Independent Air Quality Advice

Annie Street - Wickham Woolstores

1 December 2020

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Independent Air Quality Advice

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Acronyms and Abbreviations

Name	Description
ABS	Australian Bureau of Statistics
AWS	Automatic Weather Station
AQMS	Air Quality Monitoring Station
CN	City of Newcastle
COC	Chain of custody
DA	Development Application
EPAV	Environmental Protection Authority Victoria
EPL	Environmental Protection Licence
HQ	Hazard Quotient
HRA	Health Risk Assessment
IRAE	Industrial Residual Air Emissions
LOR	Limit of reporting
NATA	National Association of Testing Authorities
NPI	National Pollutant Inventory
OEHHA	(Californian) Office of Environmental Health Hazard Assessment
PULP	Premium Unleaded Petrol
ppbv	Part per billion (by volume)
$\mu g/m^3$	Microgram per cubic metre
URF	Unit risk factor
ULP	Unleaded Petrol
VOC	Volatile organic compound
VRU	Vapour recovery unit

EXECUTIVE SUMMARY

ERM Australia Pacific Pty Ltd (ERM) was commissioned by Arriscar Pty Ltd (Arriscar), on behalf of City of Newcastle (CN), to undertake an independent odour and air quality investigation to understand the potential impacts of the Caltex Site on the health and amenity of occupants of the Development.

This investigation involved completion of the following tasks:

- A review of siting cases for fuel storage and tanker loading operations in urban settings, with the objective of contextualising the potential sensitivity of the Development to the adjacent Caltex operations.
- Conduct a brief ambient monitoring campaign to gain information on ground level concentrations of Volatile Organic Compounds (VOCs) adjacent to the Caltex Site.
- Ambient odour survey to characterise the odour environment adjacent to the Caltex Site (during both commissioning and collection of evacuated canister samples).
- Atmospheric dispersion modelling that addresses fugitive emission sources across the Caltex Site, inclusive of Storage tank and Vapour Recovery Unit (VRU) emission sources.
- Human Health Risk Screening Assessment / Discussion, incorporating the results of the short-term monitoring and the dispersion modelling, as well as review of public health standards.

Based on these investigations, the following findings were made:

Review of Bulk Fuel Storage Siting Cases

A review of bulk fuel storage siting cases within NSW indicated that the (existing) Newcastle terminal features one of the lowest separation distances between site infrastructure and residential dwellings, being similar to that at the Caltex Kurnell terminal, with only the Viva Energy Gore Bay import terminal identified as having residential receptors located at a closer proximity.

With establishment of the Development, the separation between site infrastructure and residences would decrease to a separation distance similar to that at Gore Bay, albeit with a higher density of residential receptors. Whilst the emission profiles of Gore Bay and Kurnell differ from the Caltex Site (i.e. they include shipping, and possibly of a more diverse range of fuels), it is known that these two facilities have also resulted in complaints related to odour performance, and have required detailed air quality management strategies.

A review of Victorian siting cases identified that whilst the ExxonMobil Yarraville and Viva Energy Newport terminals are located within approximately 40 m of residences, for tanks of 2,000 tonnes capacity or more, EPA Victoria currently recommend separation distances of 100 m and 250 m for floating roof and fixed roof tanks (respectively), primarily for the management of potential odour and amenity impacts associated with none-routine operating conditions. These separation distances have been endorsed in planning decisions, including an example at ExxonMobil Yarraville, whereby a medium density residential development was rejected despite being located approximately 150 m further from the facility than the closest existing residences

In contrast, Tank T-352 within south western corner of the Caltex Site is located approximately 30 m from proposed residences within the Development, and comprises a fixed roof tank with a capacity of approximately 5,000 tonnes, and thus would fall significantly below the EPA Victoria separation distances of 100m and 250 m for both floating roof and fixed roof tank types.

Ambient VOC Monitoring Campaign

An ambient VOC monitoring campaign was completed over 4 sampling events, and identified that VOC concentrations in the immediate vicinity of the Development were generally low, and whilst consistent with fuel handling and storage operations in terms of substances present, were also within the range of concentrations historically measured in urban airsheds. A review of meteorology indicated that sampling was conducted downwind of emission sources within the Caltex Site, and thus are considered broadly representative of potential ground level concentrations adjacent to the Caltex Site.

Ambient Odour Surveys

A total of five ambient odour surveys were conducted, across which a range of localised odour sources were observed in the vicinity of the development, inclusive of hydrocarbon odours observed adjacent to the Caltex Site. These odours were not strong or offensive to the observer, but existed at concentrations that were able to be intermittently detected and characterised as consistent with fuels handled at the Caltex facility.

Relevant to the potential for odours to be present at the development, it is noted that:

- Observations were not taken at the most sensitive locations within the Development Site (in terms of proximity and extent to which emission sources encompass the location).
- Observations were not taken under worst case meteorological conditions for odour nuisance, which typically include morning and evenings, especially during light winds and stable atmospheric conditions.

In this context, odours associated with the Caltex Site are expected to be detectable at locations within and around the development. There is also the potential that these odours will be strong on occasions where meteorological conditions are calm and stable, and / or non-routine emissions are occurring from the development.

Atmospheric Dispersion Modelling and Human Health Risk Screening

An updated atmospheric dispersion modelling analysis was undertaken based on the emission sources detailed in AECOM (2018), which also formed the basis for TAS (2020).

- The emission estimates detailed in AECOM (2018) were augmented to include benzene emissions from automotive diesel and jet fuel storage.
- The VRU emission rates were corrected from an n-propane equivalent basis to reflect mass emissions of each respective substance, thus allowing comparison against respective criteria. For most substances, this typically resulted in a doubling of VRU emission rates against those presented in AECOM (2018).
- Annual average predictions were produced as appropriate to the assessment of chronic health risks (including carcinogenic risks).

The results of the modelling were then assessed against a range of public health-derived criteria.

The results of the this analysis show that with the exception of benzene the acute and chronic health risks from exposure to the pollutants modelled are within acceptable risk levels.

For benzene the carcinogenic risk levels exceed acceptable risk levels for both the residential and commercial scenarios. The acceptable risk levels set by NSW Health and enHealth are also exceeded for acute exposures to benzene from the terminal operations. This means that the emissions from the terminal may impact on the health of the residents and workers within the proposed development. There may also be acute effects experienced by users of the open space area from exposure to 1-hour peak concentrations.

Summary

In summary, the key findings indicate that the under routine operation of the Caltex Site, VOC concentrations at commercial and residential receptors within the Development would exceed public health-based risk criteria for Benzene exposure.

It is also identified that the risk of adverse odour impacts would be significantly increased with the change in land use, as associated with the following factors:

- Increase in density of sensitive receptors;
- Differences in expectations of amenity for residential and industrially zoned land.
- Sensitivity to potential health impacts that may be associated with the presence of odour.

Noting that the most recent air quality assessment (TAS, 2020) was based on average emission rates and did not consider non-routine operating scenarios, the odour-related conclusions of TAS (2020) are not endorsed. In this context, it is anticipated that approval of the development would potentially have significant implications for the ongoing operation of the Caltex Site, potentially including the following:

- Requirements to implement additional air emission controls, the feasibility and viability is not clear.
- Requirements to demonstrate acceptable air quality outcomes in cases where the presence of odour leads to concerns about potential health impacts.
- Restriction or curtailment of operations.
- Programming requirements and stakeholder management for non-routine works such as plant maintenance and upgrades.

1. INTRODUCTION

City of Newcastle (CN) are assessing an application (DA2017/01338) for the adaptive reuse of three heritage listed Wood Store buildings, and the erection of two buildings for mixed-use residential and commercial uses (the Development) located at Annie St Wickham (the Development Site), within the City of Newcastle, NSW.

The Development is classified as regionally significant development and the Development Application (DA) is required to be determined by the Hunter Central Coast Regional Planning Panel. The Development is located adjacent to an existing Caltex fuel storage and distribution centre (the Caltex Site), in an area currently zoned for light industrial use, and hence would require DA approval inclusive of the modification of land use.

ERM Australia Pacific Pty Ltd (ERM) has been commissioned by Arriscar Pty Ltd (Arriscar), on behalf of CN, to undertake an independent odour and air quality investigation to understand the potential air quality impacts of the Caltex Site on the health and amenity of occupants of the Development.

The objective of this investigation is to provide information for use in the CN's assessment of the Development, with specific regard to the acceptability of potential impacts of the Caltex operations on the Development.

It is also noted that the outcomes of this investigation will be considered in conjunction with a number of other environmental and planning issues, including Industrial Hazard and Risk, for which an equivalent investigation is being performed by Arriscar.

1.1 Scope of Work

To meet the project objectives ERM has been commissioned to undertake the following scope of works:

- Complete a review of siting cases for fuel storage and tanker loading operations in urban settings, with the objective of contextualising the potential sensitivity of the Development to the adjacent Caltex operations.
- Conduct a brief ambient monitoring campaign to gain information on ground level concentrations of Volatile Organic Compounds (VOCs) adjacent to the Caltex Site.
- Conduct a brief ambient odour survey to characterise the odour environment adjacent to the Caltex Site (during both commissioning and collection of evacuated canister samples).
- Undertake a screening level dispersion modelling study that addresses fugitive emission sources across the Caltex Site, inclusive of Storage tank and Vapour Recovery Unit (VRU) emission sources.
- Prepare a Human Health Risk Screening Assessment / Discussion, incorporating the results of the short-term monitoring and the dispersion modelling, as well as review of public health standards.

Detail of the methodology and findings associated with this scope of work are provided in the following sections of this report.

2. ENVIRONMENTAL SETTING

This Section provides a brief overview of the Development and existing operations on the Caltex Site.

2.1 The Development

The Development involves the adaptive reuse of the Wickham Woolstores for a combination of residential, community and commercial purposes. Figure 2.1 shows the Development Layout, and proximity to the Caltex Site.

Image source: Adapted from TZG (2020)

Figure 2.1: Development layout showing proposed Level 1 building uses and proximity to the Caltex Site

2.2 Caltex Site

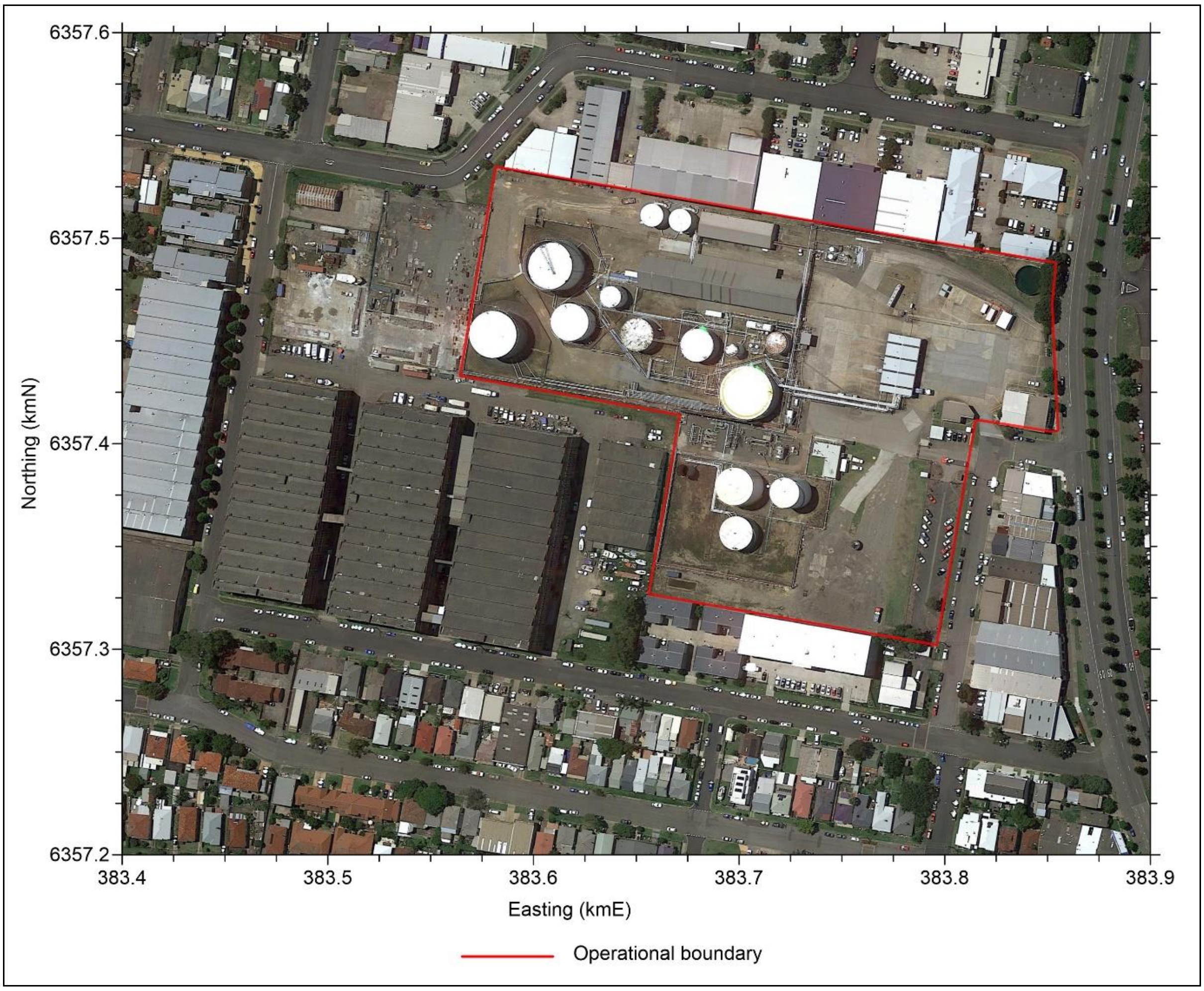
AECOM (2018) contains the following description of operations at the Caltex Site:

> *"The Site imports, stores and distributes bulk fuels from the pipeline link with Sydney fuel terminals. Positive communication from operations at each end of the pipeline is required to create a failsafe method of fuel transfer. The product is then directed from the inlet manifolds to nominated storage tanks. Operators on Site then operate a series of valves to transfer the required fuels to the Road Tanker Loading Gantry.*
> *The Site operates continuously, that is, 24 hours per day seven days per week. Road tankers currently enter and exit the site from Mary Street. Road tankers load product at one of four bays within the Loading Gantry. Tanker headspace emissions are captured during loading, and*

processed through a vapour recovery unit (VRU), with operational emissions from the VRU below the regulatory limit specified in the Site's EPL.

Road tanker operations are intermittent with peak operations generally occurring between 4am and 6am, and midday. Currently when all four bays are occupied the Site can accommodate an additional number of queued Road Tankers onsite."

Figure 2.2 shows the location of the Caltex Site with the existing 3 Woolstores buildings visible in the south-west corner of the image.



(MGA 94, Zone 56, base image sourced from Google Earth Pro)

Figure 2.2: Aerial Image showing operational boundary of Caltex Site

3. REVIEW OF SITING CASES

A review of siting for bulk fuel storage and tanker loading facilities has been undertaken with the objective of contextualising the potential sensitivity of the Development to the Caltex operations. This review has primarily focused on cases within NSW, and has been undertaken used a combination of publically available sources including:

- Aerial imagery.
- The NSW EPA Environment Protection Licence (EPL) search register[1].
- The National Pollutant Inventory (NPI) emission database[2].
- Publically available references including Works Approvals and relevant planning documents.

Each case has been reviewed for proximity to the nearest residential receptor and residence type. The number of storage tanks and fuel tanker loading stands have also been provided as general indicators of the scale of operations. These values are provided as approximate in the absence of detailed operational information for individual facilities. Lastly, National Pollutant Inventory (NPI) VOC emission data has been referenced for 2018/19 reporting year in order to provide an indication of the scale of air emissions.

3.1 NSW Siting Cases

Table 3.1 presents a summary of identified bulk fuel storage operations within NSW (sorted by proximity to residences).

Table 3.1: Summary of bulk fuel storage siting cases within NSW

Facility	Number of Storage Tanks (approximate)	Tanker Loading Stands (approximate)	Proximity of Infrastructure to Nearest Residences (m)	Closest Residence Type	2018/2019 NPI Reported VOC Emissions (t/annum)
Viva Energy Gore Bay Terminal	20	-	20	Freestanding houses[1]	0.85[2]
Caltex Newcastle Terminal (Proposed)	***10***	***4***	***30***	***Apartments***	***36***
Caltex Newcastle Terminal (Existing)	10	4	85	Freestanding houses[3]	36
Caltex Kurnell Terminal	30	-	100[4]	Freestanding houses	230
BP Newcastle Terminal	10	3	320	Freestanding houses	38
Sydney Metropolitan Pipeline Limited Silverwater Terminal	6	7	480	Freestanding houses	16
Caltex Banksmeadow Terminal	20	6	560	Freestanding houses	100
Viva Parramatta/Clyde Terminal	30+	7	600	Freestanding houses	123
Stolthaven Mayfield Fuel Terminal	10	2	850	Freestanding houses	19
Terminals Port Botany	30+	6	1400	Freestanding houses	16
Vopak Port Botany Terminal	25	6	1600	Freestanding houses	100

Notes: [1] Closest residential apartments are located approximately 50 m from site infrastructure.
[2] It is not clear as to whether this quantity includes emissions from shipping.
[3] Existing warehouse apartments on Milford St are located at approximately 125 m from site infrastructure.
[4] Aerial imagery indicates a new residential development was established at 40 m from infrastructure circa. 2008, however adjacent infrastructure has since been removed.

[1] (EPA, 2020) https://apps.epa.nsw.gov.au/prpoeoapp/ (accessed November 2020).
[2] (NPI, 2020) http://www.npi.gov.au/npi-data (accessed November 2020).

Figure 3.1 and Figure 3.2 show the proximity of fuel storage infrastructure to residences at Gore Bay and Kurnell (respectively).

(Image sourced from Google Earth Pro)

Figure 3.1: Aerial imagery showing the proximity of fuel storage infrastructure to residences at Gore Bay.

(Image sourced from Google Earth Pro)

Figure 3.2: Aerial imagery showing the proximity of fuel storage infrastructure to residences at Kurnell

As shown in Table 3.1, of the identified facilities, the (existing) Newcastle terminal features one of the lowest separation distances between site infrastructure and residential dwellings, with the Viva Gore Bay import terminal identified as the single facility with residential receptors located at a closer proximity.

With establishment of the Development, this would decrease to a separation distance similar to that at Gore Bay, albeit with a higher density of residential receptors. The quantity of VOC emissions from Gore Bay is noted to be significantly lower than those for the Caltex Site and other distribution facilities, and is considered indicative of a higher level of emission control at the Gore Bay site, employs a Vapour Emission Control System (VECS) for the control of odour and hydrocarbon emissions.

