- Conclusions regarding the necessary emissions controls for the Stage 1 remedial works.

7.1 Remediation trials

ERM (2020f) completed a series of remediation trials between October 2019 and January 2020. The remediation trials included the following:

- Four separate 100 m^3 soil stockpiles (SP1 to SP4) were prepared with material excavated from the eastern portion of AEC-9. ERM stated that this material was selected as it was the most contaminated material within AEC-9 and was suitable for the evaluation of the ability of biopiling to break down hydrocarbon contamination.
- Ex-situ biopiling: treatment of two stockpiles of excavated soil, at volume of 100 per stockpile. Nitrogen fertiliser was added into one stockpile.
- Ex-situ land farming: treatment of five stockpiles of excavated soil, at volume of 100 m^3 per stockpile (three stockpiles) and volume of 10 m^3 per stockpile (two stockpiles). These stockpiles were selected to add nitrogen fertiliser or nitrogen fertiliser/mulch.

Air monitoring was undertaken during excavation and turning of soils during land farming. Details about the air monitoring is further presented in **Section 7.2**.

7.1.1 Remediation trial results

ERM (2020d) reported the following findings from the remediation trials:

- A reduction of TRH F1 concentrations to less than SSTLs following soil handling, homogenisation and stockpiling activities. The SSTLs (ERM, 2020b) are presented in **Appendix C** (Table 3.2 from ERM, 2020d).
- Volatile TRH fractions (C6-C16) demonstrated decreasing trends throughout the eight week trial, as shown in **Figure 1** below.
- Heavier TRH fraction concentrations were variable following an initial decrease. With additional silica gel clean-up TRH analysis, decreasing trends of heavier chain hydrocarbon concentrations were measured in the final four weeks of the remediation trial period.
- Indigenous populations of hydrocarbon utilising bacteria were present in site soils.
- No distinct differences in hydrocarbon degradation rates were identified between stockpiles with nutrient or organic amendment over the eight week period of the trial.
- Reductions of heavier TRH fractions, increased bacterial populations and an increase in ratio of polar biodegradation metabolites over the course of the trail suggest that the process of biodegradation was occurring.
- Excavated soil from AEC-9 could be treated to be less than the unrestricted on-site reuse criteria (i.e. ASC NEPM management limits for TRH).

Figure 1 (Figure 4.4. from ERM, 2020f) graphs the rate of C6-C10 TRH fraction reduction throughout the course of the remediation trial.

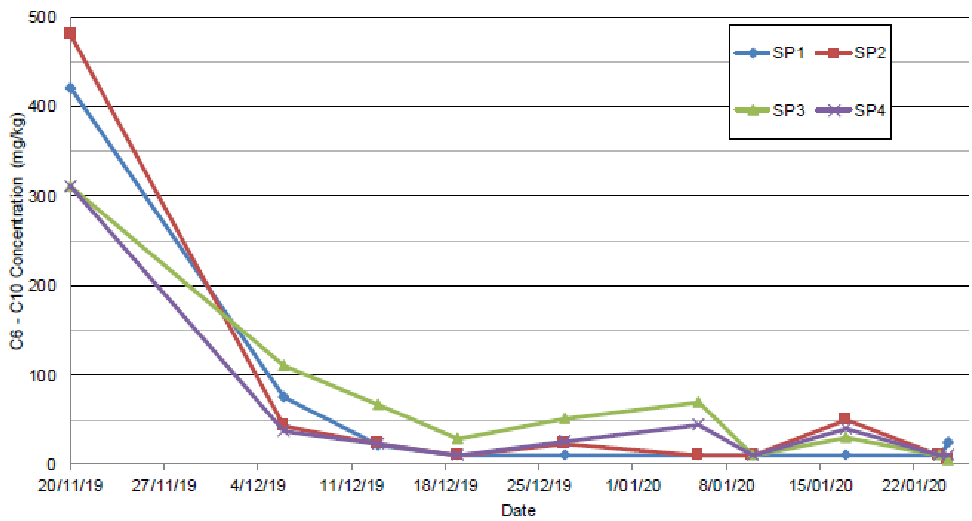


Figure 1 C6-C10 TRH concentrations measured during biopiling remediation trials over time (AEC-9 material)

7.2 Remediation trial ambient air quality monitoring

ERM (2020f) reported that Viva Energy commissioned monitoring of VOCs in ambient air during excavation and biopiling of material from AEC-9 as part of the remediation trials. These data were considered by ERM the most relevant in defining potential air emissions from Stage 1 due to the following:

- *The monitoring was conducted during handling and treatment of material from within AEC 9.*
- *The monitoring was conducted during excavation, stockpiling and biopiling activities that are consistent with the type and scale of processes and methods proposed as part of the Stage 1 remediation.*
- *Samples were collected in evacuated canisters and analysed using the US EPA TO-15 methodology, with analysis for a broad range of petroleum hydrocarbons. These included those identified in soil, groundwater, and soil vapour as well as those considered in the AQIA and the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (the Approved Methods), EPA (2017).*
- *Real time monitoring was also undertaken using Photo-Ionisation Detectors (PIDs), to provide an understanding of temporal variations during the monitoring period.*

7.2.1 Ambient air quality monitoring results

ERM (2020f) reported that the ambient monitoring of excavation activities was conducted over a three hour period during the excavation of AEC-9 on the 7 November 2019. During this period, approximately 600 m^3 of material was excavated from the east of AEC-9 and stockpiled to the west of the excavation area.

Ambient monitoring was carried out at five locations (AS_00A, AS_01A, AS_02S, AS_03A and AS_04A) including an upwind sample (AS_00A) to provide information on potential interference from upwind sources. Four downwind samples were collected (AS_01A - AS_04A) which were located at increasing distances from the excavation activities. **Figure 2** (Figure 4.5 from ERM, 2020f) shows these monitoring locations relative to the excavation area.

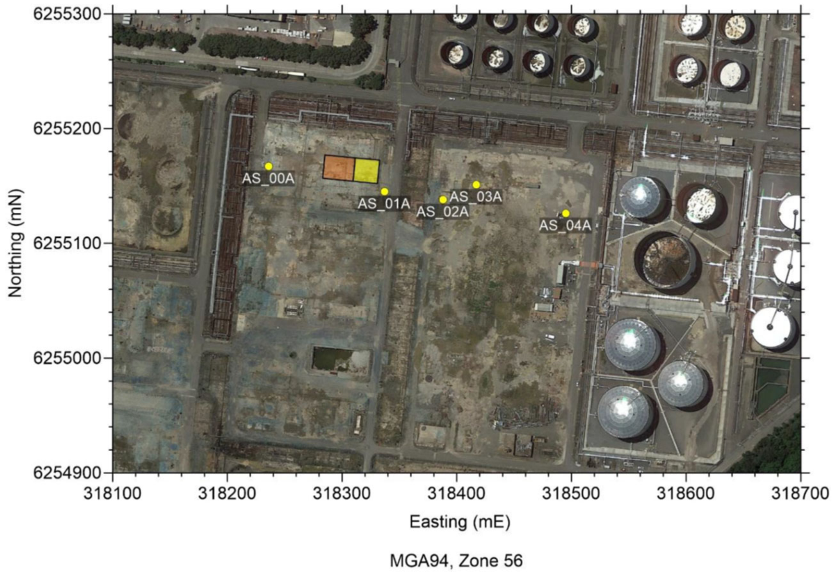


Figure 2 Remediation trial excavation area showing air quality sampling locations, excavation and stockpiling areas

ERM (2020f) reported that ambient VOC concentrations were observed to decrease significantly with distance from the remediation trial excavation area, with all compounds below the LOR at a distance of 165 metres from the excavation area.

Hydrocarbon odours similar in nature to diesel oil were observed during the excavation process. However, no odours were observed beyond 165 metres from the excavation. **Table 9** (Table 4.3 from ERM, 2020f) provides a summary of monitoring results for both evacuated canister and PID measurement methods.

Table 9 Summary of initial BTEXN and TRH fraction concentrations (air)

Compounds	Monitoring location				
	AS_00A (Upwind)	AS_01A (excavation)	AS_02A (60 m downwind)	AS_03A (85 m downwind)	AS_04A (165 m downwind)
Evacuated Canister (TO-15) (µg/m³)					
Benzene	<1	<1	<1	<1	<1
Toluene	<2	4	2	3	<2
Ethylbenzene	<2	11	3	3	<2
Xylenes	<5	34	7	6	<5
1,2,4-Trimethylbenzene	<2	108	26	16	<2
1,3,5-Trimethylbenzene	<2	29	7	<2	<2
n-Hexane	<1	8	6	<1	<1
Naphthalene	<4[9]	2,096	335	110	18
PID (ppm isobutylene equivalent)					
TVOC	NA	3.1	0.11	0.06	NA

7.2.2 Turning of biopiles ambient air results

ERM (2020f) reported that ambient monitoring of biopile turning was conducted over a one hour period on the 19 December 2019. During this period, westerly winds were observed, and both biopiles SP3 and SP4 were turned using an excavator. **Figure 3** shows the location of the biopiles and turning event air sampling locations.

Ambient monitoring was undertaken at three locations including an upwind sample (AS_00C) to provide information on potential interference from upwind sources. Two downwind samples were collected (AS_01C, AS_02C) which were located at increasing distances from the excavation activities.

ERM (2020f) reported that only xylenes and trimethylbenzenes were recorded in the air quality samples, with no detection of benzene, toluene, ethylbenzene, hexane or naphthalene.

ERM (2020f) concluded that the results were consistent with soil monitoring data, which did not record the presence of BTEXN above LOR after commissioning of the biopiles, and also noted a significant decrease in C6-C10 concentrations after commissioning. **Table 10** shows the summary of ambient monitoring results during biopile turning.

[9] Naphthalene samples should be treated qualitatively. Due to the high molecular weight, laboratory noted significant difficulty with retention of naphthalene in the sample train. Reported results represent the highest values observed across three analytical runs. TVOC – Total Volatile Organic Compounds

Table 10 Summary of ambient monitoring results during biopile turning

Compounds	Monitoring location		
	AS_00C (Upwind)	AS_01C (7 m from SP4)	AS_02A (15 m from SP4)
Benzene	< 4	< 5	< 5
Toluene	< 7.5	< 7.5	< 7.5
Ethylbenzene	< 6	< 7	< 6
Xylenes	< 18	29	< 19
1,2,4-Trimethylbenzene	< 7	64	< 7
1,3,5-Trimethylbenzene	< 7	33	< 7
n-Hexane	< 5	< 5	< 5
Naphthalene	< 29	< 33	< 31

Figure 3 Location of biopiles (SP1 to SP4) and air sampling locations

7.2.3 Toxic pollutants assessment

ERM (2020f) stated that the field data collected within the remediation trial demonstrated that the key VOCs for the Stage 1 Area comprised the following:

- Ethylbenzene
- Xylenes
- Trimethylbenzenes
- Naphthalene

ERM (2020f) concluded that whilst benzene and toluene were detected in groundwater and soil vapour, they were only detected in trace quantities (close to the LOR). These chemicals were not detected in excavated soil, or in ambient air in the immediate vicinity of the excavation of and surrounding soil, or during turning of the biopiles.

ERM noted that despite the dry conditions during the trial, the shallow depth to groundwater and the moist nature of soils both within the excavation and biopiling operations led to no observable generation of dust. Nonetheless, dust management should be incorporated into the control of air emissions.

Hydrocarbon odours similar in nature to diesel oil were noted during the excavation process, however, these odours were not observed beyond 165 metres from the excavation.

7.3 Qualitative risk ranking of Stage 1 remediation activities

ERM (2020f) reported that a risk ranking was undertaken to evaluate the factors that could influence potential air quality impacts and qualitatively rationalise air quality risks for the proposed Stage 1 activities. **Table 11** (Table 5.1 from ERM, 2020f) provides details of these factors, as outlined for each activity.

Table 11 Summary of operational activities

Parameter	Excavation	Biopiling	Surplus material storage
Proximity (industrial receptors)	~ 100 m (north)	~ 150 m (north)	~ 50 m (north)
Proximity (residential receptors)	~ 750 m (south)	~ 800 m (south - east)	~ 700 m (south)
Duration of Operations	Intermittent operations over within 2 - 3 weeks (completion of approximately five 20 x 20m excavations) within a 2 – 3 week period.	Ongoing throughout Project	Ongoing throughout Project
Scale	Small (Operations within a ~20 x 30m area)	Small (Operations within a ~20 x 10m area)	Small (Operations within a ~20 x 10m area)
Contamination of Handled Materials	Low – Moderate[10]	Clean to Moderate	N/A
Emission Intensity (Unmitigated)	Moderate - High	Moderate (intermittent active operations) – biopile construction and turning (as required)	Low (used intermittently) with small scale loading operations. Emissions limited to dust.
Effectiveness of Mitigation	High	High	High

The following aspects were noted by ERM (2020f) based on the qualitative risk assessment presented in **Table 11.**

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

- Significant buffer distances exist between all areas and adjacent non-industrial receptors.
- The lowest unmitigated emission potential exists for the surplus material storage area, due to the small intermittent scale of operations, and handling of validated/clean material.
- The highest unmitigated emission potential exists for the excavation area, however the duration and scale of these operations is low, and the effectiveness of mitigation is high, which is considered indicative of a minimal risk of adverse air quality impacts with appropriate emissions management.
- Management measures include those which are practical both to the management of emissions and progression of works and take into account the air quality concentrations measured during the remedial trial.

7.4 Review of requirement for emission control enclosures

ERM (2020f) reported that as noted in Condition B15 (i) of the conditions of consent, the AEVR should *"Include robust justification for the handling, processing, treating or storing of contaminated material proposed to be conducted outside of an emission control enclosure (ECE), that considers but is not limited to technical, logistical, financial and health and safety considerations."*

ERM (2020f) stated that the requirements for emission enclosures are driven by the significance of ambient air quality risks, the nature of the contamination, anticipated magnitude and extent of emissions, duration of activities, and proximity to receptors. In assessing the conditions that may be warranted to establish an ECE, Viva Energy commissioned a review of enclosures, as detailed in *Best Practice Remediation - Environmental Control Enclosures* (Ventia, 2019).

ERM demonstrated that the activities that are planned for the Stage 1 remedial works were not consistent with examples for which excavation is undertaken in an enclosure, as the majority of these projects:

- Include high profile contaminants such as those listed as either principal toxic air pollutants in NSW EPA Approved Methods, or are persistent organic pollutants under the Stockholm Convention (e.g. hexachlorobenzene, benzene etc.).
- Feature a close proximity to sensitive receptors (often in the vicinity of 10 to 20 metres to residential receptors).
- Feature long excavation durations on the scale of year/s, with high volumes excavated over small footprints.

Additionally, given the short duration, shallow nature of the excavation (target depth of 1.5 mbgl), absence of air emissions associated with Stage 1 Area and the distance between Stage 1 Area and receptors (presented in **Table 11**), it was concluded that an emission control enclosure was not considered a necessary measure for Stage 1. Rather, it was recommended that emission controls be implemented. These controls are to be supplemented by boundary VOC and odour monitoring as well as monitoring of the operational activities.

Nominated performance indicators associated with boundary monitoring:

- Boundary VOC concentrations are to be less than adopted screening criteria.
- No offensive odours should be detected at the boundary.
- No odour complaints from off-site receptors related to the Stage 1 remediation works.

The auditor noted that Stage 1 Area covers an area of approximately seven hectares situated within the former Process West Area. Based on the HHERA (ERM, 2020b) only the northern portion of the Stage 1 Area requires remediation (AEC 9). A figure of the Stage 1 area is presented in **Appendix A**.

It is the auditor's opinion that the AEVR prepared by ERM (ERM, 2020f) provided an assessment of the releases of volatile chemicals measured during the biopiling trials conducted in the Stage 1 Area and what factors need to be considered in relation to air emission management during full scale remediation.

Based on ambient air monitoring conducted during remediation trial excavations, Volatile Organic Compounds (include BTEX and TRH compounds) concentrations were observed to decrease significantly with distance from the excavation area, with all VOCs below the limit of reporting (LOR) at a distance of 165 metres from the excavation area. Hydrocarbon odours similar in nature to diesel oil were noted during the excavation process, however, these odours were not observed beyond 165 metres from the excavation.

Although benzene was identified in excavation water samples collected from the trial pit, neither benzene nor any other principal toxic air pollutants were detected in ambient air measurements in the immediate vicinity of either excavation, stockpiling or biopiling operations.

A range of emission controls were considered 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 the practicality with which contingency measures can be implemented. On the basis of the air quality monitoring conducted during the treatment trial and the size and nature of the works that will be required to excavate the contaminated soil and form and operate biopiles, ERM did not identify the need to establish an emissions control enclosure.

The auditor stated in IAA09, that the AEVR (ERM, 2020f) provided sufficient lines of evidence to support that an emissions control enclosure within Stage 1 Area is not required, as measured ambient VOCs or any other principal toxic air pollutants were below LOR or not considered to pose an unacceptable risk to site workers and/or neighbouring receptors.

8. Contaminants of potential concern

ERM (2020d) stated that the primary sources of soil and groundwater impacts formerly included the refinery processing infrastructure which has been decommissioned/removed from the Stage 1 Area.

The mechanism of release from these former primary sources was at the ground surface due to storage and transfer of petroleum manufacturing product within aboveground infrastructure.

The careful consideration of data generated during previous assessments resulted in the selection of the following COPC requiring remediation in Stage 1:

- Total recoverable hydrocarbons (TRH) C8-C12 Aliphatic Fractions.
- TRH C8-C12 Aromatic Fractions.
- TRH C10-C16 Aromatic Fractions.
- BTEXN and TRH C16-C40 (these chemicals have been selected as a precaution as their presence at levels greater than nominated screening levels has not been detected in Stage 1 soils).

Based on the long term use of the Stage 1 Area and considering previous monitoring results, it is the auditor's opinion that the suite of analytes to be remediated is appropriate.

A summary of previous works and principal findings is discussed in **Section 4** this SAR.

9. Validation criteria

ERM (2020d) stated that SSTLs developed for soil, groundwater and soil vapour were appropriate for consideration as remediation assessment criteria.

The HHERA (ERM, 2020b) discussed in **Section 4** of this SAR, 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:

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

ERM (2020d) reported that the SSTLs were developed for target COPC which exceeded relevant Tier 1 assessment criteria for remediation and, management considerations along with the ASC NEPM HSL for asbestos management and management limits for LNAPL. The TRH SSTLs were derived for specific aliphatic and aromatic hydrocarbons fractions.

ERM (2020d) stated that as certain remediation methods result in the breakdown of petroleum hydrocarbons that alters the fraction specific make-up (e.g. natural attenuation, bio-piling) the fraction specific SSTLs may be used in post-remediation validation. The risk assessment conclusions for remaining potential risks that warrant consideration for remediation or management are summarised in this section.

Appendix C presents a table summarising the SSTLs for Stage 1 Area.

9.1 Remediation criteria – excavations and reuse

Applicable risk-based remediation criteria for excavation bases and walls derived by ERM (2020b) were as follows. ERM also adopted the same criteria for assessing reuse of bioremediated soils.

- 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 should be used to assess the potential presence of LNAPL or residual TRH concentrations requiring future management under a 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.

The following is noted by ERM (2020d) in relation to end-use of excavated soils within other areas of the Remediation Project:

- *"If soil SSTLs are exceeded, soils are unsuitable for re-use and will require further treatment or offsite disposal*

- *If concentrations are <SSTLs, the presence of LNAPL or exceedance of TRH management limits for COPC does not indicate that soils are unsuitable for on-site re-use but that future management in areas where this soil is placed may be required; and*
- *On the basis of the restricted use, it is preferable that soils are treated to below NEPM TRH management limits to reduce long term management requirements".*

9.2 Waste disposal criteria

The Stage 1 RAP stated that off-site disposal of excavated materials is required. This will be undertaken in accordance with the Waste Guidelines (NSW EPA, 2014).

The screening levels proposed by ERM (2020d) in the Stage 1 RAP were based in Schedule B1 and B7 of the ASC NEPM and took into account the future land use scenarios during and after remediation.

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

10. Conceptual site model

A summary of the CSM relevant to the Stage 1 Area remedial works as presented in **Table 8** of the Stage 1 RAP is discussed as follows.

10.1 Potential sources and COPC

The key identified source area within Stage 1 that requires active remediation was AEC-9. Other areas will be managed with the LTEMP. COPC are as listed in **Section 8**.

10.2 Mitigation pathways

ERM (2020d) reported that the identified potential migration pathways for COPC in soil, groundwater and soil vapour were as follows:

- Leaching of soil impact or historical surface spills on hard standing to shallow groundwater or via runoff to the surface water drainage network.
- Lateral migration of contaminants in groundwater.
- Off-site groundwater migration.
- Vapour intrusion of petroleum hydrocarbon contaminated groundwater or LNAPL to indoor or outdoor environments.

10.3 Exposure pathways

The following exposure pathways for on-site receptors were presented in the Stage 1 RAP:

- 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.

10.4 Receptors

The human receptors that may be impacted by the identified COPC in soil and groundwater included the following:

- Current and future on-site commercial workers in both indoor and outdoor settings.

The following notes were presented in the CSM section of the Stage 1 RAP (ERM 2020d):

- Beneficial groundwater users (potable or non-potable) were not considered a potential receptor given the absence of registered extraction bores down gradient of the Stage 1 Area, poor natural background quality of groundwater and likely low yields.
- 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. ERM concluded that potentially complete pathways are therefore considered managed. Future land users would not be subject to the same controls. Therefore, remediation / management of any potentially complete exposure pathways would be required.

- Given the extensive coverage of the Western Area in concrete hardstand and limited available on-site habitat, there are no on-site ecological receptors.
- Given the proposed slab on grade commercial / industrial future land use, this assessment will also apply under future development scenarios. Management of the design of future landscaped areas may be required.

10.5 SPR linkages

The Stage 1 RAP identified the following SPR linkages relevant to the Stage 1 Area that may constitute a risk to future receptors:

- Indoor inhalation of vapours by future on site commercial workers from hydrocarbon impacted soil and LNAPL.
- Potential acute hazards from the pooling of hazardous ground gases from LNAPL and impacted soil/ groundwater during future excavation activities.

ERM (2020d) noted that isolated asbestos impacts requiring remediation and/or management within AEC-13 (Former transformer and substation areas) and AEC-15 (Other Areas) are situated outside the extent of the Stage 1 Area, and as such have been excluded.

The auditor noted that the CSM developed by ERM for the Stage 1 Area provided the framework for identifying the potential sources of contamination and how potential future receptors may be exposed, either during remedial works, or the future. ERM's CSM was prepared in accordance with ASC NEPM methodology.

The Stage 1 RAP identified the relevant COPC for the Stage 1 Area, assigned appropriate screening levels, and reviewed and evaluated the available data. In the auditor's opinion, this screening and subsequent focus on identified COPC was generally appropriate and in accordance with the guidance referenced above.

The auditor considered that the approach to exposure assessment via the vapour inhalation pathways adopted in the Stage 1 RAP was appropriate. Therefore, the potential risks posed by identified contamination to on-site and off-site users are likely to be low and acceptable following completion of remedial works and site validation sampling.

11. Stage 1 RAP

11.1 Remediation objectives

ERM (2020d) reported that the remedial objectives for the project, as defined within the Conceptual RAP (AECOM, 2019) are as follows:

- *"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*
- *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 1 Area is consistent with the Conceptual RAP (AECOM, 2019) which states:

Where remediation is required, the focus of the works would be on:

- *"Addressing petroleum hydrocarbon impacts on shallow soil horizons*
- *Addressing soil/sludge impacts in the drainage network and surrounds*
- *Removing shallow LNAPL to the extent practicable*
- *Ensuring short or long-term contamination risks to the environment are removed or mitigated".*

11.2 Requirements of remediation

ERM (2020d) stated that the driver for remediation within the Stage 1 Area is the potential for indoor inhalation of vapours by future on-site commercial workers from hydrocarbon impacted soil and LNAPL within the northern portion of the former Process West plant area (AEC-9). These exceedances are shown in **Appendix A** (Figures 6A, 6B and 6C from ERM 2020d).

Contaminants requiring remediation and validation within the Stage 1 Remediation area are summarised in **Table 12**.

Table 12 Requirements of remediation

Matrix	COPC requiring remediation	Comments
Soil	Volatile Petroleum Hydrocarbons including: • TRH C8-C12 Aliphatic Fractions • TRH C8-C12 Aromatic Fractions TRH C10-C16 Aromatic Fractions	Not applicable

Matrix	COPC requiring remediation	Comments
Groundwater (LNAPL)	Volatile Petroleum hydrocarbons including: • TRH C6-C10 (Less BTEX)	Single exceedance during groundwater sampling of MW12/16 in December 2012. Sample collected is representative of LNAPL, based on the noted presence during sampling.
Soil Vapour	Volatile Petroleum hydrocarbons including: • Naphthalene	Naphthalene concentrations considered to be associated with residual LNAPL at the level of groundwater, rather than overlying soils based on soil data.

11.3 Remediation extent

The estimated extent of contaminated soil requiring remediation is depicted in Figure 7 from the Stage 1 RAP as shown in **Appendix A**. Details of the vertical and lateral extent of remediation required are provided in **Table 13**.

Table 13 Extention of remediation – Stage 1 Area

AEC	Estimated area (m^2)	Estimated remediation depth (mbgl)	Estimated in-situ soil remediation volume (m^3)
AEC-9 (Process West)	2,781	1.5	4,172
Remediation Trials Excavation	840	1.5	1,260
Total Remaining	1,941	1.5	2,911.5

ERM (2020d) reported that the estimated vertical extent of remediation has been based on the following lines of evidence:

- Depth of soil samples exceeding SSTLs and depth of underlying soil samples below SSTLs.
- Depth of fill material.
- Average depth to groundwater (and associated overlying LNAPL smear zone).

ERM reported that the estimated vertical extent of remediation is proposed to remove contaminated fill material overlying natural clay material and remove residual LNAPL at or above the level of groundwater which is driving SSTL exceedances in groundwater and soil vapour.

11.4 Drainage structure

ERM (2020d) stated that following should be considered regarding the drainage network for as follows:

- Is not considered an ongoing primary source of soil and groundwater impact or a preferential pathway for migration of contaminants.
- Does not present an unacceptable future safety risk via accumulation of gases in sub grade void space.
- Is isolated from the wider Clyde network, such that future site operations will not contribute discharge to the site's WWTP.
- Cannot be recommissioned for use in future.

ERM (2020d) developed an approach to decommissioning and validation of the drainage structure via the following process:

- Preparation of a drainage decontamination summary report which documents the scope of drainage decontamination works completed to date, and any gaps to be addressed via a future decommissioning scope (to be prepared by ERM).
- Preparation of a scope of works to address identified items within the drainage decontamination summary report (to be prepared by Ventia).
- Development of a lines of evidence validation and verification methodology based on the proposed contractor scope to validate that the decommissioning objectives have been met (to be prepared by ERM).

11.5 Nominated remediation strategy – Stage 1 Area

Based on the screening prepared by ERM (**Appendix C** – Table 8.2 from ERM 2020d), the following remedial methods have been selected (in order of preference) by ERM for use in Stage 1 Area.

1. Excavation and on-site bioremediation (bio piling).
2. Excavation and off-site disposal of soils (as a contingency measure).

ERM noted that the above remediation methodologies are consistent with the shortlisted remediation methodologies outlined within the EIS (AECOM, 2018) and Conceptual RAP (AECOM, 2019). The Stage 1 RAP reported that this approach involves the selective excavation of hydrocarbon impacted soil and placement within managed biopiles.

ERM (2020d) stated that given the current assessment that hydrocarbon concentrations in groundwater are stable to decreasing, it is expected that the remediation works proposed will enhance the current natural attenuation processes to reduce residual groundwater impacts over time.

11.6 Remedial works

ERM (2020d) reported that the Stage 1 remedial of works will include performance of the following tasks:

- Task 1 – Preparation works.
- Task 2 – Removal of redundant infrastructure and waste.

- Task 3 – Remediation.
- Task 4 – Land forming.
- Task 5 – Completion of works and demobilisation.

Decommissioning of the subsurface drainage network will be completed separately to the scope of remediation works under existing SSD (5147) for the Clyde Terminal Conversion Project.

The proposed site layout for implementation of remediation works is provided in **Appendix A** (Figure 8 from ERM 2020d).

11.7 Stage 1 remediation processes

11.7.1 Excavation and screening

ERM reported that excavation will take place to a depth of approximately 1.5 metres. Excavated material will be stockpiled in small piles adjacent to the excavation, prior to screening and loading into trucks, at which point the material will be transported to the biopile treatment area for classification and treatment (as required). Oversize material will be crushed and mixed with validated soils for re-use on the project as backfill.

Upon validation, excavations will be progressively backfilled with Virgin Excavated Natural Material (VENM) or other suitable material, with restoration of the surface to the local grade.

11.7.2 Biopile construction

Biopiling is to take place in a designated biopile treatment area, formerly known as Tank Farm A2, as shown in **Appendix A** (Figure 8 from ERM 2020d).

The decommissioned tank farm covers an area of approximately 180 metres x 70 metres. Whilst internal tank infrastructure and pipework has been removed, the perimeter bunding has been retained, with the exception of a small segment on the southern side that has been removed to allow vehicular access. **Figure 4** (ERM 2020a) illustrates the proposed biopiling construction. The design of the bio piling is presented in **Appendix A** (Figure 9 from ERM, 2020d).

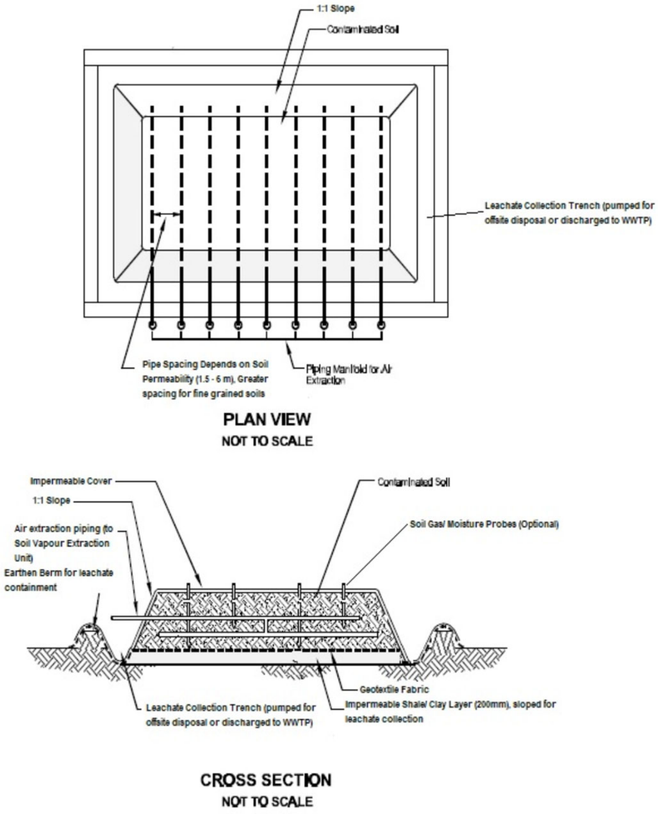


Figure 4 Biopile Construction Schematic – Adapted from USEPA (2017)

11.7.3 Biopile operation and monitoring

ERM (2020d) stated that monitoring of contaminant concentrations in soils will be performed on a fortnightly basis within the first four weeks to assess the progress of biological treatment. Subsequent progress monitoring will be undertaken on a monthly basis (as required) until remediation criteria are met. Progress monitoring will assess TRH C6-C40 and BTEXN concentrations and, if necessary, nutrient ratios, bacterial populations, pH and moisture content.

Continuous operation of the aeration system would be maintained to promote biological degradation of hydrocarbon contamination. The aeration system would be fitted with a granular activated carbon (GAC) based exhaust emission control system to minimise the release of VOCs to atmosphere.

Weekly PID monitoring of inlet, outlet, lead and lag vessels for VOC concentrations will be required to be undertaken by the Remediation Contractor within the first three months of each new biopile operation and a minimum of once per month thereafter. The upper limit of total VOC emissions at the outlet has been established as 10 ppm as per the Conceptual RAP (AECOM, 2019). Exceedance of this threshold indicates breakthrough out the carbon filter media is occurring and requires replacement.

Once treatment is complete and the material validated, the biopile would either remain in the biopile treatment area, or alternatively be moved to the surplus material storage area, prior to The surplus material stockpile area is situated within the former Tank Farm A1 as shown in **Appendix A** (Figure 8 from ERM 2020d). This decommissioned tank farm covers an area of approximately 150 metres x 75 metres.

ERM reported that this area would be used to store treated and validated soils that have been characterised as suitable for reuse on-site. The area may also store uncontaminated surplus materials such as VENM, as well as supplementary uncontaminated materials (e.g. sand, gravel, organic matter) that may be used in remediation and/or biopiling processes.

To minimise potential erosion impacts, soil stockpiles are to be covered and silt fences will be installed around stockpile areas. Erosion and sediment control requirements (developed in accordance with Managing Urban Stormwater: Soils and Construction (Landcom, 2004)) will be outlined in full within the Soil and Water Management Plan. reuse within the Stage 1 Area or during later stages of the Remediation Project.

11.7.4 Stockpiling of surplus materials

The surplus material stockpile area is situated within the former Tank Farm A1 as shown in **Appendix A** (Figure 8 from ERM 2020d). This decommissioned tank farm covers an area of approximately 150 metres x 75 metres.

ERM reported that this area would be used to store treated and validated soils that have been characterised as suitable for reuse on-site. The area may also store uncontaminated surplus materials such as VENM, as well as supplementary uncontaminated materials (e.g. sand, gravel, organic matter) that may be used in remediation and/or biopiling processes.

To minimise potential erosion impacts, soil stockpiles are to be covered and silt fences will be installed around stockpile areas. Erosion and sediment control requirements (developed in accordance with Managing Urban Stormwater: Soils and Construction (Landcom, 2004)) will be outlined in full within the Soil and Water Management Plan (SWMP).

11.8 Contingency Plan

11.8.1 Remediation contingency

ERM (2020d) reported 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 need to be reassessed using the latest information on the site and remedial contingencies developed and implemented in consultation with the auditor.

The remedial contingencies may include an action 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.

11.8.2 Soil treatment contingencies

ERM (2020d) stated that the following presents contingency measures to be taken in the event that the unforeseen conditions are encountered during soil treatment works.

Extended treatment duration**:** Although a 10 week timeframe is anticipated for the project, 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 more accurately assess the speciation (and therefore exposure potential) of elevated PID readings or odours.

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.

11.9 Monitored natural attenuation (under LTEMP)

ERM (2020d) reported that previous groundwater monitoring has indicated stable to decreasing concentrations of TRH and BTEX within groundwater collected in the vicinity of AEC-9 and the broader WARP as discussed in Section **4**.

ERM reported that following source removal (residual LNAPL in shallow soils and residual soil contamination), dissolved phase TRH concentrations are expected to show a continual reduction. Additionally, given no potential risks to human health and ecological receptors have been identified based on groundwater data, the potential for active remedial approaches for groundwater was not considered warranted.

A program of groundwater monitoring will be undertaken both during remediation (as detailed within the Groundwater Monitoring and Management Plan (GMP)) and post remediation (as specified within the LTEMP). Both groundwater management plans were prepared to meet the requirements of Conditions Consent issued by the DPIE on 7 May 2020.

ERM (2020d) stated that the assessment of groundwater conditions would involve a risk-based evaluation, including 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 do not present a risk to the ecological values of the Duck River.

Contingency actions that would be considered if areas of residual LNAPL (post-remediation) pose an unacceptable risk to the environment.

11.10 Groundwater monitoring

11.10.1 Monitoring well placement

ERM (2020d) stated that monitoring wells will be lost during the soil remediation. As the hydrogeological and contaminant characterisation data from these wells has been incorporated into the CSM and are well understood, replacement of all monitoring wells following completion of excavation and development works will not be considered necessary.

ERM reported that the focus for post-remediation monitoring will be the monitoring of groundwater quality in down gradient areas to assess groundwater flux and boundary conditions. The existing boundary monitoring well network is expected to be unaffected by earthworks undertaken throughout the Remediation Project.

11.10.2 Post remediation groundwater monitoring

ERM (2020d) reported that previous groundwater monitoring indicated stable to decreasing concentrations of TRH and BTEX has occurred within groundwater over time within monitoring wells in the Western Area. No risks to human health and ecological receptors from dissolved phase groundwater concentrations have been identified in the Stage 1 Area.

ERM stated that the assessment of groundwater conditions post-remediation would involve a risk-based evaluation, including fate and transport considerations and groundwater flux (as required). This approach would be aimed at demonstration of stable groundwater conditions post remediation and that residual groundwater impacts do not present a risk to the ecological values of the Duck River.

Ongoing monitoring will be the responsibility of Viva Energy, with specific details provided within the GMP and associated groundwater monitoring program. The requirement to provide access for ongoing monitoring following completion of remediation would be outlined within the LTEMP.

It is the auditor's opinion that the Stage 1 RAP includes the key elements for a RAP as stipulated in the Consultant Guidelines. Following remedial and validation activities discussed in the Stage 1 RAP, Stage 1 will be suitable for the proposed future use (commercial and/or industrial) in accordance with the permissible land use IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011.

12. Data quality objectives

ERM (2020d) reported that the Data Quality Objectives (DQOs) 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 Stage 1 RAP is presented in **Table 14**.

Table 14 Data quality objectives

Step	Description	Outcomes
1	State the problem	ERM (2020d) stated that the remediation objectives for the Stage 1 Area are: • *"Remediate the soil and manage groundwater within Stage 1 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."* ERM stated that the following will require validation to demonstrate the successful implementation of remediation works: • *"Soils from the walls and floors of excavation areas stockpiled soil materials originating from remediation excavations to confirm suitability for on-site re-use (before or following bio-remediation);* • *The footprint of temporary stockpiles, where applicable based on the validation strategy;* • *Imported fill materials (excluding construction and landscaping materials); and* • *Soil materials requiring off-site disposal."*
2	Identify the decisions	ERM (2020d) stated that based on the remediation objectives, the following decisions must be made: • *Has the sub-grade drainage network been satisfactorily decommissioned and isolated from the wider drainage network?*

Step	Description	Outcomes
		• *Have remediation excavations removed contaminated soil and LNAPL to the extent practicable?* • *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 its intended purpose?*
3	Identify the information inputs	ERM (2020d) stated that the inputs to make the above decisions included: • Results from previous soil, groundwater and soil vapour sampling during previous investigations the HHERA. • Field observations and analytical data collected during of remedial trials. • Field observations made during remediation works for odours, NAPL, sheens, discolouration, asbestos and other indicators of potential contamination. • Field screening of soil material during excavation works for volatile organic compounds within the AEC-9 excavation. • Characterisation of contaminant conditions via visual screening and sampling of soil from excavations and stockpiled material and subsequent laboratory analysis of selected samples. • Assessment criteria presented in the HHERA (SSTLs) for Stage 1 Area. • Confirmation of acceptable data quality by assessment of QA/QC by comparison against DQIs. • Sampling and analysis methods: Field procedures and data collection will be consistent with all relevant guidelines made or approved by the NSW EPA.
4	Defining the study boundaries	ERM (2020d) stated that the Stage 1 Area is approximately seven hectares and is situated within the former Process West area of the WARP. The extent of the Stage 1 is shown in **Appendix A** (Figure 2 from ERM 2020d). The lateral extent of required remediation excavation is shown in **Appendix A** (Figure 7 from ERM 2020d). The vertical extent of remediation will be to an anticipated maximum depth of 1.5 mbgl.

Step	Description	Outcomes
		Temporal limits: The study comprises validation activities to be completed as part of the Stage 1 RAP scope of works. 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.
5	Develop a decision rule	ERM developed the following analytical decision rules: • Have remediation excavations been completed successfully and to the extent practicable? • Soil and soil vapour analytical data compared against adopted assessment criteria? • If concentrations of COPC in soil are reported equal to or below the adopted assessment criteria in samples collected from the base and walls of the AEC-9 excavation, the answer is “Yes” • If concentrations of COPC are reported above the adopted assessment criteria in soil samples collected from the base and walls of the AEC-9. Excavation, the answer is ‘No’. Further excavation to remove impacted soils and validation sampling would be required • If LNAPL is present at the base of the excavation, Further excavation (to the extent practicable to remove impacted soils and validation sampling would be required Statistical analysis of data sets of chemical COPC concentrations will be used as inputs, consistent with guidance in the ASC NEPM (NEPC, 2013). The analysis shall include: • 95% upper confidence limit (UCL) of the arithmetic mean concentration of each analyte shall be less than or equal to the criterion • The maximum concentration of each analyte shall be less than or equal to 250% of the criterion • The standard deviation of each analyte shall be less than 50% of the criterion • If any of these are exceeded then the answer to the decision is “No” Has the subgrade drainage network been decommissioned successfully and isolated from the wider drainage network? • An appropriate lines of evidence approach to validation of drainage line decommissioning works will be prepared following a review and documentation of the previously

Step	Description	Outcomes
		completed drainage cleaning program undertaken by Ventia in 2018 A detailed decommissioning scope would be developed by the contractor, after which a validation methodology could be prepared by the Validation Consultant for consideration by the auditor in the context of the Stage 1 Remediation Project. In addition to the validation of actions taken to address the presence of contamination that presence an unacceptable risk to human health, ERM also nominated the following decision rules for material to be brought onto site for the purpose of backfilling excavations: • Is imported fill material suitable for its intended purpose? • Imported material will need to be assessed against criteria for VENM or ENM in accordance with the Waste Guidelines (NSW EPA, 2014)
6	Specify limits on decision errors	ERM (2020d) stated that the acceptable limits on decision errors applied during the review of the results will be based on the DQIs of precision, accuracy, representativeness, comparability and completeness (PARCC) in accordance with the ASC NEPM. The potential for significant decision errors will be minimised by: • *Completing a robust QA/QC assessment of the assessment data and application of the probability that 95% of data will satisfy the DQIs, therefore a limit on the decision error would be 5% that a conclusive statement may be incorrect.* • *Assessing whether appropriate sampling and analytical density (both laterally and vertically throughout the fill and soil profiles) has been achieved for the purposes of meeting the project objectives.* • *Ensuring that the criteria set was appropriate for continuing use consistent with current and proposed usage under the sites zoning (IN3 – Heavy Industrial).*
7	Optimisation of the design for obtaining data	ERM (2020d) stated that the DQOs were developed based on a review of existing data and discussions with relevant project stakeholders, including Viva Energy and the auditor. If data gathered during the assessment indicates that the objectives of the assessment programme are not being met, the sampling design will be adjusted accordingly using feedback (where necessary) from project stakeholders. In the event that the findings of the investigation identify issues which require delineation or further investigation these will be

Step	Description	Outcomes
		delineated to the extent practicable, the scope of which is subject to approval from Viva Energy.

The auditor considered that the DQOs presented by ERM (2020d) were appropriate for the purposes of collecting data of acceptable quality to validate the efficacy of the proposed remedial works.

13. Validation program

13.1 Validation methodology

ERM (2020d) reported that the general methodology for collection of soil samples will be as follows:

- Samples will be collected from stockpiles at a minimum rate of one sample per 50 m3 of material.
- A minimum of two samples per stockpile will be collected. Discrete sampling locations within the stockpile will be selected such that the samples collected will be representative of the stockpile as a whole. Composite samples are not expected to be collected due to the potential for loss of volatile contaminants during sample splitting and homogenising.
- An excavator bucket will be used preferentially to remove portions of soil from the stockpile. Representative soil samples will be collected directly from the centre of the excavator bucket.
- Samples of stockpiled material may be collected by hand or via a clean sampling trowel/shovel where logistical or safety constraints prevent the use of an excavator for sample collection. Where samples are not collected using an excavator, samples are to be collected from a minimum depth of 0.3 m below the surface of the stockpile.
- Soil will be logged by an appropriately trained and experienced scientist/engineer to record the following information: soil/rock type, colour, grain size, sorting, angularity, inclusions, moisture condition, structure, visual signs of contamination.
- Duplicate of each soil sample will be placed in a sealed snap-lock bag and will be screened using a PID fitted with a 10.6 eV lamp, calibrated at the beginning of each working day. Where the presence of volatile contaminants or other impact is suspected, additional laboratory analysis may be undertaken.
- Representative soil samples will be collected in accordance with techniques described in Australian Standard AS4482 (Part 2 – Volatile Substances) to maintain the representativeness and integrity of the samples. The samples will be placed in pre-treated, laboratory-supplied sample containers.
- Field QA/QC samples will include intra-laboratory duplicates, inter-laboratory duplicates, trip spikes and trip blanks and rinsate blanks.
- Sample containers will be sealed and immediately placed in a cooler on ice to minimise potential degradation of organic compounds.
- Any non-disposable sampling equipment required to be utilised for sampling will be decontaminated between sampling locations by initially removing any residual soil with a stiff brush, followed by washing the equipment with a 2% Decon 90/potable water solution to reduce the potential for cross contamination between sampling locations.

13.2 Excavation validation sampling

ERM (2020d) stated that validation samples will be collected from the walls and floors of all excavation areas using the following sampling pattern:

- 1/100 m^2 from floors of excavations.

- 1/10 linear metres of excavation walls.

13.3 Stockpile validation sampling

ERM (2020d) reported that where stockpiles of contaminated soil material are temporarily stored on unsealed ground within the Stage 1 Area, baseline monitoring and post-decommissioning monitoring of native soils beneath the bioremediation area will be performed to assess whether bioremediation works have impacted the treatment site.

Should a stockpile be placed on the footprint of a planned remediation to be undertaken at later stages of the Project, separate validation for residual stockpile impacts prior to removal of underlying soils is not considered warranted. ERM noted that biopile and surplus stockpile treatment areas shown in **Appendix A** (Figure 8 from ERM 2020d) have been selected in consideration of this.

Where stockpile footprint validation is undertaken outside of the Stage 1 Area, it will be reported within a validation report for the relevant area upon which sampling was undertaken.

13.4 Soil stockpile re-use validation

ERM (2020d) reported that biopiling will be undertaken to treat soil materials for on-site beneficial re-use. Initial sampling will be undertaken to determine the requirement for biopiling for less impacted materials. The assessment of stockpile suitability for re-use will be based on the following:

- Visual assessment of soil for the presence of LNAPL.
- Laboratory analytical results of stockpiled soil to determine suitability for beneficial re-use or if further treatment is required.

13.5 Validation reporting

ERM stated that upon the completion of works, a validation report will be prepared documenting the scope, methods, results and conclusions of the remedial works that meets requirements of guidance by Consultant Guidelines. The report will include conclusions regarding the suitability, from a contamination perspective, of the Stage 1 Area for the proposed land use.

The auditor considered that the Stage 1 RAP has been prepared in general accordance with guidelines made or approved by NSW EPA under S105 of the CLM Act.

The RAP outlined a clear rationale for the selection and implementation of on-site biopiling as the preferred remedial technology to address the presence of the contaminated soils on-site and to remove the potential human health risk to render the Stage 1 Area suitable for the future commercial / industrial use.

The validation plan proposed is considered to be sufficient to meet the remediation objectives in the Stage 1 RAP.

The auditor is satisfied that the Stage 1 RAP adequately demonstrates in detail all procedures and plans to be implemented to reduce risks to human health or environment, and establishes the environmental safeguards required to complete the remediation in an environmentally acceptable manner.

14. Other considerations

14.1 Ecological considerations

ERM (2020a) stated the off-site migration of LNAPL or dissolved phase petroleum hydrocarbons was not occurring at levels that could potentially cause risk to the identified environmental/ecological receptors. Testing for PFAS and metals from soil leachate and groundwater in the WARP were not considered to represent a risk to off-site receptors.

ERM (2020b) stated while on site environmental habitats were of limited value under the current and future land use, exceedance of ecological investigation levels / ecological screening levels by RSI indicated the need for consideration within future site management, particularly for design and planning of landscape for a number of identified AECs.

14.2 Aesthetic impacts

ERM (2020d) included ASC NEPM TRH management limits for LNAPL management as trigger levels for future site management considerations. Management considerations included the aesthetics impacts.

14.3 Chemical mixtures

ERM (2020d) did not specifically examine potential additive or synergistic effects of chemical mixtures.

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 1 Area were aboveground.

In addition, ERM reported groundwater concentrations of COPC generally within adopted trigger levels for ecological receptors at delineation wells down gradient of the Stage 1 Area. As such, the auditor agrees there is no complete pathway between identified groundwater impacts on-site and off-site ecological receptors.

Following completion of proposed remedial works in the Stage 1 Area, LNAPL is unlikely to be encountered during routine use of the site or subsurface maintenance activities immediately off-site. On-site intrusive maintenance works, where needed, will be managed under the site's environmental management plans and workplace health and safety procedures. Impacts such as odours are likely to be encountered in some areas of the site if excavations are undertaken.

Based on the data presented and the absence of any identified complete SPR linkage, the auditor considers that any potential chemical mixtures are unlikely to affect the assessment of potential human health risks.

15. Compliance with Regulatory requirements

Evaluation of the Stage 1 RAP in respect of its compliance with regulatory requirements is discussed below.

15.1 Consultant guidelines

The auditor's evaluation of the draft Stage 1 RAP – through comparison to the requirements of the Consultant Guidelines (NSW EPA, 2020) is presented in **Appendix B** (IAA03 – Attachment A). The auditor considered that all matters raised in IAA03 were appropriately addressed in the final version of the Stage 1 RAP.

15.2 Auditor guidelines

The evaluation of compliance of the Stage 1 RAP with Section 4.3.6 of the Auditor Guidelines is presented in **Table 15**.

Table 15 Auditor Guideline evaluation

Item	Present (Y/N)	Comment
The RAP demonstrates adequate safeguards for the protection of human health and the environment.	Y	The auditor noted a human health 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 1 RAP. The AEVR in particular presented data gathered during the biopile trial. These data demonstrated that uncontrolled emissions that could affect human health are not likely to occur during the Stage 1 remediation. The RAP includes appropriate monitoring protocols for air, water and leachate emissions.

A review of the Stage 1 RAP demonstrated adequate compliance with the requirements of these guidelines. The auditor did not consider that any identified deviations from these guidelines affected the outcome of the audit.

16. Auditor’s opinion and conclusions

The objective of the Stage 1 RAP is to remediate the soil and manage groundwater in the Stage 1 Area thereby reducing the risk of contamination from the land adversely affecting human health and the environment and to enable the land to be used for commercial/ industrial purposes.

The auditor noted that data from historical investigations undertaken in the Western Area over the past 24 years, including the most recent presented in the RSI and HHERA reports, were utilised in the development of the Stage 1 RAP. Additionally, site specific data collected from field and laboratory scale remediation trials were incorporated into a remedial options analysis for the Stage 1 Area.

Based on the HHERA outcomes, the key driver for remediation within the Stage 1 Area was identified as being the potential for indoor inhalation of vapours by future on-site commercial workers from hydrocarbon and LNAPL impacted soil within the northern portion of the former Process West plant area (AEC-9).

Biopiling of an approximately 2,900 m3 of contaminated soil within the AEC-9 has been recommended as the nominated remedial strategy with, as a contingency measure, excavation and off-site disposal of impacted material. A validation approach for assessment of excavations and beneficial re-use of treated material within later stages of the WARP has been proposed.

The auditor acknowledges that the selected remediation methodologies were consistent with the remediation methodologies outlined in the EIS (AECOM, 2018) and the Conceptual RAP (AECOM, 2019).

It is the auditor’s opinion that as petroleum hydrocarbons in groundwater are stable to decreasing, based on the annual groundwater assessments, it is expected that the proposed remediation works will enhance the current natural attenuation processes to reduce residual groundwater impacts over time.

As required in the Conditions Consent issued by the DPIE on 7 May 2020, following completion of remediation and validation works, preparation and implementation of a LTEMP will be necessary to manage residual contaminated soil and/or groundwater impacts remaining after active remediation is undertaken.

It is the auditor’s understanding that in-situ decommissioning of the subsurface drainage network within the Stage 1 Area is planned to be undertaken. However, the decommissioning works fall outside of the scope of works of the EIS, and will be completed under the existing SSD (5147) for the Clyde Terminal Conversion Project. A detailed scope for completion of decommissioning works to meet these objectives will be developed by a Contractor. This scope and associated validation approach for decommissioning works will be considered by the auditor as part of the overall validation of the Stage 1 remedial works.

It is the auditor’s opinion that following remedial and validation activities discussed in the Stage 1 RAP the site (Area 1) will be suitable for the proposed future use (commercial and/or industrial) in accordance with the permissible land use IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011.

17. Disclaimer

This Site Audit Report (SAR) and accompanying site Audit Statement (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 1 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 1 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:

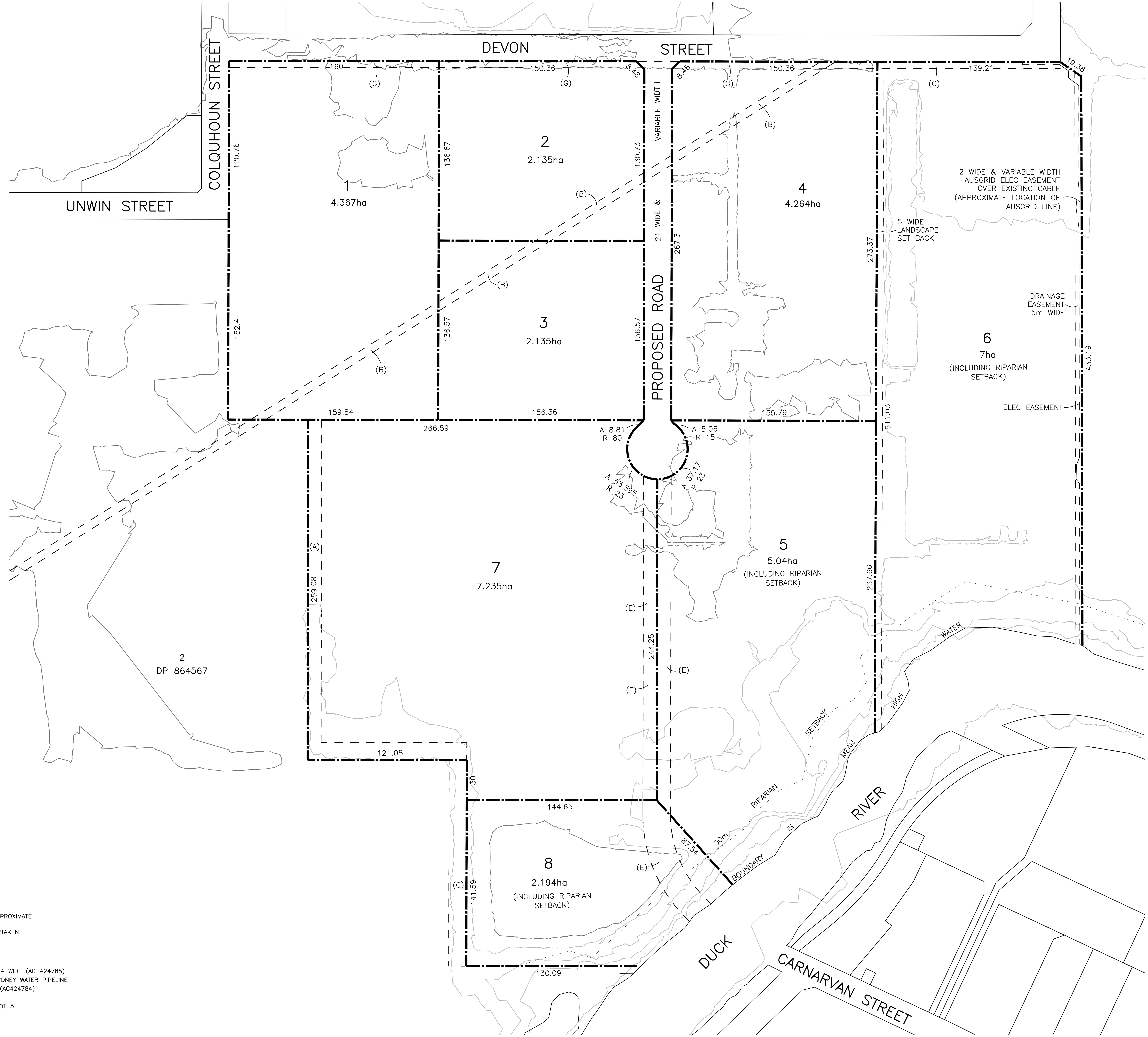
1. Arising from, or in connection with, any change to the site conditions.
2. To update this SAR if the site conditions change.

- 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

M.G.A



LEGEND

SUPER LOT BOUNDARY

NOTES:
1. MAJOR CONTOUR INTERVAL IS 5m
2. MINOR CONTOUR INTERVAL IS 1m
3. ALL DIMENSIONS SHOWN HEREON ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY
4. NO CADASTRAL SURVEY HAS BEEN UNDERTAKEN

(A) EASEMENT TO DRAIN WATER 10.2 & 13.4 WIDE (AC 424785)
(B) EASEMENT 6.095 WIDE (B309159) – SYDNEY WATER PIPELINE
(C) EASEMENT TO DRAIN WATER 13.4 WIDE (AC424784)
(E) RIGHT OF ACCESS
(F) EASEMENT FOR SERVICES TO BENEFIT LOT 5
(G) EASEMENT FOR SERVICES 3 WIDE

20 0 40 100 140m

SCALE 1:1500

CLIENT

VE PROPERTY PTY LTD

PROJECT

PLAN OF PROPOSED SUBDIVISION OF LOT 100 IN DP 1168951

NOTES

The title boundaries shown hereon were not marked at the time of survey and have been determined by plan dimensions only and not by field survey.

Services shown hereon have been located where possible by field survey. If not able to be so located, services have been plotted from the records of relevant authorities where available and have been noted accordingly on the plan. Where such records do not exist or are inadequate a notation has been made hereon.

Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.

12	GKO	12/06/2020	EXTRA LOT ADDED
11	GKO	11/06/2020	LOT BOUNDARY AMENDED
10	GKO	19/05/2020	LOT 5 & 7 BOUNDARY AMENDED
9	GKO	18/05/2020	LOT 7 BOUNDARY AMENDED
8	GKO	15/05/2020	RIGHT OF ACCESS ADDED
7	GKO	13/05/2020	LOT 7 ADDED
6	GKO	24/04/2020	LOT 6 BDY & OTHER LOTS CHANGED
5	GKO	26/03/2020	LOTS 2, 3, 4 & 5 BOUNDARIES CHANGED
4	GKO	23/03/2020	LOT 6 BDY CHANGED
3	GKO	11/03/2020	DIMENSION AMENDMENTS
2	GKO	24/09/2019	EASTERN BOUNDARY RELOCATED

SYM	CODE	DESCRIPTION
	BIN	BIN
	BM	BENCH MARK
	BO	BOLLARD
	DJM	DRAINAGE MANHOLE
	EFP	ELEC FUSE BOX
	ELP	ELEC GARDEN LIGHT
	EL	ELEC GREEN PILLAR
	LP	ELEC LIGHT POLE
	EP	ELECT SINGLE PIT
	SPL	ELEC STAY POLE
	PP	ELEC POWER POLE
	ELP	ELEC POLE/LIGHT
	TRANS	ELE POLE/TRANSFORM
	FD	FUEL DIP
	GM	GAS MAIN
	GMR	GAS METER
	GAS	GAS VALVE
	AG	GATE
	GUL	GULLY PIT
	HYD	HYDRANT
	BOR	BOREHOLE

SYM	CODE	DESCRIPTION
	OFM	OPTICAL FIBRE MARKER
	OFP	OPTICAL FIBRE PIT
	TM	PALM TREE
	SE	SEAT
	TS	SHRUB
	TCA	TELSTRA PIT
	SLH	SEWER LAMP HOLE
	SMH	SEWER MANHOLE
	SVP	SEWER VENT PIPE
	SI	SIGN
	BUS	BUS STOP SIGN
	T	TREE
	SGL	TRAFFIC LIGHT
	SCL	TRAFFIC CONTROLLER
	SJK	TRAFFIC JUNCTION BOX
	US	UNKNOWN SERVICE
	WAV	WATER AIR VALVE
	WMR	WATER METER
	WEP	WATER PUMP
	WSV	WATER STOP VALVE
	WTP	WATER TAP

Symbols shown are indicative only. The symbol size and orientation does not necessarily represent the real size or orientation of the feature.

