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Human Health Risk Assessment

Section 51, Kippax Group Centre, Holt ACT 2615

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Executive Summary

SAGE Environmental Services Pty Ltd (SAGE) were engaged by the ACT Government Environment, Planning and Sustainable Development Directorate (EPSDD) to conduct a Human Health Risk Assessment (HHRA) for the Kippax Group Centre. The site is located at Section 51, Holt, ACT (the Site).

The HHRA was prepared to characterise the risk that existing contamination at the Site poses to current and potential future users. The Site is expected to be redeveloped following the sale of the land by EPSDD, however, the proposed redevelopment and subsequent use has not been defined for the sale. This HHRA and the associated contamination investigations conducted by environmental consultant Lanterra Consulting Pty Ltd (Lanterra) were commissioned to support due diligence procedures in the divestment of this land. As future land use is not yet known, this HHRA was conducted to assess the associated contaminant risk for a range of land uses, as well as informing remedial extent and approach (as necessary).

SAGE prepared this HHRA utilising data obtained from Lanterra during various field programs carried out between 2021 and 2022. The representative groups of people who may be exposed to the contaminants of potential concern (CoPC) measured in the environment at the Site and assessed in the HHRA were:

- Commercial receptors;
- Residential receptors; and
- Recreational receptors.

The HHRA considered the potential risk for both the current land zoning and the potential allowable future land uses based on information presented in the Holt Precinct Map and Code (EPSSD, 2020). The Site is zoned as CZ1 Commercial Core which allows for both residential and commercial land uses.

The HHRA found that as a result of the impacts identified in groundwater and soil vapour at the Site, there is likely to be a low risk of harm to health for residents, commercial workers, and recreational receptors at the Site

The risk characterisation for the Site and potential land uses has been undertaken in consideration of a number of data gaps and uncertainties identified in **Section 6.4** of this report. Key uncertainties include the available data set, noting there is potential for off-Site impacts to continue to migrate towards the Site over time. Therefore, future increases in concentrations of CoPC in environmental media on-Site may affect the potential risk to human health.

SAGE recommends ongoing environmental monitoring at the Site to continue to inform the risk profile. This ongoing assessment and risk monitoring should continue until the off-Site source has been delineated and no longer presents an ongoing source of impacts to the Site. SAGE suggests vapour mitigation measures (e.g. passive or active vapour barriers) should be considered in the re-development of the Site given the uncertainty of the offsite upgradient plume migrating to the site.

The Site is also the subject of a contaminated land audit with Lange Jorstad of Geosyntec Consultants (Geosyntec) the appointed Auditor for the site. This HHRA will be relied upon by

the Auditor when considering the suitability of the Site for the current and potential future land use.

1. Introduction

SAGE Environmental Services Pty Ltd (SAGE) were engaged by the ACT Government Environment, Planning and Sustainable Development Directorate (EPSDD) to conduct a Human Health Risk Assessment (HHRA) for the Kippax Group Centre. The Site is located at Block 71, Section 51, Holt, ACT (the Site).

A series of environmental investigations have been conducted at the Site by Lanterra Consulting Pty Ltd (Lanterra). Lanterra (2022c) identified off-Site, upgradient contamination sources have resulted in the migration of groundwater impacted by a range of contaminants of potential concern (CoPC) to the Site. Volatile CoPC in groundwater have generated soil vapour that were identified to present a potentially complete exposure pathway for on-Site land users via the inhalation pathway. Lanterra have undertaken both Preliminary Site Investigations (PSI, Lanterra, 2021a) and Detailed Site Investigations (DSI, Lanterra, 2021b, 2022a, 2022b, and 2022c) for the Site. The DSI was undertaken in four stages from April 2021 to March 2022 for the purpose of collecting sufficient data to characterise the nature and extent of contamination at the site, and adequately determine the likely sources of contamination.

In accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM amended 2013), as CoPC at the Site have been identified above the adopted Tier 1 screening criteria, further assessment of site-specific risk to human health is required. This HHRA presents the further assessment, also known as a Tier 2 assessment.

This HHRA has been prepared based on the results obtained during Lanterra's investigations as documented in the DSI (Lanterra, 2022c). SAGE has prepared the site-specific risk assessment for the purpose of:

- Understanding the current and potential future risk to human health as a result of the identified impacts at the Site; and
- To inform the remedial approach, and extent, based on the potential future residential and commercial land use at the Site.

The Site is the subject of an environmental audit under Section 91C of the *Environment Protection Act 1997* (EP Act). Lange Jorstad of Geosyntec Consultants (Geosyntec) is the appointed Auditor for this site. It is understood, this HHRA will be relied upon by the Auditor when considering the suitability of the Site for its current and potential future land use.

1.1. Background

EPSDD has been coordinating the Kippax Group Centre Master Plan project for several years in an effort to divest the land from the ACT Government and promote redevelopment in line with the 2012 and 2018 ACT Planning Strategy. The Kippax Group Centre Master Plan outlines potential options for the redevelopment of the Site for community use (EPSDD, 2019).

The site contamination investigations completed by Lanterra (2021a, 2021b, 2022a to 2022c) were undertaken to support the due diligence process as part of the divestment of the land. SAGE notes that the HHRA Site is a subset of the area investigated by Lanterra, and therefore a number of sampling locations are off-Site in relation to the HHRA. A discussion of on- and off-Site locations is provided in **Section 3.2**. **Figure 3** in **Appendix A**

presents the HHRA Site boundary in relation to the on-Site and off-Site soil vapour and groundwater monitoring locations. A detailed summary of these investigations has been provided in **Section 3.1** of this report. Following the completion of the PSI (Lanterra, 2021a) in April 2021, Lanterra began a four stage DSI process. The stages of the DSI were undertaken as below:

- Stage 1 (Lanterra, 2021b) completed April/May 2021. This involved initial investigations of soil and groundwater. Volatile chlorinated hydrocarbons (VCH) were detected at GW51.
- Stage 2 (Lanterra, 2022a) completed November 2021. This was undertaken to further delineate the extent of contamination (particularly VCH) in groundwater and soil vapour and involved the installation of three additional groundwater and two soil vapour monitoring wells.
- Stage 3 (Lanterra, 2022b) completed January 2022. This was undertaken to further delineate the extent of contamination in groundwater and soil vapour and involved the installation of six additional groundwater and seven additional soil vapour monitoring wells.
- Stage 4 (Lanterra, 2022c) completed March-May 2022. This was undertaken to further delineate the extent of contamination in groundwater and soil vapour and involved the installation of ten additional groundwater and seven additional soil vapour monitoring wells. The results of all stages of the DSI were consolidated into one report during this stage.

These investigations have identified that concentrations of VCH were above the published Tier 1 assessment criteria for the current, and potential future, land uses. The DSI (Lanterra, 2022c) noted that no activities that may have introduced VCH have been identified on the Site, and inferred that the source of CoPC identified at the Site had originated from off-Site locations to the southwest of the site. These off-Site sources were identified as a historical (circa 1980s) dry cleaning facility that was located with the Kippax Fair Shopping Centre along the western boundary of the Site and a currently operational dry cleaning facility located 200 m west of the Site. The contamination generated by these dry cleaning facilities are expected to have resulted in the elevated levels of VCH detected in groundwater and soil vapour wells located on the western and north-western boundary of the Site.

1.2. Purpose

This HHRA has been prepared for the purpose of providing an assessment of potential human health risk as a result of exposure to site contamination for both current land users; and potential future site users based on the Kippax Group Centre Master Plan (EPSDD, 2019).

Using the data collected by Lanterra, SAGE has undertaken a site-specific risk assessment to characterise the potential risk that existing levels of site contamination pose to human health. As the final site use is not yet known SAGE has developed risk profiles for the Site for a range of potential future land uses. The HHRA will inform remedial planning and assist in the preparation of a site management plan (SMP) to ensure the risk to human health is managed appropriately.

The HHRA presents a quantitative assessment of current and potential future on-Site risk only. Off-Site risk has been assessed qualitatively based on the current land use only, as

the quantitative assessment of off-Site risk especially in areas closer to the off-Site sources should be undertaken in consideration of additional data.

Should future investigations identify contaminants and contaminant sources not considered within this HHRA, it is recommended that this HHRA is reassessed in light of that information.

1.3. Regulatory Framework and Methodology

This assessment has been conducted based on the framework outlined in the ASC NEPM 2013, specifically:

- Schedule B4 Guideline on Site-Specific Health Risk Assessment Methodology;
- Schedule B7 Guideline on Derivation of Health-Based Investigation Levels.

The HHRA has also been prepared with reference to methodology outlined in the following relevant nationally adopted guidance:

- Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards. Department of Health and Aging, 2012 Update (enHealth, 2012a)

Additionally, the HHRA has been performed consistent with the relevant current national and state guidance, including:

- Vapour Intrusion: Technical Practice Note. NSW Department of Environment, Climate Change and Water NSW, 2010.

This HHRA has been prepared to inform the contaminated land audit conducted for the Site under Section 91C of the EP Act.

1.4. Structure of the HHRA

This risk assessment has been prepared in accordance with the ASC NEPM 2013 Schedule B4. Appendix 1 of Schedule B4 presents the 'structure of a risk assessment report' and notes that quantitative health risk assessments should be divided into five key steps which are detailed below and have undertaken in a staged approach:

Table 1 Structure of the HHRA

Step	Description
Step 1 Issues Identification	Issues identification is the process of planning and scoping the risk assessment and problem formulation. Information presented at this stage of the HHRA includes: • Description of the rationale for undertaking the HHRA. • Identification of stakeholders relevant to the HHRA and its outcomes. • Review of current and historic community survey data and information received via stakeholder engagement activities. • Outline of the HHRA objectives. • Consideration of the decisions that need to be made in relation to risk management as a result of the outcomes of the HHRA. Issues identification is presented in **Section 2** of this report.
Step 2	Data evaluation is the process of reviewing the available data set and determining whether it is appropriate for use in the risk assessment. This is

Step	Description

Data Collection, Evaluation and Conceptual Site Model	followed by a description of the CSM and identification of the CoPC to be evaluated in the quantitative assessment. Information presented at this stage of the HHRA includes:
	• Review of the relevant available information relating to previous investigations which have been completed at the Site.
	• Assessment of the quality and quantity of data available for use in this HHRA.
	• Identification of CoPC for the quantitative HHRA.
	• Assessment of the data gaps associated with environmental investigations completed at the Site to date and their significance with respect to this HHRA.
	• Identification of any rationale for spatial zoning or statistical considerations when evaluating the data.
	• Description of the CSM, which identifies the following:
	  • The source(s) of the CoPC.
	  • Potential transport mechanisms and/or migration pathways for the CoPC.
	  • Potential human receptors that may be exposed to the CoPC in the environment via potentially complete exposure pathways.
	
	Data collection, evaluation and a description of the CSM are presented in **Section 3** of this report.

Step 3 Exposure Assessment	Exposure assessment is the process of estimating the magnitude, frequency, extent and duration of human exposure to CoPC and refinement of the CSM based on these considerations. Specifically, this stage includes: • Translation of the CSM into modelling terms and further refinement of the CSM (if necessary). • Identification of potential and complete source-pathway-receptor pathways. • Identification and justification of the expected frequency, extent and duration of exposure to environmental media by human receptors via identified exposure pathways. Exposure parameters were adopted that considered information gathered from field observations and published data from Australian and international sources. • Identification of representative exposure point concentrations (EPC) in environmental media that will be used in the HHRA. EPC are identified by evaluating the available data characterising environmental media and the current understanding of how the identified human receptors might be exposed to the PFAS and other CoPC measured in the environment. • Quantitative estimation of chemical intakes for human receptors via the identified potentially complete exposure pathways. Exposure assessment is presented in **Section 4** of this report.
Step 4 Toxicity Assessment	Toxicity assessment is the process of understanding the health effects associated with exposure to CoPC and making a quantitative link between the degree of exposure and the effect realised. This stage includes: • Qualitative review of the potential hazards to human health associated with each of the CoPC. • Review of toxicological (dose-response) criteria for each of the CoPC and identification of appropriate quantitative toxicity criteria to use in the HHRA. The approach adopted for the toxicity assessment is presented in **Section 5** of this report.

Step	Description
Step 5 Risk Characterisation	Risk characterisation is the process of summarising information from the previous steps in the risk assessment approach and integrating it into a quantitative expression of potential risk. This stage includes: • Characterisation of the nature and potential incidence of harmful effects to receptors based on comparison of estimated contaminant intake or exposures to relevant toxicity reference values. • Comparison of risk estimates against risk acceptance criteria recommended and/or adopted by state and federal regulatory agencies. • Discussion of the key uncertainties associated with the HHRA process and the assumptions and exposure modelling undertaken for the HHRA. • Sensitivity assessment and consideration of the risk estimates in the context of the identified uncertainties. The risk characterisation and sensitivity assessment are presented in **Section 6** of this report. The uncertainty evaluation is presented in **Section 6.4** of the HHRA report.

2. Step 1: Issues Identification

This section outlines the relevant aspects considered in planning and scoping the risk assessment. It provides the relevant information pertaining to the site location and environmental setting. The site-specific information has largely been adapted from the information presented by Lanterra (e.g. Lanterra 2021a; 2022c) in the various investigations prepared for the Site. Other sources that have been used to formulate an understanding of the Site have been referenced where relevant.

2.1. Site Identification

The Site is identified as Block 71 of Section 51 within the ACT Government *Territory Plan 2008* prepared under Section 46 of the *Planning and Development Act 2007*. The Holt Precinct Map and Codes published under Section 10.1 of the *Territory Plan 2008* identifies the land zoning and land use rules relevant to the Kippax Group Centre (EPSSD, 2020). **Figure 1** and **Figure 2** within **Appendix A** illustrate the location of the Site as considered within the HHRA within the context of the surrounding suburbs and the cadastral information for the Site and surrounds. The investigation boundary identified by Lanterra in their DSI (2022c) differs from the boundary that identifies the Site considered in this HHRA. The Site boundary adopted for the HHRA is consistent with the area of land being divested by the ACT Government for future development. It is noted that Lanterra's assessments were to understand the contamination across a broader area. The differences in the boundary adopted for the HHRA and by Lanterra is illustrated on Figure 2 of the Lanterra DSI (2022c) (extract added to **Appendix A**), where Block 71 (the HHRA Site) is shown within the bounds of the Lanterra site boundary.

The Site, which is the subject of this HHRA, Block 71, Section 51, is located at Kippax Place, Holt, ACT. The Site is currently zoned as CZ1 Commercial Core and allows for both commercial and residential land uses. Also located within Section 51 is Block 22 which is currently occupied by the Former Kippax Health Centre. SAGE understands this Block is considered part of the HHRA Site. In addition to the Former Kippax Health Centre, the site currently comprises open community spaces including playing fields, pathways, benches and a skate ramp.

The Site is currently bounded by a mix of roadway, commercial, residential, and open-space land uses: Kippax Place roadway is located at the south-western Site boundary; Kippax Fair Shopping Centre is positioned on the western boundary of the Site; high density residential properties are located at the northern Site boundary; and recreational open space encompasses the remainder of the northern and eastern Site boundaries.

Table 2 below provides a summary of the land zoning and uses within the Site boundaries.

Table 2 Summary of Site details

Site Characteristic	Description
Street Address	Kippax Place, Holt, ACT, 2615
Approximate Elevation (m AHD)	561 – 570
Block, Section, Division	Block 71, Section 51 Holt ACT
Current Land Zoning	CZ1: Core Zone
Future Land Zoning	CZ1: Core Zone (as per EPSSD, 2020)
Current Land Use	Public Open Space and Community Building
Future Land Use	Mixed use commercial, residential and public open space
Site Area	19,645 m^2

2.1. Environmental Setting

The topography of the Site has been described as being relatively flat with a gentle downward slope from the south to the north (Lanterra, 2021a). Elevations across the investigation area range from 561-570 m Australian Height Datum (AHD). The playing fields that occupy the greatest area of the Site and are relatively level with elevations ranging 564-566 mAHD.

The Site is underlain by two distinguishable geological units that belong to the Deakin Volcanics deposited in the late Silurian period (Lanterra, 2021a). Geology to the south of the Site (beneath the playing field and adjacent to Kippax Place) consists of tuffaceous and quartz sandstone with minor shale deposited in a shallow marine environment. The area to the north (beneath the community park and Former Kippax Health Centre) is characterised by pyroclastic igneous deposits, particularly rhyodacitic ignimbrite with clay-rich, volcaniclastic sedimentary rocks.

The bore logs presented by Lanterra (2022c) indicated that surficial soils were derived from imported fill and natural materials. Imported fill was apparent across the playing fields (on-Site) and within the road reserves associated with Kippax Place and Moyes Crescent (off-Site). The fill material was described by Lanterra (2021b) as being sandy to gravelly clay beneath the playing fields and gravelly silty sand beneath the road reserves. Lanterra assumes that the majority of the fill material was brought to the site between 1967-1973 during the construction of the Kippax Fair Shopping Centre complex (Lanterra, 2022c).

Natural materials were comprised of grey alluvial clays with high organic matter beneath the playing fields due to the presence of a former drainage channel (c. 1970s). Natural soils in other regions of the Site comprised gravelly to sandy silty clays with fragments of weather volcanic and sedimentary bedrock. The natural soils for the region are defined as belonging to the Williamsdale soil landscape which are comprised of yellow chromosols and brown kandosols on upper topographic rises, and poorly drained sodosols on lower topographic features (Lanterra, 2022c).

Table 3 below summaries the major lithologies described in the bore logs produced by Lanterra (2022c) for the purposes of the DSI. The relationship of these lithologies to environmental features and the HHRA Site are also outlined in **Table 3**. In areas below developed portions of the investigation area (e.g. roadways, reworked soils) road base and fill material comprised the upper 1.5 mbgl. Below the grassed playing field and in the community park to the north of the Site, topsoil was identified in the place of these materials to depths of approximately 0.3 mbgl. Below these surficial soils, natural unconsolidated sediments were identified with average thicknesses ranging from 2.8-4.3 m. These sediments are predominantly comprised of clay, with the presence of gravels and sand also noted. The regolith or weathered bedrock was generally apparent from depths of approximately 4.3 mbgl. This material has been described as highly weathered with a sandy clay to gravelly sand composition.

Table 3 Summary of key site lithologies

General lithological unit	General description	Average thickness (m)	Depth range (mbgl)	Locations identified
Road base	Gravel based road materials	0.2	0-0.2	Kippax Place, Hardwick Crescent (off-Site)

General lithological unit	General description	Average thickness (m)	Depth range (mbgl)	Locations identified
Topsoil	Silt to sandy silt	0.3	0-0.3	Associated with the playing fields and the community park area (on-Site)
Fill	Silt to gravelly/sandy clay. Likely sourced from site and surrounds.	1.1	0.3-1.4	Generally found beneath roadways and in areas of reworked soils (e.g. community park) (on- and off-Site)
Natural unconsolidated sediments	Predominantly clay. Gravels and sand also identified within the clay matrix.	2.8-4.3	1.3-5.6	Identified at all drilled bores (on- and off-Site).
Regolith/weathered bedrock	Highly weathered rock, likely tuff or rhyodacite. Sandy clay to gravelly sand.	5-8	4.3-12.5	Basement materials for site and greater regional area (on- and off-Site).

Groundwater within the ACT generally occurs within fractured aquifers. Ash-flow tuffs and sedimentary deposits are associated with the highest yields (Lanterra, 2021a). Regional hydrogeology and site investigations conducted by Lanterra (2022c) have inferred that groundwater flows north to north-east across the Site. Stage 1 of the DSI (Lanterra, 2021b) identified two potential localised, perched aquifers in the southern corner of the playing fields (off-Site, GW3 to GW5), with groundwater levels between 1-2 mbgl. Groundwater levels measured during Stage 4 (Lanterra, 2022c) recorded groundwater between 8-11.5 mbgl.

A stormwater drain exists at the southern corner of the playing fields (off-Site) and is inferred to flow in a northerly direction across the playing fields when saturated (through the Site). This drainage line connects with Ginninderra Creek located approximately 600 m north of the Site. The flow pathway is consistent with the drainage flow pathway of a former creek that traversed the Site prior to develop in the 1970s (see historic photographs in Lanterra, 2021a).

2.2. Proposed Land Use and Development

This HHRA has been developed to inform the potential future sale and development of the Site. The Holt Precinct Map and Code notifiable instrument published under the *Territory Plan 2008* (EPSSD, 2020) outlines the rules and criteria that apply to the allowable land uses for the Kippax Group Centre. The development area considered in this HHRA (refer to **Figure 2**) comprises part of the Kippax Group Centre and is zoned as Commercial CZ1 Core Zone (CZ1). Under the *Territory Plan 2008* CZ1 predominantly allows for commercial developments that cater to public use, retail and hospitality options and are well integrated into public transport and recreational and active transport options (e.g. cycle networks).

Based on the allowable land uses and development rules and criteria published in EPSSD, (2020) the following development options are applicable for the Site:

- Commercial use including for retail and hospitality;

- Ground floor residential along a strip of the Site at the eastern site boundary;
- Pedestrian use areas. The development of the Kippax Group Centre is required to include a footpath that will likely intersect the Site and provide a throughfare between Hardwick Crescent and Moyes Crescent.
- Construction of a basement for carparking only.

The CZ1 land zoning also allows for “Community Use” activities on the Site. The *Territory Plan 2008* defines allowable development under the Community Use to include child care centres, community activity centres, community theatres, cultural or religious facilities (e.g. place of worship), educational establishments, health facilities and hospitals.

In addition, a new road is required to be constructed (as per Criteria 24 EPSSD, 2020). This road is indicated to be positioned along the northern boundary of the Site and provide access between Hardwick Crescent and Moyes Crescent, and will provide basement access to any future development.

For the purpose of this HHRA, SAGE has assumed that the potential future basement at the site would not extend to a depth which encountered the standing water table (e.g. greater than 8 mbgl). Where basement depths extend to the groundwater table, further assessment of risk may be required, and should considers specific design elements such as basement tanking to prevent potential direct contact with impacted groundwater, and vapour mitigation methods.

3. Step 2: Data Collection, Evaluation and Conceptual Site Model

This section outlines SAGE's evaluation of the data collected and the Tier 1 screening assessment conducted for the Site. Data gaps identified relevant to the use of this information in the HHRA has been outlined in **Section 3.5**. A description of the Conceptual Site Model (CSM) and identification of the contaminants of potential concern (CoPC) to be evaluated in the quantitative assessment is also provided.

3.1. Previous Investigations

The following investigations have been conducted at the Site, and the surrounding areas:

- Robson Environmental (2017). *Hazardous Materials Survey & Management Plan Re inspection – Kippax Health Centre, 20 Kippax Place.*
- Robson Environmental (2020), *Pre-Demolition Hazardous Materials Survey: Kippax Playing Fields Toilet & Services Block, Kippax Place, Holt, ACT 2615.*
- Lanterra Consulting Pty Ltd, 2021a. *Preliminary Site Investigation: Section 51, Holt, ACT 2615.*
- Lanterra Consulting Pty Ltd, 2021b. *Detailed Site Investigation: Section 51 Kippax Group Centre, Holt, ACT 2615.*
- Lanterra Consulting Pty Ltd, 2022a. *P21083 – Results of Further Environmental Investigations Undertaken at Kippax Place, Section 51, Holt, ACT – November 2021.*
- Lanterra Consulting Pty Ltd, 2022b. *P21083 – Summary of Groundwater and Soil Vapour Sampling Results, Kippax Place, Section 51, Holt, ACT – November 2021.*
- Lanterra Consulting Pty Ltd, 2022c. *DRAFT - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT 2615.*

Robson Environmental conducted two hazardous material surveys for the Former Kippax Health Centre (Block 22), as well as the public amenities and the service block (on-Site i.e. Block 71) associated with the Kippax Playing Fields (Robson Environmental, 2017 and 2020). These locations were assessed for asbestos containing materials (ACM), lead based paints, synthetic mineral fibre (SMF), polychlorinated biphenyls (PCB), ozone depleting substances, and fuel storage facilities. ACM and SMF was identified within the Former Kippax Health Centre building and ACM was detected within the partitions within the public bathrooms. It was considered that unless disturbed these materials did not pose a risk to the users of these facilities.

The PSI (Lanterra, 2021a) was completed in April 2021 and consisted of a desktop review and site walkover to determine the site condition and identify potentially contaminating activities/ land uses at or adjacent to the Site. The site boundary that has been used for the purposes of both the PSI and DSI is presented on Figure 2 from Lanterra's DSI (2022c) (extract included in **Appendix A**). With reference to the HHRA Site boundary, Lanterra has identified three on-Site and two off-Site areas of environmental concern (AEC). These AEC have been used to inform the DSI investigations and as such nomenclature is consistent across all documents (e.g. Lanterra 2021a, 2021b, 2022a to 2022c). The AEC were identified as follows (Lanterra, 2021a; 2022c):

- AEC1 (on-Site): imported fill materials used in the development of the playing fields, roads and road reserves.
- AEC2 (on-Site): imported fill material associated with the construction of the community centre and public amenities, in addition to the ACM within these facilities. The potential for UST (associated with heating infrastructure) below the community centre was also considered.
- AEC3 (off-Site): the stormwater drain traversing the site. It was considered this may act as a conduit for the transportation of off-Site contamination across the Site.
- AEC4 (off-Site): the Kippax Fair Shopping Centre (on the western boundary of the Site). The possibility of USTs and the activities related to the former dry cleaning facility from Shop 14 were considered.
- AEC5 (off-Site): the Service Station located at the corner of Hardwick Crescent and Flack Street (south-west boundary of the Site). This facility is listed on the EPA Register of Contaminated Land and has a groundwater monitoring network associated with its operations.

A four stage DSI was undertaken by Lanterra (2021b, 2022a to 2022c) from April 2021 to March 2022 to determine the presence and extent of contamination associated with each of these AEC. Lanterra undertook the data collection activities summarised in **Section 3.2** in as part of the DSI to delineate the extent of contamination on-Site.

SAGE conducted a visit to the Site during the Stage 4 soil vapour sampling program conducted by Lanterra in March 2022. SAGE's representatives observed soil vapour sample collections at several locations across the Site, and observed the current land use and site condition at both on- and adjacent off-Site properties.

3.2. Data Collection and Evaluation

During the DSI undertaken by Lanterra (2021b, 2022a to 2022c), data was collected for soil, groundwater and soil vapour to delineate the nature and extent of contamination at the Site. Over the course of the four stage DSI Lanterra undertook the following activities:

- Installed 20 groundwater monitoring wells and collected and analysed a total of 36 primary samples from these wells and five existing wells (GW1-GW5).
- Collected and analysed 46 primary soils samples from 33 locations including groundwater wells, soil vapour wells and the surface drainage line.
- Installed 16 soil vapour monitoring wells, nine of which are screened in shallow (~1.5 mbgl) and deep (5.5 mbgl) lithologies. From these locations 28 primary samples were collected and analysed.

A summary of the sampling works conducted by Lanterra in each stage is provided in **Table 4** below.

It is noted that the area under investigation by Lanterra is not the same as the area considered in this HHRA. As such the following sample/monitoring locations are located off-Site, as illustrated in **Figure 3**:

- Soil boreholes: S4, S8, S10-S22, D1-D3, GW51, SV2 (19 locations).

- Groundwater monitoring wells: GW1-GW5, GW51, GW52, GW53, GW57, GW67, GW68, GW69, GW70 (12 locations).
- Soil vapour wells: SV1, SV2, SV5, SV6, SV12 (five locations).

SAGE notes that limited temporal and seasonal soil vapour data is currently available, all available data has been used for the purposes of undertaking the HHRA. Data for the four stage DSI was collected between April 2021 and March 2022, however, not all locations were sampled at every stage, with several only sampled once during the program (as identified in **Table 4**). Additionally, it is noted that the available data has predominantly been collected at the western site boundary, with limited data collected across the eastern and southern portion of the Site, however as the sampling locations are considered to be closer to the off-Site source, this limitation is not considered to be significant for the risk assessment.

Table 4 Summary of available data

Media	Total Number of Sampling Locations	Data collected per Sampling Round	Comment
Groundwater	25 locations: GW1-GW5 sampled once in Stage 1. GW51 installed in Stage 1 and sampled three times across Stages 1, 2 and 4. GW52 – GW54 installed in Stage 2 and sampled twice across Stage 2 and 4. GW55-GW60 installed in Stage 3 and sampled twice across Stages 3 and 4. GW61-GW70 installed in Stage 4 and sampled once in Stage 4.	**Stage 1 (Lanterra, 2021b):** Samples collected from GW1-GW5, and GW51 (six primary samples). Four QAQC samples collected. Analysis undertaken for TRH, BTEX, PAH, heavy metals and VCH. **Stage 2 (Lanterra, 2022a):** Four primary samples (GW51-GW54) and three QAQC samples analysed. Analysis undertaken for TRH, BTEX, Heavy Metals, VCH and PFAS. **Stage 3 (Lanterra, 2022b):** Six primary samples (GW55-60) and four QAQC samples analysed. Same analytical suite as Stage 2. **Stage 4 (Lanterra, 2022c):** 20 primary samples (GW51-GW70) and six QAQC samples analysed. Same analytical suite as Stage 2.	GW1-GW5 were existing wells installed to monitor groundwater associated with the service station located on the corner of Hardwick Cr and Flack St. These wells are located in the Southern corner of the Site. 20 wells (GW51-GW70) were installed by Lanterra for the purposes of this investigation. Of these wells 15 locations were sampled once, nine were sampled twice and one sampled three times. The groundwater well construction logs produced by Lanterra (2022c) for GW51-GW70 all indicated that the wells are screened the same aquifer, within the natural weathered regolith or sandy clay materials, and were constructed in the same way.
Soil	33 locations: Seven locations converted to groundwater wells (GW51-GW56, GW59). One from a soil vapour well (SV2). Three from the drainage line (D1-D3). 22 from soil boreholes (S1-S22).	**Stage 1 (Lanterra, 2021b):** 32 primary and four QAQC samples analysed from 26 locations. Analysis undertaken for TRH, BTEX, PAH, phenols, pesticides, PCB, heavy metals, VCH, asbestos and physico-chemical properties. **Stage 2 (Lanterra, 2022a):** Eight primary and one QAQC samples analysed from four locations. Locations were soil vapour (SV2), and groundwater wells (GW52-GW54). Analysis undertaken for TRH, BTEX, PAH, phenols, pesticides, PCB, and heavy metals.	One sample analysed for VCH in Stage 1 (GW51). Soil samples were not analysed for VCH in Stages 2 and 3 of the DSI. Soil samples have been collected from various depths up to 4.1 metres below ground level (mbgl). Of the 45 primary samples, 20 were collected between 0-0.1mbgl and 13 from 0.5-1.1mbgl. Four samples were collected at depths greater than 2mbgl.

Media	Total Number of Sampling Locations	Data collected per Sampling Round	Comment
		Stage 3 (Lanterra, 2022b): Six primary samples analysed from three locations (GW55, GW56, GW59). No QAQC samples collected. Same analytical suite as Stage 2. **Stage 4 (Lanterra, 2022c):** Soil not collected for analysis during this DSI stage.	
Soil Vapour	16 locations: SV01 and SV02 installed in Stage 2. Both installed to have shallow (1.3mbgl) and deep (5.4mbgl) vapour wells. Sampled twice in Stage 2 and Stage 4. SV3-SV9 installed during Stage 3. All wells installed to have shallow (from 1.2 – 1.4 mbgl) and deep (from 4.8-5.3 mbgl) vapour wells. Sampled twice in Stage 3 and Stage 4. SV10-SV16 installed during Stage 4. These wells were all screened between 2.0-2.5 mbgl. Sampled once in Stage 4.	**Stage 1 (Lanterra, 2021b):** Soil vapour not collected for analysis during this DSI stage. **Stage 2 (Lanterra, 2022a):** Three primary samples analysed from two locations (SV01s, SV01d and SV02s). Three QAQC samples (field duplicates and triplicates) and one carbon tube was analysed. **Stage 3 (Lanterra, 2022b):** Nine primary samples analysed from seven locations (SV3s, SV3d, SV04d, SV5s-SV09s, SV09d). Three QAQC samples (field duplicates and triplicates) and one carbon tube was analysed. **Stage 4 (Lanterra, 2022c):** 16 primary samples analysed from 16 locations (SV01s-SV9s, SV10-SV16). Two QAQC samples (field duplicates and triplicates) and ten carbon tubes were analysed.	Deep vapour wells (~5-5.5mbgl) were installed for SV1-SV9, however samples at this depth were only obtained at SV01 (Stage 2), and SV3, SV4 and SV9 (Stage 3). No analysis of deeper wells was undertaken in Stage 4 as Lanterra noted that deeper wells were affected by increased groundwater levels (2022c) Data from carbon tube analysis was not considered in this HHRA as it is semi-qualitative in nature and is primarily used as a second line of evidence to query high concentrations in primary samples.

Lanterra employed quality assurance and control (QAQC) measures throughout their DSI. The DSI presents Lanterra's assessment on the success of these measures during the investigation process (Lanterra, 2022c). According to their procedures all samples satisfy the criteria they have established to evaluate the quality of data collected. The satisfied quality assurance criteria include:

- Low (1.4-11%) relative percent differences between primary and field duplicate and triplicate samples;
- Collection of sufficient duplicate and triplicate samples during each field program;
- Collection of rinsate and trip blanks that recorded results below the limit of reporting indicating effective decontamination measures;
- Isopropyl alcohol (IPA) leak testing for soil vapour samples returned a maximum IPA of 0.026% within the soil vapour samples. This is below the 10% allowable concentration as per the CRC CARE guidance on petroleum hydrocarbon vapour intrusion assessments (CRC CARE, 2013); and
- All laboratory analysis were conducted by NATA accredited laboratories. Quality control and analysis procedures employed by the laboratories are discussed by Lanterra in the DSI (Lanterra, 2022c). Where exceedances were identified by the laboratory (i.e. surrogate and spike recoveries, matrix spikes, laboratory duplicates), Lanterra has evaluated the significance of these results on the reliability and interpretation of the data. In all cases, Lanterra concluded that the exceedances have not impacted the outcome of their investigation.

Based on the satisfaction of the QAQC measures implemented by Lanterra, the data is considered sufficiently reliable for use in the HHRA.

In addition to reviewing the available data in accordance with the QAQC results provided by Lanterra (2022c), SAGE has also reviewed the appropriateness of the data by comparing the adopted limit of reporting (LOR) to the adopted Tier 1 site assessment criteria. Lanterra identified several instances where the LOR was greater than the adopted site assessment criteria (Lanterra, 2022c). These have been summarised in **Table 5**. All of the listed sample locations are located off-Site from the Site considered in this HHRA. SAGE's approach to addressing this matter in the HHRA is outlined in **Table 10** of **Section 3.5**.

Table 5 Summary of analytical results where LOR is greater than assessment criteria (Lanterra, 2022c)

Sample Location/s	Media	Sampling Event	Analyte	LOR	Assessment Criteria Impacted
GW51	Groundwater	DSI Stage 2 (November 2021)	Dichloromethane	<25 µg/L	4 µg/L (ADWG)
SV1s, SV2s	Soil vapour	DSI Stage 2 (November 2021)	TCE	<270 µg/m^3 (SV1s); <27 µg/m^3 (SV2s)	20 µg/m^3 (HIL A), 80 µg/m^3 (HIL D) (NEPM, 2013)
SV1s, SV1d	Soil vapour	DSI Stage 2 (November 2021)	DCE	<200 µg/m^3	80 µg/m^3 (HIL A) (NEPM, 2013)
SV1s, SV1d	Soil vapour	DSI Stage 2 (November 2021)	Vinyl Chloride	<130 µg/m^3	30 µg/m^3 (HIL A), 100 µg/m^3 (HIL D) (NEPM, 2013)
SV1s, SV1d	Soil vapour	DSI Stage 2 (November 2021)	Naphthalene	<130 µg/m^3	30 µg/m^3 (HSL A, 0-0.1m) (NEPM, 2013)
SV5s	Soil vapour	DSI Stage 3 (January 2022)	TCE	<270 µg/m^3	20 µg/m^3 (HIL A), 80 µg/m^3 (HIL D) (NEPM, 2013)
SV5s	Soil vapour	DSI Stage 3 (January 2022)	DCE	<200 µg/m^3	80 µg/m^3 (HIL A) (NEPM, 2013)
SV5s	Soil vapour	DSI Stage 3 (January 2022)	Vinyl Chloride	<130 µg/m^3	30 µg/m^3 (HIL A), 100 µg/m^3 (HIL D) (NEPM, 2013)
SV5s	Soil vapour	DSI Stage 3 (January 2022)	Naphthalene	<260 µg/m^3	30 µg/m^3 (HSL A, 0-0.1m) (NEPM, 2013)
SV1s	Soil vapour	DSI Stage 4 (March 2022)	TCE	<100 µg/m^3	20 µg/m^3 (HIL A), 80 µg/m^3 (HIL D) (NEPM, 2013)
SV1s	Soil vapour	DSI Stage 4 (March 2022)	DCE	<100 µg/m^3	80 µg/m^3 (HIL A) (NEPM, 2013)
SV1s	Soil vapour	DSI Stage 4 (March 2022)	Vinyl Chloride	<60 µg/m^3	30 µg/m^3 (HIL A) (NEPM, 2013)
SV1s	Soil vapour	DSI Stage 4 (March 2022)	Naphthalene	<100 µg/m^3	30 µg/m^3 (HSL A, 0-0.1m) (NEPM, 2013)

3.3. Nature and Extent of Impacts

The nature and extent of on-Site and off-Site contamination was summarised most recently by Lanterra (2022c). Lanterra identified that CoPC exists in groundwater at the site as a result of groundwater migration to the site from several off-Site sources. **Table 6** summarises the locations identified as impacted by CoPC by Lanterra (2022c) and their relationship to the HHRA investigation area. The relevant contaminants of concern for each area are also identified in this table.

Table 6 Nature and extent of contamination impacts (Lanterra, 2022c)

Impacted Media	Location and description of contamination (Lanterra, 2022c)	CoPC Identified	On-site/ Off-site
Groundwater	Central western boundary of the site (Kippax Place) and on-Site adjacent to this boundary (GW54), to the south of the Former Kippax Health Centre. Historical contaminant impacts to groundwater generating a plume moving from the shopping centre to the north-east.	VCH	Off-site source with impacts both on- and off-Site.
Soil vapour	Areas to the north and south of the Former Kippax Health Centre impacted by soil vapour generated from historical groundwater plume (described above).	VCH	On-Site (off-Site source)
Groundwater	North of the Former Kippax Health Centre within the north-west section of the site. Groundwater impacts generated from an off-Site dry cleaning facility.	VCH	On-Site (off-Site source)
Groundwater	South-western corner of the existing playing fields, south of the site. Groundwater impacts associated with a service station upgradient of this area.	Benzene	Off-Site

From the data presented in Lanterra (2022c) and as identified in **Table 6**, VCH were identified as the CoPC measured above the Tier 1 criteria in groundwater and soil vapour along the central western and north-western boundaries of the Site. The specific VCH identified by Lanterra at both on-Site and off-Site locations include:

- Tetrachloroethene (also known as Perchloroethylene) (PCE);
- Trichloroethene (TCE);
- Cis 1,2-dichloroethene (DCE);
- Vinyl Chloride.

3.4. Preliminary Conceptual Site Model

Lanterra (2022c) identified inhalation of gases and soil vapour (including vapour generated from groundwater) as a potentially complete pathway at the Site.

Additionally, the following potential exposure pathways were identified to be incomplete by Lanterra:

- Direct contact with soil (including dermal contact/ingestion);
- Direct contact with groundwater (including dermal contact/ingestion);

- Inhalation of asbestos fibres.

Based on the information provided by Lanterra (2022c), and The Holt Precinct Map and Code (EPSSD, 2020), SAGE has surmised the following preliminary CSM for the Site.

Source:

Off-Site industrial activities have resulted in impacted groundwater. These impacts have resulted in a secondary source of impacts in groundwater at the Site, as a result of groundwater migration towards the Site. The off-Site activities that have likely resulted in contamination have been identified as a historical and a currently operating dry cleaning facility. These activities have resulted in elevated VCH concentrations in groundwater and soil vapour measured in both on- and off-Site locations by Lanterra (2022c), as identified in **Section 3.3**.

Transport mechanisms:

Based on the data collected it is apparent that CoPC are transported from the off-Site source via groundwater movement and vapour production from impacted groundwater. Groundwater flows north to north-east across the Site. From the concentration data presented by Lanterra (2022c) it is apparent that contaminant concentrations within groundwater decrease downgradient from the inferred sources. Transport of CoPC from the groundwater phase to the vapour phase occurs through the vadose zone as a result of volatilisation and has the potential to result in vapour intrusion for developments which exist above the secondary groundwater source.

Exposure pathways:

Based on the transport mechanisms identified, it is expected that a potential exposure pathway via the inhalation pathway could occur due to upward vapour migration from the groundwater and through the overlying soil profile.

Receptors:

Receptors for the Site can be defined as both current and potential future receptors following the redevelopment of the Site. A description of each of these groups is provided below.

Current receptors:

- On-Site commercial receptors working within the Former Kippax Health Centre, including patrons accessing this centre.
- Maintenance workers (e.g. groundskeepers, utility/services workers, cleaners).
- General public using the community areas on-Site. These areas are located in the north-west corner of Site where public seating, footpaths and a skate ramp exist.
- Patrons passing through the Site to access the shopping centre located on the western boundary of the Site (off-Site).
- On-Site and off-Site recreational users of the Kippax playing fields.
- Off-Site commercial receptors adjacent to the Site.
- Off-Site residential receptors at the northern Site boundary.

Potential future receptors:

- Residential receptors, within ground floor dwellings located at the eastern Site boundary.
- Residential receptors, in properties from the first floor with a single basement construction.
- Commercial receptors, with and without an underlying basement.
- Community use receptors, including child care facilities.
- Intrusive maintenance workers.
- General public utilising the public spaces and roadways.
- Employees of and patrons to commercial spaces.

3.5. Tier 1 Screening Assessment

A typical approach adopted in contaminated land risk assessment is to use published generic assessment criteria, relevant to the land use being assessed, to screen out chemicals that present a negligible risk, this initial screen is commonly referred to as a 'Tier 1' assessment. Where CoPC are identified above the Tier 1 assessment criteria, this is considered an indication of a potential risk to an identified receptor, and Tier 2 assessment could be undertaken to further quantify the potential risk.

As the proposed site land use for the Site is yet to be determined, Lanterra has undertaken a Tier 1 screening assessment using residential land use criteria (Lanterra, 2022c). This approach was adopted to provide the most conservative assessment of contaminant exposure risk for the Site. Lanterra adopted human health and ecological screening criteria from the following publications:

- ASC NEPM (2013);
- ANZG (2018) Guidelines for Fresh and Marine Water Quality;
- Heads of EPA (HEPA) (2020) PFAS National Environmental Management Plan (NEMP) 2.0;
- Environment Protection Regulation 2005 (ACT) (EP Regulation).

Table 7 Adopted Tier 1 Screening Criteria for DSI (Lanterra, 2022c)

Media	Human Health Screening Criteria	Ecological Screening Criteria
Soil	NEPM 2013: Health Investigation Levels for Residential Sites (HIL A) NEPM 2013: Health Screening Levels for Residential Sites (HSL A) based on clay lithology at 0-1m depth	NEPM 2013: Ecological Investigation Levels (EIL) for aged contaminants Urban Residential and Public Open Space NEPM 2013: Ecological Screening Levels (ESL) for Urban Residential and Public Open Space based on fine texture
Groundwater	NEPM 2013: HSL-A criteria for Low and High-Density residential use for clay lithology and a depth of 2m to < 4m and 4m to < 8m	ANZG 2018: Toxicant Default Guideline Values for 95% species protection in freshwater. EP Regulation 2005 (ACT): AQUA/4 – urban drains and streams

Media	Human Health Screening Criteria	Ecological Screening Criteria
	NHMRC 2011: Australian Drinking Water Guidelines (ADWG) HEPA 2020: PFAS NEMP 2.0 Human health guideline values for drinking water	HEPA 2020: PFAS NEMP 2.0 Ecological water quality guideline values for 95% species protection in freshwater
Soil Vapour	NEPM 2013: HSL-A for petroleum hydrocarbons in clay lithologies for 1 m to <2 m, 2 m to < 4 m and 4 m to <8 m NEPM 2013: Interim HIL-A for volatile organic chlorinate compounds	None used.

Tier 1 screening assessment tables provided by Lanterra (2022c) are provided in **Appendix B.**

Table 8 below presents a summary of the CoPC identified above the Tier 1 screening criteria at on-Site sampling locations. It provides the rationale for consideration of other potential CoPC where Tier 1 screening criteria were not applied, and the rationale for including or excluding CoPC in the Tier 2 assessment.

SAGE notes that there were several analytes detected above the LOR within on-Site soil vapour sampling locations by Lanterra (2022c), however, screening levels were not available to perform a Tier 1 screening assessment. SAGE has considered these analytes in determining the CoPC for the Tier 2 screening assessment and has determined that the following will not be considered further as they were generally considered within the same order of magnitude as their respective estimated quantitation limit (EQL).

- Dichlorodifluoromethane;
- Acetone;
- Ethanol;
- Carbon Disulfide;
- Styrene;
- 1,1,2,2-Tetrachloroethane;
- 4-ethyl toluene;
- 1,3,5-Trimethylbenzene;
- 1,2,4-Trimethylbenzene;
- Benzyl chloride;
- 1,2-Dichlorobenzene;
- Bromodichloromethane.

Table 8 Outcomes of Tier 1 Screening Assessment – On-Site Locations

Environmental Media	CoPC	Sampling Locations	Discussion
Groundwater	Metals (Copper, Nickel, Zinc, Arsenic, Cadmium, Chromium, Lead)	GW54, GW55, GW56, GW58, GW59, GW60, GW61, GW62, GW63, GW64, GW65, GW66	Although a number of metals were identified above the Tier 1 screening criteria, Lanterra (2022c) noted the variability of heavy metals across the investigation area, and concluded the concentrations were indicative of natural background concentrations. Therefore, no further assessment of metals is required in the HHRA.
	Trichloroethene (TCE)	GW58, GW65, GW66	TCE is volatile and will be assessed in the Tier 2 assessment using the measured soil vapour concentrations.
	Cis 1,2-Dichloroethene (DCE)	GW58	DCE is volatile and will be assessed in the Tier 2 assessment using the measured soil vapour concentrations.
	Tetrachloroethene (PCE)	GW58, GW54, GW65, GW66	PCE exceeded the Tier 1 screening criteria at GW58, detections above the LOR were recorded at GW54, GW65 and GW66. PCE is volatile and will be assessed in the Tier 2 assessment using the measured soil vapour concentrations.
	TRH (C_6-C_{10})	GW58, GW66	Detected at levels above the LOR, however no relevant criteria were adopted by Lanterra for TRH. TRH detected in groundwater is considered to be representative of the presence of chlorinated compounds as the TRH fraction represented is indicative of this. TRH will not be considered in the Tier 2 screening assessment as VCH will be assessed.
	Perfluoroalkyl and Polyfluoroalkyl Substances	GW54, GW55, GW56, GW58, GW59, GW60, GW61, GW62, GW63, GW64, GW5, GW66	Various PFAS were detected above the LOR at several on-Site locations. Exceedances of the Tier 1 screening criteria were identified at GW60 only. PFAS will not be considered in the Tier 2 screening assessment as the recorded concentrations are low (close to the LOR) and there are no known sources of PFAS considered to be providing a direct contribution to the site. It is considered that the recorded PFAS concentrations reflect regional PFAS contamination.
Soil Vapour	Tetrachloroethene (PCE)	SV9s, SV3s, SV3d, SV9d, SV4s, SV7s, SV10, SV11, SV13, SV14, SV15, SV16	Tier 1 screening criteria were exceeded only at SV9s, however, several other locations recorded concentrations above the LOR. PCE is volatile and will be assessed in the Tier 2 assessment.
	Trichloroethene (TCE)	SV4d, SV8s, SV9s, SV15, SV9d	Tier 1 screening criteria were exceeded at several on-Site locations. Concentrations at SV9d did not exceed the screening criteria but were detected above the LOR. TCE is volatile and will be assessed in the Tier 2 assessment.

Environmental Media	CoPC	Sampling Locations	Discussion
			It is noted that the locations where these exceedances occurred are the western site boundary, and do not extend to the eastern area where the residential development has been approved (EPSSD, 2020). Therefore the Tier 2 assessment of TCE will be only undertaken for the commercial and residential with basement scenarios (which may occur at the western portion of the site).
	Cis 1,2-Dichloroethene (DCE)	SV4d, SV9s	Tier 1 screening criteria were exceeded in SV4d, with concentrations above the LOR recorded at SV9s. DCE is volatile and will be assessed in the Tier 2 assessment.
	Trans 1,2-Dichloroethene	SV4d	Concentrations were above the limit of reporting at SV4d. The Tier 2 assessment conducted for cis 1,2-dichloroethene will serve as the assessment for trans 1,2-dichloroethene in this HHRA.
	2-Butanone (MEK)	SV3d, SV4d, SV7s, SV8s, SV9s, SV9d, SV10, SV11, SV13, SV14, SV15, SV16	Routinely detected at levels above the LOR, however no relevant criteria were adopted for 2-Butanone (MEK). Concentrations were generally within the same order of magnitude as the EQL, however, concentrations an order of magnitude greater were detected at SV3d and SV4d. The maximum concentration (280ug/m^3 at SV3d) was compared to the USEPA regional screening level (RSL) for residential indoor air which is 5200ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for 2-Butanone (MEK).
	Hexane	SV3s, SV3d, SV4s, SV4d, SV7s, SV8s, SV9s, SV9d, SV13	Routinely detected at levels above the LOR, however no relevant criteria were adopted for Hexane. The maximum detected concentration (1300ug/m^3 at SV9s) was compared to the USEPA RSL for residential indoor air which is 730ug/m^3. This concentration and one other (790ug/m^3 at SV7s) are above the residential RSL. However, these locations are outside the area where residential development is approved. Therefore, comparing to the commercial indoor air RSL of 3100ug/m^3 from the USEPA, the concentrations are below this RSL. As such, a Tier 2 screening assessment will not be conducted for Hexane.
	Tetrahydrofuran	SV3s, SV3d, SV4d, SV7s, SV8s, SV9s, SV9d, SV10, SV11, SV13, SV14, SV15, SV16	Routinely detected at levels above the LOR, however no relevant criteria were adopted for tetrahydrofuran. The maximum detected concentration (16000ug/m^3 at SV3d) was compared to the USEPA RSL for residential indoor air which is 2100ug/m^3. This concentration and several others exceed this RSL.

Environmental Media	CoPC	Sampling Locations	Discussion
			SAGE reviewed available information relating to the sources of tetrahydrofuran and identified that it is commonly used as a solvent for resins, adhesives and protective coatings (USEPA, 2012). Based on the conceptual site model developed for the site by SAGE and Lanterra (2022c), it is not considered that tetrahydrofuran is related to the known contaminant sources associated with the Site. Therefore, SAGE has not considered tetrahydrofuran in the Tier 2 screening assessment.
	Heptane	SV3s, SV3d, SV4d, SV7s, SV9s, SV9d.	Routinely detected at levels above the LOR, however no relevant criteria were adopted for heptane. The maximum detected concentration (370ug/m^3 at SV9s) was compared to the USEPA RSL for residential indoor air which is 420ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for heptane.
	Ethyl Acetate	SV10, SV11, SV13, SV15, SV16	Routinely detected at levels above the LOR, however no relevant criteria were adopted for ethyl acetate. The maximum detected concentration (30ug/m^3 at SV13) was compared to the USEPA RSL for residential indoor air which is 73ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for ethyl acetate
	Cyclohexane	SV3s, SV4d, SV7s, SV8s	Routinely detected at levels above the LOR, however no relevant criteria were adopted for cyclohexane. The maximum detected concentration (21ug/m^3 at SV8s) was compared to the USEPA RSL for residential indoor air which is 6300ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for cyclohexane.
	Chloroform	SV3s, SV3d, SV4s, SV7s, SV8s, SV9s, SV9d, SV10, SV13, SV14, SV15, SV16	Routinely detected at levels above the LOR, however no relevant criteria were adopted for chloroform. The maximum detected concentration (95ug/m^3 at SV7s) was compared to the USEPA RSL for residential indoor air which is 100ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for chloroform.

3.5.1. Qualitative Assessment of Risk for Off-Site Locations.

A qualitative assessment of the risk associated with CoPC identified at off-Site locations was undertaken. **Table 9** below presents a summary of the CoPC identified above the Tier 1 screening criteria at off-Site sampling locations. It provides the rationale for consideration of other potential CoPC where Tier 1 screening criteria were not applied.

Off-Site exceedances of Tier 1 screening criteria, especially in the vicinity of SV1 (shallow and deep) and SV5s (shallow) , located adjacent to Kippax Fair Shopping Centre, indicate that further assessment of risk to off-Site commercial receptors at the Kippax Fair Shopping Centre may be required.

Although concentrations of CoPC were noted to be high at SV1 and SV5, as these locations are located in roadway and pedestrian areas, the risk to off-Site receptors (adults and children) in off-Site open space areas (for example Kippax Place) is expected to be low, as recreational receptors and pedestrians are not expected to spend significant amounts of time in this area, and the potential for significant vapour accumulation is generally unlikely to occur in outdoor areas.

The risk to residential receptor to the north of the site has been qualitatively assessed as limited data is currently available to assess these receptors. It is noted, on-Site soil vapour concentrations at SV15 in the north of the Site, located between the contaminant source and off-Site residents, have indicated concentrations of TCE above the Tier 1 screening criteria. Other monitoring locations have not exceeded the Tier 1 screening for VCH but have been detected at concentrations above the LOR. Based on the results of the on-site quantitative assessment of on-site risk to receptors (as presented in **Section 6.3**), and the qualitative assessment of limited data available adjacent to the northern site boundary, the risk to off-Site residents is considered to be low, however, SAGE recommends further assessment should be considered using soil vapour and air monitoring data specific to the residential buildings in this location.

As off-Site sources have been identified hydraulically upgradient from the Site, there is potential for off-Site impacts to continue to migrate towards the Site over time, including towards the residents north of the Site, which may result in future on-Site and off-site increases in concentrations of CoPC in environmental media, and therefore subsequent changes in the risk assessment outcomes.