Whilst the emission profiles of Gore Bay and Kurnell differ from the Caltex Site (i.e. they include shipping, and handling of a more diverse range of fuels), it is known that these two facilities have experienced odour complaints. In the cased of Caltex Kurnell, a review of annual return data indicates that odour complaints have continued since the cessation of refining operations[3], however it is not clear whether these complaints are related to operational emissions from fuel storage, or other activities occurring at the site.

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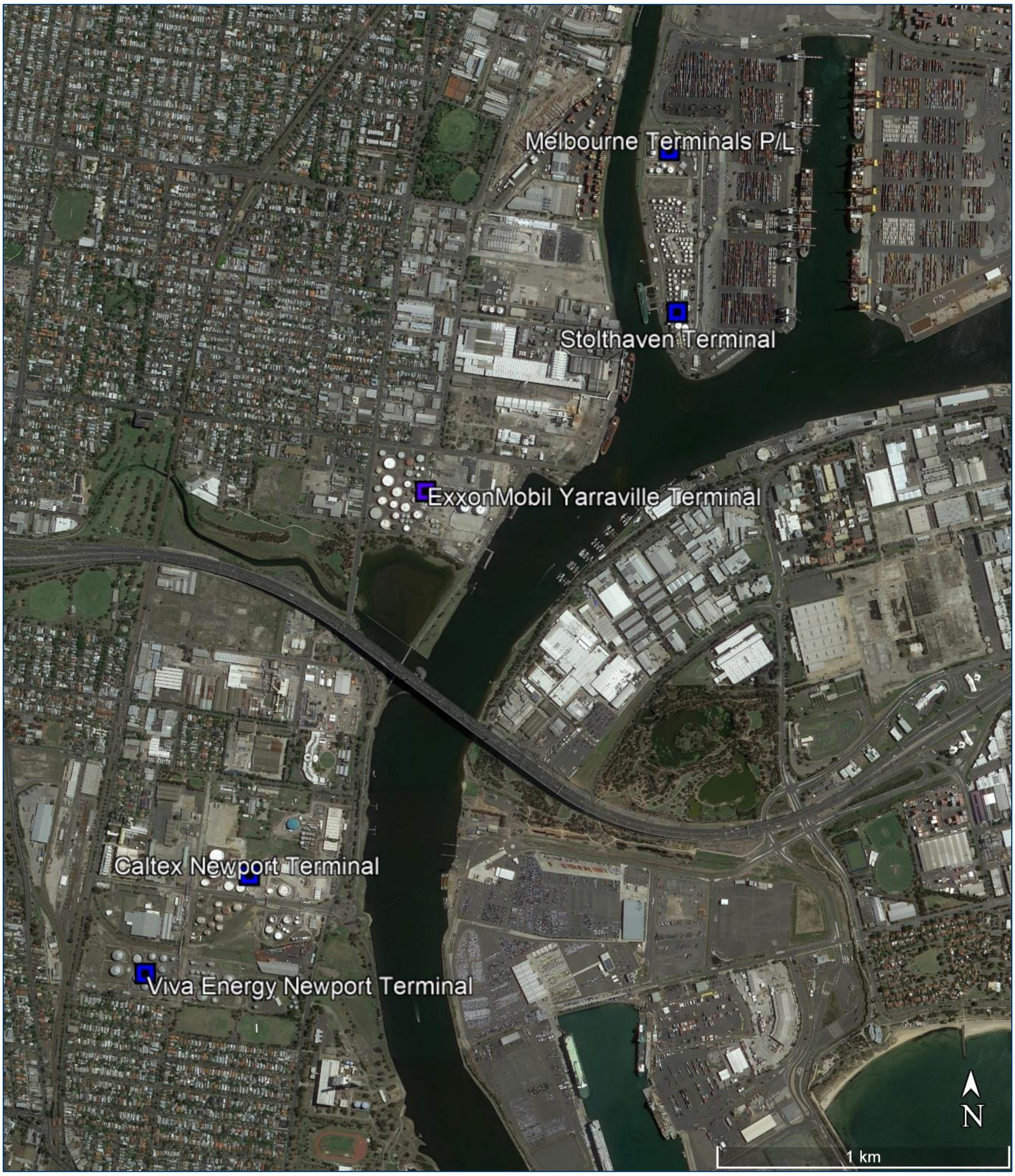
[3](EPA, 2020); (Caltex, 2020a) https://www.caltex.com.au/our-company/environment/kurnell-site-conversion (accessed November 2020).

3.2 Victorian Siting Cases

A brief summary of Victorian siting cases has been presented, noting that within metropolitan Melbourne, examples exist where fuel storage facilities are located in close proximity to residential areas. Figure 3.3 shows the proximity of identified bulk fuel storage terminals within metropolitan Melbourne.



(Image sourced from Google Earth Pro)

Figure 3.3: Aerial image showing location of bulk fuel storage terminals within metropolitan Melbourne

Table 3.2: Summary of bulk fuel storage siting cases within Metropolitan Melbourne

Facility	Number of Storage Tanks (approximate)	Tanker Loading Stands (approximate)	Proximity of Infrastructure to Residential Receptors (m)	Closest Residence Type	Annual NPI Reported VOC Emissions (t/annum)
Viva Energy Newport Terminal	25	8	40	Freestanding houses	98
ExxonMobil Yarraville Terminal	23	8	40	Freestanding houses	62
Melbourne Terminals P/L Coode Island*	20	5	700	Various	0.9
Caltex Newport Terminal	30	7	250	Freestanding houses	27
Stolthaven Coode Island*	50+	8	700	Various	N/A

Notes: *Facilities handle fuel and chemicals – limited operational information available. N/A – Not Available.

As shown in Table 3.2, fuels storage infrastructure at both the ExxonMobil Yarraville and Viva Energy Newport Terminals are located within approximately 40 m of residences. Detail of recent impacts of complaints were not identified, however it is noted that Viva Energy Newport Terminal conducts an Annual Site Odour Review which invites public participation[4], and historical odour events have been noted in relation to the specific events at the Mobil Yarraville terminal. Figure 3.4 shows the location of residences (blue shading) in proximity to the Caltex and Viva Energy Newport Terminals.

(Image sourced from Google Earth Pro)

Figure 3.4: Aerial image showing residences in proximity to Newport Terminals (blue shading)

[4] (VIVA, 2020)
https://www.vivaenergy.com.au/ArticleDocuments/293/0_136904_08Nov2019080811_Newport%20Newsletter%20Nov%202019.pdf.aspx

It is also noted that EPA Victoria recommends separation from sensitive land uses beyond those present at Yarraville and Newport. For the purpose of land use planning, the guideline *Recommended Separation Distances for Industrial Residual Air Emissions* (EPAV, 2013), for bulk petroleum storage facilities recommends the separation distances outlined in Table 3.3.

Table 3.3: EPA Victoria recommended separation distances for industrial residual air emissions

Industry Type	Industry Activity / Definition	Scale and Industry Description	Recommended separation distance (metres)
Storage and Transport			
Storage of petroleum and hydrocarbon products	Storage of petroleum products or crude oil in tanks	Tanks exceeding 2000 tonnes	
		Floating Roof	100
		Fixed Roof	250

Whilst not applicable within NSW, the basis for the nominated separation distance is considered relevant to management of potential impacts associated with industrial developments and/or development of sensitive receptors near to existing industry.

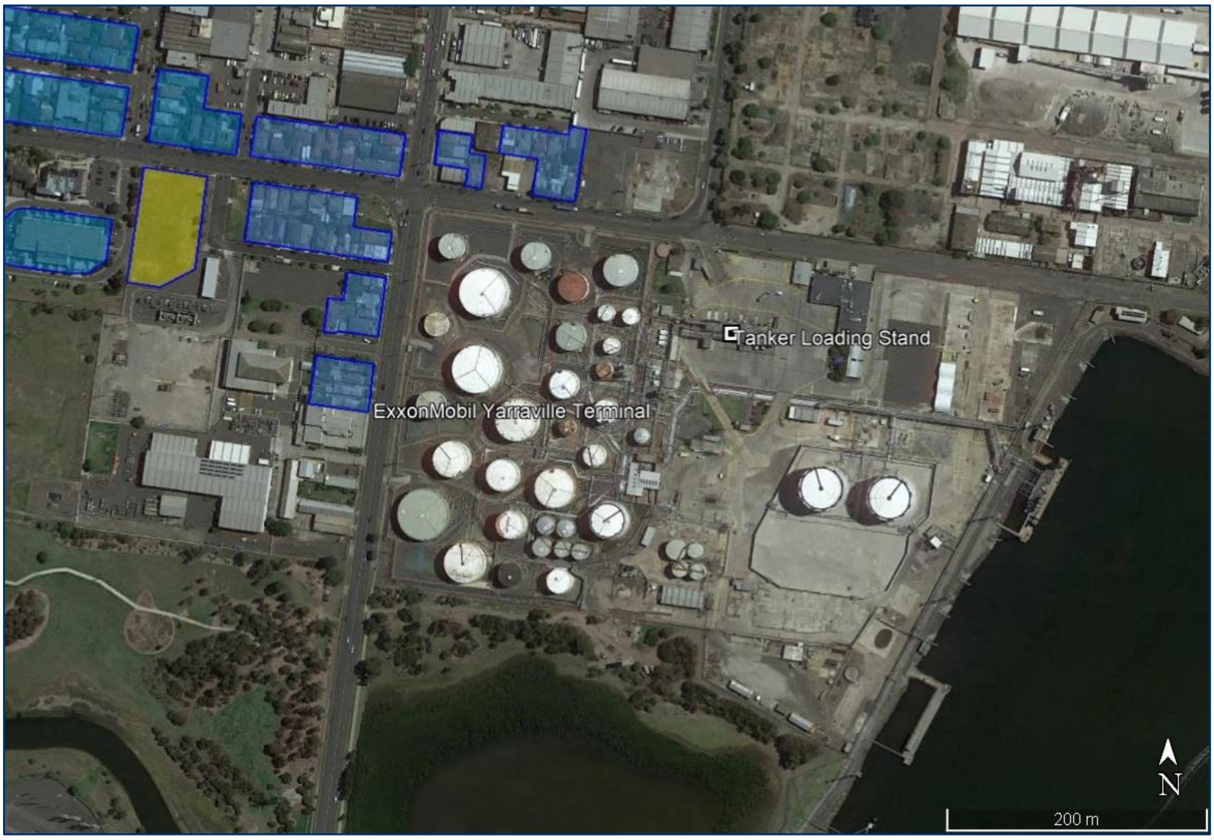
EPA Victoria provide the following context on the intent and basis for the recommended separation distances:

> *"It needs to be recognised that where there are industrial air emissions from premises, even with good pollution control technology and practice, there may still be unintended emissions which must be anticipated and allowed for. While it is not always guaranteed to achieve this goal 100 per cent of the time. Equipment failure, accidents and abnormal weather conditions are among the causes that can lead to emissions affecting sensitive land uses beyond the boundary of the source premises.*
>
> *Unlike routine emissions, unintended emissions -- industrial residual air emissions (IRAEs) -- are often intermittent or episodic and may originate at or near ground level. Separation distances seek to avoid the consequence of IRAEs. An adequate separation distance should allow IRAEs to dissipate without adverse impacts on sensitive land uses.*
>
> *However, the recommended separation distances provided in this guideline are not an alternative to source control. In preparing this guideline, EPA is not condoning uncontrolled off-site air emissions in contravention of SEPP (AQM) requirements. Rather, this guideline acknowledges that SEPP (AQM) objectives might not always be met, and the beneficial uses specified in the SEPP (AQM) might not always be protected in the vicinity of a premises.*
>
> *In addition, if a premises has been located on a site with an inadequate separation distance, subsequent remedial action to alleviate off-site effects, either within or beyond the separation distance, will be required if IRAEs occur. However it should be realised that such action may require costly, high technology solutions, which may not be economically feasible or fully effective, thus jeopardising the economic viability of the industry and potentially not alleviating off-site effects. This is a lose/lose situation which needs to be avoided."*

Of relevance to this review, it is also noted that an earlier form of EPA (2013) formed the basis on which the medium density 'Sandbar' residential development (comprising 66 dwellings) was refused[5].

Figure 3.5 shows residences in proximity to Yarraville Terminal (blue shading) and Sandbar proposal (yellow shading).

[5] VCAT (2010) http://www7.austlii.edu.au/cgi-bin/viewdoc/au/cases/vic/VCAT/2010/678.html (accessed November 2020).



(Image sourced from Google Earth Pro)

Figure 3.5: Aerial image showing residences in proximity to Yarraville Terminal (blue shading) and Sandbar proposal (yellow shading).

In their decision, the VCAT stated:

> *"We conclude that all of these considerations suggest that there should be a buffer between new or more intensive residential development and a Major Hazard Facility such as the Yarraville Terminal. On this basis we decide that no permit should be granted."*

This guidance was subsequently referenced in a planning decision for redevelopment of Port Phillip Woollen Mills site, noting that the separation distance of 100m from a floating roof tank was achieved[6].

In contrast, tanks within the Caltex Site are located at a closer proximity to sensitive uses. Tank T-352, which is located within the Caltex Newcastle Terminal is situated approximately 30 m from proposed residences within the Development, and comprises a fixed roof tank with a capacity of approximately 5,000 tonnes, and thus would fall significantly below the EPA Victoria separation distances of 100m and 250 m for both floating roof and fixed roof tank types.

[6] VCAT (2011) http://www7.austlii.edu.au/cgi-bin/viewdoc/au/cases/vic/PPV/2011/53.html (accessed November 2020).

4. AMBIENT VOC MONITORING

A brief ambient VOC monitoring campaign has been conducted to gain information on ground level concentrations of Volatile Organic Compounds (VOCs) adjacent to the Caltex Site, with the objective of identifying potential inconsistencies against modelling predictions as well as significant presence of substances not considered within existing assessments (AECOM, 2018); (TAS, 2020).

4.1 Sampling Methodology

The sampling method has involved the collection of 24-hour time-integrated samples into Silonite®-lined evacuated canisters, with canister preparation and post-sampling analysis undertaken by a third party laboratory that is NATA accredited for the TO-15 method (US EPA, 1999).

Prior to sample collection, each canister is cleaned and laboratory certified. This procedure ensures that the canisters are free of residual contamination prior to sample collection. Sample collection involved connecting a calibrated flow regulator to the canister inlet and opening the inlet valve such that a sample was drawn into the canister at a steady, continuous rate over the 24-hour sampling period. At the completion of sampling, the canister valve was closed, the remaining vacuum recorded, and the canister returned to the laboratory for analysis.

4.2 Laboratory Analysis

Samples have been analysed for a total of 82 VOCs, which include the substances assessed in AECOM (2018) and TAS (2020), as well as a range of other petroleum hydrocarbons of potential interest.

A 'limit of reporting' (LOR) of 0.5 parts per billion by volume (ppbv) has been attained for each compound analysed via TO-15. In the case of xylenes, the LOR applies to each individual isomer, equating to a total LOR of 1.5 ppbv.

4.3 Laboratory Quality Control Procedures

Laboratory quality control (QC) procedures were undertaken on each sample batch to ensure the accuracy of the laboratory analysis. These procedures included:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits – The quality control term Laboratory Duplicate refers to a randomly selected intra-laboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity.
- Method Blank (MB), Laboratory Control Spike (LCS) and Laboratory Duplicate Control Spike (DCS) Report; Recovery and Acceptance Limits – The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control terms Laboratory Control Sample (LCS) and Laboratory Duplicate Control Sample (DCS) refers to certified reference materials, or known interference free matrices spiked with target analytes. The purpose of these QC parameters are to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS and DCS.

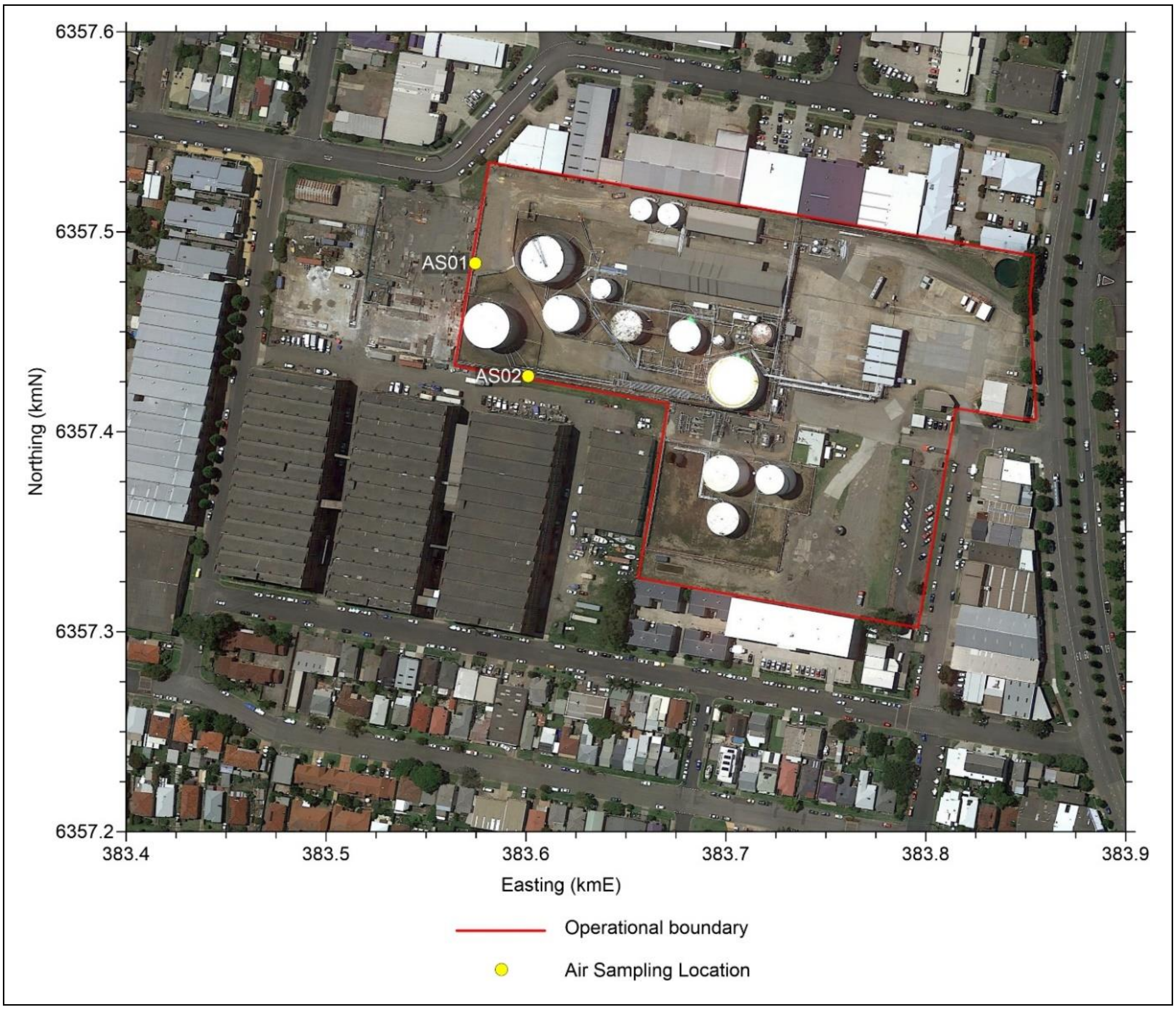
All samples have been assessed to be compliant with all QC standards. Copies of the laboratory for the QC summaries are provided in Appendix A. A copy of the Chain of Custody (COC) documentation is provided in Appendix B.