DRAINAGE PIPE U/G
DRAIN
ELECT. CABLE A/G
ELEC. CABLE U/G
GAS PIPE
FENCE LINE
SEWERAGE PIPE
TELSTRA CABLE
WATER PIPE

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e info@landpartners.com.au
w www.landpartners.com.au

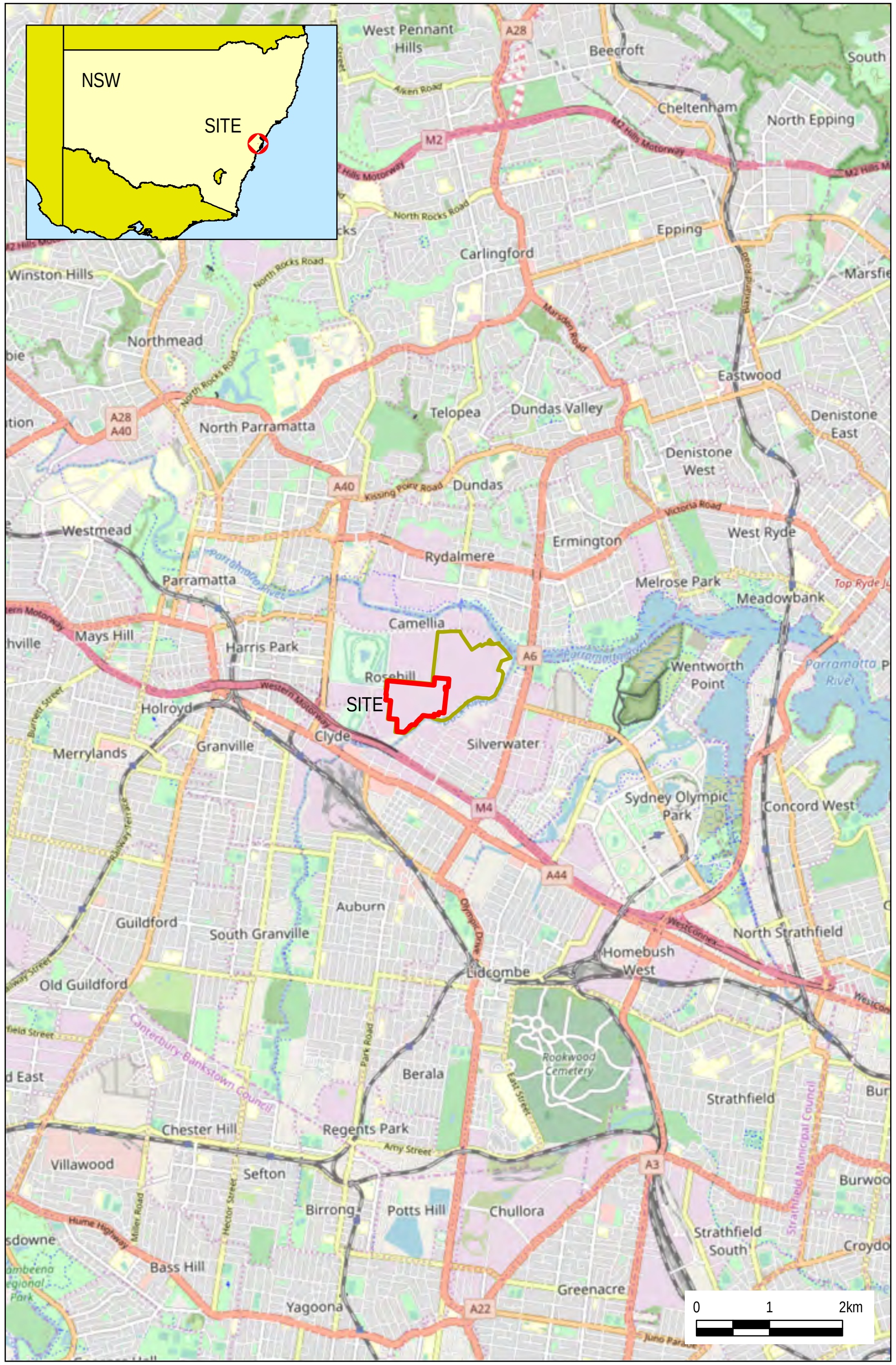
ISO 9001:2008
FS 535063

HEIGHT DATUM AHD	LOCAL AUTHORITY CITY OF PARRAMATTA
HEIGHT ORIGIN N/A	SCALE 1:1500 (A1)
MERIDIAN 56	CONTOUR INTERVAL N/A
CO-ORD SYSTEM MGA	SURVEYOR N/A — DATE OF SURVEY -
CCAD FILE 74707 ver 9 final subdivision	DRAWN SF/CLP — DATE 12/06/2020
AUTOCAD FILE SY074707.000.4.12	CHECKED GKO — DATE 12/06/2020
ARCHIVE FILE SY074707.000.4.11	APPROVED GKO — DATE 12/06/2020

PLAN NUMBER
SY074707.000.4.12

SHEET 2 OF 2

PD:PM



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)

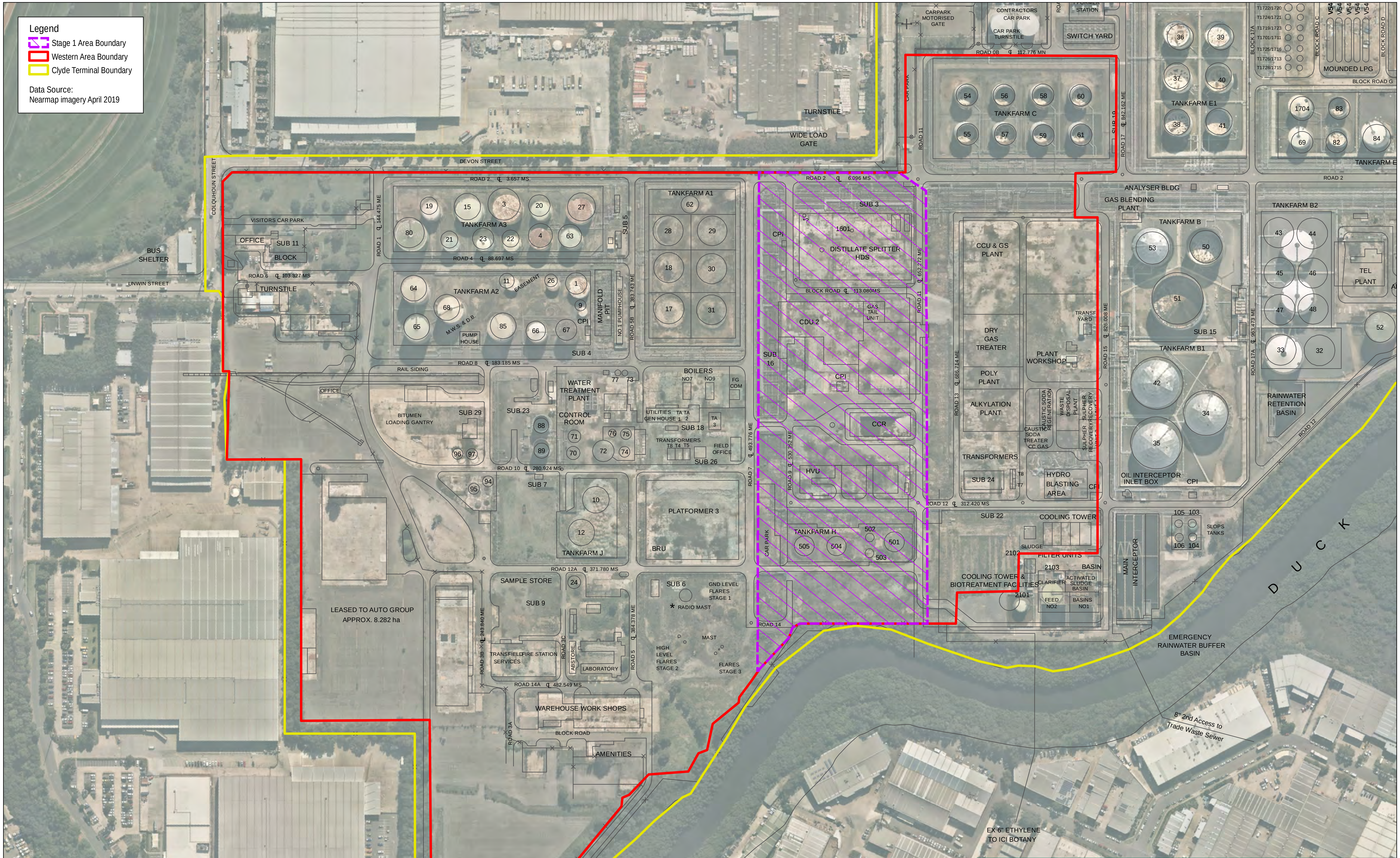
Source:
Nearmap Imagery July 2019
Locality: Esri, OpenStreetMap 2019

Site Location

F1

Drawing No:	0515132b_RAP_G001_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill
Date:	20/03/2020	Drawing Size: A4	
Drawn By:	GC / GR	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



Site Layout - Western Area

F2

Drawing No:	0515132b_RAP_G002_R0.mxd		
Date:	06/04/2020	Drawing Size:	A3
Drawn By:	GR / GC	Reviewed By:	SM

Coordinate System: GDA 1994 MGA Zone 56

0 50 100m

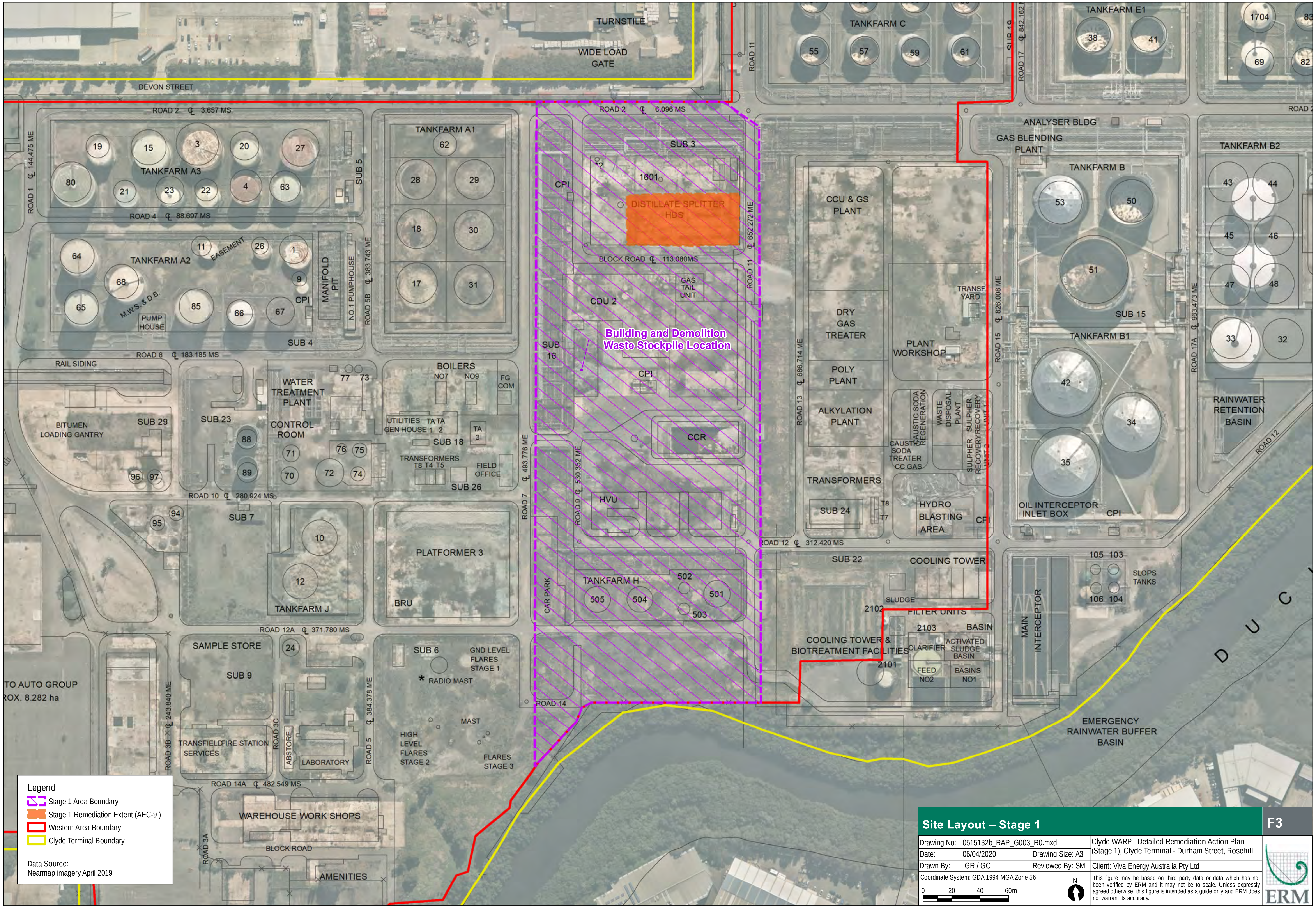
N

Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill

Client: Viva Energy Australia Pty Ltd

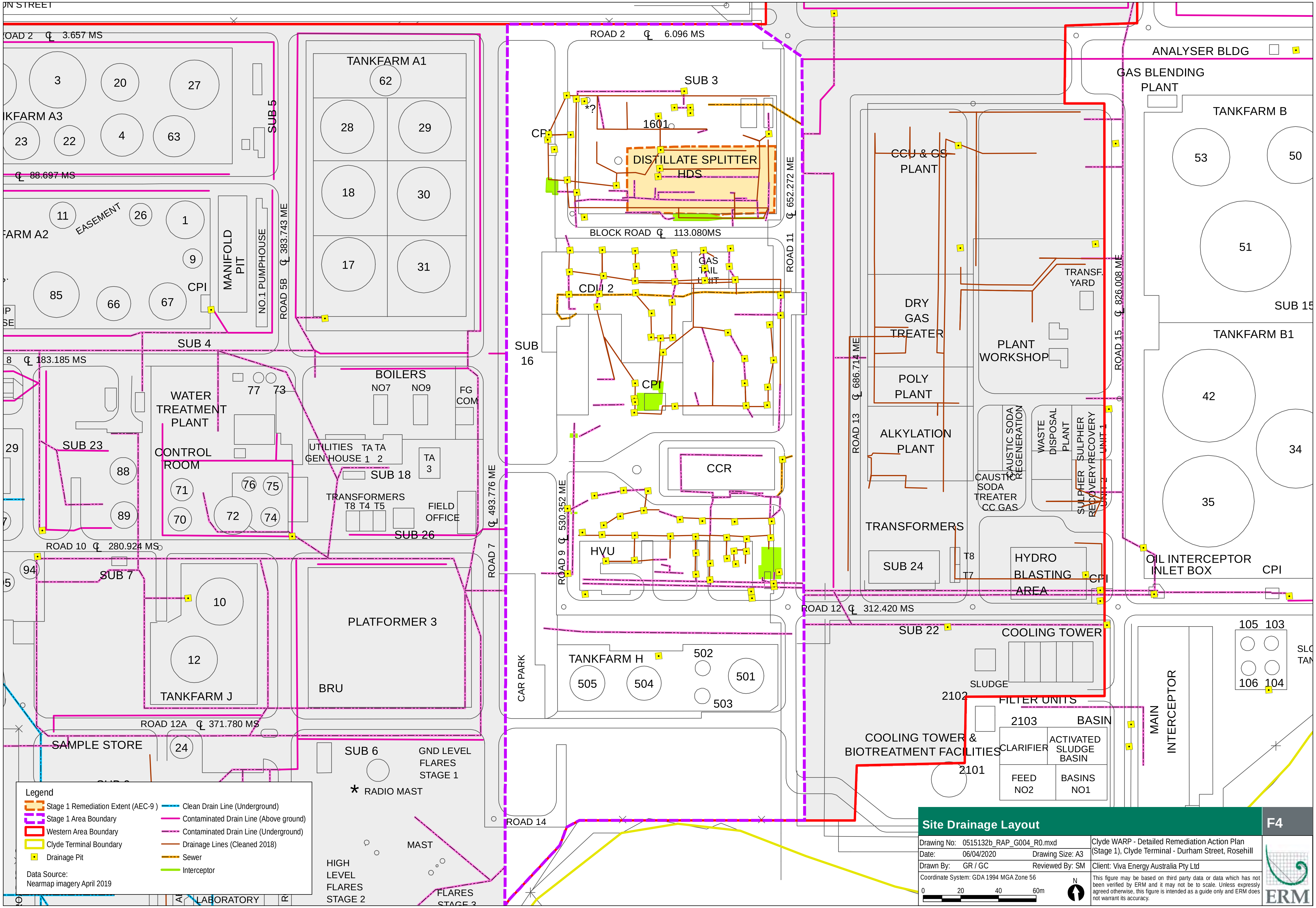
This figure may be based on third party data or data which has not been verified by ERM and it may not to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

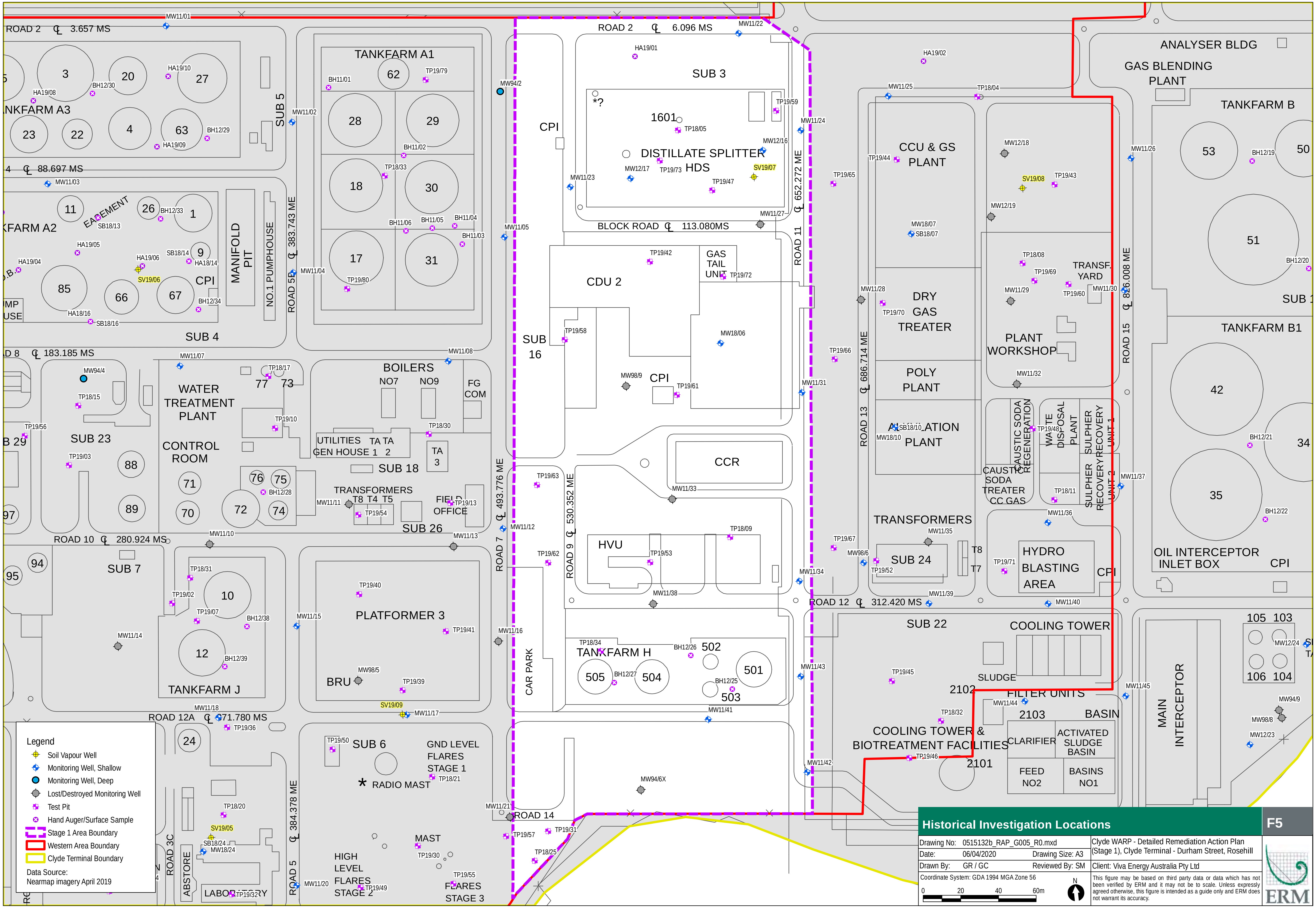
ERM

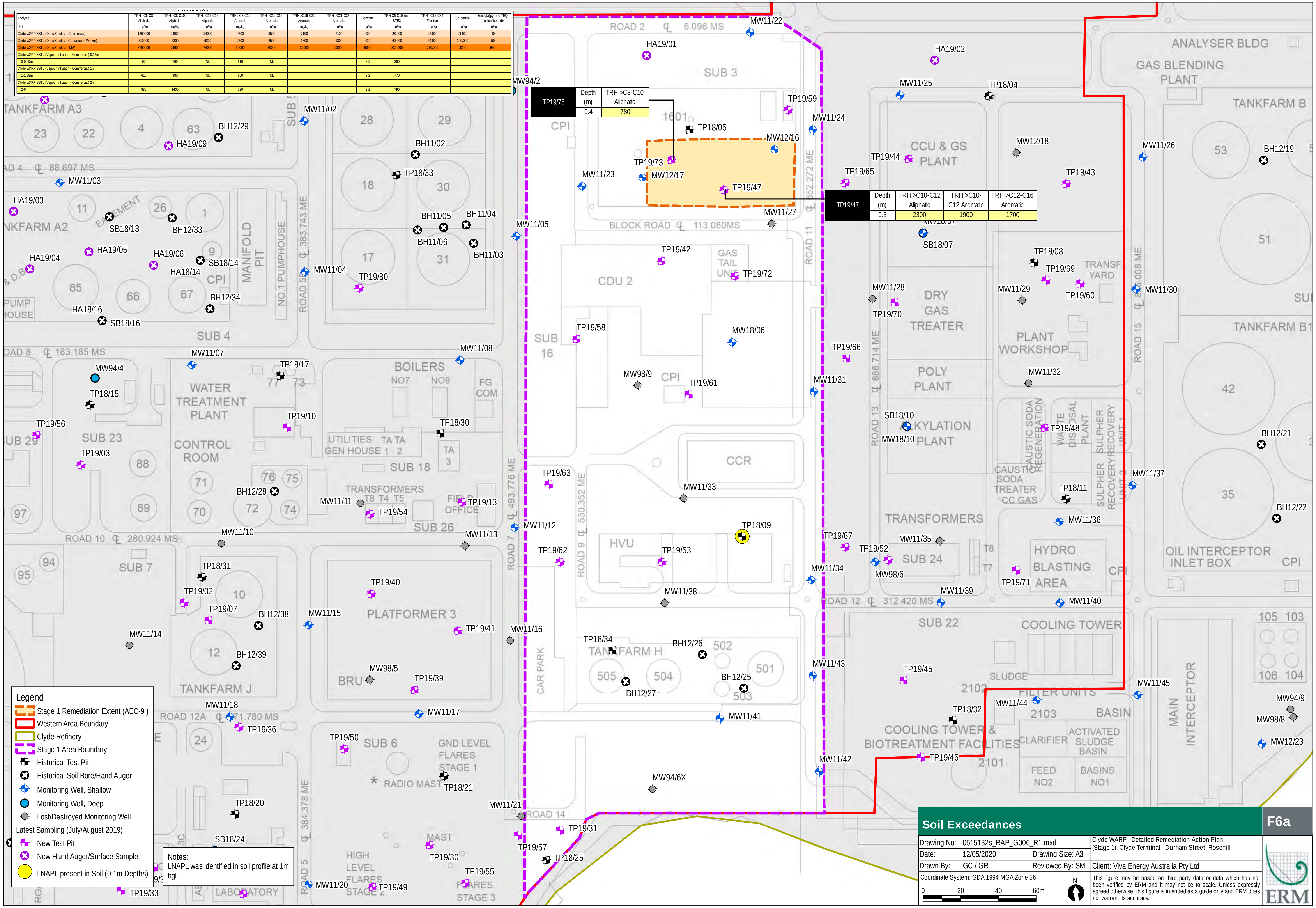


Site Layout – Stage 1 F3

Drawing No: 0515132b_RAP_G003_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill	
Date: 06/04/2020	Drawing Size: A3		
Drawn By: GR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd	
Coordinate System: GDA 1994 MGA Zone 56	0 20 40 60m	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 Drainage Layout
F4
Drawing No: 0515132b_RAP_G004_R0.mxd
Date: 06/04/2020
Drawing Size: A3
Drawn By: GR / GC
Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 20 40 60m
N
Clyde WARP - Detailed Remediation Action Plan (Stage 1), 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
Legend
Stage 1 Remediation Extent (AEC-9)
Stage 1 Area Boundary
Western Area Boundary
Clyde Terminal Boundary
Drainage Pit
Clean Drain Line (Underground)
Contaminated Drain Line (Above ground)
Contaminated Drain Line (Underground)
Drainage Lines (Cleaned 2018)
Sewer
Interceptor
Data Source:
Nearmap imagery April 2019
ROAD 2 ℄ 3.657 MS
ROAD 2 ℄ 6.096 MS
TANKFARM A1
TANKFARM A3
TANKFARM A2
SUB 5
SUB 3
SUB 4
SUB 16
1601
*?
CPI
DISTILLATE SPLITTER
HDS
℄ 88.697 MS
EASEMENT
MANIFOLD PIT
NO.1 PUMPHOUSE
℄ 383.743 ME
ROAD 5B
℄ 652.272 ME
BLOCK ROAD ℄ 113.080MS
ROAD 11
GAS TAIL UNIT
CDU 2
℄ 183.185 MS
BOILERS
NO7
NO9
FG COM
WATER TREATMENT PLANT
CONTROL ROOM
UTILITIES GEN HOUSE
TA TA 1 2
TA 3
SUB 18
SUB 23
TRANSFORMERS T8 T4 T5
FIELD OFFICE
SUB 26
℄ 493.776 ME
ROAD 7
℄ 530.352 ME
ROAD 9
CCR
HVU
ROAD 10 ℄ 280.924 MS
SUB 7
TANKFARM J
PLATFORMER 3
BRU
ROAD 12A ℄ 371.780 MS
SAMPLE STORE
SUB 6
GND LEVEL FLARES STAGE 1
RADIO MAST
MAST
HIGH LEVEL FLARES STAGE 2
FLARES STAGE 3
LABORATORY
CAR PARK
ROAD 14
TANKFARM H
ANALYSER BLDG
GAS BLENDING PLANT
TANKFARM B
TANKFARM B1
CCU & GS PLANT
DRY GAS TREATER
TRANSF. YARD
PLANT WORKSHOP
POLY PLANT
ALKYLATION PLANT
CAUSTIC SODA REGENERATION
WASTE DISPOSAL PLANT
SULPHER RECOVERY UNIT 1
SULPHER RECOVERY UNIT 2
CAUSTIC SODA TREATER CC GAS
TRANSFORMERS
SUB 24
T8
T7
HYDRO BLASTING AREA
CPI
ROAD 13
℄ 686.714 ME
ROAD 15
℄ 826.008 ME
SUB 15
OIL INTERCEPTOR INLET BOX
ROAD 12 ℄ 312.420 MS
SUB 22
COOLING TOWER
SLUDGE
FILTER UNITS
2102
2103
BASIN
CLARIFIER
ACTIVATED SLUDGE BASIN
FEED NO2
BASINS NO1
COOLING TOWER & BIOTREATMENT FACILITIES
2101
MAIN INTERCEPTOR
105 103 106 104
502 501 503 504 505


Historical Investigation Locations
F5
Drawing No: 0515132b_RAP_G005_R0.mxd
Date: 06/04/2020
Drawing Size: A3
Drawn By: GR / GC
Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 20 40 60m
N
Clyde WARP - Detailed Remediation Action Plan (Stage 1), 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
Legend
Soil Vapour Well
Monitoring Well, Shallow
Monitoring Well, Deep
Lost/Destroyed Monitoring Well
Test Pit
Hand Auger/Surface Sample
Stage 1 Area Boundary
Western Area Boundary
Clyde Terminal Boundary
Data Source:
Nearmap imagery April 2019
ROAD 2 ℄ 3.657 MS
ROAD 2 ℄ 6.096 MS
TANKFARM A1
TANKFARM A3
TANKFARM A2
SUB 3
SUB 5
SUB 4
CPI
1601
DISTILLATE SPLITTER
HDS
BLOCK ROAD ℄ 113.080MS
ROAD 11 ℄ 652.272 ME
CDU 2
GAS TAIL UNIT
SUB 16
MANIFOLD PIT
NO.1 PUMPHOUSE
ROAD 5 ℄ 383.743 ME
ROAD 8 ℄ 183.185 MS
WATER TREATMENT PLANT
CONTROL ROOM
BOILERS
NO7
NO9
FG COM
UTILITIES GEN HOUSE 1 2
TA TA
TA 3
SUB 18
TRANSFORMERS T8 T4 T5
FIELD OFFICE
SUB 26
SUB 23
ROAD 10 ℄ 280.924 MS
ROAD 7 ℄ 493.776 ME
ROAD 9 ℄ 530.352 ME
CCR
HVU
SUB 7
TANKFARM J
PLATFORMER 3
BRU
ROAD 12A ℄ 471.780 MS
CAR PARK
TANKFARM H
SUB 6
GND LEVEL FLARES STAGE 1
RADIO MAST
MAST
HIGH LEVEL FLARES STAGE 2
FLARES STAGE 3
ROAD 5 ℄ 384.378 ME
ROAD 3C
ABSTORE
LABORATORY
ROAD 14
ANALYSER BLDG
GAS BLENDING PLANT
TANKFARM B
TANKFARM B1
CCU & GS PLANT
DRY GAS TREATER
POLY PLANT
ALKYLATION PLANT
ROAD 13 ℄ 686.714 ME
PLANT WORKSHOP
TRANSF. YARD
ROAD 15 ℄ 826.008 ME
CAUSTIC SODA REGENERATION
WASTE DISPOSAL PLANT
SULPHER RECOVERY UNIT 1
SULPHER RECOVERY UNIT 2
CAUSTIC SODA TREATER
CC GAS
TRANSFORMERS
SUB 24
T8
T7
HYDRO BLASTING AREA
CPI
OIL INTERCEPTOR INLET BOX
ROAD 12 ℄ 312.420 MS
SUB 22
COOLING TOWER
SLUDGE
FILTER UNITS
BASIN
COOLING TOWER & BIOTREATMENT FACILITIES
CLARIFIER
ACTIVATED SLUDGE BASIN
FEED NO2
BASINS NO1
MAIN INTERCEPTOR
105 103 106 104



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			

TP19/73	Depth (m)	TRH >C8-C10 Aliphatic
	0.4	780

TP19/47	Depth (m)	TRH >C10-C12 Aliphatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic
	0.3	2300	1900	1700

Legend

- Stage 1 Remediation Extent (AEC-9)
- Western Area Boundary
- Clyde Refinery
- Stage 1 Area Boundary
- 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
- LNAPL present in Soil (0-1m Depths)

Notes:
LNAPL was identified in soil profile at 1m bgl.

Soil Exceedances

F6a

Drawing No:	0515132s_RAP_G006_R1.mxd		
Date:	12/05/2020	Drawing Size:	A3
Drawn By:	GC / GR	Reviewed By:	SM

Coordinate System: GDA 1994 MGA Zone 56

0 20 40 60m

N

Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill

Client: Viva Energy Australia Pty Ltd

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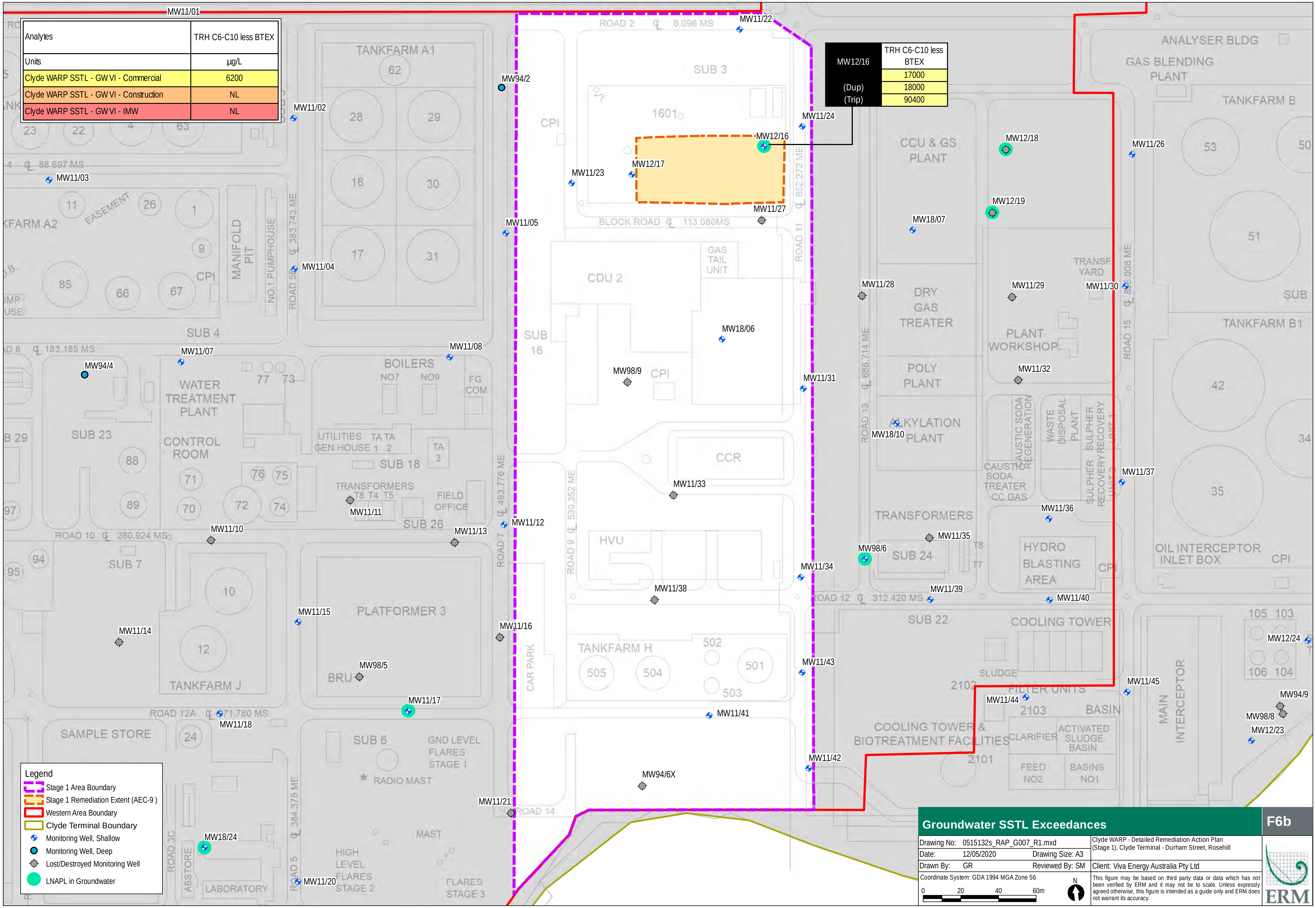
ERM



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

Legend
- Stage 1 Area Boundary
- Stage 1 Remediation Extent (AEC-9)
- Western Area Boundary
- Clyde Terminal Boundary
- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- LNAPL in Groundwater

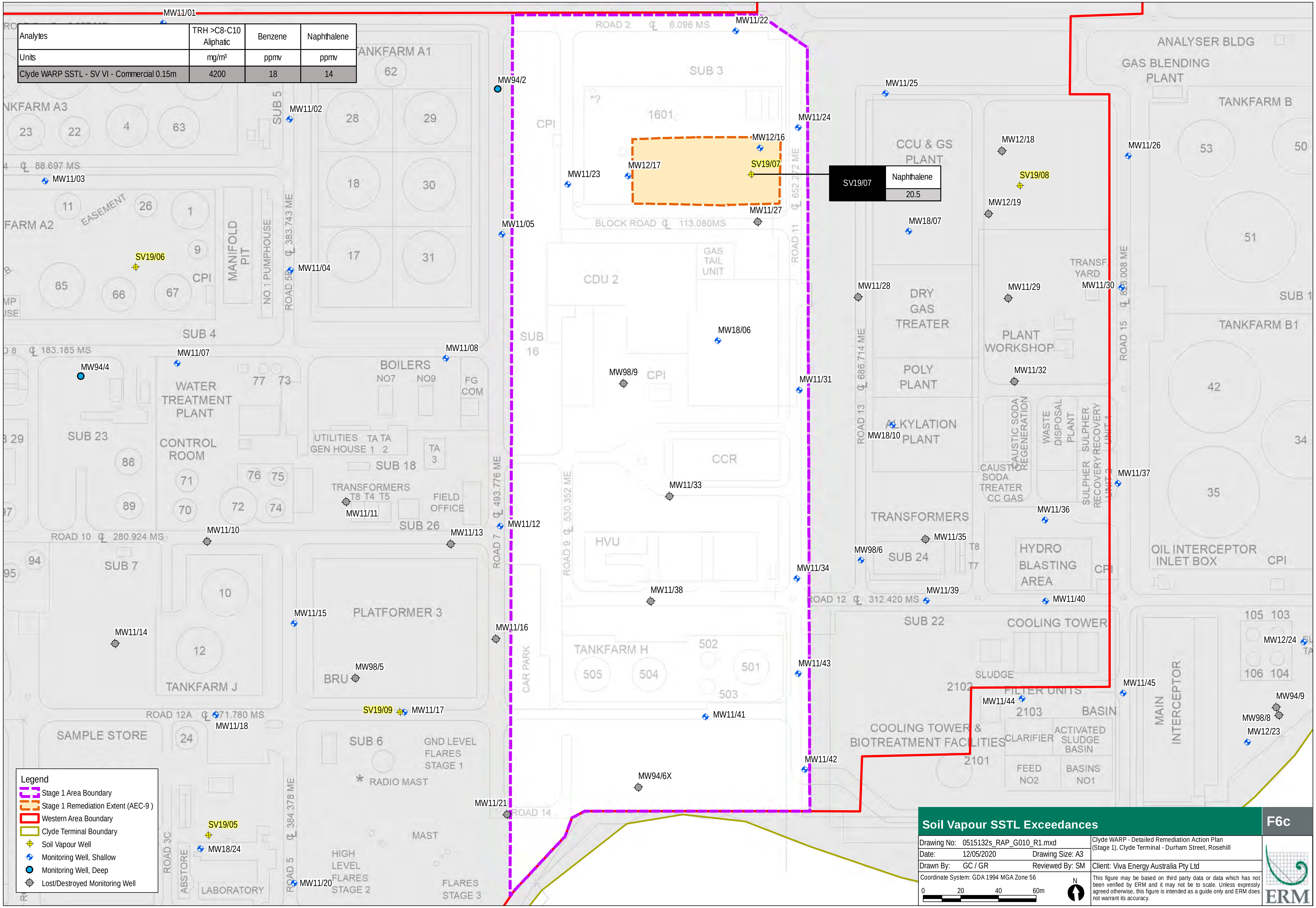
Groundwater SSTL Exceedances

F6b

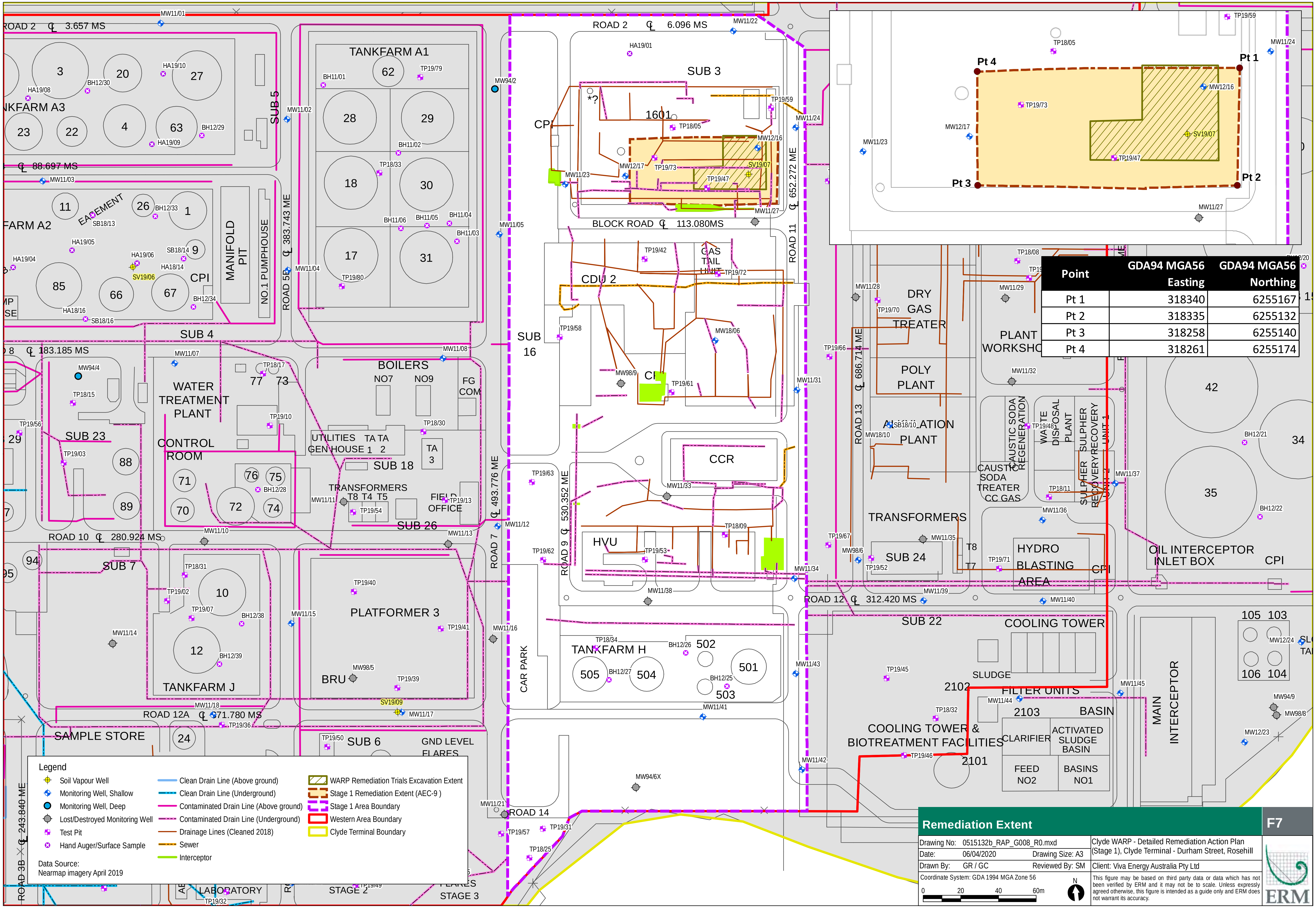
Drawing No: 0515132s_RAP_G007_R1.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill
Date: 12/05/2020	Drawing Size: A3	
Drawn By: GR	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56		This figure may be based 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.

0 20 40 60m

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
Legend
Stage 1 Area Boundary
Stage 1 Remediation Extent (AEC-9)
Western Area Boundary
Clyde Terminal Boundary
Soil Vapour Well
Monitoring Well, Shallow
Monitoring Well, Deep
Lost/Destroyed Monitoring Well
Soil Vapour SSTL Exceedances
F6c
Drawing No: 0515132s_RAP_G010_R1.mxd
Date: 12/05/2020
Drawing Size: A3
Drawn By: GC / GR
Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 20 40 60m
N
Clyde WARP - Detailed Remediation Action Plan (Stage 1), 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
SV19/05
SV19/06
SV19/07
SV19/08
SV19/09
SUB 3
1601
CDU 2
CCR
HVU
TANKFARM H
SUB 16
CPI
BOILERS
WATER TREATMENT PLANT
CONTROL ROOM
SUB 18
SUB 23
SUB 26
SUB 7
SUB 4
SUB 5
SUB 6
SUB 22
SUB 24
TANKFARM J
TANKFARM A1
TANKFARM A2
TANKFARM A3
TANKFARM B
TANKFARM B1
PLATFORMER 3
BRU
SAMPLE STORE
LABORATORY
RADIO MAST
GND LEVEL FLARES STAGE 1
HIGH LEVEL FLARES STAGE 2
FLARES STAGE 3
CCU & GS PLANT
DRY GAS TREATER
POLY PLANT
ALKYLATION PLANT
PLANT WORKSHOP
TRANSFORMERS
HYDRO BLASTING AREA
COOLING TOWER
COOLING TOWER & BIOTREATMENT FACILITIES
ANALYSER BLDG
GAS BLENDING PLANT
OIL INTERCEPTOR INLET BOX
MAIN INTERCEPTOR
ROAD 2 ℄ 6.096 MS
BLOCK ROAD ℄ 113.080MS
ROAD 10 ℄ 280.924 MS
ROAD 12 ℄ 312.420 MS
ROAD 12A ℄ 371.780 MS



Point	GDA94 MGA56 Easting	GDA94 MGA56 Northing
Pt 1	318340	6255167
Pt 2	318335	6255132
Pt 3	318258	6255140
Pt 4	318261	6255174

Legend
- Soil Vapour Well
- Monitoring Well, Shallow
- Monitoring Well, Deep
- Lost/Destroyed Monitoring Well
- Test Pit
- Hand Auger/Surface Sample
- Clean Drain Line (Above ground)
- Clean Drain Line (Underground)
- Contaminated Drain Line (Above ground)
- Contaminated Drain Line (Underground)
- Drainage Lines (Cleaned 2018)
- Sewer
- Interceptor
- WARP Remediation Trials Excavation Extent
- Stage 1 Remediation Extent (AEC-9)
- Stage 1 Area Boundary
- Western Area Boundary
- Clyde Terminal Boundary

Data Source:
Nearmap imagery April 2019

Remediation Extent

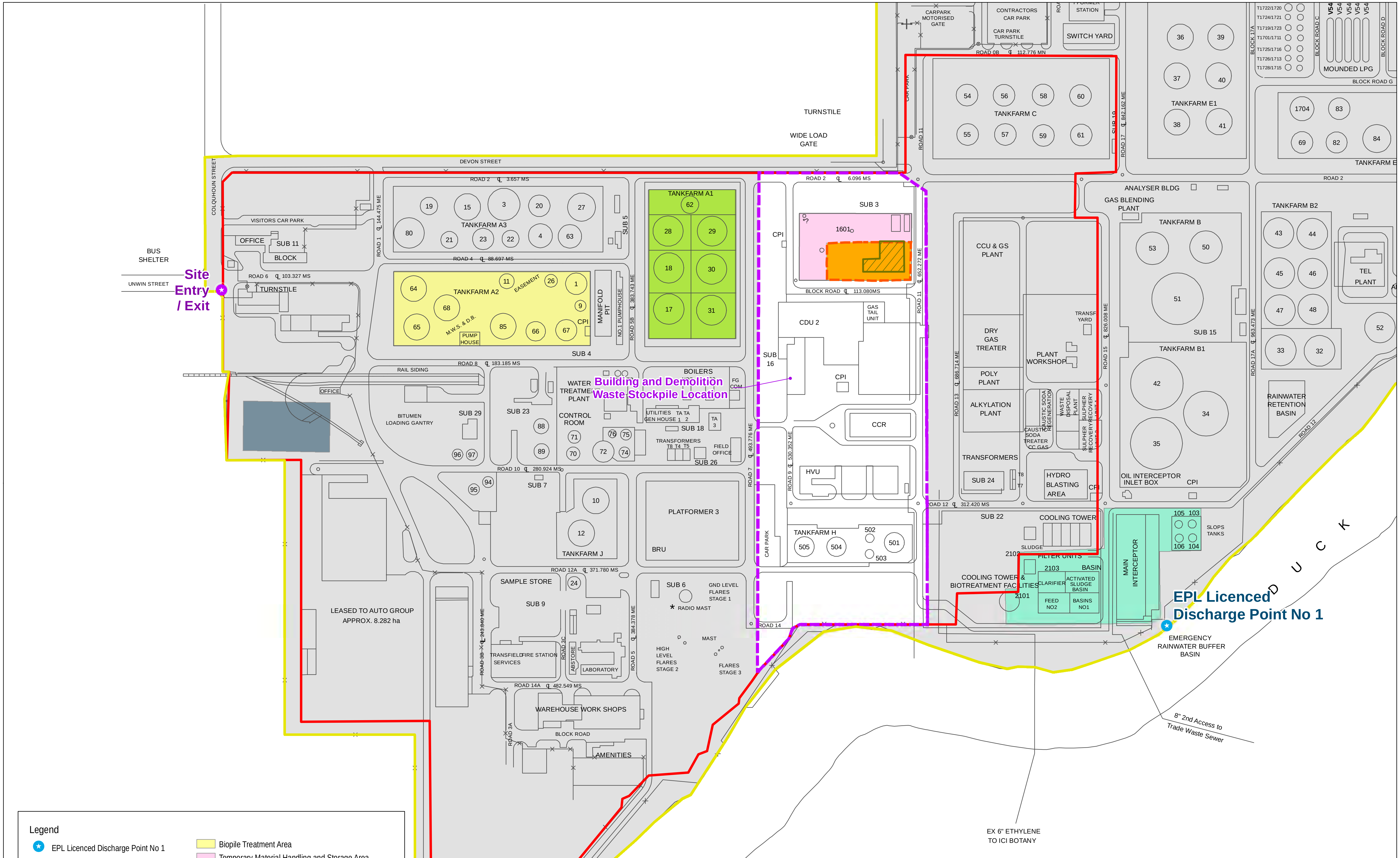
F7

Drawing No: 0515132b_RAP_G008_R0.mxd		Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill	
Date: 06/04/2020	Drawing Size: A3		
Drawn By: GR / GC	Reviewed By: SM	Client: Viva Energy Australia Pty Ltd	
Coordinate System: GDA 1994 MGA Zone 56			

0 20 40 60m

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

ERM



Legend

- EPL Licenced Discharge Point No 1
- Site Entry / Exit
- Stage 1 Area Boundary
- WARP Remediation Trials Excavation Extent
- Clyde Terminal Boundary
- Stage 1 Remediation Extent (AEC-9)
- Western Area Boundary
- Biopile Treatment Area
- Temporary Material Handling and Storage Area
- Surplus / Treated Soils Stockpiling Area (Tank Farm A1)
- Waste Water Treatment Plant (WWTP)
- Worker Carpark Area

Data Source:
Nearmap imagery April 2019

Stage 1 Remediation Site Layout

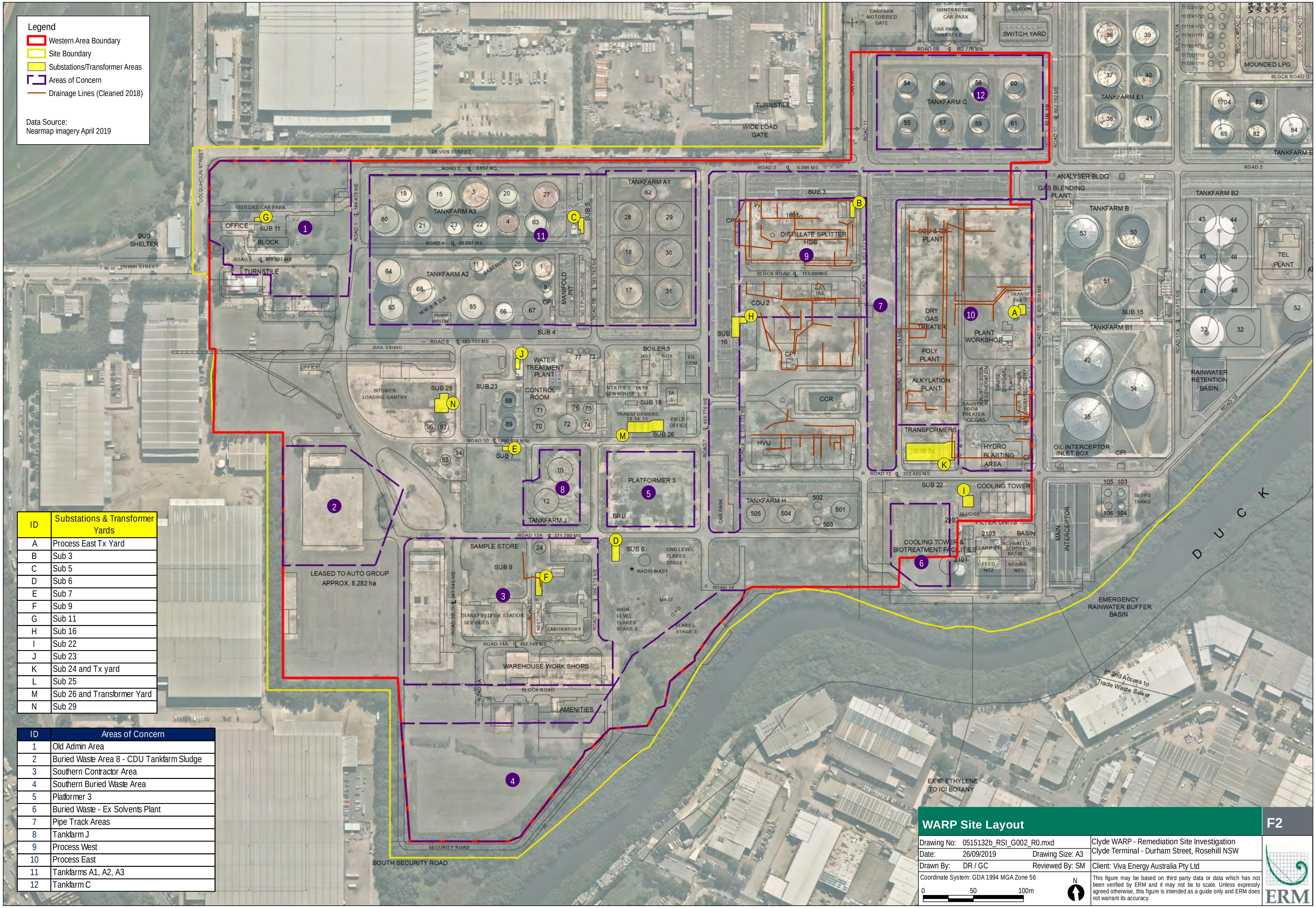
F8

Drawing No: 0515132b_RAP_G009_R0.mxd	Clyde WARP - Detailed Remediation Action Plan (Stage 1), Clyde Terminal - Durham Street, Rosehill
Date: 08/04/2020 Drawing Size: A3	
Drawn By: GR / 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	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

WARP Site Layout

F2

Drawing No: 0515132b_RSI_G002_R0.mxd
Date: 26/09/2019 Drawing Size: A3
Drawn By: DR / 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

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ERM

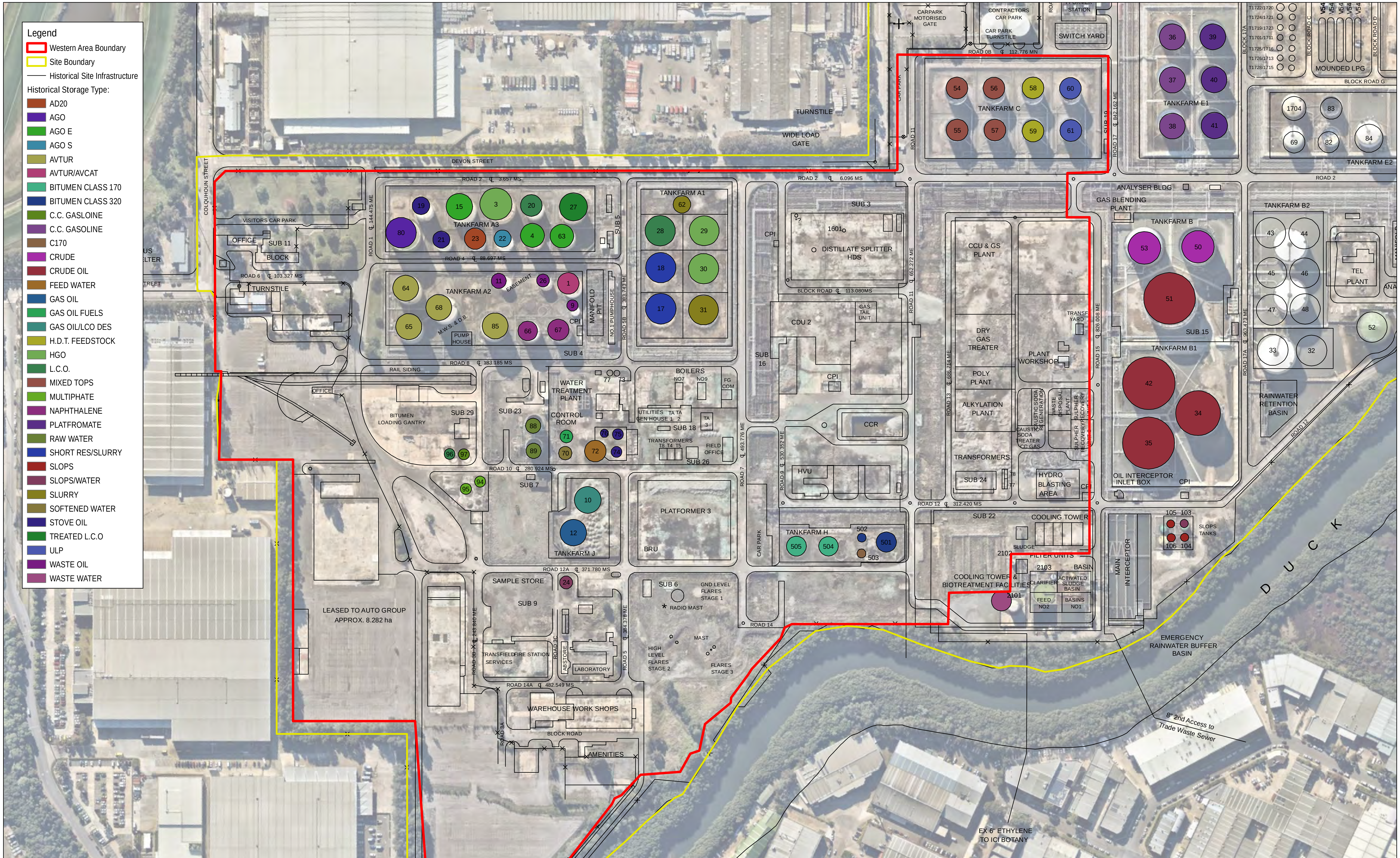
Location of Historic Infrastructure

F3

Drawing No:	0515132b_RSI_G003_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date:	26/09/2019	Drawing Size: A3	
Drawn By:	DR / GC	Reviewed By: SM	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



Location of Historic Storage Infrastructure

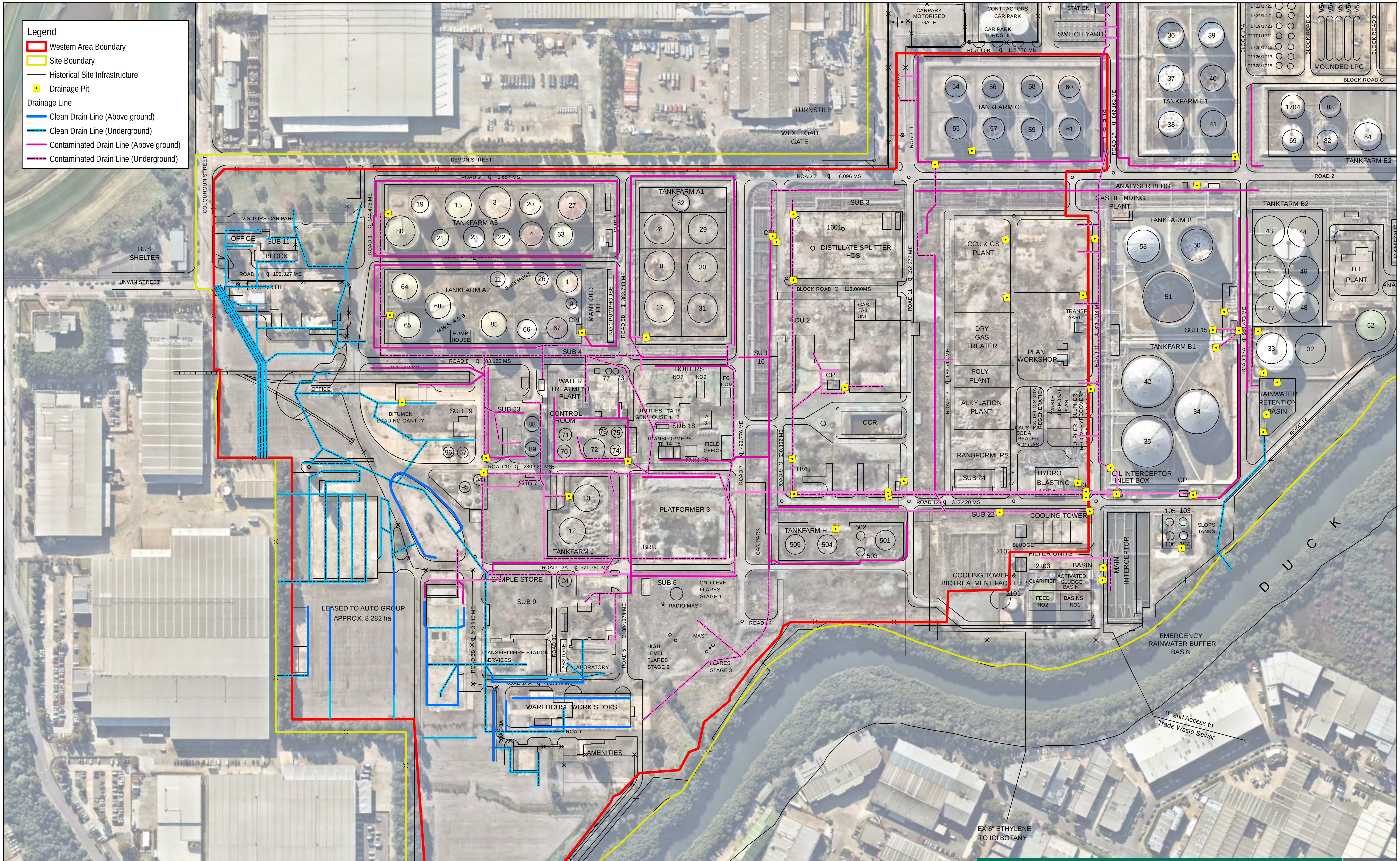
F4

Drawing No: 0515132b_RSI_G004_R0.mxd		Clyde WARP - Remediation Site Investigation Clyde Terminal - Durham Street, Rosehill NSW
Date: 26/09/2019	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

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 Drainage Infrastructure

F5

Drawing No:	0515132b_RSI_G005_R0.mxd		
Date:	26/09/2019	Drawing Size:	A3
Drawn By:	DR / 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

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

Table of contents

Table index

Appendices

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 3,4x10^{-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

<table>
<tr><th>Site aspect</th><th colspan="5">Details</th></tr>
<tr><td>Nature of LNAPL impacts</td><td colspan="5">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)</td></tr>
<tr><td>Nature of Dissolved phases impacts</td><td colspan="5">Dissolved phase hydrocarbon impacts in groundwater have been identified in various areas as illustrated in Appendix A (Figure 8-4 from the Conceptual RAP)</td></tr>
<tr><td>Nature of Vapour Impacts</td><td colspan="5">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</td></tr>
<tr><td>Potential Transport Mechanisms and Exposure Pathways</td><td colspan="5">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</td></tr>
<tr><td>Potential Receptors (Current)</td><td>On-site Ecological
None</td><td>Off-site Ecological
Duck River and Wetlands</td><td>On-site Human
Commercial and Intrusive</td><td>Off-site Human
Commercial and Intrusive</td><td>Off-site Residents
None</td></tr>
<tr><td>Summary of Complete and Potentially S>P>R Exposure Pathways</td><td colspan="5">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</td></tr>
</table>

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

0 250 500 m

Figure 3-1 Site Location Map

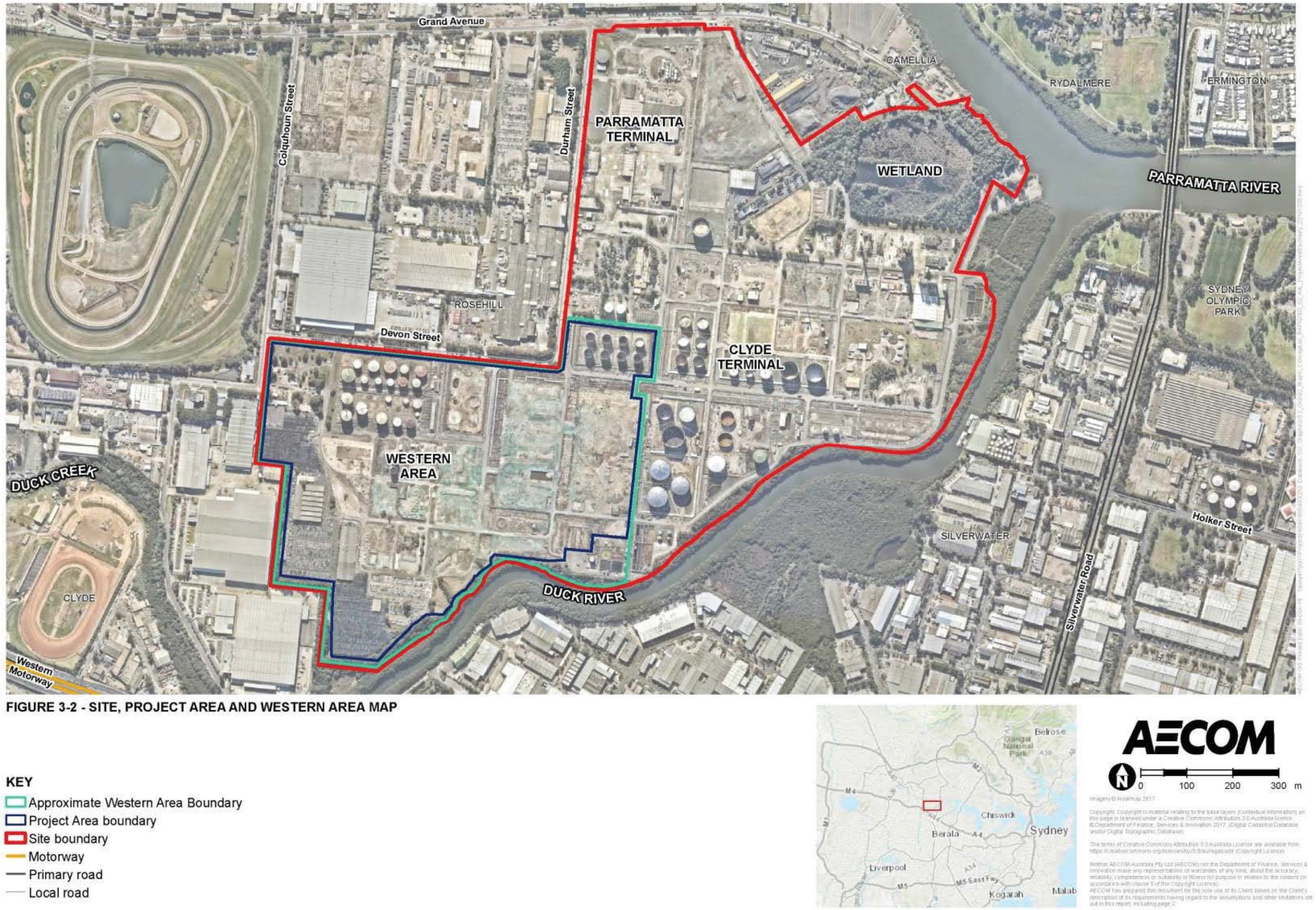


Figure 3-2 Site, Project Area and Western Area map

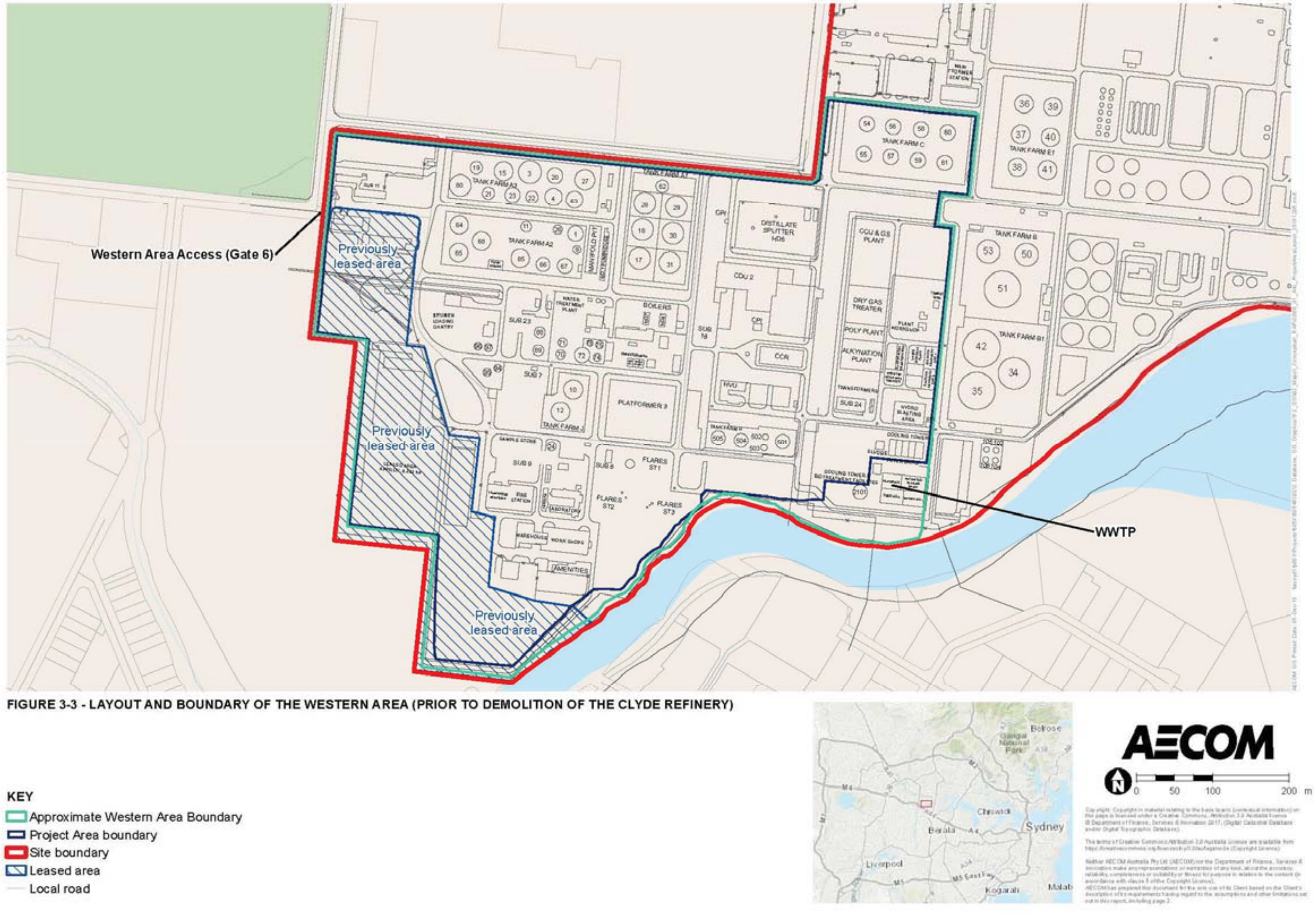


Figure 3-3 Layout and Boundary of the Western Area (prior to demolition of the Clyde Refinery)