Table 9 Outcomes of Tier 1 Screening Assessment – Off-Site Locations

Environmental Media	CoPC	Sampling Locations	Discussion
Groundwater	Metals (Copper, Nickel, Zinc, Cadmium, Lead, Chromium)	GW1, GW2, GW3, GW5, GW51, GW52, GW53, GW57, GW67, GW68, GW69, GW70	Although a number of metals were identified above the Tier 1 screening criteria, Lanterra (2022c) noted the variability of heavy metals across the investigation area, and concluded the concentrations were indicative of natural background concentrations. Therefore, no further assessment of metals is required in the HHRA.
	Tetrachloroethene (PCE)	GW51, GW52, GW68, GW69	PCE is volatile and will be assessed in the Tier 2 assessment using the measured soil vapour concentrations. All locations are located close to the inferred contaminant sources that are expected to have contributed volatile chlorinate hydrocarbons to the site.
	Trichloroethene (TCE)	GW51, GW52, GW68, GW69	TCE is volatile and will be assessed in the Tier 2 assessment using the measured soil vapour concentrations. All locations are located close to the inferred contaminant sources that are expected to have contributed volatile chlorinate hydrocarbons to the site.
	Cis-1,2-Dichloroethene (DCE)	GW68, GW69	DCE is volatile and will be assessed in the Tier 2 assessment using the measured soil vapour concentrations. GW68 and GW69 are located close to the inferred contaminant source that is expected to have contributed volatile chlorinate hydrocarbons to the site.
	Benzene	GW1, GW2, GW5	Benzene was detected above the Tier 1 screening criteria. Lanterra note (2022c) that these locations were installed to monitor downgradient contamination associated with an off-Site service station. Further assessment of CoPC associated with this service station will not be conducted for the Tier 2 assessment.
	TRH (C_6-C_{10})	GW51, GW52, GW53, GW68, GW69	Detected at levels above the LOR, however no relevant criteria were adopted by Lanterra for TRH. TRH detected in groundwater is considered to be representative of the presence of chlorinated compounds as the TRH fraction represented is indicative of this. TRH will not be considered in the Tier 2 screening assessment as VCH will be assessed.
	Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)	GW51, GW52, GW53, GW57, GW67, GW68, GW69, GW70	Various PFAS were detected above the LOR at several on-Site locations. Exceedances of the Tier 1 screening criteria were not identified. PFAS will not be considered in the Tier 2 screening assessment as the recorded concentrations are low (close to the LOR) and there are no known sources of PFAS considered to be providing a direct contribution to the site. It is considered that the

Environmental Media	CoPC	Sampling Locations	Discussion
			recorded PFAS concentrations reflect regional PFAS contamination.
Soil Vapour	Tetrachloroethene (PCE)	SV1s, SV1d, SV2s, SV5s, SV6s, SV12	Tier 1 screening criteria were exceeded at locations, except SV2s, SV6s and SV12 where concentrations were above the LOR. PCE is volatile and will be assessed in the Tier 2 assessment.
	Trichloroethene (TCE)	SV1d, SV2, SV5s, SV6s	Tier 1 screening criteria were exceeded at locations, except SV6s where concentrations were above the LOR. TCE is volatile and will be assessed in the Tier 2 assessment.
	Cis-1,2-Dichloroethene (DCE)	SV2s, SV6s	Tier 1 screening criteria were exceeded in SV2s, with concentrations above the LOR recorded at SV6s. DCE is volatile and will be assessed in the Tier 2 assessment.
	Vinyl Chloride	SV1s, SV1d, SV5s	Vinyl chloride concentrations were not recorded above the LOR during Lanterra's investigations; however, it was considered to be in exceedance of the Tier 1 screening criteria (HIL A 30 ug/m^3) at the listed locations. These locations recorded LORs of 130 ug/m^3 (SV1s, SV1d, SV5s in Stages 2 and 3) and 60 ug/m^3 (SV1s in Stage 4) which exceeds the human health screening criteria adopted by Lanterra. Given the high concentrations of other detected VCH in these locations it is likely the LOR was raised due to sample dilution, and therefore the true concentration is unknown. SAGE recommends further assessment of off-Site risk is undertaken.
	2-Butanone (MEK)	SV2s, SV6s, SV12	Routinely detected at levels above the LOR, however no relevant criteria were adopted for 2-Butanone (MEK). Concentrations were generally within the same order of magnitude as the EQL. The maximum concentration (360ug/m^3 at SV3d) was compared to the USEPA regional screening level (RSL) for residential indoor air which is 5200ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for 2-Butanone (MEK).
	Tetrahydrofuran	SV1s, SV1d, SV2s, SV5s, SV6s, SV12	Routinely detected at levels above the LOR, however no relevant criteria were adopted for tetrahydrofuran. The maximum detected concentration (27000 ug/m^3 at SV2s) was compared to the USEPA RSL for residential indoor air which is 2100 ug/m^3. This concentration and several others exceed this RSL.

Environmental Media	CoPC	Sampling Locations	Discussion
			SAGE reviewed available information relating to the sources of tetrahydrofuran and identified that it is commonly used as a solvent for resins, adhesives and protective coatings (USEPA, 2012). Based on the conceptual site model developed for the site by SAGE and Lanterra (2022c), it is not considered that tetrahydrofuran is related to the known contaminant sources associated with the Site. Therefore, SAGE has not considered tetrahydrofuran in the Tier 2 screening assessment.
	Heptane	SV2s, SV5s, SV6s	Routinely detected at levels above the LOR, however no relevant criteria were adopted for heptane. The maximum detected concentration (220ug/m^3 at SV5s) was compared to the USEPA RSL for residential indoor air which is 420ug/m^3. As the concentrations at the site are below this RSL, a Tier 2 screening assessment will not be conducted for heptane.
	Hexane	SV1s, SV1d, SV2s, SV5, SV6s, SV12	Routinely detected at levels above the LOR, however no relevant criteria were adopted for Hexane. The maximum detected concentration (4300 ug/m^3 at SV5s) was compared to the USEPA RSL for residential indoor air which is 730 ug/m^3. This concentration and one other (4060 ug/m^3 at SV2s) are above the residential RSL. However, these locations are outside the area where residential development is approved. Comparing to the commercial indoor air RSL of 3100 ug/m^3 from the USEPA, the concentrations are also above this RSL. Should assessment of off-Site risk be undertaken in the future, consideration of Hexane should be made as a CoPC.
	Chloroform	SV2s, SV6s, SV12	Routinely detected at levels above the LOR, however no relevant criteria were adopted for chloroform. The maximum detected concentration (100ug/m^3 at SV2s) was compared to the USEPA RSL for residential indoor air which is 100ug/m^3. As the concentrations at the site are the same as and the other detected concentrations are below this RSL, a Tier 2 screening assessment will not be conducted for chloroform.

3.6. Data Gaps and Limitations

Based on the information presented in Lanterra's DSI (2022c) SAGE has identified the following data gaps relevant to the preparation of the HHRA. These data gaps and how they have been approached in this HHRA are outlined in **Table 10**.

Table 10 Identified data gaps from previous investigations

Data Gap/Limitation	Potential Significance	Manner In Which the Data Gap Is Addressed in the HHRA
Limited temporal soil vapour data is available. A number of soil vapour monitoring wells have only been sampled one time. Therefore, temporal and seasonal variation of soil vapour impacts is not understood.	Measured soil vapour concentrations may not be representative of the maximum concentration in soil vapour that could occur at the Site over time.	The HHRA has considered the maximum measured concentration of each CoPC at on-Site soil vapour wells. This approach is considered to be conservative, as it combines the maximum concentrations measured at two distinct locations located approximately 50m apart.
Sampling locations are not distributed across the whole Site.	Concentrations of CoPC have not been delineated across the Site, especially at the eastern Site boundary.	As the off-Site sources have been identified to be generally located west of the Site, the measured concentrations at the western site boundary have been adopted in the Tier 2 assessment.
The site boundary for the HHRA and DSI investigation conducted by Lanterra are not the same.	The HHRA Site boundary is within the boundary of the DSI Investigations, however, this has resulted in a large volume of data collected during the DSI being considered off-Site for the purposes of the HHRA. 31 of the 74 locations where data has been collected are considered off-Site (locations are defined in **Section 3.2**).	The HHRA has identified the wells considered to be on-Site in **Section 3.2**. The HHRA has considered concentrations in soil vapour measured on-Site in the Tier 2 risk assessment.
It is noted that in several sampling events, the LOR for some analytes have been greater than the Tier 1 screening criteria. A summary of these occurrences from the Lanterra investigations is provided in **Table 5**. This has been explained by Lanterra (2022c) as being related to matrix interferences within the samples.	Where the LOR has been raised due to matrix interference Lanterra has assumed that the analyte is likely to be present in the sample. Where the LOR exceeded the assessment criteria, Lanterra has identified this as an exceedance of the Tier 1 screening assessment. As such, the true concentrations of these CoPC are not known.	It is noted that the locations where the LOR was raised relates to off-Site locations only. The maximum measured concentration at on-Site locations has been adopted in the HHRA. A key CoPC for this aspect is the vinyl chloride concentration. It is noted that vinyl chloride was not measured above the Tier 1 criteria at any of the 14 soil vapour monitoring locations located on-Site.
The future development plans for the Site are currently unknown. Assumptions regarding the potential future development are based on the approved	The HHRA can not refine the model to specific development details.	The HHRA has adopted a number of key assumptions in relation to the potential future development, including: - Basement depth will not intersect the groundwater

Data Gap/Limitation	Potential Significance	Manner In Which the Data Gap Is Addressed in the HHRA
zoning for the site as per EPSSD (2020) and outlined in **Section 2.2** .		table at the Site. A basement has been assumed to not extend beyond 4 m bgl, as this depth corresponds to the general maximum depth of available soil vapour data. - Basement construction has been assumed to occur across the entire Site. It is noted that future development design could avoid areas of higher impacts located at the central and western Site boundaries. - Building parameters used in the model are generic, and may not be representative of the "as built" development. - Basement use has been assumed for carparking with no workers present in these spaces. - The air exchange rate of a basement has been assumed to be 4 exchanges per hour in accordance with Australian Standards. Future development of the Site is expected to consider the findings of both the DSI (Lanterra, 2022c) and this HHRA. Further assessment of the potential risks at the Site should be made once the development plans are known.
Limited groundwater data is available due to wells being progressively installed over the four stage DSI. 25 wells were sampled by Lanterra over the program. Three rounds of data are available for one well, two rounds for nine wells and one round for the remaining 15 wells. In addition, the spatial distribution of monitoring wells is limited to the western and north-western	The data does not provide an accurate reflection of groundwater trends (both water level and water quality) that may be influenced by seasonality or time. The limited spatial distribution across the Site poses the risk that localised shallow or perched groundwater aquifers may exist in the uncharacterised areas of the Site. If shallower groundwater impacted by contamination exists in these	The HHRA has considered the maximum measured concentration of each CoPC at on-Site soil vapour wells. This approach is considered to be conservative, as it combines the maximum concentrations measured at two distinct locations located approximately 50m apart. The use of soil vapour data represents both groundwater and soil concentrations within the saturated zone.

Data Gap/Limitation	Potential Significance	Manner In Which the Data Gap Is Addressed in the HHRA
areas of the Site. There is no monitoring infrastructure installed to the south or east of the Site.	areas of the site, there is a risk that direct contact exposure pathways may be realised.	Shallow or perched groundwater systems have not been considered in the modelling assumptions relating to groundwater depth. SAGE has relied on the information available which indicates a depths between 8-11mbgl (Lanterra, 2022c). If shallower groundwater is identified within the Site and is considered to be impacted by contamination, further evaluation of the Site risk to human health is recommended to be undertaken.
The greatest concentrations of VCH compounds within soil vapour and groundwater were recorded at off-Site sampling locations.	Concentrations of CoPC at the on-Site area may increase over time as a result of migration of CoPC in groundwater from the hydraulically upgradient source.	Further assessment of trends in groundwater and soil vapour may be required in the future, to confirm the ongoing suitability of the Site.
No indoor air monitoring has been conducted within on-site locations (e.g. Former Kippax Health Centre).	The ability of soil vapour to move through the soil profile and into buildings (i.e. for vapour intrusion to occur) has not been measured. Furthermore, assumptions relating to the adequacy of ventilation within these buildings cannot be determined.	The HHRA has adopted published values for building parameters, to calculate the attenuation of vapour from the sub-surface to indoor air. Pending the final development design at the Site, further assessment of risk may be required, and where required should include the measurement of vapour in indoor air.

4. Step 3: Exposure Assessment

4.1. Introduction to Exposure Assessment

Exposure assessment requires a determination of the magnitude, frequency, extent, and duration of exposures to contaminants (ASC NEPM, 2013). In the context of assessing human health risks from environmental hazards at the Site, the following key elements are required to be determined / identified:

- Determine input values for contaminant concentrations. These concentrations are identified as Exposure Point Concentrations (EPC).
- Determine physicochemical properties of the identified contaminants.
- Determine physical input values for contaminant exposure pathways.
- Determine input values for the exposed populations.
- Estimate the exposure concentration at the point of exposure.
- Estimate chemical intake.

It is noted that the soil vapour data collected at the Site, provides an additional line of evidence which relates to the potential chemical concentrations associated with the groundwater source, aiding the translation of the CSM into modelling terms.

Section 4 of this HHRA considers:

- The potentially complete pathways that have been assessed in the Tier 2 HHRA.
- The algorithms that have been used to evaluate exposure via these pathways.
- The human behavioural parameters that have been adopted to undertake the exposure assessment.
- The physical parameters associated with the current and potential future development that have been adopted to undertake the exposure assessment.
- The EPC adopted within the HHRA.

4.2. Receptors and Pathways considered in the Tier 2 Assessment

Based on the available environmental data, the current preliminary CSM discussed in **Section 3.4**, which identifies the potentially exposed populations considered in this assessment, the exposure pathways that are considered in the Tier 2 assessment are summarised in **Table 11** below.

It is noted that these pathways have not been confirmed to be currently complete and are dependent on the future development of the site. Furthermore, it is possible that pathways not currently identified may be identified in the future. The HHRA therefore distinguishes between pathways which are identified as complete at the time of writing and other pathways which have the potential to be complete in the future (under the current allowable zoning (EPSSD, 2020)).



Table 11 Exposure Scenarios Considered in the Tier 2 Assessment

Exposure Scenario	Sensitive Receptor	Potential Complete Exposure Pathways	Currently Complete?	Potential to be complete in the future?
Scenario 1 – On-Site Commercial – Slab on Ground Construction.	Commercial Receptor (Adult)	Indoor vapour inhalation from a secondary groundwater source. Outdoor vapour inhalation from a secondary groundwater source.	Yes	Yes
Scenario 2 – On-Site Commercial with child care – Slab on Ground Construction.	Commercial Receptor (Adult and Child)	Indoor vapour inhalation from a secondary groundwater source. Outdoor vapour inhalation from a secondary groundwater source.	No, as no child care is currently operating at the Site.	Yes
Scenario 3 – On-Site Commercial – Basement Construction with commercial properties from the ground floor.	Commercial Receptor (Adult)	Indoor vapour inhalation from a secondary groundwater source.	No	Yes
Scenario 4 – On-Site Medium Density Residential – Basement Construction with residential properties from the first floor.	Residential Receptor (Adult and Child)	Indoor vapour inhalation from a secondary groundwater source.	No	Yes

4.2.1. Redevelopment Considerations within the Human Health Risk Assessment

As noted in **Section 2.2**, it is understood the Site may be developed in the future in accordance with The Holt Precinct Map and Code (EPSSD, 2020). However, as the design and layout of any future development is currently unknown, the following assumptions relevant to the Site, including a potential basement construction, have been adopted:

- The potential future building footprint will extend over the entire Site.
- The potential future basement will extend under the entire building footprint.
- The basement depth will be shallower than the observed standing water level at the Site (approximately 8 m bgl).
- The presence of localised shallow or perched groundwater systems have not been considered in the modelling assumptions relating to groundwater depth. SAGE has relied on the information available which indicates a depths between 8-11mbgl (Lanterra, 2022c). If shallower groundwater is identified within the Site and is considered to be impacted by contamination, further risk assessment is considered necessary.
- Basement design will mitigate the potential for groundwater to enter the basement.
- To be conservative, the risk assessment has considered the basement walls and floors construction to be approximately 150mm thick.
- The basement will be ventilated in accordance with Australian Standards.
- The basement will be an open space used for parking and storage only, and no commercial work space within the basement will be incorporated into the development.
- In accordance with Australian Standard (AS) AS1668.2 (Standards Australia, 2012), the basement levels will be maintained at a lower pressure than the overlying occupied areas. This theoretically allows vapour movement by the process of advection (where air porosity is available within soil or concrete).
- The air exchange rate within the basement car park has been assumed to be 4 per hour (in accordance with AS 1668.2).
- Where commercial and residential spaces occur above the basement carpark, the potential risk associated with outdoor inhalation of vapours above the basement area is considered to be negligible. This assumption is supported by the outdoor exposure considered for Scenario 1 and Scenario 2, which represents the slab on grade construction at the Site.

4.3. Vapour Transport Modelling

Vapour transport modelling was undertaken for this HHRA to estimate the concentrations of the vapour phase CoPCs expected to be within indoor and outdoor air. These estimates are used to determine the significance of exposure to vapour phase concentrations for human health. The methods used to provide these estimates have been based on the theoretical approaches outlined by Johnson and Ettinger (1991), as described in the following documents:

- ASTM International, 2002. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. E1739 – 95 (reapproved 2010).
- USEPA, 2004. User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings. Office of Emergency and Remedial Response. Revised February 22, 2004.

The above documents were also used as reference sources for vapour transport modelling.

The methodology and algorithms used for vapour modelling are described in more detail in **Appendix C** and the vapour modelling calculations for relevant land use scenarios are included in **Appendix E**.

The vapour model methodology provides an estimate of the concentration of vapour phase chemicals within indoor and outdoor environments. This prediction is based on measured concentrations reported in soil or groundwater. To more accurately model vapour phase chemicals within ambient or indoor environments, a volatilisation factor (VF) is applied based on the given chemical and the modelled scenario. The VF represents the transport and attenuation processes occurring between the soil or groundwater source and the space above (enclosed space or ambient air). The calculation of the VF is dependent on a number of chemical and scenario specific factors such as:

- the volatility of the chemicals;
- the depth to subsurface soil or groundwater contamination;
- the effective porosity of the overlying unsaturated soil zone;
- the presence of surface barriers (e.g. concrete slabs); and
- the extent of dilution and mixing at the surface, based primarily on:
    - building volume and air exchange rates (for indoor air); or
    - wind speed (for outdoor air).

It should be noted that the Johnson and Ettinger (1991) model was designed to be used as a conservative first tier screening model, i.e. to assess whether vapour intrusion risks are possible and therefore whether further investigation or mitigation is warranted. The model, therefore, incorporates a number of conservative assumptions, including:

- that chemical concentrations in the subsurface source (groundwater and soil vapour) remain constant over the duration of exposure (i.e. a non-depleting source not subject to degradation processes);
- equilibrium partitioning between chemicals in soil and groundwater and chemical vapours in the source zone;

- steady-state vapour and liquid-phase diffusion through the vadose zone;
- no biodegradation or loss of chemical as it diffuses towards the ground surface;
- that all chemical vapours beneath a structure will enter the structure (i.e. vapours will not migrate laterally around a structure); and
- steady, well mixed dispersion of emanating vapours within the enclosed or ambient mixing space.

According to USEPA (2004), only chemicals with a Henry's Law constant of 1 x 10^{-5} atm-m^3/mol or greater are considered sufficiently volatile to warrant consideration with respect to vapour intrusion.

4.4. Conceptual Site Models and Quantitative Exposure Assessments Including Human Behavioural Exposure Assumptions

Based on the current land use, and the potential future development detailed above, the conceptual site model for each land use scenario, including the modelled exposure assumptions are described in **Section 4.4.1** to **Section 4.4.4**

4.4.1. Scenario 1 – On-Site Commercial – Slab on Ground Construction

The CSM for the On-Site Commercial worker with a slab on ground construction has been prepared for the purpose of assessing both the current on-Site land use and the potential future land use which would not include a basement.

Adult commercial workers are considered the most sensitive human receptor for this scenario, with the potentially complete contaminant migration pathways limited to the volatilisation and vapour migration from the groundwater source through the soil profile and into indoor and outdoor air.

Human exposure parameters adopted for this scenario are summarised in **Table 12**, and have been selected from both Australian and international sources. Where necessary, some parameters are based on professional judgement and or expected site conditions.

Table 12 Exposure Parameters – Scenario 1

Parameter (units)	Adopted Value	Reference
Exposure Time (hours / day)	8 hours (indoors) 1 hour (outdoors)	NEPM (2013). Assumes average 8-hour workday.
Exposure Frequency (days / year)	240	NEPM (2013). Assumes workers are present 5 days / week across 48 weeks of the year.
Exposure Duration (years)	30	NEPM (2013) and enHealth (2012)

The geologic and building parameters adopted for the vapour intrusion modelling are summarised in **Table 13** below.

Table 13 Vapour Modelling Assumptions – Scenario 1

Parameter (units)	Adopted Value	Reference
Depth to soil contamination (cm)	130	Based on the installation depth of the probe at SV9S.
Fraction of organic carbon in soil (unitless)	0.002	Based on the description of the geology presented at SV9S. USEPA (2004) defaults for sand and gravel.
Air filled porosity (volumetric) (cm^3 / cm^3)	0.321	
Water filled porosity (volumetric) (cm^3 / cm^3)	0.054	
Total soil porosity	0.375	
Ratio of enclosed space volume to infiltration area (cm)	360	Based on the minimal floor to ceiling height of 3.6m (EPSSD, 2020).
Enclosed space foundation/wall thickness (cm)	15	ASTM (2002)
Enclosed space air exchange rate (s-1)	0.00036	1.3 / hr based on typical air exchange rate for non-residential buildings (Johnson, 2002)
Areal fraction of cracks in foundations/walls	0.0038	US EPA (2004) default value for slab on ground.
Air filled porosity in foundation wall cracks	0.321	US EPA (2004). Assumes foundation/wall cracks filled with coarse sand.
Air filled porosity in foundation wall cracks	0.054	US EPA (2004). Assumes foundation/wall cracks filled with coarse sand.
Advective vapour flow rate	Calculated	Assumes vapour advection into the building.
Wind speed in outdoor mixing zone (ambient air) (cm/s)	336	Based on average annual windspeed at Canberra Airport (19km) from the Site.
Width of source area parallel to groundwater flow direction (cm)	1500	CRC CARE (2011)
Ambient air mixing zone height (cm)	200	ASTM (2002)

4.4.2. Scenario 2 – On-Site Commercial with child care – Slab on Ground Construction

The CSM for the On-Site Commercial worker, including a child care facility, with a slab on ground construction has been prepared for the purpose of assessing the potential future land use which would not include a basement.

Children attending potential future child care facilities are considered the most sensitive human receptor for this scenario, with the potentially complete contaminant migration pathways limited to the volatilisation and vapour migration from the groundwater source through the soil profile and into indoor and outdoor air.

Human exposure parameters adopted for this scenario are summarised in **Table 14**, and have been selected from both Australian and international sources. Where necessary, some parameters are based on professional judgement and or expected site conditions.



Table 14 Exposure Parameters – Scenario 2

Parameter (units)	Adopted Value	Reference
Exposure Time (hours / day)	Adult and Child = 20 hours (indoors) and 4 hours (outdoors)	NEPM (2013). Assumes average 20 indoor hours per day, and 4 outdoor hours per day.
Exposure Frequency (days / year)	Adult and Child = 365	NEPM (2013). Assumes receptors are present every day of the year.
Exposure Duration (years)	Adult = 29 Child = 6	NEPM (2013) and enHealth (2012)

The geologic and building parameters adopted for the vapour intrusion modelling are identical to those provided in Scenario 1 and presented in **Table 13** above, as the slab construction is assumed to be the same in both instances.

4.4.3. Scenario 3 – On-Site Commercial – Basement Construction with commercial properties from the ground floor.

The CSM for the on-Site commercial worker with basement construction has been prepared for the purpose of assessing potential future land use which may include a basement.

Adult commercial workers are considered the most sensitive human receptor for this scenario, with the potentially complete contaminant migration pathways limited to the volatilisation and vapour migration from the groundwater source through the soil profile and into indoor air.

Human exposure parameters adopted for this scenario are summarised in **Table 15**, and have been selected from both Australian and international sources. Where necessary, some parameters are based on professional judgement and or expected site conditions.

Table 15 Exposure Parameters – Scenario 3

Parameter (units)	Adopted Value	Reference
Exposure Time (hours / day)	8	NEPM (2013). Assumes average 8-hour workday.
Exposure Frequency (days / year)	240	NEPM (2013). Assumes workers are present 5 days / week across 48 weeks of the year.
Exposure Duration (years)	30	NEPM (2013) and enHealth (2012)

The geologic and building parameters adopted for the vapour intrusion modelling are summarised in **Table 16** below.

Table 16 Vapour Modelling Assumptions – Scenario 3

Parameter (units)	Adopted Value	Reference
Depth to soil contamination (cm)	0.001	Negligible distance – conservatively assumes soil vapour is directly adjacent to the walls and floor of the basement.
Fraction of organic carbon in soil (unitless)	0.002	Based on the description of the geology presented at SV9S. USEPA (2004) defaults for sand and gravel.
Air filled porosity (volumetric) (cm^3 / cm^3)	0.321	

Parameter (units)	Adopted Value	Reference
Water filled porosity (volumetric) (cm^3 / cm^3)	0.054	
Total soil porosity	0.375	
Ratio of enclosed space volume to infiltration area (cm)	250	Professional Judgement: Assumes a basement height of 2.5m
Enclosed space foundation/wall thickness (cm)	15	ASTM (2002)
Enclosed space air exchange rate (s-1)	0.001	AS1668.2 minimum ventilation rate for car park (4 per hour).
Areal fraction of cracks in foundations/walls	0.0002	US EPA (2004).
Air filled porosity in foundation wall cracks	0.321	US EPA (2004). Assumes foundation/wall cracks filled with coarse sand.
Air filled porosity in foundation wall cracks	0.054	US EPA (2004). Assumes foundation/wall cracks filled with coarse sand.
Advective vapour flow rate	Calculated	Assumes vapour advection into the basement.
Wind speed in outdoor mixing zone (ambient air) (cm/s)	336	Based on average annual windspeed at Canberra Airport (19km) from the Site.

Vapours which enter the basement level (derived from impacted groundwater) are assumed to be separately mixed throughout the basement into the first floor. The estimate of vapour concentrations within the first floor are assumed to be 1/10 of the modelled concentrations within the basement and into the first and subsequent floors (CRC CARE, 2013).

4.4.4. Scenario 4 – On-Site Medium Density Residential – Basement Construction with residential properties from the ground floor.

The CSM for the On-Site residential receptor with basement construction has been prepared for the purpose of assessing potential future land use which may include a basement below residential receptors from the ground floor. It is noted that under the Holt Precinct Code (EPSDD, 2020) residential development is expected from the first floor, and not the ground floor, however as the final development layout is currently unknown ground floor residential above a basement carpark has been considered in this HHRA.

Adult and child residents are considered the most sensitive human receptor for this scenario, with the potentially complete contaminant migration pathways limited to the volatilisation and vapour migration from the groundwater source through the soil profile and into indoor air.

Human exposure parameters adopted for this scenario are summarised in **Table 17**, and have been selected from both Australian and international sources. Where necessary, some parameters are based on professional judgement and or expected site conditions.

Table 17 Exposure Parameters – Scenario 4

Parameter (units)	Adopted Value	Reference
Exposure Time (hours / day)	Adult = 20 Child = 20	NEPM (2013). Assumes average 20 indoor hours per day.

Parameter (units)	Adopted Value	Reference
Exposure Frequency (days / year)	Adult and Child = 365	NEPM (2013). Assumes residents are present 365 days of the year.
Exposure Duration (years)	Adult = 29 Child = 6	NEPM (2013) and enHealth (2012)

The geologic and building parameters adopted for the vapour intrusion modelling are identical to those provided in Scenario 3 and presented in **Table 16** above, as the basement is assumed to be the same basement.

Vapours which enter the basement level (derived from impacted groundwater) are assumed to be separately mixed throughout the basement into the first floor.

4.5. Exposure Assessment Algorithms

The equations used in the estimation of potential risk are presented in **Appendix C**. Exposure is estimated for each chemical and pathway separately.

4.6. Exposure Point Concentrations

A key element of the exposure assessment process is estimation of the concentration of CoPC in environmental media to which people may be exposed, or the Exposure Point Concentration (EPC). The EPC are:

- An estimate of the concentration of the chemical in the soil vapour that the population is exposed to, at the location where exposure is predicted to occur.
- Typically, based on an assumption that an individual receptor is equally exposed to media within all portions of the exposure unit over the timeframe of the risk assessment.

For this HHRA, due to the uncertainties in the available data set, the EPC have been selected based on the maximum concentration of the CoPC which exceeded the Tier 1 screening assessment at on-Site locations at any point in time. Additionally, for the potential future basement scenario, the maximum concentration has been considered to be adjacent to both the floor and walls of the basement. These combined approaches are considered to be conservative, as it assesses the risk of CoPC across all distinct sampling points, across the available temporal data.

Table 18 Exposure Point Concentrations Considered in the Tier 2 Assessment

CoPC	EPC (µg/m^3)	Sampling Location and Event
Tetrachloroethene (PCE)	5990	SV9S, March 2022 (Stage 4)
Trichloroethene (TCE)	550	SV9S, March 2022 (Stage 4)
cis-1,2-Dichloroethene (DCE)	1000	SV4D, January 2022 (Stage 3)

5. Step 4: Toxicity Assessment

Toxicity assessment is the process of understanding the health effects associated with exposure to a chemical and making a quantitative link between the degree of exposure and the effect realised.

Specifically, this stage of the HHRA includes:

- Qualitative review of the potential hazards to human health associated with each CoPC; and
- Review of toxicological (dose-response) criteria for each CoPC and identification of appropriate quantitative toxicity criteria to use in the HHRA.

Toxicity profiles have been compiled for the CoPC using the most recent information published by government agencies and research bodies (both within Australia and internationally). These are provided in **Appendix D**.

5.1. Non-Threshold Toxicity Criteria

The assessment of potential effects associated with genotoxic carcinogens requires the use of a non-threshold toxicity value. The values available are essentially the slope of the cancer dose-response curve for the chemical (based on relevant studies and approaches to extrapolate effects from high doses to low doses) and in relation to the inhalation pathway are termed an inhalation unit risk (IUR).

The IUR (expressed as $(\mu g/m^3)^{-1}$) is used to estimate the probability of an individual developing cancer at some point in a lifetime as a result of a specific exposure.

As described in **Appendix D**, of the CoPC identified at the Site, TCE is the only CoPC considered to be a genotoxic carcinogen and has a published IUR. TCE has therefore been assessed based on non-threshold toxicity criteria.

5.1. Threshold Toxicity Criteria

Potential health effects that are assessed on the basis of a threshold dose response utilise a threshold value which for the vapour intrusion pathway is termed reference concentration (RfC). The RfC is a chemical intake below which it is considered unlikely that adverse effects would occur in human populations, including sensitive sub-groups (e.g. the very young or elderly). The RfC is an estimate of a continuous inhalation exposure concentration to people (including sensitive subgroups) that is likely to be without risk of deleterious effects during a lifetime.

5.1.1. Potential Background Exposure to CoPC

When evaluating potential health effects for chemicals assessed on the basis of a threshold dose-response criteria, total exposure to a given chemical (i.e. the sum of the background exposure and the substance exposure from contaminated media) should not exceed the tolerable daily intake (enHealth, 2012; NEPM, 2013).

A background exposure of 10% has been considered for both PCE and TCE in accordance with the NEPM (2013), this has been accounted for in the RfC presented in **Table 19** below

5.2. Toxicity Criteria

A summary of the adopted threshold and non-threshold toxicity values for each CoPC is provided in **Table 19** below. Where possible, values published or supported by Australian entities have been adopted for this assessment. However, where the specific values were not available within published Australian guidance documents, the adopted toxicity value was selected based on an assessment of its conservativeness, the currency of the determined value and the adequacy of the studies used in deriving these values. The ASC NEPM 2013 Schedule B4 outlines a range of sources that are consider to provide information on toxicity compliant with Australian requirements. The IRIS database developed by the US EPA is one of these sources. This database has been updated since the publication of the ASC NEPM 2013 and therefore, where more recently published toxicity data was available, this was adopted to ensure the risk assessment reflected current information.

Table 19 Adopted Threshold and Non-Threshold Toxicity Values Considered in the Tier 2 Assessment

CoPC	Adopted IUR ($\mu g/m^3)^{-1}$ (Reference)	Adopted RfC (mg/m^3) (Reference)
Tetrachloroethene (PCE)	Not assessed as a non-threshold contaminant.	0.18 (WHO, 2006)*
Trichloroethene (TCE)	4.1×10^{-6} (US EPA, 2022)	0.0018 (US EPA, 2022)*
cis-1,2-Dichloroethene (DCE)	Not assessed as a non-threshold contaminant.	0.007 (NEPC, 2013)

Note: *The adopted RfC has been adjusted to consider background exposure for PCE and TCE, as discussed in **Section 5.1.1**.

6. Step 5: Risk Characterisation

Risk characterisation is the final step in the risk assessment process whereby information gathered and derived from the toxicity assessment and the exposure assessment is used to derive quantitative estimates of potential risk to human health.

PCE, TCE and cis-DCE, have all been identified to be associated with a threshold dose-response relationship, and a non-threshold response relationship has been identified for TCE.

The threshold approach assumes that there is a level at which exposure to the chemical does not result in the potential to harm the general population. Therefore, the HHRA is based on comparison of estimated chronic daily intakes of the CoPC to the adopted reference concentrations (RfC). The selection of RfC values for each CoPC has been made considering the most recent information published by government agencies and research bodies (both within Australia and internationally).

6.1. Threshold Risk Estimates - Hazard Quotient and Hazard Index

The potential for adverse effects, resulting from exposure to the CoPC, has been evaluated by comparing the exposure level for each exposure pathway, expressed as the inhalation concentration, with the threshold RfC (adjusted to account for background exposure where appropriate, as described in **Section 5.1.1**). The resulting ratio is referred to as the hazard quotient (HQ) (ASC NEPM 2013) and is derived in the following manner:

$$Hazard\ Quotient\ (HQ) = \frac{Exposure\ concentration\ in\ air\ \left(\frac{mg}{m3}\right)}{Reference\ Concentration\ (\frac{mg}{m3})}$$

A potentially unacceptable chemical intake/exposure is indicated if the exposure concentration in air exceeds the tolerable concentration (i.e. if the HQ is greater than 1).

To assess the overall potential for harmful effects posed by exposure to multiple pathways, the hazard quotients for each chemical and exposure pathway relevant to a receptor are summed. The resulting sum is referred to as the hazard index (HI):

$$Hazard\ Index\ (HI) = \sum HQ\ for\ all\ relevant\ pathways$$

The threshold HI assumes that there is a level of exposure, below which it is unlikely for humans to experience health effects, based on the available toxicological studies. If the exposure level does not exceed the threshold (i.e. HI is equal to or less than 1), then it is reasonable to conclude that no harmful effects are likely to be realised (NEPM 2013).

In this HHRA, these levels of exposure are considered to be associated with low risk of harm to health. Where the HI is greater than 1, the exposure is considered to be above a level which has been determined to have no adverse effects, but this does not necessarily mean that health effects will occur. Where the HHRA concludes that a particular receptor has the potential to exceed the tolerable concentration, the pathways that are primarily responsible for this are identified in order that a more detailed and critical evaluation of the risk may be conducted, or further investigation or appropriate exposure management measures may be considered.



6.2. Non-Threshold Risk Estimates - Incremental Lifetime Cancer Risk

Risks to human health for CoPCs considered to be genotoxic carcinogens were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of chemical exposure. The numerical estimate of incremental lifetime carcinogenic risk was calculated using the following relationship:

$$ILCR = EC_{inh} * IUR * 10^3 \frac{\mu g}{mg}$$

Where:

ILCR = Incremental Lifetime Cancer Risk (unitless)

EC_{inh} = Exposure adjusted air concentration (mg/m3)

IUR = Inhalation Unit Risk (µg/m3)-1

To assess the overall potential for effects posed by simultaneous exposure to more than one chemical that is associated with non-threshold carcinogenic effects, the risk for each chemical and pathway relevant to a receptor, and for adults and children (as relevant), were summed. The resulting sum is referred to as the cumulative incremental lifetime carcinogenic risk and is estimated as follows:

$$ILCR_{cum} = \sum_{i=1,j=1}^{n} ILCR_{i,j}$$

Where

$ILCR_{cum}$ = Cumulative ILCR for a given receptor (unitless)

$ILCR_{i,j}$ = ILCR for chemical i and pathway j

n = Number of chemicals and/or pathways relevant to land use scenario.

This approach assumes that exposure to multiple carcinogens over a lifetime results in a cumulative effect, and therefore, exposures are summed over all intake routes.

For CoPC considered to be genotoxic carcinogens and assessed on the basis of non-threshold toxicity criteria, an incremental cancer risk of 1×10^{-5} has been adopted as the acceptable cancer risk threshold for each individual chemical (NEPM, 2013).

Where the estimated cumulative cancer risk is greater than 1×10^{-5}, a more detailed and critical evaluation of the risk may be conducted, or appropriate risk management measures may be recommended.

6.3. Risk Estimate Overview

The calculated HQ (individual pathways) and HI (cumulative assessment), and the Lifetime excess cancer risk are presented in **Appendix E**.

Table 20 below presents the cumulative HI, and the lifetime excess cancer risk, estimated based on the current and potential future exposure pathways which may be complete for each receptor.

Table 20 Summary of Risk based on current and potential future exposure pathways

Scenario	Adult HI	Child HI	Lifetime Excess Cancer Risk	Overall Conclusion
Scenario 1 – On-Site Commercial – Slab on Ground Construction.	0.01	Not applicable	2.74×10^{-8}	The tolerable concentration was not exceeded, and the lifetime cancer risk was less than the adopted cumulative cancer risk of $1x\ 10^{-5}$, indicating low risk of harm to health.
Scenario 2 – On-Site Commercial with child care – Slab on Ground Construction.	0.05	0.13	1.22×10^{-7}	The tolerable concentration was not exceeded, and the lifetime cancer risk was less than the adopted cumulative cancer risk of $1x\ 10^{-5}$, indicating low risk of harm to health.
Scenario 3 – On-Site Commercial – Basement Construction with commercial properties from the ground floor.	0.0000668	Not applicable	1.26×10^{-10}	The tolerable concentration was not exceeded, and the lifetime cancer risk was less than the adopted cumulative cancer risk of $1x\ 10^{-5}$, indicating low risk of harm to health.
Scenario 4 – On-Site Medium Density Residential – Basement Construction with residential properties from the ground floor.	0.000254	0.000602	5.57×10^{-10}	The tolerable concentration was not exceeded, and the lifetime cancer risk was less than the adopted cumulative cancer risk of $1x\ 10^{-5}$, indicating low risk of harm to health.

6.4. Data Gaps and Uncertainty Assessment

The health risk assessment process involves a number of assumptions regarding Site conditions, human exposure and chemical toxicity. These assumptions are based on Site-specific information (where available), but it is not always possible to fully predict or describe site conditions and human activities at a site for the exposure period considered in the risk assessment. The assumptions adopted for this risk assessment were therefore generally selected to be conservative in nature, in order to evaluate an assumed reasonable maximum exposure scenario and provide a deliberate margin of safety.

A discussion of some of the key uncertainties associated with different components of the risk assessment process is provided in the following sections.

6.4.1. Sampling and Analysis

As described in **Section 3.6** limited temporal and seasonal data is currently available for use in the HHRA.

Lanterra (2022c) has presented the results of the detailed site assessment which has informed this HHRA. It is noted that during future intrusive works, identification of additional contamination sources may be identified at the Site (e.g. a boiler system). An unexpected finds protocol should be prepared for the Site to inform future land owners of the required process for managing this risk.

6.4.2. Toxicity Assessment

In general, the available scientific information is insufficient to provide a thorough understanding of all of the potential toxic properties of chemicals to which humans may be exposed. It is necessary, therefore, to extrapolate these properties from data obtained under other conditions of exposure and involving experimental laboratory animals. This may introduce two types of uncertainties into the risk assessment, as follows:

a) Those related to extrapolating from one species to another; and

b) Those related to extrapolating from the high exposure doses, usually used in experimental animal studies, to the lower doses usually estimated for human exposure situations.

The majority of the toxicological knowledge of chemicals comes from experiments with laboratory animals, although there may be interspecies differences in chemical absorption, metabolism, excretion and toxic response. There may also be uncertainties concerning the relevance of animal studies using exposure routes that differ from human exposure routes. In addition, the frequent necessity to extrapolate results of short-term or sub-chronic animal studies to humans exposed over a lifetime has inherent uncertainty.

In order to adjust for these uncertainties, reference concentrations incorporate safety factors that may vary from 10 to 10,000. The USEPA assumes that humans are as sensitive to carcinogens as the most sensitive animal species. The policy decision, while designed to minimise the potential for underestimating risk, introduces the potential to overestimate carcinogenic risk. Conversely, it also does not allow for the possibility that humans may be more sensitive than the most sensitive animal species.

The model used by the USEPA to determine slope factors is a linearised multistage model, which provides a conservative estimate of cancer risk at low doses and is likely to

overestimate the actual slope factor. It is assumed in this approach that a genotoxic mechanism applies, however, most carcinogens do not actually cause cancer by this mechanism. The result is that the use of slope factors has the general effect of overestimating the incremental cancer risks.

The approach for evaluating risks to mixtures of chemicals assesses dose additively and does not account for potential synergism, antagonism or differences in target organ specificity and mechanism of action. In general, the additive approach had the effect of overestimating the risks. This is because chemicals that have no additive effects are included together as well as chemicals that may have additive effects.

Table 21 summarises the uncertainty factors (UF) for the RfC adopted for each CoPC in this HHRA (refer to **Section 5** for discussion of these values). These uncertainty factors have been used by the relevant regulatory agency in applying toxicity values to humans from the studies used to define this value. Complete toxicological data for each CoPC can be found in **Appendix D**.

Table 21 Uncertainty factors (UF) applied to the adopted RfC for each CoPC

CoPC	Published RfC (mg/m^3)	Reference	UF	Comment
PCE	0.2	(WHO, 2006)	100	WHO (2006) based this value on studies observing neurotoxicological effects on humans from occupationally exposed groups. The UF is a combination of two uncertainty factors of 10 applied to account for differences between individuals and that the tolerable concentration derived was considered to reflect the lowest observed adverse effect level (LOAEL) and not a NOAEL (no OAEL).
TCE	0.002	(US EPA, 2022)	10-100	The US EPA (2022) UF accounts for: - Extrapolating the value from a LOAEL and not a NOAEL concentration. - Use of non-human data to derive the value. The studies relied upon assessed impacts to rats and mice. - Differences in impacts to sensitive humans (e.g. immunocompromised).
DCE	0.007	(NEPC, 2013)	-	The RfC has been derived from route extrapolation from an oral reference dose as described in the NEPC (2013). It is noted the US EPA (2010) oral reference dose used has an UF of 3000, which accounts for: - A factor of 10 for sensitive individuals - A factor of 10, due to use of non-human data to derive the value. The studies relied upon assessed impacts to rats. - A factor of 10, due to the use of a study of subchronic duration. - A factor of 3, to account for database deficiencies.

6.4.3. Human Exposure Parameters

Risk assessment requires the adoption of several assumptions in order to assess potential human exposure. This risk assessment included assumptions about general characteristics and patterns of human exposure relevant to areas surrounding the Site.

The assumptions used for identified on-Site receptors were conservative and developed to provide an estimate of reasonable maximum exposures rather than the actual exposures. This approach tends to overestimate the associated risks.

6.4.4. Vapour Transport Modelling

The modelling of vapour migration from a soil vapour to indoor and outdoor air has relied on a model to estimate the concentration in air based on concentrations in the subsurface. The use of a model requires the simplification of many complex processes in the subsurface as well as the potential for entry and dispersion within a building or outdoor air. To address this simplification, the vapour models available (and adopted in this HHRA) are considered to be conservative such that uncertainties are addressed through the overestimation of actual concentrations. The vapour model was applied assuming that the maximum reported CoPC concentrations in soil vapour may be present beneath the entire building foundations and that no degradation of chemicals occurred during migration through the vadose zone. These assumptions are considered highly and potentially unrealistically conservative. Despite the conservatism associated with this modelling these assumptions were adopted to account for potentially significant data gaps.

The vapour modelling undertaken in this assessment has assumed that indoor to sub slab pressure differentials are present and therefore that advective flow of sub-slab vapours into buildings as a result of these pressure differentials will occur. This assumption was adopted because the likelihood of building under-pressurisation and associated advective vapour flow in buildings in the area surrounding the Site is considered possible. It is noted that commercial buildings are expected to have adequate temperature controls such that heating and cooling systems are likely to be running for the majority of the year, and will likely create an outward pressure, reducing advection into the Site buildings and the potential future basement.

6.5. Sensitivity Assessment

When undertaking quantitative risk modelling it is important to understand the potential effects that varying exposure parameters may have on the overall calculated risks. **Table 22** below discusses how different parameters may influence the risk findings presented within this report.

Table 22 Sensitivity of Modelling Input Parameters

Parameter	Range of Values	Value adopted in HHRA	Outcome in Assessment
Concentration of CoPC measured in soil vapour.	CoPC were measured across the on-Site and off-Site areas from below the laboratory limit of reporting to above the relevant Tier 1 assessment criteria.	The HHRA has adopted the maximum observed on-Site concentration for each of the CoPC: PCE = 5990 µg/m^3 TCE = 550 µg/m^3 DCE = 1000 µg/m^3	The risk assessment has adopted the maximum measured concentration for each CoPC identified above the Tier 1 criteria in soil vapour at on-Site locations. It is noted that limited soil vapour data is available, and the off-Site source is expected to result in continued migration of impacts towards the Site. Further vapour sampling is recommended to understand both: seasonal; and temporal variation at the Site; as the potential risk at the Site may increase with increased soil vapour concentrations. Furthermore, in association with the breakdown of the chlorinated compounds in the sub-surface, the production of daughter products such as vinyl chloride may occur at the Site, therefore additional CoPC may be identified during future monitoring events.
Depth to soil vapour impacts	Soil vapour data was collected from a range of depths from 1.2 m bgl to 5.4 m bgl.	130 cm (Scenario 1) And 0.001 cm (Scenario 3 and Scenario 4)	For Scenario 1, which represents the slab on grade commercial land use model, the HHRA has adopted the soil vapour depth of 130cm bgl, based on the depth of the soil vapour probe located at SV9S, where maximum concentrations were observed for both PCE and TCE. This approach is considered to be conservative, as the maximum measured concentration does not occur across the entirety of the on-Site areas at this depth. If the depth of the maximum concentration decreased (i.e. higher concentrations of CoPC closer to the slab), risk estimates may increase. For Scenario 3 and Scenario 4, a negligible depth to soil impact has been adopted, to account for maximum vapour impacts to occur adjacent to the walls and floor of the basement.

Parameter	Range of Values	Value adopted in HHRA	Outcome in Assessment
Geology	The geology identified by Lanterra (2022c) across the site varied from sand and gravel to silty clays at depth.	The vapour modelling has adopted the conservative value of sand and gravel.	The geology adopted in the model can strongly influence the migration of vapour impacts as a result of the variation in aspects such as bulk density, pore space and organic carbon content. The adoption of a sand and gravel geology (especially for Scenario 1) is expected to be conservative, as a sand and gravel geology has not been identified across the entirety of the Site. For Scenario 3 and Scenario 4, as the profile of the sand and gravel geology is limited in depth, the effect of this parameter on the modelling is considered to be negligible.
Air exchange rate	Required air exchange rates vary for commercial (1.3 / hour); residential (0.5 / hour) and carpark areas (4/hour).	For Scenario 1, the vapour modelling has adopted the commercial air exchange rate of 1.3 per hour. For Scenario 3 and Scenario 4, the vapour modelling has adopted the required air exchange rate for carparks.	An increased air exchange rate would decrease the calculated risk.
Areal fraction of cracks in foundation / walls	Range of values from 0.01 – 0.0004	For Scenario 1, the vapour modelling has adopted the value of 0.0038. For Scenario 3 and Scenario 4, the vapour modelling has adopted the value of 0.0002.	Considered that adopted values are representative of a slab on ground building under normal conditions. The use of an areal fraction of cracks at the higher end of the range is considered conservative.
Advective flows	Advective flow has been calculated.	Calculated	Calculation of advection in the model is considered to be conservative. Where advection is not included in the model the risk would decrease.

6.1. Scenario 5 - Unplanned Residential land use not currently identified under the Holt Precinct Code (EPSDD, 2020)

To adequately characterise the risk to human health at the Site from the existing soil vapour and groundwater contamination, it was considered appropriate to include a sensitivity scenario that addressed the possibility for slab-on-ground residential land use across the Site. The Holt Precinct Code (EPSDD, 2020) identifies that residential land use may occur at the Site. Currently, the planning information has limited residential land use for future development to the eastern extent of Block 71. However, while this is the planned land use for residential purposes, as the land is zoned to allow residential use generally, the possibility for alternative constructions is necessary to consider.

As such, SAGE has prepared Scenario 5 to characterise the risk to human health associated with a slab-on-ground residential development. As the modelling has taken a conservative approach and assumed that the maximum measured concentration of each contaminant in the soil vapour phase measured by Lanterra (2022c) is present across the entire Site, this Scenario considers risk for this development across the Site (i.e. not spatially limited).

The CSM for the On-Site residential receptor with a slab on ground construction has been prepared for the purpose of assessing the potential future land use which would not include a basement.

Adult and child residents are considered the most sensitive human receptor for this scenario, with the potentially complete contaminant migration pathways limited to the volatilisation and vapour migration from the groundwater source through the soil profile and into indoor and outdoor air.

Human exposure parameters adopted for this scenario are summarised in **Table 23**, and have been selected from both Australian and international sources. Where necessary, some parameters are based on professional judgement and or expected site conditions.

Table 23 Exposure Parameters – Scenario 5

Parameter (units)	Adopted Value	Reference
Exposure Time (hours / day)	Adult and Child = 20 hours indoors 4 hours outdoors	NEPM (2013). Assumes average 20 indoor hours per day.
Exposure Frequency (days / year)	Adult and Child = 365	NEPM (2013). Assumes residents are present 365 days of the year.
Exposure Duration (years)	Adult = 29 Child = 6	NEPM (2013) and enHealth (2012)

The geologic and building parameters adopted for the vapour intrusion modelling are presented in **Table 24**.

Table 24 Vapour Modelling Assumptions – Scenario 5

Parameter (units)	Adopted Value	Reference
Depth to soil contamination (cm)	130	Based on the installation depth of the probe at SV9S
Fraction of organic carbon in soil (unitless)	0.002	Based on the description of the geology presented at SV9S.

Parameter (units)	Adopted Value	Reference
Air filled porosity (volumetric) (cm^3 / cm^3)	0.321	USEPA (2004) defaults for sand and gravel.
Water filled porosity (volumetric) (cm^3 / cm^3)	0.054	
Total soil porosity	0.375	
Ratio of enclosed space volume to infiltration area (cm)	240	Based on the minimal floor to ceiling height of 2.4m for residences (EPSSD, 2020).
Enclosed space foundation/wall thickness (cm)	15	ASTM (2002)
Enclosed space air exchange rate (s-1)	0.00014	Minimal air exchange rate for residential properties in accordance with Australian standards.
Areal fraction of cracks in foundations/walls	0.0038	US EPA (2004) default value for slab on ground.
Air filled porosity in foundation wall cracks	0.321	US EPA (2004). Assumes foundation/wall cracks filled with coarse sand.
Air filled porosity in foundation wall cracks	0.054	US EPA (2004). Assumes foundation/wall cracks filled with coarse sand.
Advective vapour flow rate	Calculated	Assumes vapour advection into the basement.
Wind speed in outdoor mixing zone (ambient air) (cm/s)	336	Based on average annual windspeed at Canberra Airport (19km) from the Site.
Width of source area parallel to groundwater flow direction (cm)	1500	CRC CARE (2011)
Ambient air mixing zone height (cm)	200	ASTM (2002)

The calculated HQ (individual pathways) and HI (cumulative assessment), and the Lifetime excess cancer risk for this Scenario are presented in **Appendix E**.

Table 25 below presents the cumulative HI, and the lifetime excess cancer risk, estimated based on the current and potential future exposure pathways which may be complete for Scenario 5.

Table 25 Summary of Risk based on current and potential future exposure pathways for Scenario 5

Scenario	Adult HI	Child HI	Lifetime Excess Cancer Risk	Overall Conclusion
Scenario 5 – On-Site Residential– Slab on Ground Construction.	0.31	0.76	7.23×10^{-7}	The tolerable concentration was not exceeded, and the lifetime cancer risk was less than the adopted cumulative cancer risk of 1×10^{-5}, indicating low risk of harm to health.

7. Remedial Approach and Extent

Although the risk estimates do not indicate a current potential health risk for on-Site receptors, consideration should be given to the future development in light of the off-Site source that is expected to continue to migrate towards the Site.

Future development of the Site should consider mitigation measures (e.g. active or passive vapour barriers) to limit the potential exposure to vapour at the Site, in addition to continuing to mitigate direct contact with groundwater. This may include limiting the extent of the basement, to areas where contamination levels are lower.

Furthermore, future development would benefit from an appreciation of where the highest concentrations of CoPC occur at the Site, as considerations in design and layout could further mitigate the potential risks associated with the up-gradient off-Site source.

8. Summary and Conclusions

Based on the data available at the time of preparation of this HHRA with respect to the concentrations reported in environmental media, and with consideration of the identified data gaps and uncertainties, the following conclusions are provided with respect to the potential for the identified on-Site human receptors to be exposed to the CoPC, that have been measured in the environment as result of the impacts identified in groundwater which are understood to have originated from an off-Site source.

The representative groups of people who may be exposed to the CoPC measured in the environment at the Site and assessed in the HHRA were:

- Commercial receptors; and
- Residential receptors.

Recreational receptors were not assessed as part of the Tier 2 assessment, but are considered to have a lower risk profile than the sensitive residential and commercial receptors that have been considered.

The HHRA assessed potential exposure that could occur as a result of current and potential future land use at the Site. These exposures were limited to the inhalation of vapours in both indoor and outdoor air.

The EPC were identified through the evaluation of the available data characterising the environmental medial and the current understanding of the impacts at the Site. The HHRA has adopted the maximum on-Site concentration of CoPC in the risk model, for the purpose of assessing the current and potential future risk at the Site. Where Site conditions are observed to change (e.g. increasing concentrations of CoPC in environmental media) further assessment of risk, including the collection of ambient air samples (where possible) may assist in the characterisation of the risk profile.

As the estimated exposure to CoPC was less than the tolerable concentration (represented by the hazard index of less than 1, and the ILCR less than 1×10^{-5}) for the pathways identified to be currently or potentially complete in the future, there is low risk of harm to health for residents, commercial workers, and recreational receptors at the Site.

As part of the HHRA, a sensitivity assessment was undertaken to characterise the potential health risk if future development included additional areas of slab on grade residential development across the Site, this scenario was considered to assess the potential risk to residential receptors allowable under the current land use zone, but not currently planned by the Holt Precinct Code (EPSDD, 2020). The sensitivity assessment conducted for a slab on ground residential scenario (Scenario 5, **Section 6.1**) also indicated the exposure of the considered receptors to CoPC was less than the tolerable concentration for the potential future pathway. However, the hazard index for this scenario return the highest estimate of all scenarios (0.31 for adult receptors and 0.76 for child receptors), therefore, SAGE considers that further assessment of the risk to human health be conducted if future development includes residential development at the ground floor in additional areas currently identified in the Holt Precinct Code (EPSDD, 2020).

Due to the existing data gaps related to the unknown source, the HHRA has presented a qualitative assessment of off-Site risk based on the current land use only. Off-Site exceedances of Tier 1 screening criteria, especially in the vicinity of Kippax Fair Shopping Centre indicate that further assessment of risk to off-Site commercial receptors and intrusive



maintenance workers is required. However, the risk to off-Site receptors (adults and children) in off-Site open space areas (for example Kippax Place) is expected to be low, as recreational receptors and pedestrians are not expected to spend significant amounts of time in this area, and the potential for significant vapour accumulation is generally unlikely to occur in outdoor areas.