4.4 Sampling Program

Sampling has been conducted at two separate locations on the boundary of the Caltex Site, with four sampling events conducted over a two week period, thus comprising a total of 8 samples. Each canister has been fitted with a 24 hour flow regulator to capture average concentrations across each respective sampling period. The coordinates of each monitoring location are tabulated in Table 4.1 and illustrated in Figure 4.1.

Table 4.1: Summary of monitoring locations

Location ID	Location (MGA94, Zone 56H)		Locality
	Easting (kmE)	Northing (kmN)	
AS01	383.573	6357.484	Site boundary – north-west of Tank 352
AS02	383.600	6357.429	Site boundary – south-east of Tank 352



(MGA 94, Zone 56, base image sourced from Google Earth Pro)

Figure 4.1: Aerial image showing monitoring locations

The VOC monitoring has been undertaken at each location for the following periods:

- Round 1: 9th - 10th November 2020
- Round 2: 11th - 12th November 2020
- Round 3: 16th - 17th November 2020
- Round 4: 18th - 19th November 2020.

A summary of the exposure duration and canister pressures is shown in Table 4.2.

Table 4.2: Overview of sampling times and durations

Sampling Round	Location ID	Deployment	Collection	Duration (hours)	Canister Vacuum ("Hg)	
					Initial	Final
Round 1	AS01	9/11/2020 10:30	10/11/2020 8:30	22	-30	-2
	AS02	9/11/2020 10:40	10/11/2020 8:30	~22	-30	-6
Round 2	AS01	11/11/2020 9:40	12/11/2020 8:10	~23	-30	-8
	AS02	11/11/2020 9:40	12/11/2020 8:10	~23	-30	-4
Round 3	AS01	16/11/2020 11:15	17/11/2020 11:03	~24	-30	-6
	AS02	16/11/2020 11:18	17/11/2020 11:06	~24	-31	-7
Round 4	AS01	18/11/2020 10:27	19/11/2020 9:17	~23	-32	-3
	AS02	18/11/2020 10:29	19/11/2020 9:15	~23	-30	-5

4.5 Sampling Conditions

A summary of meteorological conditions sourced from the Bureau of Meteorology (BoM) Newcastle Nobbys Signal Station Automatic Weather Stations (AWS) (Number 061055), located to the east of the Site at approximately 4 kilometres with the co-ordinates and details shown in Table 4.3. Meteorological parameters recorded at the BoM AWS are shown in Table 4.4.

Table 4.3: Details of Newcastle Nobbys Signal Station AWS

Parameter	Value
AWS Number	061055
Name	Newcastle Nobby's Signal Station AWS
WMO Number	94774
Latitude	-32.9184
Longitude	151.7985

Table 4.4: BoM Nobby's Signal Station meteorology during the monitoring campaign

Date	Average Temperature °C	Maximum Temperature °C	Minimum Temperature °C	Average Relative Humidity %	Average Wind Speed km/h	Wind Direction	
						9am	3am
9/11/2020	17.5	20.9	14.1	59	17	Calm	ESE
10/11/2020	17.8	20.9	14.6	68	24	Calm	E
11/11/2020	19.25	22.4	16.1	77	24	Calm	E
12/11/2020	21.3	24.5	18.1	81	23	N	ENE
16/11/2020	23.8	29.1	18.5	79	21	N	ENE
17/11/2020	20.4	21.5	19.2	78	23	S	ESE
18/11/2020	20	21.7	18.3	68	21	ENE	E
19/11/2020	20.2	22	18.4	77	24	E	ENE

Wind roses showing the distribution of winds for the monitoring period are shown in Figure 4.2, as measured by the DPIE Carrington and Newcastle AQMS. Winds were observed to be ranging across the north-easterly quadrant across the majority of the monitoring period and across the south-easterly and south quadrant for the rest of the time. Guidance on the interpretation of wind roses is provided in Appendix E.

Figure 4.2: Wind roses showing the distribution of winds for each respective monitoring period

4.6 Monitoring Results

Table 4.5 provides a summary of reported concentrations for VOCs. Low-level positive detections were reported for a range of petroleum hydrocarbons of relevance to fuel handling operations.

Table 4.5: Summary of reported VOC concentrations

Substance	Reported Concentration (µg/m³)										
	LOR	Round 1		Round 2		Round 3		Round 4		Statistics	
		AS01	AS02	AS01	AS02	AS01	AS02	AS01	AS02	Avg.	Max
Benzene	1.6	<1.6	<1.6	<1.6	<1.6	<1.6	**1.9**	**1.9**	<1.6	1.1*	1.9
Cyclohexane	1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	
Ethylbenzene	2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	
Hexane	1.8	**3.5**	**2.1**	**2.8**	<1.8	**2.8**	**3.5**	**4.2**	<1.8	2.6*	4.2
Cumene	2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	
Toluene	1.9	**8.7**	**6.0**	**8.3**	**3.0**	**6.8**	**9.8**	**10.5**	**6.8**	7.5	10.5
Xylenes	6.5	<6.5	<6.5	<6.5	<6.5	<6.5	<6.5	<6.5	<6.5	<6.5	
Isooctane	2.3	**4.7**	**2.8**	**4.2**	<2.3	**3.3**	**5.1**	**6.1**	**4.2**	4.0	6.1

Notes: LOR: Limit of Reporting. "<": Less than LOR.
Concentrations above limit of reporting shown in **bold text**.
*Average generated assuming values below the LOR are equal to half of the LOR.

In summary, these results indicate:

- The detected VOCs are generally aligned with those considered in the air quality impact assessments (AECOM, 2018); (TAS, 2020).
- The measured VOC concentrations are low, and whilst consistent with fuel handling and storage operations in terms of speciation, are also within the ranges historically measured in urban airsheds.
- Off-target detections (i.e. substances not specifically associated with fuel handling operations) were not of significance (see Section 7), and limited to the following substances:
  - Acetone: detected in 8 samples - commonly detected at low levels in ambient air. Also an industrial solvent.
  - Isopropyl alcohol: detected in 7 samples - commonly detected at low levels in ambient air. Also an industrial solvent.
  - 2-Butanone (MEK): detected in 1 sample: an industrial solvent.
  - 1,4 Dioxane – detected in 1 sample: an industrial solvent.
  - Chloromethane (detected at general ambient background concentrations).

5. AMBIENT ODOUR SURVEYS

Ambient odour surveys were conducted in conjunction with the ambient VOC monitoring campaign in order to provide an opportunity to understand the potential for hydrocarbon odours to be present in the vicinity of the Development.

5.1 Overview

A total of 5 ambient odour surveys were conducted. This involved the collection of odour observations in the vicinity of the Development between the 9th and 19th of November.

Noting limitations in accessing the Development Site, the survey was conducted on a publically accessible route spanning Annie Street, Milford Street and the Avenue as shown in Image sourced from Google Earth

Figure 5.1. For reference purposes, the odour survey route including 9 discrete observation locations OL1 – OL9.

Image sourced from Google Earth

Figure 5.1: Aerial image showing odour survey route including observation locations OL1 – OL9.

Table 5.1 presents a summary of meteorological conditions during the odour surveys. As shown in these data, an easterly component was present in all winds during the odour surveys, thus allowing surveillance of odours downwind of the Caltex Site, and in the vicinity of the Development.

Breezes ranged from light to moderate, and temperatures ranged from approximately 20°C – 30 °C.

Table 5.1: Summary of meteorological conditions during odour surveys

Survey Event	Date	Temperature	Wind Speed*	Wind Direction		Sigma Theta
		°C	m/s	°N	-	°
OS1	9/11/2020	19.4 / 19.4	3.2 / 3.2	118 / 133	ESE / SE	24 / 25
OS2	16/11/2020	29.7 / 29.5	2.6 / 2.4	24 / 21	NNE / NNE	38 / 29
OS3	17/11/2020	21.6 / 21.5	4.3 / 4.8	144 / 148	SE / SSE	19 / 15
OS4	18/11/2020	21.3 / 21.3	4 / 4.2	104 / 111	ESE / ESE	19 / 18
OS5	19/11/2020	21.4 / 21.2	2.5 / 2.3	76 / 63	ENE / ENE	22 / 24

Notes: Data values for DPIE Carrington and Newcastle AQMS shown in the format “Carrington / Newcastle”.
Wind direction provided as “blowing from”.
*Wind speed at a height of 10 m above ground level.

Table 5.2 provides a summary of odour observations across the 5 monitoring events. It is noted that a full odour survey route was not undertaken on the 17/11/2020 as the Caltex Site was shutdown due to storm damage on the previous night.

Table 5.2: Summary of odour observations

Observation Location	OS1	OS2	OS3	OS4	OS5
	9/11/2020 11:45 – 12:15 AEDT	16/11/2020 11:25 – 11:50 AEDT	17/11/2020 11:30 – 12:00 AEDT	18/11/2020 10:40 – 11:10 AEDT	19/11/2020 8:30 – 8:55 AEDT
	Site operating	Site operating	Site shutdown after storm.	Site operating – continuous tanker loading.	Site operating
OL1	Slight vegetation.	Slight clover / vegetation. Plastic newspaper wrapping possibly / musty from Woolstore. Possible slight VOC odour – unable to characterise (return trip)	N/A	No odour present.	Slight vegetation odour.
OL2	Slight building perfume / possibly cleaning product residue.	No odour detected		Slight musty odour from sub-floor vents.	Weak musty smell, old books/toast.
OL3	No odour detected.	Slight musty/earthy, old books from sub-floor vents.		No odours present	No odour detected.
OL4	No odour detected.	Vegetation – oleander bushes		Vegetation – oleander bushes	Strong vegetation odour – Oleander bushes. Laundry detergent. Cigarette smoke.
OL5	Slight musty/earthy, old books from sub-floor vents. Cigarette smoke from street.	Slight musty/earthy, old books odour from sub-floor vents.		Slight musty/earthy, old books from sub-floor vents.	Slight coffee odour from café. Possible slight hydrocarbon odour from vehicle on Milford St. Slight musty/earthy, old books from sub-floor vents.
OL6	Slight creosote/tar/asphalt from pavement repair. V. slight intermittent petroleum odour.	No odour detected.		Slight creosote/Tar/Asphalt from pavement repair. Paper/office odour from shredding operation.	Possible intermittent/slight hydrocarbon odour.
OL7	Slight creosote/Tar/Asphalt from pavement mounding.	Slight creosote/tar/asphalt from tar mound on pavement.		Slight creosote/tar/asphalt from tar mound on pavement.	Possible intermittent/slight hydrocarbon odour.
OL8	LPG forklift exhaust from storage yard / timber / grass / vegetation.	No odour detected.		Slight hydrocarbon / molten plastic smell.	Slight musty smell / wood.
OL9	Intermittent slight gasoline / light hydrocarbon odour – approximately 2 minutes of 10 minute observation period.	Slight vegetation odour.	Slight / faint gasoline/ hydrocarbon odour – intermittent – intermittent detection once every 1-2 minutes.	Very intermittent / very weak odour – unable to characterise – 3 x 5 second occasions in ~ 15 minutes.	No odour detected.

5.2 Summary of Observations

Across the 5 odour surveys, a range of localised odour sources were observed in the vicinity of the development, inclusive of hydrocarbon odours were observed at OL9 on the 9/11 and 17/11 as consistent with hydrocarbon fuels handled within the Caltex Site. These odours were not strong or offensive to the observer, but existed at a concentrations that were able to be intermittently detected and characterised as consistent with gasoline / light hydrocarbon VOCs possessing a sweet pleasant to neutral character.

Relevant to the potential for odours to be present at the development, it is noted that:

- Observations were not taken at the most sensitive locations within the Development Site (in terms of proximity and extent to which emission sources encompass the location).
- Observations were not taken under worst case meteorological conditions for odour nuisance, which typically include morning and evenings, especially during light winds and stable atmospheric conditions.

In this context, it is expected that odours associated with the Caltex Site are detectable at locations within and around the development. There is also the potential that these odours will be strong on occasions where meteorological conditions are calm and stable, and / or non-routine emissions are occurring from the Caltex Site.

6. ATMOSPHERIC DISPERSION MODELLING

Atmospheric dispersion modelling exercise has been undertaken in order to inform the assessment of potential health risks to occupants of the Development, as associated with emissions from the Caltex Site.

This modelling has augmented data from AECOM (2018) as per the following:

- The emission estimates detailed in AECOM (2018) have been augmented to include benzene emissions from automotive diesel and jet fuel storage. Whilst the benzene contents of these fuels are low, benzene, due to its volatility, forms a disproportionate fraction of VOC emissions due from these fuels, and can in some cases contribute significantly to overall site emissions from fuel storage. Mobil (2014) has been referenced to provide benzene mass emission fractions of 1.5% and 1.9% of Total VOCs, for diesel and jet fuel (respectively).
- VRU emissions have been based on a propane-weighted residual hydrocarbon emission rate of 5.94 mg/L as applied within AECOM (2018). Whilst TAS (2020) assumed continuous operation at a licence limit of 10 mg/L (as appropriate to a licencing study), this assumption is not considered reflective of typical operational emissions, as is the basis for fugitive emissions from other sources on the Caltex Site. In addition, test data provided in recent annual returns (2018 – 2020) shows a range of between 1.3 – 3.4 mg/L[7].
- The VRU emission rates have been corrected from an n-propane equivalent basis to reflect mass emissions of each respective substance, thus allowing comparison against respective criteria. For most substances, this typically results in a doubling of VRU emission rates against those presented in AECOM (2018), and presumably similar emission rates to those applied in TAS (2020) due to the cancellation effects of modelling (lower) propane-weighted emissions at the (higher) licence limit.
- Annual average predictions have been produced as appropriate to the consideration of chronic health risks.

6.1 Emission Scenarios

Dispersion modelling has been conducted for two separate emission scenarios as per the following:

6.1.1 Average Operations Scenario

Hourly tank emissions rates within AECOM (2018) are directly derived from monthly average emission rates and in this respect, reflect average emissions rate for a given source, and are considered broadly representative of net emissions across the Site at a given time.

The modelling performed for this investigation has been based on Scenario 1 from AECOM (2018), which incorporates 2017 operational data for tank emissions and a VRU operational rate that reflects continuous filling operations with the current infrastructure. Given that the site is often filling tankers on a continuous basis, this assumption is considered appropriate to prediction of peak short term impacts, and slightly conservative for the prediction of annual average impacts.

Table 6.1 and Table 6.2 provide a summary of modelled VRU and storage tank emission rates (respectively).

[7] Newcastle Terminal (Monitoring Point 1): https://www.ampol.com.au/about-ampol/future-vision/environment/environmental-monitoring-data-newcastle-terminal (accessed November 2020).

Table 6.1: Summary of modelled VRU emission rates – Average Operations Scenario (g/hr)

Pollutant	Composition* (% vol)	Emission Rate* (kg/hr, as n-propane)	Mol Wt. (g/mol.)	Emission Rate (g/hr)
Benzene	0.384	0.00876	78.11	15.52
Cyclohexane	0.287	0.00655	84.162	12.50
Ethylbenzene	0.057	0.00131	106.168	3.15
n-Hexane	0.915	0.02086	86.178	40.76
Cumene	0.002	0.00004	120.195	0.11
Toluene	0.649	0.01481	92.141	30.94
Xylenes	0.248	0.00567	106.16	13.65

Note: Source – AECOM (2018).