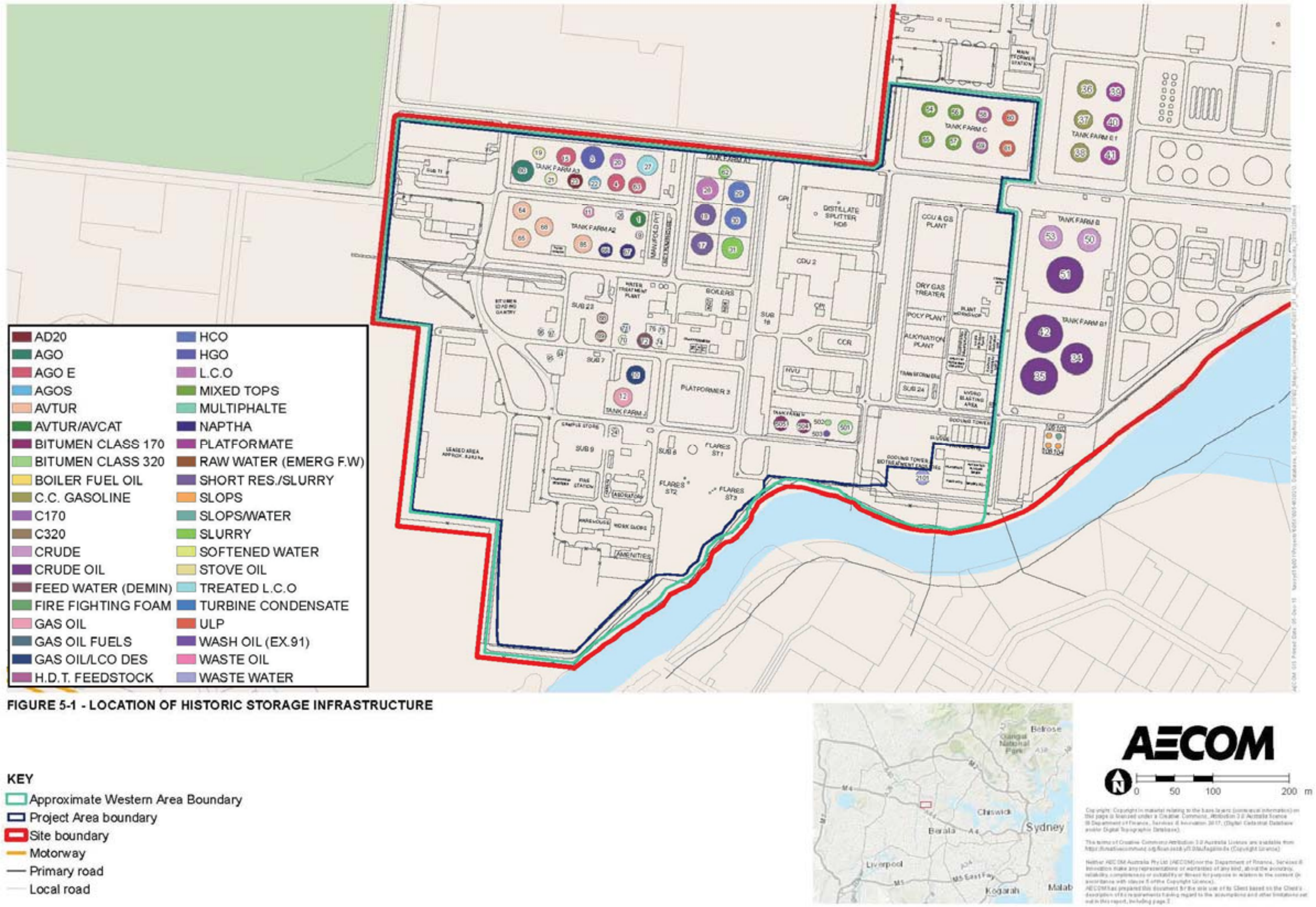


Figure 5-1 Location of Historic Storage Infrastructure

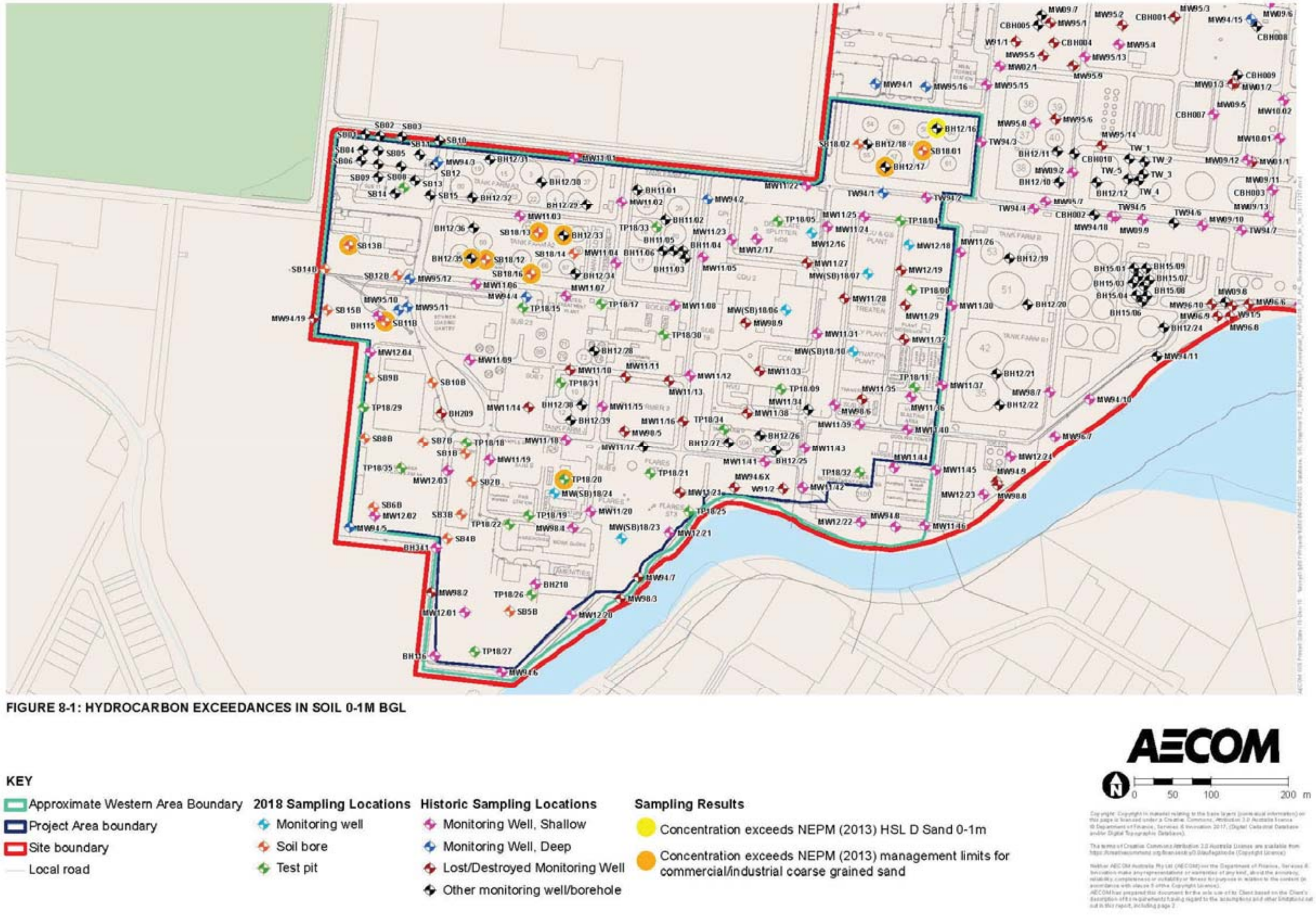


Figure 8-1 Hydrocarbon Impacts in Soil: 0-1 metre below ground level

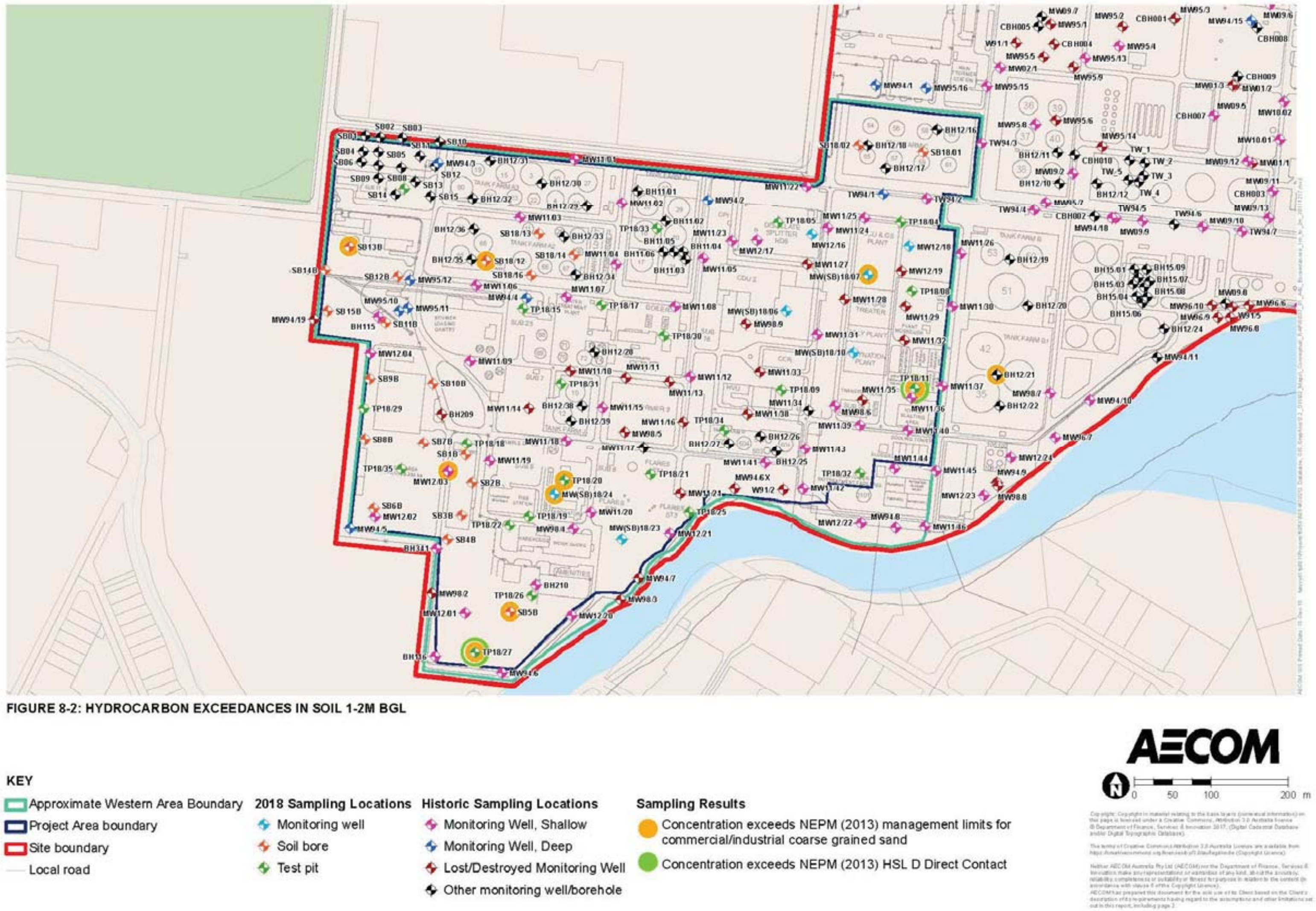


Figure 8-2 Hydrocarbon Impacts in Soil: 1-2 metres below ground level

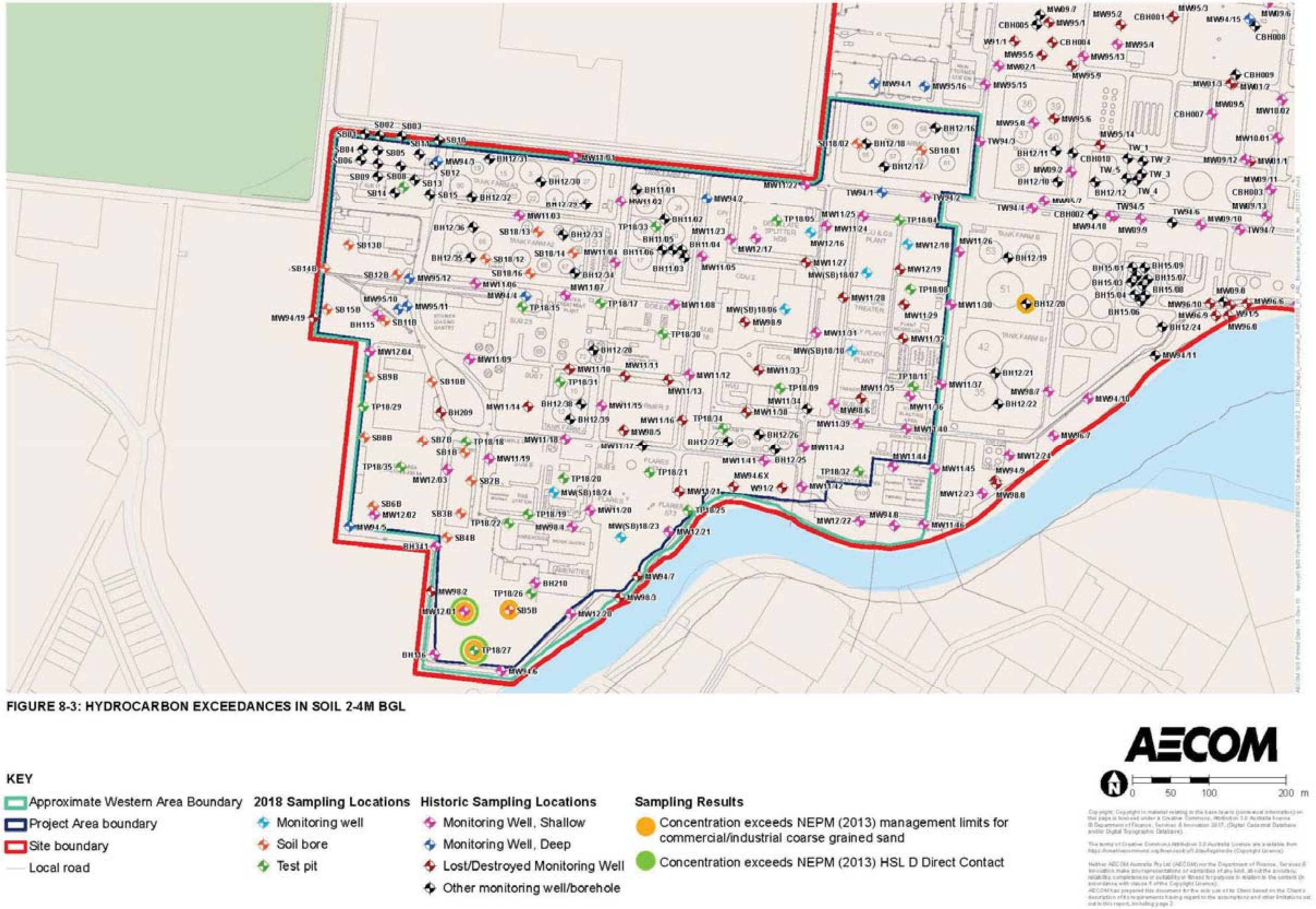


Figure 8-3 Hydrocarbon Impacts in Soil: 2-4 metres below ground level

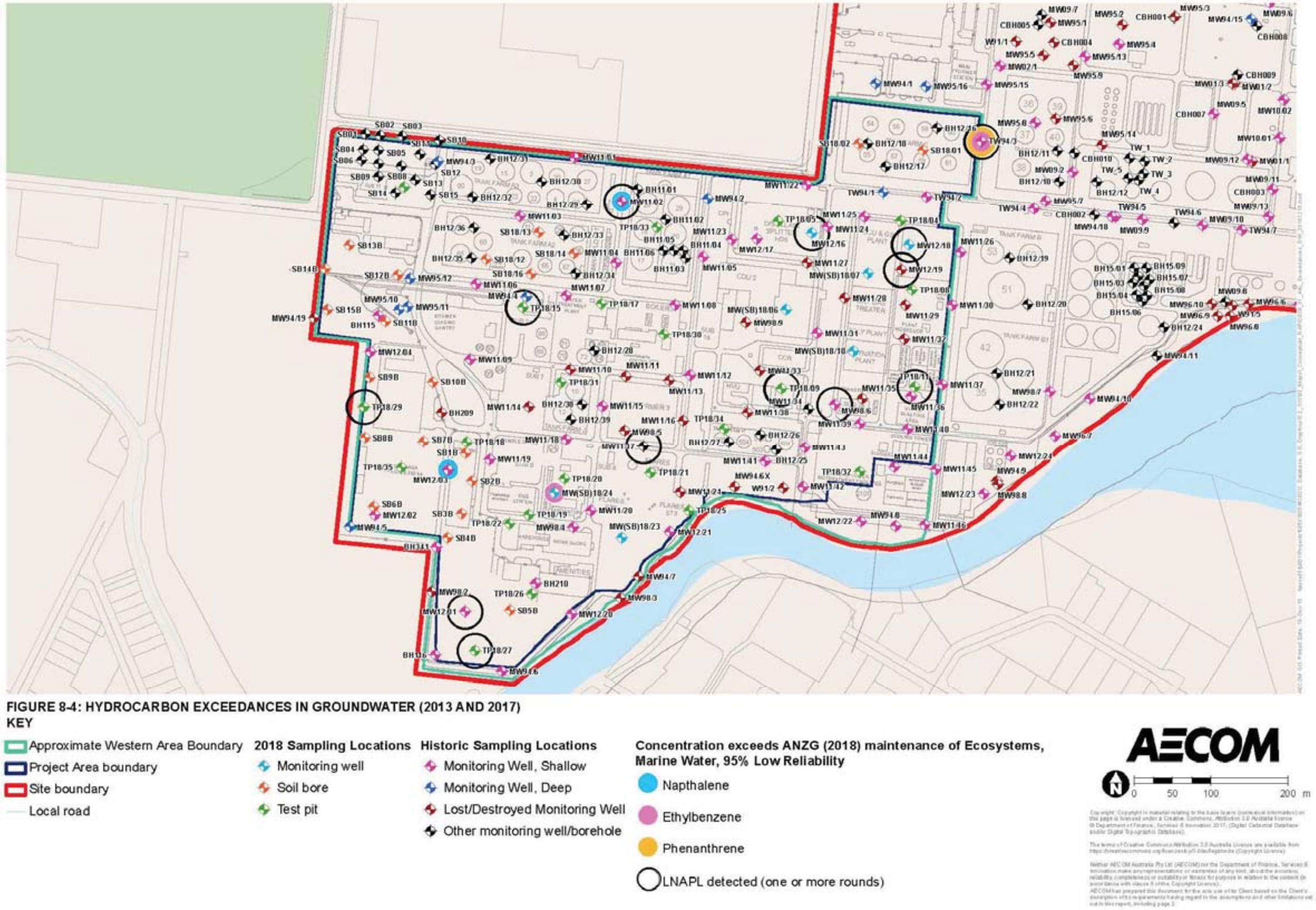


Figure 8-4 Hydrocarbon Exceedances in Groundwater (2013 and 2017)

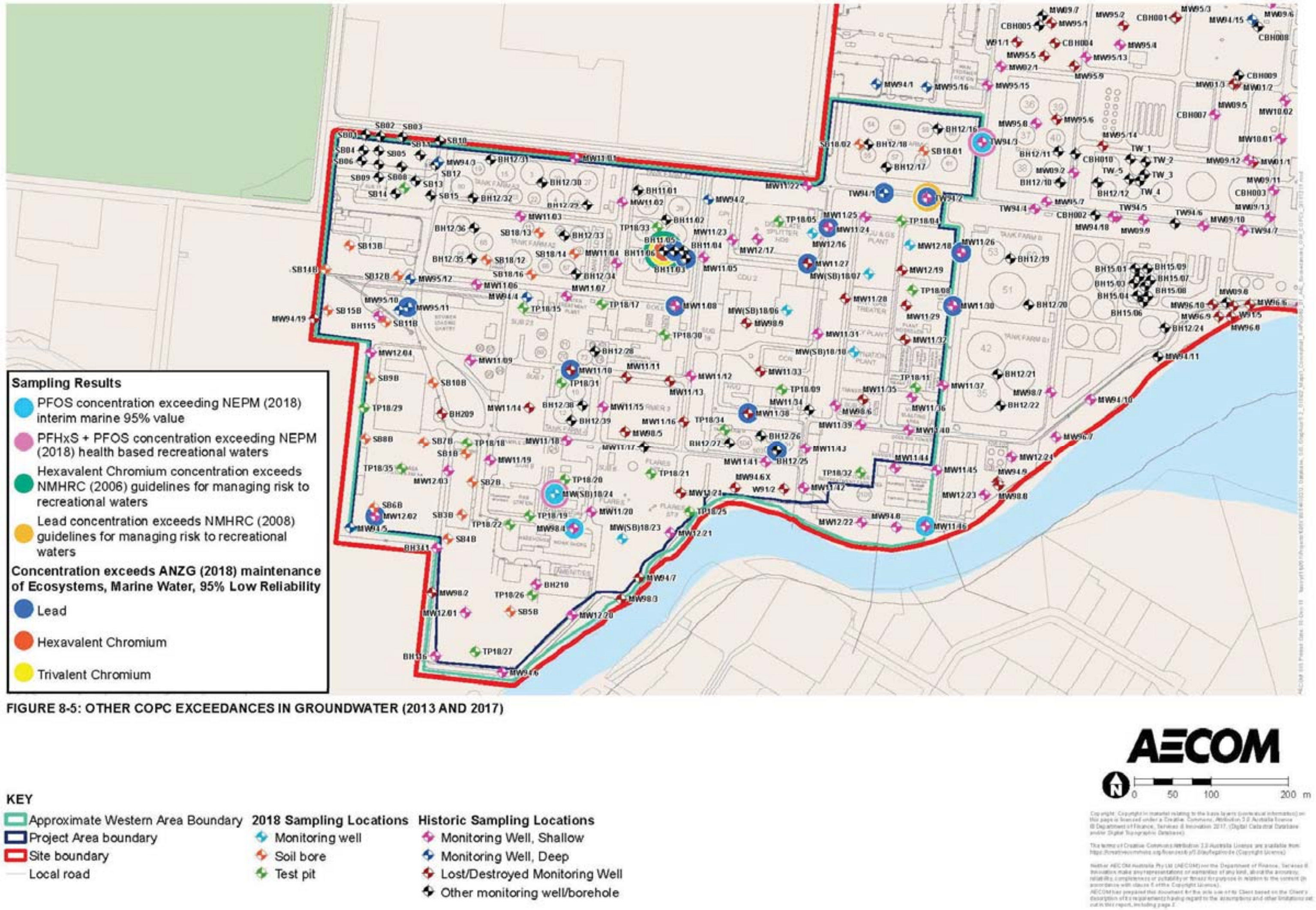


Figure 8-5 Other COPC Exceedances in Groundwater (2013 and 2017)

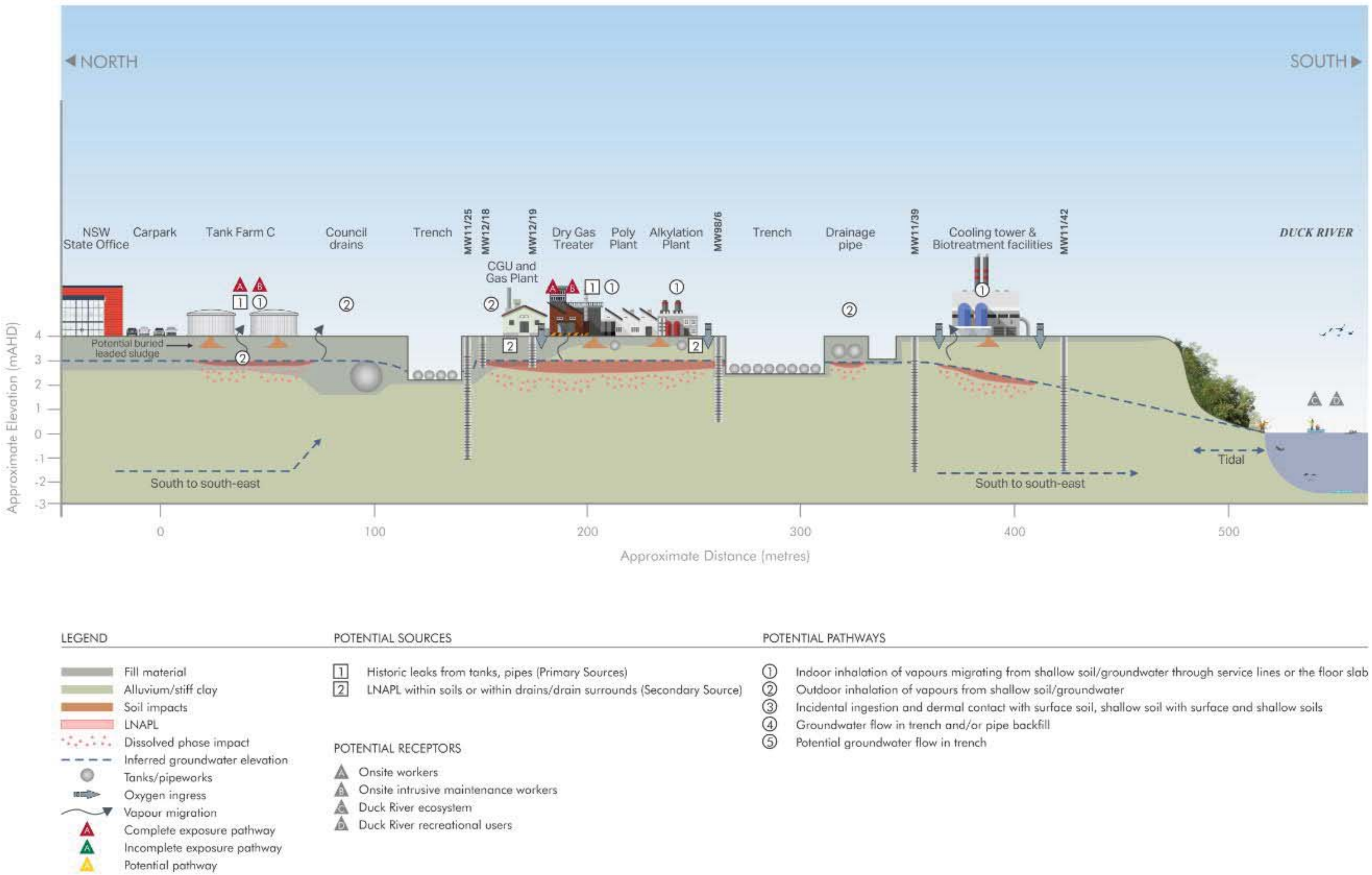


Figure 8-6 Conceptual Site Model

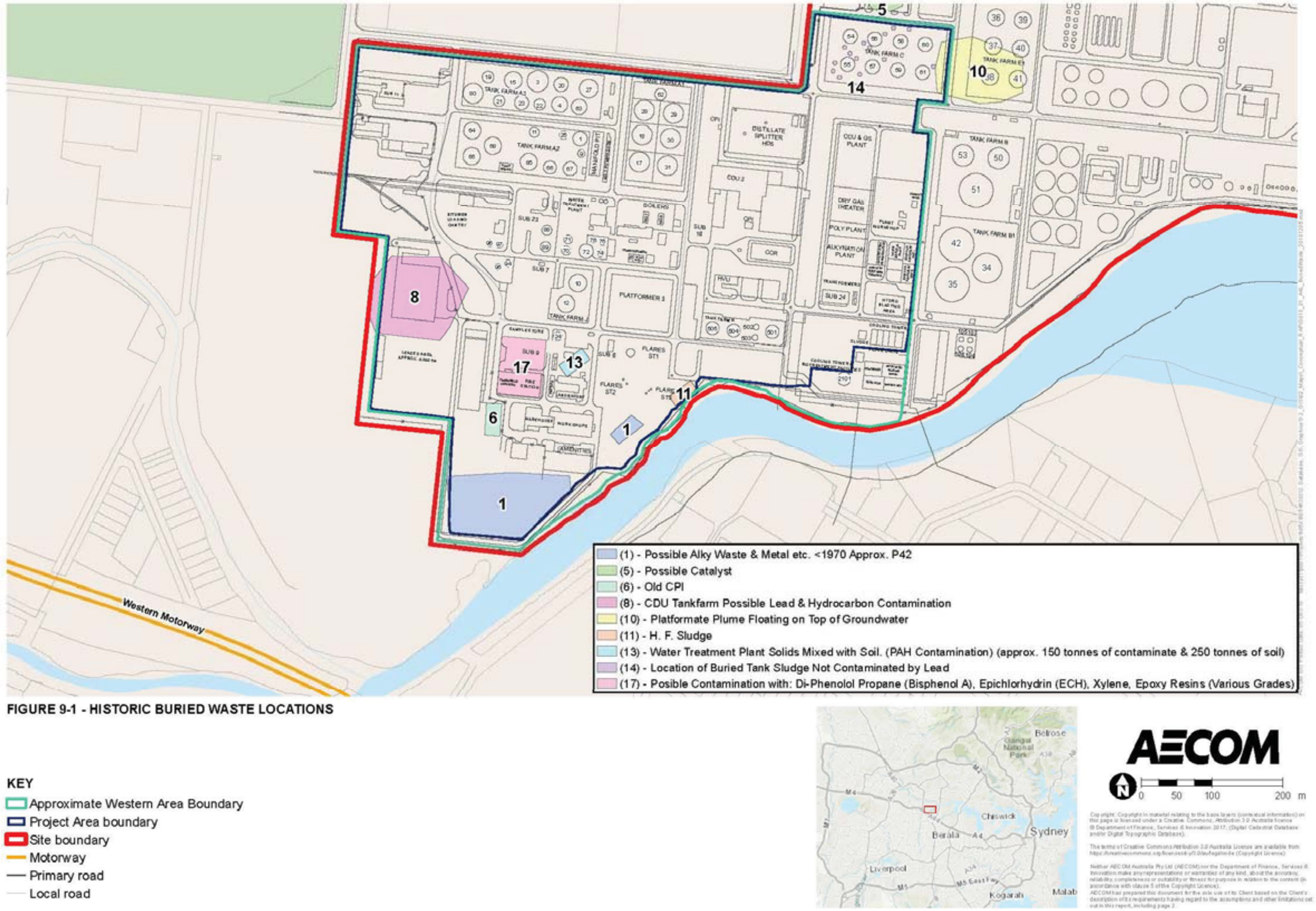


Figure 9-1 Historic buried waste locations

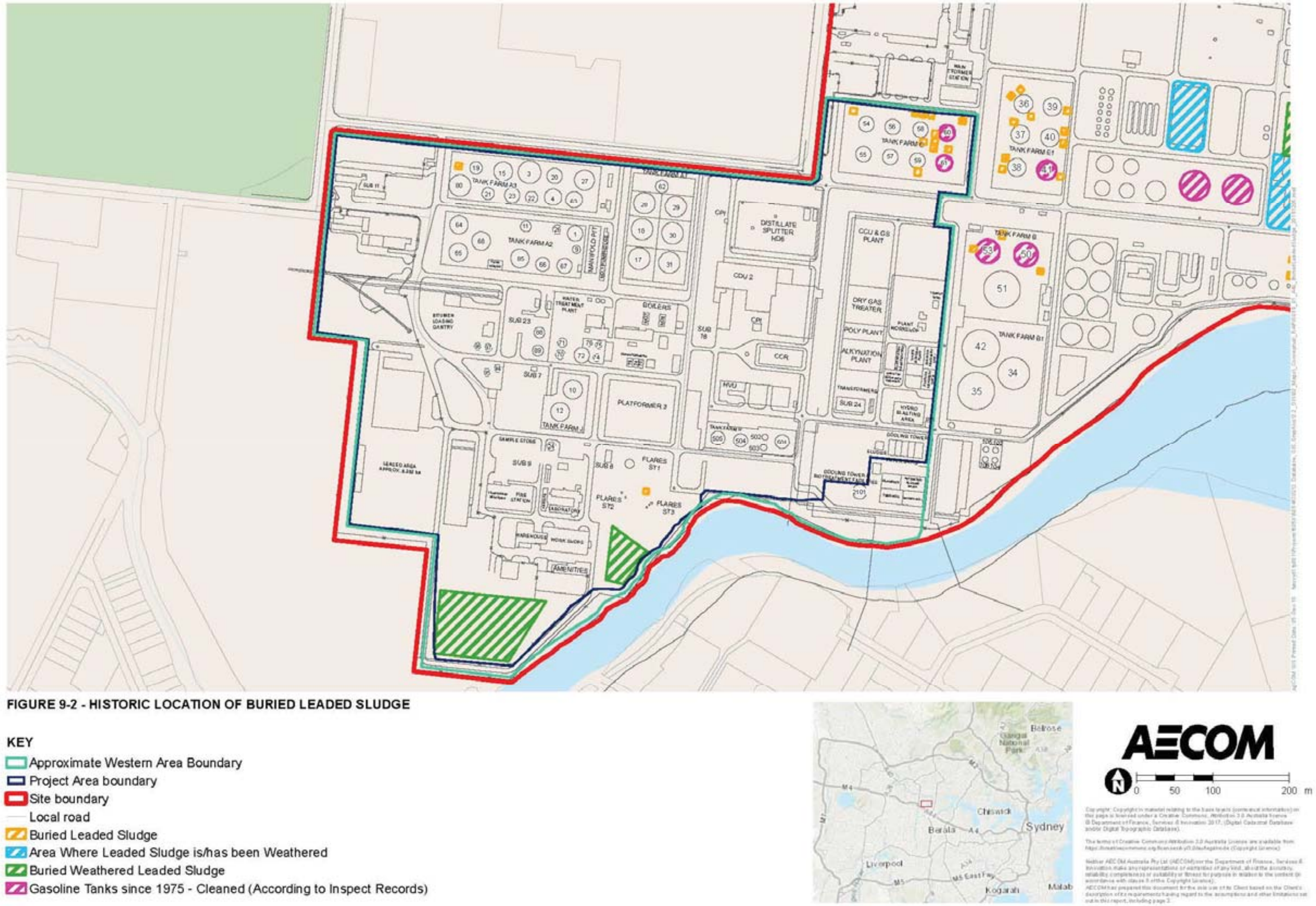


Figure 9-2 Historic location of buried leaded sludge

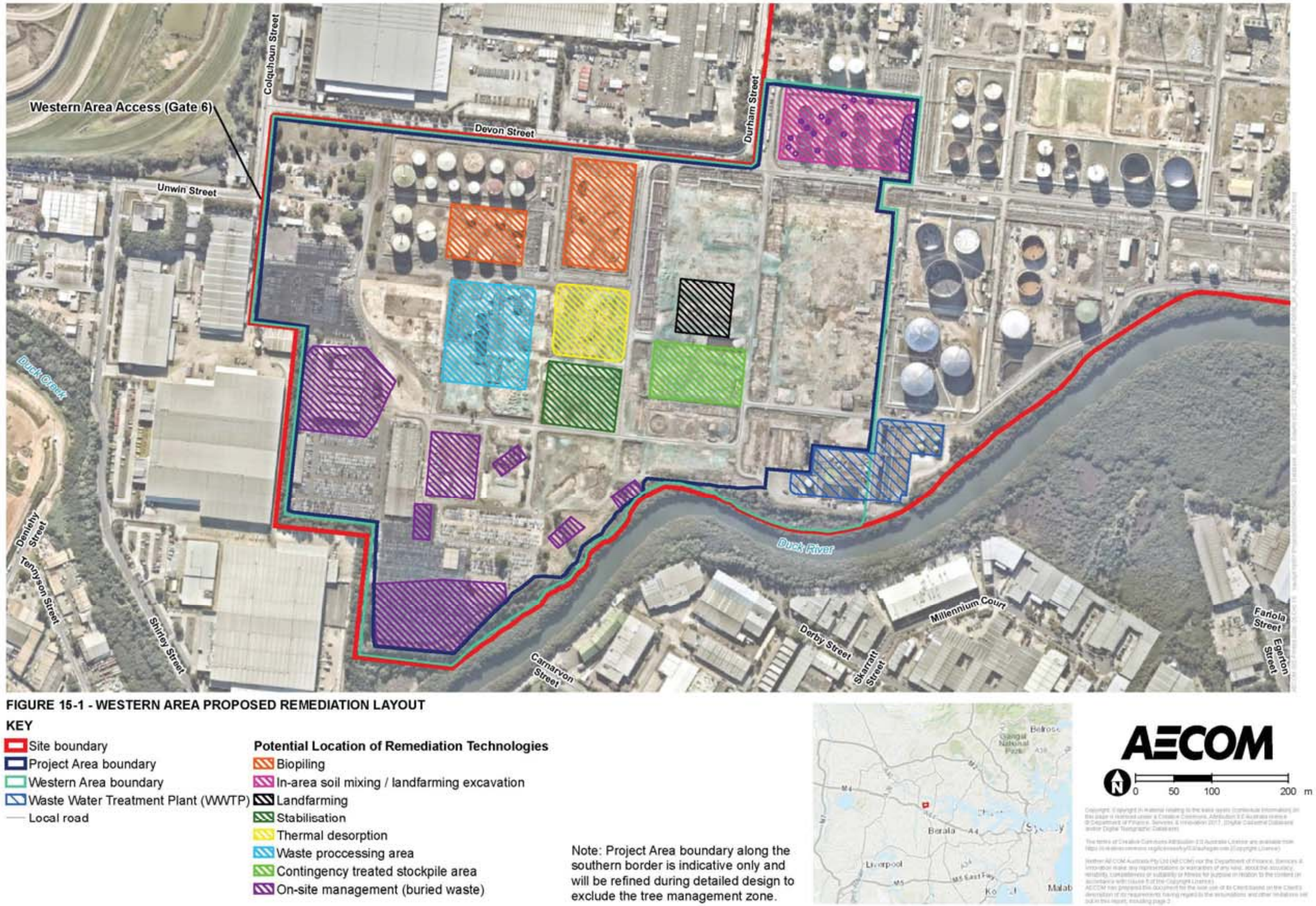


Figure 15-1 Project Area Proposed Remediation Layout

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
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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
Senior Technical Director – Contamination and Remediation
NSW EPA and WA DWER Auditor

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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.

	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.

	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.

	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”.

	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.	HIL/HSL A and B has been removed from the tables. Groundwater note has been removed
	• Groundwater ▪ The assessment criteria for PFAS was not presented in the tables.	The PFAS criteria has been added to the summary table.
	▪ Clarify why HSL D for sand 0-2 metres was not presented in the tables	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.

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	Andew Kohl	A. Kohlrusch	Andew Kohl	22/01/2019

4 July 2019

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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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Viva Energy

Clyde Western Area Remediation Project
Interim Audit Advice 03

February 2020

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Appendices

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
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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.

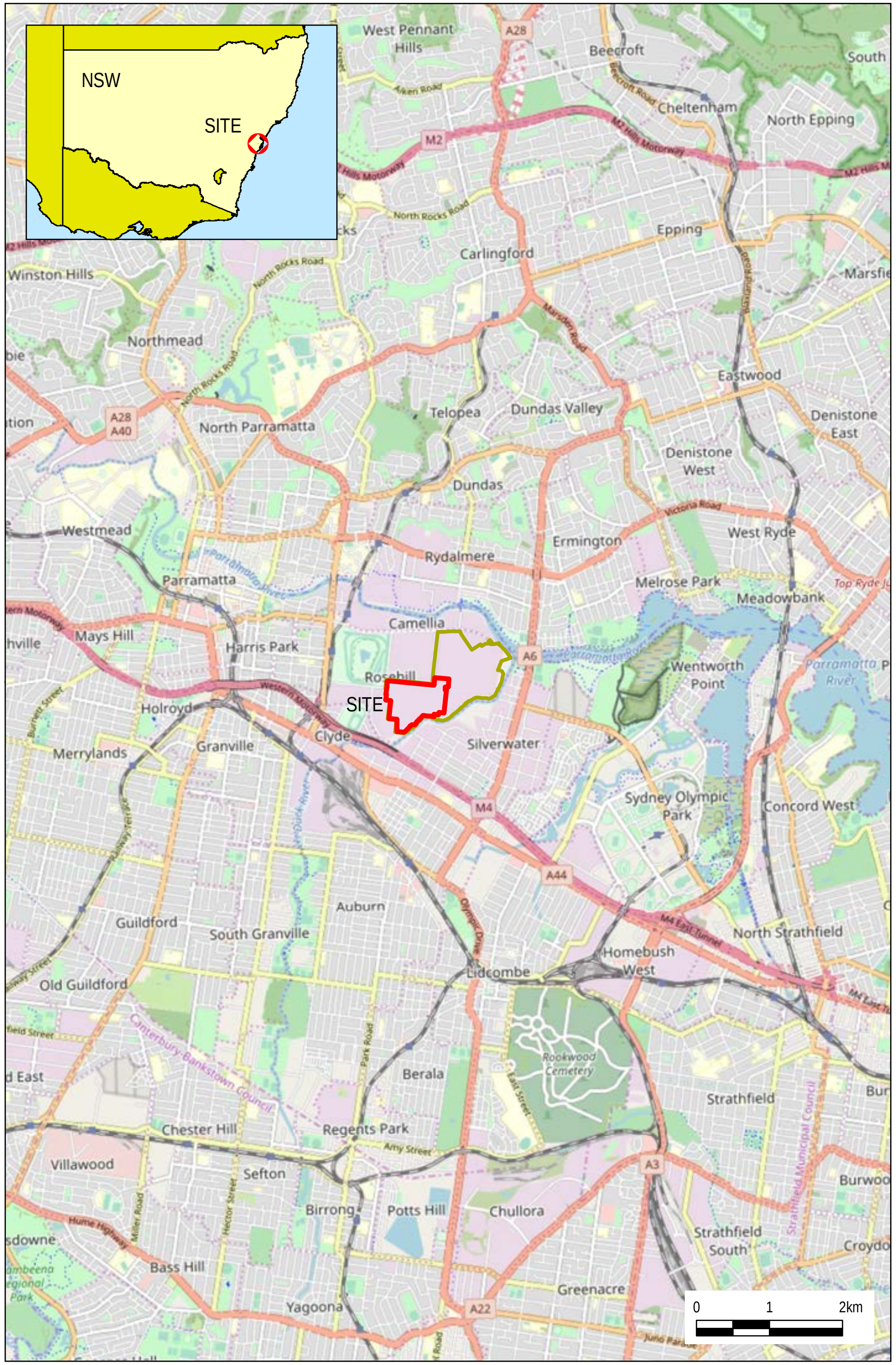
The services undertaken by the auditor, his team and GHD in connection with preparing this IAA:

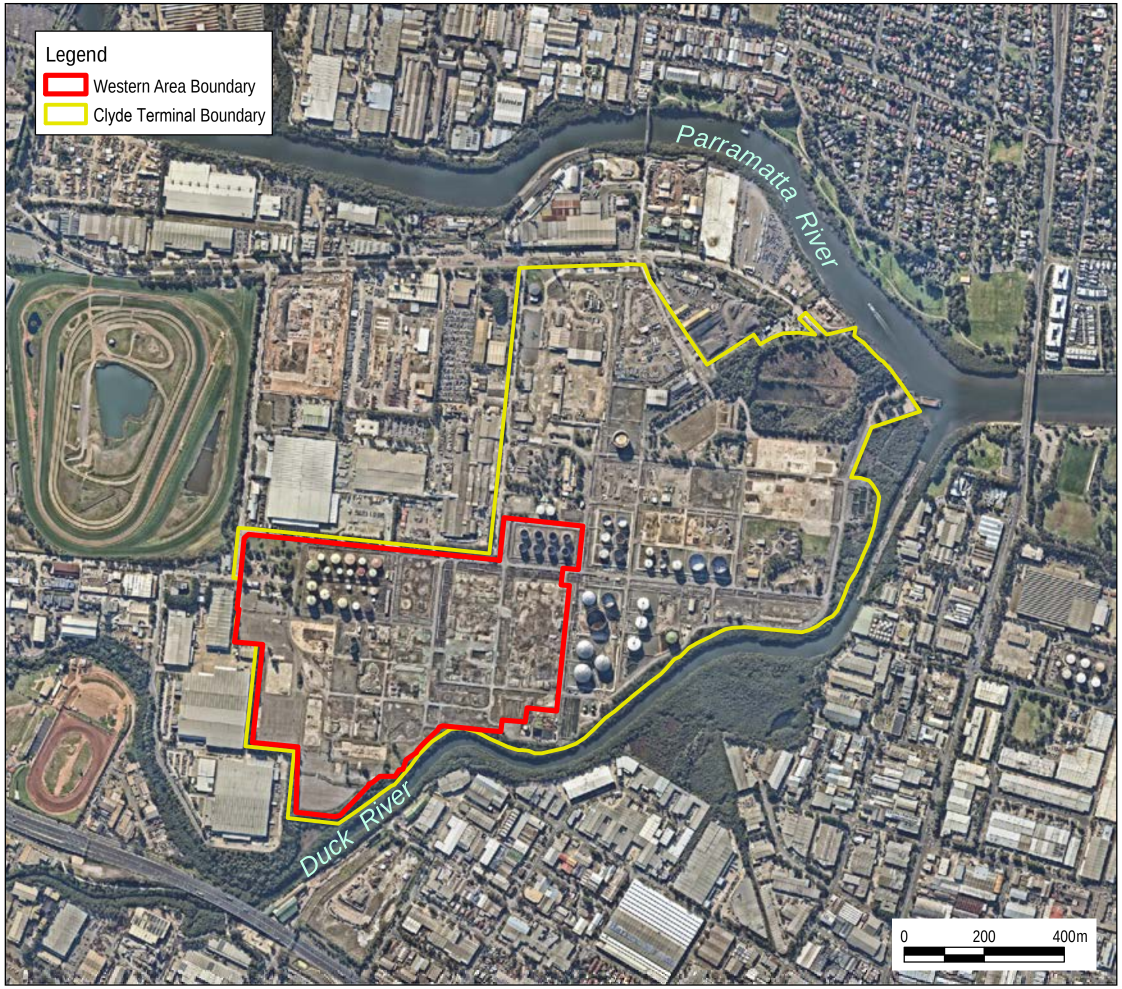
- Were undertaken in accordance with current profession practice and by reference to relevant guidelines made or approved by the NSW EPA.
- The opinions, conclusions and any recommendations in this IAA are based on assumptions made by the auditor, his team and GHD when undertaking services and preparing 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

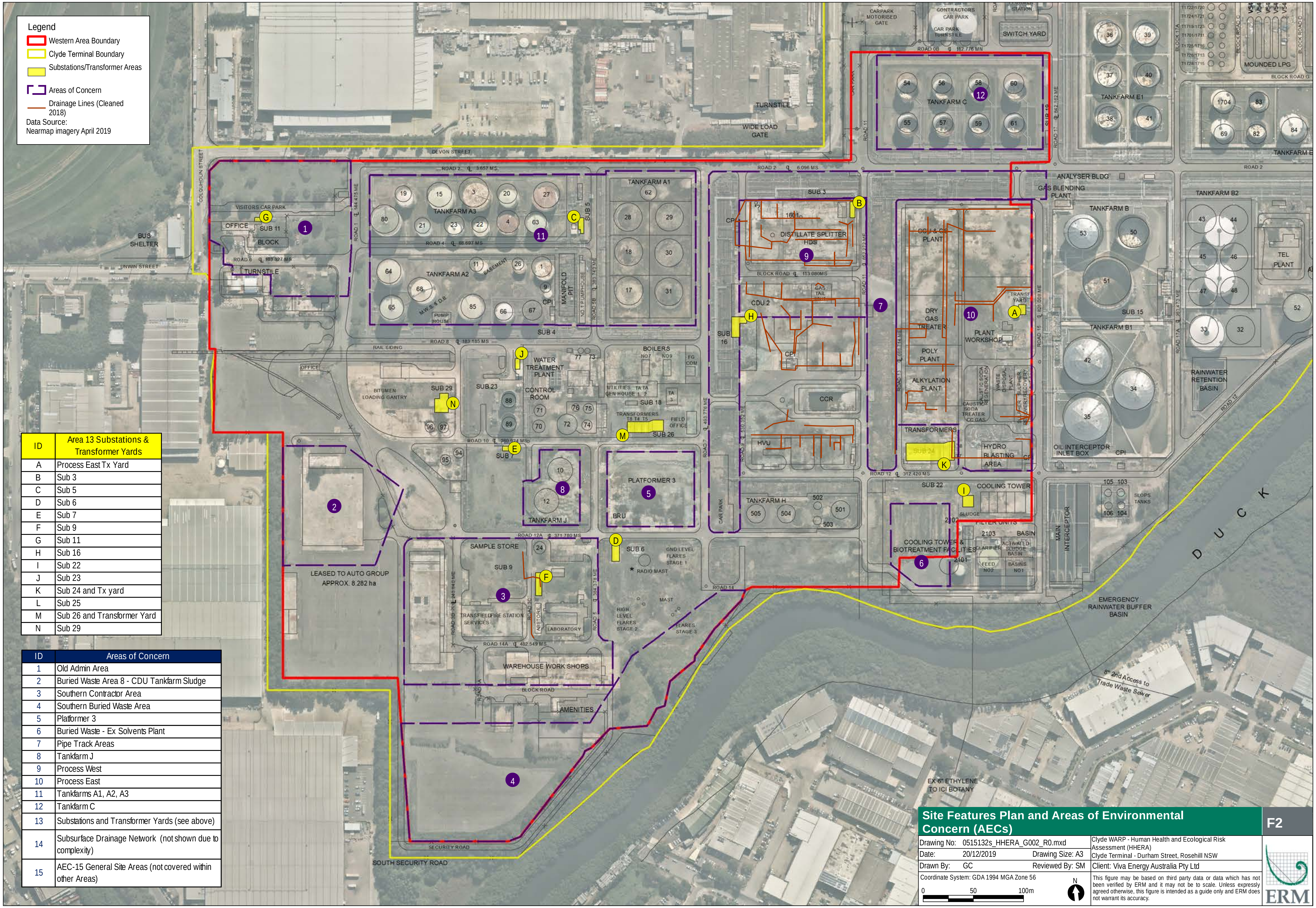
F1

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

Site Features Plan and Areas of Environmental Concern (AECs)

F2

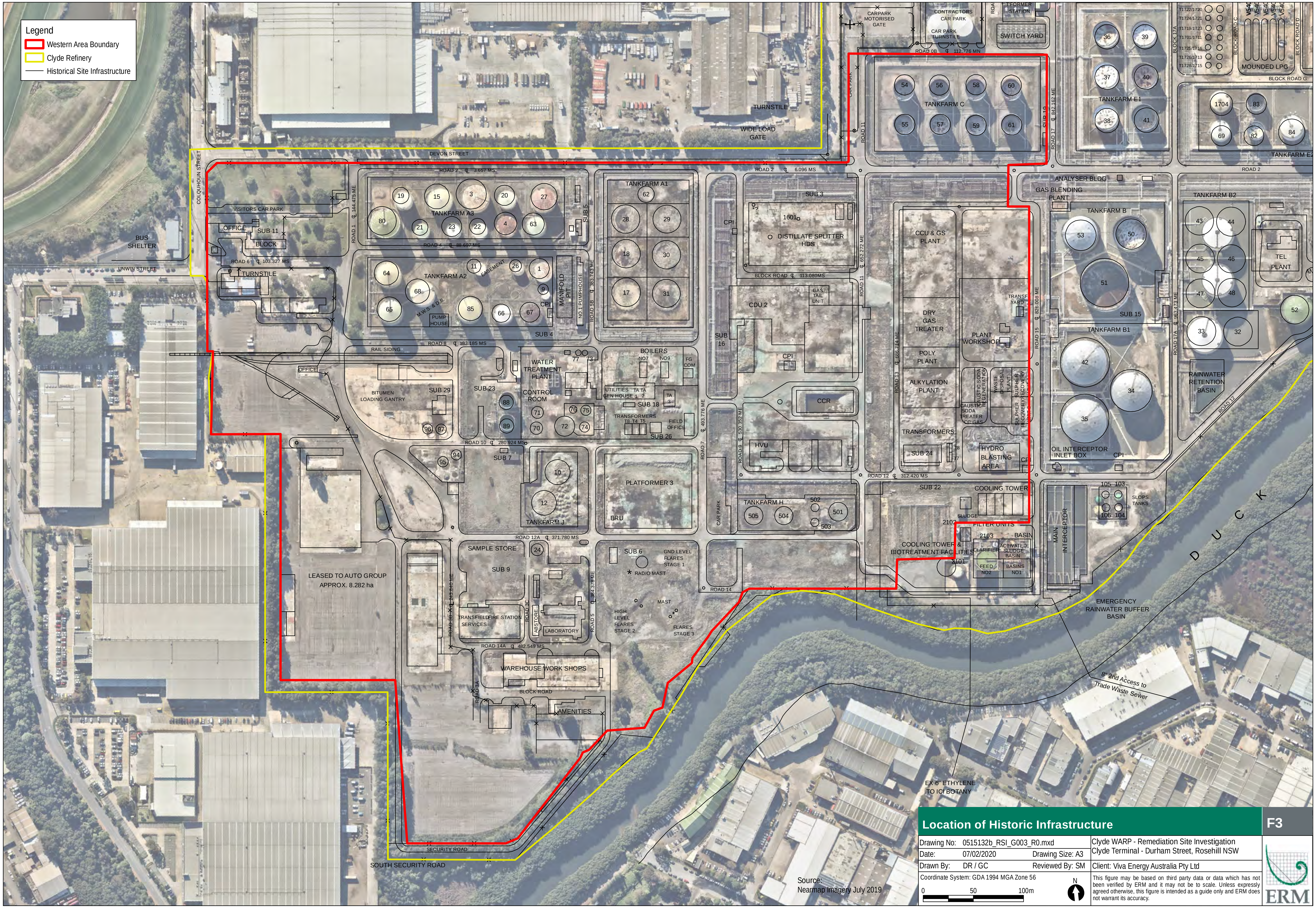


ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
B	Sub 3
C	Sub 5
D	Sub 6
E	Sub 7
F	Sub 9
G	Sub 11
H	Sub 16
I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
M	Sub 26 and Transformer Yard
N	Sub 29

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)

Drawing No: 0515132s_HHERA_G002_R0.mxd	Clyde WARP - Human Health and Ecological Risk Assessment (HHERA) Clyde Terminal - Durham Street, Rosehill NSW
Date: 20/12/2019 Drawing Size: A3	Client: Viva Energy Australia Pty Ltd
Drawn By: GC Reviewed By: SM	
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



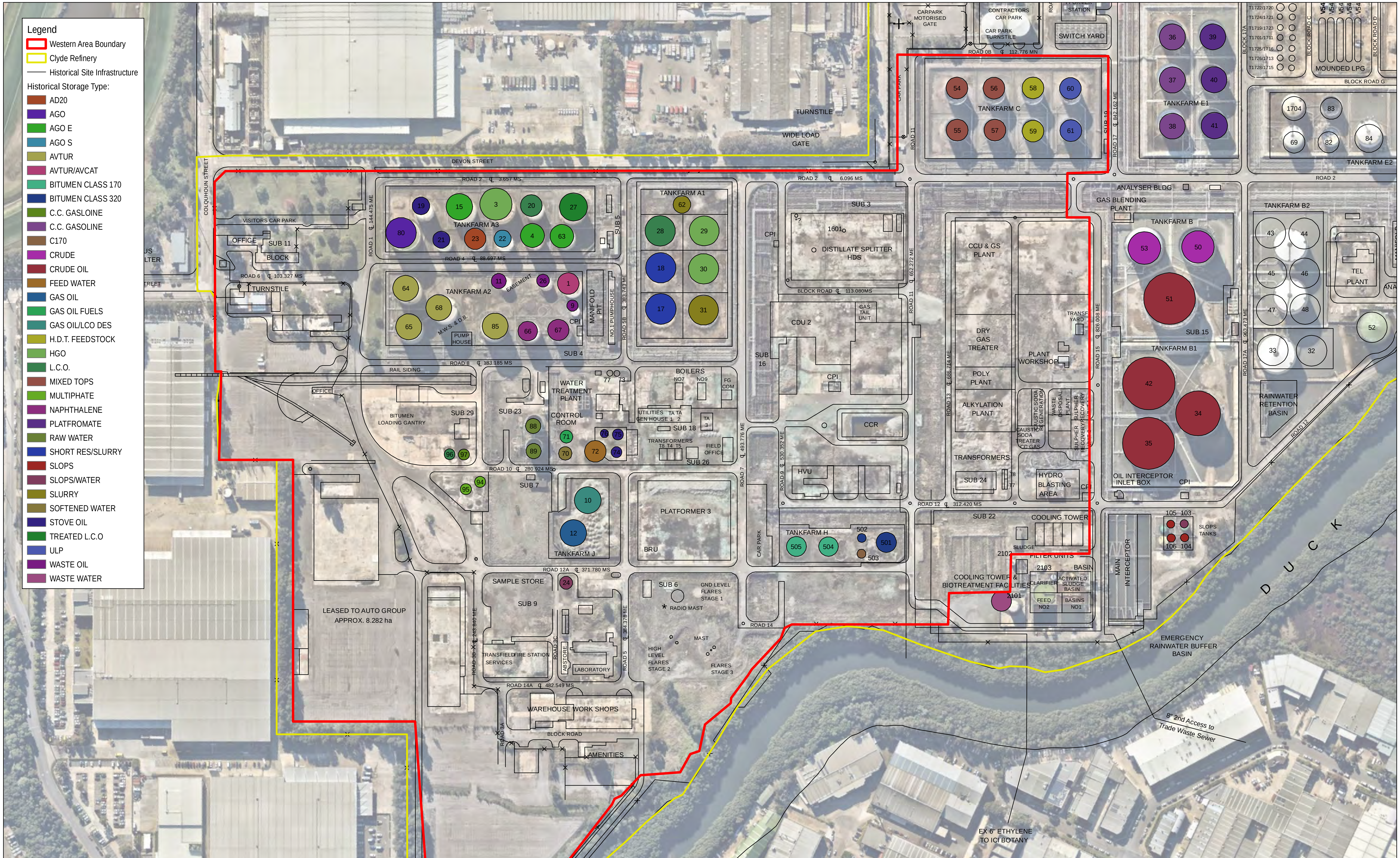
Location of Historic Infrastructure

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.

0 50 100m

ERM



Location of Historic Storage Infrastructure

F4

Drawing No: 0515132b_RSI_G004_R0.mxd
Date: 07/02/2020 Drawing Size: A3
Drawn By: DR / 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

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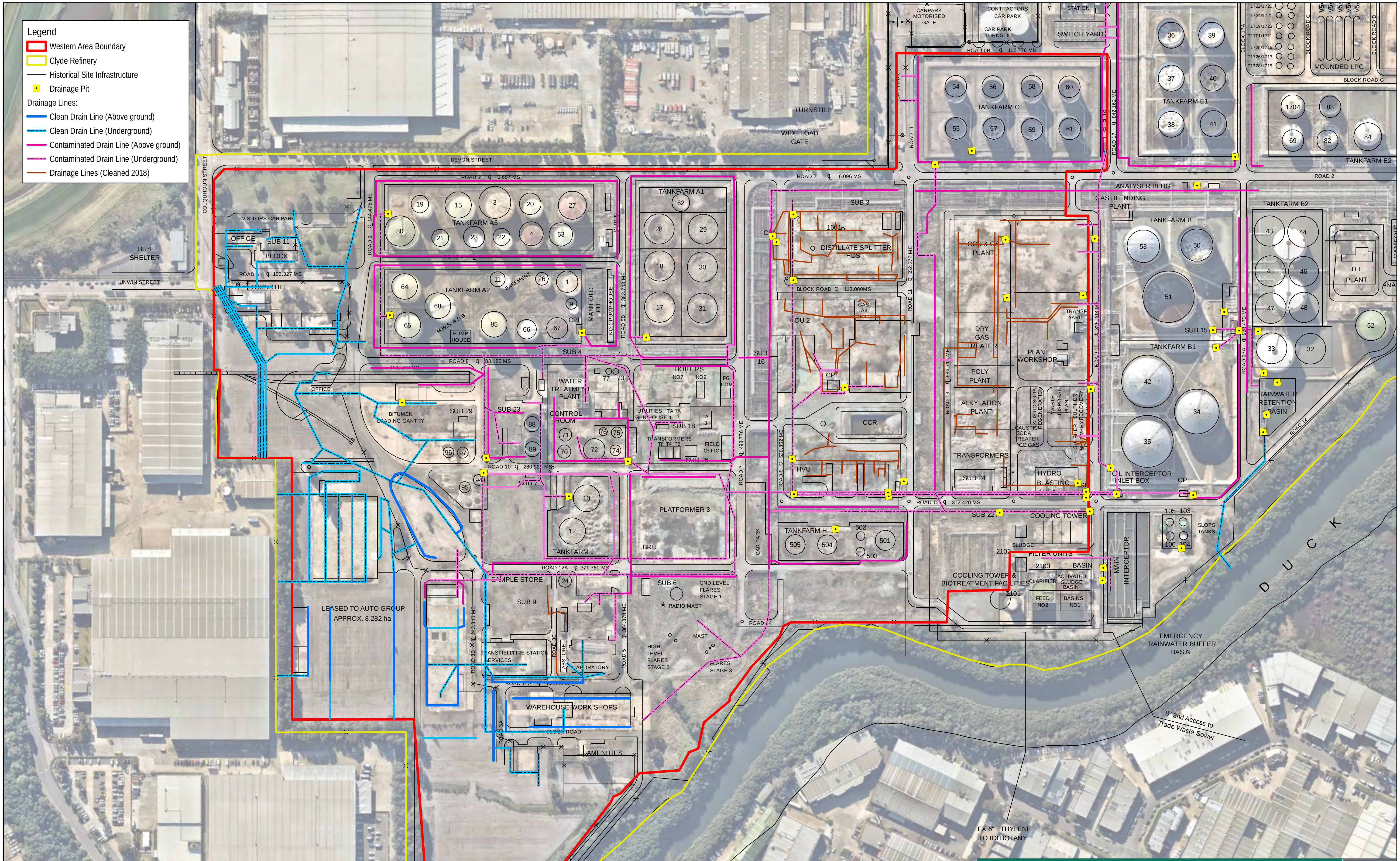
ERM



Site Drainage Infrastructure

F5

Drawing No: 0515132b_RSI_G005_R0.mxd	Clyde WARP - Remediation Site Investigation
Date: 07/02/2020 Drawing Size: A3	Clyde Terminal - Durham Street, Rosehill NSW
Drawn By: DR / GC Reviewed By: SM	Client: Viva Energy Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 50 100m

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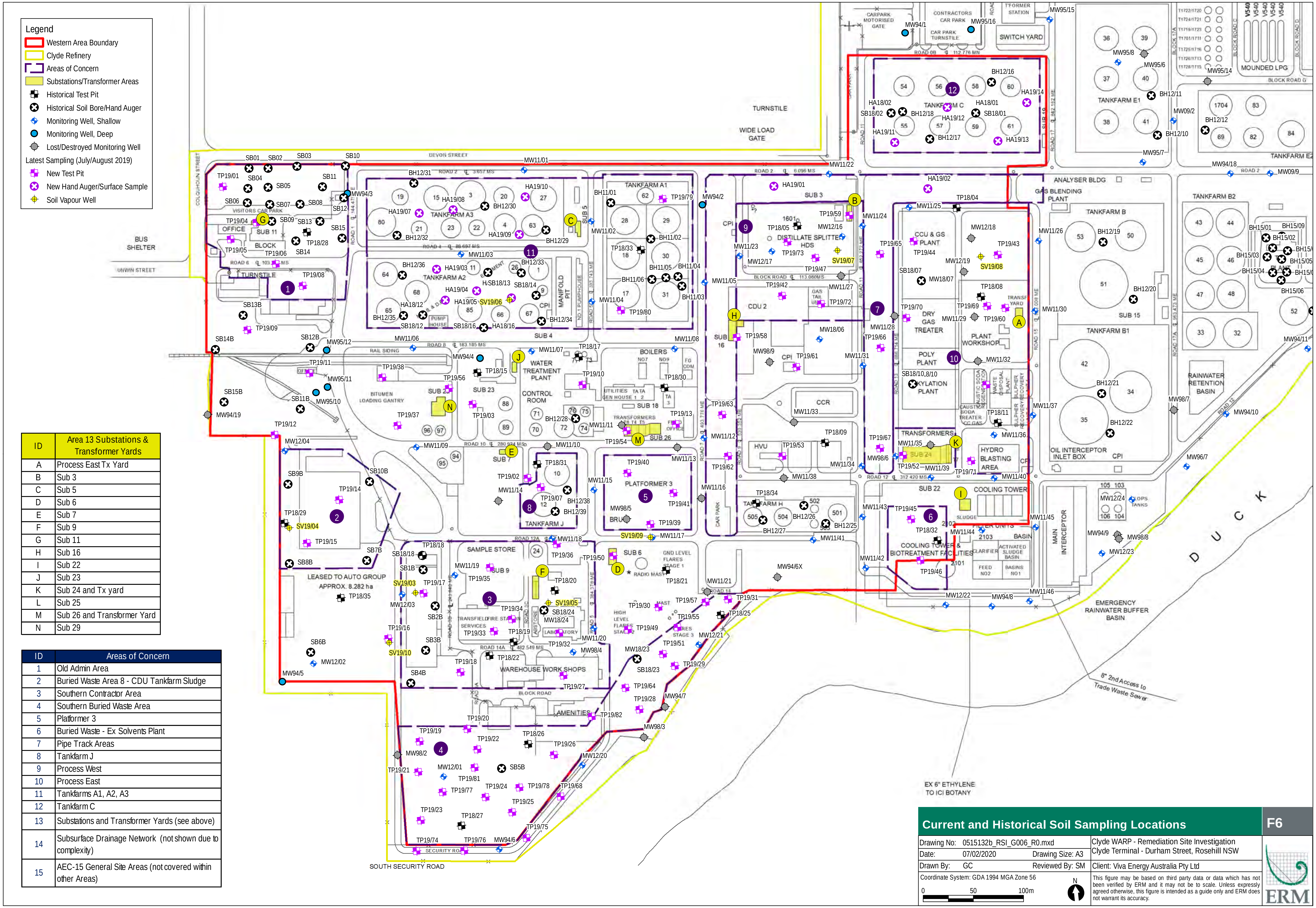
ERM



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)

Current and Historical Soil Sampling Locations

F6

Drawing No: 0515132b_RSI_G006_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

Clyde WARP - Remediation Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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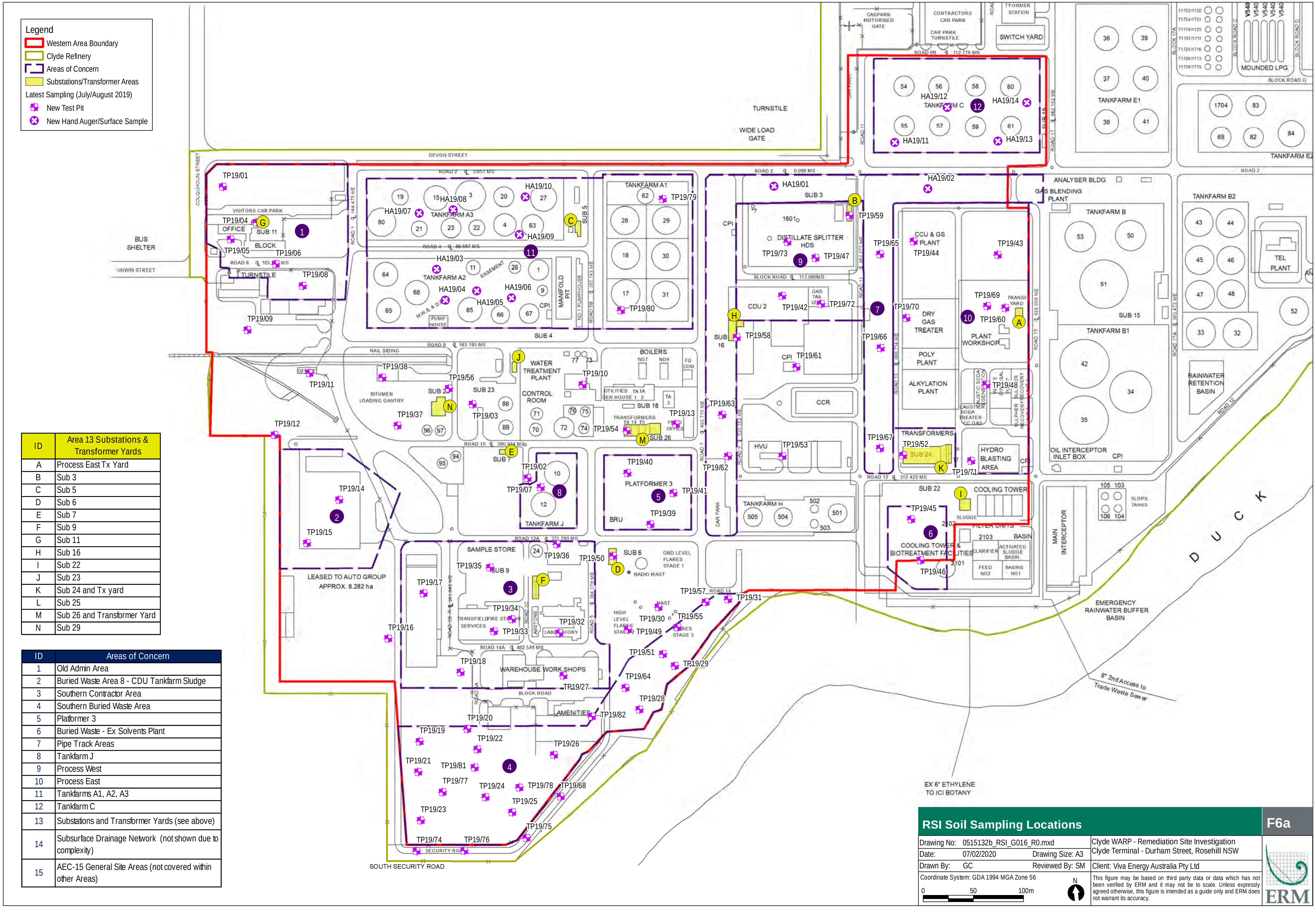
ERM



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
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I	Sub 22
J	Sub 23
K	Sub 24 and Tx yard
L	Sub 25
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N	Sub 29

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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)

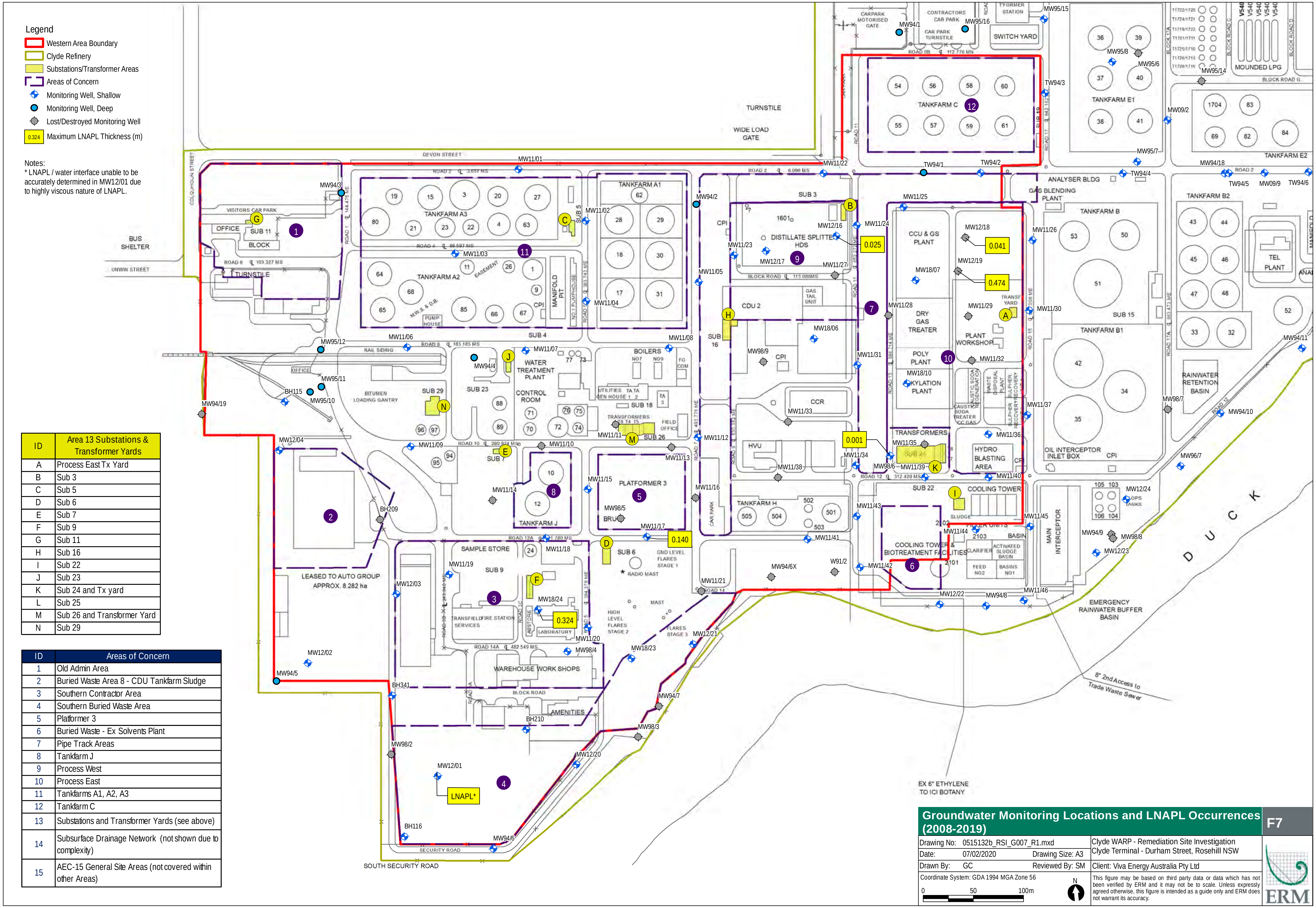
RSI Soil Sampling Locations

F6a

Drawing No: 0515132b_RSI_G016_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

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.