A qualitative assessment of the risk to residential receptor to the north of the site also indicated the risk is likely to be low. However, SAGE recommends further ongoing assessment should be considered, using soil vapour and ambient air monitoring data specific to the residential buildings in this location, as limited data is currently available to assess this receptor, and concentrations may change over time as a result of the plume migration.

A number of key assumptions were adopted in the preparation of this HHRA:

- The exact location and extent of the off-Site source remains unknown. This data gap results in the potential for concentrations of CoPC measured at the Site to continue to vary, in association with on-going migration of impacts in groundwater.
- For the purpose of this HHRA, SAGE has assumed that the potential future basement at the site would not extend to a depth which encountered the standing water table (e.g. greater than 8 mbgl). Where basement depths extend to the groundwater table, further assessment of risk may be required, and should consider specific design elements such as basement tanking to prevent potential direct contact with impacted groundwater, and vapour mitigation methods.
- Shallow or perched groundwater systems have not been considered in the modelling assumptions relating to groundwater depth. SAGE has relied on the information available which indicates a depths between 8-11mbgl (Lanterra, 2022c). If shallower groundwater is identified within the Site and is considered to be impacted by contamination, further evaluation of the Site risk to human health is recommended to be undertaken.
- The design and construction of any future basement at the Site may result in different conditions which influence the modelled outcomes presented in this report.
- The potentially complete exposure pathways and receptors presented in the HHRA are based on the information provided by Lanterra (2022c). Should additional complete (or potentially complete) exposure pathways be identified in the future, further assessment of potential health risks may be warranted.
- As groundwater is known to be impacted at the Site, future construction and maintenance works undertaken at the Site would be undertaken in accordance with a Site Management Plan that limits the potential for complete exposure pathways, and the associated potential risks.

In consideration of the data gaps and the uncertainties identified throughout the HHRA the following recommendations are made:

- Further on-going assessment of groundwater and soil vapour impacts at the Site should be undertaken as off-Site impacts may continue to increase on-Site concentrations in both groundwater and soil vapour. Where concentrations increase in soil vapour further risk assessment should be undertaken.



- A Site Management Plan should be established to mitigate potential exposure to soil vapour and groundwater impacts identified at the Site. This plan should include an unexpected finds protocol, to address the potential for additional contamination source areas to be identified on-Site.
- The proposed development should consider inclusion of vapour mitigation (passive or active) due to the potential for off-Site contamination to migrate beneath the Site in the future, thus changing the risk profile presented within this assessment to present potentially unacceptable risks to on-Site receptors.

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10. Acronyms

Term	Definition
ACM	Asbestos Containing Materials
AEC	Areas of Environmental Concern
AHD	Australian Height Datum
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013.
bgl	Below ground level
BTEX	Benzene Toluene Ethylene Xylene
CoPC	Contaminant/s of potential concern
CSM	Conceptual Site Model
DCE	cis 1,2-Dichloroethene
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level (as per NEPM, 2013)
ESL	Ecological Screening Level (as per NEPM, 2013)
EP Act	Environment Protection Act 1997
EPC	Exposure Point Concentrations
EQL	Estimated Quantitation Limit
HHRA	Human Health Risk Assessment
HI	Hazard Index
HIL	Health Investigation Level (as per NEPM, 2013)
HQ	Hazard Quotient
HSL	Health Screening Level (as per NEPM, 2013)
ILCR	Incremental Lifetime Cancer Risk
IUR	Inhalation Unit Risk
LOAEL	Lowest observed adverse effect level
LOR	Limit of Reporting
NOAEL	No observed adverse effect level
PSI	Preliminary Site Investigation
PCB	Polychlorinated biphenyls
PCE	Tetrachloroethene
PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
QAQC	Quality Assurance/Quality Control
RfC	Reference Concentration
SMF	Synthetic mineral fibre
SMP	Site Management Place
TCE	Trichloroethene
THF	Tetrahydrofuran
TRH	Total Recoverable Hydrocarbons
VCH	Volatile Chlorinated Hydrocarbon/s
VF	Volatilisation Factor

11. Statement of Limitations

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Appendix A: Figures



Human Health Risk Assessment - Section 51, Kippax Group Centre, Holt ACT 2615

Regional Site Location

Basemap imagery circa 2014, supplied via QGIS Ausmap Plugin.

Scale (AGD66/ACT Standard Grid): 1:13000

100 0 100 200 300 m

Figure 1

SAGE ENVIRONMENTAL SERVICES



Image extracted from: ACTMapi Webviewer (https://app2.actmapi.act.gov.au/actmapi/index.html?viewer=development)

Scale (WGS84 - EPSG:4326):

0 50 100m

Human Health Risk Assessment - Section 51, Kippax Group Centre, Holt ACT 2615

Detailed Site Location

Figure 2

SAGE ENVIRONMENTAL SERVICES



Basemap imagery circa 2014, supplied via QGIS Ausmap Plugin.

Scale (AGD66/ACT Standard Grid): 1:2000

25 0 25 50 75 m

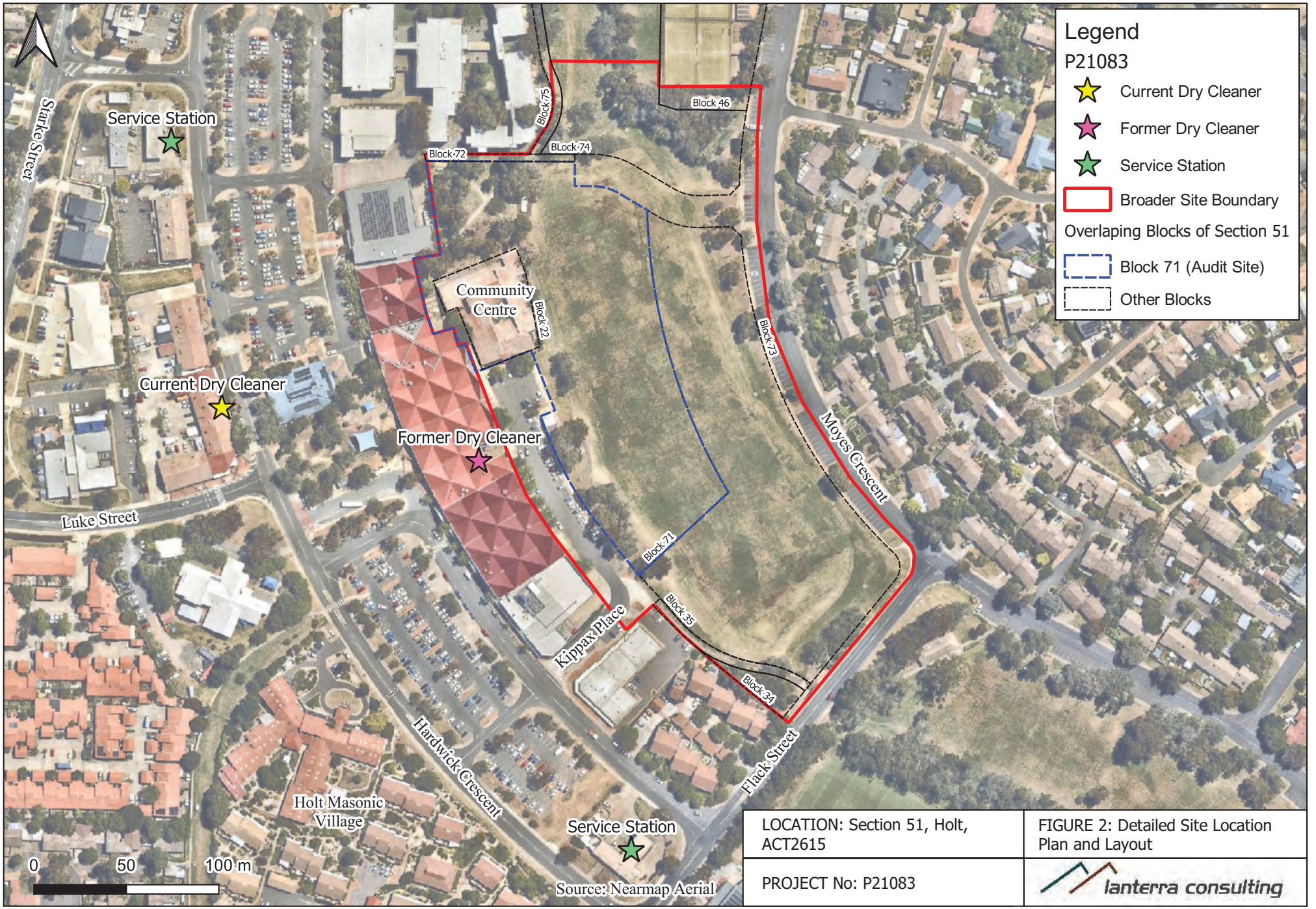
Human Health Risk Assessment - Section 51, Kippax Group Centre, Holt ACT 2615

On-site and off-site Soil Vapour and Groundwater Sampling Locations

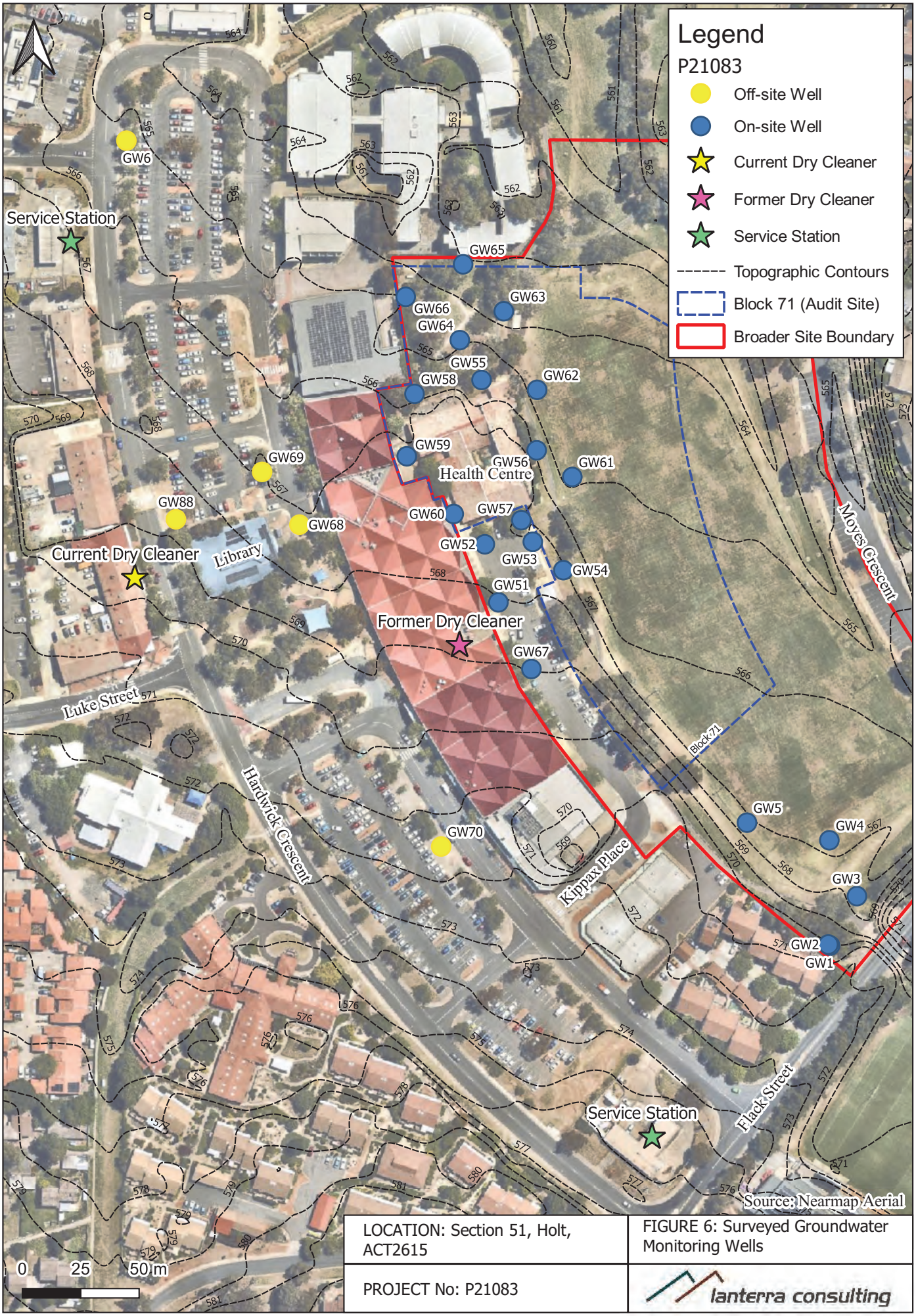
Figure 3

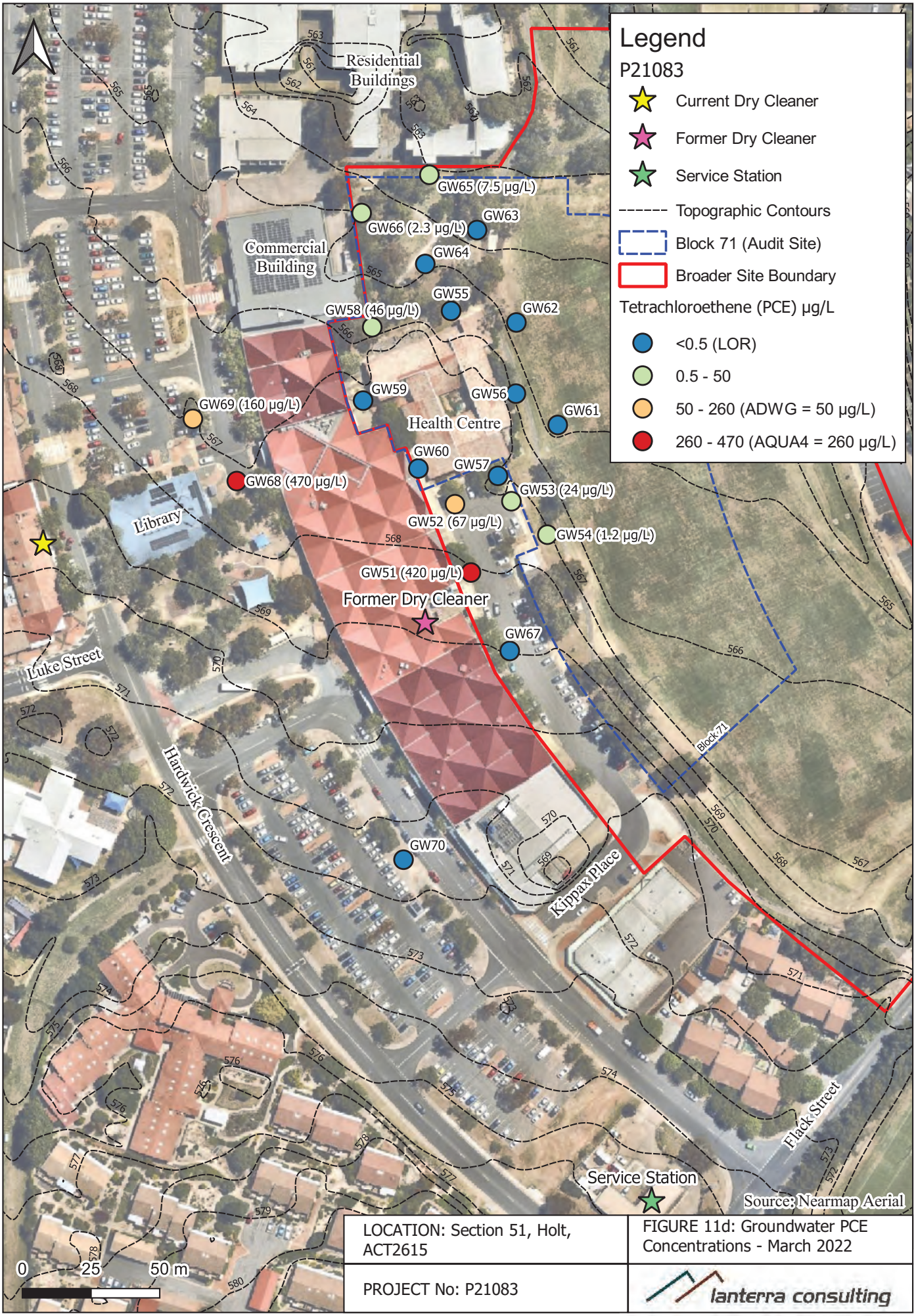
SAGE ENVIRONMENTAL SERVICES

Figures from Lanterra (2022c)

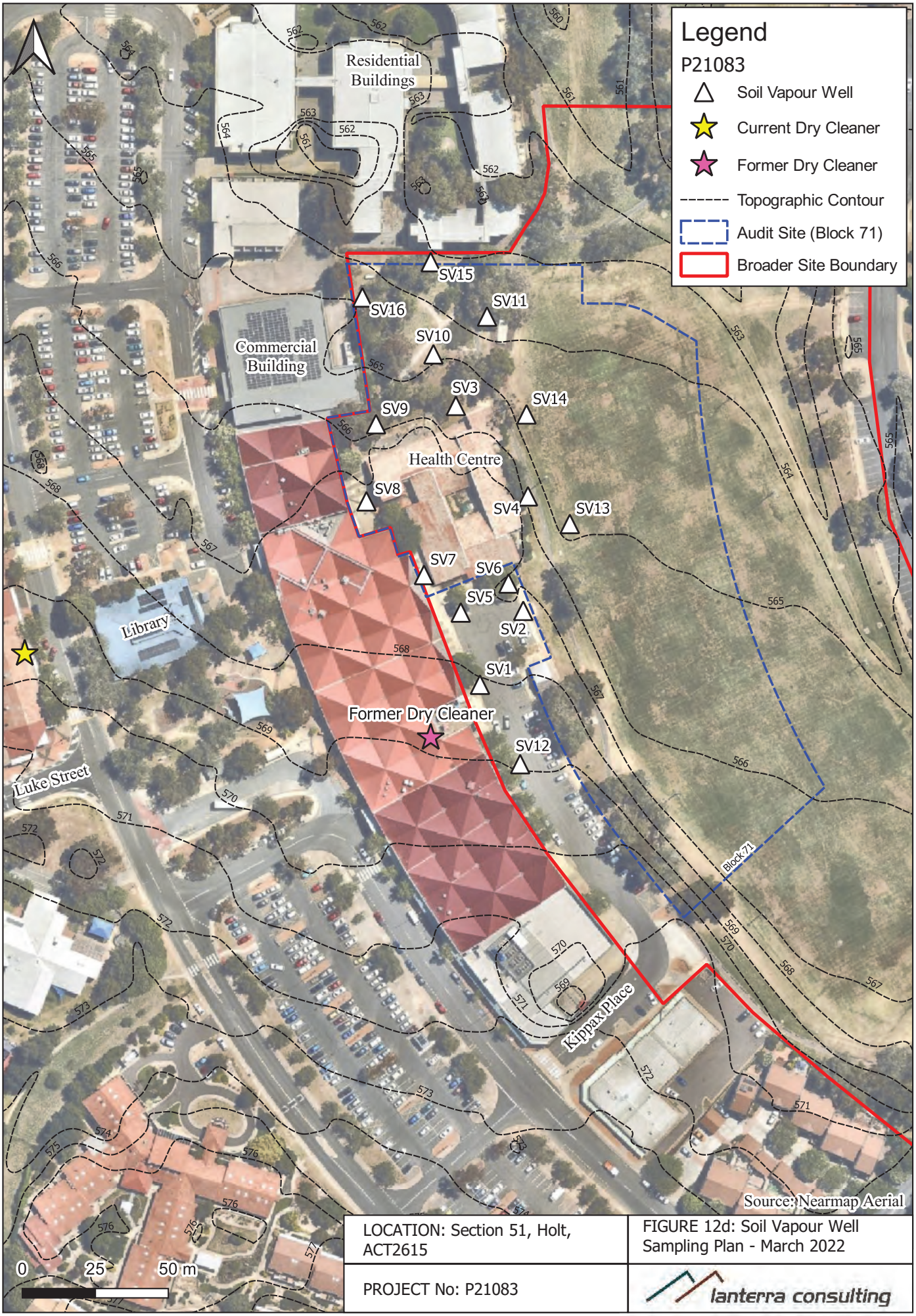


LOCATION: Section 51, Holt, ACT2615	FIGURE 2: Detailed Site Location Plan and Layout
PROJECT No: P21083	ianterra consulting


Legend
P21083
Off-site Well
On-site Well
Current Dry Cleaner
Former Dry Cleaner
Service Station
Topographic Contours
Block 71 (Audit Site)
Broader Site Boundary
GW6
Service Station
GW65
GW66
GW63
GW64
GW55
GW58
GW62
GW59
GW56
GW61
Health Centre
GW69
GW88
GW68
GW60
GW57
GW52
GW53
GW54
GW51
Current Dry Cleaner
Library
Former Dry Cleaner
GW67
Moyes Crescent
Luke Street
Block 71
Hardwick Crescent
GW70
GW5
GW4
GW3
Kippax Place
GW2
GW1
Service Station
Flack Street
Source: Nearmap Aerial
0
25
50 m
LOCATION: Section 51, Holt, ACT2615
FIGURE 6: Surveyed Groundwater Monitoring Wells
PROJECT No: P21083
lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11d: Groundwater PCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 12d: Soil Vapour Well Sampling Plan - March 2022
PROJECT No: P21083	lanterra consulting

Appendix B:
Tables (Extract from Lanterra, 2022c)

P21083 - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT2615

Table 1: Soil Analytical Results

							Field_ID	S1 0.0-0.1	S1 1.0-1.1	S2 1.0-1.1	S3 1.0-1.1	S4 0.0-0.1	S5 0.5-0.6	S5 3.0-3.1	S6 1.0-1.1	S6 4.0-4.1	S7 0.0-0.1
							Depth-m	0.0-0.1	1.0-1.1	1.0-1.1	1.0-1.1	0.0-0.1	0.5-0.6	3.0-3.1	1.0-1.1	4.0-4.1	0.0-0.1
							Sampled-date	7/04/2021	7/04/2020	13/04/2021	13/04/2021	13/04/2021	7/04/2020	7/04/2020	8/04/2020	8/04/2020	7/04/2020
							Fill/Natural										
				ASC NEPM (2013) E6/E9/E: Urban Residential and Public Open Space	ASC NEPM (2013) HSL A (mg/kg) 0.0-1.0m/1.0-2.0m/2.0-4.0m	ASC NEPM (2013) HIL A												
Method_Type	Chem Name	Units	EQL														
Metals in soil	Arsenic, As	mg/kg	1	100		100		4	N.A.	4	4	3	6	7	6	2	2
	Cadmium, Cd	mg/kg	0.2			20		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Chromium, Cr	mg/kg	0.5	140		100		13	N.A.	17	6.7	18	22	22	22	15	6.6
	Copper, Cu	mg/kg	0.5	200		6000		5.2	N.A.	8.2	5.6	5.8	7.3	7.4	7.9	8.2	3.1
	Lead, Pb	mg/kg	1	1100		300		24	N.A.	16	21	12	25	32	21	12	8
	Nickel, Ni	mg/kg	0.5	150		400		4.3	N.A.	2.8	3.7	7.9	6.7	6.9	7.4	6.1	6.2
	Zinc, Zn	mg/kg	2	660		7400		32	N.A.	8.3	17	26	26	29	20	23	17
	Mercury	mg/kg	0.05			40		0.15	N.A.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Organochlorine Pesticides	Hexachlorobenzene (HCB)	mg/kg	0.1			10		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Alpha BHC	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Lindane	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Heptachlor	mg/kg	0.1			6		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Aldrin	mg/kg	0.1			6		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Beta BHC	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Delta BHC	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Heptachlor epoxide	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	o,p'-DDE	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Alpha Endosulfan	mg/kg	0.2			270		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Gamma Chlordane	mg/kg	0.1			50		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Alpha Chlordane	mg/kg	0.1			50		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	trans-Nonachlor	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	o,p'-DDD	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Dieldrin	mg/kg	0.2			6		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Endrin	mg/kg	0.2			10		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	p,p'-DDD	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	p,p'-DDT	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Beta Endosulfan	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	p,p'-DDD	mg/kg	0.1			240		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	p,p'-DDT	mg/kg	0.1	180		240		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endosulfan sulphate	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endrin Aldehyde	mg/kg	0.1			10		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Methoxychlor	mg/kg	0.1			300		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endrin Ketone	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Isodrin	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Mirex	mg/kg	0.1			10		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Organophosphorus Pesticides	Dichlorvos	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Dimethoate	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Diazinon (Dimpylate)	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Fenitrothion	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Malathion	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2			160		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Parathion-ethyl (Parathion)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Bromophos Ethyl	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Methidathion	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Ethion	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Azinphos-methyl (Guthion)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
PAHs in Soil	Naphthalene	mg/kg	0.1	170	S/NL/NL			<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2-methylnaphthalene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	1-methylnaphthalene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluorene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Anthracene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluoranthene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Pyrene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(a)anthracene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Chrysene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(b&j)fluoranthene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(k)fluoranthene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(a)pyrene	mg/kg	0.1	0.7				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Indeno(1,2,3-cd)pyrene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Dibenz(a&h)anthracene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(g&h)perylene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ (mg/kg)	0.2			3		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.3			3		<0.3	N.A.	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2			3		<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Total PAH (18)	mg/kg	0.8			300		<0.8	N.A.	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
PCBs in Soil	Aroclor 1016	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Table 1: Soil Analytical Results

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P21083 - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT2615

Table 1: Soil Analytical Results

| Field_ID | | |

P21083 - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT2615

Table 1: Soil Analytical Results

Stage 1 - April 2021

Method_Type	ChemName	Units	EQL	ASC NEPM (2013) B1/E1L Urban Residential and Public Open Space	ASC NEPM (2013) HIL A (mg/kg) 0.0-1.0m/1.0-2.0m/2.0-4.0m	ASC NEPM (2013) HIL A	Field_ID	S7 2.0-2.1	S8 1.0-1.1	S9 0.0-0.1	QC1 (Duplicate)	RPD	QC2 (Triplicate)	RPD	S9 1.0-1.1	S10 0.0-0.1	S11 0.0-0.1	S12 0.5-0.6	QC3 (Duplicate)	RPD	QC4 (Triplicate)	RPD	S13 0.0-0.1	S14 0.0-0.1	S15 0.0-0.1	S16 0.5-0.6	S17 0.0-0.1	S18 0.5-0.6	S19 0.0-0.1	S20 0.5-0.6	S21 1.0-1.1	S22 0.5-0.6	QW01 0.0-0.1	QW01 4.0-4.1
							Depth m	2.0-2.1	1.0-1.1	0.0-0.1					1.0-1.1	0.0-0.1	0.0-0.1	0.5-0.6					0.0-0.1	0.0-0.1	0.0-0.1	0.5-0.6	0.0-0.1	0.5-0.6	0.0-0.1	0.5-0.6	1.0-1.1	0.5-0.6	0.0-0.1	4.0-4.1
							Sample/Date	7/04/2020	8/04/2020	7/04/2020	7/04/2020		7/04/2020		7/04/2020	20/04/2021	20/04/2021	20/04/2021	20/04/2021		20/04/2021		30/04/2021	30/04/2021	30/04/2021	30/04/2021	30/04/2021	21/04/2021	21/04/2021	21/04/2021	21/04/2021	21/04/2021	15/04/2021	15/04/2021
							Fill/Natural																										
Tiller Soil C10-C60 NEPM	Tiller C10-C14	mg/kg	20				1	<20	<20	<20	<20	0%	<20	0%	<20	<20	<20	<20	<20	0%	<20	0%	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	Tiller C15-C28	mg/kg	45					<45	<45	55	<45	N.A.	<220	N.A.	<45	<45	<45	<45	<45	0%	<220	0%	<45	<45	<45	<45	<45	<45	<45	<45	<45	<45	81	<45
	Tiller C29-C36	mg/kg	45					67	<45	68	51	28%	120	10%	58	<45	<45	<45	<45	0%	<220	0%	<45	<45	<45	<45	58	<45	<45	<45	<45	<45	160	<45
	Tiller C37-C40	mg/kg	100					<100	<100	<100	<100	0%	-	N.A.	<100	<100	<100	<100	<100	0%	-	N.A.	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	Tiller >C10-C16	mg/kg	25					<25	<25	<25	<25	0%	<50	0%	<25	<25	<25	<25	<25	0%	-	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	Tiller >C10-C16 - Naphthalene (F2)	mg/kg	25	120	280/NL/NL			<25	<25	<25	<25	0%	<50	0%	<25	<25	<25	<25	<25	0%	<50	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	Tiller >C16-C34 (F3)	mg/kg	90	1300				<90	<90	93	<90	N.A.	160	40%	<90	<90	<90	<90	<90	0%	<220	0%	<90	<90	<90	<90	<90	<90	<90	<90	<90	<90	<90	<90
	Tiller >C34-C40 (F4)	mg/kg	120	5600				<120	<120	<120	<120	0%	<150	0%	<120	<120	<120	<120	<120	0%	<150	0%	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	210	<120
	Tiller C10-C36 Total	mg/kg	110					<110	<110	120	<110	N.A.	-	N.A.	<110	<110	<110	<110	<110	0%	-	N.A.	<110	<110	<110	<110	<110	<110	<110	<110	<110	<110	240	<110
	Tiller >C16-C40 Total (F3 +anick)	mg/kg	210					<210	<210	<210	<210	0%	160	N.A.	<210	<210	<210	<210	<210	0%	<220	0%	<210	<210	<210	<210	<210	<210	<210	<210	<210	<210	210	<210
BTEX + VOC	Benzene	mg/kg	0.1	66	0.7/1/3			<0.1	<0.1	<0.1	<0.1	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Toluene	mg/kg	0.1	165	480/NL/NL/NL			<0.1	<0.1	<0.1	<0.1	0%	<0.5	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.5	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Ethylbenzene	mg/kg	0.1	135	NL/NL/NL			<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	m/p-xylene	mg/kg	0.2					<0.2	<0.2	<0.2	<0.2	0%	<2	0%	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<2	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	o-xylene	mg/kg	0.1					<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Total Xylenes	mg/kg	0.3	45	110/310/NL			<0.3	<0.3	<0.3	<0.3	0%	<3	0%	<0.3	<0.3	<0.3	<0.3	<0.3	0%	<3	0%	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Total BTEX	mg/kg	0.6					<0.6	<0.6	<0.6	<0.6	0%	N.A.	N.A.	<0.6	<0.6	<0.6	<0.6	<0.6	0%	-	N.A.	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
	Benzene (F0)	mg/kg	20		0.7/1/3			<0.1	<0.1	<0.1	<0.1	0%	N.A.	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	0%	-	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Tiller C6-C9	mg/kg	0.1					<20	<20	<20	<20	0%	<25	0%	<20	<20	<20	<20	<20	0%	<25	0%	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	Tiller C6-C10	mg/kg	25					<25	<25	<25	<25	0%	<25	0%	<25	<25	<25	<25	<25	0%	<25	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	Tiller C6-C10 minus BTEX (F1)	mg/kg	25	180	50/90/150			<25	<25	<25	<25	0%	<25	0%	<25	<25	<25	<25	<25	0%	<25	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Speciated Phenol	Phenol	mg/kg	0.5			3000		<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-methyl phenol (o-cresol)	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	3/4-methyl phenol (m/p-cresol)	mg/kg	1					<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Total Cresol	mg/kg	1.5			400		<1.5	<1.5	<1.5	N.A.	N.A.	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	N.A.	N.A.	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	2-chlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dimethylphenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,6-dichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4,5-trichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-nitrophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4-nitrophenol	mg/kg	1					<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	2,4,5+2,4,6-trichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,3,4,6/2,3,4,5-tetrachlorophenol	mg/kg	1					<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Pentachlorophenol	mg/kg	0.5			100		<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dichlorophenol	mg/kg	2					<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	4-chloro-3-methylphenol	mg/kg	2					<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Chlorinated Hydrocarbons	Dichlorodifluoromethane (CFC-12)	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloromethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Vinyl chloride (Chloroethene)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chloroethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Trichlorofluoromethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	1,1-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Dichloromethane (Methylene chloride)	mg/kg	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Allyl chloride	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	trans-1,2-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1-dichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	cis-1,2-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Bromochloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chloroform	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	2,2-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,1-trichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Carbon tetrachloride	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Dibromomethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Trichloroethene (Trichloroethylene TCE)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Bromodichloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	cis-1,3-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	trans-1,3-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,2-trichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,3-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Dibromochloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dibromoethane (EDB)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Tetrachloroethene (Perchloroethylene,PCE)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,1,2-tetrachloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	cis-1,4-dichloro-2-butene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Ethylbenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,2,2-tetrachloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2,3-trichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	trans-1,4-dichloro-2-butene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Bromobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	2-chlorotoluene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	4-chlorotoluene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	n-propylbenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,3-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,4-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dibromo-3-chloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2,4-trichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Hexachlorobutadiene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2,3-trichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Naphthalene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Total Chlorinated VOC	mg	3					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<3
Physicochemical Properties	pH	pH	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Cation Exchange Capacity	meq/100g	0.02					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Clay (<0.002mm)	%w/w	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Asbestos in Soil	Asbestos Detected	No unit	0			Not detected		No	No	No	No	N.A.	N.A.	N.A.	No	No	No	No	N.A.	N.A.	N.A.	N.A.	No	No	No	No	N.A.	No	No	No	No	No	No	N.A.
	Estimated Fibres	%w/w	0.01			0.001		<0.01	<0.01	<0.01	N.A.	N.A.	N.A.	N.A.	<0.01	<0.01	<0.01	N.A.	N.A.	N.A.	N.A.	N.A.	<0.01	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01	<0.01	N.A.

[Filter] 202200510_HILA_Chemistry_Output_Table - P21083_

P21083 - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT2615

Table 1: Soil Analytical Results

						Field_ID	D1	D2	D3	SV2 0.0-0.1	SV2 1.0-1.1	GW02 0.0-0.1	GW02 2.0-2.1	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW03 0.0-0.1	GW03 1.0-1.1	GW04 0.0-0.1	GW04 1.0-1.1	GW05 0.0-0.1	GW05 2.0-2.1	GW06 0.5-0.6	GW06 2.0-2.1	GW09 1.0-1.1	GW09 0.5-0.6
						Depth m	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	1.0-1.1	0.0-0.1	2.0-2.1					0.0-0.1	1.0-1.1	0.0-0.1	1.0-1.1	0.0-0.1	2.0-2.1				
						Sampled date	7/06/2020	7/04/2020	7/06/2020	2/11/2021	2/11/2021	3/11/2021	3/11/2021	3/11/2021		3/11/2021		2/11/2021	2/11/2021	3/11/2021	3/11/2021	11/01/2022	11/01/2022	10/01/2022	10/01/2022	12/01/2022	12/01/2022
						Fill/Natural																					
				ASC NEPM (2013) E1/E1c Urban Residential and Public Open Space	ASC NEPM (2013) HIL A (mg/kg) 0.0-1.0m/1.0-2.0m/2.0-4.0m	ASC NEPM (2013) HIL A	Stage 2 - November 2021																Stage 3 - January 2022					
Method_Type	CleanName	Units	LOR																								
Metals in soil	Arsenic, As	mg/kg	1	100		100	4	3	5	2	7	2	6	3	67%	4	40%	2	4	3	6	3	6	4	6	4	3
	Cadmium, Cd	mg/kg	0.3			20	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0%	<0.3	0%	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Chromium, Cr	mg/kg	0.3	560		100	14	13	23	5.6	27	5	22	10	75%	20	10%	8.2	9.5	13	26	22	23	27	27	13	14
	Copper, Cu	mg/kg	0.5	200		6000	5.2	6.7	9	3.3	9.2	5.1	8	4.9	48%	5	0%	2.6	2.9	6.1	8.3	9.2	7.7	8	8.2	2.9	5.2
	Lead, Pb	mg/kg	1	1100		300	12	13	28	13	26	10	21	15	50%	25	7%	4	12	8	21	5	15	22	46	12	8
	Nickel, Ni	mg/kg	0.5	310		600	7.8	8.2	9.7	3.8	8.8	4.1	8	6.6	54%	8	0%	4.5	3	7.1	7.8	9.8	9.6	6.8	8.5	3.8	7.3
	Zinc, Zn	mg/kg	2	460		7400	33	34	55	27	19	40	16	15	45%	12	25%	22	7.7	35	37	35	31	17	14	15	31
	Mercury	mg/kg	0.05			40	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0%	<0.1	0%	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Organochlorine Pesticides	Hexachlorobenzene (HCB)	mg/kg	0.1			10	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Alpha BHC	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Lindane	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Heptachlor	mg/kg	0.1			6	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Aldrin	mg/kg	0.1			6	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Beta BHC	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Delta BHC	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Heptachlor epoxide	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	o,p'-DDE	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Alpha Endosulfan	mg/kg	0.2			270	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Gamma Chlordane	mg/kg	0.1			50	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Alpha Chlordane	mg/kg	0.1			50	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Trans-Nonachlor	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	p,p'-DDE	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Dieldrin	mg/kg	0.2			6	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Endrin	mg/kg	0.2			10	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	o,p'-DDD	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	p,p'-DDT	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Beta Endosulfan	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	p,p'-DDD	mg/kg	0.1			240	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	p,p'-DDT	mg/kg	0.1	180		240	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endosulfan sulphate	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endrin Aldehyde	mg/kg	0.1			10	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Methoxychlor	mg/kg	0.1			300	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endrin Ketone	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Isodrin	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Mirex	mg/kg	0.1			10	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Organophosphorus Pesticides	Dichlorvos	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Dimethoate	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Diazinon (Dimpylate)	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Fenitrothion	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Malathion	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2			160	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Parathion-ethyl (Parathion)	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Bromophos Ethyl	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Methidathion	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Ethion	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Azinphos-methyl (Guthion)	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
PAHs in Soil	Naphthalene	mg/kg	0.1	170	5/NL/NL		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2-methylnaphthalene	mg/kg	0.1				<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0%	-	N.A.	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	1-methylnaphthalene	mg/kg	0.1				<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0%	-	N.A.	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluorene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	0.1				<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Anthracene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluoranthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Pyrene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(a)anthracene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Chrysene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo[b&j]fluoranthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(k)fluoranthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(a)pyrene	mg/kg	0.1	0.7			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.05	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Indeno[1,2,3-cd]pyrene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Dibenz(a&h)anthracene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(g&h)perylene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ (mg/kg)	0.2			3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<0.5	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.2			3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<0.5	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2			3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<0.5	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Total PAH (US)	mg/kg	0.8			300	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	0%	<0.8	0%	1.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
PCBs in Soil	Aroclor 1016	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

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Table 1: Soil Analytical Results

Method_Type	ChemName	Units	EQL	ASC NEPM (2013) ESL/DCL Urban Residential and Public Open Space	ASC NEPM (2013) HIL A (mg/kg) 0.0-1.0m/1.0-2.0m/2.0-4.0m	ASC NEPM (2013) HIL A	Field_ID	DS	SS2	DS	SV2 0.0-0.1	SV2 1.0-1.1	GW02 0.0-0.1	GW02 2.0-2.1	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW03 0.0-0.1	GW03 1.0-1.1	GW04 0.0-0.1	GW04 1.0-1.1	GW05 0.0-0.1	GW05 2.0-2.1	GW06 0.5-0.6	GW06 2.0-2.1	GW06 1.0-1.1	GW09 0.5-0.6
							Depth m	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	1.0-1.1	0.0-0.1	2.0-2.1					0.0-0.1	1.0-1.1	0.0-0.1	1.0-1.1	0.0-0.1	2.0-2.1				
							Sampled date	7/04/2020	7/04/2020	7/04/2020	2/11/2021	2/11/2021	3/11/2021	3/11/2021	3/11/2021				3/11/2021	2/11/2021	2/11/2021	3/11/2021	11/01/2022	11/01/2022	10/01/2022	10/01/2022	12/01/2022	12/01/2022
							Fill/Natural																						
								Stage 2 - November 2021															Stage 3 - January 2022					
Method_Type	ChemName	Units	EQL																										
	Arochlor 1221	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1232	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1242	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1248	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1254	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1260	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1262	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1268	mg/kg	0.2					<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Total PCBs (Arochlors)	mg/kg	1			1		<1	<1	<1	N.A.	<1	N.A.	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
TRH Soil C10-C40 NEPM	TRH C10-C14	mg/kg	20					<20	<20	<20	**38**	<20	<20	<20	<20	<20	0%	<20	0%	**150**	<20	<20	<20	<20	<20	<20	<20	<20	<20
	TRH C15-C28	mg/kg	45					**46**	<45	<45	**400**	<45	<45	<45	<45	<45	0%	<100	0%	**630**	<45	<45	<45	<45	<45	<45	<45	<45	<45
	TRH C29-C36	mg/kg	45					**51**	**67**	<45	**1100**	<45	<45	<45	<45	<45	0%	<100	0%	**1130**	<45	<45	<45	<45	<45	<45	<45	<45	<45
	TRH C37-C40	mg/kg	100					<100	<100	<100	**920**	<100	<100	<100	<100	<100	0%	-	N.A.	**1280**	<100	<100	<100	<100	<100	<100	<100	<100	<100
	TRH >C10-C16	mg/kg	25					<25	<25	<25	**58**	<25	<25	<25	<25	<25	0%	<50	0%	**210**	<25	<25	<25	<25	<25	<25	<25	<25	<25
	TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	120	280/NL/NL			<25	<25	<25	**58**	<25	<25	<25	<25	<25	0%	<50	0%	**210**	<25	<25	<25	<25	<25	<25	<25	<25	<25
	TRH >C16-C34 (F3)	mg/kg	90	1300				**110**	<90	<90	**880**	<90	<90	<90	<90	<90	0%	<300	0%	**1000**	<90	<90	<90	<90	<90	<90	<90	<90	<90
	TRH >C34-C40 (F4)	mg/kg	120	5600				<120	<120	<120	**1100**	<120	<120	<120	<120	<120	0%	<300	0%	**1900**	<120	<120	<120	<120	<120	<120	<120	<120	<120
	TRH C10-C36 Total	mg/kg	110					**148**	<110	<110	**1500**	<110	<110	<110	<110	<110	0%	-	N.A.	**1900**	<110	<110	<110	<110	<110	<110	<110	<110	<110
	TRH >C10-C40 Total (F Bands)	mg/kg	210					<210	<210	<210	**2400**	<210	<210	<210	<210	<210	0%	<600	0%	**3100**	<210	<210	<210	<210	<210	<210	<210	<210	<210
BTEX + VOC	Benzene	mg/kg	0.1	65	0.7/3/3			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Toluene	mg/kg	0.1	105	480/NL/NL/NL			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	0%	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Ethylbenzene	mg/kg	0.1	125	NL/NL/NL			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	0%	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	m/p-xylene	mg/kg	0.2					<0.2	<0.2	<0.2	**0.2**	<0.2	<0.2	<0.2	<0.2	<2	0%	<3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	o-xylene	mg/kg	0.1					<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<1	0%	<3	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Total Xylenes	mg/kg	0.3	45	110/210/NL			<0.3	<0.3	<0.3	**0.3**	<0.3	<0.3	<0.3	<0.3	<3	0%	<3	0%	**0.4**	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Total BTEX	mg/kg	0.6					<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	-	N.A.	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
	Benzene (F0)	mg/kg	20		0.7/3/3			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	0%	-	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	TRH C6-C9	mg/kg	0.1					<20	<20	<20	<20	<20	<20	<20	<20	<25	0%	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	TRH C6-C10	mg/kg	25					<25	<25	<25	<25	<25	<25	<25	<25	<25	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	TRH C6-C10 minus BTEX (F1)	mg/kg	25	180	50/93/160			<25	<25	<25	<25	<25	<25	<25	<25	<25	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Speciated Phenol	Phenol	mg/kg	0.5			3000		<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-methyl phenol (o-cresol)	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	3/4-methyl phenol (m/p-cresol)	mg/kg	1					<1	<1	<1	N.A.	<1	N.A.	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
	Total Cresol	mg/kg	1.5			400		<1.5	<1.5	<1.5	N.A.	<1.5	N.A.	<1.5	<1.5	N.A.	N.A.	N.A.	N.A.	<1.5	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	2-chlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dimethylphenol	mg/kg	0.5					<0.5	<0.5	<0.3	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.3
	2,4-dichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,6-dichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4,5-trichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-nitrophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4-nitrophenol	mg/kg	1					<1	<1	<1	N.A.	<1	N.A.	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
	2,4,5-trichlorophenol	mg/kg	0.5					<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,3,4,6/2,3,5,6-tetrachlorophenol	mg/kg	1					<1	<1	<1	N.A.	<1	N.A.	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
	Pentachlorophenol	mg/kg	0.5			100		<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dinitrophenol	mg/kg	2					<2	<2	<2	N.A.	<2	N.A.	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	N.A.	<2	<2	<2	<2	<2	<2	<2	<2
	4-chloro-3-methylphenol	mg/kg	2					<2	<2	<2	N.A.	<2	N.A.	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	N.A.	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Chlorinated Hydrocarbons	Dichlorodifluoromethane (CFC-12)	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloromethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Vinyl chloride (Chloroethene)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloroethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Trichlorofluoromethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dichloromethane (Methylene chloride)	mg/kg	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Allyl chloride	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	trans-1,2-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1-dichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	cis-1,2-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromochloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloroform	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2,2-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,1-trichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Carbon tetrachloride	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibromomethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Trichloroethene (Trichloroethylene- TCE)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromodichloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	cis-1,3-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	trans-1,3-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,2-trichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,3-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibromochloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dibromoethane (EDB)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Tetrachloroethene (Perchloroethylene,PCE)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,1,2-tetrachloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	cis-1,4-dichloro-2-butene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromoform	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,2,2-tetrachloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2,3-trichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	trans-1,4-dichloro-2-butene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-chlorotoluene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	4-chlorotoluene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,3-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,4-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dibromo-3-chloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2,4-trichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Hexachlorobutadiene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2,3-trichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Naphthalene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total Chlorinated VOC	mg/kg	8					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Physicochemical Properties	pH	pH	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Cation Exchange Capacity	meq/100g	0.02					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Clay (<0.002mm)	%w/w	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Asbestos in Soil	Asbestos Detected	No unit	0			Non detected		No	No	No	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Estimated Fibres	%w/w	0.01			0.001		<0.01	<0.01	<0.01	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 2: Groundwater Analytical Results

							Field_ID	GW1	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW2	GW3	GW4	GW5	GW51
							Sampled-date	22/04/2021	22/04/2021		22/04/2021		22/04/2021	22/04/2021	23/04/2021	23/04/2021	23/04/2021
							Sample type	water	water		water		water	water	water	water	water
				Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	ANZG 2018 - 95% Protection for Freshwater Species	Groundwater Sampling Event 1 (Stage 1)									
Method_Type	**ChemName**	**Units**	**EQL**														
Metals in water	Arsenic, As	µg/L	1	10	50		24	<1	<1	0%	<1	0%	<1	1	<1	1	1
	Cadmium, Cd	µg/L	0.1	2	0.2		0.2	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Chromium, Cr	µg/L	1	50	2		1	<1	<1	0%	<1	0%	<1	<1	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		1.4	1	<1	N.A	<1	N.A	1	<1	2	1	70
	Lead, Pb	µg/L	1	10	1		3.4	<1	<1	0%	<1	0%	<1	<1	<1	<1	1
	Nickel, Ni	µg/L	1	20	25		11	14	11	24%	11	24%	47	27	4	43	41
	Zinc, Zn	µg/L	5	3000**	5		8	11	9	20%	8	32%	6	8	<5	6	64
	Mercury	mg/L	0.0001	1	0.1		0.06	<0.0001	<0.0001	0%	<0.05	0%	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
PAHs	Naphthalene	µg/L	0.5			NL/NL	16	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5
	2-methylnaphthalene	µg/L	0.1					<0.1	<0.1	0%	N.A.	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	1-methylnaphthalene	µg/L	0.1					<0.1	<0.1	0%	N.A.	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthylene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluorene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Phenanthrene	µg/L	0.1				2	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Anthracene	µg/L	0.1				0.4	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluoranthene	µg/L	0.1				1.4	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Pyrene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(a)anthracene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Chrysene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(b&j)fluoranthene	µg/L	0.1					<0.1	<0.1	0%	<2	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(k)fluoranthene	µg/L	0.1					<0.1	<0.1	0%	<2	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(a)pyrene	µg/L	0.1	0.01			0.2	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Indeno(1,2,3-cd)pyrene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Dibenzo(ah)anthracene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzo(ghi)perylene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1
	Total PAH (18)	µg/L	1		3		20	<1	<1	0%	N.A.	0%	<1	<1	<1	<1	<1
TRH Soil C10-C40 NEPM	TRH C10-C14	µg/L	50					<50	<50	0%	<50	0%	<50	<50	<50	<50	<50
	TRH C15-C28	µg/L	200					<200	<200	0%	<100	0%	<200	<200	<200	<200	<200
	TRH C29-C36	µg/L	200					<200	<200	0%	<100	0%	<200	<200	<200	230	<200
	TRH C37-C40	µg/L	200					<200	<200	0%	N.A.	N.A.	<200	<200	<200	<200	<200
	TRH >C10-C16	µg/L	60					<60	<60	0%	<50	0%	<60	<60	<60	<60	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL		<60	<60	0%	<50	0%	<60	<60	<60	<60	<60
	TRH >C16-C34 (F3)	µg/L	500					<500	<500	0%	<100	0%	<500	<500	<500	<500	<500
	TRH >C34-C40 (F4)	µg/L	500					<500	<500	0%	<100	0%	<500	<500	<500	<500	<500
	TRH C10-C40	µg/L	320					<320	<320	0%	N.A.	N.A.	<320	<320	<320	<320	<320
BTEX + VOC	Benzene	µg/L	0.5	1	300	5000 / 5000	950	5.1	3.4	40%	1	134%	1.6	<0.5	<0.5	4.8	<0.5
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	180	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	80	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5
	m/p-xylene	µg/L	1				75 / 200	<1	<1	0%	<2	0%	<1	<1	<1	<1	<1
	o-xylene	µg/L	0.5				350	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5
	Naphthalene (VOC)	µg/L	0.5			NL/NL	16	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	625	<1.5	<1.5	0%	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5
	Total BTEX	µg/L	3					5	3	50%	N.A.	N.A.	<3	<3	<3	5	<3
	Benzene (F0)	µg/L	0.5			5000 / 5000		5.1	3.4	40%	N.A.	N.A.	1.6	<0.5	<0.5	4.8	<0.5
	TRH C6-C9	µg/L	40					<40	<40	0%	<10	0%	<40	<40	<40	<40	390
	TRH C6-C10	µg/L	50					<50	<50	0%	<10	0%	<50	<50	<50	<50	400
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL		<50	<50	0%	<10	0%	<50	<50	<50	<50	400
Volatile Chlorinated Compounds	Dichlorodifluoromethane (CFC-12)	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<5
	Chloromethane	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.3
	Chloroethane	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<5
	Trichlorofluoromethane	µg/L	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	1,1-dichloroethene	µg/L	0.5	30	30			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		4000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	15
	Allyl chloride	µg/L	2					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<2
	trans-1,2-dichloroethene	µg/L	0.5	60	60			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,1-dichloroethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5

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Table 2: Groundwater Analytical Results

								Field_ID	GW1	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW2	GW3	GW4	GW5	GW51
								Sampled-date	22/04/2021	22/04/2021		22/04/2021		22/04/2021	22/04/2021	23/04/2021	23/04/2021	23/04/2021
								Sample type	water	water		water		water	water	water	water	water
				Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	ANZG 2018 - 95% Protection for Freshwater Species	Groundwater Sampling Event 1 (Stage 1)										
Method_Type	ChemName	Units	EQL															
	cis-1,2-dichloroethene	µg/L	0.5	60	60			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Bromochloromethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Chloroform (THM)	µg/L	0.5	250	2		770	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	2,2-dichloropropane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2-dichloroethane	µg/L	0.5	3			1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,1,1-trichloroethane	µg/L	0.5				270	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,1-dichloropropene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Carbon tetrachloride	µg/L	0.5	3	13		240	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Dibromomethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2-dichloropropane	µg/L	0.5				900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**2.4**
	Bromodichloromethane (THM)	µg/L	0.5	250	50			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	cis-1,3-dichloropropene	µg/L	0.5	100				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	trans-1,3-dichloropropene	µg/L	0.5	100				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,1,2-trichloroethane	µg/L	0.5				6500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,3-dichloropropane	µg/L	0.5				1100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Dibromochloromethane (THM)	µg/L	0.5	250	50			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2-dibromoethane (EDB)	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**240**
	1,1,1,2-tetrachloroethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Chlorobenzene	µg/L	0.5	300/10**				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	cis-1,4-dichloro-2-butene	µg/L	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Bromoform (THM)	µg/L	0.5	250	50			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,1,2,2-tetrachloroethane	µg/L	0.5				400	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2,3-trichloropropane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	trans-1,4-dichloro-2-butene	µg/L	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Bromobenzene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	2-chlorotoluene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	4-chlorotoluene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		260	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		60	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.3
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		160	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2-dibromo-3-chloropropane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		170	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		10	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Iodomethane	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<5
	Total Chlorinated Hydrocarbons	µg/L	10					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**270**
PFAS	Perfluorobutanoic acid (PFBA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			220	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorononanoic acid (PFNA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorodecanoic acid (PFDA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				0.13	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorononane sulfonate (PFNS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	N-Methylperfluorooctanesulfonamidoacetic acid (N_MeFOSAA)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	N-Ethylperfluorooctanesulfonamidoacetic Acid (N-EtFOSAA)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total of PFAS (n=30)	µg/L	0.04					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Note: * PFAS Recreational Values

** Only aesthetic values available under the Australian Drinking Water Guidelines 2011 (version 3.5, August 2018)

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Table 2: Groundwater Analytical Results