Table 6.2: Summary of modelled storage tank emission rates – Average Operations Scenario (g/hr)

Month	Tank	Product	Total VOC	Benzene	Cyclohexane	Ethylbenzene	Hexane	Cumene	Toluene	Xylene
January	Tank_1	Diesel	13.687	0.205958601	0.683	0.098	1.622	0.016	0.293	0.469
February			13.21	0.198780823	0.658	0.091	1.564	0.01	0.28	0.45
March			13.541	0.203761629	0.677	0.091	1.597	0.016	0.28	0.463
April			14.313	0.215378495	0.706	0.094	1.663	0.016	0.296	0.472
May			14.047	0.211375792	0.677	0.085	1.61	0.015	0.28	0.445
June			13.52	0.203445626	0.643	0.082	1.537	0.009	0.265	0.416
July			13.699	0.206139174	0.652	0.085	1.549	0.009	0.268	0.415
August			14.352	0.215965357	0.683	0.085	1.628	0.015	0.28	0.439
September			14.849	0.22344409	0.712	0.094	1.701	0.016	0.296	0.466
October			14.62	0.219998155	0.713	0.098	1.695	0.015	0.299	0.476
November			14.345	0.215860023	0.706	0.094	1.676	0.016	0.296	0.479
December			14.035	0.211195219	0.701	0.098	1.658	0.016	0.293	0.482
January	Tank_214	PULP	226.162	0.878	1.085	0.037	1.975	0.003	1.969	0.878
February			241.532	0.938	1.16	0.039	2.112	0.003	2.099	0.938
March			222.352	0.86	1.067	0.037	1.939	0.003	1.92	0.86
April			219.4	0.838	1.039	0.031	1.884	0.003	1.871	0.85
May			200.343	0.75	0.933	0.03	1.695	0.003	1.683	0.774
June			197.962	0.737	0.913	0.031	1.663	0.003	1.638	0.762
July			187.875	0.695	0.86	0.03	1.567	0.003	1.549	0.726
August			191.576	0.713	0.884	0.03	1.61	0.003	1.585	0.738
September			206.252	0.775	0.964	0.031	1.745	0.003	1.726	0.794
October			208.378	0.793	0.982	0.03	1.786	0.003	1.768	0.805
November			222.96	0.857	1.065	0.038	1.921	0.003	1.915	0.863
December			222.139	0.86	1.067	0.037	1.933	0.003	1.92	0.86
January	Tank_352	Diesel	101.815	1.532087013	5.152	0.738	12.096	0.119	2.189	3.536

February			108.374	1.630785228	5.481	0.789	12.871	0.127	2.327	3.76
March			100.528	1.512720555	5.06	0.726	11.882	0.113	2.14	3.445
April			100.427	1.511200732	4.977	0.699	11.718	0.111	2.092	3.339
May			92.938	1.398508106	4.524	0.628	10.681	0.095	1.884	2.981
June			92.338	1.389479454	4.441	0.605	10.496	0.091	1.833	2.879
July			88.054	1.325014879	4.213	0.573	9.968	0.088	1.731	2.713
August			89.67	1.349332048	4.316	0.585	10.194	0.089	1.78	2.798
September			95.815	1.441800493	4.662	0.643	11	0.098	1.94	3.062
October			95.992	1.444463945	4.731	0.658	11.145	0.101	1.975	3.158
November			101.655	1.529679373	5.065	0.718	11.913	0.111	2.136	3.415
December			100.571	1.513367608	5.06	0.719	11.882	0.113	2.14	3.445
January	Tank_378	ULP	2523.098	8.718	34.135	0.219	40.214	0.017	25.569	7.706
February			2648.253	9.15	35.825	0.228	42.198	0.018	26.844	8.101
March			2330.126	8.011	31.386	0.201	36.995	0.011	23.497	7.115
April			2129.449	7.22	28.337	0.183	33.44	0.011	21.13	6.426
May			1918.966	6.395	25.118	0.159	29.709	0.011	18.607	5.664
June			2165.988	7.113	27.959	0.176	33.15	0.011	20.512	6.161
July			2088.606	6.816	26.801	0.165	31.806	0.011	19.607	5.883
August			2150.579	7.06	27.752	0.171	32.91	0.011	20.351	6.103
September			2480.133	8.24	32.375	0.195	38.341	0.011	23.826	7.106
October			2472.148	8.328	32.678	0.207	38.622	0.017	24.186	7.231
November			2672.96	9.097	35.676	0.227	42.115	0.018	26.523	7.938
December			2603.514	8.944	35.038	0.226	41.311	0.017	26.155	7.853
January	Tank_482	ULP	17312.629	66.618	82.415	2.445	150.32	0.122	134.292	45.957
February			18190.64	69.975	86.567	2.574	157.904	0.13	141.044	48.266
March			17076.639	65.35	80.879	2.39	147.631	0.116	131.432	44.859
April			17133.672	64.587	80.04	2.331	146.378	0.113	129.085	43.728
May			15959.289	59.016	73.233	2.091	134.279	0.104	116.977	39.25

June			15782.646	57.48	71.422	2.01	131.208	0.101	113.222	37.705
July			15186.4	54.937	68.295	1.908	125.585	0.091	107.911	35.818
August			15521.34	56.528	70.234	1.981	129.036	0.098	111.35	37.08
September			16506.265	60.964	75.656	2.161	138.743	0.107	120.775	40.496
October			16519.092	61.887	76.721	2.219	140.431	0.11	123.36	41.665
November			17337.764	65.702	81.388	2.381	148.734	0.113	131.599	44.698
December			17162.931	65.661	81.269	2.396	148.338	0.116	132.042	45.061
January	Tank_6	Jet	52.901	1.026851159	2.676	0.384	6.286	0.057	1.134	1.829
February			56.275	1.092343225	2.841	0.404	6.687	0.061	1.206	1.949
March			52.23	1.013826506	2.628	0.372	6.17	0.057	1.11	1.786
April			52.201	1.013263593	2.583	0.365	6.092	0.053	1.084	1.732
May			48.328	0.938085533	2.353	0.323	5.554	0.051	0.975	1.549
June			47.999	0.931699377	2.306	0.309	5.456	0.046	0.945	1.493
July			45.798	0.888976189	2.189	0.299	5.182	0.045	0.902	1.408
August			46.652	0.905553019	2.237	0.305	5.304	0.045	0.921	1.451
September			49.832	0.967279389	2.419	0.334	5.72	0.053	1.002	1.594
October			49.92	0.96898754	2.457	0.341	5.792	0.051	1.024	1.634
November			52.837	1.025608867	2.633	0.372	6.193	0.059	1.109	1.777
December			52.273	1.014661171	2.628	0.372	6.176	0.057	1.11	1.786
January	Tank_7	Jet	3.92	0.076090368	0	0	0.201	0.008	0.299	0.232
February			3.982	0.077293838	0	0	0.209	0.009	0.3	0.235
March			3.835	0.074440449	0	0	0.201	0.008	0.293	0.226
April			3.818	0.074110465	0	0	0.202	0.008	0.29	0.227
May			3.499	0.067918417	0	0	0.195	0.007	0.268	0.207
June			3.301	0.064075077	0	0	0.183	0.007	0.265	0.195
July			3.195	0.062017532	0	0	0.177	0.007	0.25	0.189
August			3.341	0.06485151	0	0	0.189	0.007	0.262	0.201
September			3.629	0.070441823	0	0	0.202	0.008	0.283	0.214

October			3.719	0.072188795	0	0	0.195	0.008	0.287	0.219
November			3.887	0.075449811	0	0	0.208	0.008	0.302	0.227
December			3.896	0.075624508	0	0	0.207	0.008	0.299	0.232

6.1.2 Tank Filling Scenario

The Average Operations scenario emissions do not reflect short-term localised emission peaks that may arise from a specific tank (e.g. due to product movements). Noting this limitation, an additional sensitivity analysis has been prepared for Tank 352 in isolation, assuming that it is filled at an average rate of 375 m³/hr, which represents the average of the range outline in Caltex's submission in response to the Development (Caltex, 2020b). Emissions have been estimated as the product of this flow rate, and concentration data for diesel headspace documented in AECOM (2016)[8], and modelled to occur on a continuous basis.

Table 6.3: Summary of modelled emission rates for the Tank Filling scenario

Substance	Headspace Concentration (mg/m³)			Emission Rate
	Sample 1	Sample 2	Average	g/hr
Benzene	24.9	26	25.5	9.5
Cyclohexane	78.1	76	77	28.9
Ethylbenzene	27.2	26	27	10.0
Hexane	143	130	137	51.2
Cumene	3.86	3.69	4	1.4
Toluene	87.4	114	101	37.8
Xylene	88	90	89	33.4

6.2 Dispersion modelling

Dispersion modelling has been conducted using the CALPUFF dispersion modelling package, in conjunction with surface meteorological observations from the Newcastle region, inclusive of the Carrington and Newcastle AQMS, located approximately 800 m and 1,800 m from the Development (respectively).

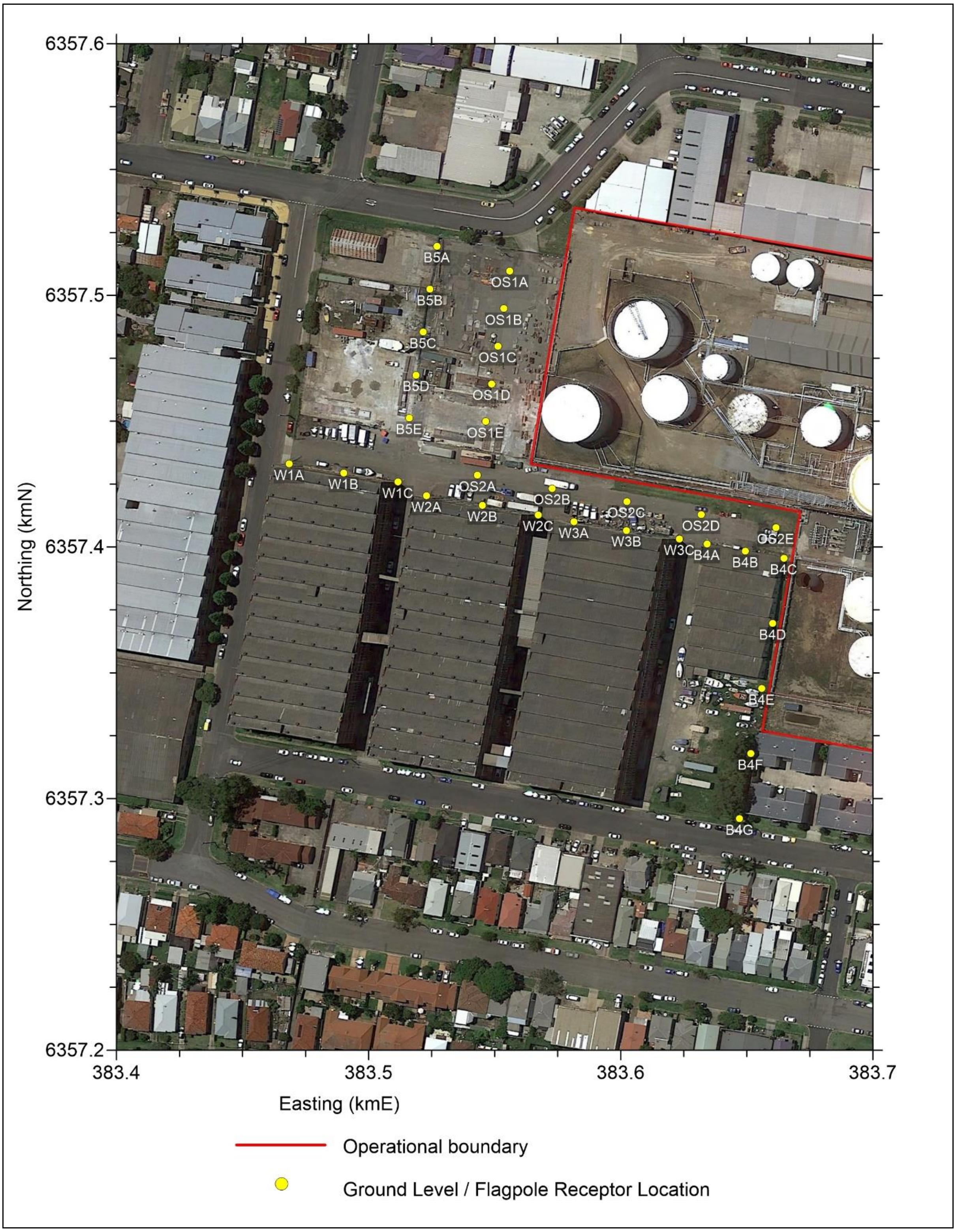
Modelling has been completed at discrete receptor locations on the closest face of each existing and proposed structure.

Ground level receptors have been modelled alongside flagpole receptors at the following heights above ground level:

- Woolstores (existing) : W1 / W2 / W3: 0 m, 4 m, 8 m, 12 m, 16 m.
- Building B4 (proposed): 0 m, 3.5 m, 7 m, 11.5 m, 14 m.
- Building B5 (proposed): 0 m, 5 m, 10 m, 15 m, 20 m.
- Open Space 1 (OS1) and Open Space 2 (OS2): 0 m.

Figure 6.1 shows the locations of these receptors.

[8] AECOM (2016) https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-7065%2120190227T094709.837%20GMT (accessed November 2020)



(MGA 94, Zone 56, base image sourced from Google Earth Pro)

Figure 6.1 Location of ground level and flagpole receptors.

7. HUMAN HEALTH RISK SCREENING

This section details the assessment of health risks as based on the modelling results, which have also been supported by the ambient VOC monitoring.

7.1 Introduction

A Health Risk Assessment (HRA) aims to quantify the potential health effects arising from exposure to, in this case, environmental pollution. Risk assessments are often conducted by considering possible or theoretical community exposures predicted from air dispersion modelling or noise modelling or using environmental concentrations that have been measured in the potentially affected population. Conservative safety margins are built into a risk assessment analysis to ensure protection of public health. Consideration of the most vulnerable subgroups within the population is part of the risk characterisation process.

The Australian guidance for conducting HRAs is set out in the enHealth Guidelines (2012). The risk assessment process detailed in the enHealth HRA Guidelines comprises five components as outlined below:

1. Issue Identification – Identifies issues that can be assessed through a risk assessment and assists in establishing a context for the risk assessment (Presented in Section 1).
2. Hazard Assessment – Identifies hazards and health endpoints associated with exposure to hazardous agents and provides a review of the current understanding of the toxicity and risk relationship of the exposure of humans to the hazards.
3. Exposure Assessment – Identifies the groups of people who may be exposed to hazardous agents and quantifies the exposure concentrations.
4. Risk Characterisation – Provides the qualitative evaluation of potential risks to human health. The characterisation of risk is based on the review of concentration response relationship and the assessment of the magnitude of exposure.
5. Uncertainty Assessment – Identifies potential sources of uncertainty and qualitative discussion of the magnitude of uncertainty and expected effects on risk estimates.

This process has been followed to conduct a screening health assessment for the emissions from the terminal on the potential residents of the proposed development as well as workers in the commercial areas and the open space.

7.2 Issues Identification

The emissions from the terminal include benzene, toluene, xylenes, cumene and a range of other volatile organic substances that can impact on health. These compounds can have both acute short-term health effects as well as long-term (chronic) cancer and non-cancer effects. As the proposed development abuts the terminal there is a need to assess the potential risks to the health of the potential residents as well as the commercial workers and the users of the open space.

7.3 Hazard Assessment

A brief summary of the health effects of the key pollutants considered in the HRA is presented in the following sections.

7.3.1 Benzene

Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness.

Benzene is a well-established cause of cancer in humans. The International Agency for Research on Cancer has classified benzene as carcinogenic to humans (Group 1). Benzene causes acute myeloid leukaemia (acute non-lymphocytic leukaemia), and there is limited evidence that benzene may also cause acute and chronic lymphocytic leukaemia, non-Hodgkin's lymphoma and multiple myeloma. Individuals who have experienced benzene poisoning requiring treatment show a substantially increased risk of mortality from leukaemia. Benzene is a genotoxic carcinogen and does not have a threshold for effect.

Chronic inhalation of certain levels of benzene causes disorders in the blood in humans. Benzene specifically affects bone marrow (the tissues that produce blood cells). Aplastic anaemia (a risk factor for acute non-lymphocytic leukaemia), excessive bleeding, and damage to the immune system (by changes in blood levels of antibodies and loss of white blood cells) may develop. In animals, chronic inhalation and oral exposure to benzene produces the same effects as seen in humans. Reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing foetus have been observed in animal tests.

7.3.2 Toluene

A serious health concern is that toluene may have an effect on the nervous system (brain and nerves). Nervous system effects can be temporary, such as headaches, dizziness, or unconsciousness. However, effects such as incoordination, cognitive impairment, and vision and hearing loss may become permanent with repeated exposure, especially at concentrations associated with intentional solvent abuse. High levels of toluene exposure during pregnancy may lead to retardation of mental abilities and growth in children. Other health effects of potential concern may include immune, kidney, liver, and reproductive effects.

Single exposures to toluene or repeated exposures over a few weeks can cause headaches and sleepiness, and can impair the ability to think clearly.

Low to moderate, day-after-day exposure to toluene in the workplace can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure is stopped. Some studies in people have shown reproductive effects, such as an increased risk of spontaneous abortions, from exposure to toluene in the workplace. Additionally, exposure to high levels of toluene could possibly damage your kidneys and liver.

The central nervous system (CNS) is the primary target organ for toluene toxicity in both humans and animals for acute (short-term) and chronic (long-term) exposures. CNS dysfunction and narcosis have been frequently observed in humans acutely exposed to elevated airborne levels of toluene; symptoms include fatigue, sleepiness, headaches, and nausea. CNS depression has been reported to occur in chronic abusers exposed to high levels of toluene. Chronic inhalation exposure of humans to toluene also causes irritation of the upper respiratory tract and eyes, sore throat, dizziness, and headache. Human studies have reported developmental effects, such as CNS dysfunction, attention deficits, and minor craniofacial and limb anomalies, in the children of pregnant women exposed to high levels of toluene or mixed solvents by inhalation.

7.3.3 Xylenes

Acute (short-term) inhalation exposure to mixed xylenes in humans results in irritation of the eyes, nose, and throat, gastrointestinal effects, eye irritation, and neurological effects. Chronic (long-term) inhalation exposure of humans to mixed xylenes results primarily in central nervous system (CNS) effects, such as headache, dizziness, fatigue, tremors, and incoordination; respiratory, cardiovascular, and kidney effects have also been reported. EPA has classified mixed xylenes as a Group D, not classifiable as to human carcinogenicity.

7.3.4 Cumene

Acute (short-term) inhalation exposure to cumene may cause headaches, dizziness, drowsiness, slight incoordination, and unconsciousness in humans. Cumene has a potent central nervous system (CNS) depressant action characterized by a slow induction period and long duration of narcotic effects in animals. Cumene is a skin and eye irritant. No information is available on the chronic (long-term), reproductive, developmental, or carcinogenic effects of cumene in humans. Animal studies have reported increased liver, kidney, and adrenal weights from inhalation exposure to cumene.

7.3.5 Ethylbenzene

Acute (short-term) exposure to ethylbenzene in humans results in respiratory effects, such as throat irritation and chest constriction, irritation of the eyes, and neurological effects such as dizziness. Chronic (long-term) exposure to ethylbenzene by inhalation in humans has shown conflicting results regarding its effects on the blood. Animal studies have reported effects on the blood, liver, and kidneys from chronic inhalation exposure to ethylbenzene. Limited information is available on the carcinogenic effects of ethylbenzene in humans. In a study by the National Toxicology Program (NTP), exposure to ethylbenzene by inhalation resulted in an increased incidence of kidney and testicular tumours in rats, and lung and liver tumours in mice. The International Agency for Research into Cancer (IARC) has classified ethylbenzene as a possible human carcinogen Class 2B.

7.3.6 Cyclohexane

In humans, inhalation of cyclohexane produces headaches, sleepiness, dizziness, limb weakness, motor changes, and verbal memory impairment, and headache and can cause irritation of the nose and throat. Recent studies in mice have demonstrated behavioural alterations, reactive gliosis (scarring of the central nervous system), and oxidative stress in the brains of cyclohexane-exposed animals.

7.3.7 n-Hexane

Acute (short-term) inhalation exposure of humans to high levels of hexane causes mild central nervous system (CNS) effects, including dizziness, giddiness, and slight nausea. Chronic (long-term) exposure to hexane in air is associated with polyneuropathy (degeneration of peripheral nerves that spreads towards the centre of the body) in humans, with numbness in the extremities, muscular weakness, blurred vision, headache, and fatigue observed. Neurotoxic effects have also been exhibited in rats. No information is available on the carcinogenic effects of hexane in humans or animals.

7.4 Exposure assessment

This HRA has used the data that has been generated in the air quality modelling presented in Section 6 of this report. The maximum data has been used for each receptor to give an estimate of the maximum potential impact of the emissions from the terminal on the proposed development. The data used is summarised in Table 7.1.