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

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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)

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			

0 50 100m

N

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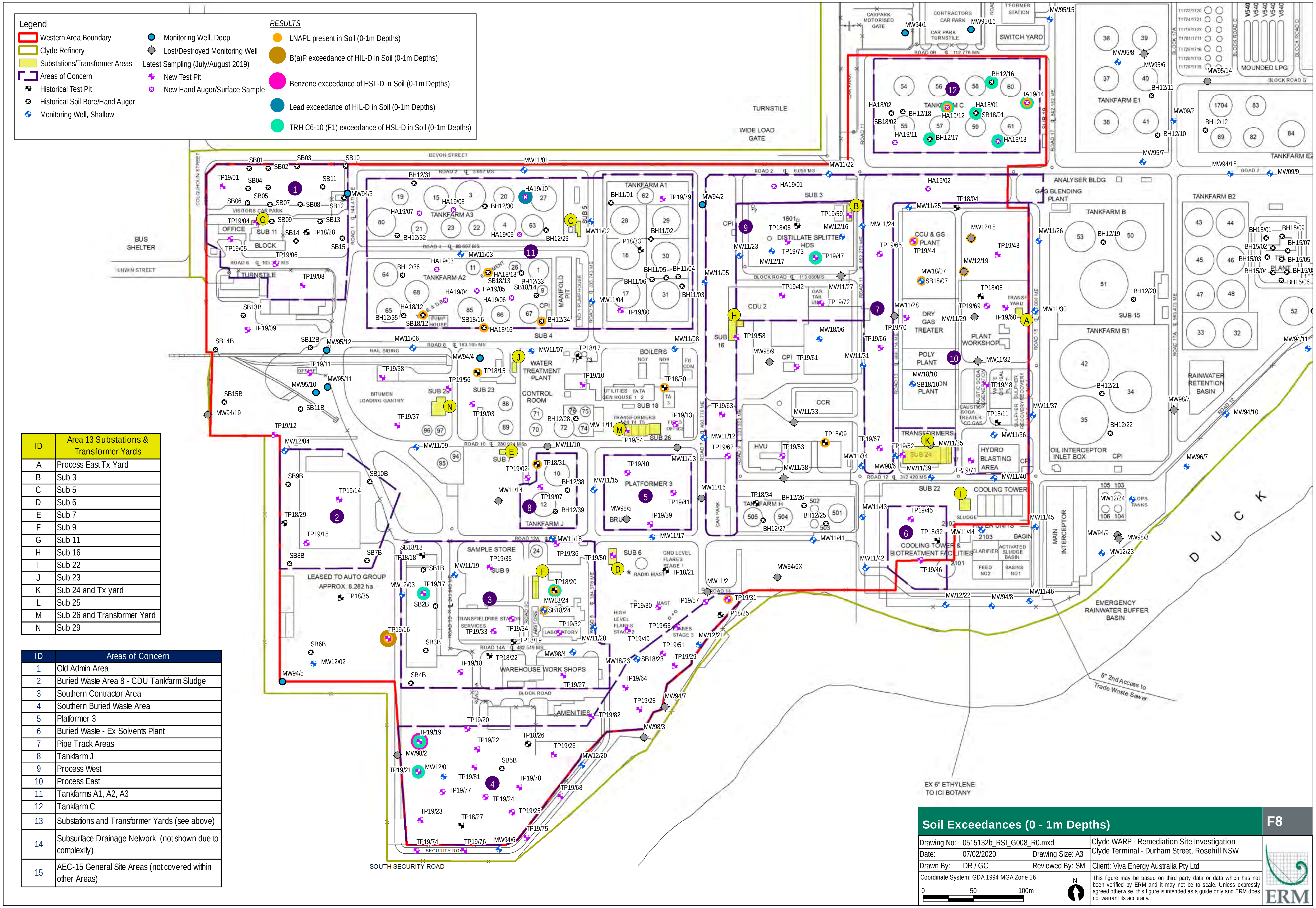
ERM



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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J	Sub 23
K	Sub 24 and Tx yard
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M	Sub 26 and Transformer Yard
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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)

Soil Exceedances (0 - 1m Depths)

F8

Drawing No: 0515132b_RSI_G008_R0.mxd
Date: 07/02/2020 Drawing Size: A3
Drawn By: DR / 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

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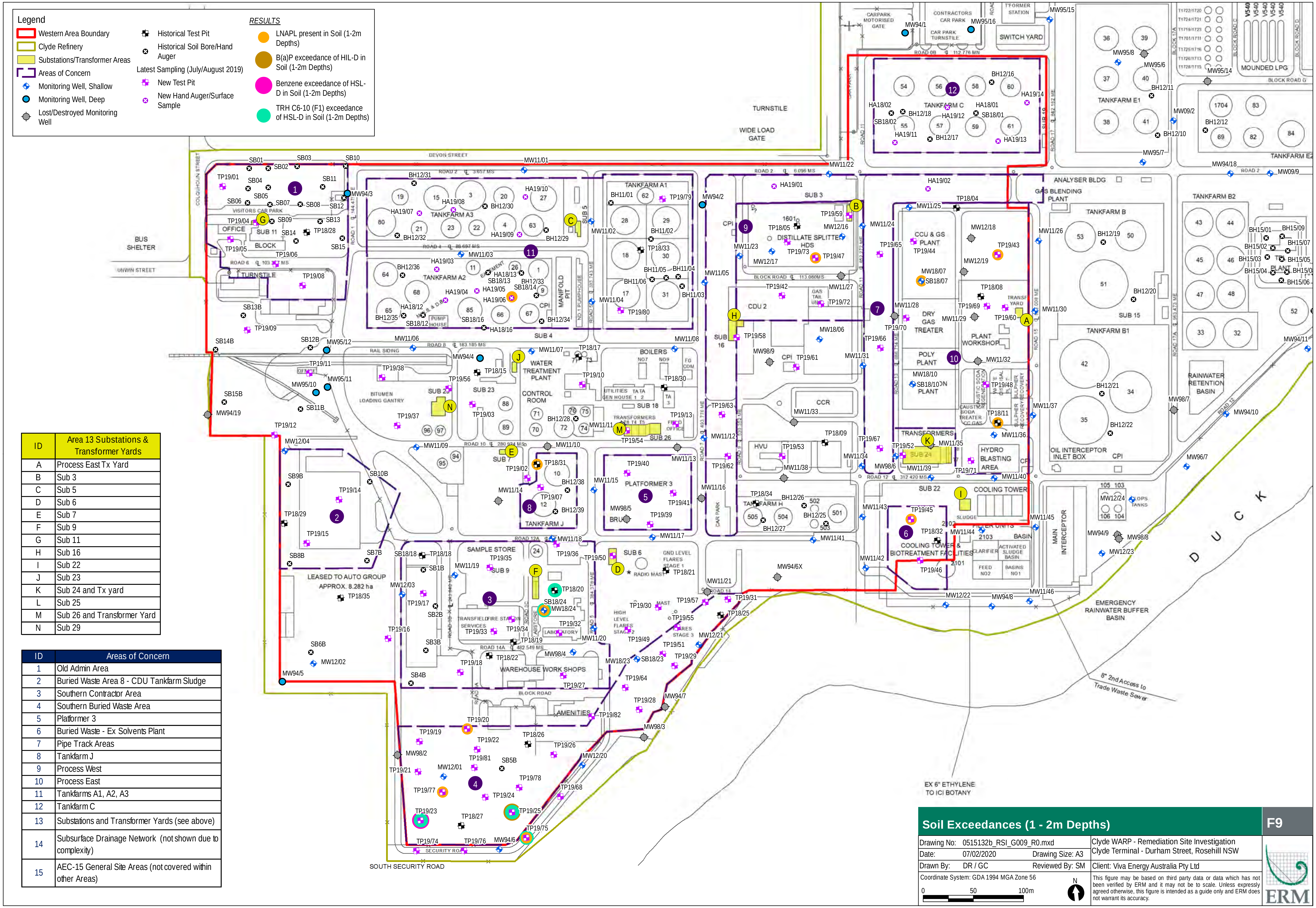
ERM



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
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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)

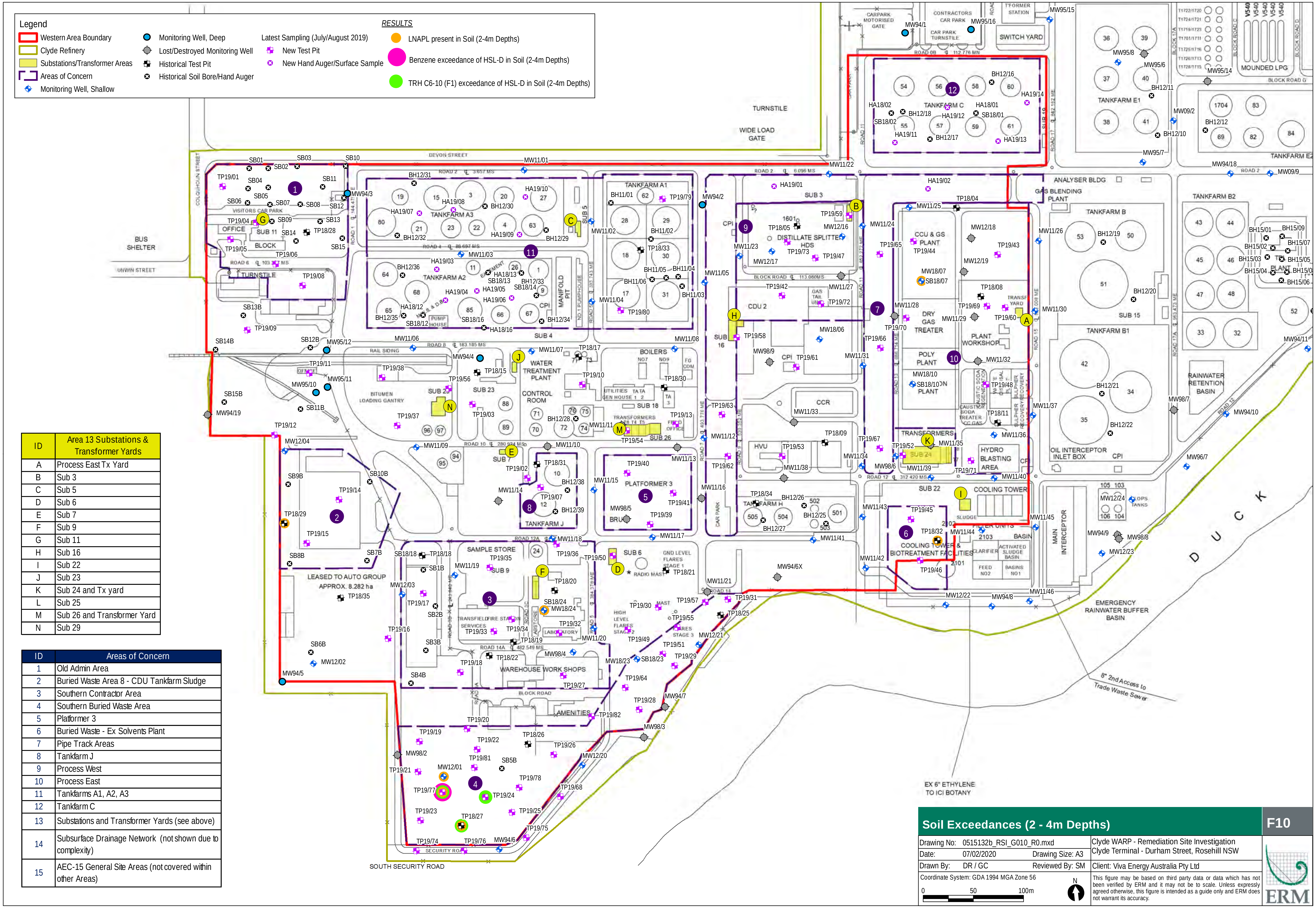
Soil Exceedances (1 - 2m Depths)

F9

Drawing No: 0515132b_RSI_G009_R0.mxd	Clyde WARP - Remediation Site Investigation
Date: 07/02/2020 Drawing Size: A3	Clyde Terminal - Durham Street, Rosehill NSW
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

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
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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)

Soil Exceedances (2 - 4m Depths)

F10

Drawing No: 0515132b_RSI_G010_R0.mxd
Date: 07/02/2020 Drawing Size: A3
Drawn By: DR / GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 50 100m

Clyde WARP - Remediation Site Investigation
Clyde Terminal - Durham Street, Rosehill NSW

Client: Viva Energy Australia Pty Ltd

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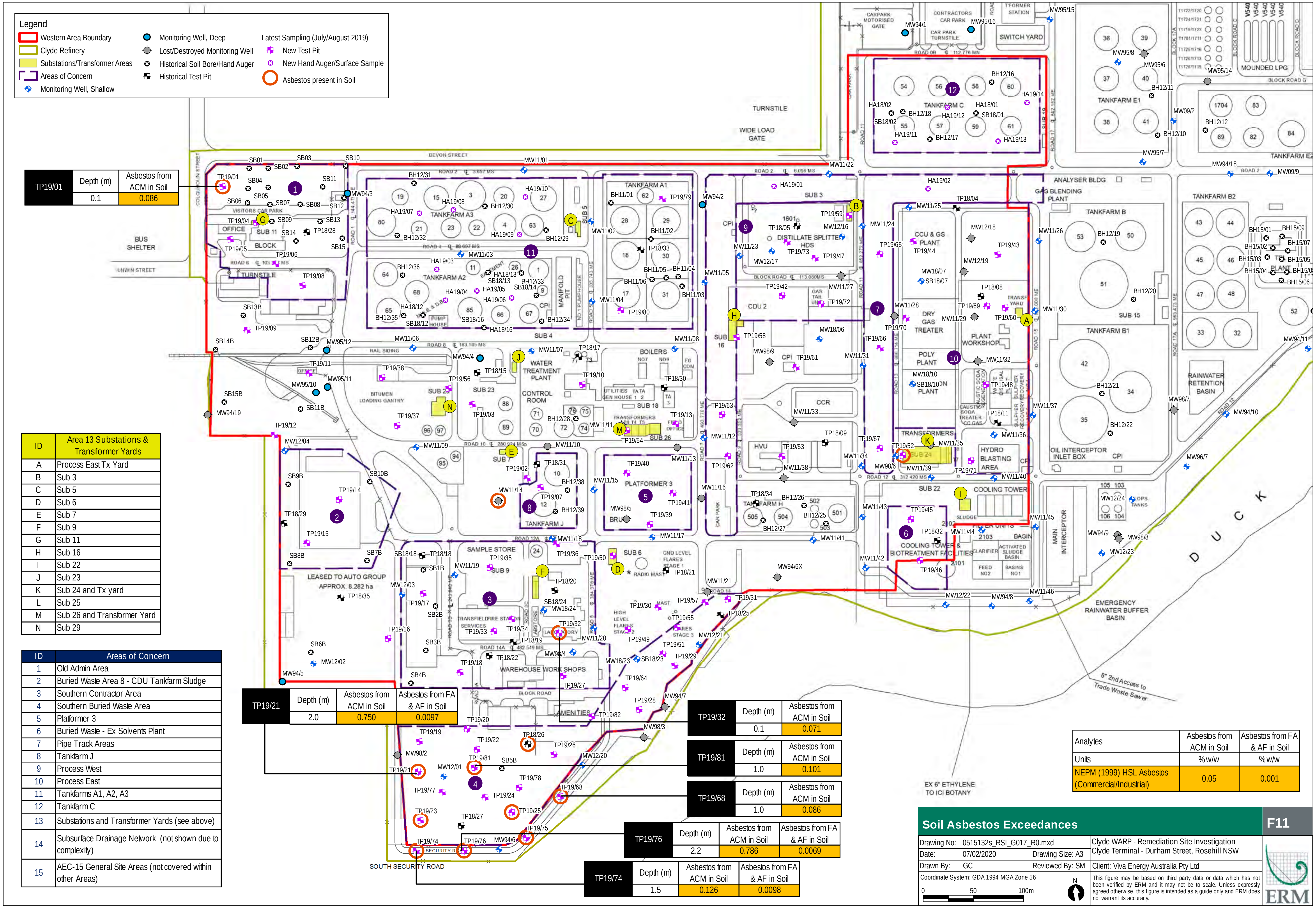
ERM



TP19/01	Depth (m)	Asbestos from ACM in Soil
	0.1	0.086

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

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A	Process East Tx Yard
B	Sub 3
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E	Sub 7
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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)

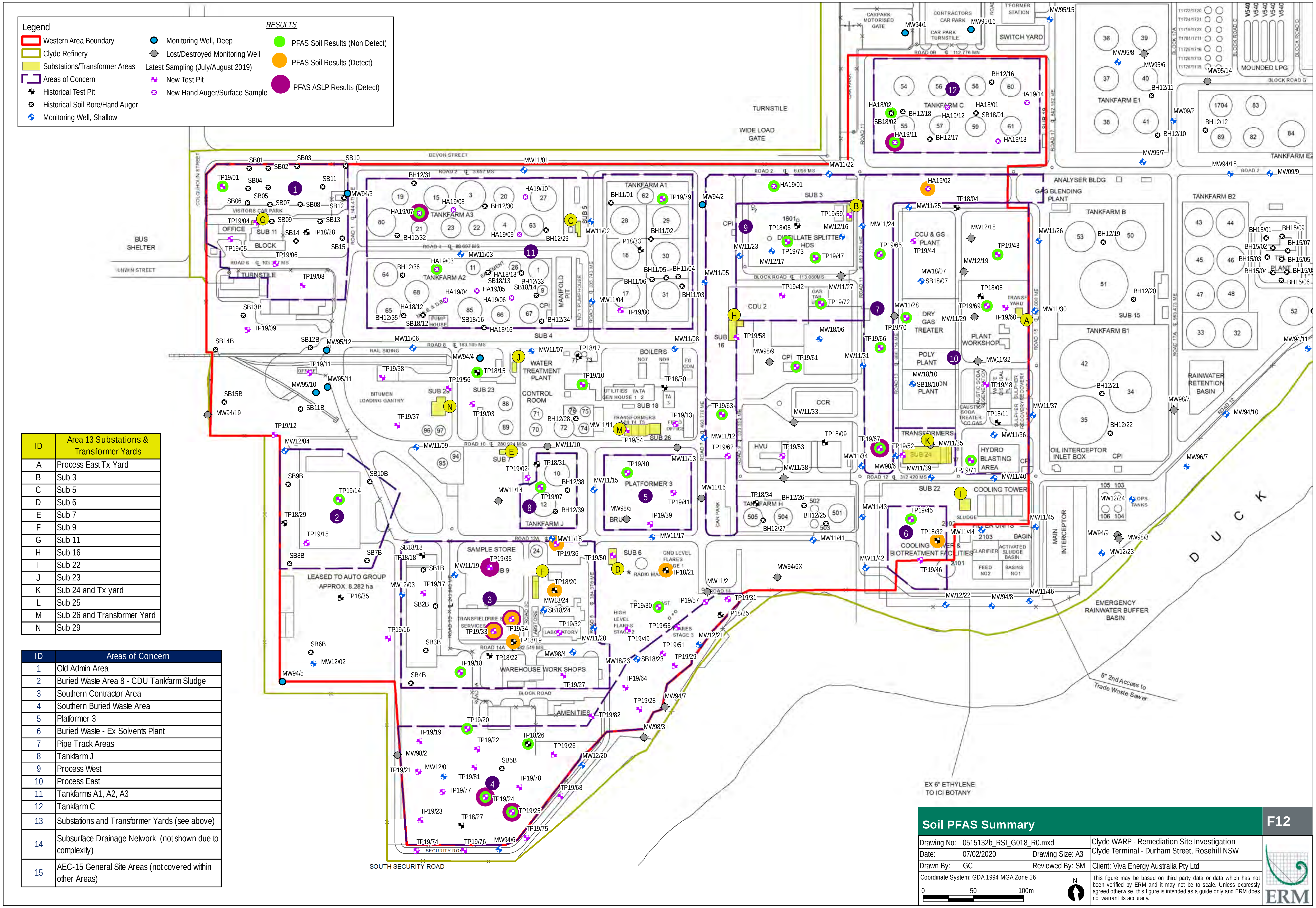
Analytes	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil
Units	%w/w	%w/w
NEPM (1999) HSL Asbestos (Commercial/Industrial)	0.05	0.001

Soil Asbestos Exceedances

F11

Drawing No: 0515132s_RSI_G017_R0.mxd	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	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
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D	Sub 6
E	Sub 7
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G	Sub 11
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M	Sub 26 and Transformer Yard
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ID	Areas of Concern
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8	Tankfarm J
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10	Process East
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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 PFAS Summary

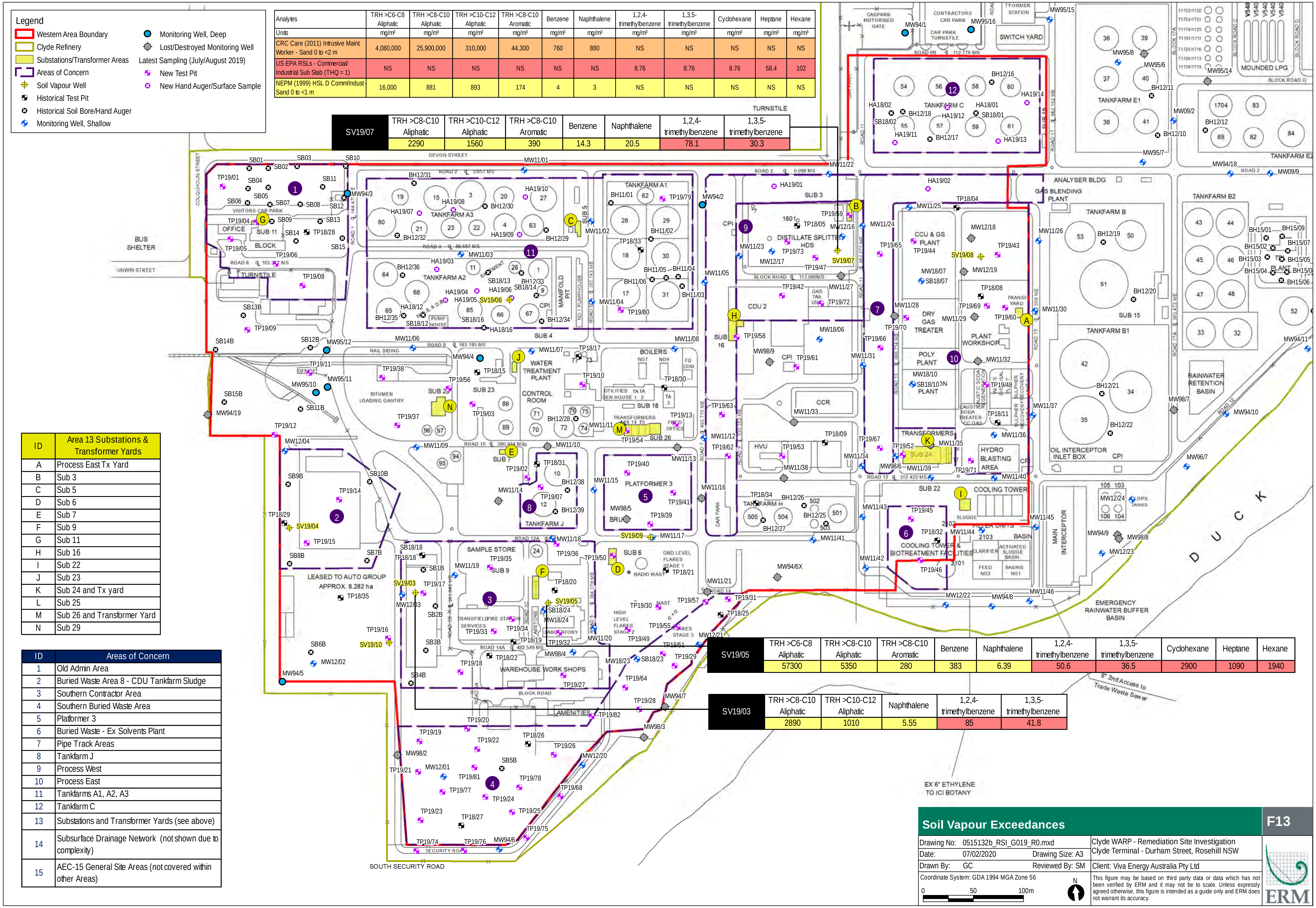
F12

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			

0 50 100m

N

ERM



Legend

- Western Area Boundary
- Clyde Refinery
- Substations/Transformer Areas
- Areas of Concern
- Soil Vapour Well
- 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

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

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8	Tankfarm J
9	Process West
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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

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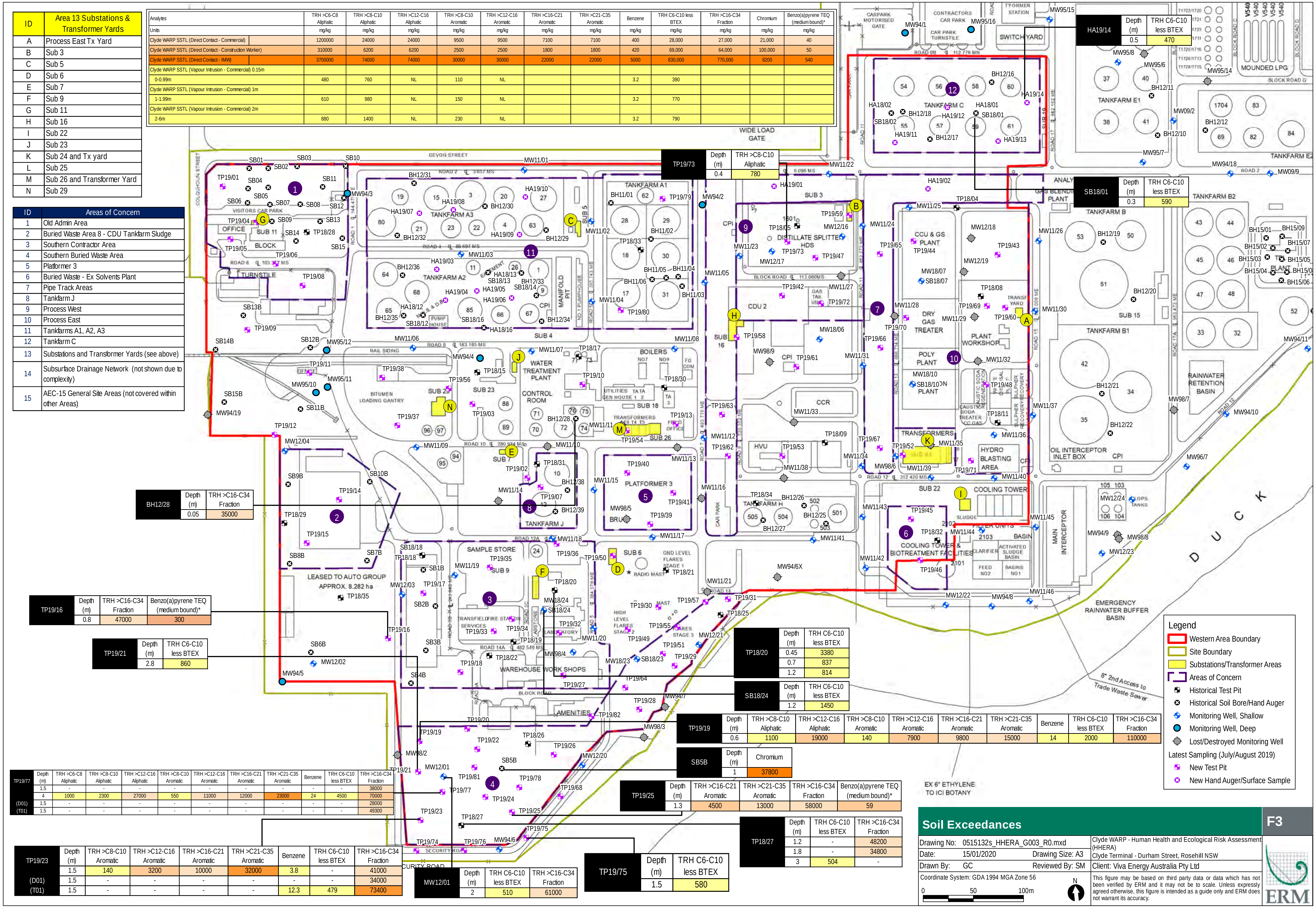
ERM



ID	Area 13 Substations & Transformer Yards
A	Process East Tx Yard
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12	Tankfarm C
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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			

HA19/14	Depth (m)	TRH C6-C10 less BTEX
	0.5	470

TP19/73	Depth (m)	TRH >C8-C10 Aliphatic
	0.4	780

SB18/01	Depth (m)	TRH C6-C10 less BTEX
	0.3	590

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

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 >C16-C21 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

TP19/77	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

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

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		
Date:	15/01/2020	Drawing Size:	A3
Drawn By:	GC	Reviewed By:	SM

Coordinate System: GDA 1994 MGA Zone 56

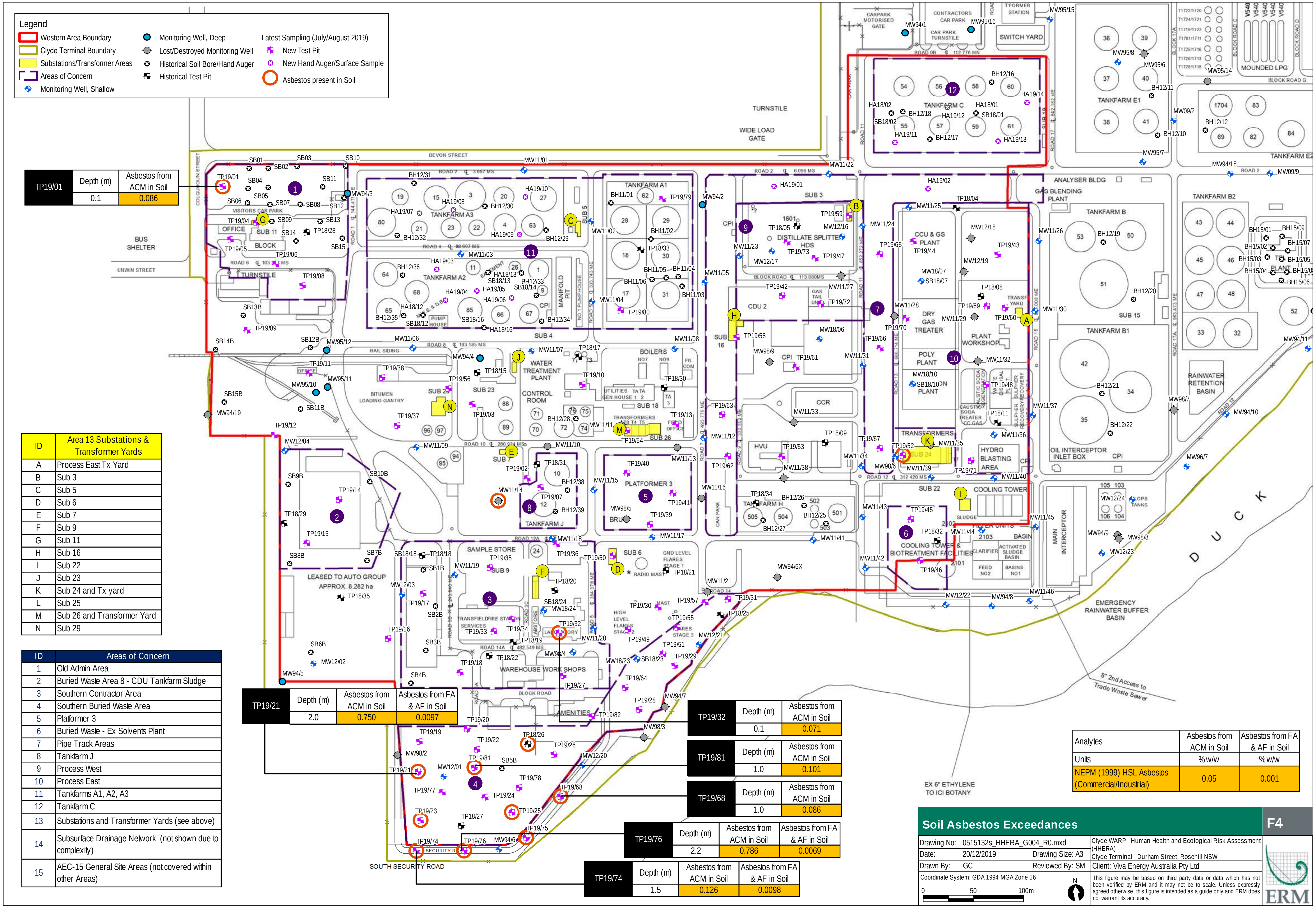
0 50 100m

N

Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)
Clyde Terminal - Durham Street, Rosehill NSW
Client: Viva Energy Australia Pty Ltd

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



TP19/01	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

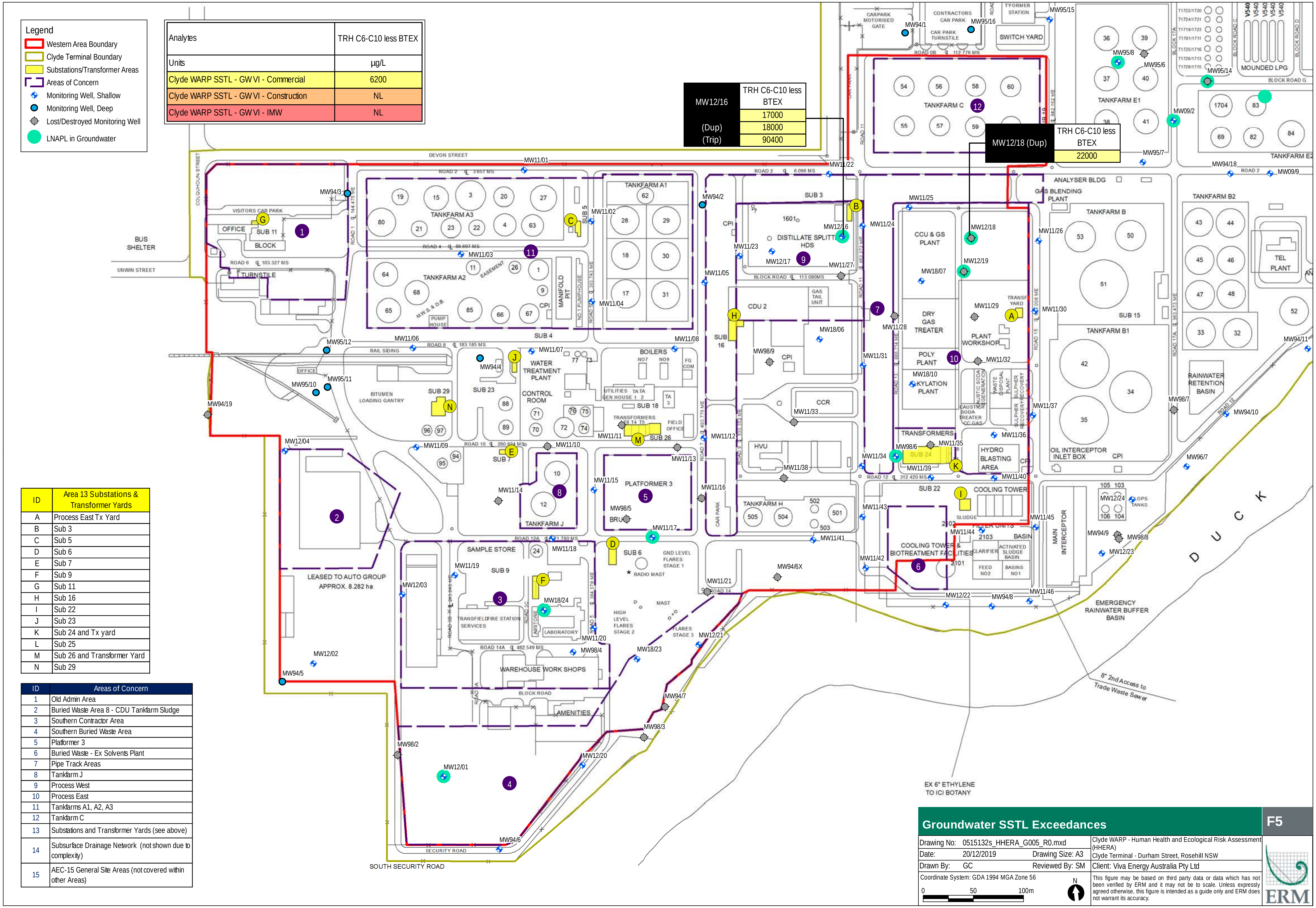
F4

Drawing No: 0515132s_HHERA_G004_R0.mxd
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

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 - GW VI - Commercial	6200
Clyde WARP SSTL - GW VI - Construction	NL
Clyde WARP SSTL - GW VI - IMW	NL

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)

Groundwater SSTL Exceedances

F5

Drawing No:	0515132s_HHERA_G005_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

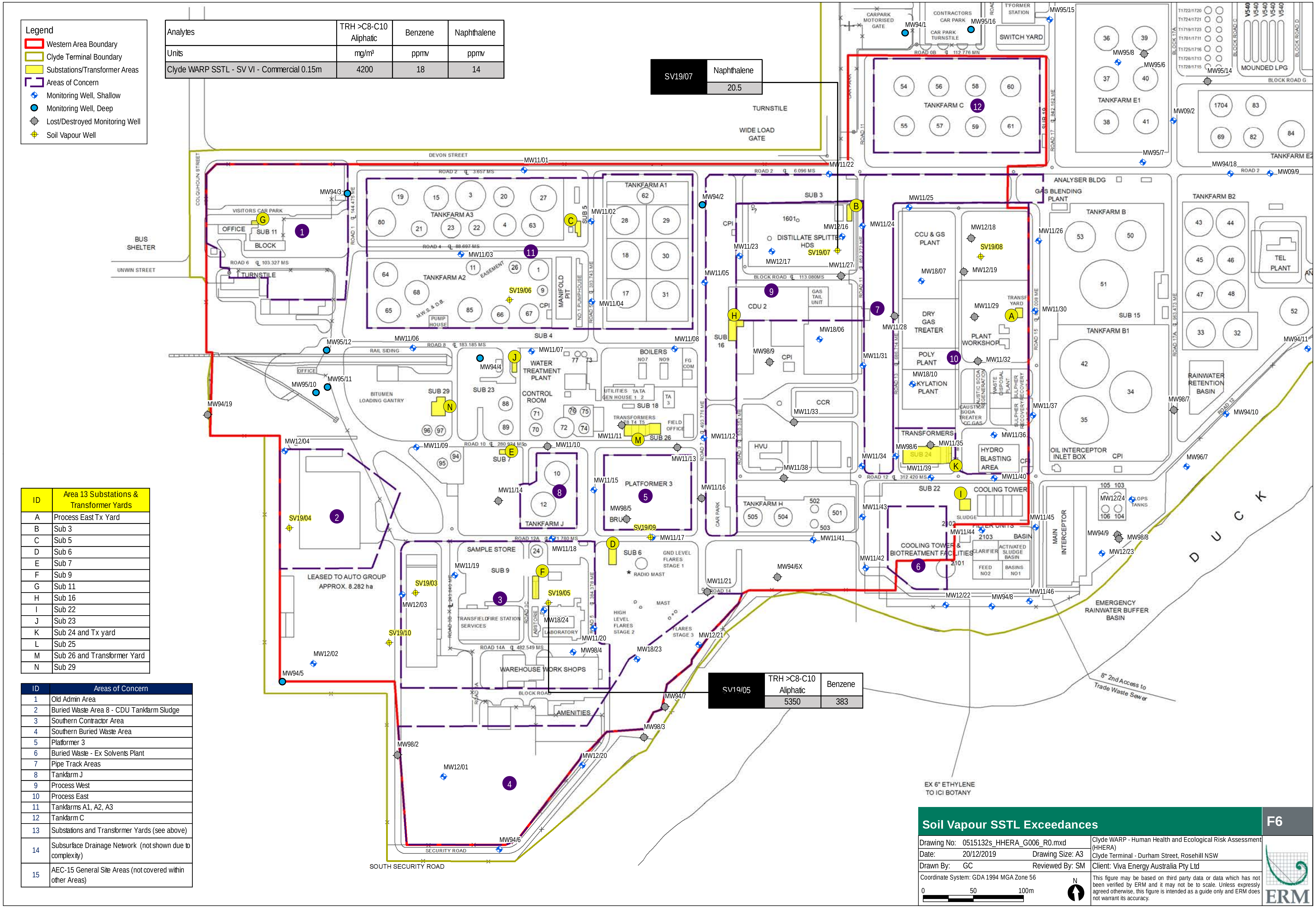
N

Clyde WARP - Human Health and Ecological Risk Assessment (HHERA)

Clyde Terminal - Durham Street, Rosehill NSW

Client: Viva Energy Australia Pty Ltd

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	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
Date: 20/12/2019 Drawing Size: A3
Drawn By: GC Reviewed By: SM
Coordinate System: GDA 1994 MGA Zone 56
0 50 100m

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

5 May 2020

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

Our ref: 21/27799/IAA04
Your ref:

Dear Adam

Former Clyde Refinery - Western Area
Interim Audit Advice 04 - Review of Remedial Action Plan (Stage 1)

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. Contaminated site investigations have identified that remediation of contaminated soils are required. Viva has decided to remediate the site in stages, the first (Stage 1) being associated with the eastern portion of the former Process West area. Stage 1 extends from Durham Street in the north to Duck River at the southern boundary of the Western Area.

As part of this audit, the auditor has reviewed the following report prepared by Environmental Resources Management (ERM):

- ERM (2020d) *Clyde Western Area Remediation Project, Stage 1 - Detailed Remediation Action Plan*, dated 24 April 2020 (the Stage 1 RAP). The aim of the Stage 1 RAP is to provide details on how Stage 1 is to be remediated to render the site suitable for a future development in accordance with the existing zoning classification (IN3 heavy industrial).

In reviewing the document, the auditor took into account the information in the following documents:

- AECOM (2018) *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 (the Conceptual RAP).
- ERM (2019a*) Clyde Western Remediation Project, Remediation Site Investigation – Sampling and Quality Plan (SAQP*), dated 28 June 2019 (the SAQP).
- ERM (2019b) *Clyde Western Area Remediation Project – Risk Assessment Methodology*, dated 9 October 2019.
- ERM (2020a) *Clyde Western Remediation Project, Remediation Site Investigation*, dated 7 February 2020 (the RSI).
- ERM (2020b) C*lyde Western Area Remediation Project, Human Health and Ecological Risk Assessment*, dated 16 February 2020 (the HHERA).
- *ERM (2020c) Clyde Terminal – Quarter 4 (2019) Groundwater Monitoring Report*, dated 7 February 2020 (the 2019 Q4 GME).

The purpose of this audit advice is to assess whether the Stage 1 RAP was prepared in a manner consistent with NSW Environment Protection Authority (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 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).

Given the scale of remedial works, the Western Area Remediation Project (WARP) was declared State Significant Development (SSD 9302) and as such, to assess the potential environmental impacts from remediation, an Environmental Impact Statement (EIS) containing a Conceptual Remedial Action Plan (RAP) was prepared (AECOM, 2018 and AECOM 2019).

In accordance with the consent conditions associated with approval SSD 9302 for the WARP, a detailed RAP and associated management plans are to be developed prior to the commencement of remedial works. The Stage 1 RAP represents the first of four stage of remedial works in the WARP. Following review of these documents, a Section B site audit report is to be issued.

3 Auditor review

The Stage 1 RAP included the key elements of the Conceptual RAP (AECOM 2019) and incorporated the additional site characterisation recommended in the latter document. The evaluation of data that has been collected in the Stage 1 area identified that the key drivers for remediation were vapour intrusion risks associated with hydrocarbon contaminated soils and light non aqueous phase liquids (LNAPL). The volume of contaminated soil and LNAPL to be remediated is approximately 2 900 cubic metres.

In preparing the Stage 1 RAP, ERM conducted a series of field remediation trials to evaluate potential remedial options and to monitor the release of volatile compounds to the atmosphere. The outcome of these trials was the selection of excavation and on-site bioremediation (bio-piling) as the preferred remedial option. Off site disposal was nominated as a contingency option.

ERM concluded that following completion of the remedial works (and validation as per the nominated validation plan) the site can be made suitable for commercial/industrial land use with a long term environmental management plan (LTEMP). The LTEMP will incorporate a groundwater monitoring program and protocols for managing LNAPL if encountered during future construction activities.

The auditor considers that the Stage 1 RAP contains many of the key elements as per the Consultant Guidelines. The review is presented as Attachment A. There are some matters however that require additional information and/or discussion before the document can be finalised and a Section B site audit report can be issued. These are as follows:

- It is acknowledged that the biopiling design is schematic. Unless the remedial contractor is to be responsible for the set up of the biopiles (and if this is the case, this should be stated in the Stage 1 RAP), there should be specifications in the Stage 1 RAP for the construction of the biopiles.
- Whether all LNAPL that has been identified in Stage 1 is to be remediated is not clear. Table 7 states that LNAPL presents a potential risk with a need for remediation or management and Section 7.4 states that the vertical extent of remediation is *to remove LNAPL*. Yet, LNAPL associated with

TP18/09 will not be subject to active remediation (Section 10.3). The term *residual LNAPL not able to be practically remediated within AEC-9* is not defined.

- As a guide, terms such as minor, trace (e.g. Section 4.6) should be avoided as they do not provide context to the discussion on contamination.
- Given the size of the Stage 1 area (seven hectares) and the number of sampling locations that have been used to characterise this area, it would be prudent to include as part of the validation program a series of sampling points in areas where there is a paucity of data.
- In relation to the air emissions verification discussion, it would be useful to include information such as wind speed observations and direction in relation to the extent of VOC measurements. A commentary on the surrounding properties that were closest to the extent of the VOC measurements would be beneficial.
- The features on some of the figure are difficult to discern (See Attachment A) and the font on the tables is too small.
- Tables of data specifically for Stage 1 would be beneficial.

In addition to these technical comments, the auditor notes the following

It will be necessary that the remediation contractors plans are consistent with the essential elements of the Stage 1 RAP

The Stage 1 RAP does not comment on the pipe decommissioning work. It is acknowledged that the scope for these works will be defined in a reverse brief from Ventia which is to include protocols for demonstrating that sludge and/or oily water has been removed. The protocols for validating the effectiveness of the decommissioning program (along with any confirmatory sampling by ERM) will need to be incorporated into the validation program. Any uncertainty in relation to the locations of the pipes and/or ability to effectively decommission the pipes will have to be recorded in the LTEMP.

4 Conclusions

It is the auditor's opinion that following remedial and validation activities discussed in the Stage 1 RAP the site (Area 1) will be suitable for the proposed future use (commercial and/or industrial) in accordance with the permissible land use IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011.

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
0447 685 055

Encl. Attachment A

Client: Viva Energy
Consultant: ERM
Report: ***Clyde Western Area Remediation Project - Stage 1 - Detailed Remediation Action Plan***, Revised Draft (Rev 02), dated 24 April 2020
IAA04
Date: 5 May 2020

Report checklist – Remedial Action Plan (RAP)

Report Section	Information required	Included (Yes or No) / Comments
Document control	Date, version number, author and reviewer (including certification details) and who commissioned the report	Overall yes. Certification details should be presented in the final version of the Stage 1 RAP.
Executive summary	Background – include a summary of site contamination	Yes. The auditor notes that the background of the site was presented not only in the executive summary but also in Sections 1.1 and 1.2. A summary of site impacts was presented in Section 4 (Summary of previous reports) and Section 5 (Nature and extent of impacts), which included discussion regarding soil, groundwater, soil vapour and air ambient emissions. Additionally, historical tables with analytical results for all media were presented in Appendix A.
	Objectives of the remediation	Yes. Further commentary is presented below in this checklist.
	Summary of selected scope of remediation works	Yes. Further commentary is presented below in this checklist.
Objectives	Objectives of the remediation	Yes. The project objectives and remedial objectives were presented in detail in Sections 1.3 and 1.4 of the Stage 1 RAP.
Scope of work	Summary of the scope of work	Yes. The scope of works was presented in Section 1.5 and included discussion about the proposed works to be conducted as part of the remedial activities as well as the draft of SSD 9302 Conditions of Consent. Please note that reference to the Consultant Guidelines should be updated in Section 1.5.
Site identification	Site identification and detail items from ASC NEPM Field Checklist 'Site information' sheet	Yes. The site identification was presented in Section 2 (including Table 2). Confirmation of the site address is required as the Conceptual RAP (AECOM 2019) stated the address was Durham Street.

Client: Viva Energy
Consultant: ERM
Report: ***Clyde Western Area Remediation Project - Stage 1 - Detailed Remediation Action Plan***, Revised Draft (Rev 02), dated 24 April 2020
IAA04
Date: 5 May 2020

Report checklist – Remedial Action Plan (RAP)

Site history	Site history items from ASC NEPM Field Checklist 'Site information' sheet. A summary is enough if detailed information was included in an available reference previous report	Yes. A summary of the site history was presented in Section 3.1. Additionally, the auditor noted that a detailed history of the site was presented in previous reports as discussed in IAA03 issued in February 2020 (following review of the Remediation Site Investigation (RSI), Human Health and Ecological Risk Assessment (HHERA) and 2019 Q4 groundwater monitoring event reports).
Site condition and surrounding environment	Site condition and surrounding environment items from ASC NEPM Field Checklist 'Site information' sheet. A summary is enough if detailed information was included in an available reference previous report	Yes. The auditor noted that detailed figures showing the surrounding areas, as well as a detailed description of these areas including the AECs were presented in the Stage 1 RAP. Additionally, detailed discussion regarding off-site ecological receptors were presented in the HHERA report.
Remediation criteria	Table listing all selected remediation criteria and references	Yes. The remedial criteria were discussed in Section 7.2. A table summarising the remediation Site Specific Target Levels (SSTLS) was presented in Appendix D.
	Rationale for the selection of criteria, including assumptions and limitations of the criteria and any deviations from the approved guidelines	Yes. The rationale for the selected criteria was presented in Sections 4.2 and 4.3 (summary of RSI and HHERA reports) and Section 7.3 (Table 9). The auditor noted that the rationale for the selection of criteria took into account the land use scenario that will be applicable during the remedial activities and land use as per current zoning (IN3 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011).
	Rationale for any site-specific remediation criteria developed through a site-specific work assessment. Refer to ASC NEPM Schedules B4, B5a, B5b, B5c, B6 and B7	Yes, as per above comments.
	Refer to HEPA (2018) PFAS National Environmental Management Plan (NEMP) for guidance on environmental levels that indicate the need for action.	Yes, the NEMP was referenced in Section 1.6, Section 9.6.5.1 and Appendix A - historical data tables. The auditor noted that PFAS has been previously assessed within the Western Area, which includes the Stage 1 Area. This assessment included the PFAS CSM and Flux Assessment Report prepared by ERM (20 December 2018).
Result	A summary is enough if detailed information was included in an available reference previous report	Yes, the auditor noted the summarised information included in Section 4. Additionally, the auditor noted that as recommended by AECOM in its Conceptual RAP (AECOM 2019) and by the auditor in IAA01, the auditor has reviewed the SAQP for the proposed RSI, the RSI report, the HHERA and the 2019 Q4 GME reports. Commentaries regarding these documents were presented in IAA02 and IAA03.

Report checklist – Remedial Action Plan (RAP)

	Tabulated previous results relating to the remedial action plan that:	
	• show all essential details such as sample identification numbers and sampling depth	Yes, historical data tables are included in Appendix A. Minor comments about the presentation of these tables are made in the end of this checklist.
	• show remediation assessment criteria	Yes, historical data tables include remedial assessment criteria.
	• highlight all results exceeding any remediation criteria	Yes. However, given the size of the font adopted in these tables, it was hard to complete detailed check.
	Sample descriptions for all media where applicable (e.g. soil, sediment, surface water, groundwater, biota)	Yes, soil, groundwater and soil vapour data were included. Additionally, a summary of the Air Emissions Verification Report (AEVR) was presented in Section 4.6.
	Site plan showing all sample locations	Yes. However, the auditor noted that TP18/02 recorded LNAPL within soils between 0 to 1 mbgl. The location of this test pit is not in AEC 9, but it is within Stage 1. A statement is required on whether remediation in and around this is necessary. Based on presented in Table 7 Risk Assessment Summary, LNAPL within AEC9 Indicated a potential risk or need for remediation or management.
	Site plan(s) showing the extent of soil and groundwater contamination exceeding selected remediation criteria for each sampling depth, including sample identification numbers and sampling depths of all samples analysed	Yes. Site plans were presented in Appendix A. Minor comments about the presentation of these figures are made at the end of this checklist.
	Site plan(s) showing the proposed extent of remediation	Yes. Minor comments about the presentation of these figures are made at the end of this checklist.
Site characterisation	A summary is enough if detailed information was included in an available referenced previous report	Yes. As noted by the auditor in IAA03, the Western Area which included the Stage 1 Area has been assessed over the past 11 years. The assessment of the Stage 1 Area included 17 test pits, four boreholes and installation of 17 groundwater monitoring wells, one vapour bore and quarterly groundwater monitoring. It is noted that it would be prudent for the validation program to include some sampling points in areas not investigated to date.
	Assessment of types of all environmental contamination	Yes, soil, groundwater, soil vapour and air emissions were assessed.

Report checklist – Remedial Action Plan (RAP)

	Assessment of extent of all identified contamination, including off-site areas	Yes, a summary of the nature and extent of impacts were presented in Section 5.
Conceptual site model	See 'Conceptual site model' checklist	Yes, the CSM was presented in Section 6 of the Stage 1 RAP. The auditor noted that the CSM has been refined throughout the site assessment process and was based on site historical and current and field information. It is the auditor's opinion that CSM prepared by ERM contained the essential elements of a CSM and largely followed the requirements of the ASC NEPM (NEPC 2013). The outcomes of the CSM were presented in Table 8 (the SPR linkages summary). The auditor noted that an updated CSM should be prepared following remediation and site validation.
Remediation Options Assessment and	Remediation objectives (these should already be defined under the general objectives and then the criteria derived.)	Yes, the remedial objectives are included in Executive summary, Section 1.4 and Section 7.
	Assessment of possible remedial options and how risk can be reduced	Yes, the auditor noted the remedial options assessment is included ins Section 8.2.

Client: Viva Energy
Consultant: ERM
Report: ***Clyde Western Area Remediation Project - Stage 1 - Detailed Remediation Action Plan*****,** Revised Draft (Rev 02), dated 24 April 2020
IAA04
Date: 5 May 2020

Report checklist – Remedial Action Plan (RAP)

Remediation Strategy	Rationale for the selection of recommended remedial option, in accordance with the preferred hierarchy of site remediation and/or management set out in Key Principles for Remediation and Management of Contaminated Sites of the ASC NEPM Toolbox	Yes, the rationale for the selection of recommended remedial option is included in Section 8.3. Additionally, the auditor noted that a Remedial Options Analysis (ROA) report was prepared by ERM. The ROA included a series of field and lab-scale remediation trials for the Western Area conducted between November 2019 to February 2020 to assess the feasibility and effectiveness of various soil remediation methods in targeted areas of the site. Biopiling and land farming trials were undertaken on soil sourced from excavation of AEC-9, within the Stage 1 Area. The auditor noted that the following remedial technologies have been selected (in order of preference): **1) Excavation and On-Site Bioremediation (bio-piling); and/or** **2) Excavation and off-site disposal of soils (as a contingency measure).** The selected remedial methods are consistent with the shortlisted remedial methods presented in the Conceptual RAP and EIS (AECOM 2018 and AECOM 2019). Based on the 2019 Q4 GME, the auditor acknowledges that hydrocarbon concentrations in groundwater are stable to decreasing. Thus, it is expected that the remedial works will enhance the current natural attenuation processes to reduce residual groundwater impacts over time. To monitoring of the natural attenuation process, a Long-Term Groundwater Monitoring Management Plan has been proposed that forms the SSD Conditions of Consent.

Report checklist – Remedial Action Plan (RAP)

	Description of the remediation works to be undertaken	Yes, the auditor noted that description of the remedial works to be undertaken is included in Section 8.3.1 and Section 9. ERM described that the Stage 1 Remediation works will include completion of the following tasks: Task 1 – Preparation works Task 2 – Removal of redundant infrastructure and waste Task 3 – Remediation Task 4 – Land forming Task 5 – Completion of works and demobilisation ERM reported that the decommissioning of the subsurface drainage network would be completed separately to the scope of remediation under existing SSD (5147) for the Clyde Terminal Conversion Remediation Project. ERM stated that the biopiling would take place in the biopile treatment area, formerly known as Tank Farm A2. This decommissioned tank farm covers an area of approximately 180 m x 70 m (~ 1.25 ha). The details of the biopile construction (Section 9.6.2) are however based on a schematic. Site specific and proposed construction specifications however should be provided. Additionally, ERM stated that whilst internal tank infrastructure and pipework has been removed, the perimeter bunding has been retained, with the exception of a small segment on the southern side that has been removed to allow vehicular access. With the exception of aeration systems, which would run continuously, biopiling operations would occur during approved operating hours for the Remedial Project

Report checklist – Remedial Action Plan (RAP)

	A validation plan which includes proposed testing to validate the site during/after remediation, including the ‘Sampling and analysis quality plan’ checklist	Yes. The auditor acknowledges that the present SAQP included the information listed in s.5.3 of Schedule B2 of the ASC NEPM. The auditor noted that the adopted DQOs for the validation program were presented as stipulated in Appendix B of Schedule B2 of the ACS NEPM.
	Confirmation that waste imported onto the site is lawful. Note: materials transported onto site will either need to meet the definition of virgin excavated natural material, or a resource recovery order and resource recovery exemption. In addition, materials imported onto the site must be adequately assessed as being appropriate for the final use of the site, including QA/QC evaluation of any sampling and analysis for material brought to site	Yes, the auditor noted that one of the decision rules in the Stage 1 RAP (Section 12.2.5) is to confirm the suitability of imported fill material for its intended purpose and that VENM or ENM criteria are used.
	Contingency plan if the selected remedial strategy fails	Yes, a contingency plan is included in Section 13.
	Interim site management plan before remediation, including fencing, erection of warning signs, stormwater diversion, etc	Yes, an interim site management plan is included in Section 9.1 preparation works.
	Site management plan requirements (operational phase):	
	• site stormwater management plan	Site stormwater management plan is not mentioned in the Stage 1 RAP. However, the auditor noted that erosion, sediment control requirements will be outlined in full within the soil and water management plan (Section 9.6.4).
	• soil management plan, including material tracking	Yes, the auditor noted that a soil and water management plan is mentioned in the Section 10.
	• noise control plan	No, the auditor noted there was no noise control plan in the Stage 1 RAP. The auditor considered however that obligations to manage noise as per relevant regulations would be the responsibility of the contractor and the omission in the RAP of a noise control plan does not require a response.

Report checklist – Remedial Action Plan (RAP)

	• dust control plan, including wheel wash (where applicable)	Yes, the auditor noted that dust control is included in the air quality and odour management plan in Section 10.
	• odour control plan	Yes, the auditor noted the air quality and odour management plan in Section 10.
	• work health and safety plan	Yes, the auditor noted that an occupational health and safety plan is mentioned in Table 13, Section 10. However, the auditor recognised that the contractor responsible for implementing the remedial works will need to prepare an activity specific health and safety plan for all it's staff, sub contractors and visitors.
	• remediation schedule	Yes, the auditor noted that an indicative remediation schedule is included in Section 9.7. The reference to Table 11 is incorrect. Establishment of the final schedule will however be the responsibility of the remediation contractor.
	• hours of operation	Yes, the hours of operation are included in Section 10.1.
	• contingency plans to respond to site incidents, to remove potential effects on surrounding environment and community	Yes, incident response is included in Section 13.3 (last paragraph).
	Description of regulatory compliance requirements such as licences and approvals or financial assurance	Yes, the description of regulatory compliance requirements is presented throughout the document. However, financial assurance is not mentioned in the Stage 1 RAP and the auditor questions why the EPA considers this is necessary.
	Names and phone numbers of appropriate personnel to contact during remediation	Yes, a community engagement plan is mentioned in the Stage 1 RAP and is to include contacts and relevant phone numbers. This information would be finalised once the remediation contractor is appointed.
	Community relations plans (where applicable)	Yes, a community engagement plan is mentioned in Section 11.
	Staged progress reporting (where appropriate)	Yes, the auditor noted that continued engagement and update is mentioned in section 11.1.

Report checklist – Remedial Action Plan (RAP)

	Outline of environmental management plan for ongoing management of contamination at the site (if needed)	Yes, the need for a long term management plan is referenced.
Waste management (if applicable)	Waste classification reports in accordance with EPA Waste Classification Guidelines (see 'Waste classification' checklist)	Yes, waste classification in accordance with EPA waste classification guidelines is mentioned in the RAP (section 12.5.3) for material that requires off-site disposal.
	Description of material handling and tracking plan	Yes, a waste management plan is mentioned in Section 10.
	Statements regarding materials being disposed via appropriately licenced facility or re-used under an order or exemption	Yes, the auditor noted the Stage 1 RAP mentioned offsite disposal of material at licensed landfill / waste facility.
	Waste disposal dockets or other waste documentation for any disposed waste	No, the waste disposal dockets or similar is not mentioned in the Stage 1 RAP. These are however not necessary at this stage as no works have taken place yet.
	Refer to the Site Auditor Guidelines section 4.3.7 Waste management for waste management requirements	Appropriate discussion on waste management is presented in the Stage 1 RAP.
Remediation Technology Pilot Trail (if applicable)	Details and results from treatability trials and Proof of Performance testing, to demonstrate the remediation option chosen was suitable for the site (for major remediation projects). If trials have not been completed, include an indicative scope of the proposed trial.	Yes, a remedial trail was completed and relevant information is included in section 4.5
Conclusions and recommendations	A list summarising the activities and physical changes proposed for the site	Yes.
	Conclusions addressing the stated objectives	Yes.
	Assumptions used in reaching the conclusions	No, but there is sufficient information in the Stage 1 RAP to demonstrate there is sufficient supporting information to justify the conclusions.

Report checklist – Remedial Action Plan (RAP)

	A clear statement as to why the consultant considers the site to be suitable for the proposed use if the remedial action plan is implemented	Overall yes. However, reference to implementation of an LTEMP should be made.
	A summary of proposed limitations and constraints on the use of the site post remediation and proposed environmental management plan for long-term management of residual contamination at the site (where applicable)	Yes.
	Recommendations for further work, if appropriate	Not applicable.
	Biopiling	As required by the Auditor Guidelines (EPA 2017), the auditor checked if the proposal for landfarming demonstrated adequate safeguards for the protection of human health and the environment. The potential for uncontrolled emissions of, for example, volatile organic compounds, leachates and odours and any other adverse effects from treatment were appropriately considered by ERM. In relation to monitoring the effectiveness of safeguards to mitigate generation of odours and /or release of chemicals to the atmosphere, section 9.6.3 for example states that "*continuous operation of the aeration system would be maintained to promote biological degradation of hydrocarbon contamination. The aeration system would be fitted with a granular activated carbon (GAC) based exhaust emission control system to minimise the release of volatile organic compounds (VOCs) to atmosphere".* *Additionally, As a minimum, weekly PID monitoring of inlet, outlet, lead and lag vessels for VOC concentrations will be required to be undertaken by the Remediation Contractor within the first 3 months of each new biopile operation and- a minimum of once per month thereafter. The upper limit of Total VOC emissions at the outlet has been established as 10 ppm (AECOM, 2019). Exceedance of this threshold indicates breakthrough out the carbon filter media is occurring and requires replacement. The SVE system would be shut down temporarily to change out filter media prior to re-operation and confirmation of clean emissions*".

Report checklist – Remedial Action Plan (RAP)

	Appendix A -Figure F6a to F6c	1 – Some of the information is difficult to discern on the figures owing to some of the background information (e.g. former structures). Would it be possible to fade these features?
	Appendix B - Historical tables	1 – It appears that the soil tables show only half the data.. 2 – A table presenting only results for Stage 1 area would be beneficial, rather than having to search for this information in the entire data set. 3 – The font size in the groundwater table is too small.

Note:
NA – Not applicable

25 May 2020

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

Our ref: 21/27799/IAA05
Your ref:

Dear Adam

Former Clyde Refinery – Western Area

Interim Audit Advice 05 – Review of Remedial Options Assessment (ROA)

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 is located at Durham Street, Rosehill on the Camellia Peninsula. Contaminated site investigations have identified that remediation of contaminated soils is required. Viva Energy has decided to remediate the site in three stages (as discussed in Section 2).

As part of this audit, the auditor has reviewed the following report prepared by Environmental Resources Management (ERM):

- ERM (2020e) *Clyde Western Area Remediation Project, Remedial Options Analysis*, dated 07 April 2020 (the ROA).

In reviewing the ROA, the auditor took into account key, relevant information from the following reports that was referenced or included in the ROA:

- AECOM (2018) *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 (the Conceptual RAP).
- ERM (2019a*) Clyde Western Remediation Project, Remediation Site Investigation – Sampling and Quality Plan (SAQP*), dated 28 June 2019 (the SAQP).
- ERM (2019b) *Clyde Western Area Remediation Project – Risk Assessment Methodology*, dated 9 October 2019.
- ERM (2020a) *Clyde Western Remediation Project, Remediation Site Investigation*, dated 7 February 2020 (the RSI).
- ERM (2020b) C*lyde Western Area Remediation Project, Human Health and Ecological Risk Assessment*, dated 16 February 2020 (the HHERA).
- *ERM (2020c) Clyde Terminal – Quarter 4 (2019) Groundwater Monitoring Report*, dated 7 February 2020 (the 2019 Q4 GME).
- *ERM (2020d) Clyde Western Area Remediation Project, Stage 1 - Detailed Remediation Action Plan,* dated 24 April 2020 (the Stage 1 RAP).

The purpose of this audit advice is to comment on whether the ROA was prepared in a manner consistent with NSW Environment Protection Authority (EPA) made or endorsed guidelines and where pertinent, met relevant conditions of consent associated with the Conditions of Consent for SSD 9302 as issued by the Department of Planning, Infrastructure and Environment. 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

Viva Energy intends to remediate the Western Area in three stages to facilitate future commercial and / or industrial development under the existing land use zoning (IN3 – Heavy Industrial). The proposed stages (based on geographical areas) are as follows:

- Stage 1: Former Process West
- Stage 2: Former Utilities and Movements and Buried Waste Area
- Stage 3: Former Process East

Given the scale of remedial works, the Western Area Remediation Project (WARP) was declared State Significant Development (SSD). As such, to assess the potential environmental impacts from remediation, an Environmental Impact Statement (EIS) (AECOM, 2018) containing a Conceptual Remedial Action Plan (the Conceptual RAP) was prepared (AECOM, 2019).

To address the data gaps noted in the Conceptual RAP (AECOM, 2019), to facilitate detailed RAP (for each stage of remediation) and management plans required as per the Conditions of Consent for SSD 9302, a remedial site investigation (RSI) was undertaken by ERM in 2019.

The RSI (ERM, 2020a) included the development of a conceptual site model (CSM) and Tier 1 screening risk assessment, which provided a preliminary evaluation of potential risks to relevant current and future on and off-site human health and ecological receptors from areas of identified contamination within the WARP.

Following completion of the RSI (ERM, 2020a), ERM developed a human health and ecological risk assessment (HHERA) (ERM, 2020b). The objectives of the HHERA were to assess the potential risks identified in the RSI, derive Site-Specific Target Levels (SSTLs) and refine the CSM from the RSI (ERM, 2020a).

The RSI and HHERA reports have been reviewed and endorsed by the auditor as discussed in IAA03, issued in February 2020 to the NSW Department of Planning, Infrastructure and Environment (DPIE). The ROA considered the information in these and other documents and was completed as part of the preparation of the Stage 1 RAP (as required by the SSD Conditions of Consent).

3 Auditor review

3.1 Remedial options analysis (ROA)

The ROA prepared by ERM took into consideration the Conceptual RAP (AECOM, 2019), the RSI (ERM, 2020a) and the HHERA (ERM, 2020b) outcomes. The auditor noted that the ROA is applicable to all three stages of remediation.

The results of the ROA assisted in the selection of the technology and management options that have the potential to reduce contaminant concentrations and apply management controls (if necessary) to render the potential human health risks to future receptors / site users as low and acceptable.

The ROA presented an assessment of potential remedial options in relation to the criteria of effectiveness, timeframes, health and safety, sustainability and cost and consideration of NSW EPA regulatory guidance relating to remedial hierarchy.

The ROA had the key findings:

- Selective excavation of asbestos impacted materials, emu picking of asbestos impacted surface materials and off-site disposal and / or on-site containment. The auditor notes that as per the RSI results (ERM, 2020a), the potential for asbestos occurrence is limited to surface soils in AECs 1, 3, 4, 6, 10 to 13 and 15. The need for asbestos management or removal will be discussed in each detailed RAP where applicable.
- Excavation and on-site bioremediation (bio piling) as the preferred remedial option. Off-site disposal was nominated as the contingency option. Details about design of the biopile, volume, etc as required by the relevant Condition of Consent will be discussed in each detailed RAP. This is the recommended option for Stage 1.
- Material located within the southern burial area (AEC-4) contained a range of COPC that may pose a risk to current / future site users through vapour intrusion and direct contact exposure pathways. However, results of the RSI (ERM, 2020a) and HHERA (ERM, 2020b) indicated that this contamination did not pose a potential risk to off-site human health or off-site sensitive ecological receptors. ERM stated the remediation and /or management requirements for impacted material within AEC-4 may require further consideration based on final land design (flooding levels, etc.) and specific future proposed land uses. The preliminary options noted by ERM for AEC-4 included a cap and contain strategy, selective excavation and bio piling, in-situ stabilisation and on-site re-use or off-site disposal of materials following treatment may be selected to manage identified contamination.

ERM concluded that following completion of the remedial works, the site would be suitable for commercial / industrial land use with implementation of a long term environmental management plan (LTEMP). The LTEMP will incorporate a groundwater monitoring program and protocols for managing LNAPL if encountered during future construction activities.

4 Conclusions

The auditor noted that excavation and on-site bioremediation for Stage 1 was based on the results of the trial that showed the effectiveness of this method. It is the auditor's opinion that the remedial option selected by ERM for Stage 1 is consistent with the options presented in the Conceptual RAP. The review by the auditor demonstrated that the ROA contained many of the relevant, key elements as per the guidelines mentioned in Section 1 and met the SSD Conditions of Consent. The review checklist is presented as **Attachment A**. Highlighting in grey shading are matters that should be considered in finalising the ROA.

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
0447 685 055

Encl. Attachment A

Client: Viva Energy
Consultant: ERM
Report: ***Clyde Western Area Remediation Project – Remedial Options Analysis***, Revised Draft (Rev 02), dated 7 April 2020
IAA05
Date: 25 May 2020

Report checklist – Remedial Options Analysis (ROA)

Report Section	Information required	Included (Yes or No) / Comments
Document control	Date, version number, author and reviewer (including certification details) and who commissioned the report	Overall yes.
Executive summary	Background	No. However, considering the purpose of this report, the auditor considers that the absence of an executive summary is not an issue that needs addressed. In addition, all the information that should have been provided in an executive summary was detailed in the following sections of the ROA report (i.e – background, objectives of the report, scope of works, results, conclusions and recommendations).
	Objectives of the report	
	Summary of selected scope of works	
Objectives	Objectives of the proposed works	Yes. The auditor noted that the objectives are included in Section 4.
Scope of work	Summary of the scope of works	Yes. The auditor noted that the scope of work is included in Section 1.3 and included discussion about the proposed remedial works to be conducted as part of the remedial activities as well as the draft of SSD 9302 Conditions of Consent, in accordance within the Conceptual RAP (AECOM, 2019) and RSI report (ERM, 2020a).
Site identification	Site identification and detail items from ASC NEPM Field Checklist 'Site information' sheet	Yes. The auditor noted the site identification is included in Section 2.1. Confirmation of the site address is required as the Conceptual RAP (AECOM, 2019) stated the address was Durham Street.
Site history	Site history items from ASC NEPM Field Checklist 'Site information' sheet. A summary is enough if detailed information was included in an available reference previous report	Yes. The auditor noted that the site history was included in Section 3. Additionally, the auditor noted that a detailed history of the site was presented in previous reports as discussed in IAA03 issued in February 2020 (following review of RSI, HHERA and 2019 Q4 GME reports) as well as in IAA04 issued in 4 May 2020 (following review of the Stage 1 RAP).