							Rinsate	Trip blank	GW51	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW52	GW53	GW54	Rinsate	GW55	GW56	GW57
							22/04/2021	22/04/2021	9/11/2021	9/11/2021		9/11/2021		9/11/2021	9/11/2021	9/11/2021	9/11/2021	19/1/2022	18/1/2022	19/1/2022
							water	water	water	water		water		water	water	water	water	water	water	water
				Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	Groundwater Sampling Event 2 (Stage 2)														
Method_Type	ChemName	Units	EQL																					
Metals in water	Arsenic, As	µg/L	1	10	50		<1	N.A.	**1**	**1**	**0%**	**2**	**67%**	**1**	**1**	<1	<1	<1	<1	**1**
	Cadmium, Cd	µg/L	0.1	2	0.2		<0.1	N.A.	<0.1	<0.1	**0%**	<0.1	**0%**	<0.1	<0.1	<0.1	<0.1	**0.2**	**0.2**	**0.1**
	Chromium, Cr	µg/L	1	50	2		<1	N.A.	<1	<1	**0%**	<1	**0%**	**1**	<1	<1	<1	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		<1	N.A.	**6**	**3**	**67%**	**3**	**67%**	**12**	**4**	**2**	<1	**3**	**43**	**14**
	Lead, Pb	µg/L	1	10	1		<1	N.A.	<1	<1	**0%**	<1	**0%**	<1	<1	<1	<1	<1	<1	<1
	Nickel, Ni	µg/L	1	20	25		<1	N.A.	**3**	**3**	**0%**	**3**	**0%**	**4**	**4**	**36**	<1	**46**	**13**	**28**
	Zinc, Zn	µg/L	5	3000**	5		<5	N.A.	**20**	**18**	**11%**	**16**	**22%**	**17**	**8**	<5	<5	**200**	**68**	**15**
	Mercury	mg/L	0.0001	1	0.1		<0.0001	N.A.	<0.0001	<0.0001	**0%**	<0.05	**0%**	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
PAHs	Naphthalene	µg/L	0.5			NL/NL	<0.5	<0.5	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-methylnaphthalene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1-methylnaphthalene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthylene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluorene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Phenanthrene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Anthracene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluoranthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Pyrene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)anthracene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chrysene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(b&j)fluoranthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(k)fluoranthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)pyrene	µg/L	0.1	0.01			<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibenzo(ah)anthracene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(ghi)perylene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total PAH (18)	µg/L	1		3		<1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
TRH Soil C10-C40 NEPM	TRH C10-C14	µg/L	50				<50	N.A.	<50	<50	**0%**	<50	**0%**	<50	<50	<50	<50	<50	<50	<50
	TRH C15-C28	µg/L	200				<200	N.A.	<200	<200	**0%**	<100	**0%**	<200	<200	<200	<200	<200	<200	<200
	TRH C29-C36	µg/L	200				<200	N.A.	<200	<200	**0%**	<100	**0%**	<200	<200	<200	<200	<200	<200	<200
	TRH C37-C40	µg/L	200				<200	N.A.	<200	<200	**0%**	N.A.	**N.A.**	<200	<200	<200	<200	<200	<200	<200
	TRH >C10-C16	µg/L	60				<60	N.A.	<60	<60	**0%**	<50	**0%**	<60	<60	<60	<60	<60	<60	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL	<60	N.A.	<60	<60	**0%**	<50	**0%**	<60	<60	<60	<60	<60	<60	<60
	TRH >C16-C34 (F3)	µg/L	500				<500	N.A.	<500	<500	**0%**	<100	**0%**	<500	<500	<500	<500	<500	<500	<500
	TRH >C34-C40 (F4)	µg/L	500				<500	N.A.	<500	<500	**0%**	<100	**0%**	<500	<500	<500	<500	<500	<500	<500
	TRH C10-C40	µg/L	320				<320	N.A.	<320	<320	**0%**	N.A.	**N.A.**	<320	<320	<320	<320	<320	<320	<320
BTEX + VOC	Benzene	µg/L	0.5	1	300	5000 / 5000	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	m/p-xylene	µg/L	1				<1	<1	<5	<5	**0%**	<2	**0%**	<1	<1	<1	<1	<1	<1	<1
	o-xylene	µg/L	0.5				<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Naphthalene (VOC)	µg/L	0.5			NL/NL	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	<1.5	<1.5	<7.5	<7.5	**0%**	N.A.	**N.A.**	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	Total BTEX	µg/L	3				<3	<3	<15	<15	**0%**	N.A.	**N.A.**	<3	<3	<3	<3	<3	<3	<3
	Benzene (F0)	µg/L	0.5			5000 / 5000	<0.5	N.A.	<2.5	<2.5	**0%**	N.A.	**N.A.**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	TRH C6-C9	µg/L	40				<40	N.A.	**630**	**590**	**7%**	**420**	**40%**	**150**	<40	<40	<40	<40	<40	<40
	TRH C6-C10	µg/L	50				<50	N.A.	**650**	**610**	**6%**	**570**	**13%**	**160**	<50	<50	<50	<50	<50	<50
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL	<50	N.A.	**650**	**610**	**6%**	**570**	**13%**	**160**	<50	<50	<50	<50	<50	<50
Volatile Chlorinated Compounds	Dichlorodifluoromethane (CFC-12)	µg/L	5				N.A.	N.A.	<25	<25	**0%**	<10	**0%**	<5	<5	<5	<5	<5	<5	<5
	Chloromethane	µg/L	5				N.A.	N.A.	<25	<25	**0%**	<10	**0%**	<5	<5	<5	<5	<5	<5	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3			N.A.	N.A.	<1.5	<1.5	**0%**	<10	**0%**	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Chloroethane	µg/L	5				N.A.	N.A.	<25	<25	**0%**	<10	**0%**	<5	<5	<5	<5	<5	<5	<5
	Trichlorofluoromethane	µg/L	1				N.A.	N.A.	<5	<5	**0%**	<10	**0%**	<1	<1	<1	<1	<1	<1	<1
	1,1-dichloroethene	µg/L	0.5	30	30		N.A.	N.A.	<2.5	<2.5	**0%**	<10	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		N.A.	N.A.	<25	<25	**0%**	N.A.	**N.A.**	<5	<5	<5	<5	<5	<5	<5
	Allyl chloride	µg/L	2				N.A.	N.A.	<10	<10	**0%**	N.A.	**N.A.**	<2	<2	<2	<2	<2	<2	<2
	trans-1,2-dichloroethene	µg/L	0.5	60	60		N.A.	N.A.	<2.5	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,1-dichloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

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Table 2: Groundwater Analytical Results

							Rinsate	Trip blank	GW51	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW52	GW53	GW54	Rinsate	GW55	GW56	GW57
							22/04/2021	22/04/2021	9/11/2021	9/11/2021		9/11/2021		9/11/2021	9/11/2021	9/11/2021	9/11/2021	19/1/2022	18/1/2022	19/1/2022
							water	water	water	water		water		water	water	water	water	water	water	water
				Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	Groundwater Sampling Event 2 (Stage 2)													
Method_Type	ChemName	Units	EQL																	
	cis-1,2-dichloroethene	µg/L	0.5	60	60		N.A.	N.A.	**2.7**	**2.6**	**4%**	**2**	**30%**	**3.1**	**2.3**	<0.5	<0.5	<0.5	<0.5	**9.3**
	Bromochloromethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Chloroform (THM)	µg/L	0.5	250	2		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,2-dichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2-dichloroethane	µg/L	0.5	3			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,1,1-trichloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,1-dichloropropene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Carbon tetrachloride	µg/L	0.5	3	13		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Dibromomethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2-dichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		N.A.	N.A.	**13**	**12**	**8%**	**12**	**8%**	**9.3**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Bromodichloromethane (THM)	µg/L	0.5	250	50		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	cis-1,3-dichloropropene	µg/L	0.5	100			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	trans-1,3-dichloropropene	µg/L	0.5	100			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,1,2-trichloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,3-dichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Dibromochloromethane (THM)	µg/L	0.5	250	50		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2-dibromoethane (EDB)	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		N.A.	N.A.	**300**	**280**	**7%**	**400**	**29%**	**71**	**6.1**	<0.5	<0.5	**0.9**	<0.5	<0.5
	1,1,1,2-tetrachloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Chlorobenzene	µg/L	0.5	300/10**			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	cis-1,4-dichloro-2-butene	µg/L	1				N.A.	N.A.	<5	<5	**0%**	N.A.	**N.A.**	<1	<1	<1	<1	<1	<1	<1
	Bromoform (THM)	µg/L	0.5	250	50		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,1,2,2-tetrachloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2,3-trichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	trans-1,4-dichloro-2-butene	µg/L	1				N.A.	N.A.	<5	<5	**0%**	N.A.	**N.A.**	<1	<1	<1	<1	<1	<1	<1
	Bromobenzene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-chlorotoluene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4-chlorotoluene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		N.A.	N.A.	<1.5	<1.5	**0%**	<1	**0%**	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2-dibromo-3-chloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Iodomethane	µg/L	5				N.A.	N.A.	<25	<25	**0%**	N.A.	N.A.	<5	<5	<5	<5	<5	<5	<5
	Total Chlorinated Hydrocarbons	µg/L	10				N.A.	N.A.	**310**	**300**	**3%**	N.A.	N.A.	**83**	<10	<10	<10	<10	<10	<10
PFAS	Perfluorobutanoic acid (PFBA)	µg/L	0.002				N.A.	N.A.	**0.008**	**0.007**	**13%**	**0.03**	**116%**	**0.008**	<0.002	<0.002	<0.002	<0.002	**0.003**	**0.004**
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002				N.A.	N.A.	**0.008**	**0.008**	**0%**	**0.02**	**86%**	**0.041**	<0.002	<0.002	<0.002	<0.002	**0.007**	**0.026**
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002				N.A.	N.A.	**0.005**	**0.004**	**22%**	**0.02**	**120%**	**0.023**	<0.002	<0.002	<0.002	<0.002	**0.016**	**0.025**
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.01	**0%**	**0.002**	<0.002	<0.002	<0.002	<0.002	**0.002**	**0.007**
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			N.A.	N.A.	**0.006**	**0.005**	**18%**	**0.02**	**108%**	**0.022**	<0.002	<0.002	<0.002	<0.002	**0.015**	**0.021**
	Perfluorononanoic acid (PFNA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.01	**0%**	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorodecanoic acid (PFDA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.02	**0%**	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.02	**0%**	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.05	**0%**	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.1	**0%**	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.5	**0%**	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				N.A.	N.A.	<0.008	<0.008	**0%**	N.A.	N.A.	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004				N.A.	N.A.	**0.005**	**0.005**	**0%**	N.A.	N.A.	**0.008**	<0.004	<0.004	<0.004	<0.004	**0.053**	**0.01**
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	N.A.	N.A.	<0.004	<0.004	<0.004	<0.004	<0.004	**0.015**	<0.004
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				N.A.	N.A.	**0.004**	**0.004**	**0%**	**0.02**	**133%**	**0.006**	**0.003**	<0.002	<0.002	**0.009**	**0.036**	**0.029**
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.01	**0%**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				N.A.	N.A.	**0.003**	**0.002**	**40%**	**0.03**	**164%**	**0.009**	<0.002	<0.002	<0.002	**0.003**	**0.015**	**0.027**
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			N.A.	N.A.	**0.007**	**0.007**	**0%**	**0.05**	**151%**	**0.015**	**0.003**	<0.002	<0.002	**0.012**	**0.05**	**0.056**
	Perfluorononane sulfonate (PFNS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.01	**0%**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				N.A.	N.A.	**0.01**	**0.009**	**11%**	**0.02**	**67%**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.02	**0%**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				N.A.	N.A.	<0.008	<0.008	**0%**	N.A.	N.A.	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.05	**0%**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.1	**0%**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.05	**0%**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.5	**0%**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	N-Methylperfluorooctanesulfonamidoacetic acid (N_MeFOSAA)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.02	**0%**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	N-Ethylperfluorooctanesulfonamidoacetic Acid (N-EtFOSAA)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.02	**0%**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Total of PFAS (n=30)	µg/L	0.04				N.A.	N.A.	**0.05**	**0.05**	**0%**	**0.16**	**105%**	**0.12**	<0.04	<0.04	<0.04	<0.04	**0.16**	**0.15**

Note: * PFAS Recreational Values

** Only aesthetic values available under the Australian Drinking Water Guidelines 2011 (version 3.5, August 2018)

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Table 2: Groundwater Analytical Results

Method_Type	ChemName	Units	EQL	Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW58	GW59	GW60	Rinsate	Trip Blank	GW51	Rinsate 2	GW52	GW53
							19/1/2022		19/1/2022		19/1/2022	19/1/2022	19/1/2022	19/1/2022	20/1/2022	29/3/2022	29/3/2022	28/3/2022	28/3/2022
							water		water		water	water	water	water	water	water	water	water	water
							Groundwater Sampling Event 3 (Stage 3)												
Metals in water	Arsenic, As	µg/L	1	10	50		2	67%	1	0%	2	3	3	<1	N.A.	1	<1	2	2
	Cadmium, Cd	µg/L	0.1	2	0.2		<0.1	N.A.	<0.1	N.A.	0.1	1	<0.1	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1
	Chromium, Cr	µg/L	1	50	2		<1	0%	<1	0%	<1	<1	2	<1	N.A.	<1	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		1	173%	<1	N.A.	47	17	61	<1	N.A.	2	<1	3	1
	Lead, Pb	µg/L	1	10	1		<1	0%	<1	0%	<1	<1	<1	<1	N.A.	<1	<1	<1	<1
	Nickel, Ni	µg/L	1	20	25		2	173%	2	173%	7	100	65	<1	N.A.	32	<1	7	25
	Zinc, Zn	µg/L	5	3000**	5		<5	N.A.	2	153%	67	220	640	<5	N.A.	11	<5	7	<5
	Mercury	mg/L	0.0001	1	0.1		<0.0001	0%	<0.05	0%	<0.0001	<0.0001	<0.0001	<0.0001	N.A.	<0.0001	<0.0001	<0.0001	<0.0001
PAHs	Naphthalene	µg/L	0.5			NL/NL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluorene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Phenanthrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chrysene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(b&j)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(k)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)pyrene	µg/L	0.1	0.01			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibenzo(ah)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(ghi)perylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total PAH (18)	µg/L	1		3		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
TRH Soil C10-C40 NEPM	TRH C10-C14	µg/L	50				<50	0%	<50	0%	<50	<50	<50	<50	N.A.	<50	<50	<50	<50
	TRH C15-C28	µg/L	200				<200	0%	<100	0%	<200	<200	<200	<200	N.A.	<200	<200	<200	<200
	TRH C29-C36	µg/L	200				<200	0%	<100	0%	<200	<200	<200	<200	N.A.	<200	<200	<200	<200
	TRH C37-C40	µg/L	200				<200	0%	N.A.	N.A.	<200	<200	<200	<200	N.A.	<200	<200	<200	<200
	TRH >C10-C16	µg/L	60				<60	0%	<50	0%	<60	<60	<60	<60	N.A.	<60	<60	<60	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL	<60	0%	<50	0%	<60	<60	<60	<60	N.A.	<60	<60	<60	<60
	TRH >C16-C34 (F3)	µg/L	500				<500	0%	<100	0%	<500	<500	<500	<500	N.A.	<500	<500	<500	<500
	TRH >C34-C40 (F4)	µg/L	500				<500	0%	<100	0%	<500	<500	<500	<500	N.A.	<500	<500	<500	<500
	TRH C10-C40	µg/L	320				<320	0%	N.A.	N.A.	<320	<320	<320	<320	N.A.	<320	<320	<320	<320
BTEX + VOC	Benzene	µg/L	0.5	1	300	5000 / 5000	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	m/p-xylene	µg/L	1				<1	0%	<2	0%	<1	<1	<1	<1	<1	<1	<1	<1	<1
	o-xylene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Naphthalene (VOC)	µg/L	0.5			NL/NL	<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	<1.5	0%	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	Total BTEX	µg/L	3				<3	0%	N.A.	N.A.	<3	<3	<3	<3	<3	<3	<3	<3	<3
	Benzene (F0)	µg/L	0.5			5000 / 5000	<0.5	0%	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	TRH C6-C9	µg/L	40				<40	0%	<10	0%	360	<40	<40	<40	N.A.	690	<40	150	54
	TRH C6-C10	µg/L	50				<50	0%	<10	0%	360	<50	<50	<50	N.A.	690	<50	150	54
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL	<50	0%	<10	0%	360	<50	<50	<50	N.A.	690	<50	150	54
Volatile Chlorinated Compounds	Dichlorodifluoromethane (CFC-12)	µg/L	5				<5	0%	<10	0%	<5	<5	<5	<5	N.A.	<5	<5	<5	<5
	Chloromethane	µg/L	5				<5	0%	<10	0%	<5	<5	<5	<5	N.A.	<5	<5	<5	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3			<0.3	0%	<10	0%	<0.3	<0.3	<0.3	<0.3	N.A.	<0.3	<0.3	<0.3	<0.3
	Chloroethane	µg/L	5				<5	0%	<10	0%	<5	<5	<5	<5	N.A.	<5	<5	<5	<5
	Trichlorofluoromethane	µg/L	1				<1	0%	<10	0%	<1	<1	<1	<1	N.A.	<1	<1	<1	<1
	1,1-dichloroethene	µg/L	0.5	30	30		<0.5	0%	<10	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		<5	0%	N.A.	N.A.	<5	<5	<5	<5	N.A.	<5	<5	<5	<5
	Allyl chloride	µg/L	2				<2	0%	N.A.	N.A.	<2	<2	<2	<2	N.A.	<2	<2	<2	<2
	trans-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,1-dichloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5

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Table 2: Groundwater Analytical Results

Method_Type	ChemName	Units	EQL	Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW58	GW59	GW60	Rinsate	Trip Blank	GW51	Rinsate 2	GW52	GW53
							19/1/2022		19/1/2022		19/1/2022	19/1/2022	19/1/2022	19/1/2022	20/1/2022	29/3/2022	29/3/2022	28/3/2022	28/3/2022
							water		water		water	water	water	water	water	water	water	water	water
							Groundwater Sampling Event 3 (Stage 3)												
	cis-1,2-dichloroethene	µg/L	0.5	60	60		9.9	6%	8	15%	92	<0.5	<0.5	<0.5	N.A.	3.3	<0.5	3.2	3.1
	Bromochloromethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Chloroform (THM)	µg/L	0.5	250	2		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	2,2-dichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2-dichloroethane	µg/L	0.5	3			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,1,1-trichloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,1-dichloropropene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Carbon tetrachloride	µg/L	0.5	3	13		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Dibromomethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2-dichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		<0.5	0%	<1	0%	61	<0.5	<0.5	<0.5	N.A.	14	<0.5	10	<0.5
	Bromodichloromethane (THM)	µg/L	0.5	250	50		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	cis-1,3-dichloropropene	µg/L	0.5	100			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	trans-1,3-dichloropropene	µg/L	0.5	100			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,1,2-trichloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,3-dichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Dibromochloromethane (THM)	µg/L	0.5	250	50		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2-dibromoethane (EDB)	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		<0.5	0%	<1	0%	89	<0.5	<0.5	<0.5	N.A.	420	<0.5	67	24
	1,1,1,2-tetrachloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Chlorobenzene	µg/L	0.5	300/10**			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	cis-1,4-dichloro-2-butene	µg/L	1				<1	0%	N.A.	N.A.	<1	<1	<1	<1	N.A.	<1	<1	<1	<1
	Bromoform (THM)	µg/L	0.5	250	50		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,1,2,2-tetrachloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2,3-trichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	trans-1,4-dichloro-2-butene	µg/L	1				<1	0%	N.A.	N.A.	<1	<1	<1	<1	N.A.	<1	<1	<1	<1
	Bromobenzene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	2-chlorotoluene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	4-chlorotoluene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		<0.3	0%	<1	0%	<0.3	<0.3	<0.3	<0.3	N.A.	<0.3	<0.3	<0.3	<0.3
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2-dibromo-3-chloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5
	Iodomethane	µg/L	5				<5	0%	N.A.	N.A.	<5	<5	<5	<5	N.A.	<5	<5	<5	<5
	Total Chlorinated Hydrocarbons	µg/L	10				<10	0%	N.A.	N.A.	240	<10	<10	<10	N.A.	440	<10	81	28
PFAS	Perfluorobutanoic acid (PFBA)	µg/L	0.002				<0.002	N.A.	<0.02	0%	0.003	0.32	<0.002	<0.002	N.A.	0.013	<0.002	0.017	0.009
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002				0.027	4%	0.04	42%	0.015	2.4	0.011	<0.002	N.A.	0.011	<0.002	0.063	<0.002
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002				0.028	11%	0.04	46%	0.013	4.1	0.018	<0.002	N.A.	0.009	<0.002	0.057	<0.002
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				0.008	13%	0.02	96%	0.005	0.22	0.004	<0.002	N.A.	0.003	<0.002	0.018	<0.002
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			0.017	21%	0.04	62%	0.018	0.009	0.011	<0.002	N.A.	0.013	<0.002	0.075	0.008
	Perfluorononanoic acid (PFNA)	µg/L	0.004				<0.004	0%	<0.01	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004	<0.004	<0.004	<0.004
	Perfluorodecanoic acid (PFDA)	µg/L	0.004				<0.004	0%	<0.02	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004	<0.004	<0.004	<0.004
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				<0.004	0%	<0.02	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004	<0.004	<0.004	<0.004
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004				<0.004	0%	<0.05	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004	<0.004	<0.004	<0.004
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				<0.004	0%	<0.1	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004	<0.004	<0.004	<0.004
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				<0.004	0%	<0.5	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004	<0.004	<0.004	<0.004
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				<0.008	0%	N.A.	0%	<0.008	<0.008	<0.008	<0.008	N.A.	<0.008	<0.008	<0.008	<0.008
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004				0.01	0%	N.A.	0%	0.008	0.11	0.006	<0.004	N.A.	0.004	<0.004	0.011	0.004
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				<0.004	0%	N.A.	0%	<0.004	0.013	<0.004	<0.004	N.A.	<0.004	<0.004	0.005	<0.004
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				0.021	32%	0.04	32%	0.019	<0.002	<0.002	<0.002	N.A.	0.019	<0.002	0.027	0.015
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				<0.002	0%	<0.01	0%	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002	<0.002	<0.002	<0.002
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				0.057	71%	0.05	60%	0.005	<0.002	0.017	<0.002	N.A.	0.025	<0.002	0.019	0.009
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			0.078	33%	0.09	47%	0.024	<0.002	0.017	<0.002	N.A.	0.044	<0.002	0.046	0.025
	Perfluorononane sulfonate (PFNS)	µg/L	0.002				<0.002	0%	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002	<0.002	<0.002	<0.002
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002				<0.002	0%	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002	<0.002	<0.002	<0.002
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				<0.002	0%	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				<0.002	0%	<0.01	0%	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				<0.002	0%	<0.01	0%	<0.002	<0.002	<0.002	<0.002	N.A.	0.11	<0.002	0.032	0.015
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				<0.002	0%	<0.02	0%	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002	<0.002	<0.002	<0.002
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				<0.008	0%	N.A.	N.A.	<0.008	<0.008	<0.008	<0.008	N.A.	<0.008	<0.008	<0.008	<0.008
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				<0.01	0%	<0.05	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				<0.01	0%	<0.1	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				<0.01	0%	<0.05	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				<0.01	0%	<0.5	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01
	N-Methylperfluorooctanesulfonamidoacetic acid (N_MeFOSAA)	µg/L	0.01				<0.01	0%	<0.02	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01
	N-Ethylperfluorooctanesulfonamidoacetic Acid (N-EtFOSAA)	µg/L	0.01				<0.01	0%	<0.02	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01	<0.01	<0.01	<0.01
	Total of PFAS (n=30)	µg/L	0.04				0.17	13%	0.24	46%	0.09	7.1	0.07	<0.04	N.A.	0.2	<0.04	0.32	0.06

Note: * PFAS Recreational Values

** Only aesthetic values available under the Australian Drinking Water Guidelines 2011 (version 3.5, August 2018)

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Table 2: Groundwater Analytical Results

							GW54	GW55	Rinsate 3	GW56	GW57	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW58	GW59	GW60
							29/3/2022	30/3/2022	30/3/2022	29/3/2022	28/3/2022	28/3/2022		31/3/2022		31/3/2022	31/3/2022	29/3/2022
							water	Water	water	water	water	water		water		water	water	water
					Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	Groundwater Sampling Event 4 (Stage 4)										
Method_Type	**ChemName**	**Units**	**EQL**															
Metals in water	Arsenic, As	µg/L	1		10	50		**1**	<1	<1	<1	**2**	**2**	**0%**	**2**	**0%**	**3**	**15**	**2**
	Cadmium, Cd	µg/L	0.1		2	0.2		<0.1	**0.3**	<0.1	<0.1	<0.1	<0.1	**0%**	<0.1	**0%**	**0.1**	<0.1	<0.1
	Chromium, Cr	µg/L	1		50	2		<1	<1	<1	<1	<1	<1	**0%**	<1	**0%**	<1	<1	<1
	Copper, Cu	µg/L	1		2000	2		**2**	**28**	<1	**2**	**1**	<1	**N.A.**	<1	**N.A.**	**42**	<1	**2**
	Lead, Pb	µg/L	1		10	1		<1	<1	<1	<1	<1	<1	**0%**	<1	**0%**	<1	<1	<1
	Nickel, Ni	µg/L	1		20	25		**35**	**140**	<1	**23**	**2**	**2**	**0%**	**2**	**0%**	**170**	**290**	**10**
	Zinc, Zn	µg/L	5		3000**	5		<5	**310**	<5	**7**	<5	<5	**0%**	**2**	**N.A.**	**50**	<5	**5**
	Mercury	mg/L	0.0001		1	0.1		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	**0%**	<0.05	**0%**	<0.0001	<0.0001	<0.0001
PAHs	Naphthalene	µg/L	0.5				NL/NL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	2-methylnaphthalene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	1-methylnaphthalene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Acenaphthylene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Acenaphthene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Fluorene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Phenanthrene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Anthracene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Fluoranthene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Pyrene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Benzo(a)anthracene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Chrysene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Benzo(b&j)fluoranthene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Benzo(k)fluoranthene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Benzo(a)pyrene	µg/L	0.1		0.01			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Dibenzo(ah)anthracene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Benzo(ghi)perylene	µg/L	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
	Total PAH (18)	µg/L	1			3		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.
TRH Soil C10-C40 NEPM	TRH C10-C14	µg/L	50					<50	<50	<50	<50	<50	<50	**0%**	<50	**0%**	<50	**190**	<50
	TRH C15-C28	µg/L	200					<200	<200	<200	<200	<200	<200	**0%**	<100	**0%**	<200	**510**	<200
	TRH C29-C36	µg/L	200					<200	<200	<200	<200	<200	<200	**0%**	<100	**0%**	<200	**680**	<200
	TRH C37-C40	µg/L	200					<200	<200	<200	<200	<200	<200	**0%**	N.A.	**N.A.**	<200	<200	<200
	TRH >C10-C16	µg/L	60					<60	<60	<60	<60	<60	<60	**0%**	<50	**0%**	<60	**190**	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60				NL/NL	<60	<60	<60	<60	<60	<60	**0%**	<50	**0%**	<60	**190**	<60
	TRH >C16-C34 (F3)	µg/L	500					<500	<500	<500	<500	<500	<500	**0%**	<100	**0%**	<500	**1000**	<500
	TRH >C34-C40 (F4)	µg/L	500					<500	<500	<500	<500	<500	<500	**0%**	<100	**0%**	<500	<500	<500
	TRH C10-C40	µg/L	320					<320	<320	<320	<320	<320	<320	**0%**	N.A.	**N.A.**	<320	**1400**	<320
BTEX + VOC	Benzene	µg/L	0.5		1	300	5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Toluene	µg/L	0.5		800 / 25**	300	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5		300 / 3 **	140	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	m/p-xylene	µg/L	1					<1	<1	<1	<1	<1	<1	**0%**	<2	**0%**	<5	<1	<1
	o-xylene	µg/L	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Naphthalene (VOC)	µg/L	0.5				NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Total Xylenes	µg/L	1.5		600 / 20**		NL/NL	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	**0%**	N.A.	**N.A.**	<7.5	<1.5	<1.5
	Total BTEX	µg/L	3					<3	<3	<3	<3	<3	<3	**0%**	N.A.	**N.A.**	<15	<3	<3
	Benzene (F0)	µg/L	0.5				5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	N.A.	**N.A.**	<2.5	<0.5	<0.5
	TRH C6-C9	µg/L	40					<40	<40	<40	<40	<40	<40	**0%**	**15**	**N.A.**	<200	<40	<40
	TRH C6-C10	µg/L	50					<50	<50	<50	<50	<50	<50	**0%**	**15**	**N.A.**	<250	<50	<50
	TRH C6-C10 minus BTEX (F1)	µg/L	50				NL/NL	<50	<50	<50	<50	<50	<50	**0%**	**15**	**N.A.**	**210**	<50	<50
Volatile Chlorinated Compounds	Dichlorodifluoromethane (CFC-12)	µg/L	5					<5	<5	<5	<5	<5	<5	**0%**	<10	**0%**	<25	<5	<5
	Chloromethane	µg/L	5					<5	<5	<5	<5	<5	<5	**0%**	<10	**0%**	<25	<5	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3		0.3			<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0%**	<10	**0%**	<1.5	<0.3	<0.3
	Chloroethane	µg/L	5					<5	<5	<5	<5	<5	<5	**0%**	<10	**0%**	<25	<5	<5
	Trichlorofluoromethane	µg/L	1					<1	<1	<1	<1	<1	<1	**0%**	<10	**0%**	<5	<1	<1
	1,1-dichloroethene	µg/L	0.5		30	30		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<10	**0%**	<2.5	<0.5	<0.5
	Dichloromethane (Methylene chloride)	µg/L	5		4	98		<5	<5	<5	<5	<5	<5	**0%**	N.A.	**N.A.**	<25	<5	<5
	Allyl chloride	µg/L	2					<2	<2	<2	<2	<2	<2	**0%**	N.A.	**N.A.**	<10	<2	<2
	trans-1,2-dichloroethene	µg/L	0.5		60	60		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,1-dichloroethane	µg/L	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5

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Table 2: Groundwater Analytical Results

Method_Type	ChemName	Units	EQL	Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	GW54	GW55	Rinsate 3	GW56	GW57	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW58	GW59	GW60
							29/3/2022	30/3/2022	30/3/2022	29/3/2022	28/3/2022	28/3/2022		31/3/2022		31/3/2022	31/3/2022	29/3/2022
							water	Water	water	water	water	water		water		water	water	water
																Groundwater Sampling Event 4 (Stage 4)		
	cis-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	**3**	**9.7**	**9.8**	**1%**	**10**	**3%**	**70**	<0.5	<0.5
	Bromochloromethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Chloroform (THM)	µg/L	0.5	250	2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	2,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2-dichloroethane	µg/L	0.5	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,1,1-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,1-dichloropropene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Carbon tetrachloride	µg/L	0.5	3	13		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Dibromomethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	**40**	<0.5	<0.5
	Bromodichloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	cis-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	trans-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,1,2-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,3-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Dibromochloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2-dibromoethane (EDB)	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		**1.2**	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	**46**	<0.5	<0.5
	1,1,1,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Chlorobenzene	µg/L	0.5	300/10**			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	cis-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	**0%**	N.A.	N.A.	<5	<1	<1
	Bromoform (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,1,2,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2,3-trichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	trans-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	**0%**	N.A.	N.A.	<5	<1	<1
	Bromobenzene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	2-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	4-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0%**	<1	**0%**	<1.5	<0.3	<0.3
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2-dibromo-3-chloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**	<2.5	<0.5	<0.5
	Iodomethane	µg/L	5				<5	<5	<5	<5	<5	<5	**0%**	N.A.	N.A.	<25	<5	<5
	Total Chlorinated Hydrocarbons	µg/L	10				<10	<10	<10	<10	<10	**10**	**N.A.**	N.A.	N.A.	**160**	<10	<10
PFAS	Perfluorobutanoic acid (PFBA)	µg/L	0.002				**0.003**	<0.002	<0.002	**0.01**	**0.015**	**0.013**	**14%**	<0.02	N.A.	**0.003**	**0.42**	**0.004**
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002				<0.002	<0.002	<0.002	**0.009**	**0.042**	**0.044**	**5%**	**0.05**	**17%**	**0.013**	**2.5**	**0.007**
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002				<0.002	<0.002	<0.002	**0.007**	**0.04**	**0.038**	**5%**	**0.05**	**22%**	**0.012**	**4.9**	**0.012**
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				<0.002	<0.002	<0.002	**0.003**	**0.012**	**0.013**	**8%**	**0.02**	50%	<0.002	**0.52**	0.005
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			**0.003**	<0.002	<0.002	**0.009**	**0.035**	**0.036**	**3%**	**0.04**	**13%**	<0.002	**0.2**	**0.023**
	Perfluorononanoic acid (PFNA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.01	**0%**	<0.004	<0.004	<0.004
	Perfluorodecanoic acid (PFDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.02	**0%**	<0.004	<0.004	<0.004
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.02	**0%**	<0.004	<0.004	<0.004
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.05	**0%**	<0.004	<0.004	<0.004
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.1	**0%**	<0.004	<0.004	<0.004
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.5	**0%**	<0.004	<0.004	<0.004
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	**0%**	N.A.	N.A.	<0.008	<0.008	<0.008
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004				<0.004	<0.004	<0.004	**0.022**	**0.013**	**0.011**	**17%**	**0.02**	**42%**	**0.007**	**0.14**	**0.007**
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				<0.004	<0.004	<0.004	**0.01**	**0.006**	**0.005**	**18%**	<0.01	N.A.	<0.004	0.033	<0.004
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				**0.01**	**0.004**	<0.002	**0.02**	**0.038**	**0.031**	**0%**	**0.05**	**27%**	**0.021**	**0.026**	**0.005**
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.01	**0%**	<0.002	<0.002	<0.002
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				**0.013**	<0.002	<0.002	**0.01**	**0.047**	**0.043**	**0%**	**0.06**	**24%**	<0.002	<0.002	**0.084**
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			**0.023**	**0.004**	<0.002	**0.03**	**0.085**	**0.073**	**15%**	**0.11**	**26%**	**0.021**	**0.026**	**0.089**
	Perfluorononane sulfonate (PFNS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.02	**0%**	<0.002	<0.002	<0.002
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.01	**0%**	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				**0.028**	**0.064**	<0.002	**0.059**	**0.019**	**0.021**	**10%**	**0.05**	90%	**0.074**	**0.041**	**0.098**
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.02	**0%**	<0.002	<0.002	<0.002
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	**0%**	<0.1	**0%**	<0.008	<0.008	<0.008
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.05	**0%**	<0.01	<0.01	<0.01
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.1	**0%**	<0.01	<0.01	<0.01
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.05	**0%**	<0.01	<0.01	<0.01
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.5	**0%**	<0.01	<0.01	<0.01
	N-Methylperfluorooctanesulfonamidoacetic acid (N_MeFOSAA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.02	**0%**	<0.01	<0.01	<0.01
	N-Ethylperfluorooctanesulfonamidoacetic Acid (N-EtFOSAA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.02	**0%**	<0.01	<0.01	<0.01
	Total of PFAS (n=30)	µg/L	0.04				**0.06**	**0.07**	<0.04	**0.16**	**0.27**	**0.25**	**8%**	**0.34**	**23%**	**0.13**	**8.8**	**0.25**

Note: * PFAS Recreational Values

** Only aesthetic values available under the Australian Drinking Water Guidelines 2011 (version 3.5, August 2018)

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Table 2: Groundwater Analytical Results

Method_Type	ChemName	Units	EQL	Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	GW61	GW62	GW63	GW64	GW65	GW66	GW67	Rinsate 1	GW68	Rinsate 4	GW69	GW70
							29/3/2022	1/4/2022	30/3/2022	30/3/2022	30/3/2022	30/3/2022	28/3/2022	28/3/2022	31/3/2022	31/3/2022	31/3/2022	31/3/2022
							water	water	water	water	water	water	water	water	water	water	water	water
Metals in water	Arsenic, As	µg/L	1	10	50		**1**	<1	<1	<1	<1	<1	**1**	<1	<1	<1	**1**	**1**
	Cadmium, Cd	µg/L	0.1	2	0.2		<0.1	**0.3**	<0.1	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	**0.2**	**0.4**
	Chromium, Cr	µg/L	1	50	2		<1	<1	<1	<1	**3**	<1	<1	<1	<1	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		**1**	**49**	<1	**2**	**3**	**4**	**3**	<1	**2**	**43**	**60**	**53**
	Lead, Pb	µg/L	1	10	1		<1	**2**	<1	<1	<1	<1	<1	<1	<1	<1	<1	**2**
	Nickel, Ni	µg/L	1	20	25		**48**	**59**	**24**	**35**	**180**	**69**	**110**	<1	**59**	<1	**53**	**110**
	Zinc, Zn	µg/L	5	3000**	5		**41**	**180**	**10**	**54**	**29**	**110**	**38**	<5	**15**	<5	**97**	**180**
	Mercury	mg/L	0.0001	1	0.1		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
PAHs	Naphthalene	µg/L	0.5			NL/NL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluorene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Phenanthrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chrysene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(b&j)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(k)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)pyrene	µg/L	0.1	0.01			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibenzo(ah)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(ghi)perylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total PAH (18)	µg/L	1		3		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
TRH Soil C10-C40 NEPM	TRH C10-C14	µg/L	50				<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
	TRH C15-C28	µg/L	200				<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
	TRH C29-C36	µg/L	200				<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
	TRH C37-C40	µg/L	200				<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
	TRH >C10-C16	µg/L	60				<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60
	TRH >C16-C34 (F3)	µg/L	500				<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
	TRH >C34-C40 (F4)	µg/L	500				<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
	TRH C10-C40	µg/L	320				<320	<320	<320	<320	<320	<320	<320	<320	<320	<320	<320	<320
BTEX + VOC	Benzene	µg/L	0.5	1	300	5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	m/p-xylene	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<5	<1
	o-xylene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Naphthalene (VOC)	µg/L	0.5			NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<15	<1.5	<7.5	<1.5
	Total BTEX	µg/L	3				<3	<3	<3	<3	<3	<3	<3	<3	<30	<3	<15	<3
	Benzene (F0)	µg/L	0.5			5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	TRH C6-C9	µg/L	40				<40	<40	<40	<40	<40	**66**	<40	<40	**1500**	<40	**610**	<40
	TRH C6-C10	µg/L	50				<50	<50	<50	<50	<50	**70**	<50	<50	**1600**	<50	**650**	<50
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL	<50	<50	<50	<50	<50	**70**	<50	<50	**1600**	<50	**650**	<50
Volatile Chlorinated Compounds	Dichlorodifluoromethane (CFC-12)	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50	<5	<25	<5
	Chloromethane	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50	<5	<25	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3			<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<3	<0.3	<1.5	<0.3
	Chloroethane	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50	<5	<25	<5
	Trichlorofluoromethane	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<5	<1
	1,1-dichloroethene	µg/L	0.5	30	30		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		<5	<5	<5	<5	<5	<5	<5	<5	<50	<5	<25	<5
	Allyl chloride	µg/L	2				<2	<2	<2	<2	<2	<2	<2	<2	<20	<2	<10	<2
	trans-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,1-dichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5

P21083 - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT2615

Table 2: Groundwater Analytical Results

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							29/3/2022	1/4/2022	30/3/2022	30/3/2022	30/3/2022	30/3/2022	28/3/2022	28/3/2022	31/3/2022	31/3/2022	31/3/2022	31/3/2022
							water	water	water	water	water	water	water	water	water	water	water	water
	cis-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	<0.5	**2**	**14**	<0.5	<0.5	**370**	<0.5	**180**	<0.5
	Bromochloromethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Chloroform (THM)	µg/L	0.5	250	2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	**51**	<2.5	<0.5
	2,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2-dichloroethane	µg/L	0.5	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,1,1-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,1-dichloropropene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Carbon tetrachloride	µg/L	0.5	3	13		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Dibromomethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		<0.5	<0.5	<0.5	<0.5	**2.4**	**9.4**	<0.5	<0.5	**300**	<0.5	**130**	<0.5
	Bromodichloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	cis-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	trans-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,1,2-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,3-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Dibromochloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2-dibromoethane (EDB)	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		<0.5	<0.5	<0.5	<0.5	**7.5**	**23**	<0.5	<0.5	**470**	<0.5	**160**	<0.5
	1,1,1,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Chlorobenzene	µg/L	0.5	300/10**			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	cis-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<5	<1
	Bromoform (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,1,2,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2,3-trichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	trans-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<5	<1
	Bromobenzene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	2-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	4-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<3	<0.3	<1.5	<0.3
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2-dibromo-3-chloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<2.5	<0.5
	Iodomethane	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50	<5	<25	<5
	Total Chlorinated Hydrocarbons	µg/L	10				<10	<10	<10	<10	**12**	**47**	<10	<10	**1200**	**51**	**470**	<10
PFAS	Perfluorobutanoic acid (PFBA)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	**0.002**	**0.033**	<0.002	**0.003**	<0.002	**0.003**	<0.002
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	**0.002**	**0.032**	<0.002	**0.007**	<0.002	**0.009**	<0.002
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002				<0.002	**0.005**	<0.002	<0.002	<0.002	**0.002**	**0.033**	<0.002	**0.006**	<0.002	**0.008**	<0.002
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.014	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.1**	<0.002	<0.002	<0.002	**0.011**	<0.002
	Perfluorononanoic acid (PFNA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorodecanoic acid (PFDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0.01**	<0.004	<0.004	<0.004	**0.006**	<0.004
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.01	<0.004	<0.004	<0.004	<0.004	<0.004
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				**0.005**	**0.008**	**0.006**	**0.004**	**0.006**	**0.005**	**0.087**	<0.002	**0.014**	<0.002	**0.01**	**0.004**
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.068**	<0.002	<0.002	<0.002	<0.002	<0.002
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			**0.005**	**0.008**	**0.006**	**0.004**	**0.006**	**0.005**	**0.15**	<0.002	**0.014**	<0.002	**0.01**	**0.004**
	Perfluorononane sulfonate (PFNS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				**0.018**	**0.056**	**0.019**	**0.006**	**0.11**	**0.035**	**0.018**	<0.002	**0.016**	<0.002	**0.009**	**0.021**
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	N-Methylperfluorooctanesulfonamidoacetic acid (N_MeFOSAA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	N-Ethylperfluorooctanesulfonamidoacetic Acid (N-EtFOSAA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Total of PFAS (n=30)	µg/L	0.04				<0.04	**0.07**	<0.04	<0.04	**0.12**	**0.05**	**0.41**	<0.04	**0.05**	<0.04	**0.06**	<0.04

Note: * PFAS Recreational Values

** Only aesthetic values available under the Australian Drinking Water Guidelines 2011 (version 3.5, August 2018)

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Table 3: Soil Vapour Analytical Results

								Field_ID	SV01s	SV01d	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	SV02s	Carbon Tube 1
								Sampled-date	09/11/2021	09/11/2021	09/11/2021		09/11/2021		09/11/2021	09/11/2021
				ASC NEPM (2013) HSLD ($\mu g/m^3$) 0.0-1.0m / 1.0-2.0m / 2.0-4.0m / 4.0-8.0m	ASC NEPM (2013) HSL A ($\mu g/m^3$) 0.0-1.0m / 1.0-2.0m / 2.0-4.0m / 4.0-8.0m	ASC NEPM (2013) HIL D ($\mu g/m^3$) 0.0-1.0m	ASC NEPM (2013) HIL A ($\mu g/m^3$) 0.0-1.0m	Sample type	vapour	vapour	vapour		vapour		vapour	
									Soil Vapour Sampling Event 1 (Stage 2)							
Method_Type	**ChemName**	**Units**	**EQL**													
US EPA Compendium Methods TO-14a/TO-15	Propylene	$\mu g/m^3$	0.9						**3700**	**1200**	**900**	**29%**	N.A.	N.A.	**5000**	N.A.
	Dichlorodifluoromethane	$\mu g/m^3$	2.5						<250	<250	<250	**0%**	N.A.	N.A.	<25	N.A.
	Chloromethane	$\mu g/m^3$	1.0						<100	<100	<100	**0%**	<2900	N.A.	<10	N.A.
	1,2-Dichlorotetrafluoroethane	$\mu g/m^3$	2.5						<250	<250	<250	**0%**	N.A.	N.A.	<25	N.A.
	Vinyl chloride	$\mu g/m^3$	1.3			100	30		<130	<130	<130	**0%**	<1600	N.A.	<13	N.A.
	1,3-Butadiene	$\mu g/m^3$	1.1						<110	<110	<110	**0%**	<1200	N.A.	<11	N.A.
	Bromomethane	$\mu g/m^3$	1.9						<190	<190	<190	**0%**	<3700	N.A.	<19	N.A.
	Chloroethane	$\mu g/m^3$	1.3						<130	<130	<130	**0%**	<2500	N.A.	<13	N.A.
	Acrolein	$\mu g/m^3$	11						<1100	<1100	<1100	**0%**	<2900	N.A.	<110	N.A.
	Acetone	$\mu g/m^3$	11.9						<1190	<1190	<1190	**0%**	N.A.	N.A.	<119	N.A.
	Ethanol	$\mu g/m^3$	9						<900	<900	<900	**0%**	N.A.	N.A.	<90	N.A.
	Isopropyl Alcohol (2-propanol)	$\mu g/m^3$	12						<1200	<1200	<1200	**0%**	N.A.	N.A.	<120	N.A.
	Isopropyl Alcohol* (tube)	$\mu g/m3$	5						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**120000000**
	Trichlorofluoromethane(Freon 11)	$\mu g/m^3$	2.8						<280	<280	<280	**0%**	N.A.	N.A.	<28	N.A.
	1,1-Dichloroethene (DCE)	$\mu g/m^3$	2.0						<200	<200	<200	**0%**	<2500	N.A.	<20	N.A.
	Methylene chloride(Dichloromethane)	$\mu g/m^3$	17						<1700	<1700	<1700	**0%**	N.A.	N.A.	<170	N.A.
	1,1,2-Trichlorotrifluoroethane	$\mu g/m^3$	3.8						<380	<380	<380	**0%**	N.A.	N.A.	<38	N.A.
	Carbon Disulfide	$\mu g/m^3$	16						<1600	<1600	<1600	**0%**	N.A.	N.A.	<160	N.A.
	trans-1,2-dichloroethene (DCE)	$\mu g/m^3$	2.0						<200	<200	<200	**0%**	<2500	N.A.	<20	N.A.
	1,1-Dichloroethane	$\mu g/m^3$	2.0						<200	<200	<200	**0%**	<2900	N.A.	<20	N.A.
	Methyl-tert-butylether (MTBE)	$\mu g/m^3$	1.8						<180	<180	<180	**0%**	<2500	N.A.	<18	N.A.
	Vinyl Acetate	$\mu g/m^3$	1.8						<180	<180	<180	**0%**	<2900	N.A.	<18	N.A.
	2-Butanone (MEK)	$\mu g/m^3$	15						<1500	<1500	<1500	**0%**	<2100	N.A.	**360**	N.A.
	cis-1,2-Dichloroethene (DCE)	$\mu g/m^3$	2.0			300	80		<200	<200	<200	**0%**	<3300	N.A.	**78**	N.A.
	Hexane	$\mu g/m^3$	1.8						**400**	**190**	<180	N.A.	<2500	N.A.	**410**	N.A.
	Chloroform	$\mu g/m^3$	2.4						<240	<240	<240	**0%**	<3700	N.A.	**100**	N.A.
	Ethyl Acetate	$\mu g/m^3$	1.8						<180	<180	<180	**0%**	<3300	N.A.	<18	N.A.
	Tetrahydrofuran	$\mu g/m^3$	1.5						**4800**	**6900**	**5700**	**19%**	<1600	N.A.	**27000**	N.A.
	1,2-Dichloroethane	$\mu g/m^3$	2.0						<200	<200	<200	**0%**	<4100	N.A.	<20	N.A.
	1,1,1-Trichloroethane	$\mu g/m^3$	2.7			230000	60000		<270	<270	<270	**0%**	<3300	N.A.	<27	N.A.
	Benzene	$\mu g/m^3$	1.6		1000 / 15000 / 40000 / 90000				<160	<160	<160	**0%**	<2100	N.A.	**23**	N.A.
	Carbon tetrachloride	$\mu g/m^3$	3.1						<310	<310	<310	**0%**	<4100	N.A.	<31	N.A.
	Cyclohexane	$\mu g/m^3$	1.7						<170	<170	<170	**0%**	<1600	N.A.	<17	N.A.
	1,2-Dichloropropane	$\mu g/m^3$	2.3						<230	<230	<230	**0%**	<7400	N.A.	<23	N.A.
	Bromodichloromethane	$\mu g/m^3$	3.4						<340	<340	<340	**0%**	<4100	N.A.	<34	N.A.
	Trichloroethene (TCE)	$\mu g/m^3$	2.7			80	20		<270	**2000**	**1400**	**35%**	<3700	N.A.	<27	N.A.
	1,4-Dioxane	$\mu g/m^3$	1.8						<180	<180	<180	**0%**	<2500	N.A.	<18	N.A.
	Heptane	$\mu g/m^3$	2.0						<200	<200	<200	**0%**	<2900	N.A.	**130**	N.A.
	Methyl Methacrylate	$\mu g/m^3$	2.0						<200	<200	<200	**0%**	<2900	N.A.	<20	N.A.
	cis-1,3-Dichloropropene	$\mu g/m^3$	2.3						<230	<230	<230	**0%**	<2500	N.A.	<23	N.A.
	4-Methyl-2-pentanone (MIBK)	$\mu g/m^3$	20						<2000	<2000	<2000	**0%**	<2500	N.A.	<200	N.A.
	trans-1,3-Dichloropropene	$\mu g/m^3$	2.3						<230	<230	<230	**0%**	<2900	N.A.	<23	N.A.
	1,1,2-Trichloroethane	$\mu g/m^3$	2.7						<270	<270	<270	**0%**	<3300	N.A.	<27	N.A.
	Toluene	$\mu g/m^3$	1.9		1600000 / 23000000 / 53000000 / 110000000				<190	<190	<190	**0%**	<2500	N.A.	**48**	N.A.
	2-Hexanone (MBK)	$\mu g/m^3$	2.0						<50	<50	<50	**0%**	<2500	N.A.	<5	N.A.
	Dibromochloromethane	$\mu g/m^3$	1.6						<160	<160	<160	**0%**	<4900	N.A.	<16	N.A.
	1,2-Dibromoethane (EDB)	$\mu g/m^3$	3.8						<380	<380	<380	**0%**	<4900	N.A.	<38	N.A.
	Tetrachloroethene (PCE)	$\mu g/m^3$	3.4			8000	2000		**51000**	**480000**	**360000**	**29%**	**890000**	**60%**	**270**	N.A.
	Chlorobenzene	$\mu g/m^3$	2.3						<230	<230	<230	**0%**	<2500	N.A.	<23	N.A.
	Ethylibenzene	$\mu g/m^3$	2.2		420000 / 6800000 / 16000000 / 35000000				<220	<220	<220	**0%**	<2500	N.A.	**61**	N.A.
	Bromoform	$\mu g/m^3$	5.2						<520	<520	<520	**0%**	<4900	N.A.	<52	N.A.
	m-& p-Xylene	$\mu g/m^3$	4.3						<430	<430	<430	**0%**	<5400	N.A.	**260**	N.A.
	Styrene	$\mu g/m^3$	2.1						<210	<210	<210	**0%**	<2500	N.A.	<21	N.A.
	1,1,2,2-Tetrachloroethane	$\mu g/m^3$	3.4						<340	<340	<340	**0%**	<2900	N.A.	<34	N.A.
	o-Xylene	$\mu g/m^3$	2.2						<220	<220	<220	**0%**	<2500	N.A.	**180**	N.A.
	4-ethyl toluene	$\mu g/m^3$	2.5						<250	<250	<250	**0%**	<2500	N.A.	<25	N.A.
	1,3,5-Trimethylbenzene	$\mu g/m^3$	2.5						<250	<250	<250	**0%**	<2500	N.A.	<25	N.A.
	1,2,4-Trimethylbenzene	$\mu g/m^3$	2.5						<250	<250	<250	**0%**	<3300	N.A.	<25	N.A.
	Benzyl chloride	$\mu g/m^3$	2.6						<260	<260	<260	**0%**	N.A.	N.A.	<26	N.A.
	1,3-Dichlorobenzene	$\mu g/m^3$	3.0						<300	<300	<300	**0%**	<5400	N.A.	<30	N.A.
	1,4-Dichlorobenzene	$\mu g/m^3$	3.0						<300	<300	<300	**0%**	<5400	N.A.	<30	N.A.
	1,2-Dichlorobenzene	$\mu g/m^3$	3.0						<300	<300	<300	**0%**	<5400	N.A.	<30	N.A.
	1,2,4-Trichlorobenzene	$\mu g/m^3$	3.7						<370	<370	<370	**0%**	<15000	N.A.	<37	N.A.
	Hexachloro-1,3-butadiene	$\mu g/m^3$	5.3						<530	<530	<530	**0%**	<8200	N.A.	<53	N.A.
	Naphthalene	$\mu g/m^3$	2.6		1000 / 20000 / 45000 / 95000				<260	<260	<260	**0%**	<8600	N.A.	<26	N.A.
	TPH C5 - C6 aliphatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C6 - C8 aliphatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C8 - C10 aliphatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C10 - C12 aliphatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C6 - C8 aromatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C8 - C10 aromatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C10 - C12 aromatic	$\mu g/m^3$							N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C10 - C12 Naphthalene (F2)	$\mu g/m^3$	40		180000 / 3800000 / NL / NL				<4000	<4000	<4000	**0%**	N.A.	N.A.	<400	N.A.
	TPH C5 - C8 Aliphatic	$\mu g/m^3$	200						**64000**	**330000**	**240000**	**32%**	N.A.	N.A.	**30000**	N.A.
	TPH C6 - C10 - BTEX (F1)	$\mu g/m^3$	200		230000 / 4200000 / 9900000 / 21000000				**45000**	**340000**	**240000**	**34%**	N.A.	N.A.	**27000**	N.A.
	TPH C9 - C10 Aromatic	$\mu g/m^3$	100						<10000	<10000	<10000	**0%**	N.A.	N.A.	<1000	N.A.
	TPH C9 - C12 Aliphatic	$\mu g/m^3$	50						<5000	<5000	<5000	**0%**	N.A.	N.A.	<500	N.A.
	Xylenes Total	$\mu g/m^3$	6.6		280000 / 4800000 / 11000000 / 24000000				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**440**	N.A.