Table 7.1: Maximum predicted air pollutant concentrations across average operations and tank filling scenarios

Substance	Statistic	Prediction - Maximum Receptor by Building/Area (µg/m³)							Prediction - Maximum Receptor by Use (µg/m³)		
		W1	W2	W3	B4	B5	OS1	OS2	Residential	Commercial	Open Space
Benzene	1 hour maximum	21	32	63	101	83	29	95	83	101	95
	8 hour maximum	6.3	9.4	18	36	31	7.4	32	31	36	32
	24 hour maximum	3.2	4.7	8.9	22	17	*3.9*	*17*	17	*22*	*17*
	Annual Average	0.5	0.8	1.7	3.4	2.9	*0.5*	*3*	2.9	*3.4*	*3.4*
Cyclohexane	1 hour maximum	26	37	78	121	97	50	118	97	121	118
	8 hour maximum	10	13	22	44	38	13	39	38	44	39
	24 hour maximum	4.4	6.2	10	24	19	*6.5*	*19*	19	*24*	*19*
	Annual Average	0.8	1.2	2.2	4.3	3.8	*0.9*	*4.2*	3.8	*4.3*	*4.2*
Ethylbenzene	1 hour maximum	1.4	1.6	2.3	3.9	3.3	1.7	3.5	3.3	3.9	3.5
	8 hour maximum	0.4	0.5	0.8	1.6	1.3	0.5	1.4	1.3	1.6	1.4
	24 hour maximum	0.2	0.2	0.4	0.8	0.7	*0.2*	*0.7*	0.7	*0.8*	*0.7*
	Annual Average	0.0	0.1	0.1	0.2	0.1	*0.0*	*0.2*	0.1	*0.2*	*0.2*
Hexane	1 hour maximum	48	68	142	222	178	77	215	178	222	215
	8 hour maximum	16	22	41	83	71	22	73	71	83	73
	24 hour maximum	7.7	11	19	45	36	*10*	*35*	36	*45*	*35*
	Annual Average	1.4	2.0	4.0	7.7	6.9	*1.4*	*7.6*	7	*7.7*	*7.6*
Cumene	1 hour maximum	0.11	0.15	0.16	0.19	0.15	0.16	0.20	0.2	0.19	0.20
	8 hour maximum	0.04	0.06	0.06	0.07	0.07	0.05	0.07	0.07	0.07	0.07
	24 hour maximum	0.02	0.03	0.03	0.04	0.03	*0.0*	*0.0*	0.0	*0.04*	*0.04*
	Annual Average	0.003	0.005	0.008	0.010	0.010	*0.0*	*0.0*	0.0	*0.01*	*0.01*
Toluene	1 hour maximum	41	60	126	198	159	60	192	159	198	192
	8 hour maximum	13	19	36	73	61	16	64	61	73	64
	24 hour maximum	6	9	16	40	32	*8*	*31*	32	*40*	*31*
	Annual Average	0.9	1.4	3.1	6.3	5.6	*0.9*	*6.2*	5.6	*6.3*	*6.2*

Xylenes	1 hour maximum	14	21	43	68	54	21	65	54	68	65
	8 hour maximum	4.8	6.7	13	25	21	6.1	22	21	25	22
	24 hour maximum	2.2	3.1	5.8	14	11	*3*	*11*	11	*14*	*11*
	Annual Average	0.4	0.6	1.2	2.3	2.0	*0.4*	*2.2*	2.0	*2.3*	*2.2*

The susceptibility of the people to the effects of air pollution has been shown to be affected by the baseline health status of the population as well as age. People with pre-existing disease, people over 65 years of age, children and people in low socioeconomic groups are known to be more vulnerable to the effects of air pollution than the general population. Table 7.2 summarises the population statistics for Wickam (ABS, 2016).

Table 7.2: Population Statistics Wickham compared to NSW and Australia

Age	Wickham (%)	NSW (%)	Australia (%)
0-4	3.7	6.2	6.3
5-14	5.6	12.3	12.4
15-64	79.6	65.1	65.8
65+	10.9	16.2	15.8

As can be seen from Table 7.2, the Wickham population has a lower percentage of children <15 years and people greater the 65 years of age than NSW or Australia. These groups are some of the more vulnerable people to the effects of air pollution. Data from the ABS also indicates that the socioeconomic status of the Wickham community is similar to that of Australia as a whole.

No health data was available for Wickham so it has been assumed that there are no differences between the health status of the community compared to Newcastle or NSW.

For the purpose of the HRA it has been assumed that the demographics and baseline health status of potential buyers within the development does not differ from the general Wickham population.

7.5 Risk Characterisation

The purpose of the risk characterization is to estimate potential acute and chronic health risks associated with emissions from the terminal on the proposed development. For the assessment of health effects where there is a known threshold for effect, the predicted air pollution level for each averaging period is compared to the health based guideline values. The ratio of the predicted level to the guideline is termed the hazard quotient (HQ) (enHealth, 2012):

HQ = predicted concentration / health based guideline

The hazard quotients are estimated for each of the averaging periods relevant to the guidelines. Hazard quotients have been calculated for the acute health effects and chronic non-cancer effects of the pollutants under consideration.

For the carcinogenic risks of benzene and ethylbenzene, unit risk factors have been used to calculate the incremental cancer risk. Both pollutants are considered to be non-threshold carcinogens. The unit risk factor (URF) is an estimate of the increase in risk with exposure to 1 µg/m^3 of the pollutant over a lifetime.

To calculate the lifetime cancer risk associated with the concentrations of benzene predicted to arise from emissions from the terminal the following equation has been used:

Increase in lifetime cancer risk = annual average concentration x unit risk factor (URF)

A review of the available unit risk factors has been undertaken. The derivation of these factors, like any standard or guideline, is based on a range of assumptions and key information on the concentrations at which these effects can be observed. To enable the risk from each of these substances to be compared, it is important that as far as practicable, all URFs are obtained from the same source and that the derivation of these values is well documented. Based on the review undertaken, the URFs from the Californian EPA Office of Environmental Health Hazard Assessment (OEHHA) has been used in this study. The URF from OEHHA is based on human studies and is the most recent URF derived by international agencies.

7.6 Exposure Times

Three types of exposures have been assessed in this HRA for carcinogenic risk:

- Residential
- Commercial workers
- Users of open space

The exposure scenarios for each differ and the assumptions used in the HRA are summarised in Table 7.3.

Table 7.3: Summary of assumed exposure durations

Scenario	Exposure Duration	Exposure per day	Number of Days per year
Residential	70 years	24 hours	365 days
Commercial Worker	26 years	8 hours	240 days
Open Space User	70 years	3 hours	365 days

For the residential scenario the modelled air pollutant concentration has been used. For the commercial worker and open space user the modelled concentration has been adjusted for the relevant exposure periods using the following equation:

$$EC = C_{air} \text{ x } ((ET \text{ x } EF \text{ x } ED)/AT)$$

Where:

EC = exposure concentration (µg/m^3)

C_{air} = concentration in air (µg/m^3).

ET = Exposure time (assumed 8 hours for commercial worker and 3 hour for open space user).

EF = Exposure frequency (days/year) (assumed 240 days/yr worker and 365 days/yr for open space user).

ED = Exposure duration (yrs) (assumed 26 years for worker and 30 years for open space user).

AT = Averaging Time (ED x EF x 24 hrs/day).

The resultant exposure concentrations have been used in the calculation of cancer risk.

7.7 Assessment of Carcinogenic Risks

The carcinogenic risks for benzene and ethylbenzene (i.e. the substances which possess carcinogenic properties), and have been calculated from the Average Operations scenario as shown in Table 7.4. Combining the maximum annual average concentrations and the unit risk factor using the equation shown above the increase in cancer risk has been calculated.

Table 7.4: Calculation of carcinogenic risks (based on Average Operations scenario).

Pollutant	Scenario	Exposure Concentration (µg/m³)	Unit Risk Factor	Incremental Risk
Benzene	Residential	2.9	2.9×10^{-5}	8.4×10^{-5}
	Commercial Worker	1.13	2.9×10^{-5}	3.3×10^{-5}
	Open Space User	0.37	2.9×10^{-5}	1.1×10^{-5}
Ethylbenzene	Residential	0.1	2.5×10^{-6}	2.5×10^{-7}
	Commercial Worker	0.07	2.5×10^{-6}	1.7×10^{-7}
	Open Space User	0.025	2.5×10^{-6}	6.3×10^{-8}

It is generally accepted by regulatory agencies including NSW Health, that an increase in risk between 1×10^{-6} (1 in a million) and 1×10^{-5} (1 in 100,000) is considered to be a low risk and within acceptable criteria. As can be seen from Table 7.4 the predicted cancer risks for the residential and commercial worker scenarios for benzene exceed the acceptable risk criteria of 1×10^{-5}. For the open space scenario the predicted incremental risk just meets the acceptable risk criteria.

For ethylbenzene the predicted cancer risks are within acceptable risk levels.

7.8 Non-carcinogenic Risks

Non-carcinogenic risks have been calculated using the hazard quotient approach. The air quality standards used in this assessment have been adopted from OEHHA acute and chronic Reference Exposure Levels (RELs). These guidelines have been developed for the protection of public health from air toxic pollutants emitted from industrial premises. They have been developed to protect sensitive members of the public in communities close to industrial facilities. These are considered to be the most appropriate set of criteria to use in this current assessment.

For cumene and cyclohexane there were no RELs available. The Effects Screening Levels from the Texas Centre for Environmental Quality (TCEQ, 2020) have been used for these substances. The ESLs are used in permitting for industries in Texas and have been derived to protect public health in potentially exposed communities.

The Hazard Quotients and relevant air quality guidelines are summarised in Table 7.5.

Table 7.5: Assessment of non-carcinogenic risks

Pollutant	Air Quality Guideline (µg/m³)	Averaging Period	Concentration (µg/m³)	Hazard Quotient (residential)	Hazard Quotient (commercial)	Hazard Quotient (open space)
Benzene	27	1 hour	83	3	3.7	3.5
	3	8 hour	31	10	12	10.7
	3	Annual average	2.9	0.9	0.32	0.12
Cyclohexane	3400	1 hour	97	0.03	0.04	0.03
	340	Annual Average	3.8	0.01	0.004	0.004
Ethylbenzene	2000	Annual Average	0.1	0.00005	0.00003	0.000006
Toluene	5000	1 hour	159	0.03	0.04	0.04
	830	8 hour	61	0.07	0.09	0.08
	420	Annual Average	5.6	0.01	0.005	0.002
Hexane	7000	Annual Average	7	0.001	0.0004	0.0001
Cumene	650	1 hour	0.2	0.0003	0.0003	0.0002
	250	Annual Average	0.008	0.00003	0.00001	0.000005
Xylenes	22000	1 hour	54	0.003	0.003	0.003
	700	Annual Average	2	0.003	0.001	0.0004

As can be seen from Table 7.5 with the exception of benzene all hazard quotients are below 1 and therefore within acceptable risk levels for all exposure scenarios – residential, commercial and open space. . For both the acute 1–hour and 8-hour averaging periods for benzene the hazard quotients exceed a value of 1 and exceed acceptable risk levels. The calculations shown in Table 7.5 are for the average scenario. As the concentrations for the tank filling scenario are lower the hazard quotients will also be lower and within acceptable risk criteria.

8. DISCUSSION

8.1 NSW EPA Submissions (02 February 2017, 27 March 2019)

Issue Raised

The 2017 EPA submissions (EPA, 2017;2019) raise the issue of land use conflicts, as associated with the establishment of residential in a light industrial zone, adjacent to an active fuel depot. The 2019 submission reiterates this issue, whilst also including a high level review of the AECOM (2018) air quality impact assessment (AQIA).

Comments on the AQIA include:

- Choice of dispersion model / absence of validation.
- Modelling of emission below the licence limit.
- Omissions (not detailed)
- Absence of a consideration of odour.

The submission indicates that responding to the comments on the AQIA is unlikely to change EPA's position materially, being that the residential apartment proposal represents a potential land-use conflict that will increase the risk of exposure of residents to odorous emission and air toxics.

Commentary

The EPA's commentary is broadly aligned with the dialogue of issues addressed in the EPA Victoria separation distance guidance (EPAV, 2013) whereby the issue of land use conflict is presented in the context of the needing to manage impacts of industry on sensitive land uses, as well as the reverse scenario, associated with the need to manage where encroachment of sensitive land uses on existing industry.

Whilst it is agreed that Section 149 'planning certificates' would go some way to inform residents and align expectations associated with potential odour exposure, this control is not considered sufficient in mitigating potential land use conflicts associated with odour, and would not address potential exposure to air toxics.

As context, there may be cases where a prospective purchaser is advised of the odour risks, but either upon, or some time after occupation, finds the presence of odour to be inconsistent with their expectations (or experience to date), or is ultimately beyond what they consider an acceptable impact for a dwelling within an approved residentially zoned area.

The risk of this disconnect would be expected to increase with time, especially if the occupant becomes sensitised to the odours, either through amenity (general unpleasantness of odours), or concerns around potential health impacts associated with those odours, either direct, or to family members. The practical implementation of this control is also not clear for the case in which investment properties are occupied by tenants.

With regard to AQIA related issues, TAS (2020) addresses the issues of model selection and modelling of the the VRU at licence limit. Whilst reference to odour is made within TAS (2020), it is based on average data, and ultimately has not taken the opportunity to include actual observations within the site, (noting that the facility is already operational). Whilst a survey would not necessarily capture upset scenarios, the presence of existing odours (e.g. as detected within this investigation) is considered more reliable than modelling predictions.

8.2 Caltex Submission (08 July 2020)

Issue Raised

The Caltex Submission (Caltex, 2020) is primarily focused on industrial hazard and risk aspects associated with the development, however the submission does address odour in the context of amenity.

The submission states:

> *"Experience in other jurisdictions is that encroachment of incompatible sensitive land uses into existing land use buffer zones surrounding hazardous facilities ultimately restricts the flexibility of industry to meet emergent market demands, hinders growth opportunities and may ultimately lead to an unsustainable position resulting in site closure. Often such factors are subtle and emerge over several years as a result of 'new occupier' objection to pre-existing minor amenity impacts (e.g. noise, traffic, odours) historically tolerated but subsequently imposed upon a much larger, less tolerant, population."*

Commentary

The position raised by Caltex is generally acknowledged in that expectations around amenity differ for residential and industrial areas, and the development would result in a higher density of sensitive receptors in the immediate vicinity of the Caltex Site, as associated with the transition of the land use to residential. In addition, as raised in commentary above, the potential for the tolerances to reduce with time is also acknowledged.

Whilst specific case studies are not referenced, the principle of introducing sensitive land uses would potentially have implications for the operation of the Caltex Site, including:

- Requirements to implement additional air emission controls, the feasibility and viability of which are not clear.
- Requirements to demonstrate acceptable air quality outcomes in cases where the presence of odour leads to concerns about potential health impacts.
- Restriction or curtailment of operations.
- Programming requirements and stakeholder management for non-routine works such as plant maintenance and upgrades.

9. CONCLUSIONS

ERM Australia Pacific Pty Ltd (ERM) has been commissioned by Arriscar Pty Ltd (Arriscar), on behalf of CN, to undertake an independent odour and air quality investigation to understand the potential air quality impacts of the Caltex Site on the health and amenity of occupants of the Development.

This investigation has involved completion of the following tasks:

- A review of siting cases for fuel storage and tanker loading operations in urban settings, with the objective of contextualising the potential sensitivity of the Development to the adjacent Caltex operations.
- Conduct a brief ambient monitoring campaign to gain information on ground level concentrations of Volatile Organic Compounds (VOCs) adjacent to the Caltex Site.
- Ambient odour survey to characterise the odour environment adjacent to the Caltex Site (during both commissioning and collection of evacuated canister samples).
- Atmospheric dispersion modelling that addresses fugitive emission sources across the Caltex Site, inclusive of Storage tank and Vapour Recovery Unit (VRU) emission sources.
- Human Health Risk Screening Assessment / Discussion, incorporating the results of the short-term monitoring and the dispersion modelling, as well as review of public health standards.

9.1 Key Findings

Based on these investigations, the following findings are made:

Review of Bulk Fuel Storage Siting Cases

A review of bulk fuel storage siting cases within NSW indicates that the (existing) Newcastle terminal features one of the lowest separation distances between site infrastructure and residential dwellings, being similar to that at the Caltex Kurnell terminal, with only the Viva Energy Gore Bay import terminal identified as having residential receptors located at a closer proximity.

With establishment of the Development, the separation between site infrastructure and residences would decrease to a separation distance similar to that at Gore Bay, albeit with a higher density of residential receptors. Whilst the emission profiles of Gore Bay and Kurnell differ from the Caltex Site (i.e. they include shipping, and possibly of a more diverse range of fuels), it is known that these two facilities have also resulted in complaints related to odour performance, and have required detailed air quality management strategies.

A review of Victorian siting cases identified that whilst the ExxonMobil Yarraville and Viva Energy Newport terminals are located within approximately 40 m of residences, for tanks of 2,000 tonnes capacity or more, EPA Victoria currently recommend separation distances of 100 m and 250 m for floating roof and fixed roof tanks (respectively), primarily for the management of potential odour and amenity impacts associated with none-routine operating conditions. These separation distances have been endorsed in planning decisions, including an example at ExxonMobil Yarraville, whereby a medium density residential development was rejected despite being located approximately 150 m further from the facility than the closest existing residences.

In contrast, Tank T-352 within south western corner of the Caltex Site is located approximately 30 m from proposed residences within the Development, and comprises a fixed roof tank with a capacity of approximately 5,000 tonnes, and thus would fall significantly below the EPA Victoria separation distances of 100m and 250 m for both floating roof and fixed roof tank types.

Ambient VOC Monitoring Campaign

An ambient VOC monitoring campaign was completed over 4 sampling events, and identified that VOC concentrations in the immediate vicinity of the Development were generally low, and whilst consistent with fuel handling and storage operations in terms of substances present, were also within the range of concentrations historically measured in urban airsheds. A review of meteorology indicated that sampling was conducted downwind of emission sources within the Caltex Site, and thus are considered broadly representative of potential ground level concentrations adjacent to the Caltex Site.

Ambient Odour Surveys

A total of five ambient odour surveys were conducted, across which a range of localised odour sources were observed in the vicinity of the development, inclusive of hydrocarbon odours observed adjacent to the Caltex Site. These odours were not strong or offensive to the observer, but existed at a concentrations that were able to be intermittently detected and characterised as consistent with fuels handled at the Caltex facility.

Relevant to the potential for odours to be present at the development, it is noted that:

- Observations were not taken at the most sensitive locations within the Development Site (in terms of proximity and extent to which emission sources encompass the location).
- Observations were not taken under worst case meteorological conditions for odour nuisance, which typically include morning and evenings, especially during light winds and stable atmospheric conditions.

In this context, odours associated with the Caltex Site are expected to be detectable at locations within and around the development. There is also the potential that these odours will be strong on occasions where meteorological conditions are calm and stable, and / or non-routine emissions are occurring from the development.

Atmospheric Dispersion Modelling and Human Health Risk Screening

An updated atmospheric dispersion modelling analysis was undertaken based on the emission sources detailed in AECOM (2018), which also formed the basis for TAS (2020).