Report checklist – Remedial Options Analysis (ROA)

Regulatory context	A summary of the regulatory framework	Yes. However, the following information should be reviewed given the recent update to: • EPA 2020, *Guidelines for Consultant Reporting on Contaminated Sites* (the Consultor Guidelines). • HEPA (2020), *PFAS National Environmental Management Plan* (the NEMP).
Site condition and surrounding environment	Site condition and surrounding environment items from ASC NEPM Field Checklist 'Site information' sheet. A summary is enough if detailed information was included in an available reference previous report	Yes. The auditor noted that figures showing the surrounding areas, as well as a detailed description of these areas including the AECs were presented in the ROA. Additionally, detailed discussion regarding off-site ecological receptors was presented.
Remedial levels	A summary of calculated remedial levels	Yes. The SSTLs calculated by ERM and discussed in its HEERA report (ERM, 2020b) were presented in Table 3.4.1 (Section 3.4).
Historical results	A summary is enough if detailed information was included in an available reference previous report	Yes. The auditor noted that a summary of previous pertinent reports for the remedial trials (RSI and HHERA reports), including the SSTLs and the CSM and LNAPL CSM were summarised in Sections 3.3 to 3.5. Additionally, the AECs were presented in Table 1.1. (Section 1.1.). The CSM was also included in Appendix B.
	Tabulated previous results relating to the remedial action plan that:	
	• show all essential details such as sample identification numbers and sampling depth	Yes. Figures are included in Appendix A.
	• show remediation assessment criteria	Yes. Figures are included in Appendix A. For completeness, please include in Appendix A specific figures showing the Stage 1 Area.
	• highlight all results exceeding any remediation criteria	Yes. Figures are included in Appendix A.
	Sample descriptions for all media where applicable (e.g. soil, sediment, surface water, groundwater, biota)	Yes, the auditor noted that soil, groundwater and soil vapour are discussed in the ROA

Report checklist – Remedial Options Analysis (ROA)

	Site plan showing all sample locations	Yes. Figures are included in Appendix A
	Site plan(s) showing the extent of soil and groundwater contamination exceeding selected remediation criteria for each sampling depth, including sample identification numbers and sampling depths of all samples analysed	Yes. Figures are included in Appendix A
	Site plan(s) showing the proposed extent of remediation	Yes. Figure 4 in ROA showing the extent of the AECs.
Site characterisation	A summary is enough if detailed information was included in an available referenced previous report	Yes. As noted by the auditor in IAA03 and IAA04, the Western Area, which included the Stage 1 Area, has been assessed over the past 11 years. The assessment of the Stage 1 Area included 17 test pits, four boreholes and installation of 17 groundwater monitoring wells, one vapour bore and quarterly groundwater monitoring. I As noted by the auditor in its IAA04 it would be prudent for the validation program to include some sampling points in areas not investigated to date.
	Assessment of extent of all identified contamination, including off-site areas	Yes. A summary of the nature and extent of impacts were presented in Section 4.2. Detailed information was presented in RSI (ERM, 2020a).
Remediation options assessment and remediation strategy	Remediation objectives (these should already be defined under the general objectives and then the criteria derived.)	Yes. The objectives were discussed in Section 4. The auditor noted that ERM during its remedial option assessment took into consideration the outcomes of the EIS, Conceptual RAP (AECOM, 2019), RSI (ERM, 2019a), HHERA (ERM, 2019b) as well as previously issued IAAs (IAA01 to IAA03).
	Assessment of possible remedial options and how risk can be reduced	Yes. The auditor noted the remedial option analysis is included ins Section 5. A detailed assessment of relevant remedial technologies, considering the COPC within each AECs is presented in Table 5.1. ERM noted that the methodology for implementation, validation and management requirement were discussed in the Stage 1 RAP.

Report checklist – Remedial Options Analysis (ROA)

	Rationale for the selection of recommended remedial option, in accordance with the preferred hierarchy of site remediation and/or management set out in Key Principles for Remediation and Management of Contaminated Sites of the ASC NEPM Toolbox	Yes. The auditor noted brief discussion on rationale of selecting remedial options is included in Section 6.
Contingency plans	Contingency plan if the selected remedial strategy fails	Not applicable for the ROA report. The auditor noted that the contingency plan for the selected remedial methodology will be discussed in the Stage 1 RAP.
Waste management (if applicable)	Waste classification reports in accordance with EPA Waste Classification Guidelines (see 'Waste classification' checklist)	Not applicable for the ROA report. The auditor noted that the waste management plan will be discussed in the Stage 1 RAP.
Remediation Technology Pilot Trail (if applicable)	Details and results from treatability trials and Proof of Performance testing, to demonstrate the remediation option chosen was suitable for the site (for major remediation projects). If trials have not been completed, include an indicative scope of the proposed trial.	No. Although the remediation trials dataset were presented in the Stage 1 appendices, discussion was not presented either in the Stage 1 RAP nor in the ROA report. A discussion including the trial objectives, methodologies, etc should be presented in this report.
Conclusions and recommendations		The auditor noted that there is no mention about the Stage 1 Area in the conclusions sections. The outcome of the ROA was the selection of excavation and on-site bioremediation (bio-piling) as the preferred remedial option. Off-site disposal was nominated as a contingency option. ERM concluded that following completion of the remedial works (and validation as per the nominated validation plan) the site could be made suitable for commercial/industrial land use with a long term environmental management plan (LTEMP). The LTEMP will incorporate a groundwater monitoring program and protocols for managing LNAPL if encountered during future construction activities.

25 May 2020

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

Our ref: 21/27799/IAA07
Your ref:

Dear Adam

Former Clyde Refinery – Western Area

Interim Audit Advice 07 – Review of Stage 1 Air Emission Verification Report (AEVR)

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 is located at Durham Street, Rosehill on the Camellia Peninsula. Contaminated site investigations have identified that remediation of contaminated soils is required in the Western Area. Viva Energy has decided to remediate the Western Area in three stages (as discussed in Section 2).

As part of this audit, the auditor has reviewed the following report prepared by Environmental Resources Management (ERM):

- ERM (2020f) *Clyde Western Area Remediation Project, Air Emission Verification Report*, dated 30 April 2020 (the AEVR).

In reviewing the AEVR, the auditor took into account key, relevant information from the following reports that was either referenced or included in the AEVR:

- AECOM (2018) *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 (the Conceptual RAP).
- ERM (2019a*) Clyde Western Remediation Project, Remediation Site Investigation – Sampling and Quality Plan (SAQP*), dated 28 June 2019 (the SAQP).
- ERM (2019b) *Clyde Western Area Remediation Project – Risk Assessment Methodology*, dated 9 October 2019.
- ERM (2020a) *Clyde Western Remediation Project, Remediation Site Investigation*, dated 7 February 2020 (the RSI).
- ERM (2020b) C*lyde Western Area Remediation Project, Human Health and Ecological Risk Assessment*, dated 16 February 2020 (the HHERA).
- *ERM (2020c) Clyde Terminal – Quarter 4 (2019) Groundwater Monitoring Report*, dated 7 February 2020 (the 2019 Q4 GME).

- *ERM (2020d) Clyde Western Area Remediation Project, Stage 1 - Detailed Remediation Action Plan,* dated 24 April 2020 (the Stage 1 RAP).
- *ERM (2020e) Clyde Western Area Remediation Project, Remedial Options Analysis,* dated 07 April 2020 (the ROA).

The purpose of this audit advice is to comment on whether the AEVR (where relevant) was prepared in a manner consistent with NSW Environment Protection Authority (EPA) made or endorsed guidelines and where pertinent, met relevant Conditions of Consent for SSD 9302 as issued by the Department of Planning, Industry and Environment. 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

Viva Energy intends to remediate the Western Area in three stages to facilitate future commercial and / or industrial development under the existing land use zoning (IN3 – Heavy Industrial). The proposed stages (based on geographical areas) are as follows:

- Stage 1: Former Process West
- Stage 2: Former Utilities and Movements and Buried Waste Area
- Stage 3: Former Process East

Given the scale of remedial works, the Western Area Remediation Project (WARP) was declared State Significant Development (SSD). As such, to assess the potential environmental impacts from remediation, an Environmental Impact Statement (EIS) (AECOM, 2018) containing a Conceptual Remedial Action Plan (Conceptual RAP) was prepared (AECOM, 2019).

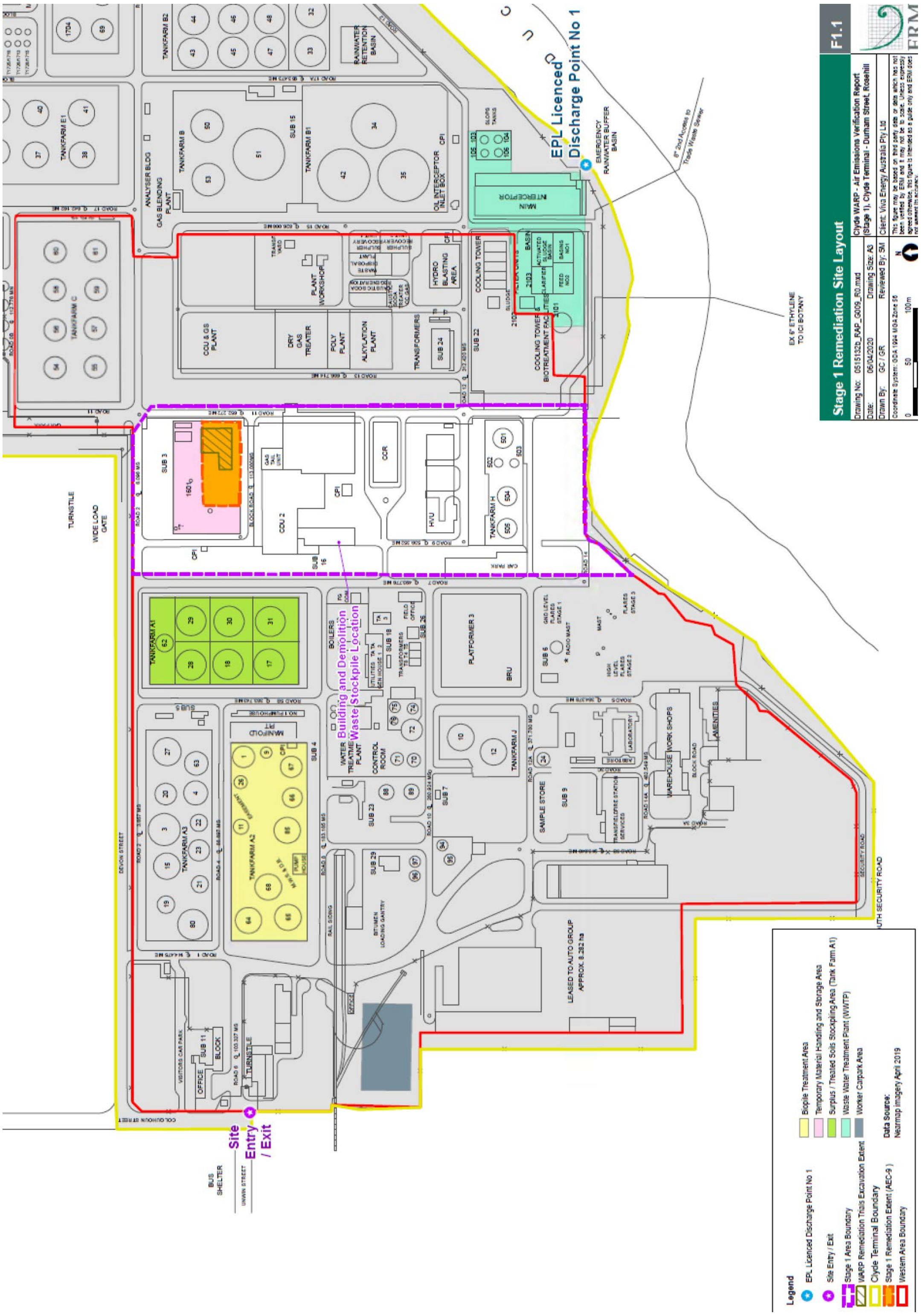
To address the data gaps noted in the Conceptual RAP (AECOM, 2019), to facilitate detailed RAPs and management plans required as per the Conditions of Consent for SSD 9302, a remedial site investigation (RSI) was undertaken by ERM in 2019. The RSI (ERM, 2020a) included the development of a Conceptual Site Model (CSM) and Tier 1 screening risk assessment, which provided a preliminary evaluation of potential risks to relevant current and future on and off-site human health and ecological receptors from areas of identified contamination within the WARP.

Following completion of the RSI (ERM, 2020a), ERM developed a Human Health and Ecological Risk Assessment (HHERA) (ERM 2020b). The objectives of the HHERA were to assess the potential risks identified in the RSI, derive Site-Specific Target Levels (SSTLs) and refine the CSM from the RSI (ERM, 2020a).

The RSI and HHERA reports have been reviewed and endorsed by the auditor as discussed in IAA03, issued in February 2020 to the NSW Department of Planning, Infrastructure and Environment (DPIE). The AVER considered the information in these and other documents and was completed as part of the preparation of the Stage 1 RAP (as required by the SSD Conditions of Consent).

3 Auditor review

Stage 1 covers an area of approximately seven hectares situated within the former Process West Area. Based on the HHERA (ERM, 2020b) only the northern portion of the Stage 1 Area requires remediation (AEC 9). A figure of the Stage 1 area (as presented in the AEVR) is presented on the following page.



The AEVR (ERM, 2020f) provided an assessment of the releases of volatile chemicals measured during the biopiling trials conducted in the Stage 1 Area and what factors need to be considered in relation to air emission management during full scale remediation.

It is the auditor's understanding that a separate AEVR will be prepared for each of the subsequent remedial stages, taking into consideration changes to, locations of and proximity to receptors.

According to the remediation design, contaminated soil in AEC-9 is to be excavated to a depth of approximately 1.5 metres with a total excavation volume of approximately 4,000 m^3. The trial excavation covered approximately 1,200 m^3 of the excavation volume, leaving approximately 2,800 m^3 to be excavated in the full scale Stage 1 remedial program. ERM did state however, that based on the proportion of oversize material encountered during the trial excavation, the 2,800 m^3 is a conservative estimate.

Based on ambient air monitoring conducted during remediation trial excavations, Volatile Organic Compounds (VOCs – include BTEX and TRH compounds) concentrations were observed to decrease significantly with distance from the excavation area, with all VOCs below the limit of reporting (LOR) at a distance of 165 metres from the excavation area. Hydrocarbon odours similar in nature to diesel oil were noted during the excavation process, however, these odours were not observed beyond 165 metres from the excavation.

Although benzene was identified in excavation water samples collected from the trial pit, neither benzene nor any other principal toxic air pollutants were detected in ambient air measurements in the immediate vicinity of either excavation, stockpiling or biopiling operations.

A range of emission controls were considered 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 the practicality with which contingency measures can be implemented. On the basis of the air quality monitoring conducted during the treatment trial and the size and nature of the works that will be required to excavate the contaminated soil and form and operate biopiles, ERM did not identify the need to establish an emissions control enclosure.

4 Conclusions

The auditor considered that the AEVR (ERM, 2020f) provided sufficient lines of evidence to support that an emissions control enclosure within Stage 1 Area is not required, as measured ambient VOCs or any other principal toxic air pollutants were below LOR or not considered to pose an unacceptable risk to site workers and/or neighbouring receptors. In addition to the technical matters that were discussed in our teleconference of 20 May 2020, there are some additional comments that need to be taken into account in finalising the document. These are presented in **Attachment A**.

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
Encl. Attachment A

Client: Viva Energy
Consultant: ERM
Report: ***Clyde Western Area Remediation Project – Stage 1 Air Emission Verification Report***, Revised Draft (Rev 0.4), dated 30 April 2020
IAA07
Date: 25 May 2020

Report review comments – Air Emission Verification Report (AEVR)

Comment No	Report section	Auditor's Comments
1	Section 1	A clear statement on the objective of the air emission verification should be included.
2	Section 1.3	The comments on the stages should clarify that they are for different portions of the overall site. It is also understood that the remediation will take place in three stages.
3	Section 3.4.2	The laying of perforated pipe is not listed as part of the biopiling process. It is not clear how addition of nutrients and pH correction will be implemented with the perforated pipe in place.
4	Section 4.1.3	Little meteorological information was provided apart from the prevailing wind during the monitoring being from the west. The auditor considers that meteorological information is required to support the selection of upwind and downwind locations. It should be recognised that the Air Quality Management Plan will need to take into account changes in wind direction and speed.
5	Section 4.3.1	It is not clear how excavation of soil to stockpile and open excavation will not be a source of particulates.
6	Section 5.2	A figure should be provided to show the distance of the industrial and residential receptors from the remediation area
7	Section 5.4	Selection of emission controls and management measures should include check of meteorological information for works planning.
8	Section 5.5.2	Requirements for PID calibration should be discussed, i.e. frequency, record
9	Section 7	Include objective(s) as per Item 1. The conclusions should be tied into the objective(s).

12 June 2020

Adam Speers
Viva Energy Australia Pty Ltd
Level 31 (Suite 2), Governor Macquarie Tower,
1 Farrer Place
Sydney NSW 2000

Our ref: 21/27799/IAA09
Your ref:

Dear Adam

Former Clyde Refinery - Western Area
Interim Audit Advice 09_ Review of Stage 1 Air Emission Verification Report (AEVR)

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 Western Area to facilitate future commercial and/or industrial development under the existing land use zoning (IN3 – Heavy Industrial). Remediation is proposed to take place in three stages, the first of which is Stage 1.

As part of this audit, the auditor has reviewed the following report prepared by Environmental Resources Management (ERM):

- *Clyde Western Area Remediation Project, Stage 1 Air Emission Verification Report*, dated 26 May 2020 (the AEVR).

In reviewing the AEVR, the auditor took into account key, relevant information from the following reports that was either referenced or included in the AEVR:

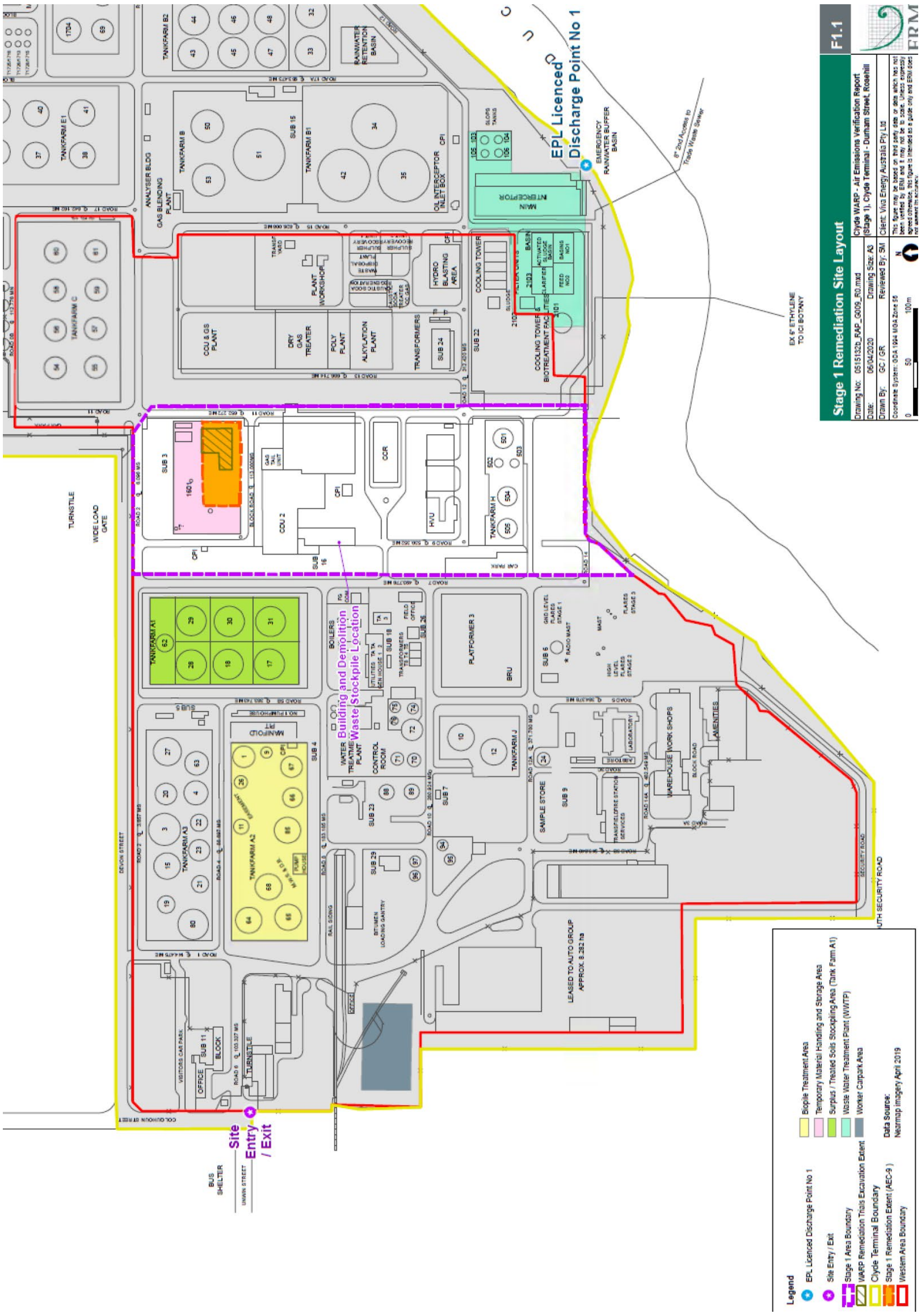
- AECOM (2019) *Viva Energy Clyde Western Area Remediation Project, Response to Submissions Report*.
- AECOM (2019) *Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan*, dated 21 January 2019 (the Conceptual RAP).
- ERM (2020) *Clyde Western Area Remediation Project, Stage 1 - Detailed Remediation Action Plan,* dated 4 June 2020 (the Stage 1 RAP).
- ERM (2020) *Clyde Western Area Remediation Project, Remedial Options Analysis,* dated 03 June 2020 (the ROA).

A draft version of the report (dated 30 April 2020) had earlier been reviewed by the auditor, who issued comments in an interim audit advice letter dated 25 May 2020.

The purpose of this audit advice is to comment on whether the 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 Scheme 3rd Edition* (the Auditor Guidelines). The AEVR was also reviewed to assess whether it met the requirements of Condition of Consent B15 for SSD 9302 as issued by the Department of Planning, Industry and Environment (7 May 2020).

2 Auditor review

Stage 1 covers an area of approximately seven hectares situated within the former Process West Area. Based on the HHERA (ERM, 2020b) only the northern portion of the Stage 1 Area requires remediation (AEC-9). The Stage 1 Area (as presented in the AEVR) is presented as follows. AEC-9 is the orange shaded area.



Biopiling has been selected as the preferred remedial option for the Stage 1 area (protocols for the nominated remedial approach in the Stage 1 Area are presented in the Stage 1 RAP). The AEVR provided an assessment of the releases of volatile chemicals measured during biopiling trials conducted in the Stage 1 Area and what factors need to be considered in relation to air emission management during full scale remediation. It is the auditor's understanding that a separate AEVR will be prepared for each of the subsequent remedial stages, taking into consideration changes to, locations of and proximity to receptors.

The remediation design will entail excavation of contaminated soil in AEC-9 to a depth of approximately 1.5 metres. The total estimated excavation volume is approximately 4,000 m^3. The trial excavation removed approximately 1,200 m^3, leaving approximately 2,800 m^3 to be excavated in the full scale Stage 1 Area remedial program. ERM did state however, that based on the proportion of oversize material encountered during the trial excavation, the residual 2,800 m^3 is a conservative estimate.

Ambient air monitoring conducted during the trial excavations recorded that Volatile Organic Compounds (VOCs – include BTEX and TRH compounds) concentrations decreased significantly with distance from the excavation area, with all VOCs below the limit of reporting (LOR) at a distance of 165 metres from the excavation area. Hydrocarbon odours similar in nature to diesel oil were noted during the excavation process, however, these odours were not observed beyond 165 metres from the excavation.

Although benzene was identified in excavation water samples collected from the trial pit, neither benzene nor any other principal toxic air pollutants were detected in ambient air measurements in the immediate vicinity of either excavation, stockpiling or biopiling operations.

A range of emission controls were considered 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 the practicality with which contingency measures can be implemented. On the basis of the air quality monitoring conducted during the treatment trial and the size and nature of the works that will be required to excavate the contaminated soil and form and operate biopiles, ERM did not identify the need to establish an emissions control enclosure.

3 Conclusions

The auditor considered all elements of Condition of Consent B15 have been appropriately considered in the AEVR and that ERM provided sufficient lines of evidence to support that an emissions control enclosure within Stage 1 Area is not required, as measured ambient VOCs or any other principal toxic air pollutants were below LOR or not considered to pose an unacceptable risk to site workers and/or neighbouring receptors.

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

Detailed Conceptual Site Model

The CSM presented below was developed within the ERM (2020) HHERA based on information collected during previous investigations and the ERM (2020) RSI.

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. Soil vapour data available 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. Detects of methane readings in soil vapour warrant management of the potential for pooling of ground gases within future excavations.	■ No potentially complete SPR linkages to ecological receptors identified
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 Soil vapour data available 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.	Soil ■ LNAPL ■ TRH C6-C10 (F1) ■ Asbestos (ACM) ■ Carcinogenic PAHs Groundwater ■ LNAPL Soil Vapour Former contractor warehouse (SV19/03): ■ TRH >C8-C10 Aliphatic; ■ TRH >C10-C12 Aliphatic; ■ Naphthalene; ■ 1,2,4-trimethylbenzene; and ■ 1,3,5-trimethylbenzene ■ Methane Former Laboratory Area (SV19/05): ■ TRH >C6-C8 Aliphatic; ■ TRH >C8-C10 Aliphatic; ■ TRH >C8-C10 Aromatic; ■ Benzene; ■ Naphthalene; ■ 1,2,4-trimethylbenzene;	■ 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 Risk Categorisation of "low risk" warrants management of ground gas for future development of 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.	■ 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
	Specific to the Fire Station area: ■ PFAS	■ 1,3,5-trimethylbenzene; ■ Cyclohexane; ■ Heptane; ■ Hexane; and ■ Methane		
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 ■ Carcinogenic PAHs (reported as BaP TEQ) ■ Asbestos (ACM and fibrous 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 as well in enclosed air spaces in future development of 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.	■ 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 Soil vapour data available 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. Detects of methane readings in soil vapour warrant management of the potential for pooling of ground gases within future excavations.	■ No potentially complete SPR linkages to ecological receptors identified
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. Tthe 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	■ 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
	■ PAH ■ Phenols ■ SVOCs ■ pH (associated with acids) ■ dioxins ■ PFAS			
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 Soil vapour data available CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PCB ■ PFAS ■ Dioxins	Soil ■ LNAPL ■ TRH C6-C10 (F1) Groundwater ■ LNAPL ■ TRH C6-C10 (F1) Soil Vapour ■ TRH >C8-C10 Aliphatic fractions; ■ TRH >C10-C12 Aliphatic fractions; ■ TRH >C8-C10 Aromatic fractions; ■ Benzene; ■ Naphthalene; ■ 1,2,4-trimethylbenzene; and ■ 1,3,5-trimethylbenzene.	■ 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. Detects of methane readings in soil vapour warrant management of the potential for pooling of ground gases within future excavations.	■ No potentially complete SPR linkages to ecological receptors identified
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 Soil vapour data available 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. Detects of methane readings in soil vapour warrant management of the potential for pooling of ground gases within future excavations.	■ 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.	Soil ■ LNAPL	■ 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	■ No potentially complete SPR

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
	■ Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS Soil vapour data available CoPCs assessed included: ■ LNAPL ■ TRH C6-C40 ■ BTEXN ■ Metals ■ PCB ■ PFAS ■ Dioxins	■ Lead (Hotspot at HA19/10)	maintenance or construction workers. Detects of methane readings in soil vapour warrant management of the potential for pooling of ground gases within future excavations. 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. ■ Direct contact or ingestion of lead impacted soils by on-site intrusive maintenance workers or construction workers undertaking earthworks (limited to HA19/01).	linkages to ecological receptors identified.
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 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.	■ 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.
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.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
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 ■ TRH C16-C34 Fractions ■ Asbestos (ACM in fill)	■ 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. ■ 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.

Area of Environmental Concern (AEC)	Location and depth (m BGL)	Soil Maximum PID reading (ppm)	Observations
AEC-1 Old Administration Area	-	-	No LNAPL identified during soil and groundwater investigations undertaken
AEC-2 Buried Waste Area 8 – CDU tank farm sludge	TP18/29 (2.2 – 3.0)	2.2 – 3.0	Sheen visible on soil, strong hydrocarbon odour.
AEC-3 Southern Contractor Area (Former Laboratory)	MW18/24 (2-4)	258.5	LNAPL has been identified during groundwater monitoring within MW18/24 since December 2018 at a maximum thickness of 0.324m in November 2019.
	TP18/20 (0.7)	642	Sheen visible on soil, strong hydrocarbon odour
AEC-3 Southern Contractor Area (Contractor Warehouse)	TP19/16 (0.7-0.8 m)	10	Black silty clay/sludge, strong hydrocarbon odour
AEC-4 Southern Buried Waste Area (1a)	TP18/27 (2.5m)	179.4	Strong sheen observed on soil and hydrocarbon odour
	MW12/01 (2.5m)	1357	LNAPL – Dark black/brown, highly viscous
	TP19/77 (1.2 – 2m, 3.8 – 4.8m)	520	Free-flowing black viscous LNAPL
	TP19/20 (1.0m)	205	Observed to be entering test pit from a concrete lined pit on southern edge of test pit. Identified as diesel oil by laboratory analysis.
	TP19/75 (2.0m)	241	Black sludge with free phase hydrocarbons observed
AEC-4 Southern Buried Waste Area (1b)	TP19/31 (0.9-1.2m)	7.7	Free phase hydrocarbon and odour noted in wall of test pit at groundwater interface
AEC-5 Platformer 3	MW11/17	0.0	No indication of impact during drilling in 2011. LNAPL has been identified during groundwater monitoring since 2013. Extent of LNAPL appears localised due to no visual indication of LNAPL within surrounding investigation locations.
AEC-6 Buried Waste – Ex Solvents Plant	TP18/32 (1.8-2 m)	80.4	Strong Hydrocarbon Odour, staining observed
	TP19/45 (1.2m)	10.7	Oily sheen, slight hydrocarbon odour from potential sludge leaking out of poly pipe

Area of Environmental Concern (AEC)	Location and depth (m BGL)	Soil Maximum PID reading (ppm)	Observations
AEC-7 Pipe Track Areas	-	-	LNAPL has not been identified during soil and groundwater investigations undertaken
AEC-8 Tank farm J	TP18/31 (0.7 - 2.4m)	146.3	Hydrocarbon odour and elevated PIDs
AEC-9 Process West	TP18/09 (1.0)	99.1	Dark free flowing LNAPL encountered, strong hydrocarbon odour
	MW12/16 (0.5m)	1487 (0.7m)	Strong odour present, no staining observed during drilling. 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.
	TP19/47 (0.2-2.0)	1140	Black impacted sand, strong hydrocarbon odour, oily substance.
AEC-10 Process East	TP18/11 (1 - 2.3) (south of main area)	7.4	Dark brown and black staining and sheen present between 1.0 – 2.3m BGL
	MW12/18 (0.9m)	320	product entering borehole at 0.9m BGL
	MW12/19 (0.9m)	940.2	product entering borehole at 0.9m BGL
	TP19/43 (1.0m)	3.5	Oily sheen and brown LNAPL entering at 1m
	TP19/44 (0.3m)	43	Oily sheen on perched water at 0.3m
	SB18/07 (0.6-4m)	562	Black staining and strong hydrocarbon odour
AEC-11 Tank farms A1, A2, A3	SB18/12 (0.5, 1.5m)	216.8	yellow/brown liquid, appears to be degraded product
	SB18/13 (0.3m)	114.8	staining, hydrocarbon odour
	SB18/16 (0.3m)	120.9	staining, hydrocarbon odour
	BH12/34 (0.6 – 1.3m)	545	oil-like staining and sheen

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 / removed from AEC-3 included: ■ laboratory; ■ contractor warehouse; ■ workshop area; Secondary sources include:	Based on the available dataset, the following Tier 1 exceedances are noted: <u>Soil</u> ■ 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).	■ Inhalation of vapours from hydrocarbon impacted soil, groundwater and LNAPL by future on 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

[1] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

	■ subsurface soils containing LNAPL	■ 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	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.

		Hazardous Ground Gas Guidance[2]. As such, consideration of hazardous ground gases in future 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	<u>Soil</u> ■ 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 Site, 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. <u>Groundwater</u> ■ LNAPL has been consistently identified in monitoring well MW12/01 since installation in 2012. The thickness of LNAPL within this well has been unable to accurately determined due to its highly viscous properties. An intermittent sheen/globules of LNAPL have been identified during recent years of groundwater monitoring at BH116. ■ Soil leachate (ASLP) analysis undertaken during this RSI has identified concentrations of benzene, toluene, ethylbenzene, naphthalene, phenanthrene from LNAPL impacted soils at the site. A review of groundwater monitoring data for monitoring wells downgradient of these areas (BH116 and MW94/6) indicates concentrations of these COPCs were below adopted screening criteria. ■ In addition to on-site delineation of COPCs in demonstrated by groundwater monitoring, the tidal influence assessment undertaken as part of this RSI indicated limited tidal influence from the Duck River on groundwater at the boundary of the Site. This limited tidal interaction is expected to further reduce potential for offsite migration and flux of contaminant mass from this AEC to the Duck River.	■ 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. 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.

[2] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC-5 Platformer 3	■ Primary sources of LNAPL include former Platformer 3 operations. This plant has been decommissioned and removed from the Site. ■ Secondary sources include subsurface soils/groundwater containing LNAPL	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 ■ 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. Soil Vapour ■ 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	■ 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.

		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.	
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 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	■ Primary sources areas within AEC-8 included former fuel storage infrastructure which has been decommissioned / removed from the Site.	■ 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.	■ 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

[3] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

	■ Secondary sources include subsurface soils containing LNAPL	■ TRH exceeding NEPM management limits was identified within sol at a depth of 0.4 m bgl	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	■ Primary sources areas within AEC-9 included former fuel processing infrastructure which has been decommissioned / removed from the Site. ■ Secondary sources include subsurface soils containing LNAPL	Soil ■ 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 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. Groundwater ■ 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.	■ 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.

		■ 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 downgradient 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.	
AEC-10 Process East	■ Primary sources areas within AEC-10 included former fuel processing infrastructure which has been decommissioned / removed from the Site ■ Secondary sources include subsurface soils containing LNAPL	<u>Soil</u> ■ LNAPL has been identified within fill materials at a number of locations within the northern portion of Process East during previous investigations and this RSI. Dark brown/ black LNAPL has been identified at MW18/07, MW12/18, MW12/19, TP19/43 and TP19/44 at depths ranging between near surface to approximately 2m BGL. ■ A black silty sludge material was identified within TP19/48 at a depth of 0.5 m bgl however no hydrocarbon odour was noted within this material	■ 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.

[4] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

		■ TP19/43 and TP19/44 exceeded NEPM management limits for TRH C10-C16 and C16-C34 at depths ranging from 0.5 m bgl – 1.2 m bgl Groundwater ■ LNAPL within groundwater has been identified during previous investigations within monitoring well MW12/18 and MW12/19, and test pit TP19/43 located to the northern portion of this AEC. LNAPL has been measured at a maximum thickness of 0.041m (MW12/18) and 0.474m (MW11/19) since installation in 2012. Residual LNAPL, in the form of sheen and ganglia has also been identified in MW98/6, situated to the west of substation 24. ■ Concentrations of TRH C6-C10 (F1) fractions in groundwater exceeded adopted HSL-D criteria for vapour intrusion at MW12/18 (associated with LNAPL); ■ Given the large distance between this AEC and the Duck River, and downgradient delineation of the above COPCs to below relevant criteria, SPR linkages with offsite receptors are considered incomplete; Soil Vapour ■ Concentrations of COPCs in soil vapour sample SV19/08, targeting were not reported 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[5]. As such, further management of hazardous ground gases are not considered likely for LNAPL at this location.	

[5] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

AEC-11 Tank farms A1, A2, A3	■ Primary sources areas within AEC-11 included fuel storage infrastructure at the time of his RSI remain onsite pending demolition. ■ 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 Tankfarm A2 (0.3 to 1.2m bgl), northern extent of Tankfarm A1 (0.3m bgl) and the eastern extent of Tankfarm 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[6]. As such, further management of hazardous ground gases are considered unllikely 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-12 Tank farm C	■ Primary sources areas within AEC-12 included fuel storage infrastructure which at the time of his RSI remain onsite pending demolition. ■ Secondary sources include subsurface soils containing LNAPL	Soil ■ An oily sheen was also identified within HA19/13 (0.3 m bgl) and HA19/14 (0.4 m bgl). ■ Results of previous investigations and this RSI identified exceedances of the adopted HSL-D criteria for TRH C6-C10 (F1) fractions within several locations. ■ LNAPL was identified within soil samples collected from depths between 0 and 1.0 m bgl Groundwater	■ 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 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

[6] NSW Environment Protection Authority (2019). *Assessment and Management of Hazardous Ground Gases*. Contaminated Land Guidelines

		■ Shallow perched groundwater has been identified across the majority of this AEC, which has prevented advancement of soil investigation works.	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		■ No LNAPL was noted within this AEC during investigation works No exceedances of tier 1 criteria for soil were reported	■ Based on field observations and results of the RSI and previous investigations, no potentially complete pathways have been identified
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 Site, concentrations of dissolved phase COPCs have been demonstrated to be stable to decreasing within the wider Site 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.

ERM

						BTEX							Naphthalene	TRH NEPM (1999)						TRH NEPM (2013)							TRH Silica Gel Cleanup							TRH Aliphatic/Aromatic Split													
						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	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 >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36	TRH >C34-C40 Silica Gel Cleanup	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 >C5-C7 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	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						0.001	0.001	0.001	0.001	0.002	0.003	0.2	0.001	10	0.02	0.05	0.1	0.1	0.1	0.02	0.02	0.05	0.05	0.1	0.1	0.1	20	50	50	50	100	50	100	0.1	10	10	10	10	10	10	0.1	0.1	1	10	10	10	10
CRC Care (2011) Direct Contact HSL D - Comm/Ind						430	99000	27000			81000		11000								26000		20000	27000		38000																					
CRC Care (2011) Direct Contact Intrusive Maint. Worker						1100	120000	85000			130000		29000								82000		62000	85000		120000																					
NEPM (1999) HIL D - Commercial/Industrial																																															
NEPM (1999) HSL D Comm/Indust - VI Sand 0 to <1 m						3	NL	NL			230		NL								260		NL																								
NEPM (1999) HSL D Comm/Indust - VI Sand 1 to <2 m						3	NL	NL			NL		NL								370		NL																								
NEPM (1999) HSL D Comm/Indust - VI Sand 2 to <4 m						3	NL	NL			NL		NL								630		NL																								
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																				700		1000		3500		10000																					
VI Intrusive Mnt. Worker Sand 0-<2 m - CRC CARE (2011)						77	NL	NL			NL		NL								NL		NL																								
VI Intrusive Mnt. Worker Sand 2-<4 m - CRC CARE (2011)						160	NL	NL			NL		NL								NL		NL																								
Monitoring_Zone	Location_Code	Field_ID	Sample_Depth_Avg	Sampled_Date_Time	Sample_Type																																										
1	TP19/01	TP19/01_0.1	0.1	18/07/2019	Normal	<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	TP19/01	TP19/01_0.8	0.8	5/08/2019	Normal	<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	TP19/01	DOI_050819	0.8	5/08/2019	Field_D	<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	TP19/04	TP19/04_0.1	0.1	5/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	50	240	210	500	<20	<20	61	61	370	601	170	<50	<50	330	170	300	160	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/05	TP19/05_0.2	0.2	5/08/2019	Normal	<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	TP19/06	TP19/06_0.5	0.5	18/07/2019	Normal	<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	TP19/06	TP19/06_1.0	1	18/07/2019	Normal	<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	TP19/08	TP19/08_0.1	0.1	18/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	130	220	350	<20	<20	<50	<50	290	290	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/08	TP19/08_1.0	1	18/07/2019	Normal	<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	TP19/14	TP19/14_1.0	1	18/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	9.1	-	<20	480	1500	160	2140	<20	<20	800	790.9	1200	2000	<100	250	400	750	500	350	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/14	TP19/14_3.0	3	18/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	1.2 - 3.6	-	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/15	TP19/15_0.8	0.8	18/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	25	2000	1500	3525	<20	<20	69	69	2900	3549	580	<20	<50	290	180	270	110	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/15	TP19/15_2.0	2	18/07/2019	Normal	<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	TP19/16	TP19/16_0.8	0.8	17/07/2019	Normal	<0.1	0.3	0.3	0.9	0.7	1.6	-	5.6 - 8.3	-	<20	1200	37,000	18,000	56,200	34	32	3200	3194.4	47,000	55,900	5700	890	2400	18,290	14,000	14,000	3400	810	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/16	TP19/16_1.2	1.2	17/07/2019	Normal	<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	TP19/17	TP19/17_0.5	0.5	18/07/2019	Normal	0.3	<0.1	4.5	<0.1	2.4	2.4	-	6.3 - 11	-	280	2200	4400	260	6860	340	330	3500	3493.7	3000	6500	<100	1200	2000	3694	2400	1600	94	<100	0.3	190	140	250	1900	1500	510	0.3	<0.1	13	38	560	690	370
3	TP19/17	TP19/17_3.5	3.5	18/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	69	150	<50	219	<20	<20	120	120	130	250	<100	27	51	117	90	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/18	TP19/18_0.3	0.3	17/07/2019	Normal	<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	TP19/18	TP19/18_0.6	0.6	17/07/2019	Normal	<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	TP19/27	TP19/27_0.6	0.6	24/07/2019	Normal	<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	TP19/27	TP19/27_1.5	1.5	24/07/2019	Normal	<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	TP19/32	TP19/32_0.1	0.1	23/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	110	100	210	<20	<20	<50	<50	180	180	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/32	TP19/32_1.0	1	23/07/2019	Normal	<0.2	<0.2	<0.2	<0.2	<0.4	<0.6	-	<1	-	<40	<20	<50	<50	<50	<40	<40	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	<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	TP19/33	DOI_240719	0.3	24/07/2019	Field_D	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	67	67	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	T01_240719	0.3	24/07/2019	Interlab_D	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<10	-	<50	<100	<100	<50	<10	<10	<50	<50	120	120	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	-	-	-	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_1.2	1.2	24/07/2019	Normal	<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	TP19/34	TP19/34_0.3	0.25	24/07/2019	Normal	<0.2	<0.2	0.3	0.6	1.2	1.8	-	<0.5	-	<40	<20	370	230	600	<40	<40	<50	<50	530	630	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_0.7	0.7	24/07/2019	Normal	<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	TP19/35	TP19/35_0.1	0.1	23/07/2019	Normal	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<10	-	<50	5210	9500	14,700	<10	<10	410	410	9470	25,500	15,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/35	TP19/35_0.7	0.7	23/07/2019	Normal	<0.5	<2.5	<0.5	<0.5	<1	<1.5	-	3.2 - 4.1	-	<100	720	630	<50	1350	<100	<100	960	955.9	350	1310	<100	610	830	1140	530	270	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	14	37	12	22	53	76	-	47	-	1100	41,000	110,000	9000	160,000	2100	2000	67,000	66,953	110,000	186,000	9000	21,000	29,000	72,000	38,000	35,000	13,000	6600	8.6	<50	1100	9200	19,000	14,000	19,000	-	27	140	1200	7900	9800	15,000
4	TP19/19	TP19/19_2.0	2	16/07/2019	Normal	<0.1	0.3	0.2	0.3	0.6	0.9	-	0.7 - 1.2	-	22	520	2700	250	3470	53	52	950	948.8	3300	4720	470	550	900	3050	1800	1800	700	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	TP19/20_0.1	0.1	16/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	380	200	580	<20	<20	<50	<50	880	1130	250	<20	<50	770	200	560	570	620	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	D01_150719	0.1	16/07/2019	Field_D	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	520	210	730	<20	<20	<50	<50	1100	1410	310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	D01_160719	0.1	16/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<20	<50	570	120	390	450	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	T01_160719	0.1	16/07/2019	Interlab_D	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	<10	-	<50	230	590	820	<10	<10	<50	<50	660	1360	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	78	400	2800	480	3680	140	140	860	860	3400	4620	360	<20	160	960	450	670	510	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	D02_160719	0.4	16/07/2019	Field_D	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 0.7	-	27	170	750	71	991	64	64	290	289.3	1100	1620	230	<20	<50	518	78	320	440	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	T02_160719	0.4	16/07/2019	Interlab_D	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1 - 0.6	46	-	260	1910	1620	3790	68	68	490	490	2820	4580	1270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/21	TP19/21_2.8	2.8	16/07/2019	Normal	<1	<1	62	<1	4.1	<3	-	24 - 39	-	520	5400	19,000	6100	30,500	930	860	8100	8061	17,000	27,600	2500	310	460	1340	790	730	240	130	<0.4	<40	490	180	330	290	330	-	0.8	40	27	240	220	230
4	TP19/21	TP19/21_4.0	4	16/07/2019	Normal	<0.2	<0.2	0.7	0.3	<0.4	<0.3	-	7.3	-	<40	630	6400	1000	8030	<40	<40	1200	1192.7	7200	8790	390	180	340	2600	1800	2000	620	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/22	TP19/22_0.5	0.5	16/07/2019	Normal	<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	TP19/22	TP19/22_1.2	1.2	16/07/2019	Normal	<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	TP19/23	TP19/23_1.5	1.5	15/07/2019	Normal	3.8	48	13	23	51	74	-	27 - 30	-	360	5000	36,000	15,000	56,000	470	330	7700	7670	41,000	53,500	4800	1900	2800	21,900	14,000	17,000	6000	1100	3.6	<100	330	1300	2700	3800	12,000	-	66	140	530	3200	10,000	32,000
4	TP19/23	D01_150719	1.5	15/07/2019	Field_D	2.7	28	7.9	12	30	42	-	22	-	190	4300	31,000	12,000	47,300	250	170	6700	6678	34,000	45,200	4500	1500	2500	27,500	16,000	21,000	10,000	1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	T01_150719	1.5	15/07/2019	Interlab_D	12.3	67.8	16.6	19.7	65.6	85.3	182	31.4 - 34	571	-	3050	55,800	17,300	86,200	661	479	5680	5650	73,400	92,900	13,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	TP19/23_3.5	3.5	15/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	230	140	370	<20	<20	<50	<50	290	290	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	<0.1	0.7	0.4	0.5	0.9	1.4	-	<0.5	-	<20	140	4100	2600	6840	<20	<20	280	280	5600	7180	1300	51	120	1981	1200	1500	730	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_3.0	3	15/07/2019	Normal	<0.1	<0.1	2.8	0.7	0.4	1.1	-	11 - 18	-	92	3500	4900	710	9110	270	270	4800	4782	3700	8890	390	5000	6000	11,720	5800	4200	920	150	<0.5	<50	200	2400	3500	2000	910	-	0.8	14	240	1800	1200	460
4	TP19/24	TP19/24_4.2	4.2	15/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	200	150	350	<20	<20	<50	<50	280	280	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	400	380	780	<20	<20	<50	<50	660	850	190	<20	<50	51	51	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_1.3	1.3	15/07/2019	Normal	1.4	28	13	25	45	70	-	20 - 21	-	<400	6900	54,000	20,000	80,900	<400	<400	11,000	10,979	58,000	76,500	7500	2100	3100	17,800	10,000	13,000	5700	1100	<1	<100	360	1200	2400	2500	6600	-	100	95	130	1700	4500	13,000
4	TP19/28	TP19/28_0.1	0.1	19/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	42	2100	1800	3942	<20	<20	100	100	3200	4120	820	<20	<50	600	390	530	210	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	D01_190719	0.1	19/07/2019	Field_D	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	57	2700	2300	5057	<20	<20	140	140	4000	5130	990	<20	<50	830	540	730	290	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	T01_190719	0.1	19/07/2019	Interlab_D	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	<10	-	200	1120	150	1470	<10	<10	410	410	1030	1440	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	TP19/28_1.0	1	19/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	230	150	380	<20	<20	<50	<50	300	300	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	76	110	186	<20	<20	<50	<50	150	150	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/29	TP19/29_2.2	2.2	22/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	85	69	154	<20	<20	<50	<50	120	120	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	TP19/30_0.4	0.4	22/07/2019	Normal	<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	TP19/30	D01_220719	0.4	22/07/2019	Field_D	<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	TP19/30	T01_220719	0.4	22/07/2019	Interlab_D	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	<10	-	<50	<100	<100	<50	<10	<10	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	TP19/30_1.2	1.2	22/07/2019	Normal	<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	TP19/31	TP19/31_1.2	1.2	22/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	89	440	120	649	21	21	180	180	410	590	<100	37	91	237	200	160	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/31	TP19/31_2.5	2.5	22/07/2019	Normal	<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	TP19/74	TP19/74_1.5	1.5	19/07/2019	Normal	<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	TP19/74	TP19/74_2.5	2.5	19/07/2019	Normal	<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	TP19/75	TP19/75_1.5	1.5	19/07/2019	Normal	<0.2	1	1.2	1.1	2.1	3.2	-	16 - 17	-	290	5700	14,000	4600	24,300	590	580	8400	8384	13,000	23,800	2400	3300	4800	17,100	8100	9500	5700	1400	<0.2	<20	310	820	1700	1500	2100	-	1.1	6.3	83	510	740	1500
4	TP19/75	TP19/75_3.0	3	19/07/2019	Normal	<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	TP19/76	TP19/76_1.5	1.5	19/07/2019	Normal	<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	TP19/76	TP19/76_2.2	2.2	19/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	98	77	175	<20	<20	<50	<50	140	140	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/77	TP19/77_1.5	1.5	15/07/2019	Normal	<1	3.2	2	<1	<2	<3	-	41	-	<200	2400	33,000	13,000	48,400	<200	<200	4500	4459	38,000	46,700	4200	1500	2900	21,800	15,000	17,000	5300	1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/77	D02_150719	1.5	15/07/2019	Field_D	<0.5	3.2	2	1	2.4	3.4	-	29	-	<100	1700	25,000	9500	36,200	<100	<100	3200	3171	28,000	33,900	2700	1100	2200	17,700	12,000	14,000	4600	1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/77	T02_150719	1.5	15/07/2019	Interlab_D	<0.5	5	3.4	1.5	2	3.5	11.9	39	54	-	2200	38,500	17,300	58,000	92	80	5200	5160	49,300	61,800	7270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/77	TP19/77_4.0	4	15/07/2019	Normal	24	75	99	77	200	280	-	150 - 220	-	3000	45,000	74,000	22,000	141,000	5000	4500	58,000	57,850	70,000	136,200	8200	30,000	38,000	76,600	37,000	30,000	9600	4800	24	1000	2300	16,000	27,000	19,000	22,000	-	75	550	2200	11,000	12,000	23,000
5	TP19/39	TP19/39_0.2	0.2	29/07/2019	Normal	<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	TP19/39	TP19/39_0.4	0.4	29/07/2019	Normal	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	-	<0.001	-	<0.02	<20 - 0.56	<50 - 27	<50 - 20	<50 - 47.56	<0.02	<0.02	<50 - 1.2	<50 - 1.2	<100 - 39	<100 - 45.4	<100 - 5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/40	TP19/40_0.1	0.2	30/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	200	200	400	<20	<20	<50	<50	350	350	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/40	TP19/40_0.2	0.2	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/40	TP19/40_0.2	2	30/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	260	56	316	<20	<20	<50	<50	280	280	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	TP19/41_0.2	0.2	29/07/2019	Normal	<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	TP19/41	D01_290719	0.2	29/07/2019	Field_D	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	68	68	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	TO1_290719	0.2	29/07/2019	Interlab_D	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1	<10	-	<50	<100	110	110	<10	<10	<50	<50	140	140	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	TP19/41_0.4	0.4	29/07/2019	Normal	<0.1	0.8	0.2	5.4	10	16	-	4.5 - 6.3	-	<80	290	130	130	550	75	59	140	135.5	200	340	<100	120	83	350	110	180	120	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	TP19/45	TP19/45_1.0	1	25/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	TP19/45	TP19/45_3.0	3	25/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	TP19/46	TP19/46_0.05	0.05	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	5500	5200	10,700	<20	<20	55	55	9300	11,055	1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	TP19/46	TP19/46_2.0	2	25/07/2019	Normal	<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	HA19/01	HA19/01_0.1	0.1	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	110	240	350	<20	<20	<50	<50	260	400	140	<20	<50	145	52	120	93	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	HA19/01	HA19/01_0.5	0.5	2/08/2019	Normal	<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	HA19/02	HA19/02_0.1	0.1	2/08/2019	Normal	<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	HA19/02	HA19/02_0.4	0.4	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	450	910	1360	<20	<20	<50	<50	970	1660	690	<20	<50	318	98	230	220	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/62	TP19/62_0.1	0.1	24/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						BTEX							Naphthalene	TRH NEPM (1999)						TRH NEPM (2013)							TRH Silica Gel Cleanup							TRH Aliphatic/Aromatic Split													
						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	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 >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36	TRH >C34-C40 Silica Gel Cleanup	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 >C5-C7 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	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						0.001	0.001	0.001	0.001	0.002	0.003	0.2	0.001	10	0.02	0.05	0.1	0.1	0.1	0.02	0.02	0.05	0.05	0.1	0.1	0.1	20	50	50	50	100	50	100	0.1	10	10	10	10	10	10	0.1	0.1	1	10	10	10	10
CRC Care (2011) Direct Contact HSL D - Comm/Ind						430	99000	27000			81000		11000								26000		20000	27000		38000																					
CRC Care (2011) Direct Contact Intrusive Maint. Worker						1100	120000	85000			130000		29000								82000		62000	85000		120000																					
NEPM (1999) HIL D - Commercial/Industrial																																															
NEPM (1999) HSL D Comm/Indust - VI Sand 0 to <1 m						3	NL	NL			230		NL								260		NL																								
NEPM (1999) HSL D Comm/Indust - VI Sand 1 to <2 m						3	NL	NL			NL		NL								370		NL																								
NEPM (1999) HSL D Comm/Indust - VI Sand 2 to <4 m						3	NL	NL			NL		NL								630		NL																								
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																				700		1000		3500		10000																					
VI Intrusive Mnt. Worker Sand 0-<2 m - CRC CARE (2011)						77	NL	NL			NL		NL								NL		NL																								
VI Intrusive Mnt. Worker Sand 2-<4 m - CRC CARE (2011)						160	NL	NL			NL		NL								NL		NL																								
Monitoring_Zone	Location_Code	Field_ID	Sample_Depth_Avg	Sampled_Date_Time	Sample_Type																																										
7	TP19/63	TP19/63_0.1	0.1	24/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	1200	640	1840	<20	<20	<50	<50	1600	1820	220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/63	TP19/63_0.6	0.6	24/07/2019	Normal	<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	TP19/65	TP19/65_0.1	0.1	25/07/2019	Normal	<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	TP19/66	TP19/66_0.5	0.5	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	<50	160	160	<20	<20	<50	<50	160	160	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/66	TP19/66_1.0	1	25/07/2019	Normal	<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	TP19/67	TP19/67_0.1	0.1	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	610	510	1120	<20	<20	<50	<50	990	1210	220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/67	TP19/67_1.0	1	25/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	TP19/07	TP19/07_0.1	0.1	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	41	1500	130	1671	<20	<20	220	220	1300	1520	<100	<20	<50	150	150	130	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	TP19/07	TP19/07_0.4	0.4	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	550	2300	73	2923	<20	<20	1300	1300	1500	2800	<100	140	320	670	530	330	<50	<100	<0.1	<10	<10	56	820	840	160	-	<0.1	<1	18	130	190	89
9	TP19/42	TP19/42_0.4	0.4	24/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	2.3 - 2.4	-	77	2400	2300	220	4920	180	180	2600	2597.7	1800	4400	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/42	TP19/42_2.2	2.2	24/07/2019	Normal	<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	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	18 - 21	-	120	4100	490	110	4700	300	300	4200	4182	220	4420	<100	9200	8200	9960	610	250	150	<100	<0.1	<10	700	2300	1300	23	230	-	<0.1	2.3	1900	1700	200	1100
9	TP19/47	TP19/47_2.0	2	29/07/2019	Normal	<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	TP19/53	TP19/53_0.3	0.3	29/07/2019	Normal	<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	TP19/53	TP19/53_1.0	1	29/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/43	TP19/43_1.2	1.2	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	5000	4000	9000	<20	<20	60	60	5400	6560	1100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/43	TP19/43_1.8	1.8	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	170	70	240	<20	<20	<50	<50	210	210	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/44	TP19/44_0.5	0.5	30/07/2019	Normal	<0.5	<0.5	<0.5	<0.5	<1	<1.5	-	20 - 21	-	<100	1800	2800	200	4800	<100	<100	2700	2680	1900	4600	<100	<20	<50	<50	<50	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/44	TP19/44_2.5	2.5	30/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/48	TP19/48_0.6	0.6	24/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	280	1800	430	2510	<20	<20	700	700	1600	2300	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/48	TP19/48_1.0	1	24/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	64	<50	64	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	<0.1	<0.1	0.5	<0.1	0.5	0.5	-	2.1 - 5.6	-	<20	49	200	<50	249	24	23	100	94.4	140	240	<100	27	60	147	120	<100	<50	<100	<0.1	<10	<10	11	41	37	18	-	<0.1	<1	<10	28	57	35
11	HA19/03	HA19/03_1.5	1.5	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	1.8	-	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/04	HA19/04_0.4	0.4	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500	750	1431	840	590	91	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/04	HA19/04_0.5	0.5	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	68	1300	2200	220	3720	200	200	2100	2100	1500	3600	<100	-	-	-	-	-	-	-	<0.1	<10	190	430	1100	590	380	-	<0.1	<1	10	240	250	280
11	HA19/04	HA19/04_1.0	1	31/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/05	HA19/05_0.05	0.05	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	75	<50	75	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/05	HA19/05_0.3	0.3	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	1200	120	<50	1320	27	27	1200	1200	<100	1200	<100	150	160	150	<50	<100	<50	<100	<0.1	<10	<10	640	540	<10	<10	-	<0.1	<1	<10	40	<10	<10
11	HA19/06	HA19/06_1.0	1	1/08/2019	Normal	<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	-	-	-	-	-	-	-	<0.1	<10	<10	<10	<10	<10	<10	-	<0.1	<1	<10	<10	<10	<10
11	HA19/06	HA19/06_2.2	2.2	1/08/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/07	HA19/07_0.05	0.05	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	60	5400	2100	7560	<20	<20	320	320	6600	7840	920	73	300	9073	7100	7300	1900	850	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/07	HA19/07_0.3	0.3	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	31	360	88	479	<20	<20	69	69	370	439	<100	<20	<50	190	190	180	<50	<100	<0.1	<10	<10	<10	<10	47	110	-	<0.1	<1	<10	<10	11	33
11	HA19/08	HA19/08_0.8	0.8	2/08/2019	Normal	<0.4	<0.4	<0.4	0.4	<0.8	<1.2	-	12 - 29	-	<80	220	470	50	740	<80	<80	310	281	380	690	<100	100	150	290	190	140	<50	<100	<0.4	<40	<40	63	140	94	59	-	<0.4	<4	37	160	270	170
11	HA19/08	HA19/08_1.2	1.2	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	2.3	-	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/09	HA19/09_0.8	0.8	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1	-	<20	2300	9700	340	12,340	<20	<20	5400	5400	6300	11,900	200	2200	5100	11,330	8900	5800	230	180	<0.1	<10	<10	310	4300	4000	830	-	<0.1	<1	21	380	800	310
11	HA19/09	HA19/09_1.4	1.4	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	46	190	<50	236	<20	<20	100	100	120	220	<100	<20	<50	77	77	<100	<50	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/10	HA19/10_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<20	<50	175	94	160	81	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/10	HA19/10_0.05	0.05	2/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	200	190	390	<20	<20	<50	<50	350	350	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/10	HA19/10_0.2	0.2	2/08/2019	Normal	<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	-	-	-	-	-	-	-	<0.1	<10	<10	<10	<10	<10	<10	-	<0.1	<1	<10	<10	<10	<10
11	TP19/79	TP19/79_0.3	0.275	26/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1.5	-	<20	930	1700	280	2910	<20	<20	1400	1400	1400	2800	<100	-	-	-	-	-	-	-	<0.1	<10	<10	44	440	310	500	-	<0.1	<1	27	370	330	590
11	TP19/79	TP19/79_1.2	1.2	26/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	TP19/80	TP19/80_0.5	0.55	26/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 1.6	-	<20	<20	<50	<50	<50	<20	<20	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	<0.1	<10	<10	<10	<10	<10	<10	-	<0.1	<1	<10	<10	<10	<10
11	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	<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	-	-	-	-	-	-	-	<0.1	<10	<10	<10	<10	<10	<10	-	<0.1	<1	<10	<10	<10	<10
11	HA19/11	HA19/11_1.4	1.4	31/07/2019	Normal	<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	HA19/12	HA19/12_0.1	0.1	31/07/2019	Normal	<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	HA19/12	HA19/12_0.4	0.4	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 0.6	-	270	540	160	<50	700	380	380	540	540	110	650	<100	67	64	67	<50	<100	<50	<100	<0.1	130	240	330	190	50	30	-	<0.1	1.4	12	36	<10	15
12	HA19/13	HA19/13_0.1	0.1	31/07/2019	Normal	<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	HA19/13	HA19/13_0.7	0.7	31/07/2019	Normal	<0.1	<0.1	0.2	0.2	0.6	0.7	-	3.6 - 5.4	-	230	320	<50	<50	320	340	340	280	274.6	<100	280	<100	190	160	190	<50	<100	<50	<100	<0.1	120	210	140	54	<10	<10	-	<0.1	6.4	41	44	<10	<10
12	HA19/14	HA19/14_0.2	0.2	31/07/2019	Normal	<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	HA19/14	HA19/14_0.5	0.5	31/07/2019	Normal	<0.1	<0.1	0.2	0.2	1.2	1.4	-	5.8 - 8.2	-	380	1000	80	<50	1080	580	580	860	851.8	<100	860	<100	470	440	470	<50	<100	<50	<100	<0.1	190	360	520	240	<10	<10	-	<0.1	19	84	84	<10	<10
12	HA19/14	D01_310719	0.5	31/07/2019	Field_D	<0.1	<0.1	0.2	0.2	1.2	1.4	-	5.9 - 6.7	-	300	990	86	<50	1076	470	470	850	843.3	<100	850	<100	500	450	500	<50	<100	<50	<100	<0.1	<10	400	330	160	<10	<10	-	<0.1	15	160	97	14	15
13	TP19/50	TP19/50_0.1	0.1	26/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/52	TP19/52_0.1	0.1	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	-	-	-	-	<20	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/54	TP19/54_0.1	0.1	1/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/56	TP19/56_0.2	0.2	1/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/58	TP19/58_0.2	0.2	1/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/59	TP19/59_0.1	0.1	1/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/60	TP19/60_0.1	0.1	25/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	-	-	-	-	<20	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/02	TP19/02_0.2	0.2	30/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	250	290	540	<20	<20	<50	<50	460	600	140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/36	TP19/36_0.4	0.4	30/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	290	280	570	<20	<20	<50	<50	500	500	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/36	TP19/36_1.6	1.5	30/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/61	TP19/61_0.4	0.4	29/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/61	TP19/61_0.8	0.8	29/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/69	TP19/69_1.0	1	30/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/69	TP19/69_3.5	3.5	30/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/70	TP19/70_0.4	0.4	30/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	240	200	440	<20	<20	<50	<50	400	400	<100	650	1200	5450	3400	3800	1400	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/70	TP19/70_1.0	1	30/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/71	TP19/71_0.2	0.2	30/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/71	TP19/71_0.6	0.6	30/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	220	160	380	<20	<20	<50	<50	340	340	<100	1500	1500	3120	1500	1200	120	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/72	TP19/72_0.2	0.2	29/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	62	120	182	<20	<20	<50	<50	150	150	<100	<20	<50	238	98	190	140	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/72	TP19/72_0.5	0.5	29/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/73	TP19/73_0.4	0.4	29/07/2019	Normal	<0.2	<0.2	<0.2	<0.2	<0.4	<0.6	-	1.5	-	140	380	120	<50	500	230	230	390	388.5	<100	390	<100	270	330	400	130	<100	<50	<100	<0.1	<10	780	200	170	20	<10	-	<0.1	23	33	42	13	<10
14	TP19/73	TP19/73_0.9	0.9	29/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/03	TP19/03_0.1	0.1	24/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/09	TP19/09_0.4	0.5	17/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/09	TP19/09_0.6	0.6	17/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/10	TP19/10_0.3	0.3	1/08/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	410	11,000	8500	19,910	<20	<20	960	960	16,000	21,660	4700	490	1000	22,690	13,000	19,000	9200	4200	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/11	TP19/11_0.4	0.4	18/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	TP19/12_0.1	0.2	17/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	D01_170719	0.2	17/07/2019	Field_D	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	T01_170719	0.2	17/07/2019	Field_D	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	TP19/12_0.3	0.3	17/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/13	TP19/13_0.1	0.2	24/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	-	<20	<20	97	89	186	<20	<20	<50	<50	150	150	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/37	TP19/37_0.2	0.2	24/07/2019	Normal	<0.2	<0.2	<0.2	<0.2	<0.4	<0.6	-	<1 - 1.6	-	<40	<20	7300	3200	10,500	<40	<40	350	350	8800	10,250	1100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/37	TP19/37_1.0	1	24/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/38	TP19/38_0.3	0.3	24/07/2019	Normal	<0.2	<0.2	<0.2	<0.2	<0.4	<0.6	-	<0.5	-	<40	<20	<50	<50	<50	<40	<40	<50	<50	<100	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/38	TP19/38_2.0	2	24/07/2019	Normal	<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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Number of Results	176	176	176	176	176	176	9	177	9	167	170	170	170	170	172	172	170	170	170	170	170	62	62	62	62	62	62	62	26	26	26	26	26	26	26	1	26	26	26	26	26	26
Number of Detects	7	14	23	20	21	20	2	38	3	19	52	84	77	89	27	27	56	56	81	86	41	36	37	52	47	42	35	23	4	5	15	21	21	18	17	1	7	14	19	21	18	18
Minimum Concentration	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	<0.2	<0.001	<10	<0.02	<20	<50	<50	<50	<0.02	<0.02	<50	<50	<100	<50	<100	<20	<50	<50	<50	<100	<50	<100	<0.1	<10	<10	<10	<10	<10	<10	0.3	<0.1	<1	<10	<10	<10	<10
Minimum Detect	0.3	0.3	0.2	0.2	0.4	0.5	11.9	0.7	46	22	25	62	50	64	21	21	55	55	110	120	100	27	51	51	51	120	81	130	0.3	120	140	11	41	20	18	0.3	0.8	1.4	10	28	11	15
Maximum Concentration	24	75	99	77	200	280	182	220	571	3000	45000	110000	27300	160000	5000	4500	67000	66953	110000	186000	15600	30000	38000	76600	38000	35000	13000	6600	24	1000	2300	16000	27000	19000	22000	0.3	100	550	2200	11000	12000	32000
Maximum Detect	24	75	99	77	200	280	182	220	571	3000	45000	110000	27300	160000	5000	4500	67000	66953	110000	186000	15600	30000	38000	76600	38000	35000	13000	6600	24	1000	2300	16000	27000	19000	22000	0.3	100	550	2200	11000	12000	32000
Average Concentration	0.39	1.8	1.4	1.2	2.8	4	22	3.9	78	57	905	3777	1360	6020	92	85	1379	1375	4202	6197	672	1426	1935	6291	3532	3669	1351	505	1.5	73	315	1413	2617	1948	2531		10	41	263	1165	1589	3394
Median Concentration	0.05	0.05	0.05	0.05	0.1	0.15	0.1	0.25	5	10	10	50	25	71.5	10	10	25	25	50	85	50	70	135	509	190	270	102	50	0.05	5	195	280	385	72	135	0.3	0.05	2.15	30	145	195	129.5
Standard Deviation	2.3	9.2	9	6.7	17	24	60	16	186	255	4742	13126	4179	20636	427	388	6926	6915	14129	21716	2125	4723	6087	14379	7667	7529	2873	1169	4.9	197	493	3492	6218	4494	5909		27	111	583	2596	3453	8129
Number of Guideline Exceedances	4	0	0	0	0	1	0	0	0	0	0	0	0	0	3	14	23	2	23	0	2	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)	4	0	0	0	0	1	0	0	0	0	0	0	0	0	3	13	23	2	23	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	1,2,3,5 & 1,2,4,5 Tetrachlorobenzene
	Metals								
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	2	0.4	2	5	5	0.1	2	5	0.5
CRC Care (2011) Direct Contact HSL D - Comm/Ind									
CRC Care (2011) Direct Contact Intrusive Maint. Worker									
USEPA (2019) RSL - Industrial Soil (Commercial Workers)									
NEPM (1999) HIL D - Commercial/Industrial	3000	900		240000	1500	730	6000	400000	
NEPM (1999) HSL D Comm/Indust - VI Sand 0 to <1 m									
NEPM (1999) HSL D Comm/Indust - VI Sand 1 to <2 m									
NEPM (1999) HSL D Comm/Indust - VI Sand 2 to <4 m									
NEPM (1999) Management Limits - Commercial/Industrial (coarse)									
VI Intrusive Mnt. Worker Sand 0-<2 m - CRC CARE (2011)									
VI Intrusive Mnt. Worker Sand 2-<4 m - CRC CARE (2011)									