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Table 3: Soil Vapour Analytical Results

				SV3s	SV3d	SV4d	SV5s	SV6s	SV7s	SV8s	SV9s	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	SV3d	Carbon Tube 2	SV1s	SV2s	Carbon Tube 8	SV3s	Carbon Tube 5	SV4s	SV5s
				21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022		21/01/2022		21/01/2022	21/01/2022	24/03/2022	28/03/2022	28/03/2022	25/03/2022	25/03/2022	29/03/2022	28/03/2022
				vapour	vapour	vapour	vapour	vapour	vapour	vapour	vapour	vapour		vapour		vapour	vapour	vapour	vapour		vapour		vapour	vapour
				Soil Vapour Sampling Event 2 (Stage 3)																				
Method_Type	**ChemName**	**Units**	**EQL**																					
US EPA Compendium Methods TO-14a/TO-15	Propylene	µg/m³	0.9	**270**	**1000**	**3600**	**39000**	**1900**	**10000**	**700**	**5400**	**5900**	**9%**	**5700**	**5%**	**880**	N.A.	<40	<5	N.A.	<2	N.A.	<5	<5
	Dichlorodifluoromethane	µg/m³	2.5	**3**	<12.5	<5	<250	**3**	<12.5	<5	<5	<5	**0%**	N.A.	**N.A.**	<2.5	N.A.	<100	<20	N.A.	<6	N.A.	<20	<10
	Chloromethane	µg/m³	1.0	<1	<5	<2	<100	<1	<5	<2	<2	<2	**0%**	<11	**N.A.**	<1	N.A.	<100	<20	N.A.	<6	N.A.	<20	<20
	1,2-Dichlorotetrafluoroethane	µg/m³	2.5	<2.5	<12.5	<5	<250	<2.5	<12.5	<5	<5	<5	**0%**	N.A.	**N.A.**	<2.5	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Vinyl chloride	µg/m³	1.3	<1.3	<6.5	<2.6	<130	<1.3	<6.5	<2.6	<2.6	<2.6	**0%**	<6.2	**N.A.**	<1.3	N.A.	<60	<8	N.A.	<3	N.A.	<8	<7
	1,3-Butadiene	µg/m³	1.1	<1.1	<5.5	<2.2	<110	<1.1	<5.5	<2.2	<2.2	<2.2	**0%**	<4.6	**N.A.**	<1.1	N.A.	<50	<7	N.A.	<3	N.A.	<7	<6
	Bromomethane	µg/m³	1.9	<1.9	<9.5	<3.8	<190	<1.9	<9.5	<3.8	<3.8	<3.8	**0%**	<14	**N.A.**	<1.9	N.A.	<500	<60	N.A.	<20	N.A.	<60	<60
	Chloroethane	µg/m³	1.3	<1.3	<6.5	<2.6	<130	<1.3	<6.5	<2.6	<2.6	<2.6	**0%**	<9.3	**N.A.**	<1.3	N.A.	<60	<8	N.A.	<3	N.A.	<8	<8
	Acrolein	µg/m³	11	<11	<55	<22	<1100	<11	<55	<22	<22	<22	**0%**	<11	**N.A.**	<11	N.A.	<60	<7	N.A.	<3	N.A.	<7	<7
	Acetone	µg/m³	11.9	**70**	<59.5	**40**	<1190	**20**	<59.5	<23.8	**40**	**50**	**22%**	N.A.	**N.A.**	**40**	N.A.	<100	<20	N.A.	**11**	N.A.	**34**	<20
	Ethanol	µg/m³	9	**10**	<45	**20**	<900	**10**	<45	<18	**20**	**30**	**40%**	N.A.	**N.A.**	**30**	N.A.	<100	<20	N.A.	**6.6**	N.A.	<10	<10
	Isopropyl Alcohol (2-propanol)	µg/m³	12	**50**	<60	<24	<1200	**20**	<60	**140**	<24	<24	**0%**	N.A.	**N.A.**	**20**	N.A.	**370**	**1650**	N.A.	**9**	N.A.	**80**	**340**
	Isopropyl Alcohol* (tube)	µg/m3	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	**110000**	N.A.	**110000000**	N.A.	**25000000**	N.A.	N.A.
	Trichlorofluoromethane(Freon 11)	µg/m³	2.8	<2.8	<14	<5.6	<280	<2.8	<14	<5.6	<5.6	<5.6	**0%**	<4.6	**N.A.**	<2.8	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,1-Dichloroethene (DCE)	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<9.3	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	Methylene chloride(Dichloromethane)	µg/m³	17	<17	<85	<34	<1700	<17	<85	<34	<34	<34	**0%**	N.A.	**N.A.**	<17	N.A.	<200	<30	N.A.	<10	N.A.	<30	<30
	1,1,2-Trichlorotrifluoroethane	µg/m³	3.8	<3.8	<19	<7.6	<380	<3.8	<19	<7.6	<7.6	<7.6	**0%**	N.A.	**N.A.**	<3.8	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Carbon Disulfide	µg/m³	16	**30**	<80	**50**	<1600	<16	<80	<32	<32	<32	**0%**	N.A.	**N.A.**	<16	N.A.	<80	**19**	N.A.	**29**	N.A.	<8	<8
	trans-1,2-dichloroethene (DCE)	µg/m³	2.0	<2	<10	**110**	<200	<2	<10	<4	<4	<4	**0%**	<9.3	**N.A.**	<2	N.A.	<100	**45**	N.A.	<5	N.A.	<10	<10
	1,1-Dichloroethane	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<11	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	Methyl-tert-butylether (MTBE)	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<9.3	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	Vinyl Acetate	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<11	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	2-Butanone (MEK)	µg/m³	15	<15	**280**	**170**	<1500	**87**	<75	**59**	**110**	**120**	**9%**	<7.7	**N.A.**	**18**	N.A.	<70	<9	N.A.	<4	N.A.	<9	<8
	cis-1,2-Dichloroethene (DCE)	µg/m³	2.0	<2	<10	**1000**	<200	**10**	<10	<4	**42**	**43**	**2%**	**57**	**30%**	<2	N.A.	<100	**190**	N.A.	<5	N.A.	<10	<10
	Hexane	µg/m³	1.8	**88**	**98**	**570**	**4300**	**410**	**790**	**24**	**1300**	**1300**	**0%**	**880**	**39%**	**360**	N.A.	<90	**4060**	N.A.	<4	N.A.	**43**	**45**
	Chloroform	µg/m³	2.4	**20**	**52**	**7**	<240	**75**	**95**	**44**	**20**	**20**	**0%**	<14	**N.A.**	**20**	N.A.	<100	<20	N.A.	<6	N.A.	<10	<10
	Ethyl Acetate	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<12	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	Tetrahydrofuran	µg/m³	1.5	**940**	**16000**	**5100**	**5500**	**4900**	**3200**	**4700**	**9000**	**9900**	**10%**	**5500**	**48%**	**1100**	N.A.	**1100**	**710**	N.A.	**530**	N.A.	**2520**	**1150**
	1,2-Dichloroethane	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<15	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	1,1,1-Trichloroethane	µg/m³	2.7	<2.7	<13.5	<5.4	<270	<2.7	<13.5	<5.4	<5.4	<5.4	**0%**	<12	**N.A.**	<2.7	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	Benzene	µg/m³	1.6	**10**	**19**	**36**	<160	**28**	**10**	<3.2	**30**	**31**	**3%**	**34**	**13%**	**10**	N.A.	<200	<60	N.A.	<10	N.A.	<20	<20
	Carbon tetrachloride	µg/m³	3.1	<3.1	<15.5	<6.2	<310	<3.1	<15.5	<6.2	<6.2	<6.2	**0%**	<15	**N.A.**	<3.1	N.A.	<200	<20	N.A.	<8	N.A.	<20	<20
	Cyclohexane	µg/m³	1.7	**18**	<8.5	**6**	<170	<1.7	**10**	**21**	<3.4	<3.4	**0%**	<6.2	**N.A.**	<1.7	N.A.	<80	<10	N.A.	<4	N.A.	<10	**22**
	1,2-Dichloropropane	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<28	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	Bromodichloromethane	µg/m³	3.4	<3.4	<17	<6.8	<340	**8**	<17	<6.8	<6.8	<6.8	**0%**	<15	**N.A.**	<3.4	N.A.	<200	<20	N.A.	<8	N.A.	<20	<20
	Trichloroethene (TCE)	µg/m³	2.7	<2.7	<13.5	**140**	<270	**33**	<13.5	**32**	**370**	**370**	**0%**	**500**	**30%**	**4**	N.A.	<100	**32**	N.A.	<7	N.A.	<20	**49**
	1,4-Dioxane	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<9.3	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	Heptane	µg/m³	2.0	**23**	**10**	**39**	**2200**	**26**	**120**	<4	**370**	**380**	**3%**	**320**	**14%**	**120**	N.A.	<100	**980**	N.A.	<5	N.A.	<10	<10
	Methyl Methacrylate	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<11	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	cis-1,3-Dichloropropene	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<9.3	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	4-Methyl-2-pentanone (MIBK)	µg/m³	20	<20	<100	<40	<2000	<20	<100	<40	<40	<40	**0%**	N.A.	**N.A.**	<20	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	trans-1,3-Dichloropropene	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<11	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	1,1,2-Trichloroethane	µg/m³	2.7	<2.7	<13.5	<5.4	<270	<2.7	<13.5	<5.4	<5.4	<5.4	**0%**	<12	**N.A.**	<2.7	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	Toluene	µg/m³	1.9	**160**	**37**	**28**	<190	**37**	**33**	**10**	**64**	**66**	**3%**	**81**	**23%**	**23**	N.A.	<90	**32**	N.A.	**15**	N.A.	<10	**21**
	2-Hexanone (MBK)	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<9.3	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	Dibromochloromethane	µg/m³	1.6	<1.6	<8	<3.2	<160	<1.6	<8	<3.2	<3.2	<3.2	**0%**	<19	**N.A.**	<1.6	N.A.	<200	<30	N.A.	<10	N.A.	<30	<20
	1,2-Dibromoethane (EDB)	µg/m³	3.8	<3.8	<19	<7.6	<380	<3.8	<19	<7.6	<7.6	<7.6	**0%**	<19	**N.A.**	<3.8	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Tetrachloroethene (PCE)	µg/m³	3.4	**93**	**190**	<6.8	**2100**	**350**	<17	<6.8	**3300**	**3300**	**0%**	**4700**	**35%**	**640**	N.A.	**121000**	**190**	N.A.	**120**	N.A.	**79**	**4980**
	Chlorobenzene	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<9.3	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	Ethylbenzene	µg/m³	2.2	**61**	**10**	**520**	<220	**22**	**43**	**10**	**30**	**31**	**3%**	**32**	**6%**	**99**	N.A.	<100	**250**	N.A.	**16**	N.A.	**25**	**50**
	Bromoform	µg/m³	5.2	<5.2	<26	<10.4	<520	<5.2	<26	<10.4	<10.4	<10.4	**0%**	<19	**N.A.**	<5.2	N.A.	<300	<30	N.A.	<10	N.A.	<30	<30
	m-& p-Xylene	µg/m³	4.3	**230**	**30**	**1700**	<430	**50**	**120**	**40**	**68**	**70**	**3%**	**61**	**11%**	**400**	N.A.	<300	**1170**	N.A.	**60**	N.A.	**98**	**270**
	Styrene	µg/m³	2.1	**9**	<10.5	<4.2	<210	**3**	<10.5	<4.2	<4.2	<4.2	**0%**	<9.3	**N.A.**	**2**	N.A.	<100	<30	N.A.	<6	N.A.	<20	<10
	1,1,2,2-Tetrachloroethane	µg/m³	3.4	<3.4	<17	<6.8	<340	<3.4	<17	<6.8	<6.8	<6.8	**0%**	<15	**N.A.**	<3.4	N.A.	<200	<20	N.A.	<8	N.A.	<20	<20
	o-Xylene	µg/m³	2.2	**140**	**20**	**450**	<220	**25**	**60**	**24**	**24**	**24**	**0%**	**20**	**18%**	**140**	N.A.	**240**	**1060**	N.A.	**44**	N.A.	**50**	**200**
	4-ethyltoluene	µg/m³	2.5	**5**	<12.5	<5	<250	<2.5	<12.5	<5	<5	<5	**0%**	**14**	**N.A.**	<2.5	N.A.	<100	<20	N.A.	<6	N.A.	<10	<10
	1,3,5-Trimethylbenzene	µg/m³	2.5	**6**	<12.5	<5	<250	**4**	<12.5	<5	<5	<5	**0%**	<9.3	**N.A.**	**3**	N.A.	<100	**39**	N.A.	<6	N.A.	<10	<10
	1,2,4-Trimethylbenzene	µg/m³	2.5	**10**	<12.5	<5	<250	**8**	<12.5	<5	<5	<5	**0%**	<12	**N.A.**	**5**	N.A.	<100	**110**	N.A.	<6	N.A.	<10	<10
	Benzyl chloride	µg/m³	2.6	<2.6	<13	<5.2	<260	<2.6	<13	<5.2	<5.2	<5.2	**0%**	N.A.	**N.A.**	<2.6	N.A.	<100	<20	N.A.	<6	N.A.	<20	<20
	1,3-Dichlorobenzene	µg/m³	3.0	<3	<15	<6	<300	<3	<15	<6	<6	<6	**0%**	<20	**N.A.**	<3	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,4-Dichlorobenzene	µg/m³	3.0	<3	<15	<6	<300	<3	<15	<6	<6	<6	**0%**	<20	**N.A.**	<3	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,2-Dichlorobenzene	µg/m³	3.0	<3.0	<15	<6	<300	<3	<15	<6	<6	<6	**0%**	<20	**N.A.**	<3	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,2,4-Trichlorobenzene	µg/m³	3.7	<3.7	<18.5	<7.4	<370	<3.7	<18.5	<7.4	<7.4	<7.4	**0%**	<56	**N.A.**	<3.7	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Hexachloro-1,3-butadiene	µg/m³	5.3	<5.3	<26.5	<10.6	<530	<5.3	<26.5	<10.6	<10.6	<10.6	**0%**	<31	**N.A.**	<5.3	N.A.	<300	<30	N.A.	<10	N.A.	<30	<30
	Naphthalene	µg/m³	2.6	<2.6	<13	<5.2	<260	**6**	<13	<5.2	<5.2	<5.2	**0%**	<32	**N.A.**	<2.6	N.A.	<100	<30	N.A.	<6	N.A.	<20	<20
	TPH C5 - C6 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	**17200**	N.A.	<40	N.A.	<100	**5200**
	TPH >C6 - C8 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<800	**13900**	N.A.	<40	N.A.	<100	<100
	TPH >C8 - C10 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	<200	N.A.	<50	N.A.	<200	<200
	TPH >C10 - C12 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	<700	N.A.	<50	N.A.	<400	<600
	TPH C6 - C8 aromatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<800	**130**	N.A.	<40	N.A.	<100	<100
	TPH >C8 - C10 aromatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	**2890**	N.A.	**140**	N.A.	**240**	**620**
	TPH >C10 - C12 aromatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	<200	N.A.	<50	N.A.	<200	<200
	TPH >C10 - C12 Naphthalene (F2)	µg/m³	40	**410**	<200	**250**	<4000	**2000**	<200	**400**	**1100**	**1000**	**10%**	N.A.	**N.A.**	**2500**	N.A.	<1000	<700	N.A.	<50	N.A.	<400	<600
	TPH C5 - C8 Aliphatic	µg/m³	200	**6500**	**18000**	**16000**	**88000**	**11000**	**15000**	**8700**	**26000**	**27000**	**4%**	N.A.	**N.A.**	**8600**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C6 - C10 - BTEX (F1)	µg/m³	200	**3900**	**16000**	**12000**	**37000**	**9300**	**8500**	**7500**	**19000**	**20000**	**5%**	N.A.	**N.A.**	**7300**	N.A.	<1000	**18500**	N.A.	<50	N.A.	<200	<200
	TPH C9 - C10 Aromatic	µg/m³	100	**100**	<500	<200	<10000	**180**	<500	<200	**580**	**570**	**2%**	N.A.	**N.A.**	**1200**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C9 - C12 Aliphatic	µg/m³	50	**570**	**290**	**370**	<5000	**2100**	**410**	**400**	**580**	**530**	**9%**	N.A.	**N.A.**	**1500**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Xylenes Total	µg/m³	6.6	**370**	**50**	**2150**	N.A.	**75**	**180**	**64**	**92**	**94**	**2%**	**81**	**13%**	**540**	N.A.	**240**	**2230**	N.A.	**104**	N.A.	**148**	**470**

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Table 3: Soil Vapour Analytical Results

				Carbon Tube 7	SV6s	Carbon Tube 9	SV7s	Carbon Tube 10	SV8s	SV9s	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	SV10	Carbon Tube 3	SV11	Carbon Tube 4	SV12	Carbon Tube 6	SV13	SV14	SV15	Carbon Tube 1	SV16	Carbon tube 2
				28/03/2022	28/03/2022 vapour	28/03/2022	28/03/2022 vapour	28/03/2022	29/03/2022 vapour	24/03/2022 vapour	24/03/2022 vapour		29/03/2022 vapour		25/03/2022 vapour	25/03/2022	25/03/2022 vapour	25/03/2022	28/03/2022 vapour	28/03/2022	24/03/2022 vapour	24/03/2022 vapour	25/03/2022 vapour	25/03/2022	25/03/2022 vapour	25/03/2022
				Soil Vapour Sampling Event 3 (Stage 4)																						
Method_Type	ChemName	Units	EQL																							
US EPA Compendium Methods TO-14a/TO-15	Propylene	µg/m³	0.9	N.A.	<0.9	N.A.	<0.9	N.A.	<5	<5	<5	0%	<32	N.A.	<0.9	N.A.	<0.8	N.A.	<0.7	N.A.	<0.9	<0.9	<0.9	N.A.	<0.9	N.A.
	Dichlorodifluoromethane	µg/m³	2.5	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	N.A.	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Chloromethane	µg/m³	1.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,2-Dichlorotetrafluoroethane	µg/m³	2.5	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	N.A.	N.A.	<4	N.A.	<3	N.A.	<3	N.A.	<3	<4	<3	N.A.	<3	N.A.
	Vinyl chloride	µg/m³	1.3	N.A.	<1	N.A.	<1	N.A.	<7	<7	<7	0%	<13	N.A.	<1	N.A.	<1	N.A.	<1	N.A.	<1	<1	<1	N.A.	<1	N.A.
	1,3-Butadiene	µg/m³	1.1	N.A.	<1	N.A.	<1	N.A.	<6	<6	<6	0%	<9.7	N.A.	<1	N.A.	<1	N.A.	<0.9	N.A.	<1	<1	<1	N.A.	<1	N.A.
	Bromomethane	µg/m³	1.9	N.A.	<8	N.A.	<8	N.A.	<50	<60	<50	0%	<29	N.A.	<10	N.A.	<10	N.A.	<8	N.A.	<8	<10	<8	N.A.	<8	N.A.
	Chloroethane	µg/m³	1.3	N.A.	<1	N.A.	<1	N.A.	<7	<8	<7	0%	<19	N.A.	<1	N.A.	<1	N.A.	<1	N.A.	<1	<1	<1	N.A.	<1	N.A.
	Acrolein	µg/m³	11	N.A.	<1	N.A.	<1	N.A.	<6	<7	<6	0%	<23	N.A.	<1	N.A.	<1	N.A.	<1	N.A.	<1	<1	<1	N.A.	<1	N.A.
	Acetone	µg/m³	11.9	N.A.	**300**	N.A.	**15**	N.A.	<20	<20	<20	0%	N.A.	N.A.	**22**	N.A.	**24**	N.A.	**25**	N.A.	**16**	**8**	**29**	N.A.	**40**	N.A.
	Ethanol	µg/m³	9	N.A.	**13**	N.A.	**5.8**	N.A.	<10	<10	<10	0%	N.A.	N.A.	**26**	N.A.	**23**	N.A.	**27**	N.A.	**43**	**18**	**14**	N.A.	**24**	N.A.
	Isopropyl Alcohol (2-propanol)	µg/m³	12	N.A.	**390**	N.A.	**7.3**	N.A.	**19**	**23**	<7	N.A.	N.A.	N.A.	**29**	N.A.	**8.9**	N.A.	<1	N.A.	**43**	**3.9**	**8.4**	N.A.	**8.4**	N.A.
	Isopropyl Alcohol* (tube)	µg/m3	5	**25000000**	N.A.	**16000000**	N.A.	**37000000**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**8300000**	N.A.	**30000000**	N.A.	**37000000**	N.A.	N.A.	N.A.	**2800000**	N.A.	**9700000**
	Trichlorofluoromethane(Freon 11)	µg/m³	2.8	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<9.7	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,1-Dichloroethene (DCE)	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Methylene chloride(Dichloromethane)	µg/m³	17	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	N.A.	N.A.	<3	N.A.	<3	N.A.	<4	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,1,2-Trichlorotrifluoroethane	µg/m³	3.8	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	N.A.	N.A.	<4	N.A.	<4	N.A.	<3	N.A.	<4	<4	<4	N.A.	<4	N.A.
	Carbon Disulfide	µg/m³	16	N.A.	<2	N.A.	**5.2**	N.A.	<9	**18**	<9	0%	N.A.	N.A.	<2	N.A.	<2	N.A.	<1	N.A.	**2.1**	**3.3**	**2.6**	N.A.	<2	N.A.
	trans-1,2-dichloroethene (DCE)	µg/m³	2.0	N.A.	**2.6**	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,1-Dichloroethane	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Methyl-tert-butylether (MTBE)	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Vinyl Acetate	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<1	N.A.	<2	<2	<2	N.A.	<2	N.A.
	2-Butanone (MEK)	µg/m³	15	N.A.	**21**	N.A.	**7.6**	N.A.	<8	**12**	**11**	9%	<16	N.A.	**4.5**	N.A.	**3.8**	N.A.	**7.1**	N.A.	**3**	**2.4**	**85**	N.A.	**60**	N.A.
	cis-1,2-Dichloroethene (DCE)	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	**69**	**62**	11%	**56**	21%	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Hexane	µg/m³	1.8	N.A.	<2	N.A.	**42**	N.A.	<10	**19**	**13**	38%	<19	N.A.	<2	N.A.	<2	N.A.	**3.5**	N.A.	**3.5**	<2	<2	N.A.	<2	N.A.
	Chloroform	µg/m³	2.4	N.A.	**4**	N.A.	**42**	N.A.	<10	<10	<10	0%	<29	N.A.	**44**	N.A.	<2	N.A.	**15**	N.A.	**35**	**8.8**	**40**	N.A.	**7.7**	N.A.
	Ethyl Acetate	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<26	N.A.	**3.9**	N.A.	**6.6**	N.A.	<2	N.A.	**30**	<2	**3.3**	N.A.	**5.8**	N.A.
	Tetrahydrofuran	µg/m³	1.5	N.A.	**1430**	N.A.	**1250**	N.A.	**1730**	**1330**	**1230**	8%	**740**	57%	**300**	N.A.	**260**	N.A.	**370**	N.A.	**280**	**160**	**8220**	N.A.	**7810**	N.A.
	1,2-Dichloroethane	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<32	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,1,1-Trichloroethane	µg/m³	2.7	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<26	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Benzene	µg/m³	1.6	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<16	N.A.	<3	N.A.	<3	N.A.	<6	N.A.	<4	<3	<4	N.A.	<3	N.A.
	Carbon tetrachloride	µg/m³	3.1	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<32	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Cyclohexane	µg/m³	1.7	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<13	N.A.	<2	N.A.	<2	N.A.	<1	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,2-Dichloropropane	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<58	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Bromodichloromethane	µg/m³	3.4	N.A.	<3	N.A.	**4.8**	N.A.	<20	<20	<20	0%	<32	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Trichloroethene (TCE)	µg/m³	2.7	N.A.	**18**	N.A.	<3	N.A.	<10	550	**520**	6%	**480**	14%	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	55	N.A.	<3	N.A.
	1,4-Dioxane	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Heptane	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Methyl Methacrylate	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	cis-1,3-Dichloropropene	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	4-Methyl-2-pentanone (MIBK)	µg/m³	20	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	N.A.	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	trans-1,3-Dichloropropene	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,1,2-Trichloroethane	µg/m³	2.7	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<26	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Toluene	µg/m³	1.9	N.A.	**4.7**	N.A.	**8.6**	N.A.	<10	**14**	<10	N.A.	<19	N.A.	**24**	N.A.	**22**	N.A.	**56**	N.A.	**37**	**17**	**38**	N.A.	**25**	N.A.
	2-Hexanone (MBK)	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Dibromochloromethane	µg/m³	1.6	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	<39	N.A.	<4	N.A.	<4	N.A.	<4	N.A.	<4	<4	<4	N.A.	<4	N.A.
	1,2-Dibromoethane (EDB)	µg/m³	3.8	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	<39	N.A.	<4	N.A.	<4	N.A.	<3	N.A.	<4	<4	<4	N.A.	<4	N.A.
	Tetrachloroethene (PCE)	µg/m³	3.4	N.A.	**330**	N.A.	**74**	N.A.	<30	5990	**5760**	4%	**6400**	7%	**12**	N.A.	**26**	N.A.	**11**	N.A.	**9.1**	**170**	**1170**	N.A.	**200**	N.A.
	Chlorobenzene	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Ethylbenzene	µg/m³	2.2	N.A.	**13**	N.A.	**95**	N.A.	<10	**35**	**16**	75%	<19	N.A.	**7.2**	N.A.	**7.5**	N.A.	**22**	N.A.	**6.9**	**5.6**	**9**	N.A.	**8.2**	N.A.
	Bromoform	µg/m³	5.2	N.A.	<5	N.A.	<5	N.A.	<30	<50	<50	0%	<39	N.A.	<5	N.A.	<5	N.A.	<4	N.A.	<5	<5	<5	N.A.	<5	N.A.
	m-& p-Xylene	µg/m³	4.3	N.A.	**51**	N.A.	**400**	N.A.	<30	**100**	**55**	58%	<42	N.A.	**18**	N.A.	**23**	N.A.	**87**	N.A.	**15**	**14**	**9.6**	N.A.	**34**	N.A.
	Styrene	µg/m³	2.1	N.A.	<4	N.A.	<4	N.A.	<20	<30	<10	0%	<19	N.A.	<5	N.A.	<5	N.A.	<7	N.A.	<5	<4	<5	N.A.	<4	N.A.
	1,1,2,2-Tetrachloroethane	µg/m³	3.4	N.A.	<3	N.A.	<3	N.A.	<20	**44**	<20	N.A.	<23	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	o-Xylene	µg/m³	2.2	N.A.	**37**	N.A.	**230**	N.A.	<20	**66**	**38**	54%	<19	N.A.	**10**	N.A.	**17**	N.A.	**49**	N.A.	**10**	**10**	**6.2**	N.A.	**16**	N.A.
	4-ethyl toluene	µg/m³	2.5	N.A.	<2	N.A.	**2.6**	N.A.	<10	<10	<10	0%	<19	N.A.	**2.8**	N.A.	**2.5**	N.A.	**10**	N.A.	<2	<2	<2	N.A.	**9.4**	N.A.
	1,3,5-Trimethylbenzene	µg/m³	2.5	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	**8.1**	N.A.	<2	<2	<2	N.A.	**19**	N.A.
	1,2,4-Trimethylbenzene	µg/m³	2.5	N.A.	<2	N.A.	**5.2**	N.A.	<10	<10	<10	0%	<26	N.A.	**3.5**	N.A.	**2.9**	N.A.	**10**	N.A.	**2.9**	<2	<2	N.A.	**57**	N.A.
	Benzyl chloride	µg/m³	2.6	N.A.	<3	N.A.	<3	N.A.	<10	<20	<10	0%	N.A.	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	**19**	N.A.
	1,3-Dichlorobenzene	µg/m³	3.0	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<42	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,4-Dichlorobenzene	µg/m³	3.0	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<42	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,2-Dichlorobenzene	µg/m³	3.0	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<42	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<6	N.A.	**3.7**	N.A.
	1,2,4-Trichlorobenzene	µg/m³	3.7	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	<120	N.A.	<4	N.A.	<4	N.A.	<3	N.A.	<4	<4	<4	N.A.	<4	N.A.
	Hexachloro-1,3-butadiene	µg/m³	5.3	N.A.	<5	N.A.	<5	N.A.	<40	<30	<30	0%	<64	N.A.	<5	N.A.	<5	N.A.	<4	N.A.	<5	<5	<5	N.A.	<5	N.A.
	Naphthalene	µg/m³	2.6	N.A.	<3	N.A.	<5	N.A.	<10	<20	<10	0%	<68	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	TPH C5 - C6 aliphatic	µg/m³		N.A.	<40	N.A.	**540**	N.A.	<300	<100	<100	0%	N.A.	N.A.	<40	N.A.	<40	N.A.	<40	N.A.	<40	<40	<40	N.A.	<40	N.A.
	TPH >C6 - C8 aliphatic	µg/m³		N.A.	<40	N.A.	<40	N.A.	<100	<100	<100	0%	N.A.	N.A.	<40	N.A.	<40	N.A.	<40	N.A.	<40	<40	<40	N.A.	<40	N.A.
	TPH >C8 - C10 aliphatic	µg/m³		N.A.	<50	N.A.	<50	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	<50	N.A.	<50	<50	<50	N.A.	<50	N.A.
	TPH >C10 - C12 aliphatic	µg/m³		N.A.	<100	N.A.	<300	N.A.	<200	<200	<200	0%	N.A.	N.A.	<200	N.A.	<100	N.A.	<200	N.A.	<100	<300	<200	N.A.	**310**	N.A.
	TPH C6 - C8 aromatic	µg/m³		N.A.	<40	N.A.	<40	N.A.	<100	<100	<100	0%	N.A.	N.A.	<40	N.A.	<40	N.A.	**62**	N.A.	**42**	<40	**42**	N.A.	<40	N.A.
	TPH >C8 - C10 aromatic	µg/m³		N.A.	**120**	N.A.	**830**	N.A.	<100	<300	<200	0%	N.A.	N.A.	<50	N.A.	**63**	N.A.	**200**	N.A.	<50	<50	<50	N.A.	**98**	N.A.
	TPH >C10 - C12 aromatic	µg/m³		N.A.	<50	N.A.	<50	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	<50	N.A.	<50	<50	<50	N.A.	**66**	N.A.
	TPH >C10 - C12 -Naphthalene (F2)	µg/m³	40	N.A.	<50	N.A.	<50	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	<50	N.A.	<50	<50	<50	N.A.	**376**	N.A.
	TPH C5 - C8 Aliphatic	µg/m³	200	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C6 - C10 - BTEX (F1)	µg/m³	200	N.A.	<50	N.A.	**140**	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	**51**	N.A.	<50	<50	<50	N.A.	<50	N.A.
	TPH C9 - C10 Aromatic	µg/m³	100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C9 - C12 Aliphatic	µg/m³	50	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Xylenes Total	µg/m³	6.6	N.A.	**88**	N.A.	**630**	N.A.	N.A.	**166**	**93**	56%	N.A.	N.A.	**28**	N.A.	**40**	N.A.	**136**	N.A.	**25**	**24**	**15.8**	N.A.	**50**	N.A.

Appendix C:
Vapour Modelling Equations

Appendix C – Vapour Modelling Equations

1.1. Vapour Emissions in Indoor Air

The algorithms used to predict indoor air vapour concentrations are those described by Johnson and Ettinger (1991). The algorithms estimate a unitless 'vapour attenuation coefficient' (α), which represents the ratio of the indoor vapour concentration (C_{indoor}) to the vapour concentration at the source (C_{source}) found at some depth (L_T) below a foundation.

The attenuation coefficient is then used to calculate a volatilization factor (VF), which represents the ratio of concentration of vapour phase hydrocarbon in indoor air to that in the source media (which is soil vapour for the Kippax Site), i.e.:

$$VF = \frac{C_{vapour(m)}}{C_m}\alpha \qquad \textbf{Equation 1}$$

where $C_{vapour(m)}$ indicates the vapour phase concentration at source media *m* (soil vapour, soil, groundwater and/or PSH), and C_m indicates the concentration in source media *m*.

The estimated air concentration is then given by:

$$C_{air(m)} = C_m VF \qquad \textbf{Equation 2}$$

where $C_{air(m)}$ is the chemical concentration associated with vapours derived from media *m*.

Parameter definitions used in the equations below can be found in **Table 1**.

The attenuation coefficient, α, is estimated by:

$$\alpha = \frac{\left[\frac{D_T^{eff} A_B}{Q_B L_T}\right]\exp\left(\frac{Q_{soil} L_{crack}}{D_{crack}^{eff}\eta A_B}\right)}{\exp\left(\frac{Q_{soil} L_{crack}}{D_{crack}^{eff}\eta A_B}\right)+\left[\frac{D_T^{eff} A_B}{Q_B L_T}\right]+\left[\frac{D_T^{eff} A_B}{Q_{soil} L_T}\right]\left(\exp\left(\frac{Q_{soil} L_{crack}}{D_{crack}^{eff}\eta A_B}\right)-1\right)} \qquad \textbf{Equation 3}$$

where $\alpha = C_{indoor}/C_{source}$ and other parameters are as listed in **Table 1**.

Q_{soil} can be specified directly, or can be calculated using the following analytical solution of Nazaroff (1988):

$$Q_{soil} = \frac{2\pi\Delta P k_v X_{crack}}{\mu \ln(2Z_{crack}/r_{crack})} \qquad \textbf{Equation 4}$$

Where r_{crack} is equal to:

$$r_{crack} = \eta(A_B / X_{crack}) \qquad \textbf{Equation 5}$$

For cases where Q_{soil} is zero, the above equation simplifies to:

$$\alpha = \frac{\left[\frac{D_T^{eff} A_B}{Q_B L_T}\right]}{1+\left[\frac{D_T^{eff} A_B}{Q_B L_T}\right]+\left[\frac{D_T^{eff} L_{crack}}{D_{crack}^{eff} L_T \eta}\right]} \qquad \textbf{Equation 6}$$

For soil vapour, L_T is equal to the depth to the subsurface soil contamination source.

For a subsurface soil vapour source, the effective vapour phase diffusion coefficient between the contaminated soil vapour source and the building foundation ($D^{eff}_{T(sv)}$) is estimated by:

$$D_{T(sv)}^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2} \qquad \textbf{Equation 10}$$

with

$$D_{cap}^{eff} = D^{air}\frac{\theta_{acap}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{wcap}^{3.33}}{\theta_T^2} \qquad \textbf{Equation 12}$$

For both soil and groundwater sources, the effective diffusion through foundation cracks (D^{eff}_{crack}) is estimated by:

$$D_{crack}^{eff} = D^{air}\frac{\theta_{acrack}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{wcrack}^{3.33}}{\theta_T^2} \qquad \textbf{Equation 13}$$

The algorithms used to predict outdoor vapour concentrations which may results from a surface soil, subsurface soil or groundwater source are those described by ASTM (2002; Table X2.5).

1.2. Vapour Emissions in Outdoor Air

The estimated outdoor air concentration is determined by Equation 2 above.

The algorithm for soil to outdoor air vapour concentration is presented in Equation 15 below based on ASTM (2002).

$$VF_{samb} = \frac{H \cdot \rho_s}{\left[\theta_{ws} + k_s \cdot \rho_s + H \cdot \theta_{as}\right]\left[1+\frac{U_{air} \cdot D \cdot L_T}{D_{T(s)}^{eff} \cdot W}\right]} \qquad \textbf{Equation 15}$$

Where $D_{T(sv)}^{eff}$ is estimated by Equation 10.

The estimated outdoor air concentration is determined by Equation 2 above.

Table 1 Vapour Model Parameter Definitions

Parameter/Symbol	Definition
A_B	surface area of the enclosed space in contact with soil (cm^2)
Air $_{Exc}$	Air exchange rate in basement (exchanges per day)
$C_{source(m)}$	vapour phase concentration at the media (*m*) source (mg/m^3)
D	ambient air mixing height (cm)
Da	diffusivity of constituent in air (cm2/s)
D^{air}	Chemical-specific diffusion coefficient in air (cm^2/s)
D^{wat}	Chemical-specific diffusion coefficient in water (cm^2/s)

Parameter/Symbol	Definition
D^{eff}_{cap}	effective overall vapour-phase diffusion coefficient through capillary fringe (cm^2/s)
D^{eff}_{crack}	effective overall vapour-phase diffusion coefficient through walls and foundation cracks (cm^2/s)
D^{eff}_{T}	effective overall vapour-phase diffusion coefficient in soil between the foundation and the depth L_T (cm^2/s)
E_B	Indoor air exchange rate with outdoor air (1/s)
f_{oc}	weight fraction of organic carbon in soil (unitless)
H or HL	unitless Henry's law constant
h_{cap}	Height of capillary zone
h_v	Height of vadose zone
K	overall mass transfer coefficient (m/s)
k_{oc}	Chemical-specific carbon-water sorption coefficient (cm^3/g)
k_v	soil vapour permeability (cm^2)
L_{crack}	the enclosed space foundation thickness (cm)
L_T	the distance (depth) to the vapour source or other point of interest below foundation (cm) (equal to $h_{cap}+h_v$ for groundwater-derived vapour, or the depth of soil contamination for soil-derived vapour)
P_T	total pressure of system (assumed to be atmospheric pressure, or 760 mm Hg)
Q	volumetric flow rate (m^3/s)
Q_B	the enclosed space volumetric air flow rate (cm^3/s) of fresh air; usually estimated to be the product of the enclosed space volume (V_B) and the indoor air exchange rate with outdoor air (E_B)
Q_{soil}	the pressure-driven soil gas flow rate from the subsurface into the enclosed space (cm^3/s)
U	windspeed (m/s)
U	windspeed (m/s)
V_B	Enclosed space volume (cm^3)
VF	volatisation factor
Vol_B	Volume of the basement (m^3)
VFwamb	volatisation factor groundwater to ambient (outdoor air) vapours
VP	Chemical specific vapour pressure of pure liquid chemical *i* (mm Hg)
W	width of source area parallel to wind or groundwater flow direction (cm)
X_{crack}	Building perimeter (cm)
Z_{crack}	Depth to bottom of slab (cm)
ΔP	pressure differential between soil surface and the enclosed space (g/cm^2-s)
η	the fraction of the enclosed space surface area open for vapour intrusion (unitless), i.e., the areal fraction of cracks in the foundation/slab
μ	viscosity of air (1.81×10^{-4} g/cm-s)

Parameter/Symbol	Definition
ρ_s	soil bulk density (g/cm^3)
θ_{as}	volumetric air content in vadose zone soils (unitless)
θ_{ws}	volumetric water content in vadose zone soils (unitless)
θ_T	total soil porosity (unitless)
θ_{acap}	volumetric air content in capillary zone soils (unitless)
θ_{wcap}	volumetric water content in capillary zone soils (unitless)
θ_{acrack}	volumetric air content in foundation/wall cracks (unitless)
θ_{wcrack}	volumetric water content in foundation/wall cracks (unitless)
μG	viscosity of air (g/cm sec): 1.86 x 10^{-4}
ρ_G	density of air (g/cm^3): 1.29 x 10^{-3}

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Appendix D: Toxicity Profiles

Toxicity Profile – Tetrachloroethene (PCE)

1. Chemical Identification

Table 1 Chemical and Physiochemical Parameters

Property	Units	Value
Molecular formula	-	C_2Cl_4
Molecular Weight	g/mol	165.83
CAS	-	127-18-4
Density (20° C)	g/ml	1.6227
Melting point	°C	-22
Boiling point	°C	121
Henry's law constant (25° C)	atm-m^3/mol	0.018
Vapour pressure (25° C)	mmHg	18.47
Water solubility (25° C)	mg/L	150
Octanol/water partition coefficient (25° C)	log K_{ow}	3.40 (measured), 2.97 (estimated)
Octanol/carbon partition coefficient (25° C)	log K_{oc}	177~350 (measured)
Diffusion in air	cm^2/s	0.0502
Diffusion in water	cm^2/s	0.0000946

Chemical structure:

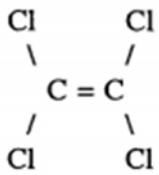


Figure 1 Chemical Structure of Tetrachloroethene

Synonyms: tetrachloroethene, tetrachloroethylene, perchloroethene, perchloroethylene, PCE, PERC, ethylene tetrachloride, 1,1,2,2-tetrachloroethylene, carbon dichloride, perchlor, carbon bichloride.

2. General

Tetrachloroethene (PCE) is a non-flammable, colourless liquid that is identified as a volatile chlorinated hydrocarbon. PCE is commonly used as a degreasing solvent, particularly within the dry-cleaning industry (WHO, 2022). It also serves as a precursor material in the production of other chemicals and consumer products (ATSDR, 2019).

Use of PCE has declined since the 1980s due to the regulation of the substance across North America and Europe (WHO, 2022).

3. Exposure Pathways and Background

PCE may be found in trace amounts in water, aquatic organisms, air, foodstuffs and human tissue. In anaerobic groundwater it may degrade to more toxic compounds, including vinyl chloride (WHO, 2022).

The primary human health exposure pathways for PCE are considered to be **inhalation** and **ingestion** (USEPA, 2012; WHO, 2022).

PCE is most commonly found in soil and groundwater mediums (ATSDR, 2019). It can occur in surface water environments, however, in this media it typically volatilises quickly (ATSDR, 2019; WHO, 2010). Within soil, PCE can leach into groundwater and into the void air space between soil particles (ATSDR, 2019). PCE released to the atmosphere is slow to degrade, having an atmospheric half-life of approximately 100 days (range 70-250 days) and in turn making it subject to long-range atmospheric transport (ATSDR, 2019; WHO, 2010).

People working with or residing near to dry cleaning industries and contaminated sites or using metal degreasing products are more likely to be exposed to PCE than other members of the population (ATSDR, 2019).

3.1. Inhalation

Where activities have resulted in PCE contamination within soil, indoor air contamination may occur due to soil vapour intrusion (WHO, 2020; ATSDR, 2019). This process may also be associated with vapour intrusion from shallow contaminated groundwater sources (WHO, 2020).

PCE is excreted slowly by exhalation and can therefore be transported from an occupational setting to a domestic one (WHO, 2010). The half-life of PCE in the lungs is about 65 hours (WHO, 2020).

Inhalation of particulates is considered likely to be insignificant compared to inhalation of volatiles and data suggests that dermal absorption is limited in humans. Data for concentrations of PCE in air in industrial, urban and regional areas are available in Australia. Detected concentrations reported by NEPC (2013) indicated an average of 0.0007 mg/m^3 in urban and regional areas in NSW, and a maximum of 0.085 mg/m^3 reported in an industrial area of Brisbane. WHO (2000) reported that background levels of PCE are likely to be higher in buildings with a dry-cleaner present where peak concentrations of 5.0 mg/m^3 have been recorded, compared to buildings in close proximity to a dry-cleaners that have recorded concentrations ranging between 0.0006-0.1242 mg/m^3 (WHO, 2020).

In absence of sufficient compound-specific absorption data for the oral, inhalation and dermal routes, the absorption for volatile COPC has been set at 1 (100%) for oral and inhalation exposure and 0.03 (3%) for dermal exposure in accordance with NEPC (2013). NEPC (2013) adopted a background intake for PCE of approximately 10% of the recommended inhalation TRVs for non-carcinogenic effects. This value has been adopted in the risk assessment.

3.2. Ingestion

Ingestion of PCE primarily occurs due to the consumption of contamination water sources, particularly groundwater (USEPA, 2012; WHO, 2022). Concentrations in groundwater are

generally higher than surface waters due to impeded volatilisation of PCE within groundwater environments (WHO, 2022; ATSDR, 2019).

Contaminated drinking water can lead to exposure via drinking, showering and washing (WHO, 2010).

Ingestion of PCE may also occur via the consumption of food items exposed to a local contamination source (for example shops directly above dry-cleaning facilities) (WHO, 2010; USEPA, 2012). However, this pathway is not considered to be a major exposure pathway for PCE (WHO, 2020).

Mean intake from food, drinking-water, and air is approximately 0.5 to 3µg/kg body weight per day (WHO, 2006). Studies on varies foods have found that foods with a high fat content sold or stored near dry-cleaning facilities may have elevated PCE compared to other foods due to the lipophilic nature of PCE (WHO, 2020).

3.3. Degradation pathways and associated contaminants

Degradation of PCE within the atmosphere is related to reaction with hydroxyl radicals, a process dependent on temperature (WHO, 2010). As such, greater reactions occur during summer months (WHO, 2010).

Through the process of reductive dechlorination, PCE biodegrades to trichloroethylene, dichloroethylene, vinyl chloride, and ethene (ATSDR, 2019). Testing has suggested that the biodegradation of PCE within water is extremely low, leading to its persistence for periods greater than several months (WHO, 2010). Further, PCE is persistent in waters where volatilisation cannot occur (WHO, 2020).

4. Human Health Effects

4.1. Non-carcinogenic effects

Acute exposure to PCE via inhalation at high concentrations, can cause central nervous system effects including inebriation, perceptual distortion and exhilaration (WHO, 2020). Inhalation of high concentrations have also been linked to fatalities driven due to the anaesthetic properties of PCE and induced cardiac arrhythmia (WHO, 2020; ATSDR, 2019). Neurological impacts from acute exposure to high concentrations include mood changes, slight ataxia and dizziness (ATSDR, 2019). Exposure to lower concentrations over a longer period of time produced symptoms of headache, dizziness, difficulty in speaking, and sleepiness (ATSDR, 2019).

Long-term exposures to PCE have been reported to damage the liver, the kidneys, as well as the immune, hematological, development and reproductive systems (WHO, 2022).

Long-term exposure to lower concentrations have been associated with neurobehavioural changes such as colour vision and contrast sensitivity (ATSDR, 2019; WHO, 2020).

Based on the available human epidemiologic data and experimental and mechanistic studies, it is concluded that PCE poses a potential human health hazard for non-carcinogenic toxicity to the central nervous system, kidney, liver, immune and hematologic system, and on development and reproduction (USEPA, 2012).

4.1.1. Non-Carcinogenic Toxicity Reference Values

The dose-response values provide an estimate of exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime. The oral exposure represents a daily value and the inhalation exposure represents continuous inhalation. These values are intended for use in risk assessments for health effects known or assumed to be produced through a nonlinear (presumed threshold) mode of action (USEPA, 2012. Available chronic dose-response values published by sources recognised and endorsed by enHealth (enHealth, 2012), NEPC (NEPC, 2013) and the USEPA and are summarised below.

Oral

The oral dose-response value is expressed in units of mg/kg/day. This value may be termed a Reference Dose (RfD), Tolerable Daily Intake (TDI), or Minimal Risk Level for oral exposure (MRL) depending on the agency of derivation.

Table 2 Published threshold response values for PCE - Oral

Agency	Oral Dose-Response Value (mg/kg/day)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
NHMRC	0.014	NHMRC (2011)	Hepatotoxic effects	Mice and Rats	1,000	Safety factor of 10 to account for possible carcinogenicity TDI based on study by Hayes et al.,1986 and Buben JA, O'Flaherty EJ., 1985
WHO	0.016	WHO (2022; 2020)	Neurological effects (decreased colour vision)	Human (occupational study)	300	Uncertainty factor of 3 to account for occupational study with intermittent exposure. Considered to be protective for cancer and non-cancer effects.
WHO	0.05	WHO (2006)	AUC in plasma (a measure of systemic exposure)	-	-	Derived using a PBPK model
RIVM	0.016	RIVM (2001)	Liver	Rat	1,000	TDI based on a study by de Vries et al., 1982
Health Canada	0.0047	Health Canada (2021)	Neurotoxicity	Human	1,000	Health Canada, 2015 (based on Cavalleri et al., 1994)
IRIS	0.006	USEPA (2022)	Neurotoxicity	Human	1,000	Extrapolated from Inhalation studies



Agency	Oral Dose-Response Value (mg/kg/day)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
						RfC based on study by Echeverria et al., 1995; Cavalleri et al., 1994
ATSDR	0.008	ATSDR (2019)	Neurobehavioural	Human	100	Chronic exposure MRL

Inhalation

The inhalation dose-response value is expressed in units of mg/m^3. This value may be termed a Reference Concentration (RfC), Tolerable Concentration (TC), or Minimal Risk Level for inhalation (MRL) depending on the agency of derivation.

Table 3 Published threshold response values for PCE - Inhalation

Agency	Inhalation Dose-Response Value (mg/m^3)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
WHO	0.2	WHO (2006)	Neurotoxicological effects	Human	100	Target concentration based on occupationally exposed cohorts
RIVM	0.25	RIVM (2001)	Kidney	Human	100	TCA based on study by Mutti et al., 1992
ATSDR	0.041	ATSDR (2019)	Neurotoxicological effects	Human	100	Chronic exposure (converted from 0.006 ppm with reference to molecular weight)
Health Canada	0.04	Health Canada (2021)	Neurotoxicological effects	Human	1,000	Based on USEPA, 2012 (derived from Echeverria et al., 1995; Cavalleri et al., 1994)
IRIS	0.04	USEPA (2022)	Neurotoxicity	Human	1,000	RfC based on study by Echeverria et al., 1995; Cavalleri et al., 1994

4.2. Carcinogenicity and genotoxicity

PCE is classified by IARC as a Group 2A carcinogen (probably carcinogenic to humans) based on limited evidence in humans and sufficient evidence in experimental animals (IARC, 1995; WHO, 2022).

The National Toxicology Program (NTP) listed PCE as: reasonably anticipated to be a human carcinogen (NTP, 2021).

A number of epidemiology studies of dry-cleaning workers occupationally exposed to PCE have shown increases in cancer, especially oesophageal and bladder cancers. PCE has been shown to cause liver tumours in mice and kidney tumours in male rats (ATSDR, 2019).

The epidemiologic evidence provides a pattern associating PCE exposure and several types of cancer, including bladder cancer, non-Hodgkin lymphoma and multiple myeloma. Additional evidence suggests oesophageal, kidney, lung, cervical and breast cancer, may occur as a result of exposure to PCE however limited data suggestive of an effect are available (ATSDR, 2019).

The results in both in vivo and in vitro assays indicate that PCE has the potential to be genotoxic (ATSDR, 2019). Studies on both humans and animals have produced mixed results for gene mutation and DNA and chromosomal damage (ATSDR, 2019). Studies in humans exposed to inhalation of PCE in occupational settings have also provided mixed results relating to genotoxicity (ATSDR, 2019). A study on dry-cleaning workers exposure indicated a greater incidence of chromosome damage in these workers compared to controls, however, the results were dependent on employment duration and the frequency of exposure (ATSDR, 2019).

Based on weight of evidence from mutagenicity studies, some PCE metabolites have been shown to be mutagenic. Thus, the hypothesis that mutagenicity contributes to the PCE carcinogenesis cannot be ruled out for one or more target organs, although the specific metabolic species or mechanistic effects are not known (USEPA, 2012). The USEPA assumes a mutagenic mode of action for evaluation of potential risks of kidney cancer from exposure to PCE. Following the guidelines for carcinogenic risk assessment (USEPA, 2005), PCE is "likely to be carcinogenic in humans by all routes of exposure" (USEPA, 2012).

Table 4 Published threshold response values for PCE – Non-Threshold

Agency	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Test Animal	Inhalation Unit Risk Factor $(\mu g/m3)^{-1}$	Test Animal	Source
IRIS	0.002	Human	2.6×10^{-7}	Humans	USEPA, 2022
OEHHA	0.54	Mice and Rats	6.1×10^{-6}	Mice and Rats	CalEPA, 2022

5. Adopted Does Response Values

Dose-response values for threshold effects associated with oral or inhalation exposure to PCE have not been published by Australian regulatory bodies.

Threshold (Non-Carcinogenic)

NEPC (2013) has assessed PCE based on threshold effects only, therefore SAGE have adopted this approach.

For assessment of potential threshold effects associated with oral exposure to PCE, SAGE has adopted the reference dose of **0.006 mg/kg/day** published by IRIS (USEPA, 2022). This value has been selected based on the recent revision date of the peer-reviewed study and the human receptor.

For assessment of potential threshold effects associated with inhalation exposure to PCE, SAGE has adopted the inhalation reference concentration of **0.2 mg/m^3** published by WHO (WHO, 2006) as per NEPC (2013).

Non-Threshold (Carcinogenic)

No values have been selected for non-threshold effects.

6. References

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WHO, 2022. *Guidelines for Drinking-water Quality*, fourth edition incorporating first and second addenda, World Health Organization, Geneva. 2022.



Revision History

Rev.	Nature of Changes	Author	Approval	Date
0.1	Draft	B White	A Lee	03/05/2022
1.0	Final	B White	A Lee	10/06/2022

Toxicity Profile – Trichloroethene (TCE)

1. Chemical Identification

Table 1 Chemical and Physiochemical Parameters

Property	Units	Value
Molecular formula	-	$C_2H_3Cl_3$
Molecular Weight	g/mol	131.4
CAS	-	79-01-6
Density (20° C)	g/ml	1.4642
Melting point	°C	-84.7
Boiling point	°C	87.2
Henry's law constant (25° C)	atm-m^3/mol	0.02
Vapour pressure (25° C)	mmHg	69
Water solubility (25° C)	mg/L	1280
Octanol/water partition coefficient (25° C)	log K_{ow}	2.61
Octanol/carbon partition coefficient (25° C)	log K_{oc}	2.42
Diffusion in air	cm^2/s	0.0687
Diffusion in water	cm^2/s	0.0000102

Chemical structure:

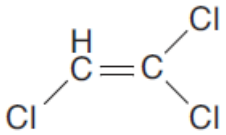


Figure 1 Chemical Structure of Trichloroethene

Synonyms: Acetylene trichloride, 1-chloro-2,2-dichloroethylene, 1,1-dichloro-2-chloroethylene, ethylene trichloride, trichloride, TCE, 1,1,2-trichlo-ethylene, trichloroethene.

2. General

Trichloroethene (TCE) is a non-flammable, colourless liquid with a slightly sweet odour. It is an industrial solvent used primarily in metal degreasing. It has also been used as general-purpose solvent for adhesives, paint removers, lubricants and pesticides (ATSDR, 2019). Historical users of TCE have also included the dry-cleaning industry (ATSDR, 2019).

TCE primarily enters the environment by evaporation from factories and chemical waste sites. It has also been found in groundwater and many surface waters as a result of the manufacture, use, and disposal of the chemical.

It is found in some foods and is believed to originate from contamination of the water used in food processing, or from food processing equipment cleaned with TCE. While there is no indication of bioaccumulation in fish, low levels have been detected. It is not anticipated that TCE would bioaccumulate in humans.

3. Exposure Pathways and Background

The most significant exposure pathway is inhalation of contaminated air, with vapours released from paints, glues, and other products, or by release from industrial sites that manufacture TCE. Inhalation of TCE may also occur in indoor environments via vapour intrusion processes from contaminated soil or groundwater underlying a building (ATSDR, 2019). Although TCE has been detected in certain foods, beverages, water and soil, these do not constitute major sources of exposure for most people (ATSDR, 2019).

Exposure to TCE may also occur via ingestion through the consumption of contaminated water (WHO, 2022; ATSDR, 2019). Concentrations of TCE are generally higher in groundwater than surface waters as the unconfined nature off surface water allows faster volatilisation of TCE (WHO, 2022). As such groundwater sources used for drinking water purposes offer a more complete pathway for TCE ingestion where contamination exists.

Data for concentrations of TCE in air in industrial, urban and regional areas are available in Australia. Detected concentrations reported by NEPC (2013) ranged from approximately 0.0002 mg/m^3 in an industrial area of Brisbane, up to a maximum of 0.019 mg/m^3 in Sydney CBD. The WHO has estimated background intakes (primarily via inhalation) to be approximately 0.04 ug/kg/day for children and 0.01 ug/kg/day for adults (NEPC, 2013). Based on this data NEPC (2013) determined a background intake for TCE of approximately 10% of the recommended inhalation TRVs for non-carcinogenic effects. This value has been adopted in the risk assessment.

In absence of sufficient compound-specific absorption data for the oral, inhalation and dermal routes, the absorption for volatile COPC has been set at 1 (100%) for oral and inhalation exposure and 0.03 (3%) for dermal exposure in accordance with NEPC (2013).

3.1. Degradation pathways and associated contaminants

TCE within the environment can degrade to vinyl chloride (CCME, 2007). It is recommended that assessments for TCE within the environment include an assessment of vinyl chloride (CCME, 2007).

4. Human Health Effects

4.1. Non-carcinogenic effects

Historically, TCE has been used as a human anaesthetic or inhaled intentionally for its narcotic purposes; most of the information regarding the effects of TCE in humans therefore comes from case studies and experiments describing effects of TCE after inhalation exposure. Fatalities have been associated with inhalation of high concentrations of TCE during anaesthetic use (ATSDR, 2019).

The USEPA review of TCE (USEPA, 2011) considers TCE poses a potential human health hazard for non-cancer toxicity to the central nervous system, kidney, liver, immune system, male reproductive system, and the developing foetus. NEPC (2013) noted that noncarcinogenic end points may be more sensitive for oral intakes.

Effects of TCE exposure include headache, vertigo, fatigue, short-term memory loss, decreased word associations, central nervous system depression, and anesthesia.

Liver damage has been reported in people occupationally exposed to high concentrations.

4.1.1. Non-Carcinogenic Toxicity Reference Values

The dose-response values provide an estimate of exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime. The oral exposure represents a daily value and the inhalation exposure represents continuous inhalation. These values are intended for use in risk assessments for health effects known or assumed to be produced through a nonlinear (presumed threshold) mode of action (USEPA, 2014). Available chronic dose-response values published by sources recognised and endorsed by enHealth (enHealth, 2012), NEPC (NEPC, 2013) and the USEPA and are summarised below.