- The emission estimates detailed in AECOM (2018) were augmented to include benzene emissions from automotive diesel and jet fuel storage.
- The VRU emission rates were corrected from an n-propane equivalent basis to reflect mass emissions of each respective substance, thus allowing comparison against respective criteria. For most substances, this typically resulted in a doubling of VRU emission rates against those presented in AECOM (2018).
- Annual average predictions were produced as appropriate to the assessment of chronic health risks (including carcinogenic risks).

The results of the modelling were then assessed against a range of public health-derived criteria.

The results of the this analysis show that with the exception of benzene the acute and chronic health risks from exposure to the pollutants modelled are within acceptable risk levels.

For benzene the carcinogenic risk levels exceed acceptable risk levels for both the residential and commercial scenarios. The acceptable risk levels set by NSW Health and enHealth are also exceeded for acute exposures to benzene from the terminal operations. This means that the emissions from the terminal may impact on the health of the residents and workers within the proposed development. There may also be acute effects experienced by users of the open space area from exposure to 1-hour peak concentrations.

9.2 Conclusions

In summary, the key findings indicate that the under routine operation of the Caltex Site, VOC concentrations at commercial and residential receptors within the Development would exceed public health-based risk criteria for Benzene exposure.

It is also identified that the risk of adverse odour impacts would be significantly increased with the change in land use, as associated with the following factors:

- Increase in density of sensitive receptors;
- Differences in expectations of amenity for residential and industrially zoned land.
- Sensitivity to potential health impacts that may be associated with the presence of odour.

Noting that TAS (2020) was based on average emission rates and did not consider non-routine operating scenarios, the odour-related conclusions of TAS (2020) are not endorsed. In this context, it is anticipated that approval of the development would potentially have significant implications for the ongoing operation of the Caltex Site, potentially including the following:

- Requirements to implement additional air emission controls, the feasibility and viability is not clear.
- Requirements to demonstrate acceptable air quality outcomes in cases where the presence of odour leads to concerns about potential health impacts.
- Restriction or curtailment of operations.
- Programming requirements and stakeholder management for non-routine works such as plant maintenance and upgrades.

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APPENDIX A CERTIFICATE OF ANALYSIS (COA)

CERTIFICATE OF ANALYSIS

Work Order	: **EN2007752**	Page	: 1 of 9
Client	: **ENVIRONMENTAL RESOURCES MANAGEMENT (ERM)**	Laboratory	: Environmental Division Newcastle
Contact	: James Grieve	Contact	: Loren Schiavon
Address	: Level 15, 309 Kent Street SYDNEY NSW AUSTRALIA 2000	Address	: 5/585 Maitland Road Mayfield West NSW Australia 2304
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: 0574490 WICKHAM AQIA/HHRA R1	Date Samples Received	: 18-Nov-2020 09:55
Order number	: 0574490	Date Analysis Commenced	: 19-Nov-2020
C-O-C number	: ----	Issue Date	: 24-Nov-2020 08:22
Sampler	: James Grieve		
Site	: ----		
Quote number	: EN/114/20		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dale Semple	Analyst	Newcastle - Organics, Mayfield West, NSW
Daniel Junek	Senior Air Analyst	Newcastle - Organics, Mayfield West, NSW
Daniel Junek	Senior Air Analyst	Newcastle, Mayfield West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP101: ALS is unable to report results for ethanol during the COVID-19 pandemic due to elevated background levels from laboratory disinfection procedures.
- EP101: Results reported in µg/m³ are calculated from PPBV results based on a temperature of 25°C and atmospheric pressure of 101.3 kPa.
- CAN-001: Results for Pressure - As Received are measured under controlled conditions using calibrated laboratory gauges. These results are expressed as an Absolute Pressure. Equivalent gauge pressures may be calculated by subtracting the Pressure - Laboratory Atmosphere taken at the time of measurement.
- CAN-001: Results for Pressure - Gauge as Received are obtained from uncalibrated field gauges and are indicative only. These results may not precisely match calibrated gauge readings and may vary from field measurements due to changes in temperature and pressure

Analytical Results

Sub-Matrix: AIR (Matrix: AIR)			Sample ID	AS01_20201109 C4991_S1834	AS02_20201109 C4759_S12208	AS01_20201116 C4988_S12210	AS02_20201116 C4741_S12211	----
			Sampling date / time	09-Nov-2020 10:30	09-Nov-2020 10:40	16-Nov-2020 11:03	16-Nov-2020 11:06	----
Compound	CAS Number	LOR	Unit	EN2007752-001	EN2007752-002	EN2007752-003	EN2007752-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15 (Calculated Concentration)								
Freon 12	75-71-8	2.5	µg/m³	<2.5	<2.5	<2.5	<2.5	----
Chloromethane	74-87-3	1.0	µg/m³	**1.2**	**1.2**	**1.2**	**1.4**	----
Freon 114	76-14-2	3.5	µg/m³	<3.5	<3.5	<3.5	<3.5	----
Vinyl chloride	75-01-4	1.3	µg/m³	<1.3	<1.3	<1.3	<1.3	----
Bromomethane	74-83-9	1.9	µg/m³	<1.9	<1.9	<1.9	<1.9	----
Chloroethane	75-00-3	1.3	µg/m³	<1.3	<1.3	<1.3	<1.3	----
Freon 11	75-69-4	2.8	µg/m³	<2.8	<2.8	<2.8	<2.8	----
1.1-Dichloroethene	75-35-4	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Dichloromethane	75-09-2	1.7	µg/m³	<1.7	<1.7	<1.7	<1.7	----
Freon 113	76-13-1	3.8	µg/m³	<3.8	<3.8	<3.8	<3.8	----
1.1-Dichloroethane	75-34-3	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
cis-1.2-Dichloroethene	156-59-2	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Chloroform	67-66-3	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
1.2-Dichloroethane	107-06-2	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
1.1.1-Trichloroethane	71-55-6	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
Benzene	71-43-2	1.6	µg/m³	<1.6	<1.6	<1.6	<1.6	----
Carbon Tetrachloride	56-23-5	3.1	µg/m³	<3.1	<3.1	<3.1	<3.1	----
1.2-Dichloropropane	78-87-5	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
Trichloroethene	79-01-6	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
cis-1.3-Dichloropropylene	10061-01-5	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
trans-1.3-Dichloropropene	10061-02-6	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
1.1.2-Trichloroethane	79-00-5	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
Toluene	108-88-3	1.9	µg/m³	**8.7**	**6.0**	**8.3**	**3.0**	----
1.2-Dibromoethane (EDB)	106-93-4	3.8	µg/m³	<3.8	<3.8	<3.8	<3.8	----
Tetrachloroethene	127-18-4	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
Chlorobenzene	108-90-7	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
Ethylbenzene	100-41-4	2.2	µg/m³	<2.2	<2.2	<2.2	<2.2	----
meta- & para-Xylene	108-38-3 106-42-3	4.3	µg/m³	<4.3	<4.3	<4.3	<4.3	----
Styrene	100-42-5	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
1.1.2.2-Tetrachloroethane	79-34-5	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
ortho-Xylene	95-47-6	2.2	µg/m³	<2.2	<2.2	<2.2	<2.2	----
4-Ethyltoluene	622-96-8	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
Total Xylenes	----	6.5	µg/m³	<6.5	<6.5	<6.5	<6.5	----
1.3.5-Trimethylbenzene	108-67-8	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----

Analytical Results

Sub-Matrix: AIR (Matrix: AIR)			Sample ID	AS01_20201109 C4991_S1834	AS02_20201109 C4759_S12208	AS01_20201116 C4988_S12210	AS02_20201116 C4741_S12211	----
			Sampling date / time	09-Nov-2020 10:30	09-Nov-2020 10:40	16-Nov-2020 11:03	16-Nov-2020 11:06	----
Compound	CAS Number	LOR	Unit	EN2007752-001	EN2007752-002	EN2007752-003	EN2007752-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15 (Calculated Concentration) - Continued								
1.2.4-Trimethylbenzene	95-63-6	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
1.3-Dichlorobenzene	541-73-1	3.0	µg/m³	<3.0	<3.0	<3.0	<3.0	----
Benzylchloride	100-44-7	2.6	µg/m³	<2.6	<2.6	<2.6	<2.6	----
1.4-Dichlorobenzene	106-46-7	3.0	µg/m³	<3.0	<3.0	<3.0	<3.0	----
1.2-Dichlorobenzene	95-50-1	3.0	µg/m³	<3.0	<3.0	<3.0	<3.0	----
1.2.4-Trichlorobenzene	120-82-1	3.7	µg/m³	<3.7	<3.7	<3.7	<3.7	----
Hexachlorobutadiene	87-68-3	5.3	µg/m³	<5.3	<5.3	<5.3	<5.3	----
Acetone	67-64-1	1.2	µg/m³	**6.6**	**3.1**	**4.7**	**4.7**	----
Bromodichloromethane	75-27-4	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
1.3-Butadiene	106-99-0	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	----
Carbon disulfide	75-15-0	1.6	µg/m³	<1.6	<1.6	<1.6	<1.6	----
2-Chlorotoluene	95-49-8	2.6	µg/m³	<2.6	<2.6	<2.6	<2.6	----
1-Chloro-2-propene (Allyl chloride)	107-05-1	1.6	µg/m³	<1.6	<1.6	<1.6	<1.6	----
Cyclohexane	110-82-7	1.7	µg/m³	<1.7	<1.7	<1.7	<1.7	----
Dibromochloromethane	124-48-1	4.3	µg/m³	<4.3	<4.3	<4.3	<4.3	----
1.4-Dioxane	123-91-1	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Ethylacetate	9002-89-5	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
trans-1.2-Dichloroethene	156-60-5	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Heptane	142-82-5	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Hexane	110-54-3	1.8	µg/m³	**3.5**	**2.1**	**2.8**	<1.8	----
Isooctane	540-84-1	2.3	µg/m³	**4.7**	**2.8**	**4.2**	<2.3	----
Isopropyl Alcohol	67-63-0	1.2	µg/m³	**4.4**	**1.5**	**1.2**	**2.2**	----
2-Butanone (MEK)	78-93-3	1.5	µg/m³	**2.1**	<1.5	<1.5	<1.5	----
Methyl iso-Butyl ketone	108-10-1	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
2-Hexanone (MBK)	591-78-6	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Propene	115-07-1	0.9	µg/m³	<0.9	<0.9	<0.9	<0.9	----
Methyl tert-Butyl Ether (MTBE)	1634-04-4	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Tetrahydrofuran	109-99-9	1.5	µg/m³	<1.5	<1.5	<1.5	<1.5	----
Bromoform	75-25-2	5.2	µg/m³	<5.2	<5.2	<5.2	<5.2	----
Vinyl Acetate	108-05-4	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Vinyl bromide	593-60-2	2.2	µg/m³	<2.2	<2.2	<2.2	<2.2	----
Acetonitrile	75-05-8	0.8	µg/m³	<0.8	<0.8	<0.8	<0.8	----
Acrolein	107-02-8	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	----

Analytical Results

Sub-Matrix: AIR (Matrix: AIR)

Compound	CAS Number	LOR	Unit	AS01_20201109 C4991_S1834	AS02_20201109 C4759_S12208	AS01_20201116 C4988_S12210	AS02_20201116 C4741_S12211	----
Sampling date / time				09-Nov-2020 10:30	09-Nov-2020 10:40	16-Nov-2020 11:03	16-Nov-2020 11:06	----
				EN2007752-001	EN2007752-002	EN2007752-003	EN2007752-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15 (Calculated Concentration) - Continued								
Acrylonitrile	107-13-1	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	----
tert-Butyl alcohol	75-65-0	1.5	µg/m³	<1.5	<1.5	<1.5	<1.5	----
2-Chloro-1.3-butadiene	126-99-8	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Di-isopropyl Ether	108-20-3	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
Ethyl tert-Butyl Ether (ETBE)	637-92-3	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
tert-Amyl Methyl Ether (TAME)	994-05-8	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
Methyl Methacrylate	80-62-6	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
1.1.1.2-Tetrachloroethane	630-20-6	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
Isopropylbenzene	98-82-8	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
n-Propylbenzene	103-65-1	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
tert-Butylbenzene	98-06-6	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
sec-Butylbenzene	135-98-8	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
2-isopropyltoluene	527-84-4	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
n-Butylbenzene	104-51-8	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
Naphthalene	91-20-3	2.6	µg/m³	<2.6	<2.6	<2.6	<2.6	----
EP101: VOCs by USEPA Method TO15r								
Freon 12	75-71-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chloromethane	74-87-3	0.5	ppbv	**0.6**	**0.6**	**0.6**	**0.7**	----
Freon 114	76-14-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Vinyl chloride	75-01-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Bromomethane	74-83-9	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chloroethane	75-00-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Freon 11	75-69-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1-Dichloroethene	75-35-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Dichloromethane	75-09-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Freon 113	76-13-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1-Dichloroethane	75-34-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
cis-1.2-Dichloroethene	156-59-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chloroform	67-66-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2-Dichloroethane	107-06-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.1-Trichloroethane	71-55-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Benzene	71-43-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Carbon Tetrachloride	56-23-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2-Dichloropropane	78-87-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: AIR
(Matrix: AIR)

			Sample ID	AS01_20201109 C4991_S1834	AS02_20201109 C4759_S12208	AS01_20201116 C4988_S12210	AS02_20201116 C4741_S12211	----
			Sampling date / time	09-Nov-2020 10:30	09-Nov-2020 10:40	16-Nov-2020 11:03	16-Nov-2020 11:06	----
Compound	CAS Number	LOR	Unit	EN2007752-001	EN2007752-002	EN2007752-003	EN2007752-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15r - Continued								
Trichloroethene	79-01-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
cis-1.3-Dichloropropylene	10061-01-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
trans-1.3-Dichloropropene	10061-02-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.2-Trichloroethane	79-00-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Toluene	108-88-3	0.5	ppbv	**2.3**	**1.6**	**2.2**	**0.8**	----
1.2-Dibromoethane (EDB)	106-93-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Tetrachloroethene	127-18-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chlorobenzene	108-90-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Ethylbenzene	100-41-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	1.0	ppbv	<1.0	<1.0	<1.0	<1.0	----
Styrene	100-42-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.2.2-Tetrachloroethane	79-34-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
4-Ethyltoluene	622-96-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.3.5-Trimethylbenzene	108-67-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2.4-Trimethylbenzene	95-63-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.3-Dichlorobenzene	541-73-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Benzylchloride	100-44-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.4-Dichlorobenzene	106-46-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2-Dichlorobenzene	95-50-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2.4-Trichlorobenzene	120-82-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Hexachlorobutadiene	87-68-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acetone	67-64-1	0.5	ppbv	**2.8**	**1.3**	**2.0**	**2.0**	----
Bromodichloromethane	75-27-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.3-Butadiene	106-99-0	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Carbon disulfide	75-15-0	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-Chlorotoluene	95-49-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1-Chloro-2-propene (Allyl chloride)	107-05-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Cyclohexane	110-82-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Dibromochloromethane	124-48-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.4-Dioxane	123-91-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Ethylacetate	9002-89-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
trans-1.2-Dichloroethene	156-60-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: AIR (Matrix: AIR)			Sample ID	AS01_20201109 C4991_S1834	AS02_20201109 C4759_S12208	AS01_20201116 C4988_S12210	AS02_20201116 C4741_S12211	----
			Sampling date / time	09-Nov-2020 10:30	09-Nov-2020 10:40	16-Nov-2020 11:03	16-Nov-2020 11:06	----
Compound	CAS Number	LOR	Unit	EN2007752-001	EN2007752-002	EN2007752-003	EN2007752-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15r - Continued								
Heptane	142-82-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Hexane	110-54-3	0.5	ppbv	**1.0**	**0.6**	**0.8**	<0.5	----
Isooctane	540-84-1	0.5	ppbv	**1.0**	**0.6**	**0.9**	<0.5	----
Isopropyl Alcohol	67-63-0	0.5	ppbv	**1.8**	**0.6**	**0.5**	**0.9**	----
2-Butanone (MEK)	78-93-3	0.5	ppbv	**0.7**	<0.5	<0.5	<0.5	----
Methyl iso-Butyl ketone	108-10-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-Hexanone (MBK)	591-78-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Propene	115-07-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Methyl tert-Butyl Ether (MTBE)	1634-04-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Tetrahydrofuran	109-99-9	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Bromoform	75-25-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Vinyl Acetate	108-05-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Vinyl bromide	593-60-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acetonitrile	75-05-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acrolein	107-02-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acrylonitrile	107-13-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
tert-Butyl alcohol	75-65-0	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-Chloro-1.3-butadiene	126-99-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Di-isopropyl Ether	108-20-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Ethyl tert-Butyl Ether (ETBE)	637-92-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
tert-Amyl Methyl Ether (TAME)	994-05-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Methyl Methacrylate	80-62-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.1.2-Tetrachloroethane	630-20-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Isopropylbenzene	98-82-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
n-Propylbenzene	103-65-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
tert-Butylbenzene	98-06-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
sec-Butylbenzene	135-98-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-isopropyltoluene	527-84-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
n-Butylbenzene	104-51-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Sampling Quality Assurance								
Pressure - As received	PRESSURE	0.1	kPaa	**91.6**	**83.5**	**85.6**	**83.4**	----
Pressure - Gauge as Received	----	1	Inches Hg	**-2**	**-6**	**-6**	**-7**	----
Pressure - Laboratory Atmosphere	----	0.1	kPaa	**102**	**102**	**102**	**102**	----

Analytical Results

Sub-Matrix: AIR (Matrix: AIR)			Sample ID	AS01_20201109 C4991_S1834	AS02_20201109 C4759_S12208	AS01_20201116 C4988_S12210	AS02_20201116 C4741_S12211	----
			Sampling date / time	09-Nov-2020 10:30	09-Nov-2020 10:40	16-Nov-2020 11:03	16-Nov-2020 11:06	----
Compound	CAS Number	LOR	Unit	EN2007752-001	EN2007752-002	EN2007752-003	EN2007752-004	--------
				Result	Result	Result	Result	----
Sampling Quality Assurance - Continued								
Temperature as Received	----	0.1	°C	22.0	22.0	22.0	22.0	----
USEPA Air Toxics Method TO15r Surrogates								
4-Bromofluorobenzene	460-00-4	0.5	%	101	101	101	101	----

Surrogate Control Limits

Sub-Matrix: **AIR**

		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
USEPA Air Toxics Method TO15r Surrogates			
4-Bromofluorobenzene	460-00-4	60	140