Monitoring Zone	Location Code	Field ID	Sample Depth Avg	Sampled Date Time	Sample Type	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
1	TP19/01	TP19/01_0.1	0.1	18/07/2019	Normal	6.6	<0.4	24	11	51	<0.1	6.4	90
1	TP19/01	TP19/01_0.8	0.8	5/08/2019	Normal	12	<0.4	35	21	31	<0.1	<5	9.2
1	TP19/01	DOI_050819	0.8	5/08/2019	Field_D	15	<0.4	44	25	32	<0.1	5.4	15
1	TP19/04	TP19/04_0.1	0.1	5/08/2019	Normal	6	2.8	52	82	97	0.2	78	480
1	TP19/05	TP19/05_0.2	0.2	5/08/2019	Normal	5.4	<0.4	<5	<5	<5	<0.1	<5	<5
1	TP19/06	TP19/06_0.5	0.5	18/07/2019	Normal	2.7	<0.4	2400	8.5	17	<0.1	58	62
1	TP19/06	TP19/06_1.0	1	18/07/2019	Normal	6.5	<0.4	150	14	19	<0.1	<5	14
1	TP19/08	TP19/08_0.1	0.1	18/07/2019	Normal	3.2	<0.4	54	25	78	0.3	11	180
1	TP19/08	TP19/08_1.0	1	18/07/2019	Normal	5.2	<0.4	30	13	17	<0.1	8.1	18
2	TP19/14	TP19/14_1.0	1	18/07/2019	Normal	6.7	<0.4	19	9.6	18	<0.1	<5	7
2	TP19/14	TP19/14_3.0	3	18/07/2019	Normal	4.5	<0.4	13	14	14	<0.1	<5	13
2	TP19/15	TP19/15_0.8	0.8	18/07/2019	Normal	4.7	<0.4	16	28	140	<0.1	8.8	210
2	TP19/15	TP19/15_2.0	2	18/07/2019	Normal	8.1	<0.4	27	15	18	<0.1	<5	17
3	TP19/16	TP19/16_0.8	0.8	17/07/2019	Normal	6	<0.4	7.6	14	62	<0.1	<5	44
3	TP19/16	TP19/16_1.2	1.2	17/07/2019	Normal	16	<0.4	22	16	22	<0.1	<5	14
3	TP19/17	TP19/17_0.5	0.5	18/07/2019	Normal	4.2	<0.4	24	6	16	<0.1	<5	8.3
3	TP19/17	TP19/17_3.5	3.5	18/07/2019	Normal	7.6	<0.4	17	15	19	<0.1	<5	9.6
3	TP19/18	TP19/18_0.3	0.3	17/07/2019	Normal	11	<0.4	38	20	24	<0.1	8.8	47
3	TP19/18	TP19/18_0.6	0.6	17/07/2019	Normal	6.6	<0.4	16	14	16	<0.1	<5	8.2
3	TP19/27	TP19/27_0.6	0.6	24/07/2019	Normal	<2	<0.4	7.7	5.9	11	<0.1	<5	13
3	TP19/27	TP19/27_1.5	1.5	24/07/2019	Normal	<2	<0.4	10	9.5	8.9	<0.1	<5	12
3	TP19/32	TP19/32_0.1	0.1	23/07/2019	Normal	3.6	0.5	27	29	47	1.8	19	230
3	TP19/32	TP19/32_1.0	1	23/07/2019	Normal	2.6	<0.4	13	<5	11	<0.1	<5	7.2
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	2.8	<0.4	22	67	15	<0.1	56	100
3	TP19/33	DOI_240719	0.3	24/07/2019	Field_D	3.2	<0.4	21	67	17	<0.1	51	95
3	TP19/33	T01_240719	0.3	24/07/2019	Interlab_D	<5	<1	11	68	13	<0.1	61	60
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_1.2	1.2	24/07/2019	Normal	7.8	<0.4	23	22	17	<0.1	<5	20
3	TP19/34	TP19/34_0.3	0.25	24/07/2019	Normal	<2	<0.4	47	58	18	<0.1	68	190
3	TP19/34	TP19/34_0.7	0.7	24/07/2019	Normal	3.1	<0.4	20	5.4	15	<0.1	8.8	16
3	TP19/35	TP19/35_0.1	0.1	23/07/2019	Normal	10	<1	30	32	75	0.2	14	70
3	TP19/35	TP19/35_0.7	0.7	23/07/2019	Normal	9.5	<0.4	36	16	24	<0.1	6.8	25
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	11	1.1	350	260	180	5.3	30	430
4	TP19/19	TP19/19_2.0	2	16/07/2019	Normal	8.2	<0.4	400	39	86	0.3	30	170
4	TP19/20	TP19/20_0.1	0.1	16/07/2019	Normal	<2	<0.4	17	61	10	<0.1	10	39
4	TP19/20	D01_150719	0.1	16/07/2019	Field_D	<2	<0.4	36	120	13	<0.1	16	55
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	TP19/53	TP19/53_1.0	1	29/07/2019	Normal	15	<0.4	19	31	19	<0.1	<5	22
10	TP19/43	TP19/43_1.2	1.2	25/07/2019	Normal	2.5	<0.4	21	43	19	<0.1	37	120
10	TP19/43	TP19/43_1.8	1.8	25/07/2019	Normal	5.1	<0.4	21	15	15	<0.1	7.2	51
10	TP19/44	TP19/44_0.5	0.5	30/07/2019	Normal	3.6	<0.4	34	58	21	<0.1	56	160
10	TP19/44	TP19/44_2.5	2.5	30/07/2019	Normal	<2	<0.4	10	9.5	16	<0.1	<5	8.8
10	TP19/48	TP19/48_0.6	0.6	24/07/2019	Normal	<2	<0.4	23	21	22	<0.1	11	49
10	TP19/48	TP19/48_1.0	1	24/07/2019	Normal	10	<0.4	34	20	21	<0.1	9.2	37
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	12	<0.4	35	19	29	<0.1	<5	15
11	HA19/03	HA19/03_1.5	1.5	31/07/2019	Normal	15	<0.4	26	27	38	<0.1	<5	66
11	HA19/04	HA19/04_0.4	0.5	31/07/2019	Normal	5.4	<0.4	29	14	30	<0.1	8.4	49
11	HA19/04	HA19/04_1.0	1	31/07/2019	Normal	9.9	<0.4	22	20	21	<0.1	<5	13
11	HA19/05	HA19/05_0.05	0.05	31/07/2019	Normal	5	1.6	150	400	650	<0.1	100	4200
11	HA19/05	HA19/05_0.3	0.3	31/07/2019	Normal	7.2	<0.4	37	48	72	<0.1	14	390
11	HA19/06	HA19/06_1.0	1	1/08/2019	Normal	17	<0.4	32	24	82	<0.1	<5	52
11	HA19/06	HA19/06_2.2	2.2	1/08/2019	Normal	4.4	<0.4	21	38	82	<0.1	6.6	210
11	HA19/07	HA19/07_0.05	0.05	2/08/2019	Normal	9.6	2.2	240	1000	660	1	35	3000
11	HA19/07	HA19/07_0.3	0.3	2/08/2019	Normal	6.1	<0.4	26	16	23	<0.1	5	89
11	HA19/08	HA19/08_0.8	0.8	2/08/2019	Normal	16	<0.4	37	33	34	<0.1	<5	99
11	HA19/08	HA19/08_1.2	1.2	2/08/2019	Normal	<2	<0.4	11	13	17	<0.1	<5	18
11	HA19/09	HA19/09_0.8	0.8	2/08/2019	Normal	6.9	<0.4	37	15	22	<0.1	9.3	28
11	HA19/09	HA19/09_1.4	1.4	2/08/2019	Normal	10	<0.4	19	17	18	<0.1	<5	14
11	HA19/10	HA19/10_0.05	0.05	2/08/2019	Normal	7.2	9.9	450	2700	1800	3.8	130	22,000
11	HA19/10	HA19/10_0.2	0.2	2/08/2019	Normal	4.8	1.3	94	390	380	1	29	3200
11	TP19/79	TP19/79_0.3	0.275	26/07/2019	Normal	3.2	<0.4	32	34	48	<0.1	17	290
11	TP19/79	TP19/79_1.2	1.2	26/07/2019	Normal	7.8	<0.4	19	14	13	<0.1	<5	11
11	TP19/80	TP19/80_0.5	0.55	26/07/2019	Normal	<2	<0.4	<5	<5	5.1	<0.1	<5	<5
12	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	2.8	<0.4	16	15	19	<0.1	<5	19
12	HA19/11	HA19/11_1.4	1.4	31/07/2019	Normal	2.5	<0.4	27	64	130	0.8	9.6	590
12	HA19/12	HA19/12_0.1	0.1	31/07/2019	Normal	7.7	0.5	110	190	540	0.2	34	1900
12	HA19/12	HA19/12_0.4	0.4	31/07/2019	Normal	8.3	<0.4	40	150	350	0.4	34	1600
12	HA19/13	HA19/13_0.1	0.1	31/07/2019	Normal	3.6	2.4	60	150	250	0.2	69	640
12	HA19/13	HA19/13_0.7	0.7	31/07/2019	Normal	3.2	<0.4	30	32	62	<0.1	21	68
12	HA19/13	TO1_310719	0.7	31/07/2019	Interlab_D	-	-	-	-	-	-	-	-
12	HA19/14	HA19/14_0.2	0.2	31/07/2019	Normal	6.3	<0.4	29	21	34	<0.1	8.3	53
12	HA19/14	HA19/14_0.5	0.5	31/07/2019	Normal	10	<0.4	21	36	35	<0.1	30	110
12	HA19/14	D01_310719	0.5	31/07/2019	Field_D	12	<0.4	25	38	48	<0.1	33	130
13	TP19/50	TP19/50_0.1	0.1	26/07/2019	Normal	<2	0.5	43	75	62	<0.1	96	320
13	TP19/52	TP19/52_0.1	0.1	25/07/2019	Normal	-	-	-	-	-	-	-	-
13	TP19/54	TP19/54_0.1	0.1	1/08/2019	Normal	-	-	-	-	-	-	-	-
13	TP19/56	TP19/56_0.2	0.2	1/08/2019	Normal	-	-	-	-	-	-	-	-
13	TP19/58	TP19/58_0.2	0.2	1/08/2019	Normal	-	-	-	-	-	-	-	-
13	TP19/59	TP19/59_0.1	0.1	1/08/2019	Normal	-	-	-	-	-	-	-	-
13	TP19/60	TP19/60_0.1	0.1	25/07/2019	Normal	-	-	-	-	-	-	-	-
14	TP19/02	TP19/02_0.2	0.2	30/07/2019	Normal	5.2	0.8	74	140	170	0.6	31	460
14	TP19/36	TP19/36_0.4	0.4	30/07/2019	Normal	5.4	<0.4	<5	9.1	27	<0.1	<5	16
14	TP19/36	TP19/36_1.6	1.5	30/07/2019	Normal	11	<0.4	26	23	18	<0.1	<5	16
14	TP19/61	TP19/61_0.4	0.4	29/07/2019	Normal	3	<0.4	54	49	29	<0.1	53	340
14	TP19/61	TP19/61_0.8	0.8	29/07/2019	Normal	4.1	<0.4	15	22	23	<0.1	<5	16
14	TP19/69	TP19/69_1.0	1	30/07/2019	Normal	<2	<0.4	18	100	5.8	<0.1	61	88
14	TP19/69	TP19/69_3.5	3.5	30/07/2019	Normal	6.2	<0.4	18	15	14	<0.1	<5	13
14	TP19/70	TP19/70_0.4	0.4	30/07/2019	Normal	3.9	1.9	53	140	65	1.8	28	420
14	TP19/70	TP19/70_1.0	1	30/07/2019	Normal	7.5	<0.4	21	16	23	<0.1	<5	13
14	TP19/71	TP19/71_0.2	0.2	30/07/2019	Normal	<2	<0.4	21	79	<5	0.1	82	77
14	TP19/71	TP19/71_0.6	0.6	30/07/2019	Normal	6.4	<0.4	19	17	30	<0.1	<5	30
14	TP19/72	TP19/72_0.2	0.2	29/07/2019	Normal	3.8	<0.4	66	46	26	1.3	100	330
14	TP19/72	TP19/72_0.5	0.5	29/07/2019	Normal	18	<0.4	52	37	46	<0.1	10	35
14	TP19/73	TP19/73_0.4	0.4	29/07/2019	Normal	8	<0.4	26	21	21	<0.1	7.5	19
14	TP19/73	TP19/73_0.9	0.9	29/07/2019	Normal	3.2	<0.4	13	19	18	<0.1	<5	10
15	TP19/03	TP19/03_0.1	0.1	24/07/2019	Normal	2.6	<0.4	94	65	25	0.2	130	210
15	TP19/09	TP19/09_0.4	0.5	17/07/2019	Normal	5	<0.4	26	6.7	17	<0.1	8	10
15	TP19/09	TP19/09_0.6	0.6	17/07/2019	Normal	5.6	<0.4	25	9.4	16	<0.1	6.9	13
15	TP19/10	TP19/10_0.3	0.3	1/08/2019	Normal	2.8	0.5	35	52	62	5.7	27	230
15	TP19/11	TP19/11_0.4	0.4	18/07/2019	Normal	<2	<0.4	<5	<5	<5	<0.1	<5	<5
15	TP19/12	TP19/12_0.1	0.2	17/07/2019	Normal	<2	<0.4	26	49	6.9	<0.1	80	65
15	TP19/12	D01_170719	0.2	17/07/2019	Field_D	3.5	<0.4	38	65	5.8	<0.1	120	88
15	TP19/12	T01_170719	0.2	17/07/2019	Field_D	<2	<0.4	29	59	7.6	<0.1	91	78
15	TP19/12	TP19/12_0.3	0.3	17/07/2019	Normal	5.8	<0.4	17	14	24	<0.1	<5	16
15	TP19/13	TP19/13_0.1	0.2	24/07/2019	Normal	11	<0.4	70	71	76	2.9	56	460
15	TP19/37	TP19/37_0.2	0.2	24/07/2019	Normal	8.8	<0.4	28	39	200	<0.1	16	170
15	TP19/37	TP19/37_1.0	1	24/07/2019	Normal	4.6	<0.4	23	17	20	<0.1	<5	13
15	TP19/38	TP19/38_0.3	0.3	24/07/2019	Normal	<2	<0.4	130	31	<5	<0.1	100	53
15	TP19/38	TP19/38_2.0	2	24/07/2019	Normal	19	<0.4	22	20	16	<0.1	<5	13

Statistical Summary

	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Number of Results	170	170	170	170	170	170	170	170
Number of Detects	133	27	164	162	159	49	115	166
Minimum Concentration	<2	<0.4	<5	<5	<5	<0.1	<2	<5
Minimum Detect	2.3	0.4	5	5	5.1	0.1	4	7
Maximum Concentration	37	9.9	2400	2700	1800	35	470	22000
Maximum Detect	37	9.9	2400	2700	1800	35	470	22000
Average Concentration	6.1	0.41	106	71	74	0.55	35	388
Median Concentration	5.15	0.2	28	26	22	0.05	10	64
Standard Deviation	5	0.84	275	225	170	2.8	54	1782
Number of Guideline Exceedances	0	0	0	0	1	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	1	0	0	0

	Semivolatile Organic Compounds
	3,4,5-Trichlorophenol
	mg/kg
EQL	0.5
CRC Care (2011) Direct Contact HSL D - Comm/Ind	
CRC Care (2011) Direct Contact Intrusive Maint. Worker	
USEPA (2019) RSL - Industrial Soil (Commercial Workers)	
NEPM (1999) HIL D - Commercial/Industrial	
NEPM (1999) HSL D Comm/Indust - VI Sand 0 to <1 m	
NEPM (1999) HSL D Comm/Indust - VI Sand 1 to <2 m	
NEPM (1999) HSL D Comm/Indust - VI Sand 2 to <4 m	
NEPM (1999) Management Limits - Commercial/Industrial (coarse)	
VI Intrusive Mnt. Worker Sand 0-<2 m - CRC CARE (2011)	
VI Intrusive Mnt. Worker Sand 2-<4 m - CRC CARE (2011)	

Monitoring Zone	Location Code	Field ID	Sample Depth Avg	Sampled Date Time	Sample Type	3,4,5-Trichlorophenol
1	TP19/01	TP19/01 0.1	0.1	18/07/2019	Normal	-
1	TP19/01	TP19/01 0.8	0.8	5/08/2019	Normal	-
1	TP19/01	DOI 050819	0.8	5/08/2019	Field D	-
1	TP19/04	TP19/04 0.1	0.1	5/08/2019	Normal	-
1	TP19/05	TP19/05 0.2	0.2	5/08/2019	Normal	-
1	TP19/06	TP19/06 0.5	0.5	18/07/2019	Normal	-
1	TP19/06	TP19/06 1.0	1	18/07/2019	Normal	-
1	TP19/08	TP19/08 0.1	0.1	18/07/2019	Normal	-
1	TP19/08	TP19/08 1.0	1	18/07/2019	Normal	-
2	TP19/14	TP19/14 1.0	1	18/07/2019	Normal	-
2	TP19/14	TP19/14 3.0	3	18/07/2019	Normal	-
2	TP19/15	TP19/15 0.8	0.8	18/07/2019	Normal	-
2	TP19/15	TP19/15 2.0	2	18/07/2019	Normal	-
3	TP19/16	TP19/16 0.8	0.8	17/07/2019	Normal	-
3	TP19/16	TP19/16 1.2	1.2	17/07/2019	Normal	-
3	TP19/17	TP19/17 0.5	0.5	18/07/2019	Normal	-
3	TP19/17	TP19/17 3.5	3.5	18/07/2019	Normal	-
3	TP19/18	TP19/18 0.3	0.3	17/07/2019	Normal	-
3	TP19/18	TP19/18 0.6	0.6	17/07/2019	Normal	-
3	TP19/27	TP19/27 0.6	0.6	24/07/2019	Normal	-
3	TP19/27	TP19/27 1.5	1.5	24/07/2019	Normal	-
3	TP19/32	TP19/32 0.1	0.1	23/07/2019	Normal	-
3	TP19/32	TP19/32 1.0	1	23/07/2019	Normal	-
3	TP19/33	TP19/33 0.3	0.3	24/07/2019	Normal	-
3	TP19/33	DOI 240719	0.3	24/07/2019	Field D	-
3	TP19/33	T01 240719	0.3	24/07/2019	Interlab D	-
3	TP19/33	TP19/33 0.5	0.5	24/07/2019	Normal	<0.5
3	TP19/33	TP19/33 1.2	1.2	24/07/2019	Normal	-
3	TP19/34	TP19/34 0.3	0.25	24/07/2019	Normal	-
3	TP19/34	TP19/34 0.7	0.7	24/07/2019	Normal	-
3	TP19/35	TP19/35 0.1	0.1	23/07/2019	Normal	<0.5
3	TP19/35	TP19/35 0.7	0.7	23/07/2019	Normal	-
4	TP19/19	TP19/19 0.6	0.6	16/07/2019	Normal	-
4	TP19/19	TP19/19 2.0	2	16/07/2019	Normal	-
4	TP19/20	TP19/20 0.1	0.1	16/07/2019	Normal	-
4	TP19/20	D01 150719	0.1	16/07/2019	Field D	-
4	TP19/20	T01 160719	0.1	16/07/2019	Interlab D	-
4	TP19/20	TP19/20 0.4	0.4	16/07/2019	Normal	-
4	TP19/20	D02 160719	0.4	16/07/2019	Field D	-
4	TP19/20	T02 160719	0.4	16/07/2019	Interlab D	-
4	TP19/21	TP19/21 2.8	2.8	16/07/2019	Normal	-
4	TP19/21	TP19/21 4.0	4	16/07/2019	Normal	-
4	TP19/22	TP19/22 0.5	0.5	16/07/2019	Normal	-
4	TP19/22	TP19/22 1.2	1.2	16/07/2019	Normal	-
4	TP19/23	TP19/23 1.5	1.5	15/07/2019	Normal	-
4	TP19/23	D01 150719	1.5	15/07/2019	Field D	-
4	TP19/23	T01 150719	1.5	15/07/2019	Interlab D	-
4	TP19/23	TP19/23 3.5	3.5	15/07/2019	Normal	-
4	TP19/24	TP19/24 1.5	1.5	15/07/2019	Normal	-
4	TP19/24	TP19/24 3.0	3	15/07/2019	Normal	-
4	TP19/24	TP19/24 4.2	4.2	15/07/2019	Normal	-
4	TP19/25	TP19/25 0.5	0.5	15/07/2019	Normal	-
4	TP19/25	TP19/25 1.3	1.3	15/07/2019	Normal	-
4	TP19/28	TP19/28 0.1	0.1	19/07/2019	Normal	-
4	TP19/28	D01_190719	0.1	19/07/2019	Field_D	-
4	TP19/28	T01_190719	0.1	19/07/2019	Interlab_D	-
4	TP19/28	TP19/28 1.0	1	19/07/2019	Normal	-
4	TP19/29	TP19/29 1.8	1.8	22/07/2019	Normal	-
4	TP19/29	TP19/29 2.2	2.2	22/07/2019	Normal	-
4	TP19/30	TP19/30 0.4	0.4	22/07/2019	Normal	-
4	TP19/30	D01_220719	0.4	22/07/2019	Field_D	-
4	TP19/30	T01_220719	0.4	22/07/2019	Interlab_D	-
4	TP19/30	TP19/30 1.2	1.2	22/07/2019	Normal	-
4	TP19/31	TP19/31 1.2	1.2	22/07/2019	Normal	-
4	TP19/31	TP19/31 2.5	2.5	22/07/2019	Normal	-
4	TP19/74	TP19/74 1.5	1.5	19/07/2019	Normal	-
4	TP19/74	TP19/74 2.5	2.5	19/07/2019	Normal	-
4	TP19/75	TP19/75 1.5	1.5	19/07/2019	Normal	-
4	TP19/75	TP19/75 3.0	3	19/07/2019	Normal	-

ERM

Monitoring Zone	Location Code	Field ID	Sample Depth Ave	Sampled Date Time	Sample Type	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	cis-1,4-Dichloro-2-butene	Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Iodomethane	Isopropylbenzene	n-butylbenzene	n-propylbenzene	Pentachloroethane	p-isopropyltoluene	sec-butylbenzene	Styrene	TCE	tert-butylbenzene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	trans-1,4-Dichloro-2-butene	Trichlorofluoromethane	Vic EPA IWRG 621 CHC (Total)*	Vic EPA IWRG 621 Other CHC (Total)*	Vinyl acetate	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	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	5	0.5
CRC Care (2011) Direct Contact HSL D - Comm/Ind																															
CRC Care (2011) Direct Contact Intrusive Maint. Worker																															
NEPM (2013) EIL - Industrial Soil Commercial Worker																															
NEPM (2013) HSL D - Commercial/Industrial																															
NEPM (2013) HSL D Comm/Indust - Vf Sand 0 to <1 m																															
NEPM (2013) HSL D Comm/Indust - Vf Sand 1 to <2 m																															
NEPM (2013) HSL D Comm/Indust - Vf Sand 2 to <4 m																															
NEPM (2013) Management Limits - Commercial/Industrial(coarse)																															
Vf Intrusive Mnt. Worker Sand 0-<2 m - CRC CARE (2011)																															
Vf Intrusive Mnt. Worker Sand 2-<4 m - CRC CARE (2011)																															
1	TP19/01	TP19/01_0.1	0.1	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/01	TP19/01_0.8	0.8	5/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/01	D01_050819	0.8	5/08/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/04	TP19/04_0.1	0.1	5/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/05	TP19/05_0.2	0.2	5/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/06	TP19/06_0.5	0.5	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/06	TP19/06_1.0	1	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/08	TP19/08_0.1	0.1	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP19/08	TP19/08_1.0	1	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/14	TP19/14_1.0	1	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/14	TP19/14_3.0	3	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/15	TP19/15_0.8	0.8	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	TP19/15	TP19/15_2.0	2	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/16	TP19/16_0.8	0.8	17/07/2019	Normal	<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
3	TP19/16	TP19/16_2.3	2.3	17/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/17	TP19/17_0.5	0.5	18/07/2019	Normal	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	0.7	-	-	-	-	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5
3	TP19/17	TP19/17_3.5	3.5	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/18	TP19/18_0.5	0.5	17/07/2019	Normal	<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
3	TP19/18	TP19/18_3.6	3.6	17/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/27	TP19/27_0.6	0.6	24/07/2019	Normal	<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
3	TP19/27	TP19/27_1.5	1.5	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/32	TP19/32_0.1	0.1	23/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/32	TP19/32_1.0	1	23/07/2019	Normal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	<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
3	TP19/33	D01_240719	0.5	24/07/2019	Field_D	<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
3	TP19/33	T01_240719	0.5	24/07/2019	Interlab_D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	TP19/33	TP19/33_3.5	3.5	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_1.2	1.2	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_0.25	0.25	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/39	TP19/39_0.7	0.7	24/07/2019	Normal	<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
4	TP19/35	TP19/35_0.1	0.1	[illegible]	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/35	TP19/35_0.7	0.7	[illegible]	Normal	<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
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/19	TP19/19_2.0	2	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	TP19/20_0.1	0.1	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	D01_160719	0.1	16/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	T01_160719	0.1	16/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	D02_160719	0.4	16/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	T02_160719	0.4	16/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/21	TP19/21_2.8	2.8	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/21	TP19/21_4.0	4	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/22	TP19/22_0.5	0.5	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/22	TP19/22_1.0	1	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	TP19/23_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	D01_150719	1.5	15/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	T01_150719	1.5	15/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	TP19/23_3.5	3.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_3.0	3	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_4.2	4.2	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	TP19/28_0.1	0.1	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	D01_190719	0.1	19/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	T01_190719	0.1	19/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	TP19/28_1.0	1	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/29	TP19/29_2.2	2.2	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	TP19/30_0.4	0.4	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	D01_220719	0.4	22/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	T01_220719	0.4	22/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	TP19/30_1.2	1.2	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/31	TP19/31_1.2	1.2	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/31	TP19/31_2.5	2.5	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/74	TP19/74_1.5	1.5	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/74	TP19/74_2.5	2.5	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/75	TP19/75_1.5	1.5	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/75	TP19/75_3.0	3	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/76	TP19/76_1.5	1.5	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/76	TP19/76_2.2	2.2	19/07/2019	Normal	<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
4	TP19/77	TP19/77_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/77	D02_150719	1.5	15/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/77	T02_150719	1.5	15/07/2019	Interlab_D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	TP19/77	TP19/77_4.0	4	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/26	TP19/26_0.2	0.2	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/39	TP19/39_0.4	0.4	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/40	TP19/40_0.2	0.2	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/40	TP19/40_2.2	2.2	28/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	TP19/41_0.2	0.2	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	D01_290719	0.2	29/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	TO1_290719	0.2	29/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	TP19/41	TP19/41_0.4	0.4	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	TP19/45	TP19/45_1.0	1	25/07/2019	Normal	<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
6	TP19/45	TP19/45_3.0	3	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	TP19/46	TP19/46_0.05	0.05	25/07/2019	Normal	<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
6	TP19/46	TP19/46_2.0	2	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	HA19/01	HA19/01_0.1	0.1	2/08/2019	Normal	<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
7	HA19/01	HA19/01_0.5	0.5	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	HA19/02	HA19/02_0.1	0.1	2/08/2019	Normal	<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
7	HA19/02	HA19/02_0.4	0.4	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/62	TP19/62_0.1	0.1	24/07/2019	Normal	<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
7	TP19/63	TP19/63_0.1	0.1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/63	TP19/63_0.6	0.6	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/65	TP19/65_0.1	0.1	25/07/2019	Normal	<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
7	TP19/66	TP19/66_0.5	0.5	25/07/2019	Normal	<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
7	TP19/66	TP19/66_1.0	1	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/67	TP19/67_0.1	0.1	25/07/2019	Normal	<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
7	TP19/67	TP19/67_1.0	1	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	TP19/07	TP19/07_0.1	0.1	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	TP19/07	TP19/07_0.4	0.4	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/42	TP19/42_0.4	0.4	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/42	TP19/42_2.2	2.2	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_2.0	2	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/53	TP19/53_0.3	0.3	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/53	TP19/53_1.0	1	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/43	TP19/43_1.2	1.2	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/43	TP19/43_1.8	1.8	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/44	TP19/44_0.5	0.5	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/44	TP19/44_2.5	2.5	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/48	TP19/48_0.6	0.6	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	TP19/48	TP19/48_1.0	1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/03	HA19/03_1.5	1.5	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/04	HA19/04_0.4	0.5	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/04	HA19/04_1.0	1	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/05	HA19/05_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/05	HA19/05_0.3	0.3	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/06	HA19/06_1.0	1	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/06	HA19/06_2.2	2.2	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/07	HA19/07_0.05	0.05	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/07	HA19/07_0.3	0.3	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/08	HA19/08_0.8	0.8	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/08	HA19/08_1.2	1.2	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/09	HA19/09_0.8	0.8	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/09	HA19/09_1.4	1.4	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/10	HA19/10_0.05	0.05	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/10	HA19/10_0.2	0.2	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	TP19/79	TP19/79_0.3	0.275	26/07/2019	Normal	<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
11	TP19/79	TP19/79_1.2	1.2	26/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	TP19/80	TP19/80_0.5	0.55	26/07/2019	Normal	<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
12	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_1.4	1.4	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/12	HA19/12_0.1	0.1	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/12	HA19/12_0.4	0.4	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/13	HA19/13_0.1	0.1	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/13	HA19/13_0.7	0.7	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/13	TO1_310719	0.7	31/07/2019	Interlab_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/14	HA19/14_0.2	0.2	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/14	HA19/14_0.5	0.5	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/14	D01_310719	0.5	31/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/50	TP19/50_0.1	0.1	26/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/52	TP19/52_0.1	0.1	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/54	TP19/54_0.1	0.1	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/56	TP19/56_0.2	0.2	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/58	TP19/58_0.2	0.2	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/59	TP19/59_0.1	0.1	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	TP19/60	TP19/60_0.1	0.1	25/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/02	TP19/02_0.2	0.2	30/07/2019	Normal	<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
14	TP19/36	TP19/36_0.4	0.4	30/07/2019	Normal	<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
14	TP19/36	TP19/36_1.6	1.5	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/61	TP19/61_0.4	0.4	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/61	TP19/61_0.8	0.8	29/07/2019	Normal	<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
14	TP19/69	TP19/69_1.0	1	30/07/2019	Normal	<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
14	TP19/69	TP19/69_3.5	3.5	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/70	TP19/70_0.4	0.4	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/70	TP19/70_1.0	1	30/07/2019	Normal	<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
14	TP19/71	TP19/71_0.2	0.2	30/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/71	TP19/71_0.6	0.6	30/07/2019	Normal	<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
14	TP19/72	TP19/72_0.2	0.2	29/07/2019	Normal	<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
14	TP19/72	TP19/72_0.5	0.5	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/73	TP19/73_0.4	0.4	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	TP19/73	TP19/73_0.9	0.9	29/07/2019	Normal	<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
15	TP19/03	TP19/03_0.1	0.1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/09	TP19/09_0.4	0.5	17/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/09	TP19/09_0.6	0.6	17/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/10	TP19/10_0.3	0.3	1/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/11	TP19/11_0.4	0.4	18/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	TP19/12_0.1	0.2	17/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	D01_170719	0.2	17/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	T01_170719	0.2	17/07/2019	Field_D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/12	TP19/12_0.3	0.3	17/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/13	TP19/13_0.1	0.2	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/37	TP19/37_0.2	0.2	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/37	TP19/37_1.0	1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/38	TP19/38_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	TP19/38	TP19/38_2.0	2	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Statistic	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	cis-1,4-Dichloro-2-butene	Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Iodomethane	Isopropylbenzene	n-butylbenzene	n-propylbenzene	Pentachloroethane	p-isopropyltoluene	sec-butylbenzene	Styrene	TCE	tert-butylbenzene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	trans-1,4-Dichloro-2-butene	Trichlorofluoromethane	Vic EPA IWRG 621 CHC (Total)*	Vic EPA IWRG 621 Other CHC (Total)*	Vinyl acetate	Vinyl chloride
Number of Results	29	29	29	1	29	29	28	29	29	1	1	1	1	1	29	29	1	29	29	29	1	29	28	28	1	29
Number of Detects	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
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	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<5	<2.5	<2.5	<0.5	<2.5	<5	<2.5	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<2.5	<0.5	<2.5	<2.5	<2.5	<0.5	<5	<2.5	<2.5	<5	<5
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.37	0.29	0.29		0.29	0.37	0.29	0.29	0.31						0.29	0.29		0.29	0.29	0.29		0.37	0.29	0.29		0.37
Median Concentration	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2.5	0.25
Standard Deviation	0.45	0.19	0.19		0.19	0.45	0.19	0.19	0.2						0.19	0.19		0.19	0.19	0.19		0.45	0.19	0.19		0.45
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
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

Field_ID	Location_Code	Sample_Depth_Avg	Sample_Type	Sampled_Date_Time	RSI Area ID	Asbestos Detected	FA- Comment	AF - Comment
						Comment	Comment	Comment
NEPM (1999) HSL Asbestos (Commercial/Industrial)								
						-	-	-
TP19/01_0.1 AS	TP19/01	0.2	Normal	18/07/2019 0:00	1	Chrysotile and amosite asbestos detected.	Nil	Nil
TP19/01_0.1 BS	TP19/01	0.2	Normal	18/07/2019 0:00	1	No asbestos detected at the reporting limit of 0.001% w/w.*Organic fibre detected.No trace asbestos detected.	Nil	Nil
TP19/32_0.1 AS	TP19/32	0.1	Normal	19/07/2019 0:00	3	Chrysotile asbestos detected.	Nil	Nil
TP19/32_0.1 BS	TP19/32	0.1	Normal	19/07/2019 0:00	3	AF:Chrysotile and amosite asbestos detected in fibre cement fragments.Approximate raw weight of AF = 0.029gEstimated asbestos content in AF = 0.0044g*Total estimated asbestos concentration in AF = 0.00066% w/w*No asbestos detected at the reporting limit of 0.001% w/w.*Organic fibre detected.No trace asbestos detected.	Nil	AF:Chrysotile and amosite asbestos detected in fibre cement fragments.No asbestos detected at the reporting limit of 0.001% w/w.*
TP19/21_ACM2.0	TP19/21	2	Normal	16/07/2019 0:00	4	Chrysotile asbestos detected.	Nil	Nil
TP19/21_2.0 AS	TP19/21	2	Normal	19/07/2019 0:00	4	Chrysotile asbestos detected.	Nil	Nil
TP19/21_2.0 BS	TP19/21	2	Normal	19/07/2019 0:00	4	FA:Chrysotile and amosite asbestos detected in soft fibrous plaster-like material.Approximate Raw weight of FA = 0.20gEstimated asbestos content in FA = 0.061g*AF:Chrysotile asbestos detected in fibre cement fragments.Approximate raw weight of AF = 0.033gEstimated asbestos content in AF = 0.0049g*Total estimated asbestos content in FA and AF = 0.066gTotal estimated asbestos concentration in FA and AF = 0.0097% w/w*Organic fibre detected.No trace asbestos detected.	FA:Chrysotile and amosite asbestos detected in soft fibrous plaster-like material.	AF:Chrysotile asbestos detected in fibre cement fragments.
TP19/23_ACM2.5	TP19/23	2.5	Normal	15/07/2019 0:00	4	Chrysotile; amosite and crocidolite asbestos detected.	Nil	Nil
TP19/25_2.5 BS	TP19/25	2.5	Normal	19/07/2019 0:00	4	No asbestos detected at the reporting limit of 0.001% w/w.*Organic fibre detected.No trace asbestos detected.	Nil	Nil
TP19/68_1.0 AS	TP19/68	1	Normal	19/07/2019 0:00	4	Chrysotile asbestos detected.	Nil	Nil
TP19/68_1.0 BS	TP19/68	1	Normal	19/07/2019 0:00	4	No asbestos detected at the reporting limit of 0.001% w/w.*Organic fibre detected.No trace asbestos detected.	Nil	Nil
TP19/74_1.5 AS	TP19/74	1.5	Normal	19/07/2019 0:00	4	Chrysotile asbestos detected.	Nil	Nil
TP19/74_1.5 BS	TP19/74	1.5	Normal	19/07/2019 0:00	4	FA:Chrysotile and amosite asbestos detected in weathered fibre cement fragments.Approximate Raw weight of FA = 0.11gEstimated asbestos content in FA = 0.034g*AF:Chrysotile and amosite asbestos detected in the form of loose fibre bundles.Approximate raw weight of AF = 0.020g*Estimated asbestos content in AF = 0.018g*Total estimated asbestos content in FA and AF = 0.052g*Total estimated asbestos concentration in FA and AF = 0.0098% w/w*Organic fibre detected.No trace asbestos detected.	FA:Chrysotile and amosite asbestos detected in weathered fibre cement fragments.	AF:Chrysotile and amosite asbestos detected in the form of loose fibre bundles.
TP19/75_0.5	TP19/75	0.5	Normal	19/07/2019 0:00	4	No asbestos detected.Synthetic mineral fibre detected.No respirable fibres detected.	Nil	Nil
TP19/75_1.5	TP19/75	1.5	Normal	19/07/2019 0:00	4	No asbestos detected at the reporting limit of 0.01% w/w.Organic fibre detected.No respirable fibres detected.	Nil	Nil
TP19/76_2.2 AS	TP19/76	2.2	Normal	19/07/2019 0:00	4	Chrysotile asbestos detected.	Nil	Nil
TP19/76_2.2 BS	TP19/76	2.2	Normal	19/07/2019 0:00	4	AF:Chrysotile asbestos detected in fibre cement fragments and in the form of loose fibre bundles.Approximate raw weight of AF = 0.21g*Estimated asbestos content in AF = 0.040g*Total estimated asbestos concentration in AF = 0.0069% w/w*Organic fibre detected.No trace asbestos detected.	Nil	AF:Chrysotile asbestos detected in fibre cement fragments and in the form of loose fibre bundles.
TP19/81_1.0 AS	TP19/81	1	Normal	19/07/2019 0:00	4	Chrysotile and amosite asbestos detected.	Nil	Nil
TP19/81_1.0 BS	TP19/81	1	Normal	19/07/2019 0:00	4	No asbestos detected at the reporting limit of 0.001% w/w.*Organic fibre detected.No trace asbestos detected.	Nil	Nil
TP19/52_0.1 AS	TP19/52	0.1	Normal	25/07/2019 0:00	13	Chrysotile asbestos detected.	Nil	Nil
TP19/52_0.1 BS	TP19/52	0.1	Normal	25/07/2019 0:00	13	No asbestos detected at the reporting limit of 0.001% w/w.*Organic fibre detected.No trace asbestos detected.	Nil	Nil

Statistical Summary

	Asbestos Detected	FA- Comment	AF - Comment
Number of Results	10	0	1
Number of Detects	10	0	1
Minimum Concentration	0.001	99999	0.001
Minimum Detect	0.001	ND	0.001
Maximum Concentration	0.21	0	0.001
Maximum Detect	0.21	ND	0.001
Average Concentration	0.056		
Median Concentration	0.0055		0.001
Standard Deviation	0.085		
ber of Guideline Exceedances	#VALUE!	#VALUE!	#VALUE!
Guideline Exceedances(Detects Only)	#VALUE!	#VALUE!	#VALUE!

						Asbestos															
						ACM - Comment	Asbestos fibres	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil	Asbestos Sample Dimensions	Mass ACM	Mass Asbestos in ACM	Mass Asbestos in FA & AF	Soil Mass sieved to 7mm	Mass of test sample for extraction	Mass asbestos in AF	Mass Asbestos in FA	Mass FA	Organic Fibres - Comment	Respirable Fibres - Comment	Synthetic Fibres - Comment
						Comment	g	%w/w	%w/w	Comment	g	g	g	g	g	g	g	g	Comment	COMMENT	COMMENT
NEPM (1999) HSL Asbestos (Commercial/Industrial)								0.05	0.001												
Field_ID	Location_Code	Sample_Depth_Avg	Sample_Type	Sampled_Date_Time	RSI Area ID	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
TP19/01_0.1 AS	TP19/01	0.2	Normal	18/07/2019 0:00	1	-	ND	0.086	ND	160x70x7	113	-	-	11000	113	-	-	-	Nil	Nil	Nil
TP19/01_0.1 BS	TP19/01	0.2	Normal	18/07/2019 0:00	1	Nil	ND	ND	ND	-	ND	ND	ND		551	ND	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/32_0.1 AS	TP19/32	0.1	Normal	19/07/2019 0:00	3	-	ND	0.071	ND	145x40x4	94	-	-	11000	94	-	-	-	Nil	Nil	Nil
TP19/32_0.1 BS	TP19/32	0.1	Normal	19/07/2019 0:00	3	Nil	0.0291	ND	0.0007	-	ND	ND	0.0044		662	0.0044	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/21_ACM2.0	TP19/21	2	Normal	16/07/2019 0:00	4	Nil	ND	ND	ND	110x70x5	-	-	-		55	-	-	-	Nil	Nil	Nil
TP19/21_2.0 AS	TP19/21	2	Normal	19/07/2019 0:00	4	-	ND	0.750	ND	100x50x5	990.6	-	-	11000	51	-	-	-	Nil	Nil	Nil
TP19/21_2.0 BS	TP19/21	2	Normal	19/07/2019 0:00	4	Nil	0.0325	ND	0.0097	-	ND	ND	0.0658		681	0.0049	0.0609	0.203	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/23_ACM2.5	TP19/23	2.5	Normal	15/07/2019 0:00	4	Nil	ND	ND	ND	90x70x3	-	-	-		97	-	-	-	Nil	Nil	Nil
TP19/25_2.5 BS	TP19/25	2.5	Normal	19/07/2019 0:00	4	Nil	ND	ND	ND	-	ND	ND	ND		630	ND	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/68_1.0 AS	TP19/68	1	Normal	19/07/2019 0:00	4	-	ND	0.086	ND	200x100x7	113	-	-	11000	113	-	-	-	Nil	Nil	Nil
TP19/68_1.0 BS	TP19/68	1	Normal	19/07/2019 0:00	4	Nil	ND	ND	ND	-	ND	ND	ND		793	ND	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/74_1.5 AS	TP19/74	1.5	Normal	19/07/2019 0:00	4	-	ND	0.126	ND	170x70x7	166	-	-	11000	166	-	-	-	Nil	Nil	Nil
TP19/74_1.5 BS	TP19/74	1.5	Normal	19/07/2019 0:00	4	Nil	0.0201	ND	0.0098	-	ND	ND	0.052		529	0.0181	0.0339	0.113	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/75_0.5	TP19/75	0.5	Normal	19/07/2019 0:00	4	Nil	ND	ND	ND	140x60x10	-	-	-		41	-	-	-	Nil	No respirable fibres detected.	Synthetic mineral fibres detected.
TP19/75_1.5	TP19/75	1.5	Normal	19/07/2019 0:00	4	Nil	ND	ND	ND	-	ND	ND	ND		54	ND	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/76_2.2 AS	TP19/76	2.2	Normal	19/07/2019 0:00	4	-	ND	0.786	ND	120x70x7	62	-	-	11000	1037.3	-	-	-	Nil	Nil	Nil
TP19/76_2.2 BS	TP19/76	2.2	Normal	19/07/2019 0:00	4	Nil	0.211	ND	0.0069	-	ND	ND	0.0401		580	0.0401	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/81_1.0 AS	TP19/81	1	Normal	19/07/2019 0:00	4	-	ND	0.101	ND	140x60x7	133	-	-	11000	133	-	-	-	Nil	Nil	Nil
TP19/81_1.0 BS	TP19/81	1	Normal	19/07/2019 0:00	4	Nil	ND	ND	ND	-	ND	ND	ND		589	ND	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil
TP19/52_0.1 AS	TP19/52	0.1	Normal	25/07/2019 0:00	13	-	ND	0.048	ND	100x70x6	63	-	-	11000	63	-	-	-	Nil	Nil	Nil
TP19/52_0.1 BS	TP19/52	0.1	Normal	25/07/2019 0:00	13	Nil	ND	ND	ND	-	ND	ND	ND		780	ND	ND	ND	Organic fibres detected.	No respirable fibres detected.	Nil

Statistical Summary

Number of Results	8	21	21	21	11	21	21	21		21	21	21	21	0	0	0
Number of Detects	8	4	8	4	11	11	11	15		21	15	13	13	0	0	0
Minimum Concentration	99999	0	0	0	90	0	0	0		41	0	0	0	99999	99999	99999
Minimum Detect	ND	0.0201	0.0477273	0.0007	90	62	ND	0.0044		41	0.0044	0.0339	0.113	ND	ND	ND
Maximum Concentration	0	0.211	0.7857576	0.0098	200	990.6	0	0.0658		1037.3	0.0401	0.0609	0.203	0	0	0
Maximum Detect	ND	0.211	0.7857576	0.0098	200	990.6	ND	0.0658		1037.3	0.0401	0.0609	0.203	ND	ND	ND
Average Concentration		0.014	0.098	0.0013	134	96	0	0.016		372	0.0068	0.0095	0.032			
Median Concentration		0	0	0	140	0	0	0		166	0	0	0			
Standard Deviation		0.046	0.23	0.0032	34	230	0	0.026		322	0.013	0.021	0.07			
ber of Guideline Exceedances	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Guideline Exceedances(Detects Only)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!		#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

						Per- and Polyfluoroalkyl Subst									PFOS and PFOA																						Organic			
						N-Ethyl perfluorooctane sulfonamide (NEtFOSA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoethanol (MeFOS	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Sum of PFAS	Sum of PFAS (WA DER List)	Sum of PFHxS and PFOS	PFOS	Perfluorooctanoate	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FtS)	8:2 Fluorotelomer sulfonate	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	N-Ethyl perfluorooctane sulfonamidoacetic acid (Et	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid	Perfluorodecanesulfonic acid (PFDS)	Perfluorohexanesulfonic acid (PFHxS)	Perfluoroundecanoic acid (PFUnA)	Perfluorodecanoic acid (PFDA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanoic acid (PFHxA)	Perfluoropentanoic acid (PFPeA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorododecanoic acid (PFDoA)	Perfluorononanoic acid (PFNA)	Perfluorooctanesulfonamide (PFOSA)	Perfluorononanesulfonic acid (PFNS)	Perfluoropropanesulfonic acid (PFPrS)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	Sum of US EPA PFAS (PFOS + PFOA)*
						µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						5	5	5	5	5	5	50	10	5	5	5	5	10	5	5	10	10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0.005	0.005	0.005	0.005
CRC Care (2011) Direct Contact HSL D - Comm/Ind																																								
CRC Care (2011) Direct Contact Intrusive Maint. Worker																																								
NEPM (1999) HIL D - Commercial/Industrial																																								
NEPM (1999) HSL D Comm/Indust - VI Sand 0 to <1 m																																								
NEPM (1999) HSL D Comm/Indust - VI Sand 1 to <2 m																																								
NEPM (1999) HSL D Comm/Indust - VI Sand 2 to <4 m																																								
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																																								
PFAS NEMP (2018) - Industrial Commercial (Direct Contact)														20000		50000																								
VI Intrusive Mnt. Worker Sand 0-<2 m - CRC CARE (2011)																																								
VI Intrusive Mnt. Worker Sand 2-<4 m - CRC CARE (2011)																																								
Monitoring_Zone	**Location_Code**	**Field_ID**	**Sample_Depth_Avg**	**Sampled_Date_Time**	**Sample_Type**																																			
1	TP19/01	TP19/01_0.1	0.1	18/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
2	TP19/14	TP19/14_3.0	3	18/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
3	TP19/18	TP19/18_0.3	0.3	17/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	5.5	5.5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.0055	0.0055
3	TP19/33	DOI_240719	0.3	24/07/2019	Field_D	<5	<5	<5	<5	<5	<5	<50	<10	7.7	7.7	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.0077	0.0077
3	TP19/33	T01_240719	0.3	24/07/2019	Interlab_D	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	5.4	5.4	5.2	4.3	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<1	<0.2	0.9	<0.2	<0.2	<0.2	0.2	<0.2	<0.5	<0.2	<0.2	<0.2	<0.2	-	-	-	-
3	TP19/34	TP19/34_0.3	0.25	24/07/2019	Normal	<5	<5	<5	<5	<5	<5	237.7	197.8	72	72	5.8	<5	<10	120	17	<10	<10	<5	<5	<5	<5	17	<5	<5	<5	<5	<5	<5	<5	5.9	<5	<0.005	<0.005	0.0778	0.0778
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
4	TP19/20	D02_160719	0.4	16/07/2019	Field_D	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
4	TP19/20	T02_160719	0.4	16/07/2019	Interlab_D	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2	<0.2	-	-	-	-
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	18	18	18	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.018	0.018
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	11	11	11	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.011	0.011
4	TP19/30	TP19/30_0.4	0.4	22/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
4	TP19/30	D01_220719	0.4	22/07/2019	Field_D	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
4	TP19/30	T01_220719	0.4	22/07/2019	Interlab_D	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2	<0.2	-	-	-	-
5	TP19/40	TP19/40_0.1	0.2	30/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
6	TP19/45	TP19/45_0.1	0.1	25/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
7	HA19/01	HA19/01_0.1	0.1	2/08/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
7	HA19/02	HA19/02_0.05	0.05	2/08/2019	Normal	<5	<5	<5	<5	<5	<5	60.7	60.7	40.9	35	6.7	<5	<10	<5	<5	<10	<10	<5	<5	<5	5.9	<5	<5	6.4	6.7	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.0476	0.0417
7	TP19/63	TP19/63_0.1	0.1	24/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
7	TP19/65	TP19/65_0.1	0.1	25/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
7	TP19/66	TP19/66_0.5	0.5	25/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
7	TP19/67	TP19/67_0.1	0.1	25/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	12	12	12	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.012	0.012
8	TP19/07	TP19/07_0.1	0.1	2/08/2019	Normal	<5	<5	<5	<5	<5	<5	<50	35	35	35	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	0.035	0.035
9	TP19/47	TP19/47_0.2	0.2	29/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
10	TP19/43	TP19/43_0.1	0.1	25/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
11	HA19/03	HA19/03_0.05	0.05	31/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
11	HA19/07	HA19/07_0.05	0.05	2/08/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	19	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
11	TP19/79	TP19/79_0.1	0.1	26/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
12	HA19/11	HA19/11_0.05	0.05	31/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/36	TP19/36_0.1	0.1	30/07/2019	Normal	<5	<5	<5	<5	<5	<5	214	<10	<5	<5	<5	<5	<10	<5	170	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	44	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/61	TP19/61_0.4	0.4	29/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/69	TP19/69_1.0	1	30/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/70	TP19/70_0.2	0.2	30/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/71	TP19/71_0.2	0.2	30/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/72	TP19/72_0.2	0.2	29/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
14	TP19/73	TP19/73_0.4	0.4	29/07/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005
15	TP19/10	TP19/10_0.3	0.3	1/08/2019	Normal	<5	<5	<5	<5	<5	<5	<50	<10	<5	<5	<5	<5	<10	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<0.005	<0.005	<0.005	<0.005

Statistical Summary

Number of Results	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	35	35	35	35
Number of Detects	0	0	0	0	0	0	4	7	9	9	2	0	0	1	3	0	0	0	0	0	2	1	0	1	2	0	0	1	0	1	0	0	0	8	8
Minimum Concentration	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2	<0.2	<0.005	<0.005	<0.005	<0.005
Minimum Detect	ND	ND	ND	ND	ND	ND	5.4	5.4	5.2	4.3	5.8	ND	ND	120	17	ND	ND	ND	ND	ND	0.9	17	ND	6.4	0.2	ND	ND	44	ND	5.9	ND	ND	ND	0.0055	0.0055
Maximum Concentration	<5	<5	<5	<5	<5	<5	237.7	197.8	72	72	6.7	<5	<10	120	170	<10	<10	<5	<5	<5	5.9	17	<5	6.4	6.7	<5	<5	44	<5	5.9	<5	<0.005	<0.005	0.0778	0.0778
Maximum Detect	ND	ND	ND	ND	ND	ND	237.7	197.8	72	72	6.7	ND	ND	120	170	ND	ND	ND	ND	ND	5.9	17	ND	6.4	6.7	ND	ND	44	ND	5.9	ND	ND	ND	0.0778	0.0778
Average Concentration	2.3	2.3	2.3	2.3	2.3	2.3	35	13	7.2	7.1	2.5	2.3	4.6	5.4	7.5	4.6	4.6	2.3	2.3	2.3	2.4	2.7	2.3	2.4	2.4	2.3	2.3	3.4	2.3	2.4	2.3	0.0025	0.0025	0.0081	0.0079
Median Concentration	2.5	2.5	2.5	2.5	2.5	2.5	25	5	2.5	2.5	2.5	2.5	5	2.5	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0025	0.0025	0.0025	0.0025
Standard Deviation	0.61	0.61	0.61	0.61	0.66	0.66	47	33	14	13	1.1	0.61	1.3	19	27	1.3	1.3	0.66	0.55	0.66	0.83	2.5	0.66	0.93	0.96	0.66	0.61	6.8	0.66	0.88	0.66	0	0	0.015	0.015
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
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

						Dioxin-Like PCBs															Dioxins & Furans (PCDD-F)															
						PCB 105	PCB 114	PCB 123	PCB 126	PCB 156	PCB 157	PCB 167	PCB 169	PCB 189	PCB 77	PCB 81	WHO(2005)-PCB TEQ (lower)	WHO(2005)-PCB TEQ (medium)	WHO(2005)-PCB TEQ (upper)	1234678-HpCDD	1234678-HpCDF	1234789-HpCDF	123478-HxCDD	123478-HxCDF	123678-HxCDD	123678-HxCDF	123789-HxCDD	123789-HxCDF	12378-PeCDF	234678-HxCDF	23478-PeCDF	2378-TCDD (13C12)	2378-TCDF	sum HeptaCDD	sum HexaCDD
						ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg
EQL							0.1	0.1	0.1		0.1					0.1					0.1			0.1				0.1		0.1		0.1			
USEPA (2019) RSL - Industrial Soil (Commercial Workers)																																			
Monitoring_Zone	**Location_Code**	**Field_ID**	**Sample_Depth_Avg**	**Sampled_Date_Time**	**Sample_Type**																														
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	329	15.9	8.16	2.74	115	30.3	37.4	<2.41	10.4	110	2.26	0.32	0.36	0.39	3360	539	41.4	4.08	7.08	72.6	3.19	16.4	<1.11	2.09	2.32	1.54	0.954	2.04	5810	405
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	561	14.4	6.93	3.89	162	44	41.7	<2.42	12.4	201	2.94	0.45	0.49	0.52	3550	94.1	15.6	3.31	4.14	43.8	2.73	14	<2.66	3.08	1.28	1.3	0.491	1.47	6240	981
7	TP19/63	TP19/63_0.1	0.1	24/07/2019	Normal	56.3	<4.68	<3.98	<5.08	<21.9	<4.48	<11	<11.9	<3.98	46.3	<3.88	0.01	0.44	0.88	44.1	<2.59	<1.89	<2.39	<1.99	<2.39	<1.99	<2.39	<1.99	<2.19	<1.99	<2.19	<0.9	<1.59	81.7	-
7	TP19/66	TP19/66_0.5	0.5	25/07/2019	Normal	79	5.11	<3.7	<4.72	35	8.84	13.1	<11.1	3.99	86.4	<3.61	0.02	0.42	0.82	93.7	4.9	<1.76	<2.22	<1.85	5.87	<2.26	5.27	<1.85	<2.04	<1.85	<2.04	<0.83	<1.48	179	34.2
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	28.7	<2.9	<2.47	<3.14	<13.6	<2.77	<6.78	<7.4	<2.47	17.5	<2.4	0.00262	0.273	0.543	6.37	<1.6	<1.17	<1.48	<1.23	<1.48	<1.23	<1.48	<1.23	<1.36	<1.23	<1.36	<0.555	<0.986	14.2	2.76
10	TP19/43	TP19/43_0.3	0.3	25/07/2019	Normal	412	19.2	13.7	8.34	144	40.4	61.4	<11.7	9.98	355	8.06	0.92	1.1	1.27	430	5.3	<1.85	5.5	<1.95	10.2	<1.95	14.8	<1.95	<2.14	<1.95	<2.14	<0.876	<1.56	733	170
11	HA19/10	HA19/13_0.5	0.5	31/07/2019	Normal	56.2	2.8	1.65	3.89	82.4	31	20.7	<2.35	11.2	20.4	<0.765	0.401	0.472	-	196	15.6	0.604	2.46	1.06	6.33	1.35	5.29	<0.392	0.784	0.94	0.816	0.654	1.17	-	-
11	TP19/80	TP19/80_0.5	0.55	26/07/2019	Normal	743	25.6	8.22	8.42	96.3	26.4	24.5	<7.72	17.8	1090	26.6	1	1.12	1.24	123	42.9	2.29	1.61	2.08	5.45	1.58	3.24	<1.29	<1.41	2.9	<1.41	4.12	1.14	222	39.8
12	HA19/13	HA19/13_0.1	0.1	2/08/2019	Normal	17.9	1.14	1.85	<2.99	17.8	7.49	13.6	<2.38	47.4	9.31	<0.773	0.00551	0.376	-	43.6	7.05	0.599	1.1	0.858	2.38	0.737	2.3	<0.396	0.59	0.514	0.553	0.29	0.806	-	-
14	TP19/61	TP19/61_0.4	0.4	29/07/2019	Normal	271	<6.67	7.61	10.7	148	46.2	67.8	<12	23.7	76	<3.89	1.11	1.29	1.47	217	39	3.39	3.44	3.44	8.95	3.19	8.76	<2	<2.2	3.79	<2.2	<0.898	2.16	363	83.2
14	TP19/72	TP19/72_0.2	0.2	29/07/2019	Normal	72.3	4.82	<3.79	<4.83	26	6.06	<10.4	<11.4	<3.79	46.1	<3.69	0.01	0.43	0.84	238	5.1	<1.8	<2.27	<1.89	5.86	<1.89	5.81	<1.89	<2.08	<1.89	<2.08	<0.85	<1.51	406	47.8
Statistical Summary																																			
Number of Results						11	11	11	11	11	11	11	11	11	11	11	11	11	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	9	8
Number of Detects						11	8	7	6	9	9	8	0	8	11	4	11	11	9	11	9	6	7	6	9	6	9	0	4	6	4	5	6	9	8
Minimum Concentration						17.9	1.14	1.65	2.74	<13.6	<2.77	<6.78	<2.35	<2.47	9.31	<0.765	0.00262	0.273	0.39	6.37	<1.6	0.599	1.1	0.858	<1.48	0.737	<1.48	<0.392	0.59	0.514	0.553	0.29	0.806	14.2	2.76
Minimum Detect						17.9	1.14	1.65	2.74	17.8	6.06	13.1	ND	3.99	9.31	2.26	0.00262	0.273	0.39	6.37	4.9	0.599	1.1	0.858	2.38	0.737	2.3	ND	0.59	0.514	0.553	0.29	0.806	14.2	2.76
Maximum Concentration						743	25.6	13.7	10.7	162	46.2	67.8	<12	47.4	1090	26.6	1.11	1.29	1.47	3550	539	41.4	5.5	7.08	72.6	3.19	16.4	<2.66	3.08	3.79	<2.2	4.12	2.16	6240	981
Maximum Detect						743	25.6	13.7	10.7	162	46.2	67.8	ND	47.4	1090	26.6	1.11	1.29	1.47	3550	539	41.4	5.5	7.08	72.6	3.19	16.4	ND	3.08	3.79	1.54	4.12	2.16	6240	981
Average Concentration						239	8.7	5	4.4	77	22	27	3.8	13	187	4.5	0.39	0.62	0.89	755	69	6.2	2.3	2.1	15	1.6	7.1	0.76	1.2	1.5	0.99	0.81	1.1	1561	220
Median Concentration						79	4.82	1.99	2.74	82.4	26.4	20.7	3.86	10.4	76	1.94	0.32	0.44	0.84	196	7.05	0.925	1.61	0.995	5.87	1.13	5.29	0.925	1.04	0.975	1.04	0.449	0.806	363	65.5
Standard Deviation						247	8.5	4.1	3.2	60	17	23	2.2	13	316	7.6	0.44	0.36	0.37	1341	159	12	1.6	2	23	0.98	5.6	0.35	0.74	1.1	0.29	1.1	0.55	2542	333
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
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

																		PCDD-F and PCB TEQ (WHO 2005)			Indicator PCB							Dioxins
Monitoring_Zone	Location_Code	Field_ID	Sample_Depth_Avg	Sampled_Date_Time	Sample_Type	sum HeptaCDF	sum HexaCDF	sum PentaCDD	sum PentaCDF	sum TetraCDD	sum Tetra- bis OctaCDD/F	sum Tetra- bis OctaCDF	sum TetraCDF	WHO-TEQ0.5	WHO(2005)-PCDD/F TEQ (lower)	WHO(2005)-PCDD/F TEQ (medium)	WHO(2005)-PCDD/F TEQ (upper)	WHO(2005)-PCDD/F+PCB TEQ (Lower Bound)	WHO(2005)-PCDD/F+PCB TEQ inc. 1/2 BG	WHO(2005)-PCDD/F+PCB TEQ (upper)	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB 28	PCB 52	12378-PeCDD
						ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	pg/g
EQL														0.1												0.1		
USEPA (2019) RSL - Industrial Soil (Commercial Workers)																			220									
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	2810	15.5	174	21.2	38.7	55,200	7420	13.5	58.5	67.3	67.3	67.4	67.6	67.7	67.8	0.93	0.6 - 0.604	1.27	0.88	0.9	0.85	0.61	1.82
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	372	74.3	528	15.4	310	34,000	811	18.3	49	53.7	53.8	53.9	54.1	54.3	54.5	0.16	0.526	1.21	0.73	1.05	0.26	0.15	1.41
7	TP19/63	TP19/63_0.1	0.1	24/07/2019	Normal	-	-	17.4	-	23.2	777	4.22	4.22	-	0.64	2.9	5.17	0.64	3.35	6.05	<0.49	<0.139	<0.36	<0.58	<0.15	0.52	0.31	-
7	TP19/66	TP19/66_0.5	0.5	25/07/2019	Normal	9.2	7.54	5.12	7.29	1.9	5190	28.3	4.26	5.7	5.13	6.47	7.81	5.15	6.89	8.63	<0.45	0.164	0.38	<0.54	0.23	0.39	<0.28	-
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	-	-	-	-	0.869	260	-	-	1.64	0.136	1.54	2.94	0.139	1.81	3.49	<0.302	<0.0863	<0.222	<0.358	<0.0925	0.465	<0.188	<0.74
10	TP19/43	TP19/43_0.3	0.3	25/07/2019	Normal	12.2	-	68.4	-	39.8	10,600	16	3.84	11.9	12.3	13.6	14.8	13.2	14.7	16.1	1.31	0.909	1.95	1.26	0.669	2.21	1.79	-
11	HA19/10	HA19/13_0.5	0.5	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	8.13	-	8.17	8.53	8.59	8.64	0.145	0.13	1.26	0.473	0.607	<0.0804	0.0794	1.6
11	TP19/80	TP19/80_0.5	0.55	26/07/2019	Normal	98.9	40.2	9.2	12.5	8.98	1960	279	11.3	-	9.2	9.5	9.8	10.2	10.6	11	0.346	0.575	0.94	0.523	1.14	0.626	0.308	-
12	HA19/13	HA19/13_0.1	0.1	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	2.83	-	2.87	2.84	3.04	3.25	<0.0971	0.0456	0.508	0.648	9.32	0.0919	<0.0604	0.77
14	TP19/61	TP19/61_0.4	0.4	29/07/2019	Normal	76	21.4	34.1	12.5	31.2	3160	199	28.4	9.17	8.52	9.43	10.3	9.63	10.7	11.8	0.58	0.612	2.04	1.4	3.3	0.74	0.39	1.85
14	TP19/72	TP19/72_0.2	0.2	29/07/2019	Normal	47.4	158	14.2	308	8.7	5250	566	33.9	6.17	4.87	6.78	8.7	4.88	7.21	9.54	<0.46	0.152	0.34	<0.55	0.24	0.748 - 0.75	0.33	<1.14

Statistical Summary

Statistical Summary	sum HeptaCDF	sum HexaCDF	sum PentaCDD	sum PentaCDF	sum TetraCDD	sum Tetra- bis OctaCDD/F	sum Tetra- bis OctaCDF	sum TetraCDF	WHO-TEQ0.5	WHO(2005)-PCDD/F TEQ (lower)	WHO(2005)-PCDD/F TEQ (medium)	WHO(2005)-PCDD/F TEQ (upper)	WHO(2005)-PCDD/F+PCB TEQ (Lower Bound)	WHO(2005)-PCDD/F+PCB TEQ inc. 1/2 BG	WHO(2005)-PCDD/F+PCB TEQ (upper)	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB 28	PCB 52	12378-PeCDD
Number of Results	7	6	8	6	9	9	8	8	7	11	9	11	11	11	11	11	11	11	11	11	11	11	7
Number of Detects	7	6	8	6	9	9	8	8	7	11	9	11	11	11	11	6	9	9	7	9	10	8	5
Minimum Concentration	9.2	7.54	5.12	7.29	0.869	260	4.22	3.84	1.64	0.136	1.54	2.87	0.139	1.81	3.25	<0.0971	0.0456	<0.222	<0.358	<0.0925	<0.0804	<0.0604	<0.74
Minimum Detect	9.2	7.54	5.12	7.29	0.869	260	4.22	3.84	1.64	0.136	1.54	2.87	0.139	1.81	3.25	0.145	0.0456	0.34	0.473	0.23	0.0919	0.0794	0.77
Maximum Concentration	2810	158	528	308	310	55200	7420	33.9	58.5	67.3	67.3	67.4	67.6	67.7	67.8	1.31	0.909	2.04	1.4	9.32	2.21	1.79	1.85
Maximum Detect	2810	158	528	308	310	55200	7420	33.9	58.5	67.3	67.3	67.4	67.6	67.7	67.8	1.31	0.909	2.04	1.4	9.32	2.21	1.79	1.85
Average Concentration	489	53	106	63	51	12933	1165	15	20	16	19	17	16	17	18	0.4	0.35	0.93	0.63	1.6	0.63	0.38	1.2
Median Concentration	76	30.8	25.75	13.95	23.2	5190	239	12.4	9.17	8.13	9.43	8.7	8.53	8.59	9.54	0.23	0.164	0.94	0.523	0.669	0.52	0.308	1.41
Standard Deviation	1031	57	179	120	98	18970	2544	11	23	23	24	22	23	22	22	0.39	0.3	0.68	0.41	2.7	0.59	0.5	0.62
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
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