Oral

The oral dose-response value is expressed in units of mg/kg/day. This value may be termed a Reference Dose (RfD), Tolerable Daily Intake (TDI), or Minimal Risk Level for oral exposure (MRL) depending on the agency of derivation.

Table 2 Published threshold response values for TCE - Oral

Agency	Oral Dose-Response Value (mg/kg/day)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
WHO	0.0005	WHO (2020; 2022)	Developmental immunotoxicity and fetal cardiac malformations	Mice and Rats	-	TDI derived from a PBPK model of three critical studies, with vastly different uncertainty factors.
RIVM	0.05	RIVM (2001)	Multiple effects.	Mice and Rats	1000	TDI (provisional). Based on a review of multiple studies.
IRIS	0.0005	USEPA (2022)	Heart malformations and immunological effects	Mice and Rats	10-1000	RfD. Based on studies by Keil et al., 2009; Peden-Adams et al., 2006 and Johnson et al., 2003.
CCME	0.00146	CCME (2007); Health Canada (2021)	Development effects.	Rat	-	TDI. Based on a study by Dawson et al., 1993.

Inhalation

The inhalation dose-response value is expressed in units of mg/m^3. This value may be termed a Reference Concentration (RfC), Tolerable Concentration (TC), Tolerable Concentration in Air (TCA) or Minimal Risk Level for inhalation (MRL) depending on the agency of derivation.

Table 3 Published Threshold Dose Response Values for TCE - Inhalation

Agency	Inhalation Dose-Response Value (mg/m^3)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
RIVM	0.2	RIVM (2001)	Liver, kidney, CNS effects.	Multiple	1000	TCA (provisional). Based on a review of multiple studies.
IRIS	0.002	USEPA (2022)	Heart malformations and immunological effects	Mice and Rats	10-100	RfC. Based on studies by Keil et al., 2009 and Johnson et al., 2003.
CCME	0.04	CCME (2007)	Liver, kidney, CNS effects, endocrine system.	Rats	1000	RfC. Based on studies by Rasmussen et al. 1993, Ruitjen et al. 1991, Vandervort et al. 1973, Okawa and Bodner 1973 and Arito et al., 1994.
Health Canada	0.002	Health Canada (2021)	Developmental toxicity; immunotoxicity	Mice and rats	10-100	TC based on studies presented in USEPA 2011.

4.2. Carcinogenicity and genotoxicity

Studies of high levels of chronic TCE exposure in humans in drinking water or in workplace air have found evidence of increased cancer. There is some evidence that TCE induces liver and lung tumours in mice. The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is “carcinogenic to humans” (Group 1) (ATSDR, 2019).

TCE is characterized as carcinogenic in humans by all routes of exposure within the Guidelines for Carcinogen Risk Assessment (USEPA, 2005). This conclusion is based on convincing evidence of a causal association between TCE exposure in humans and kidney cancer. The human evidence of carcinogenicity from epidemiologic studies of TCE exposure is strong for non-Hodgkin Lymphoma but less convincing than for kidney cancer, and more limited for liver and biliary tract cancer (NTP, 2021).

In vitro and in vivo studies regarding the genotoxicity of suggest TCE operates through a mutagenic mode of action for kidney tumours (USEPA, 2011). Uncertainties with regard to the characterization of TCE genotoxicity remain, particularly because not all TCE metabolites have been sufficiently tested in the standard genotoxicity screening battery to derive a comprehensive conclusion.

4.2.1. Carcinogenic Toxicity Reference Values

Oral

The oral dose-response value is expressed in units of $(mg/kg/day)^{-1}$. This value may be termed a Cancer Slope Factor (CSF), a Cancer Risk (CR), Unit Risk (UR), Slope Factor (SF), or Risk Specific Dose (RSD) depending on the agency of derivation. Some agencies present guideline values which may be converted to dose-response values.

Table 4 Published Non-Threshold Dose-Response Values for TCE – Oral

Agency	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	Source	Notes
WHO	0.0005	WHO (2020)	The guideline value for oral ingestion of TCE is considered protective against both cancer and noncancer effects (WHO, 2022).
Health Canada	8.11×10^{-4}	Health Canada (2021)	Oral slope factor derived based on NTP, 1988, 1990.
IRIS	0.046	USEPA (2022)	SF. PBPK model-based route-to-route extrapolation of the inhalation unit risk estimate for kidney cancer with a factor of 5 applied to include non-Hodgkin's lymphoma (NHL) and liver cancer risks, combined risk.
CCME	8.11×10^{-4}	CCME (2007)	UR, human equivalence value. Based on NTP, 1988, 1990.

Inhalation

The inhalation dose-response value is expressed in units of µg/m3. This value may be termed a Unit Risk (UR), Cancer Risk (CR), Risk Specific Concentration (RSC) or Toxic Dose (that corresponds to a 5% increase in mortality) (TD 0.05) depending on the agency of derivation.

Table 5 Published Non-Threshold Dose-Response Values for TCE - Inhalation

Agency	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$	Source	Notes
WHO	4.3×10^{-7}	WHO (2010)	UR. Cell tumours in testes of rats. Converted to risk level of 1×10^{-5}
Health Canada	4.1×10^{-3}	Health Canada (2021)	Based on occupational epidemiological data for humans reported in USEPA, 2011.
IRIS	4.1×10^{-6}	USEPA (2022)	UR. Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumours
CCME	6.4×10^{-7}	CCME (2007)	Based on older evaluation from Health Canada where a TC0.5 of $0.082 mg/m^3$ and extrapolation based on an excess lifetime cancer risk of 10^{-6}.

5. Adopted Does Response Values

Dose-response values for threshold and non-threshold effects associated with oral or inhalation exposure to TCE have not been published by Australian regulatory bodies.

Threshold (Non-Carcinogenic)

For assessment of potential threshold effects associated with oral exposure to trichloroethylene, SAGE has adopted the reference dose of **0.0005 mg/kg/day** published by WHO (WHO, 2020).

For assessment of potential threshold effects associated with inhalation exposure to trichloroethylene, SAGE has adopted the inhalation reference concentration of **0.002 mg/m^3** published by IRIS (USEPA, 2022)

Non-Threshold (Carcinogenic)

For assessment of potential non-threshold effects associated with oral exposure to trichloroethylene, SAGE has adopted the Oral Slope Factor of **7.8 x 10^{-4} (mg/kg/day)$^{-1}$** published by WHO (WHO, 2022).

For assessment of potential non-threshold effects associated with inhalation exposure to trichloroethylene, SAGE has adopted the inhalation unit risk value of **4.0 x 10^{-6} (µg/m^3)$^{-1}$** published by IRIS (USEPA, 2022).

6. References

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CCME, 2007. *Canadian Soil Guidelines, Trichloroethylene, Environmental and Human Health Effects.* Canadian Council of Ministers of the Environment. 2007.

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WHO, 2022. *Guidelines for Drinking-water Quality*, fourth edition incorporating first and second addenda, World Health Organization, Geneva. 2022.

Revision History

Rev.	Nature of Changes	Author	Approval	Date
0.1	Draft	T Lancaster	A Lee	03/05/2022
1.0	Final	T Lancaster	A Lee	10/06/2022

Toxicity Profile – 1,2-Dichloroethene (DCE)

1. Chemical Identification

Table 1 Chemical and Physiochemical Parameters

Property	Units	Value
Molecular formula	-	$C_2H_2Cl_2$
Molecular Weight	g/mol	96.95
CAS	-	156-59-2 (cis-1.2-dichlorothene), 156-60-5 (trans-1,2-dichloroethene), 540-59-0 (mixture)
Density (20 °C)	g/ml	1.2837 (cis), 1.2565 (trans)
Melting point	°C	-81 (cis), -50 (trans)
Boiling point (at 760mm/Hg)	°C	60.3 (cis), 48-48.5 (trans)
Henry's law constant (25 °C)	atm-m^3/mol	$3.37x10^{-3}$ (cis), $6.72x10^{-3}$ (trans)
Vapour pressure (20 °C)	mmHg	180 (cis), 265 (trans)
Water solubility (25 °C)	mg/L	3500 (cis), 6300 (trans)
Octanol/water partition coefficient (25 °C)	log K_{ow}	1.86 (cis), 2.09 (trans)
Octanol/carbon partition coefficient (25 °C)	log K_{oc}	1.69 (cis - estimated), 1.56 (trans - estimated)
Diffusion in air	cm^2/s	0.0884
Diffusion in water	cm^2/s	0.0000113

Chemical structure:

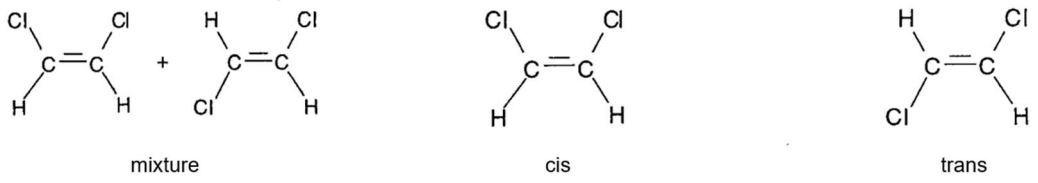


Figure 1 Chemical Structure of cis-1,2-Dichloroethene

Synonyms: 1,2-dichlorethylene (cis and trans), (cis-, trans-) acetylene dichloride

2. General

1,2-Dichloroethene (1,2-DCE) exists in two isomeric forms: cis and trans. The two forms vary in the positioning of the chlorine atoms in relation to the double carbon bond. Both forms are highly volatile, flammable, lipophilic molecules that easily move through the respiratory and gastrointestinal systems. Toxicokinetic evidence shows they have a high affinity for lipids and blood, but little accumulation occurs in tissues. 1,2-DCE isomers inhibit liver enzymes involved in metabolism and may increase the "toxic" response to other chemicals.

1,2-DCE is not known to occur naturally. Environmental sources of 1,2-DCE are industrial activity, landfills and hazardous waste sites; 1,2-DCE has been found in air, water, and soil. The trans isomer is the more common industrial product while the cis isomer is commonly

found in groundwater associated with the degradation of tetrachloroethene (PCE) and trichloroethene (TCE).

3. Exposure Pathways and Background

The most significant exposure pathway is inhalation of contaminated air, with vapours released from industrial products, or by release from industrial sites that manufacture 1,2-DCE.

1,2-DCE is not considered to be a typical air contaminant and few data are available for concentrations of 1,2 DCE in air in industrial, urban and regional areas in Australia. Detected concentrations reported by NEPC (2013) indicated an average of 0.8 ug/m^3 in a study conducted in Perth, with a maximum of 8.3 ug/m^3. Based on these data NEPC (2013) determined that background intake for 1,2-DCE was likely to be less than 5% of the recommended inhalation TRVs and was therefore considered negligible (0%). This value has been adopted in the risk assessment.

1,2-DCE has not been detected in Australian drinking waters (NHMRC, 2011). Studies from the United States indicate 1,2-DCE within water is associated with groundwater contamination by other chlorinated solvents (NHMRC, 2011).

In absence of sufficient compound-specific absorption data for the oral, inhalation and dermal routes, the absorption for volatile COPC has been set at 1 (100%) for oral and inhalation exposure and 0.03 (3%) for dermal exposure in accordance with NEPC (2013).

3.1. Degradation pathways and associated contaminants

Cis- 1,2 DCE is associated with the degradation of tetrachloroethene (PCE) and trichloroethene (TCE) in groundwater.

4. Human Health Effects

4.1. Non-carcinogenic effects

The most significant effects of 1,2-DCE exposure are hematological and hepatic (ATSDR, 1996). 1,2-DCE is readily absorbed via the lungs and gastrointestinal system from where distribution to the liver and kidneys occurs (NHMRC, 2011). At high levels of exposure, reported clinical symptoms in humans exposed to 1,2-DCE in air include nausea, drowsiness, fatigue, intracranial pressure and ocular irritation. One fatality has been reported. No information is available on oral toxicity for 1,2-DCE in humans.

Pathological lesions of the heart, liver, and lungs have been reported in rats exposed to trans-1,2-DCE in air. Ataxia and respiratory depression occur in the terminal stages prior to death in animals. Since these conditions have not been observed in humans, their relevance to public health is not known.

4.1.1. Non-Carcinogenic Toxicity Reference Values

The dose-response values provide an estimate of exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime. The oral exposure represents a daily value and the inhalation exposure represents continuous

inhalation. These values are intended for use in risk assessments for health effects known or assumed to be produced through a nonlinear (presumed threshold) mode of action (USEPA, 2014). Available chronic dose-response values published by sources recognised and endorsed by enHealth (enHealth, 2012), NEPC (NEPC, 2013) and the USEPA and are summarised below.

Oral

The oral dose-response value is expressed in units of mg/kg/day. This value may be termed a Reference Dose (RfD), Tolerable Daily Intake (TDI), or Minimal Risk Level for oral exposure (MRL) depending on the agency of derivation.

Table 2 Published threshold response values for DCE - Oral

Agency	Oral Dose-Response Value (mg/kg/day)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
NHMRC	0.017	NHMRC (2011)	Liver effects	Mice	1000	Based on trans-1,2-DCE
WHO	0.017	WHO (2022)	Liver effects	Mice	1000	Based on trans-1,2-DCE
RIVM	0.006	RIVM (2001)	Liver weight	Rat	5000	Based on cis-1,2-DCE
IRIS	0.002	USEPA (2022)	Increased kidney weight	Rat	3000	Based on cis-1,2-DCE
IRIS	0.02	USEPA (2010)	Decrease in number of antibody forming cells (AFCs) against sheep red blood cells (sRBCs) in male mice	Mice	3000	Based on trans-1,2-DCE
ATSDR	1.0	ATSDR (1996)	Hematological	Rats	100	Derived for acute exposures (<14 days) using cis-isomer

Inhalation

The inhalation dose-response value is expressed in units of mg/m^3. This value may be termed a Reference Concentration (RfC), Tolerable Concentration (TC), Tolerable Concentration in Air (TCA) or Minimal Risk Level for inhalation (MRL) depending on the agency of derivation.

Table 3 Published threshold response values for DCE - Inhalation

Agency	Inhalation Dose-Response Value (mg/m^3)	Source	Target Endpoint	Test Animal	Uncertainty Factor	Notes
NEPC	0.007	NEPC (2013)	Route-to-route extrapolation	Rat	-	Based on USEPA (2010) RfD for cis-1,2-DCE
RIVM	0.03	RIVM (2001)	Route-to-route extraploation	Rat	5000	Based on cis-1,2-DCE

USEPA	0.04	USEPA (2020)	Decreased lymphocyte counts	Rat	3000	Based on chronic RfC for trans-1,2-DCE

4.2. Carcinogenicity and genotoxicity

It is considered that inadequate information is currently available to assess the carcinogenic potential of cis- or trans- 1,2-DCE (USEPA, 2022). The IARC and NTP have not classified cis- or trans-1,2-DCE in relation to its carcinogenic potential.

5. Adopted Does Response Values

Threshold (Non-Carcinogenic)

For assessment of potential threshold effects associated with oral exposure to cis-1,2-DCE, SAGE has adopted the reference dose of **0.002 mg/kg/day** published by IRIS (USEPA, 2022). This study was considered by NEPC (2013) to be more recent and therefore more appropriate than the NHMRC (2011) RfD.

For assessment of potential threshold effects associated with oral exposure to trans-1,2-DCE, SAGE has adopted the reference dose of **0.017 mg/kg/day** published by NMHRC (2011).

For assessment of potential threshold effects associated with inhalation exposure to cis-1,2-DCE, SAGE has adopted the inhalation reference concentration of **0.007 mg/m^3** published by NEPC (NEPC, 2013).

For assessment of potential threshold effects associated with inhalation exposure to trans-1,2-DCE, SAGE has adopted the inhalation reference concentration of **0.04 mg/m^3** published in PPRTV derived by USEPA (2020).

Non-Threshold (Carcinogenic)

To SAGE's knowledge, non-threshold dose-response criteria for inhalation exposure to 1,2-DCE have not been published by Australian or international regulatory bodies. Potential health risks associated with exposure to 1,2-DCE have therefore been assessed on the basis of threshold criteria only, consistent with the approach adopted by NEPC (2013).

6. References

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WHO, 2022. *Guidelines for Drinking-water Quality*, fourth edition incorporating first and second addenda, World Health Organization, Geneva. 2022.

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0.1	Draft	B White	A Lee	03/05/2022

Appendix E:
Risk Model Calculations

Scenario 1 to Scenario 4

				Scenario 1				Scenario 2				Scenario 3				Scenario 4			
			Description	On-Site Commercial – Slab on Ground Construction				On-Site Commercial Daycare – Slab on Ground Construction				On-Site Commercial – Basement Construction				On-Site Medium Density Residential – Basement Construction			
			Parameter (units)	Units	Adopted Value		Source / Reference	Additional Rationale	Adopted Value		Source / Reference	Additional Rationale	Adopted Value		Source / Reference	Additional Rationale	Adopted Value		Source / Reference	Additional Rationale
					Adult	Child			Adult	Child			Adult	Child			Adult	Child		
			Body Weight	Kg	70	-	ASC NEPM (2013)	-	**70**	**15**	**ASC NEPM (2013)**	**-**	70	-	ASC NEPM (2013)	-	**70**	**15**	**ASC NEPM (2013)**	
			Averaging time (carcinogens)	Years	70	-	ASC NEPM (2013)	-	70	70	ASC NEPM (2013)	-	70	-	ASC NEPM (2013)	-	70	70	ASC NEPM (2013)	
			Averaging time (non-carcinogens)	Years	30	-	ASC NEPM (2013)	Equal to exposure duration	29	6	ASC NEPM (2013)	Equal to exposure duration	30	-	ASC NEPM (2013)	Equal to exposure duration	29	6	ASC NEPM (2013)	Equal to exposure duration
			Exposure Frequency	Days / Year	240	-	ASC NEPM (2013)	-	365	365	ASC NEPM (2013)	-	240	-	ASC NEPM (2013)	-	365	365	ASC NEPM (2013)	
			Exposure Duration	Years	30	-	ASC NEPM (2013)	-	29	6	ASC NEPM (2013)	-	30	-	ASC NEPM (2013)	-	29	6	ASC NEPM (2013)	
			Exposure time (indoor air)	Hours / Day	8	-	ASC NEPM (2013)	-	20	20	ASC NEPM (2013)	-	8	-	ASC NEPM (2013)	-	20	20	ASC NEPM (2013)	
			Exposure time (outdoor air)	Hours / Day	1	-	ASC NEPM (2013)	-	4	4	ASC NEPM (2013)	-	1	-	ASC NEPM (2013)	-	4	4	ASC NEPM (2013)	
Risk Calculations for Soil Vapour Inhalation in Indoor Air	**Tetrachloroethene (PCE)**																			
		Soil Vapour Concentration	(mg/m3)	5.99		SV9S	-	5.99		SV9S	-	5.99		SV9S	-	5.99		SV9S	-
		Volatilisation Factor from Soil Vapour to Indoor Air	[(mg/m3)/(mg/m3)]	1.21E-04		-	-	1.21E-04		-	-	4.36E-07		-	-	4.36E-07		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil	(mg/m3)	7.25E-04		-	-	7.25E-04		-	-	2.61E-07		-	-	2.61E-07		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	1.80E-01		-	-	1.80E-01		-	-	1.80E-01		-	-	1.80E-01		-	-
		Adult Exposure Factor (threshold)	unitless	2.65E-05	-	-	-	1.01E-04	-	-	-	9.56E-08	-	-	-	3.63E-07	-	-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	1.59E-04	-	-	-	6.04E-04	-	-	-	5.72E-07	-	-	-	2.18E-06	-	-	-
		Hazard Index (Adult)	**(unitless)**	**8.83E-04**	**-**	-	-	**3.36E-03**	**-**	-	-	**3.18E-06**	**-**	-	-	**1.21E-05**	**-**	-	-
		Child Exposure Factor (threshold)	unitless	-	-	-	Not Applicable	-	1.01E-04	-	-	-	-	Not Applicable	-	-	3.63E-07	-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	-	-	Not Applicable	-	6.04E-04	-	-	-	-	Not Applicable	-	-	2.18E-06	-	-
		Hazard Index (Child)	**(unitless)**	**-**	**-**	-	Not Applicable	**-**	**3.36E-03**	-	-	**-**	**-**	Not Applicable	-	**-**	**1.21E-05**	-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	**-**	**-**	-	Not Applicable	**-**	**-**	-	Not Applicable	**-**	**-**	-	Not Applicable	**-**	**-**	-	Not Applicable
	Trichloroethene (TCE)																		
		Soil Vapour Concentration	(mg/m3)	0.55		SV9S	-	0.55		SV9S	-	0.55		SV9S	-	0.55		SV9S	-
		Volatilisation Factor from Soil Vapour to Indoor Air	[(mg/m3)/(mg/m3)]	1.29E-04		-	-	1.29E-04		-	-	5.93E-07		-	-	5.93E-07		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil	(mg/m3)	7.10E-05		-	-	7.10E-05		-	-	3.26E-08		-	-	3.26E-08		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	1.80E-03	-	-	-	1.80E-03	-	-	-	1.80E-03	-	-	-	1.80E-03	-	-	-
		Adult Exposure Factor (threshold)	unitless	2.83E-05	-	-	-	1.08E-04	-	-	-	1.30E-07	-	-	-	4.94E-07	-	-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	1.56E-05	-	-	-	5.91E-05	-	-	-	7.15E-08	-	-	-	2.72E-07	-	-	-
		Hazard Index (Adult)	**(unitless)**	**8.64E-03**	**-**	-	-	**3.28E-02**	**-**	-	-	**3.97E-05**	**-**	-	-	**1.51E-04**	**-**	-	-
		Child Exposure Factor (threshold)	unitless	-	-	-	Not Applicable	-	1.08E-04	-	-	-	-	Not Applicable	-	-	4.94E-07	-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	-	-	Not Applicable	-	1.95E-04	-	-	-	-	Not Applicable	-	-	8.98E-07	-	-
		Hazard Index (Child)	**(unitless)**	**-**	**-**	-	Not Applicable	**-**	**1.09E-01**	-	-	**-**	**-**	Not Applicable	-	**-**	**4.99E-04**	-	-
										-								-	
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	4.10E-06		-	-	4.10E-06		-	-	4.10E-06		-	-	4.10E-06		-	-
		Adult Exposure Factor (non-threshold)	unitless	1.21E-05	-	-	-	4.45E-05	-	-	-	5.57E-08	-	-	-	2.05E-07	-	-	-
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	9.21E-06	-	-	-	-	-	Not Applicable	-	4.24E-08	-	-
		Lifetime Exposure Factor (non-threshold)	unitless	1.21E-05		-	-	5.38E-05		-	-	5.57E-08		-	-	2.47E-07		-	-
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	6.66E-06		-	-	2.96E-05		-	-	3.06E-08		-	-	1.36E-07		-	-
		Lifetime Excess Cancer Risk	**(unitless)**	**2.73E-08**		-	-	**1.21E-07**		-	-	**1.26E-10**		-	-	**5.57E-10**		-	-
	Dichloroethene (cis) 1,2- (DCE)																		
		Soil Vapour Concentration	(mg/m3)	1		SV4D	-	1		SV4D	-	1		SV4D	-	1		SV4D	-
		Volatilisation Factor from Soil Vapour to Indoor Air	[(mg/m3)/(mg/m3)]	1.36E-04		-	-	1.36E-04		-	-	7.63E-07		-	-	7.63E-07		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil	(mg/m3)	1.36E-04		-	-	1.36E-04		-	-	7.63E-08		-	-	7.63E-08		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	7.00E-03	-	-	-	7.00E-03	-	-	-	7.00E-03	-	-	-	7.00E-03	-	-	-
		Adult Exposure Factor (threshold)	unitless	2.98E-05	-	-	-	1.13E-04	-	-	-	1.67E-07	-	-	-	6.36E-07	-	-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	2.98E-05	-	-	-	1.13E-04	-	-	-	1.67E-07	-	-	-	6.36E-07	-	-	-
		Hazard Index (Adult)	**(unitless)**	**4.26E-03**	-	-	-	**1.62E-02**	-	-	-	**2.39E-05**	-	-	-	**9.08E-05**	-	-	-
		Child Exposure Factor (threshold)	unitless	-	-	-	Not Applicable	-	1.13E-04	-	-	-	-	Not Applicable	-	-	6.36E-07	-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	-	-	Not Applicable	-	1.13E-04	-	-	-	-	Not Applicable	-	-	6.36E-07	-	-
		Hazard Index (Child)	**(unitless)**	**-**	**-**	-	Not Applicable	**-**	**1.62E-02**	-	-	**-**	**-**	Not Applicable	-	**-**	**9.08E-05**	-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**unitless**	**-**	**-**	-	**Not Applicable**	**-**	**-**	-	**Not Applicable**	**-**	**-**	-	**Not Applicable**	**-**	**-**	-	**Not Applicable**
	Total Hazard Index		unitless	**1.38E-02**	**-**			**5.24E-02**	**1.28E-01**			**6.68E-05**	**-**			**2.54E-04**	**6.02E-04**		
	Lifetime Excess Cancer Risk		unitless	**2.73E-08**				**1.21E-07**				**1.26E-10**				**5.57E-10**			

Scenario 1 to Scenario 4

				Scenario 1				Scenario 2				Scenario 3				Scenario 4			
	Scenario Description			On-Site Commercial – Slab on Ground Construction				On-Site Commercial Daycare – Slab on Ground Construction				On-Site Commercial – Basement Construction				On-Site Medium Density Residential – Basement Construction			
Risk Calculations for Soil Vapour Inhalation in Outdoor Air	Tetrachloroethene (PCE)																		
		Soil Vapour Concentration	(mg/m3)	5.99		SV9S	-	5.99		SV9S	-	-		Not Applicable		-		-	Not Applicable
		Volatilisation Factor from Soil Vapour to Outdoor Air	[(mg/m3)/(mg/m3)]	1.40E-06		-	-	1.40E-06		-	-	-		Not Applicable		-		-	Not Applicable
		Vapour Concentration in Outdoor Air (From Subsurface Soil Vapour)	(mg/m3)	8.39E-06		-	-	8.39E-06		-	-	-		Not Applicable		-		-	Not Applicable
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	1.80E-01		-	-	1.80E-01		-	-	-		Not Applicable		-		-	Not Applicable
		Adult Exposure Factor (threshold)	unitless	3.84E-08	-	-	-	2.33E-07	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	2.30E-07	-	-	-	1.40E-06	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Hazard Index (Adult)	**(unitless)**	**1.28E-06**	-	-	-	**7.76E-06**	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Factor (threshold)	unitless	-	-	-	Not Applicable	-	2.33E-07	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	-	-	Not Applicable	-	1.40E-06	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Hazard Index (Child)	**(unitless)**	**-**	**-**	-	Not Applicable	-	**7.76E-06**	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
												-	-	Not Applicable	-	-	-	-	Not Applicable
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	**-**	**-**	-	**Not Applicable**	-	-	-	**Not Applicable**	-	-	**Not Applicable**	-	-	-	-	**Not Applicable**
	Trichloroethene (TCE)																		
		Soil Vapour Concentration	(mg/m3)	0.55		SV9S	-	0.55		SV9S	-			Not Applicable		-		-	Not Applicable
		Volatilisation Factor from Soil Vapour to Outdoor Air	[(mg/m3)/(mg/m3)]	1.91E-06		-	-	1.91E-06		-	-	-		Not Applicable		-		-	Not Applicable
		Vapour Concentration in Indoor Air (From Subsurface Soil Vapour)	(mg/m3)	1.05E-06		-	-	1.05E-06		-	-	-		Not Applicable		-		-	Not Applicable
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	1.80E-03		-	-	1.80E-03		-	-	-		Not Applicable		-		-	Not Applicable
		Adult Exposure Factor (threshold)	unitless	5.23E-08	-	-	-	3.18E-07	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	2.88E-08	-	-	-	1.75E-07	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Hazard Index (Adult)	**(unitless)**	**1.60E-05**	-	-	-	**9.73E-05**	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Factor (threshold)	unitless	-	-	-	Not Applicable	-	3.18E-07	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	-	-	Not Applicable	-	1.75E-07	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Hazard Index (Child)	**(unitless)**	**-**	**-**	-	Not Applicable	-	**9.73E-05**	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
														Not Applicable	-	-	-	-	Not Applicable
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	4.10E-06		-	-	4.10E-06		-	-	-		Not Applicable	-	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	2.24E-08	-	-	-	1.32E-07	-	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	2.73E-08	-	-	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	2.24E-08		-	-	1.59E-07		-	-	-		Not Applicable	-	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	1.23E-08		-	-	8.75E-08		-	-	-		Not Applicable	-	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	**5.06E-11**		-	-	**3.59E-10**		-	-	-		Not Applicable	-	-	-	-	Not Applicable
	Dichloroethene (cis) 1,2- (DCE)																		
		Soil Vapour Concentration	(mg/m3)	1		SV4D	-	1		SV4D	Not Applicable	-		Not Applicable		-		-	Not Applicable
		Volatilisation Factor from Soil Vapour to Outdoor Air	[(mg/m3)/(mg/m3)]	2.45E-06		-	-	2.45E-06		-	Not Applicable	-		Not Applicable		-		-	Not Applicable
		Vapour Concentration in Indoor Air (From Subsurface Soil Vapour)	(mg/m3)	2.45E-06		-	-	2.45E-06		-	Not Applicable	-		Not Applicable		-		-	Not Applicable
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	7.00E-03		-	-	7.00E-03		-	Not Applicable	-		Not Applicable		-		-	Not Applicable
		Adult Exposure Factor (threshold)	unitless	6.71E-08	-	-	-	4.08E-07	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	6.71E-08	-	-	-	4.08E-07	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Hazard Index (Adult)	**(unitless)**	**9.59E-06**	-	-	-	**5.83E-05**	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Factor (threshold)	unitless	-	-	-	Not Applicable	-	4.08E-07	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	-	-	Not Applicable	-	4.08E-07	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Hazard Index (Child)	**(unitless)**	**-**	**-**	-	Not Applicable	-	**5.83E-05**	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
												-	-	Not Applicable	-	-	-	-	Not Applicable
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-	-	Not Applicable	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	**-**	**-**	-	**Not Applicable**	-	-	-	Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
											Not Applicable	-	-	Not Applicable	-	-	-	-	Not Applicable
	Threshold Risk Estimate	**Hazard Index**	unitless	**2.69E-05**	-			**1.63E-04**	**1.63E-04**			**0.00E+00**	-			**0.00E+00**	**0.00E+00**		
	Non-Threshold Risk Estimate	**Lifetime Excess Cancer Risk**	unitless	**5.06E-11**				**3.59E-10**				**0.00E+00**				**0.00E+00**			
All Pathway	**Total Threshold Risk Estimate**	**Total Hazard Index (All Pathways)**	**unitless**	**0.01**	-			**0.05**	**0.13**			**6.68E-05**	-			**2.54E-04**	**6.02E-04**		
	Total Non-Threshold Risk Estima	**Lifetime Excess Cancer Risk (All Pathways**	**unitless**	**2.74E-08**				**1.22E-07**				**1.26E-10**				**5.57E-10**			

Scenario 1 and 2 – On-Site Commercial – Slab on Ground Construction

A. Model Input Parameters

Parameter Definition	Units	Notes	Site-Specific Value	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to soil vapour data (below building, ground surface or trench)	cm			LSV	130	Auto calculates from layer thicknesses
Vadose Zone Layer 1						
Thickness	cm		130	HV	130	Based on the installation depth of the probe at SV9S.
SCS Soil Type:			Sand and gravel (<12% fines)			Based on the description of the geology presented at SV9S.
Fraction of organic carbon	unitless		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm3/cm3		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3		0.054	vwcvz	0.054	
Total soil porosity	cm3/cm3		0.375	TPOR	0.375	
Vadose zone biodegradation adjustment	unitless		1	BioA_SV	1	
Building Characteristics						
Enclosed-space volume/infiltration area	cm	(a)	360	LB	360	Based on the minimal floor to ceiling height of 3.6m (ESD, 2020)
Enclosed-space foundation or wall thickness	cm		1.50E+01	Lcrack	15	ASTM (2002)
Enclosed-space air exchange rate	1/s		3.60E-04	ENCAER	3.60E-04	1.3 / hr based on typical air exchange rate for non-residential buildings (Johnson, 2002)
Areal fraction of cracks in foundations/walls	cm^2-cracks/cm^2-total area		3.80E-03	NU	0.0038	US EPA (2004)
Volumetric air content in found./wall cracks	cc/cc		0.321	VACF	0.321	US EPA (2004)
Volumetric water content in found./wall cracks	cc/cc		0.054	vwcfnd	0.054	US EPA (2004)
Advective Flow Parameters						
Include advective flows?			Y	Conv	Y	
Slab Area	cm2		4.00E+06	Ab	4.00E+06	Based on an area of 20m x 20m.
Building Volume	cm^3			BV	1.44E+09	
Building Ventilation Rate (USEPA Equation 14)	cm^3/s			Qbuilding	5.18E+05	
Average Vapour Flow Rate into Building	cm^3/s		0.001	Qsoil	8.33E+01	
Outdoor Air Characteristics						
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	(b)	336	windsp	336	Based on average annual windspeed at Canberra Airpot (19km) from the Site.
Width of source area parallel to wind or groundwater flow direction	cm	(c)	1500	WSA	1500	CRC CARE (2011)
Ambient air mixing zone height	cm		200	AAMZH	200	ASTM 1739-95

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D^{air}	D^{wat}	MW	VP	Volatile?
	(cm^3/g)	(cm^3/g)	(cc-$H_2$0 / cc-air)	(mg/l-water)	(cm^2/s)	(cm^2/s)	(g/mol)	(mmHg)	
Tetrachloroethene (PCE)	9.49E+01	1.90E-01	7.24E-01	2.06E+02	5.05E-02	9.46E-06	1.66E+02	1.85E+01	Y
Trichloroethene (TCE)	6.07E+01	1.21E-01	4.03E-01	1.28E+03	6.87E-02	1.02E-05	1.31E+02	6.90E+01	Y
Dichloroethene (cis) 1,2- (DCE)	3.96E+01	7.92E-02	1.67E-01	6.41E+03	8.84E-02	1.13E-05	9.69E+01	2.01E+02	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

C. Chemical-Specific Diffusion Coefficients

Chemical	D_{s1}	D_{s2}	D_{s3}	D_{stot}	D_{crack}	Advective Factor	Exponent of advective factor
	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 12	ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 17	EXP (USEPA (2004) Equation No. 17)
	(cm^2/s)				(cm^2/s)	Factor (unitless)	(unitless)
Tetrachloroethene (PCE)	8.16E-03	-	-	8.16E-03	8.16E-03	1.01E+01	2.37E+04
Trichloroethene (TCE)	1.11E-02	-	-	1.11E-02	1.11E-02	7.40E+00	1.64E+03
Dichloroethene (cis) 1,2- (DCE)	1.43E-02	-	-	1.43E-02	1.43E-02	5.75E+00	3.16E+02

Definition of Parameters

D_s	Effective diffusion coefficient in soil based on vapour-phase concentration	Advective Factor	Estimated advective flow from the subsurface space to indoor air
D_{stot}	Effective diffusion coefficient in soil based on vapour-phase concentration (total of all relevant vadose zone layers)		
D_{crack}	Effective diffusion coefficient through foundation cracks		

D. Chemical-Specific Volatilisation Factors

Chemical	Subsurface to indoor air attenuation factor	Subsurface to indoor air attenuation factor if the exponent of the advective factor is too great to be calculated	VF_{svesp}	VF_{svamb}
	USEPA (2004) Equation No. 13	USEPA (2004) Equation No. 18	USEPA (2004) Equation No. 13 (α) ASTM (2010) Equation (Table X2.5)	ASTM (2010) Equation (Table X2.5)
	(unitless)	(unitless)	(mg/m^3-air / mg/m3-sv)	(mg/m^3-air / mg/L-sv)
Tetrachloroethene (PCE)	1.21E-04	N/A	1.21E-04	1.40E-06
Trichloroethene (TCE)	1.29E-04	N/A	1.29E-04	1.91E-06
Dichloroethene (cis) 1,2- (DCE)	1.36E-04	N/A	1.36E-04	2.45E-06

Definition of Parameters

VF_{svesp}	Volatilization factor from soil vapour to enclosed-space air.
VF_{svamb}	Volatilization factor from soil vapour to ambient (outdoor) air.

Scenario 3 – On-Site Commercial – Basement Construction with commercial properties from the ground floor
&
Scenario 4 – On-Site Medium Density Residential – Basement Construction with residential properties from the ground floor

A. Model Input Parameters

Parameter Definition	Units	Notes	Site-Specific Value	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to soil vapour data (below building, ground surface or trench)	cm			LSV	0.001	Auto calculates from layer thicknesses
Vadose Zone Layer 1						
Thickness	cm		0.001	HV	0.001	Negligible distance – assumes soil vapour is directly adjacent to the walls and floor of the basement.
SCS Soil Type:			Sand and gravel (<12% fines)			Based on the description of the geology presented at SV9S.
Fraction of organic carbon	unitless		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm3/cm3		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3		0.054	vwcvz	0.054	
Total soil porosity	cm3/cm3		0.375	TPOR	0.375	
Vadose zone biodegradation adjustment	unitless		1	BioA_SV	1	
Building Characteristics						
Enclosed-space volume/infiltration area	cm	(a)	250	LB	250	Professional Judgement: Assumes a basement height of 2.5m
Enclosed-space foundation or wall thickness	cm		1.50E+01	Lcrack	15	ASTM (2002)
Enclosed-space air exchange rate	1/s		1.00E-03	ENCAER	1.00E-03	AS1668.2 minimum ventilation rate for car park (4 per hour).
Areal fraction of cracks in foundations/walls	cm^2-cracks/cm^2-total area		2.00E-04	NU	0.0002	US EPA (2004)
Volumetric air content in found./wall cracks	cc/cc		0.321	VACF	0.321	Assumes foundation/wall cracks filled with sand (values are USEPA, 2004a defaults for coarse sand).
Volumetric water content in found./wall cracks	cc/cc		0.054	vwcfnd	0.054	Assumes foundation/wall cracks filled with sand (values are USEPA, 2004a defaults for coarse sand).
Advective Flow Parameters						
Include advective flows?			Y	Conv	Y	
Slab Area	cm2		4.00E+06	Ab	4.00E+06	Based on an area of 20m x 20m.
Building Volume	cm^3			BV	1.00E+09	
Building Ventilation Rate (USEPA Equation 14)	cm^3/s			Qbuilding	1.00E+06	
Average Vapour Flow Rate into Building	cm^3/s		0.001	Qsoil	1.00E-03	AS1668.2 minimum ventilation rate for car park (4 per hour).

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D^{air}	D^{wat}	MW	VP	Volatile?
	(cm^3/g)	(cm^3/g)	(cc-H_2O / cc-air)	(mg/l-water)	(cm^2/s)	(cm^2/s)	(g/mol)	(mmHg)	
Tetrachloroethene (PCE)	9.49E+01	1.90E-01	7.24E-01	2.06E+02	5.05E-02	9.46E-06	1.66E+02	1.85E+01	Y
Trichloroethene (TCE)	6.07E+01	1.21E-01	4.03E-01	1.28E+03	6.87E-02	1.02E-05	1.31E+02	6.90E+01	Y
Dichloroethene (cis) 1,2- (DCE)	3.96E+01	7.92E-02	1.67E-01	6.41E+03	8.84E-02	1.13E-05	9.69E+01	2.01E+02	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

C. Chemical-Specific Diffusion Coefficients

Chemical	D_{s1}	D_{s2}	D_{s3}	D_{stot}	D_{crack}	Advective Factor	Exponent of advective factor
	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 12	ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 17	EXP (USEPA (2004) Equation No. 17)
	(cm^2/s)				(cm^2/s)	Factor (unitless)	(unitless)
Tetrachloroethene (PCE)	8.16E-03	-	-	8.16E-03	8.16E-03	2.30E-03	1.00E+00
Trichloroethene (TCE)	1.11E-02	-	-	1.11E-02	1.11E-02	1.69E-03	1.00E+00
Dichloroethene (cis) 1,2- (DCE)	1.43E-02	-	-	1.43E-02	1.43E-02	1.31E-03	1.00E+00

Definition of Parameters

D_s	Effective diffusion coefficient in soil based on vapour-phase concentration	Advective Factor	Estimated advective flow from the subsurface space to indoor air
D_{stot}	Effective diffusion coefficient in soil based on vapour-phase concentration (total of all relevant vadose zone layers)		
D_{crack}	Effective diffusion coefficient through foundation cracks		

D. Chemical-Specific Volatilisation Factors

Chemical	Subsurface to indoor air attenuation factor	Subsurface to indoor air attenuation factor if the exponent of the advective factor is too great to be calculated	VF_{svesp}	VF_{svamb}
	USEPA (2004) Equation No. 13	USEPA (2004) Equation No. 18	USEPA (2004) Equation No. 13 (α) ASTM (2010) Equation (Table X2.5)	ASTM (2010) Equation (Table X2.5)
	(unitless)	(unitless)	(mg/m^3-air / mg/m3-sv)	(mg/m^3-air / mg/L-sv)
Tetrachloroethene (PCE)	4.36E-07	N/A	4.36E-07	7.18E-01
Trichloroethene (TCE)	5.93E-07	N/A	5.93E-07	7.76E-01
Dichloroethene (cis) 1,2- (DCE)	7.63E-07	N/A	7.63E-07	8.17E-01

Definition of Parameters

VF_{svesp}	Volatilization factor from soil vapour to enclosed-space air.
VF_{svamb}	Volatilization factor from soil vapour to ambient (outdoor) air.

Sensitivity Assessment - Scenario 5

		Scenario		**Scenario 5**			
		Description		On-Site Residential – Slab on Ground Construction			
		Parameter (units)	**Units**	**Adopted Value**		**Source / Reference**	**Additional Rationale**
				Adult	**Child**		
		Body Weight	Kg	70	15	ASC NEPM (2013)	-
		Averaging time (carcinogens)	Years	70	70	ASC NEPM (2013)	-
		Averaging time (non-carcinogens)	Years	29	6	ASC NEPM (2013)	Equal to exposure duration
		Exposure Frequency	Days / Year	365	365	ASC NEPM (2013)	-
		Exposure Duration	Years	29	6	ASC NEPM (2013)	-
		Exposure time (indoor air)	Hours / Day	20	20	ASC NEPM (2013)	-
		Exposure time (outdoor air)	Hours / Day	4	4	ASC NEPM (2013)	-
Risk Calculations for Soil Vapour Inhalation in Indoor Air	**Tetrachloroethene (PCE)**						
		Soil Vapour Concentration	(mg/m3)	5.99		SV9S	-
		Volatilisation Factor from Soil Vapour to Indoor Air	[(mg/m3)/(mg/m3)]	6.93E-04		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil	(mg/m3)	4.15E-04		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	1.80E-01		-	-
		Adult Exposure Factor (threshold)	unitless	5.78E-04	-	-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	3.46E-03	-	-	-
		Hazard Index (Adult)	**(unitless)**	**1.92E-02**	**-**	-	-
		Child Exposure Factor (threshold)	unitless	-	5.78E-04	-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	3.46E-03	-	-
		Hazard Index (Child)	**(unitless)**	**-**	**1.92E-02**	-	-
						-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	**-**	**-**	-	Not Applicable
	Trichloroethene (TCE)						
		Soil Vapour Concentration	(mg/m3)	0.55		SV9S	-
		Volatilisation Factor from Soil Vapour to Indoor Air	[(mg/m3)/(mg/m3)]	7.69E-04		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil	(mg/m3)	4.23E-05		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	1.80E-03	-	-	-
		Adult Exposure Factor (threshold)	unitless	6.41E-04	-	-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	3.52E-04	-	-	-
		Hazard Index (Adult)	**(unitless)**	**1.96E-01**	**-**	-	-
		Child Exposure Factor (threshold)	unitless	-	6.41E-04	-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	1.17E-03	-	-
		Hazard Index (Child)	**(unitless)**	**-**	**6.47E-01**	-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	4.10E-06		-	-
		Adult Exposure Factor (non-threshold)	unitless	2.65E-04	-	-	-
		Child Exposure Factor (non-threshold)	unitless	-	5.49E-05	-	-
		Lifetime Exposure Factor (non-threshold)	unitless	3.20E-04		-	-
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	1.76E-04		-	-
		Lifetime Excess Cancer Risk	**(unitless)**	**7.23E-07**		-	-
	Dichloroethene (cis) 1,2- (DCE)						
		Soil Vapour Concentration	(mg/m3)	1		SV4D	-
		Volatilisation Factor from Soil Vapour to Indoor Air	[(mg/m3)/(mg/m3)]	8.25E-04		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil	(mg/m3)	8.25E-05		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)	7.00E-03	-	-	-
		Adult Exposure Factor (threshold)	unitless	6.88E-04	-	-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	6.88E-04	-	-	-
		Hazard Index (Adult)	**(unitless)**	**9.82E-02**	-	-	-
		Child Exposure Factor (threshold)	unitless	-	6.88E-04	-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	6.88E-04	-	-
		Hazard Index (Child)	**(unitless)**	**-**	**9.82E-02**	-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-	-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-	-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-	-	Not Applicable
		Lifetime Excess Cancer Risk	**unitless**	**-**	**-**	-	**Not Applicable**
	Total Hazard Index		unitless	**3.13E-01**	**7.65E-01**		
	Lifetime Excess Cancer Risk		unitless	**7.23E-07**			

Sensitivity Assessment - Scenario 5

				Scenario Description	Scenario 5 On-Site Residential – Slab on Ground Construction			
Risk Calculations for Soil Vapour Inhalation in Outdoor Air	**Tetrachloroethene (PCE)**							
		Soil Vapour Concentration	(mg/m3)		5.99		SV9S	-
		Volatilisation Factor from Soil Vapour to Outdoor Air	[(mg/m3)/(mg/m3)]		1.40E-06		-	-
		Vapour Concentration in Outdoor Air (From Subsurface Soil Vapour)	(mg/m3)		8.39E-06		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)		1.80E-01		-	-
		Adult Exposure Factor (threshold)	unitless	2.33E-07	-		-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	1.40E-06	-		-	-
		Hazard Index (Adult)	**(unitless)**	**7.76E-06**	-		-	-
		Child Exposure Factor (threshold)	unitless	-	2.33E-07		-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	1.40E-06		-	-
		Hazard Index (Child)	**(unitless)**	-	**7.76E-06**		-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-		-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-		-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-		-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-		-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-		-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	-	-		-	Not Applicable
	Trichloroethene (TCE)							
		Soil Vapour Concentration	(mg/m3)		0.55		SV9S	-
		Volatilisation Factor from Soil Vapour to Outdoor Air	[(mg/m3)/(mg/m3)]		1.91E-06		-	-
		Vapour Concentration in Indoor Air (From Subsurface Soil Vapour)	(mg/m3)		1.05E-06		-	-
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)		1.80E-03		-	-
		Adult Exposure Factor (threshold)	unitless	3.18E-07	-		-	-
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	1.75E-07	-		-	-
		Hazard Index (Adult)	**(unitless)**	**9.73E-05**	-		-	-
		Child Exposure Factor (threshold)	unitless	-	3.18E-07		-	-
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	1.75E-07		-	-
		Hazard Index (Child)	**(unitless)**	-	**9.73E-05**		-	-
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1		4.10E-06		-	-
		Adult Exposure Factor (non-threshold)	unitless	1.32E-07	-		-	-
		Child Exposure Factor (non-threshold)	unitless	-	2.73E-08		-	-
		Lifetime Exposure Factor (non-threshold)	unitless		1.59E-07		-	-
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)		8.75E-08		-	-
		Lifetime Excess Cancer Risk	**(unitless)**		**3.59E-10**		-	-
	Dichloroethene (cis) 1,2- (DCE)							
		Soil Vapour Concentration	(mg/m3)		1		SV4D	Not Applicable
		Volatilisation Factor from Soil Vapour to Outdoor Air	[(mg/m3)/(mg/m3)]		2.45E-06		-	Not Applicable
		Vapour Concentration in Indoor Air (From Subsurface Soil Vapour)	(mg/m3)		2.45E-06		-	Not Applicable
	Threshold Intake and Risk Calculations	Inhalation RfC (Background Corrected)	(mg/m3)		7.00E-03		-	Not Applicable
		Adult Exposure Factor (threshold)	unitless	4.08E-07	-		-	Not Applicable
		Adult Exposure Adjusted Air Concentration (threshold)	(mg/m3)	4.08E-07	-		-	Not Applicable
		Hazard Index (Adult)	**(unitless)**	**5.83E-05**	-		-	Not Applicable
		Child Exposure Factor (threshold)	unitless	-	4.08E-07		-	Not Applicable
		Child Exposure Adjusted Air Concentration (threshold)	(mg/m3)	-	4.08E-07		-	Not Applicable
		Hazard Index (Child)	**(unitless)**	-	**5.83E-05**		-	Not Applicable
	Non-Threshold Intake and Risk Calculations	Inhalation Unit Risk	(ug/m3)-1	-	-		-	Not Applicable
		Adult Exposure Factor (non-threshold)	unitless	-	-		-	Not Applicable
		Child Exposure Factor (non-threshold)	unitless	-	-		-	Not Applicable
		Lifetime Exposure Factor (non-threshold)	unitless	-	-		-	Not Applicable
		Lifetime Exposure Adjusted Air Concentration (non-threshold	(mg/m3)	-	-		-	Not Applicable
		Lifetime Excess Cancer Risk	**(unitless)**	-	-		-	Not Applicable
	Threshold Risk Estimate	**Hazard Index**	unitless	**1.63E-04**	**1.63E-04**			
	Non-Threshold Risk Estimate	**Lifetime Excess Cancer Risk**	unitless		**3.59E-10**			
All Pathway	**Total Threshold Risk Estimate**	**Total Hazard Index (All Pathways)**	**unitless**	**0.31**	**0.76**			
	Total Non-Threshold Risk Estimate	**Lifetime Excess Cancer Risk (All Pathways**	**unitless**		**7.23E-07**			

Scenario 5 – On-Site Residential – Slab on Ground Construction

A. Model Input Parameters

Parameter Definition	Units	Notes	Site-Specific Value	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to soil vapour data (below building, ground surface or trench)	cm			LSV	130	Auto calculates from layer thicknesses
Vadose Zone Layer 1						
Thickness	cm		130	HV	130	Based on the installation depth of the probe at SV9S.
SCS Soil Type:			Sand and gravel (<12% fines)			Based on the description of the geology presented at SV9S.
Fraction of organic carbon	unitless		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm3/cm3		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3		0.054	vwcvz	0.054	
Total soil porosity	cm3/cm3		0.375	TPOR	0.375	
Vadose zone biodegradation adjustment	unitless		1	BioA_SV	1	
Building Characteristics						
Enclosed-space volume/infiltration area	cm	(a)	240	LB	240	Based on the minimal floor to ceiling height of 2.4m (ESD, 2020)
Enclosed-space foundation or wall thickness	cm		1.50E+01	Lcrack	15	ASTM (2002)
Enclosed-space air exchange rate	1/s		1.40E-04	ENCAER	1.40E-04	Minimal air exchange rate for residential properties in accordance with Australian standards.
Areal fraction of cracks in foundations/walls	cm^2-cracks/cm^2-total area		3.80E-03	NU	0.0038	US EPA (2004) - Slab on ground
Volumetric air content in found./wall cracks	cc/cc		0.321	VACF	0.321	US EPA (2004)
Volumetric water content in found./wall cracks	cc/cc		0.054	vwcfnd	0.054	US EPA (2004)
Advective Flow Parameters						
Include advective flows?			Y	Conv	Y	
Slab Area	cm2		2.25E+06	Ab	2.25E+06	Based on an typical house area of 15m x 15m.
Building Volume	cm^3			BV	5.40E+08	
Building Ventilation Rate (USEPA Equation 14)	cm^3/s			Qbuilding	7.56E+04	
Average Vapour Flow Rate into Building	cm^3/s		0.001	Qsoil	8.33E+01	
Outdoor Air Characteristics						
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	(b)	336	windsp	336	Based on average annual windspeed at Canberra Airpot (19km) from the Site.
Width of source area parallel to wind or groundwater flow direction	cm	(c)	1500	WSA	1500	CRC CARE (2011)
Ambient air mixing zone height	cm		200	AAMZH	200	ASTM 1739-95

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D^{air}	D^{wat}	MW	VP	Volatile?
	(cm^3/g)	(cm^3/g)	(cc-$H_2$0 / cc-air)	(mg/l-water)	(cm^2/s)	(cm^2/s)	(g/mol)	(mmHg)	
Tetrachloroethene (PCE)	9.49E+01	1.90E-01	7.24E-01	2.06E+02	5.05E-02	9.46E-06	1.66E+02	1.85E+01	Y
Trichloroethene (TCE)	6.07E+01	1.21E-01	4.03E-01	1.28E+03	6.87E-02	1.02E-05	1.31E+02	6.90E+01	Y
Dichloroethene (cis) 1,2- (DCE)	3.96E+01	7.92E-02	1.67E-01	6.41E+03	8.84E-02	1.13E-05	9.69E+01	2.01E+02	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

C. Chemical-Specific Diffusion Coefficients

Chemical	D_{s1}	D_{s2}	D_{s3}	D_{stot}	D_{crack}	Advective Factor	Exponent of advective factor
	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 6 ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 12	ASTM (2010) Equation (Table X2.5)	USEPA (2004) Equation No. 17	EXP (USEPA (2004) Equation No. 17)
	(cm^2/s)				(cm^2/s)	Factor (unitless)	(unitless)
Tetrachloroethene (PCE)	8.16E-03	-	-	8.16E-03	8.16E-03	1.79E+01	5.99E+07
Trichloroethene (TCE)	1.11E-02	-	-	1.11E-02	1.11E-02	1.32E+01	5.21E+05
Dichloroethene (cis) 1,2- (DCE)	1.43E-02	-	-	1.43E-02	1.43E-02	1.02E+01	2.77E+04

Definition of Parameters

D_s	Effective diffusion coefficient in soil based on vapour-phase concentration	Advective Factor	Estimated advective flow from the subsurface space to indoor air
D_{stot}	Effective diffusion coefficient in soil based on vapour-phase concentration (total of all relevant vadose zone layers)		
D_{crack}	Effective diffusion coefficient through foundation cracks		

D. Chemical-Specific Volatilisation Factors

Chemical	Subsurface to indoor air attenuation factor	Subsurface to indoor air attenuation factor if the exponent of the advective factor is too great to be calculated	VF_{svesp}	VF_{svamb}
	USEPA (2004) Equation No. 13	USEPA (2004) Equation No. 18	USEPA (2004) Equation No. 13 (α) ASTM (2010) Equation (Table X2.5)	ASTM (2010) Equation (Table X2.5)
	(unitless)	(unitless)	(mg/m^3-air / mg/m3-sv)	(mg/m^3-air / mg/L-sv)
Tetrachloroethene (PCE)	6.93E-04	N/A	6.93E-04	1.40E-06
Trichloroethene (TCE)	7.69E-04	N/A	7.69E-04	1.91E-06
Dichloroethene (cis) 1,2- (DCE)	8.25E-04	N/A	8.25E-04	2.45E-06

Definition of Parameters

VF_{svesp}	Volatilization factor from soil vapour to enclosed-space air.
VF_{svamb}	Volatilization factor from soil vapour to ambient (outdoor) air.