CERTIFICATE OF ANALYSIS

Work Order	: **EN2007768**	Page	: 1 of 9
Client	: **ENVIRONMENTAL RESOURCES MANAGEMENT (ERM)**	Laboratory	: Environmental Division Newcastle
Contact	: James Grieve	Contact	: Loren Schiavon
Address	: Level 15, 309 Kent Street SYDNEY NSW AUSTRALIA 2000	Address	: 5/585 Maitland Road Mayfield West NSW Australia 2304
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: 0574490 WICKHAM AQIA/HHRA	Date Samples Received	: 19-Nov-2020 09:45
Order number	: 0574490	Date Analysis Commenced	: 23-Nov-2020
C-O-C number	: ----	Issue Date	: 25-Nov-2020 16:25
Sampler	: James Grieve		
Site	: ----		
Quote number	: EN/114/20		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dale Semple	Analyst	Newcastle - Organics, Mayfield West, NSW
Daniel Junek	Senior Air Analyst	Newcastle - Organics, Mayfield West, NSW
Daniel Junek	Senior Air Analyst	Newcastle, Mayfield West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP101: ALS is unable to report results for ethanol during the COVID-19 pandemic due to elevated background levels from laboratory disinfection procedures.
- EP101: Results reported in µg/m³ are calculated from PPBV results based on a temperature of 25°C and atmospheric pressure of 101.3 kPa.
- CAN-001: Results for Pressure - As Received are measured under controlled conditions using calibrated laboratory gauges. These results are expressed as an Absolute Pressure. Equivalent gauge pressures may be calculated by subtracting the Pressure - Laboratory Atmosphere taken at the time of measurement.
- CAN-001: Results for Pressure - Gauge as Received are obtained from uncalibrated field gauges and are indicative only. These results may not precisely match calibrated gauge readings and may vary from field measurements due to changes in temperature and pressure

Analytical Results

Sub-Matrix: AMBIENT (Matrix: AIR)			Sample ID	AS01_20201111 C222_S2832	AS02_20201111 C217_S2821	AS01_20201118 C220_S1619	AS02_20201118 C212_S2854	----
			Sampling date / time	11-Nov-2020 00:00	11-Nov-2020 00:00	18-Nov-2020 00:00	18-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	EN2007768-001	EN2007768-002	EN2007768-003	EN2007768-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15 (Calculated Concentration)								
Freon 12	75-71-8	2.5	µg/m³	<2.5	<2.5	<2.5	<2.5	----
Chloromethane	74-87-3	1.0	µg/m³	**1.4**	**1.2**	**1.2**	**1.2**	----
Freon 114	76-14-2	3.5	µg/m³	<3.5	<3.5	<3.5	<3.5	----
Vinyl chloride	75-01-4	1.3	µg/m³	<1.3	<1.3	<1.3	<1.3	----
Bromomethane	74-83-9	1.9	µg/m³	<1.9	<1.9	<1.9	<1.9	----
Chloroethane	75-00-3	1.3	µg/m³	<1.3	<1.3	<1.3	<1.3	----
Freon 11	75-69-4	2.8	µg/m³	<2.8	<2.8	<2.8	<2.8	----
1.1-Dichloroethene	75-35-4	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Dichloromethane	75-09-2	1.7	µg/m³	<1.7	<1.7	<1.7	<1.7	----
Freon 113	76-13-1	3.8	µg/m³	<3.8	<3.8	<3.8	<3.8	----
1.1-Dichloroethane	75-34-3	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
cis-1.2-Dichloroethene	156-59-2	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Chloroform	67-66-3	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
1.2-Dichloroethane	107-06-2	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
1.1.1-Trichloroethane	71-55-6	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
Benzene	71-43-2	1.6	µg/m³	<1.6	**1.9**	**1.9**	<1.6	----
Carbon Tetrachloride	56-23-5	3.1	µg/m³	<3.1	<3.1	<3.1	<3.1	----
1.2-Dichloropropane	78-87-5	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
Trichloroethene	79-01-6	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
cis-1.3-Dichloropropylene	10061-01-5	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
trans-1.3-Dichloropropene	10061-02-6	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
1.1.2-Trichloroethane	79-00-5	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
Toluene	108-88-3	1.9	µg/m³	**6.8**	**9.8**	**10.5**	**6.8**	----
1.2-Dibromoethane (EDB)	106-93-4	3.8	µg/m³	<3.8	<3.8	<3.8	<3.8	----
Tetrachloroethene	127-18-4	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
Chlorobenzene	108-90-7	2.3	µg/m³	<2.3	<2.3	<2.3	<2.3	----
Ethylbenzene	100-41-4	2.2	µg/m³	<2.2	<2.2	<2.2	<2.2	----
meta- & para-Xylene	108-38-3 106-42-3	4.3	µg/m³	<4.3	<4.3	<4.3	<4.3	----
Styrene	100-42-5	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
1.1.2.2-Tetrachloroethane	79-34-5	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
ortho-Xylene	95-47-6	2.2	µg/m³	<2.2	<2.2	<2.2	<2.2	----
4-Ethyltoluene	622-96-8	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
Total Xylenes	----	6.5	µg/m³	<6.5	<6.5	<6.5	<6.5	----
1.3.5-Trimethylbenzene	108-67-8	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----

Analytical Results

Sub-Matrix: AMBIENT (Matrix: AIR)			Sample ID	AS01_20201111 C222_S2832	AS02_20201111 C217_S2821	AS01_20201118 C220_S1619	AS02_20201118 C212_S2854	----
			Sampling date / time	11-Nov-2020 00:00	11-Nov-2020 00:00	18-Nov-2020 00:00	18-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	EN2007768-001	EN2007768-002	EN2007768-003	EN2007768-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15 (Calculated Concentration) - Continued								
1.2.4-Trimethylbenzene	95-63-6	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
1.3-Dichlorobenzene	541-73-1	3.0	µg/m³	<3.0	<3.0	<3.0	<3.0	----
Benzylchloride	100-44-7	2.6	µg/m³	<2.6	<2.6	<2.6	<2.6	----
1.4-Dichlorobenzene	106-46-7	3.0	µg/m³	<3.0	<3.0	<3.0	<3.0	----
1.2-Dichlorobenzene	95-50-1	3.0	µg/m³	<3.0	<3.0	<3.0	<3.0	----
1.2.4-Trichlorobenzene	120-82-1	3.7	µg/m³	<3.7	<3.7	<3.7	<3.7	----
Hexachlorobutadiene	87-68-3	5.3	µg/m³	<5.3	<5.3	<5.3	<5.3	----
Acetone	67-64-1	1.2	µg/m³	**8.3**	**8.8**	**5.2**	**4.7**	----
Bromodichloromethane	75-27-4	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
1.3-Butadiene	106-99-0	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	----
Carbon disulfide	75-15-0	1.6	µg/m³	<1.6	<1.6	<1.6	<1.6	----
2-Chlorotoluene	95-49-8	2.6	µg/m³	<2.6	<2.6	<2.6	<2.6	----
1-Chloro-2-propene (Allyl chloride)	107-05-1	1.6	µg/m³	<1.6	<1.6	<1.6	<1.6	----
Cyclohexane	110-82-7	1.7	µg/m³	<1.7	<1.7	<1.7	<1.7	----
Dibromochloromethane	124-48-1	4.3	µg/m³	<4.3	<4.3	<4.3	<4.3	----
1.4-Dioxane	123-91-1	1.8	µg/m³	<1.8	**3.2**	<1.8	<1.8	----
Ethylacetate	9002-89-5	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
trans-1.2-Dichloroethene	156-60-5	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Heptane	142-82-5	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Hexane	110-54-3	1.8	µg/m³	**2.8**	**3.5**	**4.2**	<1.8	----
Isooctane	540-84-1	2.3	µg/m³	**3.3**	**5.1**	**6.1**	**4.2**	----
Isopropyl Alcohol	67-63-0	1.2	µg/m³	**4.4**	**2.7**	**7.8**	**3.4**	----
2-Butanone (MEK)	78-93-3	1.5	µg/m³	**1.8**	<1.5	<1.5	<1.5	----
Methyl iso-Butyl ketone	108-10-1	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
2-Hexanone (MBK)	591-78-6	2.0	µg/m³	<2.0	<2.0	<2.0	<2.0	----
Propene	115-07-1	0.9	µg/m³	<0.9	<0.9	<0.9	<0.9	----
Methyl tert-Butyl Ether (MTBE)	1634-04-4	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Tetrahydrofuran	109-99-9	1.5	µg/m³	<1.5	<1.5	<1.5	<1.5	----
Bromoform	75-25-2	5.2	µg/m³	<5.2	<5.2	<5.2	<5.2	----
Vinyl Acetate	108-05-4	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Vinyl bromide	593-60-2	2.2	µg/m³	<2.2	<2.2	<2.2	<2.2	----
Acetonitrile	75-05-8	0.8	µg/m³	<0.8	<0.8	<0.8	<0.8	----
Acrolein	107-02-8	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	----

Analytical Results

Sub-Matrix: AMBIENT (Matrix: AIR)			Sample ID	AS01_20201111 C222_S2832	AS02_20201111 C217_S2821	AS01_20201118 C220_S1619	AS02_20201118 C212_S2854	----
			Sampling date / time	11-Nov-2020 00:00	11-Nov-2020 00:00	18-Nov-2020 00:00	18-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	EN2007768-001	EN2007768-002	EN2007768-003	EN2007768-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15 (Calculated Concentration) - Continued								
Acrylonitrile	107-13-1	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	----
tert-Butyl alcohol	75-65-0	1.5	µg/m³	<1.5	<1.5	<1.5	<1.5	----
2-Chloro-1.3-butadiene	126-99-8	1.8	µg/m³	<1.8	<1.8	<1.8	<1.8	----
Di-isopropyl Ether	108-20-3	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
Ethyl tert-Butyl Ether (ETBE)	637-92-3	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
tert-Amyl Methyl Ether (TAME)	994-05-8	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
Methyl Methacrylate	80-62-6	2.1	µg/m³	<2.1	<2.1	<2.1	<2.1	----
1.1.1.2-Tetrachloroethane	630-20-6	3.4	µg/m³	<3.4	<3.4	<3.4	<3.4	----
Isopropylbenzene	98-82-8	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
n-Propylbenzene	103-65-1	2.4	µg/m³	<2.4	<2.4	<2.4	<2.4	----
tert-Butylbenzene	98-06-6	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
sec-Butylbenzene	135-98-8	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
2-isopropyltoluene	527-84-4	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
n-Butylbenzene	104-51-8	2.7	µg/m³	<2.7	<2.7	<2.7	<2.7	----
Naphthalene	91-20-3	2.6	µg/m³	<2.6	<2.6	<2.6	<2.6	----
EP101: VOCs by USEPA Method TO15r								
Freon 12	75-71-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chloromethane	74-87-3	0.5	ppbv	**0.7**	**0.6**	**0.6**	**0.6**	----
Freon 114	76-14-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Vinyl chloride	75-01-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Bromomethane	74-83-9	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chloroethane	75-00-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Freon 11	75-69-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1-Dichloroethene	75-35-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Dichloromethane	75-09-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Freon 113	76-13-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1-Dichloroethane	75-34-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
cis-1.2-Dichloroethene	156-59-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chloroform	67-66-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2-Dichloroethane	107-06-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.1-Trichloroethane	71-55-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Benzene	71-43-2	0.5	ppbv	<0.5	**0.6**	**0.6**	<0.5	----
Carbon Tetrachloride	56-23-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2-Dichloropropane	78-87-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: AMBIENT (Matrix: AIR)			Sample ID	AS01_20201111 C222_S2832	AS02_20201111 C217_S2821	AS01_20201118 C220_S1619	AS02_20201118 C212_S2854	----
			Sampling date / time	11-Nov-2020 00:00	11-Nov-2020 00:00	18-Nov-2020 00:00	18-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	EN2007768-001	EN2007768-002	EN2007768-003	EN2007768-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15r - Continued								
Trichloroethene	79-01-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
cis-1.3-Dichloropropylene	10061-01-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
trans-1.3-Dichloropropene	10061-02-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.2-Trichloroethane	79-00-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Toluene	108-88-3	0.5	ppbv	**1.8**	**2.6**	**2.8**	**1.8**	----
1.2-Dibromoethane (EDB)	106-93-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Tetrachloroethene	127-18-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Chlorobenzene	108-90-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Ethylbenzene	100-41-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	1.0	ppbv	<1.0	<1.0	<1.0	<1.0	----
Styrene	100-42-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.2.2-Tetrachloroethane	79-34-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
4-Ethyltoluene	622-96-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.3.5-Trimethylbenzene	108-67-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2.4-Trimethylbenzene	95-63-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.3-Dichlorobenzene	541-73-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Benzylchloride	100-44-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.4-Dichlorobenzene	106-46-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2-Dichlorobenzene	95-50-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.2.4-Trichlorobenzene	120-82-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Hexachlorobutadiene	87-68-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acetone	67-64-1	0.5	ppbv	**3.5**	**3.7**	**2.2**	**2.0**	----
Bromodichloromethane	75-27-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.3-Butadiene	106-99-0	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Carbon disulfide	75-15-0	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-Chlorotoluene	95-49-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1-Chloro-2-propene (Allyl chloride)	107-05-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Cyclohexane	110-82-7	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Dibromochloromethane	124-48-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.4-Dioxane	123-91-1	0.5	ppbv	<0.5	**0.9**	<0.5	<0.5	----
Ethylacetate	9002-89-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
trans-1.2-Dichloroethene	156-60-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: AMBIENT (Matrix: AIR)			Sample ID	AS01_20201111 C222_S2832	AS02_20201111 C217_S2821	AS01_20201118 C220_S1619	AS02_20201118 C212_S2854	----
			Sampling date / time	11-Nov-2020 00:00	11-Nov-2020 00:00	18-Nov-2020 00:00	18-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	EN2007768-001	EN2007768-002	EN2007768-003	EN2007768-004	--------
				Result	Result	Result	Result	----
EP101: VOCs by USEPA Method TO15r - Continued								
Heptane	142-82-5	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Hexane	110-54-3	0.5	ppbv	**0.8**	**1.0**	**1.2**	<0.5	----
Isooctane	540-84-1	0.5	ppbv	**0.7**	**1.1**	**1.3**	**0.9**	----
Isopropyl Alcohol	67-63-0	0.5	ppbv	**1.8**	**1.1**	**3.2**	**1.4**	----
2-Butanone (MEK)	78-93-3	0.5	ppbv	**0.6**	<0.5	<0.5	<0.5	----
Methyl iso-Butyl ketone	108-10-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-Hexanone (MBK)	591-78-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Propene	115-07-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Methyl tert-Butyl Ether (MTBE)	1634-04-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Tetrahydrofuran	109-99-9	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Bromoform	75-25-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Vinyl Acetate	108-05-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Vinyl bromide	593-60-2	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acetonitrile	75-05-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acrolein	107-02-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Acrylonitrile	107-13-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
tert-Butyl alcohol	75-65-0	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-Chloro-1.3-butadiene	126-99-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Di-isopropyl Ether	108-20-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Ethyl tert-Butyl Ether (ETBE)	637-92-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
tert-Amyl Methyl Ether (TAME)	994-05-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Methyl Methacrylate	80-62-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
1.1.1.2-Tetrachloroethane	630-20-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Isopropylbenzene	98-82-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
n-Propylbenzene	103-65-1	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
tert-Butylbenzene	98-06-6	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
sec-Butylbenzene	135-98-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
2-isopropyltoluene	527-84-4	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
n-Butylbenzene	104-51-8	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	0.5	ppbv	<0.5	<0.5	<0.5	<0.5	----
Sampling Quality Assurance								
Pressure - As received	PRESSURE	0.1	kPaa	**81.9**	**85.6**	**100**	**86.7**	----
Pressure - Gauge as Received	----	1	Inches Hg	**-8**	**-4**	**-4**	**-5**	----
Pressure - Laboratory Atmosphere	----	0.1	kPaa	**101**	**101**	**101**	**101**	----

Analytical Results

Sub-Matrix: AMBIENT (Matrix: AIR)			Sample ID	AS01_20201111 C222_S2832	AS02_20201111 C217_S2821	AS01_20201118 C220_S1619	AS02_20201118 C212_S2854	----
			Sampling date / time	11-Nov-2020 00:00	11-Nov-2020 00:00	18-Nov-2020 00:00	18-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	EN2007768-001	EN2007768-002	EN2007768-003	EN2007768-004	--------
				Result	Result	Result	Result	----
Sampling Quality Assurance - Continued								
Temperature as Received	----	0.1	°C	21.0	21.0	21.0	21.0	----
USEPA Air Toxics Method TO15r Surrogates								
4-Bromofluorobenzene	460-00-4	0.5	%	102	101	101	101	----

Surrogate Control Limits

Sub-Matrix: **AMBIENT**

Compound	CAS Number	Recovery Limits (%) Low	High
USEPA Air Toxics Method TO15r Surrogates			
4-Bromofluorobenzene	460-00-4	60	140

APPENDIX B QUALITY CONTROL REPORT (QCR)

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EN2007752**	Page	: 1 of 4
Client	: **ENVIRONMENTAL RESOURCES MANAGEMENT (ERM)**	Laboratory	: Environmental Division Newcastle
Contact	: James Grieve	Telephone	: +61 2 8784 8555
Project	: 0574490 WICKHAM AQIA/HHRA R1	Date Samples Received	: 18-Nov-2020
Site	: ----	Issue Date	: 24-Nov-2020
Sampler	: James Grieve	No. of samples received	: 4
Order number	: 0574490	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **AIR**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EP101: VOCs by USEPA Method TO15r							
Summa style Canister - ALS Supplied Silonite (EP101-15X) AS01_20201109 - C4991_S1834, AS02_20201109 - C4759_S12208	**09-Nov-2020**	**----**	----	----	**20-Nov-2020**	09-Dec-2020	✓
Summa style Canister - ALS Supplied Silonite (EP101-15X) AS01_20201116 - C4988_S12210, AS02_20201116 - C4741_S12211	**16-Nov-2020**	**----**	----	----	**20-Nov-2020**	16-Dec-2020	✓
Sampling Quality Assurance							
Summa style Canister - ALS Supplied Silonite (CAN-001) AS01_20201109 - C4991_S1834, AS02_20201109 - C4759_S12208	**09-Nov-2020**	**----**	----	----	**19-Nov-2020**	09-Nov-2021	✓
Summa style Canister - ALS Supplied Silonite (CAN-001) AS01_20201116 - C4988_S12210, AS02_20201116 - C4741_S12211	**16-Nov-2020**	**----**	----	----	**19-Nov-2020**	16-Nov-2021	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **AIR**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Duplicate Control Samples (DCS)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Duplicates (DUP)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Canister Sampling - Field Data	CAN-001	AIR	In house: Referenced to USEPA TO14 / TO15
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	AIR	In house: Referenced to USEPA TO15r Volatile Organic Compounds in Air by USEPA TO15. Extended Suite
VOCs in Air by USEPA TO15r - Extended Suite (mass/volume)	EP101-15X-MV	AIR	In house: Referenced to USEPA TO15r Volatile Organic Compounds in Air by USEPA TO15. Extended Suite (Calculated Concentration)