Field_ID	Location_Code	Sample_Depth_Avg	Sample_Type	Sampled_Date_Time	Monitoring_Zone	Moisture Content (dried @ 103°C)	pH (aqueous extract)	DENSITY	Total Organic Carbon	pH (Field)	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 (20Je)	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	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
						Inorganics	pH	Bulk Density	TOC	ASS Field Screen			Chromium Reducible Sulfur							SPOCAS											Extraneous Material				PSD						
						%	pH Units	g/cm3	MG/KG	pH units	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	%	G	G	%	%W/W	%W/W	%W/W	%W/W	%W/W	%W/W	%W/W
EQL						1	0.1	0.01	0.1	0.1	0.1		3	10	0.02	0.02	0.02	2	1	0.01	0.5	0.005	0.02	1	10	0.02	0.1	0.003	0.02	2	0.1	0.005	0.005	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
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															
TP19/01_0.1	TP19/01	0.1	Normal	18/07/2019	1	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/01_0.8	TP19/01	0.85	Normal	5/08/2019	1	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DOI_050819	TP19/01	0.85	Field_D	5/08/2019	1	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/04_0.1	TP19/04	0.05	Normal	5/08/2019	1	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/05_0.2	TP19/05	0.15	Normal	5/08/2019	1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/06_0.5	TP19/06	0.5	Normal	18/07/2019	1	19 - 25	-	-	-	7.1	3.7	4	45	-	-	-	-	-	2	-	1.5	0.071	-	4.6	61	0.1	5.7	0.03	-	17	<0.1	<0.005	42	100	-	-	-	-	-	-	-
TP19/06_1.0	TP19/06	1	Normal	18/07/2019	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/08_0.1	TP19/08	0.1	Normal	18/07/2019	1	12 - 13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/08_1.0	TP19/08	1	Normal	18/07/2019	1	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/14_1.0	TP19/14	1	Normal	18/07/2019	2	16 - 17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/14_3.0	TP19/14	3	Normal	18/07/2019	2	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/15_0.8	TP19/15	0.8	Normal	18/07/2019	2	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/15_2.0	TP19/15	2	Normal	18/07/2019	2	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/16_0.8	TP19/16	0.8	Normal	17/07/2019	3	15 - 17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/16_1.2	TP19/16	1.2	Normal	17/07/2019	3	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/17_0.5	TP19/17	0.5	Normal	18/07/2019	3	19 - 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/17_3.5	TP19/17	3.5	Normal	18/07/2019	3	14 - 15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/18_0.3	TP19/18	0.3	Normal	17/07/2019	3	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/18_0.6	TP19/18	0.6	Normal	17/07/2019	3	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/27_0.6	TP19/27	0.6	Normal	24/07/2019	3	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/27_1.5	TP19/27	1.5	Normal	24/07/2019	3	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/32_0.1	TP19/32	0.1	Normal	23/07/2019	3	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/32_1.0	TP19/32	1	Normal	23/07/2019	3	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/33_0.3	TP19/33	0.25	Normal	24/07/2019	3	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DOI_240719	TP19/33	0.25	Field_D	24/07/2019	3	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/33_1.2	TP19/33	1.1	Normal	24/07/2019	3	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/34_0.3	TP19/34	0.25	Normal	24/07/2019	3	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/34_0.3	TP19/34	0.3	Normal	24/07/2019	3	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/34_0.7	TP19/34	0.65	Normal	24/07/2019	3	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/35_0.1	TP19/35	0.2	Normal	23/07/2019	3	20.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/35_0.7	TP19/35	0.7	Normal	23/07/2019	3	20 - 21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/19_0.6	TP19/19	0.6	Normal	16/07/2019	4	35 - 46	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/19_2.0	TP19/19	2	Normal	16/07/2019	4	16 - 18	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/20_0.1	TP19/20	0.1	Normal	16/07/2019	4	6.3 - 7.4	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_160719	TP19/20	0.1	Field_D	16/07/2019	4	6.5 - 6.9	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T01_160719	TP19/20	0.1	Interlab_D	16/07/2019	4	4.9	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/20_0.4	TP19/20	0.4	Normal	16/07/2019	4	10 - 12	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D02_160719	TP19/20	0.4	Field_D	16/07/2019	4	7.5 - 11	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T02_160719	TP19/20	0.4	Interlab_D	16/07/2019	4	13.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/21_2.8	TP19/21	2.8	Normal	16/07/2019	4	28 - 33	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/21_4.0	TP19/21	4	Normal	16/07/2019	4	17 - 18	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/22_0.5	TP19/22	0.5	Normal	16/07/2019	4	9.1	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/22_1.2	TP19/22	1.2	Normal	16/07/2019	4	23	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/23_1.5	TP19/23	1.5	Normal	15/07/2019	4	14 - 17	8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_150719	TP19/23	1.5	Field_D	15/07/2019	4	6.5	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T01_150719	TP19/23	1.5	Interlab_D	15/07/2019	4	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/23_3.5	TP19/23	3.5	Normal	15/07/2019	4	15 - 18	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_1.5	TP19/24	1.5	Normal	15/07/2019	4	4.2 - 15	8.5	1.3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_3.0	TP19/24	3	Normal	15/07/2019	4	3.7 - 16	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_4.2	TP19/24	4.2	Normal	15/07/2019	4	10 - 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_0.5	TP19/25	0.5	Normal	15/07/2019	4	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_0.5	TP19/25	0.65	Normal	15/07/2019	4	2.2	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_1.3	TP19/25	1.3	Normal	15/07/2019	4	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_1.3	TP19/25	1.4	Normal	15/07/2019	4	14	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/26_0.5	TP19/26	0.5	Normal	16/07/2019	4	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/26_1.0	TP19/26	1	Normal	16/07/2019	4	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/28_0.1	TP19/28	0.1	Normal	19/07/2019	4	13	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_190719	TP19/28	0.1	Field_D	19/07/2019	4	12	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T01_190719	TP19/28	0.1	Interlab_D	19/07/2019	4	24.4	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/28_1.0	TP19/28	1	Normal	19/07/2019	4	13 - 14	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/29_1.8	TP19/29	1.8	Normal	22/07/2019	4	16 - 17	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/29_2.2	TP19/29	2.2	Normal	22/07/2019	4	24	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/30_0.4	TP19/30	0.4	Normal	22/07/2019	4	14	9.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_220719	TP19/30	0.4	Field_D	22/07/2019	4	11	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/30_1.2	TP19/30	1.2	Normal	22/07/2019	4	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T01_220719	TP19/30		Interlab_D	22/07/2019	4	10.2	9.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/31_1.2	TP19/31	1.2	Normal	22/07/2019	4	21 - 23	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/31_2.0	TP19/31	2	Normal	22/07/2019	4	-	-	-	-	8.3	7.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/31_2.5	TP19/31	2.5	Normal	22/07/2019	4	12	9.9	-	-	10	9	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/51_4.0	TP19/51	4	Normal	17/07/2019	4	28	-	-	-	9	2.7	4	1100	-	-	-	-	770	2	3.8	1.5	1.7	-	43	570	0.91	8.3	<0.003	1.2	<2	<0.1	<0.005	39	100	-	-	-	-	-	-	-
TP19/74_1.5	TP19/74	1.5	Normal	19/07/2019	4	18	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/74_2.5	TP19/74	2.5	Normal	19/07/2019	4	21	8.1	-	-	8	6.2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/75_1.5	TP19/75	1.5	Normal	19/07/2019	4	17 - 19	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_150719	TP19/75	1.5	Field_D	15/07/2019	4	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/75_3.0	TP19/75	3	Normal	19/07/2019	4	23	7.8	-	-	7.4	4.4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/76_1.5	TP19/76	1.5	Normal	19/07/2019	4	12	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/76_2.2	TP19/76	2.2	Normal	19/07/2019	4	16	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/77_1.5	TP19/77	1.5	Normal	15/07/2019	4	4.1 - 13	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D02_150719	TP19/77	1.5	Field_D	15/07/2019	4	6.3 - 15	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T02_150719	TP19/77	1.5	Interlab_D	15/07/2019	4	13.6	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/77_4.0	TP19/77	4	Normal	15/07/2019	4	49 - 52	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/39_0.2	TP19/39	0.25	Normal	29/07/2019	5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/39_0.4	TP19/39	0.35	Normal	29/07/2019	5	9.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/40_0.1	TP19/40	0.1	Normal	30/07/2019	5	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/40_0.1	TP19/40	0.2	Normal	30/07/2019	5	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/40_0.2	TP19/40	0.2	Normal	30/07/2019	5	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/40_0.2	TP19/40	2	Normal	30/07/2019	5	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/41_0.2	TP19/41	0.25	Normal	29/07/2019	5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_290719	TP19/41	0.25	Field_D	29/07/2019	5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T01_290719	TP19/41	0.25	Interlab_D	29/07/2019	5	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/41_0.4	TP19/41	0.4	Normal	29/07/2019	5	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/45_0.1	TP19/45	0.05	Normal	25/07/2019	6	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/45_1.0	TP19/45	1.1	Normal	25/07/2019	6	20	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/45_3.0	TP19/45	2.9	Normal	25/07/2019	6	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/46_0.05	TP19/46	0.05	Normal	24/07/2019	6	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/46_0.05	TP19/46	0.1	Normal	25/07/2019	6	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/46_2.0	TP19/46	2	Normal	25/07/2019	6	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/01_0.1	HA19/01	0.05	Normal	2/08/2019	7	17	9.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/01_0.5	HA19/01	0.45	Normal	2/08/2019	7	21	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/02_0.05	HA19/02	0.025	Normal	2/08/2019	7	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/02_0.1	HA19/02	0.15	Normal	2/08/2019	7	18	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/02_0.4	HA19/02	0.45	Normal	2/08/2019	7	9.1	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/62_0.1	TP19/62	0.2	Normal	24/07/2019	7	18	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/63_0.1	TP19/63	0.05	Normal	24/07/2019	7	25	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/63_0.1	TP19/63	0.1	Normal	24/07/2019	7	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/63_0.6	TP19/63	0.6	Normal	24/07/2019	7	14	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/65_0.1	TP19/65	0.5	Normal	25/07/2019	7	35	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/66_0.5	TP19/66	0.025	Normal	25/07/2019	7	7.7	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/66_0.5	TP19/66	0.5	Normal	24/07/2019	7	8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/66_1.0	TP19/66	0.9	Normal	25/07/2019	7	15	5.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/67_0.1	TP19/67	0.05	Normal	25/07/2019	7	8.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/67_0.1	TP19/67	0.1	Normal	24/07/2019	7	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/67_1.0	TP19/67	0.9	Normal	25/07/2019	7	18	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/07_0.1	TP19/07	0.05	Normal	2/08/2019	8	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/07_0.4	TP19/07	0.45	Normal	2/08/2019	8	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/42_0.4	TP19/42	0.4	Normal	24/07/2019	9	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/42_2.2	TP19/42	2	Normal	24/07/2019	9	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/47_0.2	TP19/47	0.25	Normal	29/07/2019	9	9.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/47_0.3	TP19/47	0.4	Normal	29/07/2019	9	18	7	1.5	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	2.9	0.7	24	25	4	3.7
TP19/47_2.0	TP19/47	1.9	Normal	29/07/2019	9	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/53_0.4	TP19/53	0.4	Normal	29/07/2019	9	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/53_1.0	TP19/53	1	Normal	29/07/2019	9	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/43_0.1	TP19/43	0.05	Normal	25/07/2019	10	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/43_0.3	TP19/43	0.3	Normal	25/07/2019	10	16	-	1.2	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/43_1.2	TP19/43	1.2	Normal	24/07/2019	10	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/43_1.2	TP19/43	1.2	Normal	25/07/2019	10	16	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/43_1.8	TP19/43	1.7	Normal	25/07/2019	10	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/43_1.8	TP19/43	1.8	Normal	24/07/2019	10	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/44_0.5	TP19/44	0.5	Normal	30/07/2019	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/44_0.5	TP19/44	0.55	Normal	30/07/2019	10	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/44_2.5	TP19/44	2.4	Normal	30/07/2019	10	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/48_0.6	TP19/48	0.6	Normal	24/07/2019	10	20 - 21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/48_1.0	TP19/48	0.9	Normal	24/07/2019	10	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/03_0.05	HA19/03	0.025	Normal	31/07/2019	11	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/03_0.8	HA19/03	0.85	Normal	31/07/2019	11	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/03_1.5	HA19/03	1.45	Normal	31/07/2019	11	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/04_0.4	HA19/04	0.45	Normal	31/07/2019	11	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/04_1.0	HA19/04	0.95	Normal	31/07/2019	11	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/05_0.05	HA19/05	0.025	Normal	31/07/2019	11	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/05_0.3	HA19/05	0.25	Normal	31/07/2019	11	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/06_1.0	HA19/06	1	Normal	1/08/2019	11	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/06_2.2	HA19/06	2.1	Normal	1/08/2019	11	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/07_0.05	HA19/07	0.025	Normal	2/08/2019	11	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/07_0.3	HA19/07	0.35	Normal	2/08/2019	11	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/08_0.8	HA19/08	0.85	Normal	2/08/2019	11	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/08_1.2	HA19/08	1.25	Normal	2/08/2019	11	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/09_0.8	HA19/09	0.75	Normal	2/08/2019	11	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/09_1.4	HA19/09	1.4	Normal	2/08/2019	11	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/10_0.05	HA19/10	0.025	Normal	2/08/2019	11	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/10_0.2	HA19/10	0.25	Normal	2/08/2019	11	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/79_0.1	TP19/79	0.1	Normal	26/07/2019	11	4.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/79_0.3	TP19/79	0.275	Normal	26/07/2019	11	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/79_0.3	TP19/79	0.3	Normal	24/07/2019	11	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/79_1.2	TP19/79	1.2	Normal	26/07/2019	11	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/80_0.5	TP19/80	0.55	Normal	26/07/2019	11	18	-	1.2	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_0.05	HA19/11	0.025	Normal	31/07/2019	12	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_0.5	HA19/11	0.45	Normal	31/07/2019	12	22	-	0.98	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_1.4	HA19/11	1.35	Normal	31/07/2019	12	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/12_0.1	HA19/12	0.1	Normal	31/07/2019	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/12_0.4	HA19/12	0.35	Normal	31/07/2019	12	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/13_0.1	HA19/13	0.05	Normal	31/07/2019	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/13_0.7	HA19/13	0.65	Normal	31/07/2019	12	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TO1_310719	HA19/13	0.65	Interlab_D	31/07/2019	12	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/14_0.2	HA19/14	0.25	Normal	31/07/2019	12	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/14_0.5	HA19/14	0.45	Normal	31/07/2019	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_310719	HA19/14	0.45	Field_D	31/07/2019	12	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/50_0.1	TP19/50	0.1	Normal	26/07/2019	13	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/52_0.1	TP19/52	0.2	Normal	25/07/2019	13	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/54_0.1	TP19/54	0.2	Normal	1/08/2019	13	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/56_0.2	TP19/56	0.2	Normal	1/08/2019	13	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/58_0.2	TP19/58	0.2	Normal	1/08/2019	13	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/59_0.1	TP19/59	0.2	Normal	1/08/2019	13	3.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/60_0.1	TP19/60	0.2	Normal	25/07/2019	13	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/02_0.2	TP19/02	0.2	Normal	30/07/2019	14	12 - 13	8.9	1.4	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/36_0.1	TP19/36	0.2	Normal	30/07/2019	14	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/36_0.4	TP19/36	0.4	Normal	30/07/2019	14	18	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/36_1.6	TP19/36	1.5	Normal	30/07/2019	14	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/61_0.4	TP19/61	0.4	Normal	29/07/2019	14	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/61_0.8	TP19/61	0.9	Normal	29/07/2019	14	16	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/69_1.0	TP19/69	0.2	Normal	30/07/2019	14	11	9.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/69_3.5	TP19/69	3.4	Normal	30/07/2019	14	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/70_0.2	TP19/70	0.2	Normal	30/07/2019	14	9.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/70_0.4	TP19/70	0.4	Normal	30/07/2019	14	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/70_1.0	TP19/70	1	Normal	30/07/2019	14	21	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/71_0.2	TP19/71	0.2	Normal	30/07/2019	14	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/71_0.6	TP19/71	0.6	Normal	30/07/2019	14	17 - 21	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/72_0.2	TP19/72	0.2	Normal	29/07/2019	14	7.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/72_0.5	TP19/72	0.5	Normal	29/07/2019	14	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/73_0.4	TP19/73	0.4	Normal	29/07/2019	14	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/73_0.9	TP19/73	0.9	Normal	29/07/2019	14	19	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/03_0.1	TP19/03	0.1	Normal	24/07/2019	15	4.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/09_0.4	TP19/09	0.5	Normal	17/07/2019	15	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/09_0.6	TP19/09	0.5	Normal	17/07/2019	15	23	-	-	-	-	-	-	3.3	21	0.09	0.05	0.03	-	2	-	1.5	0.005	0.05	11	150	0.24	4.3	0.2	-	130	<0.1	<0.005	36	100	-	-	-	-	-	-	-
TP19/09_0.6	TP19/09	0.6	Normal	17/07/2019	15	26	-	-	-	4.9	3.5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/10_0.3	TP19/10	0.25	Normal	1/08/2019	15	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/11_0.4	TP19/11	0.4	Normal	18/07/2019	15	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/12_0.1	TP19/12	0.2	Normal	17/07/2019	15	9.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_170719	TP19/12	0.2	Field_D	17/07/2019	15	8.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T01_170719	TP19/12	0.2	Field_D	17/07/2019	15	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/12_0.3	TP19/12	0.3	Normal	17/07/2019	15	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/13_0.1	TP19/13	0.1	Normal	24/07/2019	15	8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/13_0.1	TP19/13	0.2	Normal	24/07/2019	15	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/37_0.2	TP19/37	0.15	Normal	24/07/2019	15	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/37_0.2	TP19/37	0.2	Normal	24/07/2019	15	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/37_1.0	TP19/37	1	Normal	24/07/2019	15	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/38_0.3	TP19/38	0.4	Normal	24/07/2019	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/38_2.0	TP19/38	1.9	Normal	24/07/2019	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Statistic	Moisture Content	pH (aqueous extract)	DENSITY	Total Organic Carbon	pH (Field)	pH (Fox)	Reaction Rate	acidity - CRS (a-22B)	acidity - NASS (a-20J)	HCl Extractable Sulfur (20Be)	NASS (20Je)	sulfidic - NASS (s-20J)	ANC - 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	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
Number of Results	206	62	6	6	7	7	7	3	1	1	1	1	1	3	1	3	3	1	3	3	3	3	3	1	3	3	3	3	3	1	1	1	1	1	1	1
Number of Detects	206	62	6	6	7	7	7	3	1	1	1	1	1	3	1	3	3	1	3	3	3	3	2	1	2	0	0	3	3	1	1	1	1	1	1	1
Minimum Concentration	1.1	4.1	0.98	0.2	4.9	2.7	2	3.3	21	0.09	0.05	0.03	770	2	3.8	1.5	0.005	0.05	4.6	61	0.1	4.3	<0.003	1.2	<2	<0.1	<0.005	36	100	40	2.9	0.7	24	25	4	3.7
Minimum Detect	1.1	4.1	0.98	0.2	4.9	2.7	2	3.3	21	0.09	0.05	0.03	770	2	3.8	1.5	0.005	0.05	4.6	61	0.1	4.3	0.03	1.2	17	ND	ND	36	100	40	2.9	0.7	24	25	4	3.7
Maximum Concentration	52	9.9	1.5	4	10	9	4	1100	21	0.09	0.05	0.03	770	2	3.8	1.5	1.7	0.05	43	570	0.91	8.3	0.2	1.2	130	<0.1	<0.005	42	100	40	2.9	0.7	24	25	4	3.7
Maximum Detect	52	9.9	1.5	4	10	9	4	1100	21	0.09	0.05	0.03	770	2	3.8	1.5	1.7	0.05	43	570	0.91	8.3	0.2	1.2	130	ND	ND	42	100	40	2.9	0.7	24	25	4	3.7
Average Concentration	15	7.7	1.3	1.4	7.8	5.2	3.7	383						2		1.5	0.59		20	260	0.42	6.1	0.077		49	0.05	0.0025	39	100							
Median Concentration	16	7.9	1.25	0.9	8	4.4	4	45	21	0.09	0.05	0.03	770	2	3.8	1.5	0.071	0.05	11	150	0.24	5.7	0.03	1.2	17	0.05	0.0025	39	100	40	2.9	0.7	24	25	4	3.7
Standard Deviation	6.7	1.2	0.18	1.4	1.6	2.3	0.76	621						0		0	0.96		21	272	0.43	2	0.11		70	0	0	3	0							
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	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	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Env Stds Comments

Monitoring_Zone	Location_Code	Field_ID	Sample_Depth_Avg	Sampled_Date_Time	Sample_Type						ASLP	OCP		Per- and Polyfluoroalkyl Subst								
						Epichlorohydrin	Final pH	Initial pH	Leachate Fluid	pH (Leachate fluid)	pH (AUS ZHE - off)	Vic EPA IWRG 621 OCP (Total)*	Vic EPA IWRG 621 Other OCP (Total)*	N-Ethyl perfluorooctane sulfonamide (NEtFOSA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoethanol (MeFOS	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Sum of PFAS	Sum of PFAS (WA DER List)	Sum of PFHxS and PFOS
						µg/L	pH_units	pH_units	mg/l	pH Units	PH UNITS	MG/KG	MG/KG	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL						0.2	0.1	0.1		0.1	0.1	0.001	0.001	0.05	0.05	0.05	0.05	0.01	0.01	0.1	0.05	0.01
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																						7
NEPM (1999) GIL - Marine Water																						
NEPM (2013) - Marine Water																						
NEPM (2013) - Recreational						5																
NHMRC (2019) Recreational Water																						2
PFAS NEMP 2018 Table 5 Interim marine 95%																						
11	HA19/03	HA19/03_0.05	0.05	31/07/2019	Normal	-	7.6	7.9	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.1	<0.05	0.01
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	-	6.8	6.1	4	7	6.8	<0.001	<0.001	-	-	-	-	-	-	-	-	-
11	HA19/07	HA19/07_0.1	0.1	2/08/2019	Normal	-	7.6	7.1	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	0.03	<0.01	1.1	1.05	0.68
12	HA19/11	HA19/11_0.05	0.05	31/07/2019	Normal	-	8.5	8.4	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.15	0.07	0.03
12	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	-	6.2	5.1	4	7	6.2	<0.001	<0.001	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	-	7.8	8.1	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.32	0.26	0.26
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	<0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_0.3	0.3	24/07/2019	Normal	-	9.8	9.6	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.16	0.16	0.16
3	TP19/35	TP19/35_0.1	0.1	23/07/2019	Normal	<0.2	4.5	4.8	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.16	0.14	0.13
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	-	6.4	9.1	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	-	5	8.5	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/21	TP19/21_2.8	2.8	16/07/2019	Normal	-	6.9	9.3	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/22	TP19/22_0.5	0.5	16/07/2019	Normal	-	5.3	8.4	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/23	TP19/23_1.5	1.5	15/07/2019	Normal	-	5.4	10	4	7	8.5	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	-	8.4	7.6	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.56	0.56	0.56
4	TP19/24	TP19/24_3.0	3	15/07/2019	Normal	-	5.4	9.4	4	7	8.6	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	-	8.2	8.1	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.35	0.29	0.27
4	TP19/25	TP19/25_1.3	1.3	15/07/2019	Normal	-	5.4	9.8	4	7	8.4	-	-	-	-	-	-	-	-	-	-	-
4	TP19/28	TP19/28_0.1	0.1	19/07/2019	Normal	-	5.1	7.3	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	-	5.2	7	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/30	TP19/30_1.2	1.2	22/07/2019	Normal	-	5.1	6.8	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/31	TP19/31_1.2	1.2	22/07/2019	Normal	-	5.6	7.8	1	5.1	-	-	-	-	-	-	-	-	-	-	-	-
7	TP19/67	TP19/67_0.1	0.1	24/07/2019	Normal	-	8.8	9.3	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	0.01	5.73	4.75	1.46
9	TP19/47	TP19/47_0.2	0.2	29/07/2019	Normal	-	8.9	8.4	4	7	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.1	0.08	0.08
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	-	-	-	4	7	7.6	<0.001	<0.001	-	-	-	-	-	-	-	-	-

Field_ID	PFOS and PFOA																					
	PFOS	Perfluorooctanoate	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FtS)	8:2 Fluorotelomer sulfonate	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	N-Ethyl perfluorooctane sulfonamidoacetic acid (Et	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid	Perfluorodecanesulfonic acid (PFDS)	Perfluorohexanesulfonic acid (PFHxS)	Perfluoroundecanoic acid (PFUnA)	Perfluorodecanoic acid (PFDA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanoic acid (PFHxA)	Perfluoropentanoic acid (PFPeA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorododecanoic acid (PFDoA)	Perfluorononanoic acid (PFNA)	Perfluorooctanesulfonamide (PFOSA)
	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	0.01	0.01	0.01	0.05	0.01	0.01	0.05	0.05	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																						
NEPM (1999) GIL - Marine Water																						
NEPM (2013) - Marine Water																						
NEPM (2013) - Recreational																						
NHMRC (2019) Recreational Water		10																				
PFAS NEMP 2018 Table 5 Interim marine 95%	0.13	220																				
HA19/03_0.05	0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
HA19/03_0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/07_0.1	0.6	0.09	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	0.03	<0.05	<0.01	0.08	<0.01	<0.01	0.09	0.08	0.08	<0.01	<0.01	<0.01	0.02	<0.05
HA19/11_0.05	0.03	0.02	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	<0.01	0.03	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.05
HA19/11_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/33_0.3	0.26	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.05
TP19/33_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/34_0.3	0.12	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
TP19/35_0.1	0.12	0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.05
TP19/19_0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/20_0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/21_2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/22_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/23_1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_1.5	0.48	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
TP19/24_3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_0.5	0.24	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	0.03	0.03	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.03	<0.05
TP19/25_1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/28_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/29_1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/30_1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/31_1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/67_0.1	1.4	0.31	<0.01	0.45	2.3	0.17	<0.05	<0.05	<0.01	<0.05	<0.01	0.06	0.48	0.09	0.08	0.08	0.07	<0.01	<0.01	<0.01	0.23	<0.05
TP19/47_0.2	0.08	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
TP19/47_0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Statistic	Epichlorohydrin	Final pH	Initial pH	Leachate Fluid	pH (Leachate fluid)	pH (AUS ZHE - off)	Vic EPA IWRG 621 OCP (Total)*	Vic EPA IWRG 621 Other OCP (Total)*	NEtFOSA	EtFOSE	MeFOSA	MeFOSE	PFPeS	PFHpS	Sum of PFAS	Sum of PFAS (WA DER List)	Sum of PFHxS and PFOS
Number of Results	2	23	23	24	24	6	3	3	10	10	10	10	10	10	10	10	10
Number of Detects	0	23	23	24	24	6	0	0	0	0	0	0	1	1	8	9	10
Minimum Concentration	<0.2	4.5	4.8	1	5.1	6.2	<0.001	<0.001	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.1	<0.05	0.01
Minimum Detect	ND	4.5	4.8	1	5.1	6.2	ND	ND	ND	ND	ND	ND	0.03	0.01	0.15	0.07	0.01
Maximum Concentration	<0.2	9.8	10	4	7	8.6	<0.001	<0.001	<0.05	<0.05	<0.05	<0.05	0.03	0.01	5.73	4.75	1.46
Maximum Detect	ND	9.8	10	4	7	8.6	ND	ND	ND	ND	ND	ND	0.03	0.01	5.73	4.75	1.46
Average Concentration		6.7	8	3	6.4	7.7	0.0005	0.0005	0.025	0.025	0.025	0.025	0.0075	0.0055	0.86	0.74	0.36
Median Concentration	0.1	6.4	8.1	4	7	8	0.0005	0.0005	0.025	0.025	0.025	0.025	0.005	0.005	0.24	0.21	0.21
Standard Deviation		1.6	1.4	1.4	0.91	1	0	0	0	0	0	0	0.0079	0.0016	1.7	1.4	0.44
Number of Guideline Exceedances	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

Statistic	PFOS	PFOA	4:2 FTS	6:2 FtS	8:2 FTS	10:2 FTS	NEtFOSAA	NMeFOSAA	PFBS	PFBA	PFDS	PFHxS	PFUnA	PFDA	PFHpA	PFHxA	PFPeA	PFTeDA	PFTrDA	PFDoA	PFNA	PFOSA
Number of Results	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Number of Detects	10	4	0	1	1	1	0	0	1	0	0	6	3	2	3	3	2	0	0	0	6	0
Minimum Concentration	0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
Minimum Detect	0.01	0.01	ND	0.45	2.3	0.17	ND	ND	0.03	ND	ND	0.01	0.02	0.03	0.02	0.02	0.07	ND	ND	ND	0.02	ND
Maximum Concentration	1.4	0.31	<0.01	0.45	2.3	0.17	<0.05	<0.05	0.03	<0.05	<0.01	0.08	0.48	0.09	0.09	0.08	0.08	<0.01	<0.01	<0.01	0.23	<0.05
Maximum Detect	1.4	0.31	ND	0.45	2.3	0.17	ND	ND	0.03	ND	ND	0.08	0.48	0.09	0.09	0.08	0.08	ND	ND	ND	0.23	ND
Average Concentration	0.33	0.046	0.005	0.068	0.23	0.022	0.025	0.025	0.0075	0.025	0.005	0.032	0.057	0.016	0.023	0.022	0.019	0.005	0.005	0.005	0.041	0.025
Median Concentration	0.18	0.005	0.005	0.025	0.005	0.005	0.025	0.025	0.005	0.025	0.005	0.02	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.02	0.025
Standard Deviation	0.42	0.096	0	0.13	0.73	0.052	0	0	0.0079	0	0	0.031	0.15	0.027	0.033	0.031	0.03	0	0	0	0.068	0
Number of Guideline Exceedances	5	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)	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ERM

						BTEX						Naphthalene	TRH NEPM (1999)				
						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
						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						20	20	20	20	20	60	1	1000	50	100	100	100
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																	
NEPM (1999) GIL - Marine Water						500|950	180	5	350	275		50					
NEPM (2013) - Marine Water						500						50					
NEPM (2013) - Recreational						10	8000	3000			6000						
NHMRC (2019) Recreational Water																	
PFAS NEMP 2018 Table 5 Interim marine 95%																	
Monitoring_Zone	**Location_Code**	**Field_ID**	**Sample_Depth_Avg**	**Sampled_Date_Time**	**Sample_Type**												
11	HA19/03	HA19/03_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	<20	<20	<20	<20	<40	<60	18 - 200	<1000	290	300	<100	590
11	HA19/07	HA19/07_0.1	0.1	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	<20	<20	<20	<20	<40	<60	<1 - 140	<1000	420	<100	<100	420
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/35	TP19/35_0.1	0.1	23/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	-	-	-	-	-	-	37	-	1200	2300	<200	3500
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	-	-	-	-	-	-	2	-	<100	<200	<200	<200
4	TP19/21	TP19/21_2.8	2.8	16/07/2019	Normal	-	-	-	-	-	-	57	-	700	1500	<200	2200
4	TP19/22	TP19/22_0.5	0.5	16/07/2019	Normal	-	-	-	-	-	-	<1	-	<100	<200	<200	<200
4	TP19/23	TP19/23_1.5	1.5	15/07/2019	Normal	50	470	60	100	210	310	<100 - 36	1400	1000	3200	<200	4200
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_3.0	3	15/07/2019	Normal	<20	<20	30	<20	<20	<60	<100 - 60	<1000	700	<200	<200	700
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_1.3	1.3	15/07/2019	Normal	30	1600	40	100	170	280	<100 - 17	2900	1100	6900	<200	8000
4	TP19/28	TP19/28_0.1	0.1	19/07/2019	Normal	-	-	-	-	-	-	<1	-	<100	<200	<200	<200
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	-	-	-	-	-	-	<1	-	<100	<200	<200	<200
4	TP19/30	TP19/30_1.2	1.2	22/07/2019	Normal	-	-	-	-	-	-	<1	-	<100	<200	<200	<200
4	TP19/31	TP19/31_1.2	1.2	22/07/2019	Normal	-	-	-	-	-	-	<1	-	<100	<200	<200	<200
7	TP19/67	TP19/67_0.1	0.1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.2	0.2	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	<20	<20	<20	<20	<40	<60	210 - 830	<1000	7400	1200	300	8900
Statistical Summary																	
Number of Results						6	6	6	6	6	6	14	6	14	14	14	14
Number of Detects						2	2	3	2	2	2	9	2	8	6	1	8
Minimum Concentration						<20	<20	<20	<20	<20	<60	<1	<1000	<100	<100	<100	<200
Minimum Detect						30	470	30	100	170	280	2	1400	290	300	300	420
Maximum Concentration						50	1600	60	100	210	310	830	2900	7400	6900	300	8900
Maximum Detect						50	1600	60	100	210	310	830	2900	7400	6900	300	8900
Average Concentration						20	352	27	40	75	118	66	1050	936	1154	107	2079
Median Concentration						10	10	20	10	20	30	35.25	500	355	100	100	505
Standard Deviation						17	639	21	46	90	137	135	975	1909	1929	58	3019
Number of Guideline Exceedances						6	2	6	0	0	0	5	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)						2	2	3	0	0	0	5	0	0	0	0	0

	TRH NEPM (2013)							TRH	Metals									
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 >C10-C40 Fraction	TRH >C34-C40 Fraction	TRH (Total)	Arsenic	Cadmium	Chromium	Chromium (hexavalent)	Chromium (Trivalent)	Copper	Lead	Mercury	Nickel	Zinc
	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	1000	20	50	50	100	100	100	100	5	0.5	10	5	5	10	10	0.1	10	10
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																		
NEPM (1999) GIL - Marine Water									2.3	0.7	4.4			1.3	4.4	0.1	7	8|15
NEPM (2013) - Marine Water										0.7		4.4	27	1.3	4.4	0.1	7	15
NEPM (2013) - Recreational									100	20		500		20000	100	10	200	30000
NHMRC (2019) Recreational Water																		
PFAS NEMP 2018 Table 5 Interim marine 95%																		
HA19/03_0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/03_0.8	<1000	<1000	290	90	200	490	<100	-	<5	<0.5	20	<5	20	<10	10	<0.1	<10	30
HA19/07_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_0.5	<1000	<1000	220	80	<100	220	<100	-	12	<0.5	110	<5	110	110	100	<0.1	30	210
TP19/33_0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/33_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/34_0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/35_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/19_0.6	-	-	1700	-	1600	3300	<100	3300	<10	<5	<10	-	-	<10	<10	<1	80	120
TP19/20_0.4	-	-	<50	-	<100	<100	<100	<100	<10	<5	<10	-	-	50	60	<1	30	470
TP19/21_2.8	-	-	800	-	1200	2000	<100	2000	<10	<5	<10	-	-	<10	<10	<1	50	70
TP19/22_0.5	-	-	<50	-	<100	<100	<100	<100	<10	<5	<10	-	-	<10	40	<1	120	130
TP19/23_1.5	1700	810	1200	1200	2400	3600	<100	-	<10	<5	50	-	-	<10	20	<1	1000	970
TP19/24_1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_3.0	<1000	<1000	860	860	<100	860	<100	-	<10	6	<10	-	-	<10	40	<1	120	760
TP19/25_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_1.3	3300	1400	1400	1400	5700	7100	<100	-	<10	<5	50	-	-	<10	10	<1	1800	640
TP19/28_0.1	-	-	<50	-	<100	<100	<100	<100	<10	7	20	-	-	40	10	<1	130	2300
TP19/29_1.8	-	-	<50	-	<100	<100	<100	<100	<10	<5	<10	-	-	<10	<10	<1	10	230
TP19/30_1.2	-	-	<50	-	<100	<100	<100	<100	<10	<5	<10	-	-	<10	<10	<1	<10	410
TP19/31_1.2	-	-	<50	-	<100	<100	<100	<100	<10	<5	20	-	-	<10	<10	<1	<10	2200
TP19/67_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/47_0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/47_0.3	<1000	<1000	7700	6870	700	8600	200	-	<5	<0.5	<10	<5	<5	<10	<10	<0.1	<10	20
Statistical Summary																		
Number of Results	6	6	14	6	14	14	14	8	14	14	14	3	3	14	14	14	14	14
Number of Detects	2	2	8	6	6	8	1	2	1	2	6	0	2	3	8	0	10	14
Minimum Concentration	<1000	810	<50	80	<100	<100	<100	<100	<5	<0.5	<10	<5	<5	<10	<10	<0.1	<10	20
Minimum Detect	1700	810	220	80	200	220	200	2000	12	6	20	ND	20	40	10	ND	10	20
Maximum Concentration	3300	1400	7700	6870	5700	8600	200	3300	12	7	110	<5	110	110	100	<1	1800	2300
Maximum Detect	3300	1400	7700	6870	5700	8600	200	3300	12	7	110	ND	110	110	100	ND	1800	2300
Average Concentration	1167	702	1023	1750	871	1891	61	700	5.1	2.6	22	2.5	44	18	23	0.4	242	611
Median Concentration	500	500	255	1030	50	355	50	50	5	2.5	5	2.5	20	5	10	0.5	40	320
Standard Deviation	1150	364	2009	2568	1573	2818	40	1253	2.2	1.9	30	0	58	30	28	0.19	517	752
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	14	11	14	3	1	14	14	11	14	14
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	1	2	6	0	1	3	8	0	10	14

	OCs															
Field_ID	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde
	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	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																
NEPM (1999) GIL - Marine Water																
NEPM (2013) - Marine Water															0.004	
NEPM (2013) - Recreational				3					90							
NHMRC (2019) Recreational Water																
PFAS NEMP 2018 Table 5 Interim marine 95%																
HA19/03_0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/03_0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
HA19/07_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA19/11_0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TP19/33_0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/33_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/34_0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/35_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/19_0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/20_0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/21_2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/22_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/23_1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/24_3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/25_1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/28_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/29_1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/30_1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/31_1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/67_0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/47_0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP19/47_0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Statistical Summary																
Number of Results	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Number of Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.05	0.05	0.05	0.05	0.05	0.5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Median Concentration	0.05	0.05	0.05	0.05	0.05	0.5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Standard Deviation	0	0	0	0	0	0	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	3	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

												OPs																								Organic																	
						Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Toxaphene	Azinophos methyl	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dichlorvos	Dimethoate	Disulfoton	Ethion	Fenitrothion	Fenthion	Malathion	Methyl parathion	Mevinphos (Phosdrin)	Monocrotophos	Naled (Dibrom)	Omethoate	Parathion	Phorate	Pirimiphos-methyl	Pyrazophos	Ronnel	Terbufos	Tokuthion	Tetrachlorvinphos	Trichloronate	Perfluorononanesulfonic acid (PFNS)	Perfluoropropanesulfonic acid (PFPrS)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	Sum of US EPA PFAS (PFOS + PFOA)*	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-chloro-3-methylphenol	4-nitrophenol	Acenaphthene
						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	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	UG/L	UG/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						0.1	0.1	0.1	0.1	0.1	10	2	2	20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0.02	2	2	2	2	0.002	2	0.01	0.01	0.01	0.01	10	10	3	3	30	3	3	3	10	6	30	10	30	1
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																																																							
NEPM (1999) GIL - Marine Water																																											20	160				490							
NEPM (2013) - Marine Water														0.009																																									
NEPM (2013) - Recreational							100	3		3000		300		100		40	50	70	40	40	70	70	700	7	50	20		10	200		0.9	200		9		1							200	2000				3000							
NHMRC (2019) Recreational Water																																																							
PFAS NEMP 2018 Table 5 Interim marine 95%																																																							
Monitoring_Zone	Location_Code	Field_ID	Sample_Depth_Avg	Sampled_Date_Time	Sample_Type																																																		
11	HA19/03	HA19/03_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.01	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.1	<10	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
11	HA19/07	HA19/07_0.1	0.1	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.77	0.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.05	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.1	<10	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.26	0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.16	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/35	TP19/35_0.1	0.1	23/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.14	0.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	140	<30	<3	<3	58	<10	<6	<30	<10	<30	1
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
4	TP19/21	TP19/21_2.8	2.8	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	2
4	TP19/22	TP19/22_0.5	0.5	16/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
4	TP19/23	TP19/23_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	29	<30	<3	<3	15	<10	7	<30	<10	<30	2
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.56	0.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_3.0	3	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	3
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.27	0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_1.3	1.3	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	31	<30	<3	<3	27	<10	9	<30	<10	<30	2
4	TP19/28	TP19/28_0.1	0.1	19/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
4	TP19/30	TP19/30_1.2	1.2	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
4	TP19/31	TP19/31_1.2	1.2	22/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
7	TP19/67	TP19/67_0.1	0.1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	1.77	1.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.2	0.2	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	<0.01	0.08	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	<0.1	<0.1	<0.1	<0.1	<0.1	<10	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2	-	-	-	-	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
Statistical Summary																																																							
Number of Results						3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	10	10	10	10	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Number of Detects						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	10	10	0	0	0	3	0	0	0	3	0	2	0	0	0	5
Minimum Concentration						<0.1	<0.1	<0.1	<0.1	<0.1	<10	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2	<0.01	<0.01	0.01	0.01	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
Minimum Detect						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.01	ND	ND	ND	29	ND	ND	ND	15	ND	7	ND	ND	ND	1
Maximum Concentration						<0.1	<0.1	<0.1	<0.1	<0.1	<10	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2	<0.01	<0.01	1.77	1.71	<10	<10	<3	140	<30	<3	<3	58	<10	9	<30	<10	<30	3
Maximum Detect						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.77	1.71	ND	ND	ND	140	ND	ND	ND	58	ND	9	ND	ND	ND	3
Average Concentration						0.05	0.05	0.05	0.05	0.05	5	1	1	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.01	1	1	1	1	0.001	1	0.005	0.005	0.41	0.38	5	5	1.5	15	15	1.5	1.5	8.3	5	3.7	15	5	15	1
Median Concentration						0.05	0.05	0.05	0.05	0.05	5	1	1	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.01	1	1	1	1	0.001	1	0.005	0.005	0.21	0.185	5	5	1.5	1.5	15	1.5	1.5	1.5	5	3	15	5	15	0.5
Standard Deviation						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	0.54	0.51	0	0	0	37	0	0	0	16	0	1.9	0	0	0	0.84
Number of Guideline Exceedances						0	0	0	0	0	0	0	0	3	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	0	0	0	0	0	0	0	0	0

						PAH/Phenols																					PCBs								Pesticides		SVOC							
						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	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)	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	Bolstar (Sulprofos)	Merphos	4,6-Dinitro-o-cyclohexyl phenol	Coumaphos	Demeton-O	Demeton-S	EPN	Ethoprop	Fensulfothion	Hexachlorobenzene
						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	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL						1	1	1	1	1	1	1	1	1	100	1	1	1	10	1	3	1	30	10	100	1	5	1	5	5	5	5	5	1	2	0.002	100	20	2	20	2	2	2	0.1
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																																												
NEPM (1999) GIL - Marine Water							0.01		0.2							1.4				2	400																							
NEPM (2013) - Marine Water																			11		400																							
NEPM (2013) - Recreational																			100																100							10	100	
NHMRC (2019) Recreational Water																																												
PFAS NEMP 2018 Table 5 Interim marine 95%																																												
Monitoring_Zone	**Location_Code**	**Field_ID**	**Sample_Depth_Avg**	**Sampled_Date_Time**	**Sample_Type**																																							
11	HA19/03	HA19/03_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HA19/03	HA19/03_0.8	0.8	31/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	3	<1	<10	13	<3	<1	<30	<10	<100	34	<5	<1	<5	<5	<5	<5	<5	<1	<2	<0.002	<100	<20	<2	<20	<2	<2	<2	<0.1
11	HA19/07	HA19/07_0.1	0.1	2/08/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_0.05	0.05	31/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	HA19/11	HA19/11_0.5	0.5	31/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	<5	<1	<5	<5	<5	<5	<5	<1	<2	<0.002	<100	<20	<2	<20	<2	<2	<2	<0.1
3	TP19/33	TP19/33_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/33	TP19/33_0.5	0.5	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/34	TP19/34_0.3	0.3	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	TP19/35	TP19/35_0.1	0.1	23/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/19	TP19/19_0.6	0.6	16/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	2	<1	<10	2	<3	<1	<30	<10	198	42	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/20	TP19/20_0.4	0.4	16/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	2	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/21	TP19/21_2.8	2.8	16/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	4	<1	<10	5	<3	<1	<30	<10	<100	68	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/22	TP19/22_0.5	0.5	16/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/23	TP19/23_1.5	1.5	15/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	3	<1	<10	2	<3	<1	<30	<10	<100	43	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/24	TP19/24_1.5	1.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/24	TP19/24_3.0	3	15/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	4	<1	<10	2	<3	<1	<30	<10	<100	69	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/25	TP19/25_0.5	0.5	15/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	TP19/25	TP19/25_1.3	1.3	15/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	3	<1	<10	2	<3	<1	<30	<10	<100	24	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/28	TP19/28_0.1	0.1	19/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/29	TP19/29_1.8	1.8	22/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/30	TP19/30_1.2	1.2	22/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
4	TP19/31	TP19/31_1.2	1.2	22/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	-	-	-	-	-	-	-	-	-	-	<100	-	-	-	-	-	-	-
7	TP19/67	TP19/67_0.1	0.1	24/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.2	0.2	29/07/2019	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	TP19/47	TP19/47_0.3	0.3	29/07/2019	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	210	<5	<1	<5	<5	<5	<5	<5	<1	<2	<0.002	<100	<20	<2	<20	<2	<2	<2	<0.1
Statistical Summary																																												
Number of Results						14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	3	3	3	3	3	3	3	3	3	3	14	3	3	3	3	3	3	3
Number of Detects						0	0	0	0	0	0	0	0	0	0	0	6	0	0	6	0	0	0	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration						<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1	<5	<1	<5	<5	<5	<5	<5	<1	<2	<0.002	<100	<20	<2	<20	<2	<2	<2	<0.1
Minimum Detect						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	2	ND	ND	ND	ND	198	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration						<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	4	<1	<10	13	<3	<1	<30	<10	198	210	<5	<1	<5	<5	<5	<5	<5	<1	<2	<0.002	<100	<20	<2	<20	<2	<2	<2	<0.1
Maximum Detect						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND	13	ND	ND	ND	ND	198	210	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration						0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	50	0.5	1.6	0.5	5	2.1	1.5	0.5	15	5	61	35	2.5	0.5	2.5	2.5	2.5	2.5	2.5	0.5	1	0.001	50	10	1	10	1	1	1	0.05
Median Concentration						0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	50	0.5	0.5	0.5	5	0.5	1.5	0.5	15	5	50	13	2.5	0.5	2.5	2.5	2.5	2.5	2.5	0.5	1	0.001	50	10	1	10	1	1	1	0.05
Standard Deviation						0	0	0	0	0	0	0	0	0	0	0	1.4	0	0	3.4	0	0	0	0	40	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances						0	14	0	14	0	0	0	0	0	0	0	0	0	0	6	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	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ERM

Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time	Electrical Conductivity @ 25°C	MNA: Ammonia as N	MNA: Nitrate (as N)	MNA: TDS	OCP: Vic EPA IWRG 621 OCP (Total)*	OCP: Vic EPA IWRG 621 Other OCP (Total)*	Per- and Polyfluoroalkyl Subst: N-Ethyl perfluorooctane sulfonamide (NEtFOSA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoethanol (MeFOS	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Sum of PFAS	Sum of PFAS (WA DER List)	Sum of PFHxS and PFOS
				µS/cm	mg/L	mg/l	mg/L	MG/KG	MG/KG	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL				1	0.01	0.02	10	0.001	0.001	0.05	0.05	0.05	0.05	0.01	0.01	0.1	0.05	0.01
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																		20
NEPM (1999) GIL - Marine Water																		
NEPM (2013) - Recreational							6000											
PFAS NEMP 2018 Table 1 Health Recreational Water																		2
PFAS NEMP 2018 Table 5 Interim marine 95%																		
10	TP19/43	TP19/43	25/07/2019	-	1.4	-	-	<0.001	<0.001	<0.05	<0.05	<0.05	<0.05	0.01	<0.01	0.74	0.71	0.04
11	TP19/80	TP19/80	29/07/2019	920	0.33	0.1	780	<0.001	<0.001	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.1	<0.05	<0.01
Statistical Summary																		
Number of Results				1	2	1	1	2	2	2	2	2	2	2	2	2	2	2
Number of Detects				1	2	1	1	0	0	0	0	0	0	1	0	1	1	1
Minimum Concentration				920	0.33	0.1	780	<0.001	<0.001	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.1	<0.05	<0.01
Minimum Detect				920	0.33	0.1	780	ND	ND	ND	ND	ND	ND	0.01	ND	0.74	0.71	0.04
Maximum Concentration				920	1.4	0.1	780	<0.001	<0.001	<0.05	<0.05	<0.05	<0.05	0.01	<0.01	0.74	0.71	0.04
Maximum Detect				920	1.4	0.1	780	ND	ND	ND	ND	ND	ND	0.01	ND	0.74	0.71	0.04
Average Concentration																		
Median Concentration				920	0.865	0.1	780	0.0005	0.0005	0.025	0.025	0.025	0.025	0.0075	0.005	0.395	0.3675	0.0225
Standard Deviation																		
Number of Guideline Exceedances				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

Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time	PFOS and PFOA: PFOS	Perfluorooctanoate	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FtS)	8:2 Fluorotelomer sulfonate	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	N-Ethyl perfluorooctane sulfonamidoacetic acid (Et	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid	Perfluorodecanesulfonic acid (PFDS)	Perfluorohexanesulfonic acid (PFHxS)	Perfluoroundecanoic acid (PFUnA)	Perfluorodecanoic acid (PFDA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanoic acid (PFHxA)	Perfluoropentanoic acid (PFPeA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorododecanoic acid (PFDoA)	Perfluorononanoic acid (PFNA)	Perfluorooctanesulfonamide (PFOSA)
				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				0.01	0.01	0.01	0.05	0.01	0.01	0.05	0.05	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)					100																				
NEPM (1999) GIL - Marine Water																									
NEPM (2013) - Recreational																									
PFAS NEMP 2018 Table 1 Health Recreational Water					10																				
PFAS NEMP 2018 Table 5 Interim marine 95%				0.13	220																				
10	TP19/43	TP19/43	25/07/2019	<0.01	0.15	<0.01	<0.05	0.02	<0.01	<0.05	<0.05	0.03	0.09	<0.01	0.04	<0.01	<0.01	0.15	0.12	0.11	<0.01	<0.01	<0.01	0.02	<0.05
11	TP19/80	TP19/80	29/07/2019	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
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
Number of Detects				0	1	0	0	1	0	0	0	1	1	0	1	0	0	1	1	1	0	0	0	1	0
Minimum Concentration				<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
Minimum Detect				ND	0.15	ND	ND	0.02	ND	ND	ND	0.03	0.09	ND	0.04	ND	ND	0.15	0.12	0.11	ND	ND	ND	0.02	ND
Maximum Concentration				<0.01	0.15	<0.01	<0.05	0.02	<0.01	<0.05	<0.05	0.03	0.09	<0.01	0.04	<0.01	<0.01	0.15	0.12	0.11	<0.01	<0.01	<0.01	0.02	<0.05
Maximum Detect				ND	0.15	ND	ND	0.02	ND	ND	ND	0.03	0.09	ND	0.04	ND	ND	0.15	0.12	0.11	ND	ND	ND	0.02	ND
Average Concentration																									
Median Concentration				0.005	0.0775	0.005	0.025	0.0125	0.005	0.025	0.025	0.0175	0.0575	0.005	0.0225	0.005	0.005	0.0775	0.0625	0.0575	0.005	0.005	0.005	0.0125	0.025
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
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

ERM

				BTEX						Naphthalene	TRH NEPM (1999)					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 >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
EQL				1	1	1	1	2	3	1	20	50	100	100	100	20	20	50	50	100	100	100
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																						
NEPM (1999) GIL - Marine Water				500|950	180	5	350	275		50												
NEPM (2013) - Recreational				10	8000	3000			6000													
PFAS NEMP 2018 Table 1 Health Recreational Water																						
PFAS NEMP 2018 Table 5 Interim marine 95%																						
Monitoring_Zone	**Field_ID**	**Location_Code**	**Sampled_Date_Time**																			
10	TP19/43	TP19/43	25/07/2019	<1	<1	<1	<1	<2	<3	<1	<20	560	27,000	20,000	47,560	<20	<20	1200	1200	39,000	45,400	5200
11	TP19/80	TP19/80	29/07/2019	<1	<1	<1	<1	<2	<3	<1	40	100	200	<100	300	60	60	120	120	100	220	<100

				Inorganics		Metals										
				Nitrite (as N)	TSS	Arsenic (Filtered)	Cadmium (Filtered)	Chromium	Chromium (Filtered)	Chromium (hexavalent)	Chromium (Trivalent)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)
				mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/l	µg/L	µg/L	µg/L
EQL				0.02	1	1	0.2	1	1	5	1	1	1	0.1	1	5
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																
NEPM (1999) GIL - Marine Water						2.3	0.7			4.4	27	1.3	4.4	0.1	7	8|15
NEPM (2013) - Recreational						100	20			500		20000	100	10	200	30000
PFAS NEMP 2018 Table 1 Health Recreational Water																
PFAS NEMP 2018 Table 5 Interim marine 95%																
Monitoring_Zone	**Field_ID**	**Location_Code**	**Sampled_Date_Time**													
10	TP19/43	TP19/43	25/07/2019	<0.02	-	<1	<0.2	<1	<1	<5	<1	3	<1	<0.1	1	6
11	TP19/80	TP19/80	29/07/2019	<0.02	910	<1	<0.2	61	<1	<50	60	<1	<1	<0.1	<1	9

				OCs																					
				4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Toxaphene
				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				0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	10
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																									
NEPM (1999) GIL - Marine Water																									
NEPM (2013) - Recreational							3					90									100	3		3000	
PFAS NEMP 2018 Table 1 Health Recreational Water																									
PFAS NEMP 2018 Table 5 Interim marine 95%																									
Monitoring_Zone	**Field_ID**	**Location_Code**	**Sampled_Date_Time**																						
10	TP19/43	TP19/43	25/07/2019	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<10
11	TP19/80	TP19/80	29/07/2019	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<10

Statistical Summary

	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
Number of Results	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	0	0	0	0	1	2	2	1	2	1	1	2	2	2	2	1
Minimum Concentration	<1	<1	<1	<1	<2	<3	<1	<20	100	200	<100	300	<20	<20	120	120	100	220	<100
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	40	100	200	20000	300	60	60	120	120	100	220	5200
Maximum Concentration	<1	<1	<1	<1	<2	<3	<1	40	560	27000	20000	47560	60	60	1200	1200	39000	45400	5200
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	40	560	27000	20000	47560	60	60	1200	1200	39000	45400	5200
Average Concentration																			
Median Concentration	0.5	0.5	0.5	0.5	1	1.5	0.5	25	330	13600	10025	23930	35	35	660	660	19550	22810	2625
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
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

	Nitrite (as N)	TSS	Arsenic (Filtered)	Cadmium (Filtered)	Chromium	Chromium (Filtered)	Chromium (hexavalent)	Chromium (Trivalent)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)
Number of Results	2	1	2	2	2	2	2	2	2	2	2	2	2
Number of Detects	0	1	0	0	1	0	0	1	1	0	0	1	2
Minimum Concentration	<0.02	910	<1	<0.2	<1	<1	<5	<1	<1	<1	<0.1	<1	6
Minimum Detect	ND	910	ND	ND	61	ND	ND	60	3	ND	ND	1	6
Maximum Concentration	<0.02	910	<1	<0.2	61	<1	<50	60	3	<1	<0.1	1	9
Maximum Detect	ND	910	ND	ND	61	ND	ND	60	3	ND	ND	1	9
Average Concentration													
Median Concentration	0.01	910	0.5	0.1	30.75	0.5	13.75	30.25	1.75	0.5	0.05	0.75	7.5
Standard Deviation													
Number of Guideline Exceedances	0	0	0	0	1	0	2	1	1	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	1	0	0	1	1	0	0	0	0

	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Toxaphene
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
Number of Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<10
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<10
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																						
Median Concentration	0.05	0.05	0.05	0.05	0.05	0.5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	5
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
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

ERM

OPs

Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time	Azinophos methyl	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dichlorvos	Dimethoate	Disulfoton	Ethion	Fenitrothion	Fenthion	Malathion	Methyl parathion	Mevinphos (Phosdrin)	Monocrotophos	Naled (Dibrom)	Omethoate	Parathion	Phorate	Pirimiphos-methyl	Pyrazophos	Ronnel	Terbufos	Tokuthion	Tetrachlorvinphos	Trichloronate
				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	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L
EQL				2	2	20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0.02	2	2	2	2	0.002	2
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																													
NEPM (1999) GIL - Marine Water																													
NEPM (2013) - Recreational				300		100		40	50	70	40	40	70	70	700	7	50	20		10	200		0.9	200		9		1	
PFAS NEMP 2018 Table 1 Health Recreational Water																													
PFAS NEMP 2018 Table 5 Interim marine 95%																													
10	TP19/43	TP19/43	25/07/2019	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2
11	TP19/80	TP19/80	29/07/2019	<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2
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
Number of Detects				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
Minimum Concentration				<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<2	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.02	<2	<2	<2	<2	<0.002	<2
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																													
Median Concentration				1	1	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.01	1	1	1	1	0.001	1
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
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

Organic

Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time	Perfluorononanesulfonic acid (PFNS)	Perfluoropropanesulfonic acid (PFPrS)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	Sum of US EPA PFAS (PFOS + PFOA)*
				UG/L	UG/L	µg/L	µg/L
EQL				0.01	0.01	0.01	0.01
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)							
NEPM (1999) GIL - Marine Water							
NEPM (2013) - Recreational							
PFAS NEMP 2018 Table 1 Health Recreational Water							
PFAS NEMP 2018 Table 5 Interim marine 95%							
10	TP19/43	TP19/43	25/07/2019	<0.01	<0.01	0.19	0.15
11	TP19/80	TP19/80	29/07/2019	<0.01	<0.01	<0.01	<0.01
Statistical Summary							
Number of Results				2	2	2	2
Number of Detects				0	0	1	1
Minimum Concentration				<0.01	<0.01	<0.01	<0.01
Minimum Detect				ND	ND	0.19	0.15
Maximum Concentration				<0.01	<0.01	0.19	0.15
Maximum Detect				ND	ND	0.19	0.15
Average Concentration							
Median Concentration				0.005	0.005	0.0975	0.0775
Standard Deviation							
Number of Guideline Exceedances				0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0

Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time	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-chloro-3-methylphenol	4-nitrophenol	Acenaphthene
				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				10	10	3	3	30	3	3	3	10	6	30	10	30	1
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																	
NEPM (1999) GIL - Marine Water					20	160				490							
NEPM (2013) - Recreational					200	2000				3000							
PFAS NEMP 2018 Table 1 Health Recreational Water																	
PFAS NEMP 2018 Table 5 Interim marine 95%																	
10	TP19/43	TP19/43	25/07/2019	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
11	TP19/80	TP19/80	29/07/2019	<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
Statistical Summary																	
Number of Results				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	0	0	0	0	0	0
Minimum Concentration				<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<10	<10	<3	<3	<30	<3	<3	<3	<10	<6	<30	<10	<30	<1
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																	
Median Concentration				5	5	1.5	1.5	15	1.5	1.5	1.5	5	3	15	5	15	0.5
Standard Deviation																	
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

ERM

				PAH/Phenols																				
				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	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)
				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	ug/l	µg/L	µg/L	µg/L
EQL				1	1	1	1	1	1	1	1	1	100	1	1	1	10	1	3	1	30	10	100	1
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																								
NEPM (1999) GIL - Marine Water					0.01		0.2							1.4				2	400					
NEPM (2013) - Recreational																	100							
PFAS NEMP 2018 Table 1 Health Recreational Water																								
PFAS NEMP 2018 Table 5 Interim marine 95%																								
Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time																					
10	TP19/43	TP19/43	25/07/2019	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1
11	TP19/80	TP19/80	29/07/2019	<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1
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
Number of Detects				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration				<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<1	<1	<1	<1	<1	<1	<1	<1	<1	<100	<1	<1	<1	<10	<1	<3	<1	<30	<10	<100	<1
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																								
Median Concentration				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	50	0.5	0.5	0.5	5	0.5	1.5	0.5	15	5	50	0.5
Standard Deviation																								
Number of Guideline Exceedances				0	2	0	2	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

				PCBs								Pesticides		pH	SVOC							
				Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	Bolstar (Sulprofos)	Merphos	pH (Lab)	4,6-Dinitro-o-cyclohexyl phenol	Coumaphos	Demeton-O	Demeton-S	EPN	Ethoprop	Fensulfothion	Hexachlorobenzene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	pH units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL				1	1	1	1	1	1	1	1	2	0.002	0.1	100	20	2	20	2	2	2	0.1
Clyde SSTL PFAS - Intrusive Maintenance Worker (Direct Contact)																						
NEPM (1999) GIL - Marine Water																						
NEPM (2013) - Recreational												100		85						10	100	
PFAS NEMP 2018 Table 1 Health Recreational Water																						
PFAS NEMP 2018 Table 5 Interim marine 95%																						
Monitoring_Zone	Field_ID	Location_Code	Sampled_Date_Time																			
10	TP19/43	TP19/43	25/07/2019	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.002	-	<100	<20	<2	<20	<2	<2	<2	<0.1
11	TP19/80	TP19/80	29/07/2019	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.002	6.5	<100	<20	<2	<20	<2	<2	<2	<0.1
Statistical Summary																						
Number of Results				2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2
Number of Detects				0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Minimum Concentration				<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.002	6.5	<100	<20	<2	<20	<2	<2	<2	<0.1
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.5	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.002	6.5	<100	<20	<2	<20	<2	<2	<2	<0.1
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.5	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																						
Median Concentration				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.001	6.5	50	10	1	10	1	1	1	0.05
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
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

ERM

Excavation Recharge Testing

Test Pit ID	Test Commencement	Test Termination	Test Time (hours)	Excavation Area			Recharge Rates				Calculated recharge rate (m3/hr)	Calculated recharge rate (m3/day)
				Length	Width	Area (m2)	Final water depth (m BGL)	Depth of Excavation (m)	Final Water Depth (m)	Recharge volume (m3)		
TP19/43	25/07/2019 11:50	26/07/2019 7:50	21.00	1.5	1	1.5	1	1.8	0.8	1.2	0.06	1.37
TP19/80	26/07/2019 11:00	29/07/2019 7:30	68.50	1.5	1	1.5	2.7	3	0.3	0.45	0.01	0.16

ERM

Monitoring_Zone	Field_ID	Location_Code	Comment	Sampled_Date_Time	Field: Dissolved Oxygen (Field) (Filtered)	Field: Electrical Conductivity (Field)	Field: pH (Field)	Field: Redox (Field)	Field: Temperature (Field)	MNA: Sulfate as SO4 - Turbidimetric (Filtered)	MNA: Ferrous Iron - Fe2+	MNA: Methane	MNA: Nitrate (as N)
					mg/L	uS/cm	pH units	mV	oC	mg/L	mg/L	mg/L	mg/l
EQL										1	0.05	0.01	0.01
10	MW11/40	MW11/40	downgradient	12/06/2019	-	-	-	-	-	478	204	0.198	<0.1
3	MW98/4	MW98/4	downgradient	12/06/2019	0.91	2146	3.97	146.8	21.4	477	4.51	<0.01	<0.01
CSM2	TW94/2	TW94/2	downgradient	12/06/2019	-	-	-	-	-	158	10.8	0.017	0.98
11	MW11/02	MW11/02	downgradient - dissolved	7/06/2019	0.99	3467	4.41	140.2	21.6	-	-	-	-
11	DO2_120619	MW11/02	downgradient - dissolved	12/06/2019	-	-	-	-	-	163	8.92	0.02	0.19
11	MW11/02	MW11/02	downgradient - dissolved	12/06/2019	-	-	-	-	-	66	9.13	0.019	0.18
11	MW11/04	MW11/04	downgradient - dissolved	7/06/2019	1.07	6060	5	45.8	21.8	-	-	-	-
11	DO1_120619	MW11/04	downgradient - dissolved	12/06/2019	-	-	-	-	-	396	16.4	0.066	0.03
11	MW11/04	MW11/04	downgradient - dissolved	12/06/2019	-	-	-	-	-	399	16.6	0.066	0.02
15	MW11/07	MW11/07	downgradient - dissolved	5/06/2019	1.24	10,444	5.18	64.1	19.1	597	26.5	0.229	0.02
15	MW11/08	MW11/08	downgradient - dissolved	7/06/2019	0.97	13,090	4.29	164.8	22.8	-	-	-	-
15	MW11/08	MW11/08	downgradient - dissolved	12/06/2019	-	-	-	-	-	368	12.1	<0.01	0.02
3	MW11/18	MW11/18	downgradient - unimpacted	12/06/2019	-	-	-	-	-	227	2.31	<0.01	0.13
10	MW11/30	MW11/30	Source	7/06/2019	0.97	13,090	4.29	164.8	22.8	-	-	-	-
10	MW11/30	MW11/30	Source	12/06/2019	-	-	-	-	-	1480	295	0.19	<0.01
9	MW12/16	MW12/16	Source	12/06/2019	-	-	-	-	-	27	35.6	7.7	0.01
15	MW11/01	MW11/01	upgradient	12/06/2019	-	-	-	-	-	194	<0.05	<0.01	0.25
15	MW11/22	MW11/22	upgradient	12/06/2019	-	-	-	-	-	2230	4.59	0.046	0.02

Field_ID	TRH Silica Gel Cleanup: 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 Silica Gel Cleanup: TRH >C10-C16 Fraction SG less Naphthalene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	50	100	50	100	100	100	50	100	100
MW11/40	<50	<100	<50	<100	<100	<100	<50	<100	<100
MW98/4	<50	<100	<50	<100	<100	<100	<50	<100	<100
TW94/2	-	-	-	-	-	-	-	-	-
MW11/02	<50	<100	<50	<100	<100	<100	<50	<100	<100
DO2_120619	-	-	-	-	-	-	-	-	-
MW11/02	-	-	-	-	-	-	-	-	-
MW11/04	<50	<100	<50	<100	<100	<100	<50	<100	<100
DO1_120619	-	-	-	-	-	-	-	-	-
MW11/04	-	-	-	-	-	-	-	-	-
MW11/07	<50	<100	<50	<100	<100	<100	<50	<100	<100
MW11/08	<50	<100	<50	<100	<100	<100	<50	<100	<100
MW11/08	-	-	-	-	-	-	-	-	-
MW11/18	-	-	-	-	-	-	-	-	-
MW11/30	<50	<100	<50	<100	<100	<100	<50	<100	<100
MW11/30	-	-	-	-	-	-	-	-	-
MW12/16	<50	<100	<50	<100	<100	<100	<50	<100	<100
MW11/01	<50	<100	<50	<100	<100	<100	<50	<100	<100
MW11/22	<50	<100	<50	<100	<100	<100	<50	<100	<100

Field_ID	BTEX: Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene: Naphthalene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	1	2	2	2	2	2	1	5
MW11/40	<1	<2	<2	<2	<2	<2	<1	<5
MW98/4	<1	<2	<2	<2	<2	<2	<1	<5
TW94/2	-	-	-	-	-	-	-	-
MW11/02	<1	<2	<2	<2	<2	<2	<1	11
DO2_120619	-	-	-	-	-	-	-	-
MW11/02	-	-	-	-	-	-	-	-
MW11/04	<1	<2	<2	<2	<2	<2	<1	<5
DO1_120619	-	-	-	-	-	-	-	-
MW11/04	-	-	-	-	-	-	-	-
MW11/07	<1	<2	<2	<2	<2	<2	<1	<5
MW11/08	<1	<2	<2	<2	<2	<2	<1	<5
MW11/08	-	-	-	-	-	-	-	-
MW11/18	-	-	-	-	-	-	-	-
MW11/30	5	<2	<2	<2	<2	<2	5	<5
MW11/30	-	-	-	-	-	-	-	-
MW12/16	832	<5	968	21	73	94	1890	150
MW11/01	<1	<2	<2	<2	<2	<2	<1	<5
MW11/22	<1	<2	<2	<2	<2	<2	<1	<5

Field_ID	TRH NEPM (1999): TRH C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH NEPM (2013): 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
EQL	20	50	100	50	50	20	20	100	100	100	100	100
MW11/40	<20	130	180	220	530	<20	<20	160	160	310	470	<100
MW98/4	<20	100	390	<50	490	<20	<20	210	210	290	500	<100
TW94/2	-	-	-	-	-	-	-	-	-	-	-	-
MW11/02	<20	200	<100	<50	200	<20	<20	220	210	<100	220	<100
DO2_120619	-	-	-	-	-	-	-	-	-	-	-	-
MW11/02	-	-	-	-	-	-	-	-	-	-	-	-
MW11/04	<20	60	<100	540	600	<20	<20	<100	<100	590	590	<100
DO1_120619	-	-	-	-	-	-	-	-	-	-	-	-
MW11/04	-	-	-	-	-	-	-	-	-	-	-	-
MW11/07	<20	200	<100	410	610	<20	<20	230	230	340	730	160
MW11/08	<20	<50	<100	400	400	<20	<20	<100	<100	400	400	<100
MW11/08	-	-	-	-	-	-	-	-	-	-	-	-
MW11/18	-	-	-	-	-	-	-	-	-	-	-	-
MW11/30	<20	<50	<100	480	480	<20	<20	<100	<100	510	510	<100
MW11/30	-	-	-	-	-	-	-	-	-	-	-	-
MW12/16	2830	370	<100	130	500	3300	1410	400	250	140	540	<100
MW11/01	<20	<50	<100	130	130	<20	<20	<100	<100	<100	<100	<100
MW11/22	<20	170	<100	480	650	<20	<20	180	180	360	750	210

Statistical Summary

Statistical Summary	Dissolved Oxygen (Field) (Filtered)	Electrical Conductivity (Field)	pH (Field)	Redox (Field)	Temperature (Field)	Sulfate as SO4 - Turbidimetric (Filtered)	Ferrous Iron - Fe2+	Methane	Nitrate (as N)
Number of Results	6	6	6	6	6	14	14	14	14
Number of Detects	6	6	6	6	6	14	13	10	11
Minimum Concentration	0.91	2146	3.97	45.8	19.1	27	<0.05	<0.01	<0.01
Minimum Detect	0.91	2146	3.97	45.8	19.1	27	2.31	0.017	0.01
Maximum Concentration	1.24	13090	5.18	164.8	22.8	2230	295	7.7	0.98
Maximum Detect	1.24	13090	5.18	164.8	22.8	2230	295	7.7	0.98
Average Concentration	1	8050	4.5	121	22	519	46	0.61	0.14
Median Concentration	0.98	8252	4.35	143.5	21.7	382	11.45	0.033	0.025
Standard Deviation	0.12	4824	0.47	52	1.4	608	88	2	0.26
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0

Statistical Summary	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
Number of Results	10	10	10	10	10	10	10	10	10
Number of Detects	0	0	0	0	0	0	0	0	0
Minimum Concentration	<50	<100	<50	<100	<100	<100	<50	<100	<100
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<50	<100	<50	<100	<100	<100	<50	<100	<100
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	25	50	25	50	50	50	25	50	50
Median Concentration	25	50	25	50	50	50	25	50	50
Standard Deviation	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0

Statistical Summary	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene
Number of Results	10	10	10	10	10	10	10	10
Number of Detects	2	0	1	1	1	1	2	2
Minimum Concentration	<1	<2	<2	<2	<2	<2	<1	<5
Minimum Detect	5	ND	968	21	73	94	5	11
Maximum Concentration	832	<5	968	21	73	94	1890	150
Maximum Detect	832	ND	968	21	73	94	1890	150
Average Concentration	84	1.2	98	3	8.2	10	190	18
Median Concentration	0.5	1	1	1	1	1	0.5	2.5
Standard Deviation	263	0.47	306	6.3	23	29	597	46
Number of Guideline Exceedances	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0

Statistical Summary	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
Number of Results	10	10	10	10	10	10	10	10	10	10	10	10
Number of Detects	1	7	2	8	10	1	1	6	6	8	9	2
Minimum Concentration	<20	<50	<100	<50	130	<20	<20	<100	<100	<100	<100	<100
Minimum Detect	2830	60	180	130	130	3300	1410	160	160	140	220	160
Maximum Concentration	2830	370	390	540	650	3300	1410	400	250	590	750	210
Maximum Detect	2830	370	390	540	650	3300	1410	400	250	590	750	210
Average Concentration	292	131	97	284	459	339	150	160	144	304	476	77
Median Concentration	10	115	50	310	495	10	10	170	170	325	505	50
Standard Deviation	892	109	111	199	172	1040	443	114	84	181	214	58
Number of Guideline Exceedances	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

						Canister Sampling - Field Data	Ether-oxygenates	Permanent Gases				Pressure		TRH Aliphatic/Aromatic Split								
					Temperature - As Received	Vacuum - As received	Methyltributyl Ether	Carbon Dioxide (free)	Carbon Monoxide	Hydrogen	Oxygen	Pressure - As received	Pressure - Laboratory Atmosphere	TRH >C5-C6 Aliphatic	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH C6-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C10-C16 Aliphatic	TRH >C5-C7 Aromatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic
					°C	mg/m3	ug/m3	mg/m^3	mg/m^3	mg/m^3	Mol %	kPaa	kPaa	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
EQL					0.1	0.03	180	0.005	0.0005	0.005	0.1	0.1	0.1	16.5	20	25	20	30	37	0.16	0.19	1.25
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m															4,080,000	25,900,000		310,000				44,300
NEPM (1999) HSL D Comm/Indust - Sand 0 to <1 m															16,000	881		893				174
Monitoring_Zone	**Field_ID**	**Location_Code**	**Well**	**Sampled_Date_Time**																		
2	SV19/04	SV19/04	SV19/04	28/08/2019	21	1.83	<180	8190	0.003	<0.01[#1]	12.3	96	102	<16.5	<20	<25	<20	<30	<37	<0.16	<0.19	<1.25
3	D01_280819	SV19/03	SV19/03	28/08/2019	21	1.3	<360[#1]	176,000	<0.001[#1]	<0.01[#1]	10.8	97.7	102	384	1390	2970	3690	1040	1710	1.33	<0.38[#1]	150
3	SV19/03	SV19/03	SV19/03	28/08/2019	21	1.24	<360[#1]	171,000	<0.001[#1]	<0.01[#1]	10.9	98	102	374	1360	2890	3630	1010	1660	1.31	<0.38[#1]	144
3	SV19/05	SV19/05	SV19/05	28/08/2019	21	1.89	<3600[#1]	138,000	<0.001[#1]	<0.01[#1]	11.6	95.7	102	15,200	57300	5350	49,700	<600[#1]	<740[#1]	328	<3.8[#1]	280
3	SV19/10	SV19/10	SV19/10	28/08/2019	21	0.5	<180	27,700	0.0039	<0.01[#1]	12.7	100	102	<16.5	<20	<25	<20	<30	<37	<0.16	<0.19	<1.25
5	SV19/09	SV19/09	SV19/09	28/08/2019	21	1.95	<180	9560	<0.001[#1]	<0.01[#1]	20.8	95.6	102	<16.5	<20	<25	<20	<30	<37	<0.16	<0.19	<1.25
9	SV19/07	SV19/07	SV19/07	28/08/2019	21	1.39	<180	40,400	<0.001[#1]	<0.01[#1]	18.1	97.5	102	177	1790	2290	3160	1560	2570	12.3	0.228	390
10	SV19/08	SV19/08	SV19/08	28/08/2019	21	1.54	<180	27,500	<0.001[#1]	<0.01[#1]	18	96.9	102	<16.5	<20	<25	<20	<30	<37	<0.16	<0.19	<1.25
11	SV19/06	SV19/06	SV19/06	28/08/2019	21	1.8	<180	10,500	<0.001[#1]	<0.01[#1]	19	96	102	<16.5	96.8	103	168	95.9	229	0.37	<0.19	2.57
	SV19/07 shroud		-	28/08/2019	21	0.8	-	-	-	-	-	99.5	102	-	-	-	-	-	-	-	-	-