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engineers | scientists | innovators



SITE AUDIT REPORT

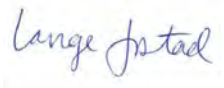
Blocks 22 & 71 Section 51 Holt, ACT 2615

Environment, Planning and Sustainable Development Directorate
26 July 2022

GSY0165 SAR LBJ 21/04 Final

Quality Management

Document Distribution

Issue/Revision	Issue 1	Revision 1	Revision 2
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Prepared by	Lange Jorstad with assistance from: • Sarah Silver	Lange Jorstad with assistance from: • Sarah Silver	Lange Jorstad with assistance from: Sarah Silver
Signature	DRAFT	DRAFT	
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This report was prepared in accordance with the scope of services set out in the contract between Geosyntec Consultants Pty Ltd (ABN 23 154 745 525) and the client.

Geosyntec Consultants Pty Ltd
ABN 23 154 745 525
www.geosyntec.com.au

ACT Environment Protection Authority

SITE AUDIT STATEMENT

Environment Protection Act 1997

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

PART I: Site audit identification

Site audit statement no. LBJ 21_04

This site audit is a ~~**statutory audit**~~**/non-statutory audit*** within the meaning of the *Environment Protection Act 1997*.

Site auditor details (approved under the *Environment Protection Act 1997*)

Name:	Lange Jorstad	Company:	Geosyntec Consultants Pty Ltd
Address:	Suite 1, Level 9, 189 Kent Street		
	Sydney, NSW	Postcode:	2000
Phone:	0447 249 250	Fax:	Not available

Site details

Address: Corner of Flack Street and Moyes Crescent, Holt, ACT

Postcode: 2615

Property description *(attach a list if several properties are included in the site audit)*

- Block 22 Section 51 Holt, Belconnen
- Block 71 Section 51 Holt, Belconnen

Area of site (e.g. hectares): 19645 m^2

Current zoning:

- Block 71 Section 51 Holt: CZ1: Core Zone, PRZ1: Urban Open Space
- Block 22 Section 51 Holt: CZ1: Core Zone

To the best of my knowledge, the site ~~is~~**/is not*** the subject of an order or agreement under the *Environment Protection Act 1997*.

~~**Order/Agreement * no(s)** .....~~

**** Strike out as appropriate***

Site audit commissioned by

Name: Nyah Donaldson

Company: ACT Government, Environment, Planning and Sustainable Development Directorate

Address: Level 2, 480 Northbourne Avenue, Dickson ACT

Postcode: 2602

Phone: 02 6205 9216 Fax: n/a

Name and phone number of contact person (if different from above):

Not applicable

Purpose of site audit

☑ A. To determine land use suitability *(please specify intended use[s])*

Block 22 - CZ1: Core Zone

Block 71 – CZ1: Core Zone, PRZ1: Urban Open Space

OR

☐ ~~B(i) To determine the nature and extent of contamination, and/or~~

☐ ~~B(ii) To determine the appropriateness of an investigation/remedial action/management plan*, and/or~~

☐ ~~B(iii) To determine if the land can be made suitable for a particular use or uses by implementation of a specified remedial action plan/management plan* (please specify intended use[s])~~

……

Information sources for site audit

Consultancy(ies) which conducted the site investigation(s) and/or remediation:

- Lanterra Consultants (Lanterra)
- SAGE Environmental Services Pty Ltd (SAGE)

Title(s) of report(s) reviewed

- Lanterra Consulting (Lanterra) (22 April 2021) Preliminary Site Investigation, Section 51, Holt, ACT 2615 (Ref: P21016_PSI Section 51 Kippax Group Centre_20210325_R01)
- Lanterra (13 December 2021) P21083 – Results of Groundwater and Soil Vapour Investigations, Kippax Place, Section 51, Holt, ACT (ref: n/a)
- Lanterra (14 June 2022) Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT 2615 (Ref: P21083_DSI Section 51 Kippax Centre_20221408_R05)
- SAGE Environmental Services Pty Ltd (SAGE) (12 July 2022) Human Health Risk Assessment, Section 51, Kippax Group Centre. Holt ACT (Ref: DRAFT REV3.0)
- Lanterra (22 July 2022) Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT 2615 (Ref: P21083_DSI Section 51 Kippax Centre_20221408_R05)

** **Strike out as appropriate***

- Lanterra (26 July 2022) P22067 – Review of Preferential Pathways, Section 88, Holt, ACT
- Lanterra (27 July 2022) Site Management Plan, Blocks 22 and 71, Section 51, Holt, (Ref: P22067_SMP_20222707 R07)

Other information reviewed (including previous site audit reports and statements relating to the site):

- EPSDD (4 September 2020) Holt Precinct Map and Code includes Kippax Group Centre (Ref: NI2008-27)
- EPSDD (March 2019) Kippax Group Centre Master Plan.

Site audit report

Title:	Site Audit Report, Blocks 22 & 71 Section 51 Holt, ACT 2615
Report no:	GSY0165 SAR LBJ 21_04 Final
Date:	27 July 2022

**** Strike out as appropriate***

PART II: Auditor's findings

Please complete either Section A or Section B, **not** both. *(Strike out the irrelevant section.)*

Use Section A where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land use(s).

Use Section B where the audit is to determine the nature and extent of contamination and/or the appropriateness of an investigation or remedial action or management plan and/or whether the site can be made suitable for a specified land use or uses subject to the successful implementation of a remedial action or management plan.

Section A

☑ **I certify that, in my opinion, the site is SUITABLE for the following use(s) permitted by its zoning "CZ1: Core Zone" and "PRZ1: Urban Open Space Zone" as detailed in the ACT *Territory Plan 2008 R270 effective 24 June 2022* (Holt, NI2008-27*)*. A list of ALL permitted land uses is presented below:**

CZ1 Uses: (land uses listed for the "minimum assessment track: merit")

ancillary use
car park
civic administration
club
COMMERCIAL ACCOMMODATION USE
communications facility
COMMUNITY USE
consolidation
craft workshop
demolition
development in a location and of a type identified in a precinct map as additional merit track development
drink establishment
emergency services facility
home business
indoor entertainment facility
indoor recreation facility
light industry
minor road
minor use
NON RETAIL COMMERCIAL USE
outdoor recreation facility
parkland
pedestrian plaza
place of assembly
public transport facility
recyclable materials collection
RESIDENTIAL USE
restaurant
service station
SHOP
sign
subdivision
temporary use
tourist facility

PRZ1 Uses: (land uses listed for the "minimum assessment track: merit"):

Ancillary use
Aquatic recreation facility
Communications facility
Community activity centre
Consolidation
Demolition
Development in a location and of a type identified in a precinct map as additional merit track development
Major road
Major utility installation
Minor road
Minor use

Municipal depot	Subdivision
Outdoor recreational facility	Temporary use
Parkland	Varying a lease (where not prohibited, code track or impact track assessable)
Playing field	
Sign	

subject to compliance with the following environmental management plan:

Lanterra (27 July 2022) Site Management Plan, Blocks 22 and 71, Section 51, Holt (Ref: P22067_SMP_20222707 R07)

in light of contamination remaining on the site:

- The delineation of groundwater contamination at the site is as follows:
  - volatile chlorinated hydrocarbons (VCHs) were detected in groundwater to the north and south of the Kippax Health Centre building on the western site boundary. The concentrations of various VCH compounds including perchloroethylene (PCE), trichloroethene (TCE) and cis-1,2-dichloroethane (cis 1,2 DCE) exceeded the adopted ADWG (2011) criteria and the Environment Protection Regulation 2005 (ACT) – AQUA/4 – Urban Drains and Streams: Pollutants entering Waterways taken to cause Environmental Harm Aquatic Habitat criteria.
  - The VCH is likely to originate from offsite sources to the west and/or southwest of the site.
  - Concentrations of select heavy metals (arsenic, cadmium, chromium, lead, nickel and zinc) exceeded the adopted site criteria. These concentrations were relatively consistent across the site and sampling events and were attributed to background concentrations associated to the geology of the site
- Investigations of soil vapour identified VCH concentrations above the HSL A and HSL D criteria for residential and commercial/industrial uses, within the southern area of Kippax Health Centre building and to the north of the health centre on the western site boundary. It is inferred that the source of the vapour in soil is the VCH identified in groundwater.

~~**OR**~~

☐ ~~**I certify that, in my opinion, the site is NOT SUITABLE for any use due to the risk of harm from contamination.**~~

Overall comments

Based on the results of the environmental assessment and Human Health Risk Assessment the audit area was demonstrated to be suitable for the permissible land uses under the zoning CZ1 and PRZ1, subject to the implementation of the Site Management Plan (Lanterra 2022b, SMP). The custodians of the land must comply with the requirements specified in Sections 9.3.8 (unleased or government leased land) or 9.3.9 (private leased land) of the *Contaminated Sites Environment Protection Policy* regarding legal enforceability of Site Management Plans as a condition of this audit determination.

The Auditor notes that although there are no unacceptable contamination risks associated with the site in its current condition, the nature and extent of contamination and proximity to receptors must be re-evaluated as part of any future development of the land. This requirement is specified in the SMP, and the Auditor understands that compliance with the SMP will be a condition of approval for any future development applications for the land.

Groundwater should not be extracted or used for any beneficial purpose at the site including irrigation; and dewatering, if required, will require preparation of a Dewatering Management Plan as specified in the SMP.

Section B

Purpose of the plan[1] which is the subject of the audit .....

.....

I certify that, in my opinion:

- ☐ **the nature and extent of the contamination HAS/HAS NOT* been appropriately determined**

AND/OR

- ☐ **the investigation/remedial action plan/management plan* IS/IS NOT* appropriate for the purpose stated above**

AND/OR

- ☐ **the site CAN BE MADE SUITABLE for the following use(s) permitted by its zoning 'XXXXXXX' as detailed in the ACT *Territory Plan 2008 updated on DATE*:**

  List Uses:

  if the site is remediated/managed* in accordance with the following remedial action plan/management plan* *(insert title, date and author of plan)*

  .....

  .....

  .....

  .....

  subject to compliance with the following condition(s):

  .....

  .....

  .....

Overall comments

.....

.....

.....

.....

.....

.....

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

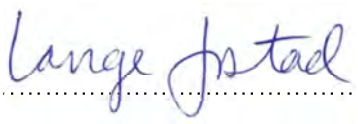
PART III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority under the *Contaminated Land Management Act 1997* (Accreditation No. 1001), and therefore approved as an Environmental Auditor under the *Environment Protection Act 1997*.

I certify that:

- I have completed the site audit free of any conflicts of interest and have not carried out an assessment or remediation of the land to which the audit relates, and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Environment Protection Act 1997* for wilfully making false or misleading statements.

Signed  Date 27 July 2022

Attachment: 1. Survey

2. Lanterra (27 July 2022) Site Management Plan, Blocks 22 and 71, Section 51, Holt (Ref: P22067_SMP_20222707 R07)

Executive Summary

The ACT Government Environment, Planning and Sustainable Development Directorate (EPSDD) commissioned Lange Jorstad of Geosyntec Consultants, a New South Wales Environment Protection Authority accredited Site Auditor (Accreditation Number 1001), duly approved by the ACT Environment Protection Authority (ACT EPA) under Section 75(5) of the Environment Protection Act 1997, to conduct a contaminated land Site Audit.

This Site Audit was conducted to assess the suitability of Block 22 and Block 71, Section 51 Holt, ACT 2615 ('the site'). Land uses permissible in Block 22 include CZ1: Core Zone and the land uses permissible in Block 71 include CZ1: Core Zone and PRZ1: Urban Open Space Zone. The boundary of this Audit is shown in the attached Survey Plan included in Appendix A.

This Site Audit Report (SAR LBJ 21/04) and associated Site Audit Statement (SAS LBJ 21/04) considers investigation and assessment works conducted by Lanterra Consultants (Lanterra) and SAGE Environmental Services Pty Ltd (SAGE) to form an opinion on whether the site is suitable for the permissible land uses under the zoning CZ1: Core Zone and PRZ1: Urban Open Space.

This is currently a non-statutory Audit under Division 9.2 of the Environment Protection Act 1997, conducted in accordance with ACT Environment Protection Authority Contaminated Sites Environment Protection Policy (CSEPP, 2017) and the requirements outlined in NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition). The NSW guidance adopted is approved by the ACT EPA for use in the ACT through the CSEPP.

Lanterra (2021) completed a preliminary site investigation (PSI) to assess the potential risk of contamination and assess the suitability of the investigation area for re-development, considering the current land uses permitted. Following the PSI, Lanterra (2022a) completed a multi-stage detailed site investigation (DSI) of soil, groundwater and soil vapour at the site. They considered the following contaminants of potential concern: Total recoverable hydrocarbons (TRH), Benzene, toluene, ethylbenzene, xylene (BTEX),Polycyclic aromatic hydrocarbons (PAH), Polychlorinated biphenyls (PCBs), Phenols, Organochlorine pesticides/ organophosphorus pesticides (OCP/OPPs), Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), Asbestos, Per- and Polyfluoroalkyl Substances (PFAS), and volatile chlorinated hydrocarbons (VCHs).

Based on results of their investigations, Lanterra concluded that the soil has not been contaminated by the historical or current land uses. However, groundwater and soil vapour in the central-west and northwest portions of the site are impacted with VCHs, likely to originate from off-site sources to the west and / or southwest of the site. They conclude that although the exposure pathway between impacted groundwater and human receptors through dermal contact or ingestion is currently considered incomplete, the presence of VCH compounds at the reported concentrations in groundwater serve as an ongoing source for soil vapour beneath the site. The VCH was inferred to be associated with two separate, off-site sources: an active drycleaner business on Hardwick Crescent to the west of Kippax Fair Shopping Centre, and a former drycleaner business within the Kippax Fair Shopping Centre. A review of underground services plans did not suggest the likelihood of underground services acting as preferential pathways between the two sources or the site.

The reported concentrations of VCH compounds in soil vapour at the site indicated that there may be an unacceptable risk to human health for certain future land uses in certain areas of the site. A conservative Tier II human health risk assessment was completed by SAGE to quantify the potential risk to future uses. The HHRA concluded that the VCHs in soil vapour and groundwater at the site are likely to present a low risk of harm (hazard index < 1) to the health of residents, commercial workers, and recreational receptors at the Site, considering the highest concentrations of the chemicals of concern identified.

Lanterra (2022a) concluded that based on the lateral extent of VCH compounds in groundwater and soil vapour, the elevated concentrations have the potential to pose an unacceptable health risk

to land uses on adjacent properties, most notably the adjacent commercial properties located on Blocks 59, 61, 65 and 76 Section 51 Holt and the residential properties located to the north on Block 60 Section 51 Holt. The contamination status of these properties is outside the scope of this audit, however it is recommended that EPSDD notifies EPA of the investigation findings and potential risks.

Lanterra (2022b) developed a Site Management Plan (SMP) which summarises the distribution of contamination at the site and outlines management measures and responsibilities to prevent unacceptable exposure to contamination for the permissible land uses at the site. The SMP and its mitigation measures are to be considered in the re-development planning stages for the site.

On this basis a Section A SAS will be issued certifying that, in the opinion of the Auditor, the site is suitable for the permissible land uses within current Zoning CZ1 (Core Zone) and PRZ1 (Urban Open Space Zone), including commercial and residential use, subject to the implementation of the SMP (Lanterra 2022b).

The Auditor notes that although there are no unacceptable contamination risks associated with the site in its current condition, the nature and extent of contamination and proximity to receptors must be re-evaluated as part of any future development of the land. This requirement is specified in the SMP, and the Auditor understands that compliance with the SMP will be a condition of approval for any future development applications for the land.

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1 Introduction

This audit was commissioned by Environment, Planning and Sustainable Development Directorate (EPSDD) to assess the suitability of Blocks 22 and 71 Section 51 Holt, Belconnen ACT 2615 ('the site') for the permissible land uses under the zoning: CZ1: Core Zone and PRZ1: Urban Open Space Zone.

This Site Audit Report (SAR LBJ 21/04) and associated Site Audit Statement (SAS LBJ 21/04) were produced by Lange Jorstad (Accreditation No. 1001) employed by Geosyntec Consultants Pty Ltd (Geosyntec). Sarah Silver of Geosyntec supported the completion of the Audit.

The site occupies an area of approximately 19,645 m^2 and is shown in the survey plan and consultant's figures reproduced in Appendix A.

1.1 Site Background

1.1.1 Regulatory Requirements for Audit

This audit was commissioned on a voluntary basis to assist with the divestment of the subject land. To the best of the Auditor's knowledge at the time this SAR and SAS were issued, there was no requirement to complete this audit in an instrument issued under an Act. Accordingly, the audit is a non-statutory audit in the meaning of the EP Act 1997. This audit was completed in accordance with guidelines made or approved by ACT EPA.

1.1.2 Previous Site Audit

The Auditor is unaware of any previous Audits having been conducted at the site.

1.2 Overview of Site Audit Process

The Audit has been conducted in accordance with the contaminated land provisions of the Environment Protection (EP) Act 1997 (ACT) and Environment Protection Regulation (2005), the ACT EPA Contaminated Sites Environment Protection Policy (CSEPP, December 2017), and relevant policies and guidelines made or approved by the ACT EPA under the EP Act 1997.

The audit has been conducted in accordance with the requirements of the EP Act 1997, which describes a site audit as (S.91A(2)):

- An environmental audit for assessment or remediation of contaminated land is an audit by an auditor:
  a. That relates to management (whether under this Act or otherwise) of the actual or possible contamination of land; and
  b. That is conducted for the purpose of determining any one or more of the following matters:
     i. the nature and extent of the assessment or remediation undertaken;
     ii. the nature and extent of any contamination or remaining contamination of the land;
     iii. what further assessment or remediation is necessary before the land is suitable for any specified use or range of uses.
     iv. the appropriateness of any remediation plan, long-term management plan, assessment proposal or remediation proposal.

Sections 91C (5) and 91D (5) of the EP Act 1997 describe that in preparing site audits reports, ACT EPA approved Site Auditors must take the following matters into account:

- The provisions of the EP Act 1997 and the EP Regulations;

- The permitted and approved uses of the land to which the assessment relates;
- The degree or extent of contamination;
- Any relevant environment protection policies; and
- Any relevant environment protection measures.

The NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition), which is approved by the ACT EPA through the CSEPP, describes the site assessment and audit process as:

1. The Consultant is commissioned to assess contamination. The contaminated site consultant designs and undertakes the site assessment and, where required, all remediation and validation activities to achieve the objectives specified by the owner or developer; and
2. The Site auditor reviews the Consultant's work. The site owner or developer commissions the site auditor to review the consultant's work. The auditor prepares a site audit report and a site audit statement at the conclusion of the review, which are given to the owner or developer.

Therefore, the contaminated land consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations, standards and guidelines and is suitable based on the site history and the proposed land use.

1.3 Relevant Guidelines

The National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended in 2013 (NEPM, April 2013) is prescribed under the Environment Protection Act 1997 and is a National approach to the assessment of land contamination. According to the ACT Environment Protection Authority 'Contaminated Sites Environment Policy' (December 2017) the guidelines listed below should be used, as appropriate, for contaminated land assessment or remediation.

ACT EPA Publications:

- Environment Protection Act (1997)
- Planning and Development Act (2007)
- Dangerous Substances Act (2004)
- Waste Minimisation Act (2001)
- Building Act (2004)
- Strategic Plan, Contaminated Sites Management (August 1995)
- Contaminated Site Environment Protection Policy (EPP) (December 2017)
- Information Sheet No.1 - Contaminated Sites - Decommissioning, Assessment and Audit of Sites Containing Above Ground or Underground Fuel Storage Tanks, (October 2016)
- Information Sheet No.2 - Contaminated Sites - Requirements for the Assessment and Validation of Former Service Station Sites in the ACT (October 2016)
- Information Sheet No.3 - Contaminated Sites - Requirements for the Assessment and Validation of Sites Containing Above Ground or Underground Fuel Storage Tanks in the ACT (October 2016)
- Information Sheet No.4 - Contaminated Sites - Requirements for Re-use and Disposal of Contaminated Soil (October 2016)
- Information Sheet No. 5 – Requirements for the Transport and Disposal of Asbestos Contaminated Wastes (October 2016)

- Information Sheet No. 6 – Management of Small Scale, Low Risk Soil Asbestos Contamination (October 2016)
- Information Sheet No. 7 – Guidance for undertaking preliminary contamination investigations for development or lease variation purposes (December 2020)
- Information Sheet No. 9 – Management of groundwater impacted by light non-aqueous phase liquids (LNAPL) (April 2019)
- Information Sheet No. 10 – Virgin Excavated Natural Material (VENM) (August 2019)
- Information Sheet No.11 – Environment Protection Authority Report Submission Requirements (February 2020)
- Environmental Protection Guidelines for Construction and Land Development in the ACT (March 2011)
- Procedure for Management of Contaminated Assets (May 2013)
- Environmental Standards: Assessment and Classification of Liquid and Non-Liquid Wastes (July 2021)

NSW EPA publications of relevance to this audit that are recognised by ACT EPA include:

- DECCW (2010) Vapour Intrusion: Technical Practice Note.
- NSW EPA (September 1995) Sampling Design Guidelines.
- NSW EPA (October 2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition).
- NSW EPA (2020) Consultants Reporting on Contaminated Land - Contaminated Land Guidelines, noting that some of the reports were prepared prior to the issue of these guidelines and were audited against NSW OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites.

EPA Victoria publications recognised by ACT EPA are:

- Groundwater Sampling Guidelines: Publication 669, EPA Victoria, 2000
- Hydrogeological Assessment (Groundwater Quality) Guidelines, Publication 668, EPA Victoria, 2006
- Sampling and Analysis of Waters, Wastewaters, Soils and Wastes, Publication IWRG701, EPA Victoria, 2009

Department of Health Western Australian publications recognised by ACT EPA are:

- Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia (2021).

Other publications and references referred to by the Auditor:

- CRC CARE Technical Reports
- Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards. Department of Health and Aging, 2012 Update (enHealth, 2012a)
- Heads of EPA (HEPA) PFAS National Environmental Management Plan (NEMP) 2.0 (January 2020)
- National Environment Protection Council (2013) National Environment Protection (Assessment of Site Contamination) Measure (referred to herein as NEPM (2013))
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3, Primary Industries - Rationale and Background Information.

- NHMRC/NRMMC (2011) Australian Drinking Water Guidelines. National Health and Medical Research Council and National Resource Management Ministerial Council of Australia and New Zealand.
- Guidelines that refer to the:
  - Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000), are replaced as of 29 August 2018 by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), with the exception of the water quality for primary industries component, which still refer to the ANZECC & ARMCANZ (2000) guidelines.
  - National Environment Protection (Assessment of Site Contamination) Measure 1999 are replaced as of 16 May 2013 by the National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013).

1.4 Reports Reviewed

During the course of the Audit, the following reports were provided to the Auditor:

- Lanterra Consulting (Lanterra) (22 April 2021) Preliminary Site Investigation, Section 51, Holt, ACT 2615 (Ref: P21016_PSI Section 51 Kippax Group Centre_20210325_R01)
- Lanterra (13 December 2021) P21083 – Results of Groundwater and Soil Vapour Investigations, Kippax Place, Section 51, Holt, ACT (ref: n/a)
- Lanterra (14 June 2022) Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT 2615 (Ref: P21083_DSI Section 51 Kippax Centre_20221408_R05)
- SAGE Environmental Services Pty Ltd (SAGE) (12 July 2022) Human Health Risk Assessment, Section 51, Kippax Group Centre. Holt ACT (Ref: DRAFT REV3.0)
- Lanterra (22 July 2022) Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT 2615 (Ref: P21083_DSI Section 51 Kippax Centre_20221408_R05)
- Lanterra (26 July 2022) P22067 – Review of Preferential Pathways, Section 88, Holt, ACT
- Lanterra (27 July 2022) Site Management Plan, Blocks 22 and 71, Section 51, Holt, Ref: P22067_SMP_20222707 R07

The audit report refers to the following documents:

- EPSDD (4 September 2020) Holt Precinct Map and Code includes Kippax Group Centre (Ref: NI2008-27)
- EPSDD (March 2019) Kippax Group Centre Master Plan.

1.5 Audit Correspondence

The Auditor provided feedback to the consultant during the course of the Audit in the form of interim advice letters or email correspondence. A copy of these letters or relevant email correspondence is included in Appendix B together with any relevant consultant responses. Where appropriate, these are referred to in the audit report.

2 Site Identification and Description

This section provides detail on land use and surrounding properties. This information has been sourced from the reports referenced in Section 1.4.

2.1 Site Identification and Details

The site location is shown in Consultant Figures reproduced in Appendix A. The site identification and land use details include:

Table 2.1: Site Identification

Title	Details
Site Name or Description:	Kippax Centre Expansion
Street Address:	Kippax Place, Holt ACT 2615
Property Description:	Blocks 22 and 71 Section 51, Holt, ACT
Current Site lessee/custodians:	.
Current Occupier(s):	Grassland, playing fields, footpaths, mini-skate ramp, footpaths, and Kippax Health centre building (vacant)
Geographical Coordinates (approximate centre of site):	Lat: 35.2218° Long: 149.0206°
Site Area and Dimensions:	Block 71 = 19645 m^2, including 2,207 m^2 for the Kippax Health centre (Block 22)
Local Government Authority:	ACT Territory
Current Zoning:	Block 22 CZ1: Core Zone Block 71: CZ1: Core Zone and PRZ1: Urban Open Space
Previous Zoning:	Not provide, however the site has historically been used as recreational area and a health centre.
Future Zoning	CZ1: Core Zone (as per the Kippax Group Centre Master Plan, EPSDD 2019)
Locality Map:	Provided in Consultant's reports reproduced in Appendix A.
Trigger for Assessment	Proposal for divestment and redevelopment of the land.
Proposed Landuse:	Mixed Use – residential, commercial and public spaces

2.2 Site Zoning and Land Use

Block 22 is zoned to CZ1: Core Zone and Block 71 us zoned for both CZ1: Core Zone and PRZ1: Urban Open Space.

With reference to the Territory Plan 2008 (NI2008-27, Version-R270 dated 24 June 2022), the land use objectives of the CZ1: Core Zone are as follows:

a. Encourage a mix of predominantly commercial land uses that contribute to a diverse and active character
b. Provide for a range of conveniently located retail and service outlets
c. Promote vibrant, interesting and lively street frontages including during evenings and weekends
d. Encourage an attractive, safe pedestrian environment with ready access to public transport
e. Maintain and enhance a high standard of urban design through use of sustainable design and materials and ensure that buildings retain a high level of design consistency and compatibility

f. Provide opportunities for business investment and employment

g. Maintain and enhance environmental amenity.

h. Promote the establishment of cultural and community identity that is representative of, and appropriate to, the place

The permissible land uses for CZ1 are presented in **Table 2-2** (i.e. those listed for the minimum assessment track "merit").

Table 2-2: Summary of Permissible Land Uses

Territory Plan – CZ1: Core Zone

ancillary use	minor road
car park	minor use
civic administration	Non Retail Commercial use
club	outdoor recreation facility
Commercial Accommodation Use	parkland
communications facility	pedestrian plaza
Community Use	place of assembly
consolidation	public transport facility
craft workshop	recyclable materials collection
demolition	Residential use
development in a location and of a type identified in a precinct map as additional merit track development	restaurant
drink establishment	service station
emergency services facility	Shop
home business	sign
indoor entertainment facility	subdivision
indoor recreation facility	temporary use
light industry	tourist facility

Notes:

The definition of "Community Use" in Section 13 of the Territory Plan is an Umbrella Term that includes the following land uses: Child care centre, community activity centre, community theatre, cultural facility, educational establishment, health facility, hospital, place of worship and religious associated use.

Under the Territory Plan, the land use objectives of the permissible land uses for PRZ1: Urban Open Space Zone are as follows:

a. Provide an appropriate quality, quantity and distribution of parks and open spaces that will contribute to the recreational and social needs of the community

b. Establish a variety of settings that will support a range of recreational and leisure activities as well as protect flora and fauna habitats and corridors, natural and cultural features and landscape character

c. Allow for stormwater drainage and the protection of water quality, stream flows and stream environs in a sustainable, environmentally responsible manner and which provides opportunities for the community to interact with and interpret the natural environment

d. Allow for ancillary uses that support the care, management and enjoyment of these open spaces including park maintenance depots, small-scale community activity centres

e. Ensure that development does not unacceptably affect the landscape or scenic quality of the area, adequacy of open space for other purposes, or users, access to open space, or amenity of adjoining residents

f. Provide for integrated land and water planning and management

g. Provide safe pedestrian and cycling access to urban open space to promote active living.

The permissible land uses for PRZ1: Urban Open Space are presented in Table 2-3:

Table 2-3: Summary of Permissible Land Uses

Territory Plan – PRZ1: Urban Open Space Zone

Ancillary use	Minor use
Aquatic recreation facility	Municipal depot
Communications facility	Outdoor recreational facility
Community activity centre	Parkland
Consolidation	Playing field
Demolition	Sign
Development in a location and of a type identified in a precinct map as additional merit track development	Subdivision
Major road	Temporary use
Major utility installation	Varying a lease (where not prohibited, code track or impact track assessable)
Minor road	

Notes:

Some development that would otherwise be prohibited may be assessed under the merit track if they can be defined as ancillary, minor or temporary use. For example, a car park alone is prohibited, but could be considered if it is ancillary to a playing field which is an assessable development under the merit track

2.3 Proposed Development

The proposed development is to comprise an expansion of the Kippax Group Centre which is zoned for Commercial CZ1 Core Zone (CZ1) allowing for commercial and residential land use.

The Kippax Group Centre Master Plan (EPSDD 2019) states that the potential retail expansion to the east of Kippax Fair will see the existing community building (on Block 22) demolished and rebuilt off of the current site. This block has been rezoned from CFZ: Community Facilities to CZ1: Core Zone.

Under the Territory Plan 2008, CZ1 allows for a mix of predominately commercial developments for public use, retail service, and hospitality outlets that is integrated with public transport, extra space, and active transport options. Residential land use is permissible under CZ1 and basement construction is permissible for carparking only.

2.4 Auditor Discussion

The information required by NSW EPA (2020), relating to site identification and condition, was provided, and is consistent with observations made during site inspections conducted as part of this Audit. Where necessary information is required under NSW EPA (2020), the Auditor contacted Lanterra or EPSDD to obtain the necessary information.

3 Stages of Work

3.1 Summary of Works

The table below provides a summary of the investigation, remediation, validation and management works that have taken place at the site:

Table 3.1: Summary of Works Completed

Date	Report Objectives, Scope and Outcomes
Lanterra 22 April 2021 Preliminary Site Investigation (PSI) Section 51, Holt, ACT 2615 Ref: P21016_PSI Section 51 Kippax Group Centre_ 20210325_R01	***The PSI considered a larger investigation area than the site audit area boundary.*** The objectives of the report were to assess the potential risk of contamination and assess the suitability of the site for the proposed development and the land uses permitted under the CZ1: Core Zone, PRZ1: Urban Open Space and TSZ1: Transport Zone. The scope of work included: • Acquisition and review of desktop documentation and associated historical information to assess whether there are any known contaminating activities either on the site or on neighbouring properties. • A review of the environmental setting with regards to geology, topography, hydrology, and hydrogeology. • Site visit to characterise the property setting, which included the gauging of existing groundwater monitoring wells located on the site and inspection of the site surface for obvious and visible signs of potential contamination and / or contaminant sources. • A visual evaluation of surrounding land uses to identify any neighbouring activities which may have affected or present a potential risk to the environmental quality of the site. Lanterra considered the following contaminants of potential concern: Total recoverable hydrocarbons (TRH), Benzene, toluene, ethylbenzene, xylene (BTEX),Polycyclic aromatic hydrocarbons (PAH), Polychlorinated biphenyls (PCBs), Phenols, Organochlorine pesticides/ organophosphorus pesticides (OCP/OPPs), Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), Asbestos, and Volatile chlorinated hydrocarbons (VOCs) The PSI identified the following areas of environmental concern: On-site AECs • AEC 1: - Potential imported fill material used for the establishment of playing fields, Moyes Crescent, Kippax Place and Flack Street and their associated road reserve. • AEC2 - Potential imported fill material used for the construction of the Kippax Health centre Building and Public Toilets; - presence of asbestos containing materials (ACM) in these facilities. - Evidence for possible underground fuel storage tanks (UST) at the Kippax Health centre was not observed, based on the age and use of Kippax Health centre building, the possibility of USTs and their associated infrastructure being present can not be eliminated. Off-site AECs • AEC3 - Stormwater drainage across the site which receives potentially contaminated loads from off-site locations upstream. If contaminated, the drainage could act as a migration pathway for contaminants across the site. • AEC4 - Kippax Fair Commercial Centre has the potential to have USTs and related infrastructure underneath these facilities. - It is understood that a dry-cleaner was present in Unit 14 of the shopping centre, introducing the risk of contamination associated with this activity (i.e., VOCs including chlorinated compounds such as perchloroethylene (PCE) and trichloroethylene (TCE)) • AEC5 - The service station located at the corner of Hardwick Crescent and Flack Street. A groundwater monitoring network was observed from the service station to the south-eastern section of the site. It is possible that contaminants such as TRH, BTEX and lead are migrating onto the site from this source.

Date	Report Objectives, Scope and Outcomes
	Lanterra conclude that there was insufficient information to assess whether the site is suitable for development and a detailed investigation was recommended to investigate the contamination risks associated with each area of environmental concern.
Lanterra 13 December 2021 P21083 – Results of groundwater and Soil Vapour Investigations, Kippax Place, Section 51, Holt, ACT Ref: n/a	The objectives and scope of this investigation were incorporated within the scope of the DSI (below).
Lanterra 14 June 2022 Detailed Site Investigation (DSI) Section 51 Kippax Group Centre, Holt, ACT 2615 Ref: P21083_DSI Section 51 Kippax Centre_20220614_R05	***The DSI considered a larger investigation area than the site audit area boundary.*** Lanterra stated that the objectives of the DSI were to assess the suitability of the site for the land uses permitted under the following zonings: CZ1: Core Zone, PRZ1: Urban Open Space, and TSZ1: Transport, and to adequately characterise the condition of the site including groundwater and soil from a contamination perspective. The DSI considers results and findings from four investigation stages. A summary of the scope of work and results for each stage is provided below Stage 1 (April 2021) • soil investigation in areas of environmental concern (AEC). AEC 1 (imported fill for establishment of the playing fields, roads and buildings), AEC 2 (imported fill for construction of Kippax Health centre and public toilets) and AEC 3 (potential contamination from stormwater drainage across the site). Also, the objective was to assess potential off site contamination sources at AEC 4 (dry cleaner facility formerly located within Kippax Fair Commercial Centre), and AEC (potential contamination related to an ongoing service station southwest of the DSI site, as listed on EPA Register of Contaminated Land). • Soil: - Fill materials were identified in the soil across the site corresponding with an imported road base layer used as a part of the establishment of Moyes Crescent and Kippax Place and reworked materials likely sourced from the site and its surroundings. - Fill was also identified, for the construction of the playing fields where a creek was filled for levelling purposes. - No anthropogenic material was observed with the exception of borehole S3 on the playing field with traces of concrete and brick. - No potential asbestos containing materials (ACM) were observed - Contaminants of potential concern (COPCs) were below the adopted criteria in all soil samples analysed. • Groundwater - A perched body of water was observed in the locations of monitoring wells GW3 and GW5 at approximately 1 – 2 m bgl. - A deeper aquifer at 6 – 10 m bgl was inferred based on the depths of existing wells and water strike at 9.5 m bgl observed while installing well GW51. - Monitoring well GW51 recorded concentrations of volatile chlorinated hydrocarbons (VCH) and heavy metals (copper, lead, nickel and zinc) above the ADWG (2011) criteria. The source of VCH contaminants is inferred to be a former drycleaner that was located at Unit 14 inside the Kippax Fair shopping centre. - Concentrations of copper and zinc in GW51 could be a combination of natural background levels associated with mineralisation of the host rock or possible impact from the former dry cleaner. - Concentrations of copper, lead, nickel and zinc exceeded the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) and Urban Drains and Streams: Pollutants entering Waterways taken to cause Environmental Harm Aquatic Habitat (AQUA/4, 2005) criteria in groundwater samples collected from GW1, GW2, GW3, GW5 and GW51. It is noted that the AQUA/4 (2005) criteria are highly conservative values developed for the protection of sensitive aquatic ecosystems and given that the nearest waterway which is the stormwater channel located approximately 120m east of GW51, the contamination risk groundwater may pose to ecological receptors is negligible. - While there were some concentrations of contaminants of concern that exceeded the ADWG (2011), the risk of ingestion of impacted water is negligible due to the fact that there are no abstraction wells for beneficial groundwater use within the site boundary

or surrounding properties. In addition, based on the shallow depth of the aquifer across the site area, it is unlikely that abstraction wells would be installed on-site in the future

- Sampling of existing groundwater monitoring wells (GW1 to GW5) located in the southwest corner of the site to assess potential groundwater contamination inferred to be migrating onto the site from a nearby (off-site) service station (AEC 5) at the Hardwick Crescent and Flack Street in Block 1 Section 53, currently listed on EPA Contaminated Land Register. Benzene was reported in samples from wells GW1, GW2 and GW5 ranging in concentration from 1 to 5.1 µg/L, likely impacted from the operating service station. Dissolved metals were also identified in groundwater, likely associated with mineralisation of the natural rock.
- Installation, development, and sampling of a groundwater monitoring well (GW51) to assess the potential for on-site contamination migration from off-site contamination source AEC 4 (former dry cleaner at Shop 14 of Kippax Fair Commercial Centre). Volatile chlorinated compounds (VCH) were reported in the sample from GW51 above the Australian Drinking Water Guidelines (ADWG, 2011) criteria, which were inferred to potentially be associated with the former dry cleaner.

Stage 2 (November 2021)

- Installation, development, and sampling of three groundwater monitoring wells (GW52 to GW54) down hydraulic gradient from GW51 and the former drycleaners to delineate the extent of the impact
- Installation and sampling of two multi-level soil vapour probes (SV1 and SV2) to assess the presence of VCH in soil vapour in the vicinity of GW51 and GW53.
- Collection of 3 indoor air samples from the Kippax health building.
- Results of this investigation stage identified:
  - VCH in groundwater at GW51 and GW52 at concentrations exceeding the ADWG (2011) criteria, and
  - VCH in soil vapour in shallow and deeper probes at SV1 exceeding the residential and commercial health screening levels (HSLs), and in shallow and deeper probes at SV2 below the residential land use criteria.
  - Further delineation of VCH in groundwater and soil vapour was recommended.

Stage 3 (January 2022)

- Installation, development, and sampling of 6 groundwater monitoring wells (GW55 to GW60) and 7 soil vapour probes (SV3 to SV9) to delineate the nature and extent of VCH in soil vapour.
- Sampling of existing
- Results of this investigation stage identified:
  - VCH in groundwater at GW51 and GW52 at concentrations exceeding the ADWG (2011) criteria, and
  - VCH in soil vapour in shallow and deeper probes at SV1 exceeding the residential and commercial health screening levels (HSLs), and in shallow and deeper probes at SV2 below the residential land use criteria.
  - Further delineation of VCH in groundwater and soil vapour was recommended.

Stage 4 (March 2022)

- Installation, development, and sampling of 10 additional groundwater wells (GW61 to GW70) and 7 soil vapour probes () to further delineate the extent of the VHC plumes
- All previously installed groundwater wells (GW51 to GW70) and soil vapour wells (SV1 to SV16, shallow probes only) were also sampled.
- Groundwater was inferred to flow in an overall north-northeast direction, similar to the local topography.
- Groundwater concentrations for PCE, TCE and cis-1,2-DCE were observed above the assessment criteria in wells GW51, GW52, and GW58 and concentrations above the laboratory LOR but below the assessment criteria were reported in wells GW53, GW54, GW56, and GW57.
- Wells GW68 and GW69 were installed on the western side of the Kippax Fair Shopping Centre, in the vicinity of existing well GW88, to assess for potential contributing sources of VCH based on the presence of an operational drycleaner business on Hardwick Crescent. Based on the groundwater contour plot, these wells were located approximately up hydraulic gradient from GW58, GW65 and GW66. The reported concentrations of PCE, TCE and cis-1,2-DCE exceeded the relevant criteria in the three wells to the west of the shopping centre, and TCE and cis-1,2-DCE approximately 1-2 orders of magnitude lower but still exceeding the groundwater quality criteria in the downgradient wells to the east of the shopping centre.
  - The wells to the west of the shopping centre reported PCE concentrations of a similar magnitude to GW51, but TCE and cis-1,2-DCE concentrations were 1-2 orders of

magnitude higher than in GW51. Based on the groundwater flow analysis and different relative concentrations of VCH species, Lanterra concluded that the VCH detections in groundwater to the south of the Kippax Health centre were likely to be from a different source from the detections to the north of the building (supported by several "non-detect" wells between the two VCH plumes).

- PCE, TCE and cis-1,2-DCE exceeded the HIL A assessment criteria in wells SV1, SV2 and SV5 located in Kippax Place (the PCE vapour concentration in SV1 exceeded all land use criteria). PCE and TCE at SV9, and TCE only at SV15, exceeded the HIL A assessment criteria to the north of the Kippax Health centre, which was consistent with previous sampling events.
  - SV15 is close to the inferred downgradient property boundary with a residential development to the north and is spatially correlated with monitoring well GW65 in which elevated VCH were also reported. Based on these observations it is possible that the groundwater and vapour VCH impacts could extend into the northern property.
- The highest concentrations of VCH compounds in soil vapour were reported close to the suspected contamination source (former drycleaners) in vapour probe SV1, with exceedances also reported in SV2 and SV5 a short distance north, reducing to detectable VCH concentrations but below the criteria beyond. VCH exceedances were also reported in SV9 and SV15 located to the north of the Kippax Health centre, separated from the southern vapour cluster by lower concentrations. Based on the spatial VCH vapour distribution, and correlation to the groundwater VCH spatial distribution, it was inferred that VCH in soil vapour is likely attributable to volatilisation from two separate VCH groundwater plumes.
- Per- and polyfluoroalkyl substances (PFAS) were detected above the laboratory LOR in groundwater samples GW55 to GW60. However, PFOA, PFOS, and PFHxS+PFOS were below the PFAS NEMP 2.0 assessment criteria with the exception of GW57 which recorded a concentration of 0.085 µg/L for the sum of PFHxS+PFOS (exceeding the drinking water criterion of 0.070 µg/L).

Lanterra identify the following data gaps:

- The potential impact the northern groundwater plume may have on the adjacent residential property is not known. Given that concentrations of VCH in groundwater were detected along the northern boundary of the site, while TCE in the vapour phase was above the HIL A criteria, further investigation into the impact VCH on the residential property was recommended.
- Requirement to assess for seasonal variations.
- The extent of groundwater impact on the carpark to the west of the site, as well as the Kippax Fair Shopping Centre has not been delineated. No soil vapour sampling has been completed at these locations. Further investigations of soil, groundwater and soil vapour should be completed.
- The concentration of VCH compounds measured in SV1 indicate a potential risk to human health. The potential impact that vapour in the vicinity of SV1 may have on the adjacent shopping centre is not known. As a minimum, indoor air sampling of indoor air spaces within the shopping centre should be completed.
- Soil vapour impacts may extend further east of SV2 than has currently been investigated (extending into the current audit site area (playing fields));

Lanterra conclude the following:

- Soil across the site does not show indications that it has been impacted by the historical or current activities. No further soil investigations are considered necessary from a contamination perspective.
- Considering no activities that may introduce VCH compounds have been identified on the site, the commercial land uses that surround the site and the inferred direction of groundwater flow, the source(s) of VCH beneath the site are inferred to originate from off-site locations to the southwest of the site. The VCH was inferred to be associated with two separate, off-site sources: an active drycleaner business on Hardwick Crescent to the west of Kippax Fair Shopping Centre, and a former drycleaner business within the Kippax Fair Shopping Centre. A review of underground services plans did not suggest the likelihood of underground services acting as preferential pathways between the two sources or the site.
- Although the exposure pathway between impacted groundwater and human receptors through dermal contact or ingestion is considered incomplete, the presence of VCH compounds at the measured concentrations in groundwater serve as a source for soil vapour beneath Kippax Place and to the north of the Kippax Health centre.
- The measured concentration of VCH compounds in soil vapour in Kippax Place and around the Kippax Health centre indicated that there may be an unacceptable risk to human health for future development. A Tier II human health risk assessment is currently in progress to quantify the potential risk to future uses. This is being prepared by SAGE

Date	Report Objectives, Scope and Outcomes
	Environmental Services Pty Ltd and would provide further insights about the magnitude and extent of the risk to human health and associated land use constraints. • Based on the lateral extent of VCH compounds measured in groundwater and soil vapour, there is a risk that the adjacent properties, most notably the adjacent commercial properties located on Blocks 59, 61, 65 and 76 Section 51 Holt and the residential properties located to the north on Block 60 Section 51 Holt may have groundwater and/or soil vapour concentrations that may pose a human health risk to the occupants of these properties. Lanterra conclude that based on the results of this investigation and regardless of the current use, the potential risk of harm to human health beneath portions of the audit site, broader investigation boundary and the surrounding offsite of the investigation area are high. Therefore, the audit site and broader investigation area are considered unsuitable for residential development, most sensitive land use permitted under the CZ1: Core Zone zonation, and potentially unsuitable for commercial use depending on future development plans, without some form of remediation or management to mitigate contamination exposure risks from the vapour intrusion pathway. The following recommendations are made: • Further investigation on the adjacent Block 59 Section 51 Holt which is the location of the Kippax Fair Shopping Centre to delineate the extent of the groundwater and soil vapour impacts to the west of the site. • Further investigation of groundwater and soil vapour on Block 5 Section 88 Holt to assess the extent of impacted groundwater to the west of the site. • Further sampling of the groundwater and soil vapour monitoring wells located in Kippax Place, the northern residential properties and around the Kippax Health centre. Existing wells should be sampled on a quarterly bases to investigate the behaviour of contaminants as a function of seasonal variations. • Based on groundwater VCH analytical results, it appears that the level where the dense non-aqueous phase liquid (DNAPL) is located has not been found during this investigation. Lanterra recommends that further investigation is undertaken to assess the vertical delineation of the impacted plume (s). • Specific hydraulic testing would be required in monitoring wells to estimate site-specific hydrogeologic characteristics to assess the contaminant fate and transport potential of the VCH impacted plumes. • A Site Management Plan reflecting the current state and configuration of the site must be prepared. This must include requirements for ongoing sampling of groundwater and soil vapour as well as requirements for personnel to perform any subsurface maintenance works including access to service pits and trenches in Kippax Place and around the Kippax Health centre. • The SMP must specify any future development will require further contamination assessment to investigate the potential impact contaminants in groundwater and soil vapour may have on a specific development. • Hydraulic testing may be required to estimate site-specific hydrogeologic characteristics to assess contaminant fate and transport potential of the VCH impacted plumes. • The ACT EPA should be notified of the existence of contaminated land under Section 25A of the Environment Protection Act 1997 to make them aware of the potential risks associated with impacted groundwater and soil vapour.
SAGE 12 July 2022 Human Health Risk Assessment (HHRA) Section 51, Kippax Group Centre, Holt ACT 2615 Ref: DRAFT REV3.0	SAGE Environmental (SAGE) prepared a Human Health and Ecological Risk Assessment to characterise the risk from existing contamination at the audit site and quantify the risk it poses to current and potential future users. Sage states that this HHRA and the associated contamination investigations were conducted to support due diligence procedures for the divestment of the site. Referring to Lanterra (2022a), there is elevated VCH in groundwater and soil vapour at the site due to contaminated groundwater migration to the site from what are inferred to be off-Site sources. It is expected that a potential exposure pathway via the inhalation pathway could occur due to upward vapour migration from the groundwater and through the overlying soil profile. SAGE's preliminary conceptual site model (CSM), derived from Lanterra (2022), considered various potential exposure scenarios and considered the only reasonable exposure pathway is via inhalation of vapour-phase volatile contaminants derived from contaminated groundwater. SAGE consider the following current and potential future receptors at the site: Current: • On-Site commercial receptors working within the Former Kippax Health Centre, including patrons accessing this centre.

Date	Report Objectives, Scope and Outcomes
	• Maintenance workers (e.g. groundskeepers, utility/services workers, cleaners). • General public using the community areas on-Site. These areas are located in the north-west corner of Site where public seating, footpaths and a skate ramp exist. • Patrons passing through the Site to access the shopping centre located to the west of the Site (off-Site). • On-Site and off-Site recreational users of the Kippax playing fields. • Off-Site commercial land uses adjacent to the Site. • Off-Site residential land uses to the north of the Site boundary Future: • Residential land uses, within ground floor dwellings (slab on grade construction) located at the eastern Site boundary. • Residential land uses, in properties from the first floor with a single basement level construction. • Commercial receptors, with and without an underlying basement. • Community use receptors, including child care facilities. • Intrusive maintenance workers. • General public utilising the public spaces and roadways. • Employees and patrons of commercial businesses. The HHRA considered five risk scenarios: • Scenario 1: On-Site commercial – slab on grade construction. • Scenario 2: On-Site Commercial with child care – Slab on Ground Construction • Scenario 3: On-Site commercial – basement construction with commercial land use on the ground floor. • Scenario 4: On-Site medium density residential – basement construction with residential properties from the first floor. • Scenario 5: Ground floor residential on slab (noting that this scenario is not currently planned as per Holt Precinct Code (EPSDD 2020) The HHRA concluded that the volatile chlorinated hydrocarbons (VCH) in soil vapour and groundwater at the Site are likely to present a low risk (tolerable concentration not exceeded) of harm to the health of residents, commercial workers, and recreational receptors at the Site, based on Tier 1 and Tier 2 assessment of the highest concentrations of the chemicals of concern identified anywhere on site. However, it is noted that the hazard index for Scenario 5 had the highest estimate of all scenarios (0.31 for adult receptors and 0.76 for child receptors). SAGE qualified their risk characterisation with respect to various considerations and assumptions: • Due to the VCH sources being off-site, contamination will likely continue to migrate into the site and the future development of the site should consider mitigation measures to limit potential exposure to vapour-phase contaminants, in addition to continuing to mitigate direct contact with groundwater which may include limiting the construction of basement to areas where dissolved VCH were not detected, basement tanking to prevent potential ingress of contaminated groundwater, and/or vapour mitigation techniques. • The available VCH data is based on a limited data set over a short investigation duration (in some cases, a single sample). There is no information about temporal concentration variation, or variations in groundwater flow that could cause the VCH plumes to migrate further into the audit site. • A development plan for the site is not currently available, so a broad range of potential development that is consistent with permissible land uses under the zoning was considered, as well as generic assumptions about the location of VCH contamination relative to different types of development. • SAGE did not consider presence of shallow or perched groundwater systems, relying on depths to groundwater 8-11mbgl as per the DSI. If shallower groundwater is identified at the Site and is considered to be impacted by contamination, further evaluation of the risks to human health should be completed. Only a qualitative assessment of off-site risk is presented in the HHRA. SAGE indicated that off-site exceedances of Tier 1 screening criteria, especially in the vicinity of SV1 (shallow and deep) and SV5 (shallow) indicate that further assessment of risk to off-Site commercial land uses, and intrusive maintenance workers is recommended. However, the risk to off-Site receptors (adults and children) in off-Site open space areas (for example Kippax Place) is expected to be low, as recreational receptors and pedestrians are expected to spend limited time these areas (it is a roadway with parking), and significant vapour accumulation is unlikely to occur in outdoor areas. As for the risk to residential receptors to the north of the site, this was also indicated to be low; however SAGE recommended further ongoing assessment

Date	Report Objectives, Scope and Outcomes
	using soil vapour and ambient air monitoring data specific in this area as limited data is currently available. Due to the identified presence of groundwater contamination, future construction and maintenance works should be undertaken in accordance with a Site Management Plan (to be prepared by Lanterra) that identifies the nature and extent of the contamination (to the extent characterised to date) and provides guidance for preventing unacceptable exposure to contamination for future land uses.
Lanterra 27 July 2022 Site Management Plan (SMP) Blocks 22 and 71, Section 51, Holt Ref: P22067_SMP_20222707 R07	Lanterra state that the objectives of their Site Management Plan is to the location of VCH contamination and provide guidance and management requirements for preventing unacceptable exposure to contamination for the land uses permitted under the CZ1: Core Zone and PRZ1: Urban Open Space. The various custodians of the site will be responsible for implementation and management of this SMP: • Provide the SMP to custodians earthwork contractors, builders, utilities or communication workers wo my need to disturb the soil, break asphalt at Kippax Place or access any services within the contaminated areas. • Ensure all workers understand the requirements of the SAMP and are inducted to this SMP • Maintain records related to inductions and asbestos related work at the site • Ensure that the SMP is maintained and updated as required. Changes to the SMP must require site auditor and ACT EPA approval. • Ensure all workers comply with the requirements within the SMP. The SMP is to remain in effect until the known contamination has been reduced to concentrations considered to be acceptable and no longer pose a risk to human health or the environment. Any proposal to terminate the SMP must be prepared by a qualified consultant and agreed to by the Auditor and ACT EPA. Any change in custodianship, the new custodian must acknowledge in writing that they will assume responsibility for the SMP. The SMP outlines management requirements within the following scenarios: • Maintenance Works in Service Pits • Potential interactions with groundwater • Maintenance of playing field irrigation systems • Ongoing groundwater and soil vapour monitoring • Demolition of the health centre • Future use of the former Kippax Health Centre • Removal and Disposal of Soil from Site • Requirements for future development The SMP also outlines an unexpected finds protocol to assist site workers with the identification and management of contamination at the site. The SMP also includes a requirement for a verification report documenting compliance with the SMP in conjunction with any future development. Further review of the details within the SMP are provided in Section 10 of this audit report.

3.2 Auditor Discussion

The following chapters of this audit report contain details relevant to the site to the extent information is available.

The Auditor considers the works completed, followed an iterative process collecting information to characterise the contamination on the site.

The Auditor considers that the areas of concern have been adequately identified. Comments on the investigations were made in Interim Advice, presented in Appendix B, and further noting:

- The boundaries of the investigation area and the audit area to consider was adjusted over the course of the audit.
- The only currently approved zoning for the audit area is CZ1: Core Zone and PRZ1: Urban Open Space Zone.

- The HHRA provides scenarios for future development of the site:
  - On-Site commercial – slab on grade construction.
  - On-Site Commercial with child care – Slab on Ground Construction
  - On-Site commercial – basement construction with commercial land use on the ground floor.
  - On-Site medium density residential – basement construction with residential properties from the first floor.
  - Ground floor residential on slab (noting that this scenario is not currently planned as per Holt Precinct Code (EPSDD 2020)
  - Recreational / Open space land use (Extra space)
- Both the HHRA and DSI provide recommendations for further characterisation of the offsite contamination sources and temporal trends for onsite and offsite portions of the VCH plumes. The Auditor endorses these recommendations, noting that some of the recommendations apply to offsite contamination that is outside the scope of this audit. The additional monitoring recommended for temporal characterisation of contaminant concentration trends is specified in the SMP, which forms a condition to this audit determination.
- It is understood that the DSI and HHRA were provided to the EPA to assist in their decision process on whether there is a requirement for notification to the adjacent landowner.