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EN2007768**	Page	: 1 of 4
Client	: **ENVIRONMENTAL RESOURCES MANAGEMENT (ERM)**	Laboratory	: Environmental Division Newcastle
Contact	: James Grieve	Telephone	: +61 2 8784 8555
Project	: 0574490 WICKHAM AQIA/HHRA	Date Samples Received	: 19-Nov-2020
Site	: ----	Issue Date	: 25-Nov-2020
Sampler	: James Grieve	No. of samples received	: 4
Order number	: 0574490	No. of samples analysed	: 4

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Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

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- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

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This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **AIR**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP101: VOCs by USEPA Method TO15r							
Summa style Canister - ALS Supplied Silonite (EP101-15X) AS01_20201111 - C222_S2832, AS02_20201111 - C217_S2821	**11-Nov-2020**	**----**	----	----	**23-Nov-2020**	11-Dec-2020	✓
Summa style Canister - ALS Supplied Silonite (EP101-15X) AS01_20201118 - C220_S1619, AS02_20201118 - C212_S2854	**18-Nov-2020**	**----**	----	----	**23-Nov-2020**	18-Dec-2020	✓
Sampling Quality Assurance							
Summa style Canister - ALS Supplied Silonite (CAN-001) AS01_20201111 - C222_S2832, AS02_20201111 - C217_S2821	**11-Nov-2020**	**----**	----	----	**25-Nov-2020**	11-Nov-2021	✓
Summa style Canister - ALS Supplied Silonite (CAN-001) AS01_20201118 - C220_S1619, AS02_20201118 - C212_S2854	**18-Nov-2020**	**----**	----	----	**25-Nov-2020**	18-Nov-2021	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **AIR**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Duplicate Control Samples (DCS)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Duplicates (DUP)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Canister Sampling - Field Data	CAN-001	AIR	In house: Referenced to USEPA TO14 / TO15
VOCs in Air by USEPA TO15r - Extended Suite	EP101-15X	AIR	In house: Referenced to USEPA TO15r Volatile Organic Compounds in Air by USEPA TO15. Extended Suite
VOCs in Air by USEPA TO15r - Extended Suite (mass/volume)	EP101-15X-MV	AIR	In house: Referenced to USEPA TO15r Volatile Organic Compounds in Air by USEPA TO15. Extended Suite (Calculated Concentration)

APPENDIX C CHAIN OF CUSTODY (COC)

AIR CANISTER CHAIN OF CUSTODY

If sourced from an ALS Laboratory: please tick →

Client Supplied Canister(s)? Y / N

CLIENT:	ARRISCAR AUST P/L
OFFICE:	SYDNEY
PROJECT:	WICKHAM AQIA / HHRA R1
PROJECT NO:	0574490
CANISTER REQUEST NO:	—
PURCHASE ORDER NO.:	0574490
PROJECT MANAGER:	J. GRIEVE
CONTACT PH:	—
SAMPLER:	J. GRIEVE
SAMPLER MOBILE:	—
COC Emailed to ALS?	(YES / NO) YES
EDD FORMAT (or default):	
Email Reports to (will default to PM if no other addresses are listed):	james.grieve@erm.com
Email Invoice to (will default to PM if no other addresses are listed):	james.grieve@erm.com
COMMENTS/SPECIAL HANDLING/REPLACEMENT OR RETURN INSTRUCTIONS:	

TURNAROUND REQUIREMENTS: (Standard TAT may be extended for multiple sequential analysis suites)

- [x] Standard TAT (List due date):
- [ ] Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: EN/114/20

COUNTRY OF ORIGIN: AUSTRALIA

COC SEQUENCE NUMBER (Circle)

COC: 1 2 3 4 5 6 7

OF: 1 2 3 4 5 6 7

LABORATORY USE ONLY (Circle) Receiver to initial and date/time

Custody Seal Intact? Rec Lab Y/N NE Y/N N/A

Valves closed on Receipt? Rec Lab Y/N NE Y/N N/A

Canister/Sampler Complete and Not Damaged Yes No

Other comment: Temperature °C

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
J. GRIEVE (DIRECT TO LAB) 18/11/2020 Signature and date/time	Signature and date/time	Signature and date/time	Signature and date/time
RECEIVED BY: MM 18/11/20 9.55am Signature and date/time	RECEIVED BY: Signature and date/time	RECEIVED BY: Signature and date/time	RECEIVED BY: Signature and date/time

GAS SAMPLE CONTAINER INFORMATION

ALS USE ONLY LAB ID	CANISTER SERIAL NO.	FLOW CONTROLLER SERIAL NO.	CLIENT SAMPLE ID	DATE / TIME SAMPLED	MATRIX (eg Air, Soil Gas)	Canister Gauge Pressures (PSI) Pre-Sampling	Post Sampling	LORs Ambient Air	Soil Gas (NEPM)	Other / Indoor	Units ppbv, µg/m³	ppmv, mg/m³	ANALYSES REQUESTED (Suite Codes must be listed to attract suite price)	Additional Information (Comments on LORs required, potential hazards, likely contaminant levels, or samples requiring specific QC analysis etc. (LOR defaults to routine method LOR after dilution))
	4991	1834	AS01_20201109	9/11/20 10:30	AIR	-30	-2	X			X		EP101-15X (REPORT FULL LIST)	AMBIENT AIR SAMPLES
	4759	12208	AS02_20201109	9/11/20 10:40	AIR	-30	-6	X			X			
	4988	12210	AS01_20201116	16/11/20 11:03	AIR	-30	-6	X			X			
	4741	12211	AS02_20201116	16/11/20 11:06	AIR	-31	-7	X			X			

Reporting Requirements: Refer to Canister Verification Reports and COAs for pressures measured by the Lab

Environmental Division Newcastle
Work Order Reference
EN2007752

Telephone: + 61 2 4014 2500

Job Specific Instructions:

AIR SAMPLING EQUIPMENT DISPATCH RECORD

Inquiries: Client Services - Newcastle **Phone: +61 (02) 4014 2500** E-mail: alsenviro.newcastle@alsglobal.com

Dispatch to:		ALS Use ONLY	
Client / Office:	ERM	Request Received By:	TB 30/10/20
Contact:	James Grieve	Deliver By:	09/11/20
Telephone:	0448 468 623	Dispatched By:	09/11/20
ALS Quotation:		Workorder:	
Delivery Address:	Pick up 09/11/20	Agreed Rent Free Period:	21 days

SPECIAL INSTRUCTIONS:

Air Sampling Equipment Request

CANISTERS

No.	Canister Type	Size	Gauge	Valve	Cap	Rental	No Returned	Leak Checked	Certified OK
4	Entech Silonite Canister (Summa™)	6L	Yes	S	Yes	$200 ea		✓ Dales 5.11.20	

Analysts Initials & Date

CONNECTORS AND FLOW CONTROL DEVICES

No.	Equipment Type	Duration (hr)	Flow Rate	T-Piece	Gauge	Certified	Sealed / Vacuum	Connection to Quick Connect or Swagelok	No. Returned	Rental
4	Passive Sampler -TWA	24		No	Yes	Yes	Yes / No	S		Incl Above
4	¼" Swagelok connectors and ferrules (spares)	-	-	-	-	-	-			$5 ea. Replacement

X Other (specify) T-Piece

[1] *Refer to Acceptance of Terms*

ALS use only			
Sampling Guide Included (Y/N) N	Packed by:		Dispatch Time / Date
Number of Boxes:	2	Consignment Note Number:	—
Courier / Dispatcher:	—	Consignment Dispatched by:	MM

Dales
5.11.20

AIR SAMPLING EQUIPMENT DISPATCH RECORD

ALS SUPPLIED EQUIPMENT

Item	Quantity	Item Description	Serial Nos
	4	6L Silonite Summa™ canister	[redacted]
	4	Passive Sampler - TWA	[redacted]

AIR CANISTER CHAIN OF CUSTODY

ALS

If sourced from an ALS Laboratory: please tick →

Client Supplied Canister(s)? Y / N

☐ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 81625130 E: adelaide@alsglobal.com
☐BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
☐MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 49525795 E: ALSEnviro.Mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E:samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☒NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 26 Rigali Way Wangara WA 6065 Ph: 08 94061301 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 13 Carlton Street Kirwan QLD 4817 Ph: 07 47730000 E: ALSEnviro.Townsville@alsglobal.com
☐WOLLONGONG 1/19-21 Ralph Black Drive Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: ARRISCAR AUST P/L

OFFICE: SYDNEY

PROJECT: WICKHAM AQIA/HHRA **PROJECT NO:** 0574490

CANISTER REQUEST NO: – **PURCHASE ORDER NO.:** 0574490

PROJECT MANAGER: J. GRIEVE **CONTACT PH:** –

SAMPLER: J. GRIEVE **SAMPLER MOBILE:** –

COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**

Email Reports to (will default to PM if no other addresses are listed): james.grieve@erm.com

Email Invoice to (will default to PM if no other addresses are listed): james.grieve@erm.com

COMMENTS/SPECIAL HANDLING/REPLACEMENT OR RETURN INSTRUCTIONS:

TURNAROUND REQUIREMENTS: (Standard TAT may be extended for multiple sequential analysis suites)
☒ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: EN/114/20

COUNTRY OF ORIGIN:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Valves closed on Receipt? Yes No N/A
Canister/Sample Complete and Not Damaged? Yes No N/A
Other comment: Temperature:

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
J.GRIEVE 19/11/20 (DIRECT TO LAB) Signature and date/time	Signature and date/time	Signature and date/time	Signature and date/time
RECEIVED BY: MM 19/11/20 9-45am Signature and date/time	**RECEIVED BY:** Signature and date/time	**RECEIVED BY:** Signature and date/time	**RECEIVED BY:** Signature and date/time

GAS SAMPLE CONTAINER INFORMATION

LAB ID	CANISTER SERIAL NO.	FLOW CONTROLLER SERIAL NO.	CLIENT SAMPLE ID	DATE / TIME SAMPLED	MATRIX (eg Air, Soil Gas)	Canister Gauge Pressures (PSI) Pre-Sampling	Post Sampling	LORs Ambient Air	Soil Gas (NEPM)	Other / Indoor	Units ppbv, µg/m³	ppmv, mg/m³	ANALYSES REQUESTED (Suite Codes must be listed to attract suite price)	Additional Information (Comments on LORs required, potential hazards, likely contaminant levels, or samples requiring specific QC analysis etc. (LOR defaults to routine method LOR after dilution))
1	222	2832	AS01_20201111	11/11/20 9:40	AIR	-30	-8	X			X		EP101-15X (REPORT FULL LIST)	AMBIENT AIR SAMPLES
2	217	2821	AS02_20201111	11/11/20 9:40	AIR	-30	-4	X			X			
3	220	1619	AS01_20201118	18/11/20 10:27	AIR	-32	-3	X			X			
4	212	2854	AS02_20201118	18/11/20 10:29	AIR	-30	-5	X			X			

Refer to Canister Verification Reports and COAs for pressures measured by the Lab

Environmental Division
Newcastle
Work Order Reference
EN2007768

Telephone : + 61 2 4014 2500

Job Specific Instructions:

Minerals Coal Environmental Tribology Food & Pharmaceutical Industrial

AIR SAMPLING EQUIPMENT DISPATCH RECORD

Inquiries: Client Services - Newcastle **Phone: +61 (02) 4014 2500** E-mail: alsenviro.newcastle@alsglobal.com

Dispatch to:

Client / Office:	ERM	**ALS Use ONLY**	
Contact:	James Grieve	**Request Received By:**	TB 05/11/20
Telephone:	0448 468 623	**Deliver By:**	10/11/20
ALS Quotation:		**Dispatched By:**	10/11/20
Delivery Address:	Pick up 10/11/20	**Workorder:**	
		Agreed Rent Free Period:	21 days

SPECIAL INSTRUCTIONS: ....

Air Sampling Equipment Request

CANISTERS

No.	Canister Type	Size	Gauge	Valve	Cap	Rental[1]	No Returned	Leak Checked	Certified OK
4	Entech Silonite Canister (Summa™)	3.2L	Yes	S	Yes	$200 ea		✓	TQ

Analysts Initials & Date

10.11.20

CONNECTORS AND FLOW CONTROL DEVICES

No.	Equipment Type	Duration (hr)	Flow (mL/min)	T-Piece	Gauge	Certified	Sealed/ Vacuum	Connection Q Quick Connect S Swagelok	No. Returned	Rental
4	Passive Sampler -TWA	24		No	Yes	Yes	Yes / No	S		Incl Above
4	¼" Swagelok connectors and ferrules (spares)	-	-	-	-	-	-			$5 ea. Replacement

☒ Other (specify) T-Piece ✓

[1] *Refer to Acceptance of Terms*

ALS use only			
Sampling Guide Included (Y / N):	Packed by:		Dispatch Time / Date:
Number of Boxes: 1		Consignment Note Number:	
Courier / Dispatcher:		Consignment Dispatched by: KP 10-11-2020	

RIGHT SOLUTIONS

Minerals Coal Environmental Tribology Food & Pharmaceutical Industrial

AIR SAMPLING EQUIPMENT DISPATCH RECORD

ALS SUPPLIED EQUIPMENT

Item	Quantity	Item Description	Serial Nos
	4	3.2L Silonite Summa™ canister	222 ✓ 212 ✓ 217 ✓ 220 ✓
	4	Passive Sampler - TWA	2832 ✓ 2821 ✓ 2854 ✓ 1619 ✓

ENFMCDR1.1 11-05-11

RIGHT SOLUTIONS

Brisbane · Adelaide · Bendigo · Canberra · Geelong · Gladstone · Melbourne (Scoresby) · Melbourne (Springvale) · Mudgee · Newcastle · Nowra · Perth · Wollongong · Sydney · Townsville · Traralgon · Wangaratta

www.alsglobal.com

ALS

Minerals Coal Environmental Tribology Food & Pharmaceutical Industrial

AIR SAMPLING EQUIPMENT DISPATCH RECORD

Acceptance of Terms:

Acceptance and use of the accompanying ALS Air Sampling Equipment constitutes acceptance of the following terms:

1. This equipment remains the property of ALS Laboratory Group.
2. Subject to the conditions below and unless stated otherwise in the relevant quotation, the supply and use of this equipment is included the price of analysis.
3. No responsibility is accepted by ALS for equipment requirements that have been incorrectly or incompletely specified by the client. Interfacing of ALS equipment with other sampling equipment or structures is solely the client's responsibility.
4. Sampling equipment is configured and supplied based on client specified requirements. ALS will take all reasonable care to meet these specifications, but will not accept responsibility for changes in equipment calibration or failures during transit. Replacement equipment will be provided at no charge if required.
5. Equipment calibration and verification records are available for review on request. Verification reports are provided with equipment and electronic copies are available on request.
6. This air sampling equipment is provided solely for the use of the nominated client. Responsibility for ensuring the equipment is not damaged and for returning this equipment to ALS remains with the nominated client until all equipment is returned to the ALS Group.
7. Unless otherwise agreed in writing, if equipment is not returned within the agreed rent free period after dispatch, the quoted rental fees above will apply per week per unit thereafter. If equipment is returned unused, the cleaning fees quoted will apply (1 weeks rental charge). If sampling equipment return is delayed, please contact the laboratory prior to expiry of the rent free period to negotiate and extension.
8. Irreparably damaged equipment and any equipment not returned within 40 days will be charged to the client at a replacement cost per unit equal to 15 weeks rent less rental costs already paid.
9. Cleaning costs will apply for equipment marked or defaced by the client. Please attach labels for sample identification and recording of field data.

If these conditions are not acceptable please return all equipment to ALS Newcastle immediately.

EQUIPMENT SUPPLY AND LOGISTICS

Additional air sampling equipment can be ordered through any ALS Environmental Laboratory and supplied direct to your site or office by courier. For the fastest turnaround, equipment should be returned direct to Newcastle Laboratory.

ALS Environmental, Newcastle
5/585 Maitland Road
Mayfield West, NSW 2304

Note that Dangerous Goods Transport Regulations may apply after sampling if the air cylinders are pressurised or contain hazardous materials.

APPENDIX D WIND ROSE GUIDANCE

How to read a wind rose

A wind rose shows the frequency of occurrence of winds by direction and strength, presented as 16 bars that correspond to the compass points (N, NNE, NE, etc). The length of each bar represents the frequency of occurrence of winds from that direction, and the colours of the bar sections correspond to wind speed categories, the darker colours representing stronger winds.

In this example, 29% of winds are from the WNW direction, and the winds from this direction have the following speed distribution:

- 10% between 1.5 m/s and 3 m/s
- 10% between 3 m/s and 4.5 m/s
- 3% between 4.5 m/s and 6 m/s
- 2% between 6 m/s and 7.5 m/s

Predominant wind direction

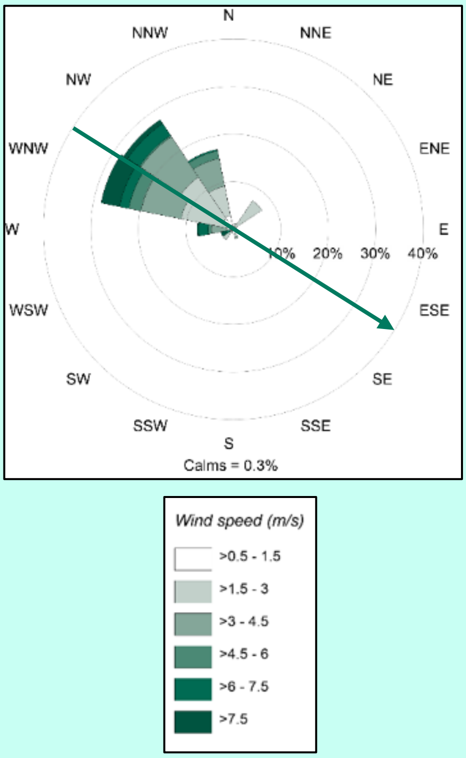

Figure E-1: Guidance on the interpretation of wind roses

ERM has over 160 offices across the following countries and territories worldwide

Argentina	The Netherlands
Australia	New Zealand
Belgium	Norway
Brazil	Panama
Canada	Peru
Chile	Poland
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Colombia	Puerto Rico
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Guyana	Singapore
Hong Kong	South Africa
India	South Korea
Indonesia	Spain
Ireland	Sweden
Italy	Switzerland
Japan	Taiwan
Kazakhstan	Tanzania
Kenya	Thailand
Malaysia	UAE
Mexico	UK
Mozambique	US
Myanmar	Vietnam

ERM's Sydney Office
Level 15, 309 Kent Street
Sydney NSW 200

www.erm.com

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ERM