Statistical Summary

	Temperature - As Received	Vacuum - As received	Methyltributyl Ether	Carbon Dioxide (free)	Carbon Monoxide	Hydrogen	Oxygen	Pressure - As received	Pressure - Laboratory Atmosphere	TRH >C5-C6 Aliphatic	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH C6-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C10-C16 Aliphatic	TRH >C5-C7 Aromatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic
Number of Results	10	10	9	9	9	9	9	10	10	9	9	9	9	9	9	9	9	9
Number of Detects	10	10	0	9	2	0	9	10	10	4	5	5	5	4	4	5	1	5
Minimum Concentration	21	0.5	<180	8190	<0.001	<0.01	10.8	95.6	102	<16.5	<20	<25	<20	<30	<37	<0.16	<0.19	<1.25
Minimum Detect	21	0.5	ND	8190	0.003	ND	10.8	95.6	102	177	96.8	103	168	95.9	229	0.37	0.228	2.57
Maximum Concentration	21	1.95	<3600	176000	0.0039	<0.01	20.8	100	102	15200	57300	5350	49700	1560	2570	328	<3.8	390
Maximum Detect	21	1.95	ND	176000	0.0039	ND	20.8	100	102	15200	57300	5350	49700	1560	2570	328	0.228	390
Average Concentration	21	1.4	300	67650	0.0012	0.005	15	97	102	1797	6886	1517	6710	452	735	38	0.33	108
Median Concentration	21	1.465	90	27700	0.0005	0.005	12.7	97.2	102	8.25	96.8	103	168	95.9	229	0.37	0.095	2.57
Standard Deviation	0	0.48	564	72021	0.0013	0	4	1.6	0	5028	18919	1947	16208	591	976	109	0.59	146
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	1	4	0	3	0	0	0	2
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	1	4	0	3	0	0	0	2

Env Stds Comments

#1:CRC CARE (2011) Intrusive Maintenance Worker

Data Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

									BTEX						Iso-propanol	Naphthalene
					TRH C6-C10 Aromatic	TRH C6-C10 less BTEX Aromatic	TRH >C10-C12 Aromatic	TRH >C10-C16 Aromatic	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Iso-propanol	Naphthalene
					mg/m^3	mg/m^3	mg/m^3	mg/m^3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	mg/m^3	ug/m3
EQL					3	1.4	2.5	1.4	0.1	0.19	0.22	0.22	0.43	0.65	0.12	0.1
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m							51,700		760	NL	NL			NL		880
NEPM (1999) HSL D Comm/Indust - Sand 0 to <1 m							176		4	4800	1300			840		3
Monitoring_Zone	**Field_ID**	**Location_Code**	**Well**	**Sampled_Date_Time**												
2	SV19/04	SV19/04	SV19/04	28/08/2019	<3	<1.4	<2.5	<1.4	<0.1	<0.19	<0.22	<0.22	<0.43	<0.65	<0.12	<0.1
3	D01_280819	SV19/03	SV19/03	28/08/2019	152	127	28.1	28.1	1.55	<0.38[#1]	26.7	<0.44[#1]	<0.86[#1]	<1.3[#1]	<0.24[#1]	6.76
3	SV19/03	SV19/03	SV19/03	28/08/2019	145	121	26.2	26.2	1.52	<0.38[#1]	25.7	<0.44[#1]	<0.86[#1]	<1.3[#1]	<0.24[#1]	5.55
3	SV19/05	SV19/05	SV19/05	28/08/2019	609	123	<50[#1]	<28[#1]	383	<3.8[#1]	162	<4.4[#1]	15.6	15.6	<2.4[#1]	6.39
3	SV19/10	SV19/10	SV19/10	28/08/2019	<3	<1.4	<2.5	<1.4	<0.1	<0.19	<0.22	<0.22	<0.43	<0.65	<0.12	<0.1
5	SV19/09	SV19/09	SV19/09	28/08/2019	<3	<1.4	<2.5	<1.4	<0.1	<0.19	<0.22	<0.22	<0.43	<0.65	<0.12	<0.1
9	SV19/07	SV19/07	SV19/07	28/08/2019	403	339	87.5	87.5	14.3	0.273	43.8	0.69	14.1	14.8	<0.12	20.5
10	SV19/08	SV19/08	SV19/08	28/08/2019	<3	<1.4	<2.5	<1.4	<0.1	<0.19	<0.22	<0.22	<0.43	<0.65	<0.12	<0.1
11	SV19/06	SV19/06	SV19/06	28/08/2019	3.08	1.88	<2.5	2.18	0.431	<0.19	0.529	<0.22	<0.43	<0.65	<0.12	0.88
	SV19/07 shroud		-	28/08/2019	-	-	-	-	-	-	-	-	-	-	14,700	-

	SVOC										
	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Benzyl chloride	Hexachlorobutadiene	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene
	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
EQL	0.37	0.3	0.3	0.3	0.26	0.53	0.27	0.34	0.27	0.2	0.2
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m											
NEPM (1999) HSL D Comm/Indust - Sand 0 to <1 m											
Field_ID											
SV19/04	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
D01_280819	<0.74[#1]	<0.6[#1]	<0.6[#1]	<0.6[#1]	<0.52[#1]	<1.06[#1]	<0.54[#1]	<0.68[#1]	<0.54[#1]	<0.4[#1]	<0.4[#1]
SV19/03	<0.74[#1]	<0.6[#1]	<0.6[#1]	<0.6[#1]	<0.52[#1]	<1.06[#1]	<0.54[#1]	<0.68[#1]	<0.54[#1]	<0.4[#1]	<0.4[#1]
SV19/05	<7.4[#1]	<6[#1]	<6[#1]	<6[#1]	<5.2[#1]	<10.6[#1]	<5.4[#1]	<6.8[#1]	<5.4[#1]	<4[#1]	<4[#1]
SV19/10	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
SV19/09	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
SV19/07	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
SV19/08	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
SV19/06	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
SV19/07 shroud	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

	TRH C6-C10 Aromatic	TRH C6-C10 less BTEX Aromatic	TRH >C10-C12 Aromatic	TRH >C10-C16 Aromatic	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Iso-propanol	Naphthalene
Number of Results	9	9	9	9	9	9	9	9	9	9	10	9
Number of Detects	5	5	3	4	5	1	5	1	2	2	1	5
Minimum Concentration	<3	<1.4	<2.5	<1.4	<0.1	<0.19	<0.22	<0.22	<0.43	<0.65	<0.12	<0.1
Minimum Detect	3.08	1.88	26.2	2.18	0.431	0.273	0.529	0.69	14.1	14.8	14700	0.88
Maximum Concentration	609	339	87.5	87.5	383	<3.8	162	<4.4	15.6	15.6	14700	20.5
Maximum Detect	609	339	87.5	87.5	383	0.273	162	0.69	15.6	15.6	14700	20.5
Average Concentration	146	79	19	18	45	0.34	29	0.43	3.5	3.7	1470	4.5
Median Concentration	3.08	1.88	1.25	2.18	0.431	0.095	0.529	0.11	0.215	0.325	0.06	0.88
Standard Deviation	219	114	28	28	127	0.59	53	0.69	6.4	6.5	4648	6.7
Number of Guideline Exceedances	0	0	0	0	2	0	0	0	0	0	0	4
Number of Guideline Exceedances(Detects Only)	0	0	0	0	2	0	0	0	0	0	0	4

	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Benzyl chloride	Hexachlorobutadiene	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene
Number of Results	9	9	9	9	9	9	9	9	9	9	9
Number of Detects	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.37	<0.3	<0.3	<0.3	<0.26	<0.53	<0.27	<0.34	<0.27	<0.2	<0.2
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<7.4	<6	<6	<6	<5.2	<10.6	<5.4	<6.8	<5.4	<4	<4
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.62	0.5	0.5	0.5	0.43	0.88	0.45	0.57	0.45	0.33	0.33
Median Concentration	0.185	0.15	0.15	0.15	0.13	0.265	0.135	0.17	0.135	0.1	0.1
Standard Deviation	1.2	0.94	0.94	0.94	0.81	1.7	0.85	1.1	0.85	0.63	0.63
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

Env Stds Comments

#1:CRC CARE (2011) Intrusive Maintenance Worker

Data Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

VOC (columns 1–13)

	1,2,4-trimethylbenzene	1,2-dibromoethane	1,2-dichloroethane	1,2-dichloropropane	1,3,5-trimethylbenzene	1,3-Butadiene	1,4-Dioxane	1-methyl-4 ethyl benzene	2-butanone (MEK)	2-hexanone (MBK)	4-methyl-2-pentanone (MIBK)	Acetone	Allyl chloride
	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
EQL	0.24	0.38	0.2	0.23	0.24	0.11	0.18	0.24	0.15	0.2	0.2	0.12	0.16
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m													
NEPM (1999) HSL D Comm/Indust - Sand 0 to <1 m													

VOC (columns 14–25)

	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene
	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
EQL	0.34	0.52	0.19	0.16	0.31	0.23	0.43	0.13	0.24	0.1	0.02	0.23
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m												
NEPM (1999) HSL D Comm/Indust - Sand 0 to <1 m												

Monitoring_Zone	Field_ID	Location_Code	Well	Sampled_Date_Time	1,2,4-trimethylbenzene	1,2-dibromoethane	1,2-dichloroethane	1,2-dichloropropane	1,3,5-trimethylbenzene	1,3-Butadiene	1,4-Dioxane	1-methyl-4 ethyl benzene	2-butanone (MEK)	2-hexanone (MBK)	4-methyl-2-pentanone (MIBK)	Acetone	Allyl chloride
2	SV19/04	SV19/04	SV19/04	28/08/2019	<0.24	<0.38	<0.2	<0.23	<0.24	<0.11	<0.18	<0.24	<0.15	<0.2	<0.2	<0.12	<0.16
3	D01_280819	SV19/03	SV19/03	28/08/2019	89.4	<0.76[#1]	<0.4[#1]	<0.46[#1]	43.7	<0.22[#1]	<0.36[#1]	1.28	<0.3[#1]	<0.4[#1]	<0.4[#1]	<0.24[#1]	<0.32[#1]
3	SV19/03	SV19/03	SV19/03	28/08/2019	85	<0.76[#1]	<0.4[#1]	<0.46[#1]	41.8	<0.22[#1]	<0.36[#1]	1.23	<0.3[#1]	<0.4[#1]	<0.4[#1]	<0.24[#1]	<0.32[#1]
3	SV19/05	SV19/05	SV19/05	28/08/2019	50.6	<7.6[#1]	<4[#1]	<4.6[#1]	36.5	<2.2[#1]	<3.6[#1]	6.48	<3[#1]	<4[#1]	<4[#1]	<2.4[#1]	<3.2[#1]
3	SV19/10	SV19/10	SV19/10	28/08/2019	<0.24	<0.38	<0.2	<0.23	<0.24	<0.11	<0.18	<0.24	<0.15	<0.2	<0.2	0.205	<0.16
5	SV19/09	SV19/09	SV19/09	28/08/2019	<0.24	<0.38	<0.2	<0.23	<0.24	<0.11	<0.18	<0.24	<0.15	<0.2	<0.2	<0.12	<0.16
9	SV19/07	SV19/07	SV19/07	28/08/2019	78.1	<0.38	<0.2	<0.23	30.3	<0.11	<0.18	8.5	<0.15	<0.2	<0.2	<0.12	<0.16
10	SV19/08	SV19/08	SV19/08	28/08/2019	<0.24	<0.38	<0.2	<0.23	<0.24	<0.11	<0.18	<0.24	<0.15	<0.2	<0.2	<0.12	<0.16
11	SV19/06	SV19/06	SV19/06	28/08/2019	0.565	<0.38	<0.2	<0.23	0.938	<0.11	<0.18	<0.24	<0.15	<0.2	<0.2	<0.12	<0.16
	SV19/07 shroud		-	28/08/2019	-	-	-	-	-	-	-	-	-	-	-	-	-

Field_ID	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene
SV19/04	<0.34	<0.52	<0.19	0.168	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.02	<0.23
D01_280819	<0.68[#1]	<1.04[#1]	<0.38[#1]	<0.32[#1]	<0.62[#1]	<0.46[#1]	<0.86[#1]	<0.26[#1]	<0.48[#1]	<0.2[#1]	<0.4[#1]	<0.46[#1]
SV19/03	<0.68[#1]	<1.04[#1]	<0.38[#1]	<0.32[#1]	<0.62[#1]	<0.46[#1]	<0.86[#1]	<0.26[#1]	<0.48[#1]	<0.2[#1]	<0.4[#1]	<0.46[#1]
SV19/05	<6.8[#1]	<10.4[#1]	<3.8[#1]	<3.2[#1]	<6.2[#1]	<4.6[#1]	<8.6[#1]	<2.6[#1]	<4.8[#1]	<2[#1]	<4[#1]	<4.6[#1]
SV19/10	<0.34	<0.52	<0.19	0.358	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.02	<0.23
SV19/09	<0.34	<0.52	<0.19	<0.16	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.02	<0.23
SV19/07	<0.34	<0.52	<0.19	0.32	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.2[#1]	<0.23
SV19/08	<0.34	<0.52	<0.19	<0.16	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.02	<0.23
SV19/06	<0.34	<0.52	<0.19	<0.16	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.02	<0.23
SV19/07 shroud	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

	1,2,4-trimethylbenzene	1,2-dibromoethane	1,2-dichloroethane	1,2-dichloropropane	1,3,5-trimethylbenzene	1,3-Butadiene	1,4-Dioxane	1-methyl-4 ethyl benzene	2-butanone (MEK)	2-hexanone (MBK)	4-methyl-2-pentanone (MIBK)	Acetone	Allyl chloride
Number of Results	9	9	9	9	9	9	9	9	9	9	9	9	9
Number of Detects	5	0	0	0	5	0	0	4	0	0	0	1	0
Minimum Concentration	<0.24	<0.38	<0.2	<0.23	<0.24	<0.11	<0.18	<0.24	<0.15	<0.2	<0.2	<0.12	<0.16
Minimum Detect	0.565	ND	ND	ND	0.938	ND	ND	1.23	ND	ND	ND	0.205	ND
Maximum Concentration	89.4	<7.6	<4	<4.6	43.7	<2.2	<3.6	8.5	<3	<4	<4	<2.4	<3.2
Maximum Detect	89.4	ND	ND	ND	43.7	ND	ND	8.5	ND	ND	ND	0.205	ND
Average Concentration	34	0.63	0.33	0.38	17	0.18	0.3	2	0.25	0.33	0.33	0.22	0.27
Median Concentration	0.565	0.19	0.1	0.115	0.938	0.055	0.09	0.12	0.075	0.1	0.1	0.06	0.08
Standard Deviation	41	1.2	0.63	0.72	20	0.34	0.56	3.2	0.47	0.63	0.63	0.37	0.5
Number of Guideline Exceedances	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

	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene
Number of Results	9	9	9	9	9	9	9	9	9	9	9	9
Number of Detects	0	0	0	3	0	0	0	0	0	0	0	0
Minimum Concentration	<0.34	<0.52	<0.19	<0.16	<0.31	<0.23	<0.43	<0.13	<0.24	<0.1	<0.02	<0.23
Minimum Detect	ND	ND	ND	0.168	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<6.8	<10.4	<3.8	<3.2	<6.2	<4.6	<8.6	<2.6	<4.8	<2	<4	<4.6
Maximum Detect	ND	ND	ND	0.358	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.57	0.87	0.32	0.33	0.52	0.38	0.72	0.22	0.4	0.17	0.28	0.38
Median Concentration	0.17	0.26	0.095	0.16	0.155	0.115	0.215	0.065	0.12	0.05	0.01	0.115
Standard Deviation	1.1	1.6	0.6	0.49	0.97	0.72	1.3	0.41	0.75	0.31	0.65	0.72
Number of Guideline Exceedances	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

Env Stds Comments

#1:CRC CARE (2011) Intrusive Maintenance Worker

Data Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Monitoring_Zone	Field_ID	Location_Code	Well	Sampled_Date_Time	Cyclohexane	Dichlorodifluoromethane	Dichloromethane	Ethyl acetate	Freon 113	Freon 114	Heptane	Hexane	Isooctane	Propene	Styrene	TCE	Tetrachloroethene	Tetrahydrofuran	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Trichlorofluoromethane	Vinyl acetate	Vinyl bromide (bromoethene)	Vinyl chloride
					mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
EQL					0.17	0.25	0.17	0.18	0.38	0.35	0.2	0.18	0.23	0.09	0.21	0.005	0.34	0.15	0.2	0.23	0.28	0.18	0.22	0.0051
CRC Care (2011) Intrusive Maint. Worker - Sand 0 to <2 m																								
NEPM (1999) HSL D Comm/Indust - Sand 0 to <1 m																								
2	SV19/04	SV19/04	SV19/04	28/08/2019	<0.17	<0.25	<0.17	<0.18	<0.38	<0.35	<0.2	<0.18	<0.23	0.767	<0.21	<0.005	<0.34	<0.15	<0.2	<0.23	<0.28	<0.18	<0.22	<0.0051
3	D01_280819	SV19/03	SV19/03	28/08/2019	2.34	<0.5[#1]	<0.34[#1]	<0.36[#1]	<0.76[#1]	<0.7[#1]	<0.4[#1]	<0.36[#1]	34.9	0.18	<0.42[#1]	<0.5[#1]	<0.68[#1]	<0.3[#1]	<0.4[#1]	<0.46[#1]	<0.56[#1]	<0.36[#1]	<0.44[#1]	<0.255[#1]
3	SV19/03	SV19/03	SV19/03	28/08/2019	2.29	<0.5[#1]	<0.34[#1]	<0.36[#1]	<0.76[#1]	<0.7[#1]	<0.4[#1]	<0.36[#1]	34.2	0.196	<0.42[#1]	<0.5[#1]	<0.68[#1]	<0.3[#1]	<0.4[#1]	<0.46[#1]	<0.56[#1]	19.8	<0.44[#1]	<0.255[#1]
3	SV19/05	SV19/05	SV19/05	28/08/2019	2900	<5[#1]	<3.4[#1]	<3.6[#1]	<7.6[#1]	<7[#1]	1090	1940	6490	<1.8[#1]	<4.2[#1]	<5[#1]	<6.8[#1]	<3[#1]	<4[#1]	<4.6[#1]	<5.6[#1]	<3.6[#1]	<4.4[#1]	<2.55[#1]
3	SV19/10	SV19/10	SV19/10	28/08/2019	<0.17	<0.25	<0.17	<0.18	<0.38	<0.35	<0.2	<0.18	<0.23	0.862	<0.21	<0.25[#1]	<0.34	<0.15	<0.2	<0.23	<0.28	<0.18	<0.22	<0.0051
5	SV19/09	SV19/09	SV19/09	28/08/2019	<0.17	<0.25	<0.17	<0.18	<0.38	<0.35	<0.2	<0.18	<0.23	<0.09	<0.21	<0.005	<0.34	<0.15	<0.2	<0.23	<0.28	<0.18	<0.22	<0.0051
9	SV19/07	SV19/07	SV19/07	28/08/2019	49.2	<0.25	<0.17	<0.18	<0.38	<0.35	3.89	6.73	34.2	0.227	<0.21	<0.25[#1]	<0.34	<0.15	<0.2	<0.23	<0.28	<0.18	<0.22	<0.128[#1]
10	SV19/08	SV19/08	SV19/08	28/08/2019	<0.17	<0.25	<0.17	<0.18	<0.38	<0.35	<0.2	<0.18	<0.23	<0.09	<0.21	<0.005	<0.34	<0.15	<0.2	<0.23	<0.28	<0.18	<0.22	<0.0051
11	SV19/06	SV19/06	SV19/06	28/08/2019	1.13	<0.25	<0.17	<0.18	<0.38	<0.35	<0.2	<0.18	<0.23	<0.09	<0.21	<0.005	<0.34	<0.15	<0.2	<0.23	<0.28	0.185	<0.22	<0.0051
	SV19/07 shroud		-	28/08/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistical Summary

Statistical Summary	Cyclohexane	Dichlorodifluoromethane	Dichloromethane	Ethyl acetate	Freon 113	Freon 114	Heptane	Hexane	Isooctane	Propene	Styrene	TCE	Tetrachloroethene	Tetrahydrofuran	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Trichlorofluoromethane	Vinyl acetate	Vinyl bromide (bromoethene)	Vinyl chloride
Number of Results	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Number of Detects	5	0	0	0	0	0	2	2	4	5	0	0	0	0	0	0	0	2	0	0
Minimum Concentration	<0.17	<0.25	<0.17	<0.18	<0.38	<0.35	<0.2	<0.18	<0.23	<0.09	<0.21	<0.005	<0.34	<0.15	<0.2	<0.23	<0.28	<0.18	<0.22	<0.0051
Minimum Detect	1.13	ND	ND	ND	ND	ND	3.89	6.73	34.2	0.18	ND	ND	ND	ND	ND	ND	ND	0.185	ND	ND
Maximum Concentration	2900	<5	<3.4	<3.6	<7.6	<7	1090	1940	6490	<1.8	<4.2	<5	<6.8	<3	<4	<4.6	<5.6	19.8	<4.4	<2.55
Maximum Detect	2900	ND	ND	ND	ND	ND	1090	1940	6490	0.862	ND	ND	ND	ND	ND	ND	ND	19.8	ND	ND
Average Concentration	328	0.42	0.28	0.3	0.63	0.58	122	216	733	0.36	0.35	0.36	0.57	0.25	0.33	0.38	0.47	2.5	0.37	0.18
Median Concentration	1.13	0.125	0.085	0.09	0.19	0.175	0.1	0.09	0.115	0.196	0.105	0.125	0.17	0.075	0.1	0.115	0.14	0.09	0.11	0.00255
Standard Deviation	964	0.78	0.53	0.56	1.2	1.1	363	646	2159	0.37	0.66	0.81	1.1	0.47	0.63	0.72	0.88	6.5	0.69	0.41
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

Env Stds Comments

#1:CRC CARE (2011) Intrusive Maintenance Worker

Data Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Areas of Concern	Sub-Area	Area Requiring Remediation (m2)	Remediation Depth (m BGL)	COPCs Requiring Remediation 1	Long Term Management Requirements 2	Estimated volume requiring remediation / management	Volume Calculation Assumptions
AEC -1 (Old Administration Area)	Former building footprint	200	0.2	■ Inhalation - Asbestos	Ecological (future landscaping considerations): ■ benzo(a)pyrene	40	■ Assumes remediation / management of the upper 0.2m to due to surface ACM associated with building demolition.
AEC-2 (Buried Waste Area 8 – CDU)	NA	0	0	■ No Remediation Required	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation Ecological (future landscaping considerations): ■ TRH >C10-C16 Fractions ■ Benzo(a)pyrene	0	■ NA
AEC-3 (Southern Contractor Area)	A - Former Laboratory	2280	2	■ Vapour Intrusion - Benzene, naphthalene, TRH >C6-C10 (F1) Fractions, methane	LNAPL Management: Management plans required to address the following: ■ Management of potential acute exposure to ground gases during future excavation Consideration of hazardous ground gases for the development of enclosed spaces (ie buildings) - limited to AEC-3a and 3d Ecological (future landscaping considerations): ■ Benzo(a) pyrene ■ F1 (TRH C6-C10 Fraction) ■ F2 (TRH >C10-C16 Fraction)	4560	■ Assumes average depth of impact is 2m depth based on max depth of impacts at SB-MW18/24 of 2.2m, shallower (to 0.5 at TP18/20)
	B - Former Laboratory (ACM impacted Area)	848	0.8	■ Inhalation - Asbestos		678	■ Fill material containing demolition waste (0.8m BGL), based on TP19/32 and similar material observed across surface of area
	C - Former Contactor Warehouse (PAH hotspot)	426	1	■ Direct Contact - Carcinogenic PAHs		426	■ 0.2m into natural clay around TP19/16 (1m)
	D - Former Contactor Warehouse	421	2	■ Vapour Intrusion - TRH >C8-C12 (aliphatic) fractions, benzene, naphthalene		842	■ Assumes contamination associated with soil vapour impacts to an average depth of 2m (shallows soils and groundwater) based on PID readings at TP19/17 to 2m within clay
AEC-4 (Southern Buried Waste Area)	NA	13936	3.63	■ Vapour Intrusion - Benzene, TRH> C6-C10 (F1) Fractions ■ Inhalation - Asbestos ■ Direct Contact - TRH >C10-C34, Carcinogenic PAHs, hexavalent Chromium	LNAPL Management - Management plans required to address the following: ■ Management of potential acute exposure to ground gases during future excavation ■ Consideration of hazardous ground gases for the development of enclosed spaces (ie buildings) Onsite Ecological (future landscaping considerations): ■ Toluene ■ F1 (TRH C6-C10 Fraction) ■ F2 (TRH >C10-C16 Fraction) ■ Benzo(a) pyrene	**50,588**	■ Due to the heterogeneous nature of buried waste in this area, it has been assumed all fill material will require remediation/management to an average depth of 4m. Average depth of fill material has been used for calculations.

Areas of Concern	Sub-Area	Area Requiring Remediation (m2)	Remediation Depth (m BGL)	COPCs Requiring Remediation 1	Long Term Management Requirements 2	Estimated volume requiring remediation / management	Volume Calculation Assumptions
AEC-5 (Platformer 3)	NA	0	0	■ No Remediation Required	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation	**0**	■ No Remediation Required - Long Term Management Proposed
AEC-6 (Buried Waste - Ex Solvents Plant)	NA	400	1	■ Inhalation - Asbestos	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation	**400**	■ Extent of impact includes 2 x 200m3 asbestos containing stockpiles present within the area
AEC-7 (Pipe Track Areas)	NA	0	0	■ No Remediation Required	NA	**0**	■ NA
AEC-8 (Tank Farm J)	NA	0	0	■ No remediation required	LNAPL Management: Management of potential acute exposure to ground gases during future excavation Ecological (future landscaping considerations): ■ F2 (TRH >C10-C16 Fraction)	**0**	■ NA
AEC-9 (Process West)	NA	2781	1.5	■ Vapour Intrusion - TRH > C8-10 Aliphatic and Aromatic Fractions, naphthalene	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation Ecological (future landscaping considerations): ■ F1 (TRH C6-C10 Fraction) ■ F2 (TRH >C10-C16 Fraction)	■ 4172	■ Assumes remediation and / or management of fill and 0.2m of clay. Volumes do not exclude the approximate 800m3 of soils excavated for remediation trials from this area of the Site.
AEC-10 (Process East)	NA	0	0	■ No Remediation Required	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation. Ecological (future landscaping considerations): ■ F1 (TRH C6-C10 Fraction) ■ F2 (TRH >C10-C16 Fraction)	■ 0	■ No Remediation Required - Long Term Management Proposed

Areas of Concern	Sub-Area	Area Requiring Remediation (m2)	Remediation Depth (m BGL)	COPCs Requiring Remediation 1	Long Term Management Requirements 2	Estimated volume requiring remediation / management	Volume Calculation Assumptions
AEC-11 (Tankfarms A1, A2, A3)	NA	0	0	■ No Remediation Required	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation Ecological (future landscaping considerations): ■ Benzo(a) pyrene ■ Lead ■ F2 (TRH >C10-C16 Fraction	■ 0	■ No Remediation Required - Long Term Management Proposed
AEC-12 (Tankfarm C)	NA	10170	1.8	**Vapour Intrusion -** TRH >C6-C12 (aliphatic), TRH >C8-C16 (Aromatic), TRH >C6-C10 (F1), benzene **Direct Contact (Commercial Workers) -** TRH >C6-C16 Fractions, TRH >C8-C12 Aromatic fractions	■ LNAPL Management: Management of potential acute exposure to ground gases during future excavation Ecological (future landscaping considerations): ■ F1 (TRH C6-C10 Fraction) ■ F2 (TRH >C10-C16 Fraction)	■ 18306	■ Estimated volumes includes remediation / management of 0.2m into underlying clay (average fill depth approximately 1.6 m)
AEC-13	Former Substation 24	54	0.5	**Inhalation -** Asbestos	-	**27**	■ Remediation / management of ACM associated with building demolition.
AEC-14 (Subsurface Drainage Network)	NA	0	0	-	-	**0**	■ Assumes that total volumes are captured within relevant AECs Unexpected finds protocol to be implemented throughout sub-grade demolition to determine requirement for localised remediation of backfill material
AEC-15 (General Site Areas)	AEC-15a (Asbestos Hotspot MW11/14)	174	0.2	**Inhalation -** Asbestos	-	**35**	■ Assumes remediation / management of materials to depth of 0.2m to clear surface in accordance with NEPM
	Other Areas	0	0	-	LNAPL Management: ■ Management of potential acute exposure to ground gases during future excavation Ecological (future landscaping considerations): ■ Benzo(a)pyrene ■ F2 (TRH >C10-C16 Fraction)	**0**	■ No Remediation Required - Long Term Management Proposed
TOTAL In-Situ Volume Estimate (m3)						**80,073 m^3**	

The following table summarises the assessment of relevant remedial technologies for CoPCs within each AEC.

Table 5.1 Remedial Options Assessment

Contaminant	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
	Multi-Phase Vacuum Extraction ■ The extraction of total fluids and soil vapour from recovery wells utilising a vacuum source. The effluent is then treated and disposed. The soil gas generated is treated and then vented to the atmosphere.	Soil and Water	■ Contamination at the Site has identified to be present within shallow fill / groundwater (i.e. <1.5 m bgl). ■ ERM notes that areas of deeper impact have been identified (>4m bgl) – assessment of remedial options for these areas is discussed below within co-mingled contamination ■ Under suitable circumstances, MPVE generates a larger radius of influence around each recovery well in comparison to traditional pumps or skimmers, thereby requiring less recovery wells.	■ MPVE can be deployed as a mobile system utilising existing wells very quickly. ■ MPVE can achieve significant reduction in mass within a relatively short timeframe (i.e. 1 – 3 years)	■ MPVE may be disruptive to the site, especially when conducted as mobile events versus a permanent system and will require consideration of existing / potential future site users due to truck movements. ■ Potential safety concerns associated with trenching and installation of infrastructure for ongoing operation.	■ Moderate complexity associated with design, installation and ongoing operation / maintenance of system.	■ MPVE has a high degree of power or fuel consumption to run. ■ Aesthetic issues include sight and noise from the machinery and vapour discharge. ■ Several waste streams are produced (soil vapour, Napl and groundwater requiring treatment and disposal.	■ Moderate costs primarily associated with the establishment of extraction wells, ongoing equipment costs and disposal of collected waste water.	■ 2
LNAPL	In-situ Chemical Oxidation ■ Destroying organic contaminants in situ via injection of chemical oxidants in temporary injection points, injection wells, trenches or excavations	Soil and Water	■ Proven common method that can work quickly where applicable. ■ Primarily used for moderate to high dissolved phase contaminants. ■ Will work with limited residual or trace amounts of LNAPL. ■ Where contaminant has diffused into aquifer matrix, matrix back-diffusion may lead to a long-term source that will require multiple chemical oxidant injections.	■ May require multiple treatments considering contaminant load. ■ Difficult to employ in fine grained soils/sediments or bedrock with low permeability resulting in potential extended timeframes for use within Clyde site.	■ Requires low to moderate land disturbances. ■ Some concerns regarding storage / handling of chemical products.	■ Moderate – high design complexity considering fragmented nature of LNAPL plume within the Site. ■ Achieving contact of chemical oxidant with contaminant in groundwater can be challenging.	■ Typically, no ongoing power sources or equipment is needed between injection events.	■ Moderate costs associated with installation of required injection points, purchase of required injection chemicals and ongoing monitoring,	■ 1.8
	Monitored Natural Attenuation / Natural Source Zone Depletion (Ongoing site management only) ■ ERM notes that in preparing this ROA, MNA is viewed as a site management approach and not a remedial technique. ■ MNA involves monitoring the natural biological and geo-chemical degradation (aerobic and to a	Soil and Water	■ Effective in dealing with residual / degraded LNAPL contamination derived from the dissolution of LNAPL or the mass fluctuations from sorbed to dissolved petroleum.	■ Potential for protracted period of monitoring to be required. ■ Degradation of plume by natural weathering process can take a long time in comparison to	■ Few safety concerns, monitoring would be undertaken as per established standard site monitoring procedures / permitting requirements.	■ Low complexity in terms of ongoing monitoring, however establishment of an agreed remedial objective, and demonstrating that the objective has	■ No ongoing use of infrastructure, power generation required.	■ Low remedial costs, however ongoing monitoring costs are dependent on the nature and specific requirements of closure criteria / monitoring requirements.	■ 1.2

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
	lesser amount, anaerobic), volatilisation, dispersion, sorption, dilution of contaminants in the groundwater plume or soil column. ■ NSZD		■ Natural attenuation is likely ongoing to some degree and will reduce the concentrations of petroleum in the formation over time. ■ Natural source zone depletion (NSZD) is used to extend the traditional understanding of natural attenuation to the light non-aqueous phase liquid (LNAPL) source zone. It describes the collective, naturally occurring processes of dissolution, volatilisation, and biodegradation that result in mass losses of LNAPL petroleum hydrocarbon constituents from the subsurface. This process can be used to provide additional lines of evidence to support the degradation of NAPL within the Site. ■ The plume must be stable or shrinking to consider, which has been demonstrated at the Clyde site.	more active technologies, however in this instance, the lack of active methods that are likely to be effective lessons the relevance of a longer timeframe		been met can be challenging.			
Volatile Hydrocarbons i.e TRH C6 – C24	<u>Passive Ex-Situ Bioremediation</u> ■ Typically suitable for soils contaminated with low-medium molecular weight hydrocarbons at concentrations closer to the site reuse criteria. Soils are excavated and stored above grade whilst monitoring for contaminant reductions. Some turning of soils may be required.	Soil	■ Proven common method. ■ Can support natural attenuation processes already in action.	■ A longer process if LNAPL is present within soil matrix.	■ Potential safety concerns relating to release of vapours liberated during excavation and movement of soils.	■ Potential for emission control enclosure requirements for the excavation, handling and treatment of materials, however where remedial works are staged (reducing the risk of air emissions / odours) enclosures may not be required. ■ Low complexity in relation to establishment and implementation.	■ Limited infrastructure / power generation required	■ Low cost	■ 1.5

Contaminant	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
						■ Longer timeframes required can introduce complications relating to site management requirements etc.,			
	<u>Active Ex-Situ Bioremediation:</u> ■ Designed to treat hydrocarbon impacted soil, and combines basic nutrient, pH and moisture conditioning with active extraction of air through soil piles.	Soil	■ Proven common method. ■ Enhances natural attenuation processes already in action.	■ Higher contaminant loading will require a higher degree of conditioning and or extraction of air.	■ Turning is not required therefore disruption / safety risks through equipment movement onsite is minimised. ■ Potential safety concerns relating to release of vapours liberated during excavation and movement of soils.	■ Requires suitable existing bacterial populations to be present within soil matrix. ERM notes that this has been confirmed through initial sampling of materials within process area east and west ■ Low complexity in relation to establishment and implementation of remedial approach. ■ Potential for emission control enclosure requirements for the excavation, handling and treatment of materials, however where remedial works are staged (reducing the risk of air emissions / odours) enclosures may not be required.	■ Process requires operation of generators for air extraction resulting in moderate power consumption – however ERM notes that power consumption would be reduced as the need for air extraction and requirement for oxygen lessens during later stages of works.	■ Moderate costs associated with establishment of bio-piles, equipment required (generators) and power consumption. ■ Potential for emission control enclosures for the excavation, handling and treatment of materials, however where remedial works are staged (reducing the risk of air emissions / odours) enclosures may not be required.	■ 1.16
	<u>Enhanced In-Situ Bio-Remediation</u> ■ Typically, injection of oxygen enhancing chemicals to support microbial biodegradation of hydrocarbons.	Soil	■ Proven common method. ■ Can support natural attenuation processes already in action. ■ Effective for low to medium contaminant loading.	■ May require multiple / long term treatment considering contaminant load.	■ Some concerns regarding storage / handling of chemical products. ■ As process is in-situ turning is not required therefore disruption / safety risks through equipment movement onsite is minimised.	■ Requires suitable existing bacterial populations to be present within soil matrix. ERM notes that this has been confirmed through initial sampling of materials within process area east and west ■ Low complexity in relation to establishment and implementation of remedial approach.	■ The chemicals break down during the oxygen producing process into Carbon dioxide and water. ■ Very little power usage is required and only during the injection phases.	■ Moderate costs associated with establishment of equipment required, chemicals and limited power consumption.	■ **1.16**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
	Immobilisation including Stabilisation ■ Decreasing the mobility of contaminants by changing conditions such as pH , adding bonding agents, oxidising or reducing reactions.	Soil	■ Can be technically challenging to stabilise short chain hydrocarbons. ■ Application of amendments can significantly decrease the mobility, toxicity and bioavailability various contaminants in soil and groundwater. ■ Where contaminants are immobilised through potentially reversible reactions, a change in geochemical conditions in the subsurface could remobilise contaminants.	■ 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.	■ Moderate complexity associated with screening and sorting of material to ensure contamination is suitably bound within the stabilising matrix.	■ Moderate costs associated with equipment and application of stabilisation matrix	■ The cost is highly dependent on the volume to be treated. There is a scale of efficiency associated with larger volumes undertaking treatment.	■ **1.5**
	In-situ Soil Vapour Extraction ■ A process that extracts volatile contaminants from the unsaturated soils whilst promoting enhanced Bio-remediation by adding oxygen to the subsurface. Extracted vapours can be treated prior to discharge to the atmosphere if necessary	Soil	■ Will remove volatile organics in vapour phase from the soil with simple readily available equipment. ■ It complements air sparging and creates moderate site disturbance ■ It has very limited to no effect with groundwater contamination and creates moderate site disturbance.	■ Timeframes are dependent on the nature of underlying materials and potential back diffusion from contaminated groundwater. Due to the nature of impact at the Clyde Site, it is the opinion of ERM that remedial works would require up to 5 years for successful completion.	■ Soil vapour extraction may be disruptive to the site and will require consideration of existing site users. ■ Potential safety concerns associated with trenching and installation of infrastructure for ongoing operation / potential generation of explosive atmospheres within enclosures.	■ Moderate complexity associated with design, installation and ongoing operation / maintenance of system. ■ Extracted vapours may need treatment before releasing to atmosphere.	■ SVE has a moderate - high degree of power or fuel consumption to run.	■ Moderate costs primarily associated with installation of required equipment, ongoing operation of equipment and monitoring	■ 2.1
	Multi-Phase Vacuum Extraction ■ The extraction of total fluids and soil vapour from recovery wells utilising a vacuum source. The effluent is then treated and disposed. The soil gas generated is treated and then vented to the atmosphere.	Soil and Water	■ Contamination at the Site has identified to be present within shallow fill / groundwater (i.e. <1.5 m bgl). ■ ERM notes that areas of deeper impact have been identified (>4m bgl) – assessment of remedial options for these areas is discussed below within co-mingled contamination	■ MPVE can be deployed as a mobile system utilising existing wells very quickly. ■ MPVE can achieve significant reduction in mass within a relatively short timeframe (i.e. 1 – 3 years)	■ MPVE may be disruptive to the site, especially when conducted as mobile events versus a permanent system and will require consideration of existing site users. ■ Potential safety concerns associated with trenching and	■ Moderate complexity associated with design, installation and ongoing operation / maintenance of system. ■ Extracted vapours may need treatment before releasing to atmosphere.	■ MPVE has a high degree of power or fuel consumption to run. ■ Aesthetic issues include sight and noise from the machinery and vapour discharge. ■ Several waste streams are produced (soil vapour, Napl and groundwater requiring treatment and disposal.	■ Moderate costs Primarily associated with the establishment of extraction wells, ongoing equipment costs and disposal of collected waste water.	■ 1.6

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
			■ Under suitable circumstances, MPVE generates a larger radius of influence around each recovery well in comparison to traditional pumps or skimmers, thereby requiring less recovery wells.		installation of infrastructure for ongoing operation / potential generation of explosive atmospheres within enclosures.				
	<u>In-situ Chemical Oxidation</u> ■ Destroying organic contaminants in situ via injection of chemical oxidants in temporary injection points, injection wells, trenches or excavations	Soil and Water	■ Proven common method that can work quickly, however may be difficult to achieve suitable contact with contamination due to subsurface conditions. ■ Primarily used for moderate to high dissolved phase contaminants. ■ Easy to obtain injection chemicals from multiple vendors. ■ Achieving contact of chemical oxidant with contaminant can be challenging within fine grained soils. ■ Where contaminant has diffused into aquifer matrix, matrix back-diffusion may lead to a long-term source that will require multiple chemical oxidant injections. ■ May require multiple treatments considering contaminant load.	■ In-situ chemical oxidation can achieve significant reduction in mass within a relatively short timeframe (i.e. 1 – 3 years)	■ Requires low to moderate land disturbances. ■ Concerns regarding storage / handling of chemical products. ■	■ Design of approach requires consideration of back diffusion and other factors that may impact the effectiveness of the approach. ■ Requires low to moderate land disturbances.	■ In-situ chemical oxidation requires a moderate amount of equipment / chemicals for implementation of remedial approach however has low power requirements.	■ Moderate costs	■ **1.83**
	<u>In-Situ Thermal Treatment</u> ■ The injection of energy into the subsurface to mobilize and recover volatile and semi-volatile organic contaminants by producing heat. Requires active soil vapour recovery to collect subsurface emissions.	Soil and water	■ 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 depending on the composition of materials.	■ 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,	■ 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,	■ Due to asbestos within the soil matrix – where thermal is undertaken specific requirements relating to asbestos controls will be required.	■ High energy usage. ■ In-situ thermal requires significant infrastructure to be installed within the site and therefore High equipment costs	■ In-situ thermal treatment can be expensive to deploy and operate and typically requires vapour extraction to remove vapours produced	■ **2.1**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
			■ ERM notes the presence of asbestos within primary remedial areas (AEC-4) that may impact the appropriateness of thermal treatment.	timeframes may vary depending on underlying materials.	concerns relating to the release of asbestos fines / fibres during handling and treatment.				
	<u>Ex-Situ Thermal Treatment</u> ■ The excavation of soils and treatment with heat to enhance desorption of contaminants and strip volatiles more readily.	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 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.	■ 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.	■ Due to asbestos within the soil matrix – where thermal is undertaken specific requirements relating to asbestos controls will be required. ■ 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.	■ Significant costs associated with enclosures for the treatment / handling of materials [prior to treatment. ■ High energy usage. ■ High equipment costs	■ High costs	■ **2.3**
Heavy End Hydrocarbons i.e. TRH >C16 and PAHs	<u>Passive Ex-Situ Bioremediation</u> ■ Typically suitable for soils contaminated with low-medium molecular weight hydrocarbons at concentrations closer to the site reuse criteria. Soils are excavated and stored above grade whilst monitoring for contaminant reductions. Some turning of soils may be required.	Soil	■ Limited effectiveness for longer chain hydrocarbons. ■ Can support natural attenuation processes already in action.	■ May require significant timeframes where long chain hydrocarbons are present, however ERM notes that remedial timeframes (up to 3 years) outlined within EIS would likely be sufficient	■ Potential safety concerns relating to release of vapours etc. liberated during excavation and movement of soils during remedial works, however it is the opinion of ERM that this risk can be easily managed.	■ Low complexity in relation to establishment and implementation of remedial approach. ■ Longer timeframes can introduce complexity relating to site management requirements etc.,	■ Limited infrastructure / power generation required	■ Low cost, however due to long timeframes ongoing management costs may increase. ■ Potential for emission control enclosure for the excavation, handling and treatment of materials, however where remedial works are staged (reducing the risk of air emissions / odours) enclosures may not be required.	■ **1.16**
	<u>Active Bioremediation</u>: ■ Designed to treat hydrocarbon impacted soil, and combines basic nutrient, pH and moisture conditioning with active extraction of air through the bio-pile	Soil	■ Proven common method. ■ Can support natural attenuation processes already in action. ■ ERM notes that initial remedial trials indicate	■ Will require a higher degree of conditioning and or extraction of air depending on contaminant load.	■ Turning is not required therefore disruption / safety risks through equipment movement onsite is minimised.	■ Requires suitable existing bacterial populations to be present within soil matrix. ERM notes that this has been confirmed through	■ Process requires operation of generators for air extraction resulting in moderate power consumption.	■ Moderate costs associated with establishment of bio-piles, equipment required (generators) and	■ **1.0**

Contaminant	Technology	Matrix	Effectiveness Effective Limited Ineffective	Timeframe <1 year 1-5 Years >5 Years	Health & Safety Few concerns Mod concerns Many concerns	Complexity Low Moderate High	Sustainability Above Average Average Below Average	Relative Costs Low cost Mod Cost High Cost	Relative Score 1.0 -1.5 1.5 – 2.5 2.5 – 3.0
			breakdown of heavy end fractions to be occurring within active bio-piles.		■ will require a higher degree of conditioning and or extraction of air.	initial sampling of materials within process area east and west ■ Low complexity in relation to establishment and implementation of remedial approach.		power consumption. ■ Potential for emission control enclosure for the excavation, handling and treatment of materials, however where remedial works are staged (reducing the risk of air emissions / odours) enclosures may not be required.	
	<u>Enhanced Bio-Remediation</u> ■ Typically, injection of oxygen enhancing chemicals that supplies electron receptors to increase biodegradation of VOCs	Soil	■ Proven common method. ■ Can support natural attenuation processes already in action.	■ May require multiple / long term treatment considering contaminant load, however the approach is considered more aggressive than passive and active bio piling and may therefore require shorter remedial timeframes. .	■ Some concerns regarding storage / handling of chemical products. ■ Turning is not required therefore disruption / safety risks through equipment movement onsite is minimised.	■ Requires suitable existing bacterial populations to be present within soil matrix. ERM notes that this has been confirmed through initial sampling of materials within process area east and west ■ Low complexity in relation to establishment and implementation of remedial approach.	■ Process requires operation of generators for air extraction resulting in moderate power consumption.	■ Moderate costs associated with establishment of bio-piles, equipment required (generators), required chemicals and power consumption. ■ Potential for emission control enclosure for the excavation, handling and treatment of materials, however where remedial works are staged (reducing the risk of air emissions / odours) enclosures may not be required.	■ **1.0**
	<u>Containment (Slurry Walls- GW, Surface Cap etc.)</u> ■ Physical Barriers to prevent migration of contaminants by reducing movement or preventing rainfall infiltration and subsequent mobilisation	Soil and water	■ While the approach is beneficial to mitigate migration of contamination, risk mitigation to onsite users will be limited. ■ Can be undertaken concurrently with in-situ stabilisation thereby reducing groundwater flow through stabilised materials. ■ Can be a very long solution if installed appropriately. ■ Good alternative if the contaminants are highly recalcitrant to	■ Implementation of approach can be undertaken within a short timeframe, however the approach may require planning associated with site management and subsequent land use planning that may require lengthy timeframes.	■ Health and safety concerns associated with onsite machinery / equipment. Can be managed under existing site safety and permitting requirements.	■ Design will require consideration of future land use planning requirements, geotechnical considerations and groundwater chemistry.	■ Infrastructure / power generation required during installation only.	■ Moderate costs for implementation of approach, however ongoing monitoring may be required to demonstrate effectiveness creating low costs but over a long timeframe.	■ 1.3

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
			typical treatment options or too expansive to remediate.						
	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 (AEC-4) 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.	■ 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.	■ 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	■ Limited infrastructure / power generation required	■ Moderate costs for implementation of approach, however ongoing monitoring may be required to demonstrate effectiveness.	■ **1.5**
	In-Situ Thermal Treatment ■ The injection of energy into the subsurface to mobilize and recover volatile and semi-volatile organic contaminants by producing	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 depending on the composition of materials. ■ ERM notes the presence of asbestos within primary remedial areas (AEC-4) that may impact the appropriateness of thermal treatment.	■ 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.	■ Due to asbestos within the soil matrix – where thermal is undertaken specific requirements relating to asbestos controls will be required.	■ In-situ chemical oxidation requires a moderate amount of equipment / chemicals for implementation of remedial approach however has low power requirements.	■ Insitu treatment can be expensive to deploy and operate and typically requires vapour extraction to remove vapours produced	■ **2.5**
	Ex-Situ Thermal Treatment ■ The injection of energy into the subsurface to mobilize and recover	Soil	■ Destroys a broad range of hydrocarbons quickly and thoroughly	■ Due to the heterogeneous nature of	■ Health and Safety concerns due to site disturbance,	■ Due to asbestos within the soil matrix – where	■ High energy usage. ■ In-situ thermal requires significant	■ High costs	■ **2.5**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
	volatile and semi-volatile organic contaminants by producing		■ 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 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.	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.	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.	thermal is undertaken specific requirements relating to asbestos controls will be required. ■ 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.	infrastructure to be installed within the site and therefore High equipment costs		
Asbestos	Excavation and Off-site Disposal ■ Removal of contaminated soils and offsite disposal to a suitably licenced receiving facility	Soil	■ Offsite disposal of soil material will effectively treat onsite asbestos contamination	■ Remediation can be undertaken within short timeframes	■ Health and safety concerns associated with the excavation, handling, transport and disposal of asbestos materials	■ Low complexity	■ Low sustainability due to due to the high volume of trucks movement and use of landfill resources.	■ Moderate costs due to trucking and waste levies. ERM notes that minor volumes of asbestos were identified (with the exception of AEC-4) however where additional material is identified costs increase proportionally with volumes.	■ **1.5**
	Emu Picking / Selective Excavation of Surface Impact ■ Removal of surface asbestos contamination via “emu picking” and selective excavation of surficial soils	Soil	■ Emu picking / limited selective excavation of asbestos within surface soils material will effectively treat onsite asbestos contamination	■ Remediation can be undertaken within short timeframes	■ Health and safety concerns associated with the excavation, handling, transport and disposal of asbestos materials ■ It is the opinion of ERM that due to existing and other standard health and safety procedures the health and safety risk during works would be easily managed.	■ Low complexity	■ Limited resources required. Where soil volumes can be minimised through selective excavation, limited truck movement will be required	■ Potentially low cost approach where spoil volume can be appropriately managed / reduced.	■ **1.0**
	Onsite Containment ■ Remediation would involve excavation of impacted fill materials	Soil	■ The containment location will require careful consideration to ensure it does not	■ Remedial works can be undertaken within a short timeframe,	■ Health and safety concerns associated with the excavation,	Low complexity	Limited resources required	Low cost. Scale of efficiency where larger volumes of materials	■ **1.0**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
	and placement within a location identified to require filling for construction purposes. Where a suitable location can be identified within the site a single placement location may be excavated to contain all impacted fill material.		encounter groundwater or acid sulphate soils (ERM notes that likelihood of ASS in the WARP is low). ■ Placement locations should also be selected within areas that would undergo minimal future disturbance such as under site car parking or underneath building structures (where services are not located), with a cover comprising a constructed capping layer placed over impacted fill with no requirement for a liner at the base of waste material.	however negotiation with councils and future land holders may be required to confirm ongoing management requirements are appropriate	handling, transport and disposal of asbestos materials			can be placed within a consolidated location.	
Co-Mingled Contaminants (Hydrocarbons and Heavy Metals)	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	■ Remediation can be undertaken within short timeframes	■ Health and safety concerns associated with the excavation, handling, transport and disposal of contaminated materials	■ Low complexity	■ Low sustainability due to due to the high volume of trucks movement and use of landfill resources.	■ High costs due to trucking and waste levies.	■ **1.8**
	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 (AEC-4) 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	■ 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.	■ 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	■ Limited infrastructure / power generation required	■ Moderate costs for implementation of approach, however ongoing monitoring may be required to demonstrate effectiveness.	■ **1.6**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
			subsurface could remobilise contaminants.						
	Containment (Slurry Walls- GW, Surface Cap etc.) ■ Physical Barriers to prevent migration of contaminants	Soil	■ Can be undertaken concurrently with in-situ stabilisation thereby reducing groundwater flow through stabilised materials. ■ Good alternative if the contaminants are highly recalcitrant to typical treatment options or too expensive to remediate.	■ Implementation of approach can be undertaken within a short timeframe, however the approach may require planning associated with site management and subsequent land use planning that may require lengthy timeframes.	■ Health and safety concerns associated with onsite machinery / equipment. Can be managed under existing site safety and permitting requirements.	■ Design will require consideration of future land use planning requirements, geotechnical considerations and groundwater chemistry.	■ Limited infrastructure / power generation required	■ Moderate costs for implementation of approach, however ongoing monitoring may be required to demonstrate effectiveness,	■ **1.6**
	In-Situ Thermal Treatment ■ The injection of energy into the subsurface to mobilize and recover volatile and semi-volatile organic contaminants by producing	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 depending on the composition of materials. ■ ERM notes the presence of asbestos within primary remedial areas (AEC-4) that may impact the appropriateness of thermal treatment.	■ 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 requireements for development of appropraiet system.	■ High energy usage. ■ In-situ thermal requires significant infrastructure to be installed within the site and therefore High equipment costs	■ 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 ■ The injection of energy into the subsurface to mobilize and recover volatile and semi-volatile organic contaminants by producing	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 enclosure where concentrations of volatile contaminants pose a risk from air borne emissions / odour.	■ 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	■ 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.	■ 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.	■ Significant costs associated with enclosures for the treatment / handling of materials [prior to treatment. ■ High energy usage. ■ High equipment costs	■ High cost	■ **2.5**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
			■ ERM notes the presence of asbestos within primary remedial areas (AEC-4) that may impact the appropriateness of thermal treatment.	equipment procurement can result in extensive lead times.					
	Soil Washing ■ Physical separation of the soil particles to which the bulk of contamination is sorbed from soil fractions or chemical washing where contaminants are removed by chemicals & subsequently recovered from solution.	Soil	■ Proven technology that can remove large percentage of mass in short timeframes ■ Process will produce significant volumes of waste water requiring additional treatment	■ Can be completed within a short timeframe, however due to the heterogeneous nature of soils, significant sorting, screening etc. will be required,	■ Health and safety concerns associated with the excavation, handling, transport and disposal of contaminated materials ■ Risks associated with infrastructure requirements / moving equipment within the Site ■ Risk of spreading contaminated soil during soil handling.	■ Risk of spreading contaminated soil during soil handling. ■ Potential requirements for the handling and processing of materials within an enclosure to minimise potential air emissions / odours.	■ High energy usage. ■ High equipment costs	■ High equipment / sit management costs ■ Can result in large volumes of contaminated waste water that requires treatment / disposal	■ **2.6**
	Onsite Containment and Ongoing management Remediation would involve excavation of impacted fill materials and placement within a location identified to require filling for construction purposes. Where a suitable location can be identified within the site a single placement location may be excavated to contain all impacted fill material. Placed materials would be managed under Site / Environmental Management Plans including requirements for ongoing monitoring, trigger / action levels to prevent future offsite impacts.	Soil	■ The containment location will require careful consideration to ensure it does not encounter groundwater or acid sulphate soils. ■ Placement locations should also be selected within areas that would undergo minimal future disturbance such as under site car parking or underneath building structures (where services are not located), with a cover comprising a constructed capping layer placed over impacted fill with no requirement for a liner at the base of waste material.	■ Remedial 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	■ Health and safety concerns associated with the excavation, handling, transport and disposal of asbestos materials	■ Low complexity associated with implementation, however strategy will require ongoing monitoring plans to be developed with defined trigger levels, action items etc. ■ All management plans will require endorsement by NSW EPA accredited auditor and DPIE.	■ Limited resources required	■ Low cost. Scale of efficiency where larger volumes of materials can be placed within a consolidated location. ■ 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**
Co-Mingled Contaminants (Hydrocarbons, metals and Asbestos)	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	■ Remediation can be undertaken within short timeframes	■ Health and safety concerns associated with the excavation, handling, transport and	■ Low complexity	■ Low sustainability due to due to the high volume of trucks movement and use of landfill resources.	■ High costs due to trucking and waste levies.	■ **1.6**

Contaminant	Technology	Matrix	Effectiveness ● Effective ● Limited ● Ineffective	Timeframe ● <1 year ● 1-5 Years ● >5 Years	Health & Safety ● Few concerns ● Mod concerns ● Many concerns	Complexity ● Low ● Moderate ● High	Sustainability ● Above Average ● Average ● Below Average	Relative Costs ● Low cost ● Mod Cost ● High Cost	Relative Score ● 1.0 -1.5 ● 1.5 – 2.5 ● 2.5 – 3.0
					disposal of contaminated materials				
	Treatment / Stabilisation and On-site containment ■ Physical Barriers to prevent migration of contaminants	Soil	■ Application of amendments / stabilising agents can significantly decrease the mobility, toxicity and bioavailability various contaminants in soil and groundwater ■ Due to heterogeneous nature of fill materials (AEC-4) 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.	■ 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.	■ 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	■ Limited infrastructure / power generation required	■ Moderate costs for implementation of approach, however ongoing monitoring may be required to demonstrate effectiveness.	■ **1.5**
	Onsite Containment and Ongoing management Remediation would involve excavation of impacted fill materials and placement within a location identified to require filling for construction purposes. Where a suitable location can be identified within the site a single placement location may be excavated to contain all impacted fill material. Placed materials would be managed under Site / Environmental Management Plans including requirements for ongoing monitoring, trigger / action levels to prevent future offsite.	Soil	■ The containment location will require careful consideration to ensure it does not encounter groundwater or acid sulphate soils. ■ Placement locations should also be selected within areas that would undergo minimal future disturbance such as under site car parking or underneath building structures (where services are not located), with a cover comprising a constructed capping layer placed over impacted fill with no requirement for a liner at the base of waste material.	■ Remedial works can be undertaken within a short timeframe, however negotiation with councils and future land holders may be required to confirm ongoing management requirements are appropriate	■ Health and safety concerns associated with the excavation, handling, transport and disposal of asbestos materials	■ Low complexity associated with implementation, however strategy will require ongoing monitoring plans to be developed with defined trigger levels, action items etc. All management plans will require endorsement by ACT EPA accredited auditor and other regulating agencies / bodies.	■ Limited resources required	■ Low cost. Scale of efficiency where larger volumes of materials can be placed within a consolidated location. ■ 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 ACT EPA accredited auditor and other regulating agencies / bodies	■ **1.3**

Table 6.1 Preferred Remedial Approach

ERM notes that the preferred remedial / site management strategy presented below is based on the objective that the desired end use is Commercial/Industrial, while reducing ongoing liability and complexity in ongoing management requirements. Upon completion of final landform design / final land use planning ERM notes the potential for in-situ management of identified contamination (such as a cap and contain strategy) can be re-considered within each AEC.

AEC	CoPC	Preferred Remedial Approach
AEC – 1: Old Administration Area	■ Asbestos	■ Based on the isolated nature of asbestos identified within AEC-1, ERM recommends a remedial approach including selective excavation and removal / emu picking of surface asbestos impact be adopted. ■ Specific validation criteria /requirements for demonstrating the effectiveness of the remedial approach will be documented within the detailed RAP.
AEC – 2: Buried Waste Area 8 – CDU tank farm sludge	■ LNAPL	■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-2. As such, it is the opinion of ERM that the management of LNAPL within AEC-2 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion . ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 3: Southern Contractor Area	■ Benzene ■ Naphthalene ■ TRH C6-C10 less BTEX ■ TRH C8-12 ■ Carcinogenic PAHs ■ Asbestos ■ LNAPL	Based on the ERMs current understanding of proposed land use for the Site, it is the opinion of ERM that areas within AEC-3 identified to contain CoPCs presenting a potential dermal contact risk may be managed via a “cap and contain” approach including ongoing monitoring / management (i.e. AEC-C). Other areas of AEC 3 may be subject to the following remedial / site management approaches. **Volatile hydrocarbons** ■ Selective excavation of hydrocarbon impacted material resulting in a vapour intrusion risk (AEC-3 A & D) and placement within onsite managed active bio-piles. Following completion of bio-piling the material would either be re-used. ■ ERM notes that where asbestos is identified within soil material impacted with volatile hydrocarbons, specific management controls to prevent fugitive dust emissions during excavation, transport and subsequent bio piling will be provided within the Detailed RAP. ■ ERM notes that site specific management requirements and endpoints for bio-piling will be provided within the Detailed RAP. **Asbestos** ■ Based on the isolated nature of asbestos identified within AEC-3, ERM recommends a remedial approach including selective excavation and surface asbestos impact be adopted. ■ Specific validation criteria /requirements for demonstrating the effectiveness of the remedial approach will be documented within the detailed RAP. **LNAPL** ■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-3. As such, it is the opinion of ERM As such, it is the opinion of ERM that the management of LNAPL within AEC-3 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors. .
AEC – 4: Southern Buried Waste Area	■ Benzene ■ TRH C6-C10 ■ TRH C10-C34 ■ Carcinogenic PAHs ■ Metals (Hexavalent Chromium) ■ Asbestos ■ LNAPL	ERM notes that due to the heterogeneous nature of contamination within AEC-4 (including fibrous asbestos within the fill matrix), depth of observed impacts in relation to groundwater levels, and the location of impacts with respect to both off-site receptors, ERM considers that an approach including multiple remedial techniques could be undertaken. ■ ERM notes however, the specific and detailed remedial solution for AEC-4 should also account for a number of non-technical factors that are yet to be established. These include, but are not limited to, consideration and influence of any potential staging of prior remediation within the broader project area, specific land use scenarios, cut and fill requirements within the area and future management requiremnts associated with residual impacts. Based upon the current status of the site, and objective to enable future commercial / industrial land uses, ERM notes that the following range of potential options may be considered suitable for AEC-4 depending on the final selected land use: ■ Where future commercial/industrial land use remains the objective of remedial works, and related site development requirements (i.e. flood level planning etc.) require modification of existing / current site levels within the vicinity of AEC-4, approaches may be undertaken such as the excavation and onsite active bio-piling of material located above the saturated zone. Upon completion of bio-piling, due to the presence of asbestos, remediated soil materials could be managed onsite within a specifcally designated an onsite encapsulation area or disposed offsite to a suitably licensed receiving facility. Materials located within the saturated zone may be managed via a range of alternative approaches, including but not limited to, in-situ stabilisation, excavation and ex-situ stabilisation. ■ ERM notes that as the results of the ERM (2020) RSI / HHERA did not identify a risk to off-site receptors from materials within AEC-4, depending on future land-use / land-form planning and the nature of future land uses, materials within AEC-4 could be managed via a cap and contain strategy that limits exposure to current and future site users and provides ongoing management / monitoring of the area to ensure there is no change to the risk to offsite receptors. ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring

		requirements and potential trigger levels that would require consideration for alternative / active remedial approaches where a change in site conditions result in a risk to human health or ecological receptors.
AEC – 5: Platformer 3	■ LNAPL	■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-5. As such, it is the opinion of ERM that the management of LNAPL within AEC-5 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors. .
AEC – 6: Buried Waste – Ex Solvents Plant	■ LNAPL ■ Asbestos	**Asbestos** ■ Based on the isolated nature of asbestos identified within AEC-6, ERM recommends a remedial approach including selective excavation and surface asbestos impact be adopted. Specific validation criteria /requirements for demonstrating the effectiveness of the remedial approach will be documented within the detailed RAP. **LNAPL** ■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-6. As such, it is the opinion of ERM that the management of LNAPL within AEC-6 should be via ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 7: Pipe Track Areas	■ NA	■ Development and implementation of an Unexpected Finds Protocol to manage potential unexpected finds of contamination during excavation / demolition works.
AEC – 8: Tank farm J	■ LNAPL	■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-8. As such, it is the opinion of ERM that the management of LNAPL within AEC-8 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 9: Process West	■ Naphthalene ■ TRH C8-C12 (aliphatic and aromatic) ■ TRH C10 – C16 (aromatic) ■ LNAPL	**Volatile hydrocarbons** ■ Selective excavation of hydrocarbon impacted and placement within onsite managed active bio-piles. Following completion of bio-piling the material would either be re-used onsite or disposed offsite to a suitably licensed receiving facility ■ ERM notes that site specific management requirements and endpoints for bio-piling will be provided within the Detailed RAP. **LNAPL** ■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-9. As such, it is the opinion of ERM that remediation within AEC-9 should comprise ongoing Monitored Natural Attenuation. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 10: Process East	■ LNAPL	■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-10. As such, it is the opinion of ERM that remediation within AEC-10 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 11: Tank farms A1, A2, A3	■ LNAPL	■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-11. As such, it is the opinion of ERM that remediation within AEC-11 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 12: Tank farm C	■ TRH C6-C16 ■ TRH C8-C12 Aromatic ■ TRH C6-C12 (Aliphatic) ■ TRH C8-C16 Aromatic ■ TRH C6-C10 (unspecified)	**Volatile hydrocarbons** ■ Selective excavation of hydrocarbon impacted and placement within onsite managed active bio-piles. Following completion of bio-piling the material would either be re-used onsite or disposed offsite to a suitably licensed receiving facility ■ ERM notes that site specific management requirements and endpoints for bio-piling will be provided within the Detailed RAP. **LNAPL**

	■ Benzene ■ LNAPL	■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-12. As such, it is the opinion of ERM that remediation within AEC-12 should comprise ongoing Monitored Natural Attenuation. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.
AEC – 13: Substation Areas and Transformer Yards	■ Asbestos	Based on the isolated nature of asbestos identified within AEC-13, ERM recommends a remedial approach including Emu Picking / Selective Excavation of Surface asbestos impact be adopted. ■ Specific validation criteria /requirements for demonstrating the effectiveness of the remedial approach will be documented within the detailed RAP.
AEC – 14: Subsurface drainage network	■ NA	■ Development and implementation of an Unexpected Finds Protocol to manage finds of potential unexpected finds of contamination during excavation / demolition works.
AEC- 15: Other areas within the Site illustrated on Figure 2	■ LNAPL ■ Asbestos	**Asbestos** ■ Based on the isolated nature of asbestos identified within AEC-15, ERM recommends a remedial approach including Emu Picking / Selective Excavation of Surface asbestos impact be adopted. ■ Specific validation criteria /requirements for demonstrating the effectiveness of the remedial approach will be documented within the detailed RAP. **LNAPL** ■ The results of previous investigations and the ERM (2020) HHERA did not identify a risk to human health or ecological receptors from LNAPL within AEC-15. As such, it is the opinion of ERM that remediation within AEC-15 should comprise ongoing Monitored Natural Attenuation / Natural Source Zone Depletion. ■ ERM notes that the Detailed RAP and/or LTEMP will include details on monitoring requirements and potential trigger levels that would require consideration for alternative / active remedial approaches should MNA / NSZD be demonstrated to not be effective or a change in site conditions result in a risk to human health or ecological receptors.

Table 5.2: Summary of Selected Emission Controls and Management Measures

Activity	Nominated Emission Controls and Monitoring Measures	
	VOC/Odour	Particulate Matter
Excavation Area		
Excavation of soil to stockpile Open excavation Stockpile surface Loading / screening to truck	▪ Conducting periodic downwind boundary surveys (Total VOC and odour) during the handling of odorous materials. ▪ Use of PID with alarm to provide timely alerts as to elevated VOC emissions. Investigation of alarms prior to progression of works. ▪ Backfilling excavations with non-odorous material as soon as practicable. ▪ Application of an interim barrier (such as suppressant foam or light fill cover) to odorous excavation faces that are not able to be backfilled to local grade at the completion of excavation operations for the day. ▪ Covering stockpiled material that is required to remain in the excavation area overnight. ▪ Preventing excessive accumulation of odorous water in excavations through either pump-out or management of excavation depth.	▪ Maintaining a visual awareness of dust emissions. ▪ Wetting down dry materials prior to handling. ▪ Applying water sprays during handling of dusty material. ▪ Reducing or suspending dust generating works during high winds.
Biopile Treatment Area		
Unloading and Receipt / Construction / Turning (as required)	▪ Preference of potentially emissive operations within the southern extent of the biopile treatment area so as to maximise buffer distances between biopiling operations and the Site boundary. ▪ Monitoring near field Total VOC and odour levels. ▪ Understanding the odour potential of material prior to delivery at biopile treatment area (via communication with excavation team). ▪ Covering received material that is not able to be directly used in biopile construction. ▪ Maintaining work area in a clean condition with minimisation of odorous materials in trafficked areas.	▪ Preference of potentially emissive operations within the southern extent of the biopile treatment area such as to maximise buffer distances between biopiling operations and the Site boundary. ▪ Maintaining a visual awareness of dust emissions. ▪ Wetting down dry materials prior to handling. ▪ Applying water sprays during handling of dusty material. ▪ Reducing or suspending work during high winds. ▪ Maintaining work area in a clean condition with minimisation of loose materials in trafficked areas.
Dismantling / Loading	N/A	
Aeration System	▪ Using Granular Activated Carbon (GAC) adsorption to capture VOCs/odour from vacuum aeration system. System should comprise a minimum of two adsorption vessels in series (i.e. a 'lead and 'lag' vessel). ▪ Routine PID monitoring of Total VOC concentrations in the aeration system exhaust, and between lead and lag vessels.	N/A

	■ Undertaking change-out of GAC media upon breakthrough of the lead vessel, with switching of lag vessel into the lead position.	
Surplus Material Storage Area		
Unloading	N/A	■ Application of water sprays to stockpiles of potentially dusty materials where not covered. ■ Covering stockpiles during storage periods of greater than one day. ■ Maintaining a visual awareness of dust emissions. ■ Wetting down dry materials prior to handling. ■ Applying water sprays during handling of dusty material. ■ Maintaining work area in a clean condition with minimisation of loose materials in trafficked areas. ■ Reducing or suspending work during high winds.
Storage		
Loading		
Misc. Areas		
Material transport between areas	■ Covering soil loads where there is potential for odour generation.	■ Use of a wheel wash to minimise track-out. ■ Maintaining sealed roads in a clean condition. ■ Applying speed limits of 10 km/h on unsealed surfaces, and 20 km/h on sealed surfaces. ■ Watering unsealed roads that are in frequent use. ■ Covering soil loads where there is potential for dust generation.

Notes: 'N/A' – Not applicable.

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