4 Evaluation of Conceptual Site Model

4.1 Site Condition and Surrounding Environment

The site condition prior to commencement of the works described in this audit report is summarised in this section together with potential sensitive human health and environmental receptors. This information has been sourced from the reports listed in Section 1.4.

Table 4.1: Site Condition and Surrounding Environment

Title	Details
Site inspection:	Auditor completed site inspection on 12 March 2021 and the observations are included in the items below. The Auditor observed the installation of a groundwater monitoring well and soil vapour probe during the inspection.
Topography and Elevation of Site and in Relation to Surrounding Land:	Section 4.1 in Lanterra (2021a) states that the ACTmapi indicates the site has an elevation of approximately 561 to 570 m AHD. The site is relatively flat and gently slopes from south to north. The above information was confirmed during site visit.
Position on Slope, Quantification of Slope:	As stated above, Section 4.1 in Lanterra (2021a) states the site gently slopes from south to north. The above information was confirmed during site visit.
Summary of Local Meteorology and Climate conditions:	The average climatic data from Canberra Airport weather station (070351) between 2008 and 2021 are as follows: • Mean maximum temperatures range between 12.8°C (July) and 30.6°C (January) • Mean minimum temperatures range between 0.0°C (July) and 14.2°C (January) • Mean monthly rainfall ranges between 28.0 mm in May to 75 mm in December.
Current Landuse:	Section 2.1 of Lanterra (2022a) states that the site is currently used for Public Open Space and a vacant Kippax Health centre.
Surrounding Landuses:	Section 2.3 of Lanterra (2021a) states that surrounding landuses included: • North: Northern boundary is adjacent to commercial buildings, public open space, and a tennis club. Southern Cross Drive and residential dwellings are observed beyond. • South: Immediately south of the site, commercial and residential facilities and Flack Street are observed. Open public space and private sport facilities are observed further south. • East: Moyes Crescent is located on the eastern boundary of the site. Residential dwellings and Southern Cross Drive are observed further east. • West: Commercial buildings of the Kippax Group Centre are observed to the west of the site. Hardwick Crescent and more commercial facilities are observed further west.
Density of Residential Use in Surrounding Area:	The site is located in a mixed residential, recreational and commercial use area.
Boundary Condition:	Section 2.2 in Lanterra (2021a) states that the site is accessible from every front and its topography gently slopes from south to north.
Location and Conditions of All Visible Features:	Section 2.2 in Lanterra (2021a) states that the site is primarily open space or roads/paths. The sealed areas of the site include Kippax Health centre, bike paths, pedestrian roads.
Site Building Information:	Section 2.1 of Lanterra (2022a) states that the Kippax Health centre is surrounded on the north and east sides by retaining walls that are used as garden beds. Fill has been used in these areas. Air conditioning units are observed on the north and east sides of the centre. ACM and SMF was identified within the Kippax Health centre. and ACM was detected within the partitions within the public bathrooms.
Condition and Type of Surface Cover:	Section 2.1 in Lanterra (2022a) states that the areas sealed with asphalt/bitumen including Kippax Place, bike paths, pedestrian paths, and Moyes Crescent (offsite) appear in good condition and no significant cracks and/or fuel/oil staining was observed. The grassed

Title	Details
	areas appear to be clean and well maintained with no significant presence of anthropogenic materials observed.
Chemical Storage and Transfer Areas Including the Presence of Chemical Containers:	Section 3.10 in Lanterra (2021a) states that there was no evidence of chemical storage on the site, based on the site visit on 12 March 2021.
Above Ground and Underground Storage Systems and Associated Infrastructure:	Section 2.1 in Lanterra (2022a) states no evidence of underground storage tanks was observed around the Kippax Health centre.
Evidence of Debris, Waste Disposal, Lagoons, Drums, Chemical Storage or Other Indicators of Potential Contamination Sources:	Section 3.10 in Lanterra (2021a) states that there was no evidence of chemical storage on the site. Section 2.1 in Lanterra (2022a) states the grassed areas appear to be clean and well maintained with no significant presence of anthropogenic materials observed. No evidence of debris and lagoons or other chemical storage were observed by the Auditor's assistant during the site visit.
Location of Settlement Ponds:	None discussed by consultants nor observed during the site visit.
Description and Location of Services and Utilities Including On-site Septic Systems:	Lanterra (2022a) provides service utilities maps, which identify the following: • TPG underground assets within the north western portion of the site. • Telstra cable through the Kippax Health centre • Underground electricity cables for street lights through the north western portion of the site. • Underground water network through the north and continues south, on the eastern boundary of the health centre. • Sewer lines running north to south east of the health centre and east towards Moyes crescent
Identification of Electrical Transformers/Substation/ Capacitors:	No detail provided.
Odours:	Section 4.3 in Lanterra (2022a) states there were no olfactory indicators of possible contamination noted during soil and groundwater sampling in April 2021, November 2021, January 2022 and March 2022. No odours were encountered during the Auditor's site visit.
Visible Signs of Contamination:	Section 4.2 in Lanterra (2022a) states there were no visible indications of contamination observed during the site visit conducted on 12 and 18 March 2021. No signs of contamination were noted during borehole and groundwater well construction and sampling in April 2021, November 2021, January 2022 and March 2022.
Presence of Any Stockpiled Material, Imported Soil or Fill Material:	Section 4.4 in Lanterra (2022a) states that major earthworks were executed across the site for its establishment between 1967 and 1973 which could have included import of fill material for levelling purposes, playing field development, and street and road reserve construction. During the site visit retaining walls, containing fill material were observed in the eastern and northern sections of the Kippax Health centre. These areas are used as garden beds. Fill material was observed during soil sampling across the site. This material corresponded with an imported road base fill and reworked fill sourced from the site and / or its surroundings The above information was confirmed during site visit.
Vegetation Type, Extent and Condition of Cover:	Section 4.6 in Lanterra (2022a) states that no significant vegetation stress was observed across the site. Several trees including native and non-native were observed in healthy condition within the site and its surroundings. Playing fields were completely covered by grass The above information was confirmed during site visit.
Surface Water Bodies:	No surface water bonding was identified during the site inspection. Section 5.3 in Lanterra (2022a) states Ginninderra Creek situated approximately 600 m to the north of the site.

Title	Details
Surface Water Drainage, Run-off and Identification of Ponding Areas:	
Depth of Any Standing Water, the Direction and Rate of Flow of Rivers, Streams or Canals:	No standing water identified by the consultant on the audit site boundaries.
Surface Water and Groundwater Use Onsite:	No surface water or groundwater uses were identified at the site.
Evidence of Possible Naturally Occurring Contaminants:	The Auditor's review of the ACT soils map indicates the site is not located in an area with known naturally occurring asbestos.
Identification of Environmentally Sensitive or Significant Features or Habitats:	Section 2.1 in Lanterra (2021a) states that the following sensitive receptors were identified: • A stormwater drainage channel originating south of the site, parallel with Flack Street, which then runs north-south east of the eastern site boundary. The stormwater load eventually drains into Ginninderra Creek to the north. • A childcare centre is located approximately 100 m northwest of the site. • Residential areas located to the east of the site beyond Moyes Crescent, at the northern site boundary and south of the site beyond Kippax Pl • Playing field occupants
Evidence Chemical Substances Have Migrated or are Likely to Have Migrated:	Section 2.1 in Lanterra (2022a) states that an operational service station is located approximately 150 m to the southwest of the southern portion of the site. A network of groundwater monitoring wells was observed in the surroundings of the service station and five (5) wells in the southern corner of the site. Lanterra has assumed that these wells are associated with previous and/or current environmental studies investigating contamination originating from the service station. Lanterra label the service states as the AEC5 and state that it is possible that contaminants such as TRH, BTEX and lead are migrating onto the site from this source Additionally, the CSM identifies that the Kippax Fair Commercial Centre has the potential to have USTs and related infrastructure underneath their facilities. In addition, it is understood that a drycleaner was present in Unit 14 of the shopping centre. Drycleaning fluids historically contained chlorinated hydrocarbons such as perchloroethylene and trichloroethylene, such as those detected beneath the site.
Photographs of Site and Surrounding:	Lanterra (2021a) provide site photographs site photographs in an appendix, depicting the site features and buildings, carpark, paths, fields and existing groundwater wells. Lanterra (2022a) provide site photographs depicting soil profiles encountered during drilling activities.

4.2 Geology, Hydrogeology and Hydrology

The geology, hydrogeology and hydrology are summarised in this section. This information has been sourced from the reports listed in Section 1.4.

Table 4.3 Subsurface Conditions

Title	Details
Geology Map Conditions:	Section 5.1 in Lanterra (2022a) reports that the 1:100,000 Geological Series, Canberra, New South Wales and Australian Capital Territory, Sheet 8727 (Bureau of Mineral Resources, 1992) shows that the site is underlain by the Deakin Volcanics of the late Silurian. Rhyodacitic ignimbrite and minor volcaniclastic and argillaceous sediments are expected in the northern section of the site while tuffaceous and quartz sandstone and minor shale would be found in the southern portion.
Soil Map Conditions:	The Auditor referred to eSpade v2.2 which identified that the site is within the Williamsdale soil landscape, characterised by moderately deep moderately well drained yellow Chromosols on red and brown Kandosols on upper rises and fan elements.

Title	Details
	Moderately to very deep, poorly to imperfectly drained Sodosols on lower rises and fan elements
Acid Sulfate Soils:	Results of the Lotsearch in Appendix D of Lanterra (2022a) reports that there is a low probability of ASS occurrence (Class B) at, and in the area of, the site.
Logs/Soil Classification Method:	Borehole/test pit logs and well construction logs are reproduced in Appendix D. The boreholes identify soil classification was in accordance with unified soil classification system.
Site-specific Geology Conditions:	Section 12.1 of Lanterra (2022a) provides the following site geology: • 0-0.3mbgl: Gravelly sandy silt – sandy silt, brown to dark brown, dry and soft (topsoil) for most of the site, Gravelly silty sand, dark brown to reddish grey (road base) underneath asphalt. • 0.3-0.6 to 2.5mbgl: Gravelly sandy clay – gravelly clayey sand, brown to pale brown, dry to moist, soft-hard and plastic (reworked fill)
Cation Exchange Capacity:	Section 7.1 of Lanterra (2022a) provides an average CEC of 9.4 meq / 100g (S1 1.0-1.1 and S6 1.0-1.1).
Soil pH:	Section 7.1 of Lanterra (2022a) provides an average soil pH of 6.9 100g (S1 1.0-1.1 and S6 1.0-1.1).
Redox Potential:	The redox of groundwater was reported between 137.8 and 279.3 mV.
Regional Hydrogeology:	Section 5.2 of Lanterra (2021a) presents a review of the Bureau of Mineral Resources (1984) Hydrogeology of the Australian Capital Territory and Environs indicates that groundwater is hosted in fractured aquifers with higher yielding zones associated with the upper and lower portions of the individual ash-flow tuffs and interbedded sediments of the late Silurian. The quality of groundwater is expected to be variable, the total dissolved solids (TDS) anticipated to vary between 500 - 1000 milligrams per litre (mg/l) and the yield is estimated to be between 0.5 and 1.0 litres per second (l/sec). The regional aquifer was inferred to be between 6 – 10 m bgl based on the water strike levels encountered in GW51 (9.5 m bgl) and the depth of the existing groundwater wells across the southern portion of the site (range of 6.2 m to 9.9 m bgl).
Site-specific Hydrogeology:	Section 13.2 of Lanterra (2021a) presents that the basic groundwater modelling was completed for the site to assess the groundwater flow direction. Given that the standing water levels associated with monitoring wells GW3 and GW5 are considered to be associated with a perched body of water in those locations.
Aquifer Types:	Lanterra (2022a) present that there is a perched body of water was observed in the locations of monitoring wells GW3 and GW5 at approximately 1 – 2 m bgl. A deeper aquifer at 6 – 10 m bgl was inferred based on the depths of existing wells and water strike at 9.5 m bgl observed while installing well GW51.
Direction and Rate of Groundwater Flow:	Section 12.1.2 of Lanterra (2022a) present that the contours and flow direction of groundwater across the site and its surroundings was inferred to follow an overall north, northeast direction. Lanterra state that it appears the groundwater flow is strongly influenced by topography that follows the drainage observed to the north which eventually reaches Ginninderra Creek.
Aquifer Characteristics (Hydraulic and Piezometric Heads and Hydraulic Gradients, Hydraulic Conductivity, Porosity and Transmissivity):	Lanterra (2022a) provides a hydraulic contour map which identifies a steep hydraulic gradient to the northwest of the Kippax Health centre between GW58 and GW59. The apparent mounding could be occurring due to the presence of underground services
Depth to Groundwater:	As above, the perched aquifer was observed at approximately 1 – 2 m bgl in the south west portion of the DSI area (offsite of the audit area). A deeper aquifer at 6 – 10 m bgl was inferred based on the depths of existing wells and water strike at 9.5 m bgl observed while installing well GW51.

Title	Details
Use of Water Abstraction:	Section 5.2 of Lanterra (2021a) states that a groundwater bore search was provided within the Lotsearch report which identified two abstraction well within 2000 m of the site and four groundwater boreholes registered with the Bureau of Meteorology within 2000 m of the site. Nine groundwater wells were observed in the southwest area of the site and gauged in March 2021. Depth to water ranged between 1.50 and 5.81 m depth.
Summary of Monitoring Wells:	Summary of wells monitored as part of the DSI is as follows:

Well ID	Well depth (mbgl)	Screened depth (mTOC)	Screened lithology	SWL (drilling) (mAHD)
GW1	9.9		Unknown	
GW2	6.2		Unknown	
GW3	7.7		Unknown	
GW4	8.4		Unknown	
GW5	7.16		Unknown	
GW51	12.9	6.5-12.5	Sandy, silty CLAY / volcanic rock	568.123
GW52	12.5	9.5-12.5	Deakin Volcanics	567.393
GW53	12.7	8.6-11.6	Deakin Volcanics	567.076
GW54	12.7	9.3-12.3	Silty Sand	567.309
GW55	10.5	7.5-10.5	Deakin Volcanics	565.774
GW56	9.1	7 - 10	Gravelly Clayey SAND	565.845
GW57	10	7 - 10	Gravelly Clayey SAND	566.755
GW58	10	7 - 10	Sandy CLAY	565.84
GW59	10	7 - 10	Gravelly sandy CLAY	567.148
GW60	10	7 - 10	Gravelly clayey SAND	567.065
GW61	10.5	7.5 - 10.5	Gravelly sandy SILT	564.946
GW62	12.5	9.5 - 12.5	Deakin Volcanics	564.562
GW63	10	7 - 10	Deakin Volcanics	563.756
GW64	14.3	11.3 - 14.3	Sandy silty CLAY	564.716
GW65	10	7 - 10	Sandy silty CLAY	563.344
GW66	10	7 - 10	Gravelly sandy SILT	564.836
GW67	10	7 - 10	Deakin Volcanics	569.046
GW68	10	7 - 10	Sandy SILT	567.344
GW69	11	8 - 11	Sandy clayey SILT	567.138
GW70	10	7 - 10	Sandy SILT	571.634

Beneficial Uses of Aquifer:	Lanterra (2022a) state that there are no abstraction wells in the area of the site, reducing the beneficial groundwater use of the aquifer. Additionally, based on the shallow depth of the aquifer across the site area, it is unlikely that abstraction wells would be installed on-site in the future (with the exception of potential dewatering during construction stages).

Title	Details
Future Realistic Uses of Aquifer:	As above, based on the shallow depth of the aquifer, it is unlikely that abstraction wells would be installed on-site in the future. Given the impact identified, Lanterra (2022a) notes that groundwater beneath the site must not be used for beneficial purposes (e.g. as potable water supply or for irrigation purposes) unless is demonstrated by further investigations that there is no risk associated with these uses.
Potential Groundwater/Surface Water Receptors:	Section 15 of Lanterra (2022a) states that the nearest sensitive receptor is the grass swale located approximately 120 m northeast of the site which flows into Ginninderra Creek. Based on the measured concentrations of VCH compounds and heavy metals across the site and the distance to the receptor, the risk of contaminants impacting aquatic ecosystems associated with these receptors is considered negligible Additionally, the exposure pathway (ingestion) between the impacted groundwater and potential human receptors to be incomplete thus impacted groundwater poses a negligible risk to human health.
Flow Paths for Surface Runoff:	Section 5.3 of Lanterra (2021a) states Surface water on the site is expected to follow the topographic contours of the site and flow from the southeast to the northwest of the site following the stormwater drain and captured by the stormwater channel system located 100 m north from the site.
Background Water Quality:	Section 5.2 of Lanterra (2022a) states the quality of groundwater is expected to be variable, the total dissolved solids (TDS) anticipated to vary between 500 - 1000 mg/L.
Preferential Water Courses:	Ginninderra Creek is situated approximately 600 m to the north of the site. It is identified as a high potential groundwater dependent ecosystem .

4.3 Site History

The site history is summarised in this section. This information has been sourced from the reports listed in Section 1.4:

Table 4.2: Site History

Title	Details
Historical Title Search:	Section 3.3 in Lanterra (2021a) states land title searches for the biggest blocks of the site, which include Blocks 22, 47 and 66 of Section 51, was completed and indicated that the proprietor of the Block 22, where the Kippax Health centre is located, is the Australian Capital Territory. Searches of Blocks 47 and 66 did not show any results.
Review of Historical Aerial and Site Photography:	Section 3.4 in Lanterra (2021a) provides the following aerial photography review: • 1961: The site appears to be cleared rural land. A creek runs from southeast to northwest across the site. The surrounding land appears to be a rural area/grassland. • 1967: No discernible differences to the site. Earth works observed 150 m to the north of the site, presumably associated with stormwater drainage works and the early establishment of Southern Cross Drive. • 1973: Major earthworks are observed across the site, associated with the Kippax Centre and its surroundings. Major earthworks occurring around the site are observed. Southern Cross Drive and Stark Street appeared to be sealed. To the west of Stark Street, residential constructions are observed. Several roads are starting to be developed and are unsealed. These include Moyes and Hardwick Crescent, and Flack and Luke Street. • 1978: Kippax Health centre building has been constructed and the stormwater drainage across the site appears to be established. Car parking in the road reserve of Moyes Crescent is sealed. Kippax Fair Centre has been constructed adjacent to the western boundary of the site. The roads and carparks of the centre appeared sealed. Several commercial buildings to the west of Hardwick Street have been constructed. Both service stations located in the corner of Hardwick Crescent and Flack Street (currently Caltex) and Hardwick Crescent (currently 7- Eleven) are present. To the north of the site, a large area has been developed with residential dwellings. Major earthworks are being undertaken to the east of Moyes Crescent. A few residential facilities have been constructed to the southwest of the site and ongoing earthworks are occurring in the same area.

Title	Details
	• 1981: The playing fields appear to have grass. It appears that trees have been planted to the north of the Kippax Health centre and along the boundaries of the site. The tennis club appears constructed to the north of the site. Towards the east, several house dwellings have been built. The same occurred to the southwest of the site where further housing development is observed. Two extra commercial buildings haven been constructed towards the northwest of the site • 1985: No discernible differences to the site. The surrounding area has been largely developed. More residential facilities beyond Moyes Crescent to the east have been built. To the south, a few new residential dwellings and the private sport facility are constructed • 1992: Apart from a bike/pedestrian path observed in the northern section of the site, no discernible differences to the site are apparent. More residential dwellings and a church have been constructed to the southwest of the site, beyond Hardwick Crescent. A new building, currently the Laverty Pathology Ochre Centre, has been constructed to the northwest of the site • 1997: No discernible differences to the site or surroundings. • 2004: No discernible differences to the site. Previous buildings located towards the northwest of the site have been demolished and a new building site appears to have been settled. Excavations, stockpiles, and machinery are observed in that area. The stormwater channel towards the north of the site appears to have been upgraded. The service station observed to the northwest of the site appears to have been renovated. • 2008: New pedestrian paths appeared developed in across the site north of the Kippax Health centre. New commercial buildings appear constructed to the northwest adjacent to the site. The Kippax Public Library and playground of the centre has been constructed to the west of the site • 2014: No discernible differences to the site. New building to the northwest of the site has been constructed. The West Belconnen Child and Family Centre has been constructed to the west of the site and ongoing earthworks are observed to the north of these facilities • 2020 No discernible differences to the site. YMCA Early Learning Centre and a residential building has been constructed to the north the Child and Family centre, along Starke Street. A childcare centre has been constructed to the northwest of the site, beyond the commercial premises. Groundwater wells associated with current remediation works are observed in the surroundings of the service station located 100 m to the southwest of the southern corner of the site.
Previous Land Use & Chronological List:	Section 3.4 in Lanterra (2021a) provides a summary of historical business Directorate. The search identified the following activities: • 1991: Photographic developing, printing and/or colouring services (Kippax Pharmacy, Shop 8, Kippax Fair Shopping Centre) - the pharmacy is still located in shop 8, however, no photography developing is offered in the store • 1982: Dry cleaners and pressers (60 Minute Cleaners, Shop 14, Kippax Fair Shopping Centre) - The dry cleaner's business no longer exists in these facilities. The former lessee advised that this was a drop off location and no chemicals were stored or used on site. • 1982: Motor garages and service Stations (Caltex All Star Service Station, Hardwick Crescent) • 1991: Motor wheel aligning and balancing services (Kippax Tyres, Hardwick Crescent) - likely that both are associated with the service station located in the corner of Hardwick Crescent and Flack Street approximately 100 m to the southwest of the site.
Details, Charts and Diagrams of Previous Buildings and Site Structures:	A development application (DA 202239918, lodged 14 April 2022) has been submitted for the demolition of the Kippax Health centre (the only on-site structure), which includes a diagram of the facility indicating multiple office/health consult rooms with a common kitchen and courtyard area.
Description of historical Manufacturing / Industrial Processes and Location, including Transfer Lines:	Section 3.11 in Lanterra (2021a) states there are no known manufacturing processes that currently occur or have previously occurred on the site.
Products Discharged during historical Manufacturing:	The historical data review has identified no manufacturing occurred on site.

Title	Details
Locations of Historical Chemical Storage and Transfer Areas:	Section 3.10 in Lanterra (2021a) states there was no evidence of chemical storage on the site, based on the site visit on 12 March 2021.
Wastes Discharged during historical Manufacturing:	The historical data review has identified no manufacturing occurred on site.
Historical Disposal Locations:	The history established has not identified historical disposal locations on the site.
Historical Discharges to Land, Air & Water:	Section 3.12 in Lanterra (2021a) states that no information regarding discharges to land, water and air was available for review at the time of writing this report. As no manufacturing operations are known to have occurred at the site, it is unlikely that there may have been previous discharges to land, water or air in the past.
Historical Product Spill and Loss History:	The consultant does not provide an overview. As stated above, As no manufacturing operations are known to have occurred within the boundaries of the site, it is unlikely that there may have been previous discharges to land, water or air in the past.
Historical Sewer & Services Plans:	Sewer diagrams depict the sewer trunk main runs north to south east of the Kippax Health Centre. Underground street line lines run through the park area in the northern portion of the stie and the reticulation water line runs from north to south, east of the Kippax Health centre and through the Health Centre car park.
Earthmoving Activities Carried out on Site:	Review of site history in Section 3 of Lanterra (2021a) notes the site has remained largely vacant and unchanged over the site history. In the context of earthmoving activities of relevance are fill was required for the construction of the playing fields where a creek was filled for levelling purposes.
Previous Offsite Landuses with Potentially Contaminating Activity:	Section 6.1 provides an overview of potential offsite contaminating activities: • A former dry cleaner used to operate in Shop 14 of the Kippax Fair Shopping Centre. These activities introduce the risk of contamination to the site due to use of volatile organic compounds, including chlorinated compounds. As dry-cleaning solvents such as perchloroethylene are volatile compounds, it is possible that impacted groundwater may pose a vapour risk to future site developments. Additionally, the possibility of USTs and related infrastructure existing beneath the commercial centre cannot be ruled out. This could introduce the risk of hydrocarbon contamination to the site if spills and leaks occurred. • The service station located to the south-west of the site appears to be subject of ongoing remediation events. Therefore, any issues related to fuel storage may contaminate the underlying groundwater that migrates to the site which could impact the soil beneath the site as volatile compounds may emit a vapour that migrates towards the surface
Complaint History:	No information provided
ACT EPA Records:	Section 3.5 in Lanterra (2021a) states that a contaminated land search under Section 21 (A) of the Environment Protection Act (1997) from the ACT EPA did not list notices or declarations for the site under Section 58 of the CLM Act 1997.
Worksafe ACT Dangerous Goods Licenses/ USTs/ ASTs:	Section 3.6 in Lanterra (2021a) states that a search of the Worksafe ACT Dangerous Substances Register, Dangerous Goods database and Manifest Quality Notification was not submitted by the time of issuing this report. A search will be performed for the Kippax Health Centre and Kippax Fair Commercial Centre once an approval letter is obtained from the current owner of those buildings. The future results of this search will be provided in an addendum to this report…
Historical Site Photographs:	Site photos from Lanterra's (2021) site visit are provided in the PSI. Historical maps of the region are provided in the Lotsearch report within the PSI.
Local Literature:	None provided
Previous Land Use Potentially Associated with PFAS:	The site and surrounds are not listed in any per- and polyfluoroalkyl substances (PFAS) investigation and management programs. Including the EPA PFAS Investigation Program, Defence PFAS Investigation and Management Programs and Airservices Australia National PFAS Management Program.

Title	Details
Potential Offsite Impacts:	Impacted groundwater may be migrating onto the service station site from the southwest. Additional impact to groundwater may be originating from the former drycleaner that was within the Kippax Fair shopping centre
Site Plans Showing Detailed Site Features:	As above - the development application ((DA 202239918, lodged 14 April 2022) submitted for the demolition of the Kippax Health centre includes a diagram which indicates the facility includes multiple office/health consult rooms with a common kitchen and courtyard area.

4.4 Conceptual Site Model

The following table provides review of conceptual site model of the site.

Table 4.4: Conceptual Site Model

Item	Conceptual Site Model
Areas of Environmental Concern (AECs) and Contaminants of Potential Concentrations (COPCs):	Section 6.2 in Lanterra (2022a) provides the following (AECs) and COPCs:

AEC	Activity	COPCs
Imported Fill (site wide)	Uncontrolled Filling during establishment of playing fields and roads. A former creek passed through the area occupied by the oval.	heavy metals (M8), total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), monocyclic aromatic hydrocarbons (BTEXN), organochlorine pesticides (OCP), phenol, polychlorinated biphenyls (PCB) and asbestos
Health Centre and Public Toilet	ACM recorded in the building material.	TRH, BTEX, PAH, PCB, phenol, OCP/OPP, heavy metals, asbestos.
Stormwater Drain	Stormwater may receive potentially contaminated loads from offsite locations upstream, acting as a migration pathway across the site.	TRH, BTEX, PAH, PCB, phenol, OCP/OPP, heavy metals, asbestos.
Kippax Fair Shopping Centre (Offsite)	Former drycleaner may have used volatile organic compounds, possible UST related infrastructure may exist beneath the centre – contributing to contamination of underlying groundwater	TRH, BTEX, PAH, lead, volatile organic compounds (VOCs)
Service Station (Offsite)	Service station southwest of the site is undergoing remediation works. Contaminated groundwater may migrate to site and may emit vapours.	TRH, BTEX, PAH, lead

Potential Affected Media:	The consultant has considered the following media: • Soil • Soil vapour • Groundwater
Spatial and Temporal Variations:	The Consultant has conducted soil vapour sampling during dry conditions.

Item	Conceptual Site Model
Current and Potential Exposure Source, Pathway and Receptors:	Section 6.3 in Lanterra (2022a) considers the following current and future receptors: • Onsite workers associated with current and future site use • Current site users • Future construction workers • Future residential occupants • Future maintenance workers • Ecological receptors • Groundwater Lanterra considers the following potentially complete exposure pathways: • Inhalation of hazardous ground gas/vapours • Ingestion, dermal contact, inhalation of dust Lanterra concluded that contact with groundwater was not considered to be a complete pathway as no abstraction bores are located at the site. However, the pathway could become complete if, for example, future development includes dewatering or excavations that extend to the water table in impacted areas.
Data Gaps:	Lanterra (2022a, 2022b) identify the following data gaps: • The potential impact of northern groundwater plume may have on the adjacent residential property (offsite) • Assessment as to the seasonal variation of contaminant concentrations to aid in development design. • The extent of groundwater and soil vapour impact on the carpark to the west of the site, as well as the Kippax Fair Shopping Centre has not been delineated (offsite). • Indoor air concentrations within the shopping centre (offsite). • Soil vapour impacts may extend further east of SV2 than has currently been investigated (extending into the current audit site area);

4.5 Auditor Discussion

The information required by NSW EPA (2020), in regard to site condition and history, geology, hydrology and hydrogeology, has been provided, and is consistent with the Auditor's understanding of the site area. Those items not provided are listed above but their omission is not considered to affect the conclusions of this audit.

The Auditor concurs with Lanterra that the COPCs and potentially impacted media are those as listed above for the Areas of Environmental Concern (AECs) at the site.

5 Sampling and Analysis Plan

This section provides a summary of the review of the sampling and analysis plan and associated methodologies adopted by the consultant(s) for the investigation and validation works conducted at the site. This information has been sourced from the documents presented in Section 1.4. Detailed review is provided in Table E1 in Appendix E.

5.1 Auditor Discussion

Sufficient information required by NSW EPA (2020) related to the sampling and analysis plan and associated methodologies, has been provided to enable appropriate conclusions to be drawn for all investigations characterising the site. The Auditor considers that the information is appropriate given the conceptual model for the site with the following considerations to be addressed:

- While rate of intra and inter-laboratory duplicates meet the set DQOs, Lanterra (2022a) do not provide detail as to the sample splitting techniques for soil, soil vapour or groundwater.
- Lanterra (2022a) do not comment on the groundwater RPD exceedances however noting the exceedances were for minor CoPCs (Total BTEX, PFAS and heavy metals)
- Lanterra (2022a) do not state whether soil vapour field blanks were collected.
- Analytical LORs for specific analytes were higher than the accepted criteria in multiple groundwater and soil vapour samples:
  - Groundwater GW51 during Stage 2:
    - Dichloromethane (Stage 2)
  - Soil Vapour, select wells during Stage 2, Stage 3 or Stage 4:
    - TCE (SV1s, SV2s, SV5s)
    - DCE (SV1s, SV1d, SV5s)
    - Vinyl chloride (SV1s, SV1d, SV5s)
    - Naphthalene (SV1s, SV1d, SV5s)

Further comments on the consultants' reports are provided in the Interim Advice correspondence presented in Appendix B.

Additionally, the NSW EPA (2017) requires that an Auditor must check key requirements of the sampling and analysis plan by the Consultant and therefore makes the following statements:

- The Auditor confirms that Lanterra (2022a) included a general statement of the predetermined DQOs for field and laboratory procedures (including quantitative DQOs);
- The Auditor confirms that Lanterra (2022a) included a plan to achieve pre-determined DQOs; and
- The Auditor confirms that Lanterra (2022a) included procedures to be conducted if the data did not meet the expected DQOs.

6 Evaluation of Site Criteria

As the final redevelopment design for the site has not been decided, for their detailed site investigation, Lanterra considered assessment criteria based on all permissible land uses under the allowable zoning at the time of the Stage 1 investigation (noting the investigation area was significantly greater than the current audit site area). The zoning considered by Lanterra (2022a) included:

- PRZ1: Urban Open Space;
- TSZ1: Transport;
- CF: Community Facilities; and
- CZ1: Core Zone, where residential uses are permitted.

Considering the above, Lanterra (2022a) state that the site would be assessed with consideration for residential land use, being the most conservative set of criteria.

6.1 Assessment Criteria for Soil

The soil assessment criteria used by Lanterra (2022a) include:

- NEPM (2013) HIL A for low density residential land use;
- NEPM (2013) HSL A/B for low / high density residential land use in a clay soil at 0-1 m depth;
- NEPM (2013) EIL for urban residential and public open space;
- NEPM (2013) ESL for urban residential and public open space based on fine texture; and
- NEPM (2013) HSL A guidelines for asbestos.

Additionally, the Auditor includes consideration of:

- NEPM (2013) Management Limits for residential, parkland and public open space for a coarse soil.

6.2 Assessment Criteria for Groundwater

The assessment criteria used by Lanterra (2022a) included the following:

- NHRMC 2011, Australian Drinking Water Guideline – Version 3.5. (The Auditor notes that these guidelines have been updated to Version 3.7, January 2022);
- ANZG (2018) 95% LoP Fresh Water and low reliability trigger values; and
- NEPM (2013) HSL A/B for volatile vapours in groundwater for clay soils at 2-4m and 4-8m depth; and
- Environment Protection Regulation 2005 (ACT) – AQUA/4 – Urban Drains and Streams: Pollutants entering Waterways taken to cause Environmental Harm Aquatic Habitat
- PFAS NEMP 2.0, Human health guideline values for drinking water guideline value for the potential abstraction bore – Table 1.
- PFAS NEMP 2.0, Ecological water quality guideline values for 95% species protection in freshwater – Table 5.

6.3 Assessment Criteria for Soil Vapour

The assessment criteria considered by Lanterra (2022a) for soil vapour include NEPM Health Screening Levels (HSL-A and HSL D) for petroleum hydrocarbons for residential and commercial land use scenarios.

6.4 Other Assessment Criteria

Where no Australia criterion is available, the limit of reporting (LOR) will be adopted as a preliminary screening criterion. Where the concentration exceeds the LOR, reference criteria will be selected from national and international guidance as appropriate to determine the significance or otherwise of the detected analyte.

6.5 Waste Classification

Waste classification is to be conducted in accordance with Environmental ACT (2021) Environmental Standards: Assessment and Classification of Liquid and Non-Liquid Wastes.

6.6 Auditor Discussion

The adopted criteria are appropriate for the contaminants of concern identified for the guidelines present at the time of reporting, the environmental setting for the site and the proposed future land use.

7 Assessment of Investigation Results

The results for all investigation phases completed at the site and presented in Lanterra (2022a) are summarised below, including an analysis of onsite and offsite sampling locations. Refer to Appendix A and C for sample locations and analytical result summary tables.

7.1 Soil Analytical Results

Table 7.1: Summary of Soil Results (mg/kg)

Constituents	Num. of Samples	Max Result	HIL A/ HSL A/B	HIL B/ HSL A/B[1]	HIL D/ HSL D[1]	EIL/ ESL[2]	ML[3]	No. Samples > Criteria (Exceedance)
Arsenic	43	12	100	500	3000	100	-	0
Cadmium	43	0.7	20	150	900	-	-	0
Chromium	43	27	100	500	3600	540	-	0
Copper	43	12	6000	30000	240000	200	-	0
Lead	43	270	300	1200	1500	1100	-	0
Mercury	43	0.15	40	120	730	-	-	0
Nickel	43	9.6	400	1200	6000	150	-	0
Zinc	43	150	7400	60000	400000	460	-	0
F1 TRH C6-C10 less BTEX	43	<25	50 (0-<1m) 90 (1<2m) 150 (2-<4m) 290 (4m+)	50 (0-<1m) 90 (1<2m) 150 (2-<4m) 290 (4m+)	310 (0-<1m) 480 (1<2m) NL (2m+)	180	700	0
F2 TRH >C10-C16 less Naphthalene	43	250	280 (0-<1m) NL (1-4m+)	280 (0-<1m) NL (1-4m+)	NL	120	1000	EIL - GW53 0.0-0.1
F3 TRH >C16-C34	43	1000	-	-	-	1300	2500	0
F4 TPH C34-C40	43	1900	-	-	-	5600	10000	0
Benzene	43	<0.1	0.7 (0-<1m) 1 (1-<2m) 2 (2-<4m) 3 (4m+)	0.7 (0-<1m) 1 (1-<2m) 2 (2-<4m) 3 (4m+)	4 (0-<1m) 6 (1-<2m) 9 (2-<4m) 20 (4m+)	65	-	0
Toluene	43	<0.1	480 (0-<1m) NL (1m+)	480 (0-<1m) NL (1m+)	NL	105	-	0
Ethylbenzene	43	<0.1	NL	NL	NL	125	-	0
Xylenes	43	0.4	110 (0-<1m) 310 (1-<2m) NL (2m+)	110 (0-<1m) 310 (1-<2m) NL (2m+)	NL	45	-	0
Naphthalene	43	<0.1	5 (0-<1m) NL (1m+)	5 (0-<1m) NL (1m+)	NL	170	-	0

Constituents	Num. of Samples	Max Result	HIL A/ HSL A/B	HIL B/ HSL A/B[1]	HIL D/ HSL D[1]	EIL/ ESL[2]	ML[3]	No. Samples > Criteria (Exceedance)
BaP TEQ	43	<0.3	3	4	40	-	-	0
BaP	43	<0.1	-	-	-	0.7	-	0
Total PAH	43	1.8	300	400	4000	-	-	0
PCB	43	<1	1	1	7	-	-	0
Phenol	43	<0.5	3000	45000	240000	-	-	0
OCP (various)	43	<0.1	6-300	10-600	45-3600	-	-	0
OPP (various)	43	<0.2	160	340	2000	-	-	0
VOC (various)	1	<0.1	<0.05-<0.5	<0.05-<0.5	<0.05-<0.5	-	-	0
Bonded ACM (500mL sample)	28	<0.01	0.01%	0.04%	0.05%	-	-	0
Bonded ACM (10L sample)	None analysed		0.01%	0.04%	0.05%	-	-	-
FA and AF (500mL sample)[7]	None analysed		0.001%	0.001%	0.001%	-	-	-
Asbestos identification	28	Not detected	Not Detected	Not Detected	Not Detected	-	-	0

Notes:
1 NEPM (2013) HIL A/ HSL A/B soil vapour intrusion for sandy soil
2 NEPM (2013) EIL/ESL – Urban residential and open public space
3 NEPM (2013) Management limits Residential, parkland public open space, coarse soil
4 Laboratory results for TPH fractions determined prior to 2013 are different to those used in the NEPM (2013). However, older data has been compared to the NEPM (2013) criteria to assist in determining site suitability.
5 HEPA NEMP 2.0 (2020) health investigation level for residential landuse
6 HEPA NEMP 2.0 (2020) ecological guideline value6
7 Reported in laboratory report, noting that this is conservative as AF and FA has been combined, and also noting that WA DoH (2019)/NEPM (2013) require FA to be collected from 10L sample.
Note that some ESL for TRH F2 applies for TRH >C10-C16 without subtraction of naphthalene, and ML for TRH F1 and TRH F2 apply for TRH C6-C10 and TRH >C10-C16 without subtraction of BTEX and naphthalene, respectively.
NL No Limit
- No guideline

7.1.1 Auditor Discussion on Contamination Status of Soil

Based on the number of soil samples analysed across investigation areas, the sampling spread and soil type encountered at the site, the soil has been adequately characterised when the data set is considered as a whole.

From the information presented in Table 7.1 above, the Auditor draws the following conclusions regarding the contamination status of the soils at the site:

- Soil samples were collected between 0 and 4.1 m below ground level, with the majority of analysed samples collected from fill material noting soil samples were not analysed in the later stages of the DSI.
- Concentrations of OPP/OCP, PCB, Phenols, BTEX and asbestos were below the laboratory limit of reporting (LOR). Where detected, the concentrations were below the adopted criteria with the exception of GW53 0-0.1 which was recovered underneath the asphalt during drilling of well GW53 which recorded an F2 concentration of 250 mg/kg above the ESL criteria. Lanterra argue that given that the soil is located underneath the asphalt, it is not considered to pose a risk for the environment.

- PFAS was not analysed in the soils. Given the lack of identification of a local or historically PFAS source during Lanterra's historical review of the site and the low level PFAS detections in groundwater, the lack of PFAS testing in soils is considered acceptable.
- Lanterra limited their analysis of asbestos to identification (presence/absence) which does not meet NEPM (2013) guidelines. While no asbestos was found in the soils analysed, the lack of appropriate analysis is considered to be a non-conformance. Consideration of asbestos in soils is specified in the SMP (Lanterra 2022b) during demolition of the Kippax Health Centre and after material that is suspected of being contaminated has been identified. ACM is to be appropriately disposed of during demolition of asbestos-containing structures, and that the demolition footprint should be confirmed to be free of asbestos contamination.

7.2 Groundwater Analytical Results

Table 7.2: Summary of Groundwater Results (µg/L)

Constituents	Num. of Samples	Fresh Water[1] (µg/L)	ACT AQUA/2 [2] (µg/L)	NEPM (2013) HSL A[3] (µg/L)	NEPM (2013) Drinking Water[4] (µg/L)	Maximum Result (µg/L)	No. Samples > Criteria (Exceedance)
Arsenic	31	24/13[4]	50	-	10	15	1 DW – GW59
Cadmium	31	0.2	0.2	-	2	1	8 AQUA – GW55 (2), GW56, GW59, GW62, GW67, GW69, GW70
Chromium [5]	31	1	2	-	-/50	3	3 FW & 2 AQUA – GW52, GW60, GW65
Copper	31	1.4	2	-	2000	70	24 – site wide
Lead	31	3.4	1	-	10	2	3 AQUA – GW51, GW62, GW70
Mercury	31	0.06	0.1	-	1	<0.0001	0
Nickel	31	11	25	-	20	290	24 – site wide
Zinc	31	8	5	-	-	640	26 – site wide
F1 TRH C6-C10 less BTEX	31	-	-	NL	-	1600	0
F2 TRH >C_{10}-C_{16} less Naphthalene	31	-	-	NL	-	190	0
TRH C_{16}-C_{34}	31	-	-	-	-	1000	0
TRH C_{34}-C_{40}	31	-	-	-	-	<500	0
Benzene	31	950	300	5000	1	5.1	3 (GW1, GW2, GW5 - off site
Toluene	31	180	300	NL	800	<0.5	0
Ethylbenzene	31	80	140	NL	300	<0.5	0
Xylenes	31	350/75/200[6]	-	NL	600	<1.5	0

Constituents	Num. of Samples	Fresh Water[1] (µg/L)	ACT AQUA/2 [2] (µg/L)	NEPM (2013) HSL A[3] (µg/L)	NEPM (2013) Drinking Water[4] (µg/L)	Maximum Result (µg/L)	No. Samples > Criteria (Exceedance)
Naphthalene	31	16	-	NL	-	<0.5	0
Benzo(a)pyrene	6	0.1	-	-	0.01	<0.1	0
Tetrachloroethene (PCE)	31	-	260	-	50	470	9 DW & 4 AQUA – GW51 (x3 and QC1), GW52 (x2), GW58, GW68, GW69
Trichloroethylene TCE	31	-	0.02	-	-	300	12 AQUA – GW51 (x3 and QC1), GW52 (x2), GW58 (x2), GW65, GW66, GW68 and GW69.
Cis-1,2 dichlorothene	31	-	60	-	60	370	4 DW & AQUA – GW58 (x2), GW68 and GW69
Vinyl Chloride	5	-	-	-	0.3	<0.3	0
PFOS	4	0.13[8]	-	-	-	0.084	0
PFOA	4	220[8]	-	-	0.56	0.2	0
PFOS + PFHxS	4	-	-	-	0.07	0.15	5 DW – GW57 (primary and QC1 x 2), GW60, GW67

Notes:
1 NEPM (2013) Fresh water Groundwater Investigation Level and low reliability criteria, which have been updated against ANZG (2018)
2 AQUA/2 Environment Protection Regulation 2005)
3 NEPM (2013) HSL A for vapour intrusion in a sandy soil assuming water level >2 to 4m bgl
4 NEPM (2013) Drinking Water GIL, or NHMRC & NRMMC (2011) Australian Drinking Water Guidelines.
5 Value for Cr (III) / Cr (VI)
6 Value for o-Xylene / m-Xylene / p-Xylene
8 HEPA NEMP 2.0 (2020) ecological water quality guideline value for 95% protection of species.
NL No Limit
- No Guideline

7.2.1 Auditor Discussion on Contamination Status of Groundwater

Based on the number of groundwater samples analysed, the location of monitoring wells and COPC encountered at the site, groundwater has been adequately characterised when the data set is considered as a whole.

From the information presented in Table 7.2 above, the Auditor draws the following conclusions regarding the contamination status of the groundwater at the site:

- Concentrations of heavy metals and VCH compounds in groundwater samples were observed above the adopted criteria for the protection of the human and environmental health on residential sites.
- Concentrations of BTEX and PFAS compounds in groundwater samples were observed above the laboratory limit of report but below the adopted criteria of the investigation

- PCE and TCE in GW51 and GW52 (offsite) were observed above the AQUA/4 criteria. Concentrations in onsite wells GW54 and GW56 were above detection but below criteria. The Auditor agrees with Lanterra conclusions that the source of contamination to the aquifer is offsite, potentially associated with the drycleaner that used to operate in the Kippax Fair Shopping Centre.
- TCE concentrations in onsite wells GW58, GW65 and GW66 exceeded AQUA/4 criteria. The source of VCH is considered to be offsite, and Lanterra considered the most likely source to be an active drycleaner on Hardwick Crescent. Based on the concentrations measured, and the spatial distribution observed in groundwater and soil vapour wells across the investigation areas, Lanterra inferred that the concentrations of contaminants decrease with distance from the contaminant source. The Auditor is satisfied with this conclusion.
- A review by Lanterra of underground services plans in the vicinity of the investigation area did not suggest the likelihood of underground services acting as preferential pathways between the two offsite VCH sources or the site.
- The detections of PFOS + PFHxS at GW57 (offsite), GW60 and GW67 (offsite) marginally exceeded the ADWG (2011) criterion of 0.07 µg/L, recording concentrations of 0.085 µg/L, 0.089 µg/L and 0.15 µg/L respectively. Lanterra do not provide any further comment as to these exceedances. Considering the magnitude of the concentrations, that there are no abstraction wells in the area or down gradient of the site, and that there is a low likelihood that abstraction wells would be installed on-site in the future (with the exception of potential dewatering during construction stages), the Auditor is satisfied that the exceedances do not pose a risk to human health or the environment.

7.3 Soil Vapour Analytical Results

Table 7.4: Summary of Soil Vapour Results (ug/m^3)

Constituents	No of Samples	Max Result	HSL A[1]	HSL D[1]	No. Samples > Criteria (Exceedance)
TRH F1 C6-C10	31	340	230 (0-<1m) 4200 (1-<2m) 9900 (2-<4m) 21000 (4-<8m) 44000 (8m+)	680 (0-<1m) 2800 (1-<2m) 7000 (2-<4m) 15000 (4-<8m) 32000 (8m+)	0 – noting SV01s exceeded HSL A at 0-1 m depth but not exceedance given SV01d sample collected at ~5 m depth
TRH F2 C10-C16	31	2.50	180 (0-<1m) 3800 (1-<2m) NL (2-8m+)	500 (0-<1m) 2400 (1-<2m) NL (2-<4m) NL (4-<8m) NL (8m+)	0
Benzene	31	0.036	1 (0-<1m) 15 (1-<2m) 40 (2-<4m) 90 (4-<8m) 180 (8m+)	4 (0-<1m) 10 (1-<2m) 30 (2-<4m) 65 (4-<8m) 130 (8m+)	0
Toluene	31	0.160	1600 (0-<1m) 23000 (1-<2m) 53000 (2-<4m) 110000 (4-<8m) NL (8m+)	4800 (0-<1m) 16000 (1-<2m) 39000 (2-<4m) 84000 (4-<8m) NL (8m+)	0

Constituents	No of Samples	Max Result	HSL A[1]	HSL D[1]	No. Samples > Criteria (Exceedance)
Ethylbenzene	31	0.520	420 (0-<1m) 6800 (1-<2m) 16000 (2-<4m) 35000 (4-<8m) NL (8m+)	1300 (0-<1m) 4600 (1-<2m) 11000 (2-<4m) 25000 (4-<8m) 53000 (8m+)	0
Xylenes	31	2.23	280 (0-<1m) 4800 (1-<2m) 11000 (2-<4m) 24000 (4-<8m) 50000 (8m+)	HSL D[1]	0
Naphthalene	31	0.006	1 (0-<1m) 20 (1-<2m) 45 (2-<4m) 95 (4-<8m) 200 (8m+)	680 (0-<1m) 2800 (1-<2m) 7000 (2-<4m) 15000 (4-<8m) 32000 (8m+)	0
PCE	31	480	2	8	3 HSL A - SV01s (x3), SV01d,
TCE	31	2	0.02	0.08	4 HSL A - SV01d, SV4d, SV9s (x2)
1,1,1 TCA	31	<.27	60	230	0
Cis 1,2 DCE	31	1	0.08	0.3	1 HSL A - SV4d,
Vinyl Chloride	31	<0.13	0.03	0.1	0 noting detection Limit > criteria

Note:
1 NEPM (2013) HSL A and HSL D adopted due to basement or ground floor low-high density residential and commercial land use, respectively, in clay

7.3.1 Auditor Discussion on Contamination Status of Soil Vapour

Based on the number of soil vapour samples analysed, the location of monitoring wells and COPC encountered at the site, the soil vapour has been adequately characterised when the data set is considered as a whole.

From the information presented in Table 7.3 above, the Auditor draws the following conclusions regarding the contamination status of the soil vapour at the site:

- The general pattern for soil vapour is that concentrations (of both TRH and VCH compounds) decrease with distance from the contamination sources and increase with depth.
- The concentration of TRH F1 in sample SV01d exceeded the HSL A criteria for a depth between 0.0 – 0.1; however noting SV01d was obtained from a depth of 5.6 m bgl.
- Lanterra noted that the laboratory LOR for benzene (160 µg/m3), toluene (190 µg/m3), ethylbenzene (220 µg/m3), total xylenes (430 µg/m3), and naphthalene (130 µg/m3) for samples SV01d and SV01s has been raised due to matrix interference in the samples and thus considered that these (BTEX and naphthalene) may be present in samples SV01s and SV01d.
- The LOR for some VCHs exceeded the criteria, as outlined in Section 5. SAGE accepted these exceedances in the Tier II HHRA as the locations are offsite in relation to the current audit; however, this non-conformance must be considered in any future offsite investigation.

8 Evaluation of Quality Assurance (QA) and Quality Control (QC)

The NSW EPA (2017) requires that an Auditor must check key requirements of the quality assurance and quality control of Consultant's work and makes the following statements:

- The Auditor confirms that the applicability and limitations of field sampling methodology are discussed and addressed in Lanterra's reports;
- The Auditor confirms that Lanterra has ensured adequate calibration of field instruments;
- The Auditor confirms that Lanterra's reports have assessed the significance of the field determination of the results compared with the laboratory results and where not compatible has been explained by the consultant;
- The applicability and limitations of laboratory methodology are discussed and addressed in the consultants' reports. The Auditor is satisfied that a NATA accredited method and laboratories were used by Lanterra;
- The Auditor confirms that the methods used for site investigation are of sufficient precision and accuracy and sensitivity to achieve the assessment of risk;
- The laboratory results meet the accuracy criteria specified by Lanterra for each performance method; and
- Lanterra indicates that the results meet the criteria specified by the consultant in their DQO with some exceptions.

The above statements are based on the tabulated evaluation presented in Table E2 in Appendix E for investigation, remediation and validation works conducted at the site.

9 Human Health Risk Assessment

SAGE Environmental (SAGE) HHRA has been reviewed against the checklist provided in Appendix E of the EPA (2017) Contaminated Land Management Guidelines for the NSW Auditor Scheme (3rd edition) in Table 9.1 below.

Table 9.1: Summary of SAGE (2022) Human Health and Ecological Risk Assessment

Requirement	Consultant Consideration	Auditor Comment
Hazard Identification		
Have all appropriate sources of information regarding chemicals of potential concern been identified and assessed?	Section 1 identifies off site upgradient contamination sources and that the DSI noted no activities that may have introduced VCH on the site and inferred that the source of CoPC identified at the site had originated from off-site sources to the southwest of the site. Table 6 outlines the following sources of contamination and associated chemicals of potential concern have been identified: • VCH off site source - Central western boundary of the site (Kippax Place) and on-Site adjacent to this boundary (GW54), to the south of the Former Kippax Health Centre. Historical contaminant impacts to groundwater generating a plume moving from the shopping centre to the north-east.; • VCH off site source - Areas to the north and south of the Former Kippax Health Centre impacted by soil vapour generated from historical groundwater plume (described above); • VCH off site source - North of the Former Kippax Health Centre within the north-west section of the site. Groundwater impacts generated from an off-Site dry cleaning facility; and • Benzene off site source - off-site groundwater impact to southwest. (Note: The HHRA does not include consideration of this CoPC from an off-site source within the assessment)	The Auditor considers that the chemicals of potential concern have been identified and appraised, noting risk assessment was prepared in conjunction with use of Tier 1 Risk Based criteria.
Has justification been given for the selection of the chemicals of potential concern?	Table 8 of the HHRA outlines the outcomes of the Tier 1 Screening on-site and a discussion of impacts in the relevant media. Table 9 outlines the results for off-site locations noting that SAGE do not provide a quantitative assessment of risk for off-site locations in this HHRA. Section 3.3 lists the COPCs in groundwater and soil vapour selected for HHRA include: • Tetrachloroethene or Perchloroethylene (PCE); • Trichloroethene (TCE); • Cis 1,2-dichloroethene (DCE); • Vinyl Chloride. SAGE acknowledge that as these off-Site sampling locations are hydraulically upgradient from the Site, there is potential for off-Site impacts to continue to migrate towards the Site over time, which may result	Appropriate justification has been presented for selection of COPC for inclusion in the HHERA. The COPCs omitted have been justified.

Requirement	Consultant Consideration	Auditor Comment
	in future on-Site increases in concentrations of CoPC in environmental media	
Toxicological Assessment		
Have all critical toxic effects been identified? Have the effects on each body system (for example renal, hepatic, cardiovascular and developmental) and the types of effects (for example genotoxic and carcinogenic) been summarised?	Section 5 presents the toxicity assessment. Appendix D presents the toxicity profiles. The effects of COPC on body systems are discussed, where relevant, and all critical toxic effects are identified. SAGE acknowledge that PCE has the potential to be genotoxic, some PCE metabolites are mutagenic, and PCE is likely to be carcinogenic in humans by all routes of exposure. However, SAGE assessed PCE based on threshold effects only, following NEPC (2013).	Requirement has been met.
Has the dose-response relationship for chemicals of potential concern been discussed?	Appendix D presents the toxicity profiles, which include discussion of the dose-response relationships for COPC.	Requirement has been met. .
Have all relevant toxicological data been considered and checked for accuracy?	Summary tables of available toxicological data from data source agencies are provided in the toxicity profiles in Appendix D.	The toxicological information relating to each COPC has been selected in accordance with prevailing guidelines at the time of preparation.
Have relevant primary toxicological resources been considered? Has the adequacy of available toxicological database been commented on? Have different toxicity data from different resources been assessed and discussed?	Appendix D presents a summary of data published by sources recognised and endorsed by enHealth, NEPC, and USEPA. Sources for inhalation dose response values include NEPC, RIVM, USEPA, ATSDR, Health Canada, IRIS, and CCME. Section 6.4.2 presents a discussion of uncertainties in the toxicity assessment, including the use of safety factors to account for animal to human extrapolation and other limitations.	The sources are appropriate and reliable. The toxicity data are considered adequate for the COPCs assessed.
Have the selected toxicity data been adequately justified?	Appendix D provides rationale for the adopted toxicity data.	Requirement has been met.
Exposure Assessment		
Has a comprehensive and appropriate conceptual site model been presented that indicates all potential pathways and receptors?	Section 3.4 provides a preliminary conceptual site model of the site. SAGE indicated that the DSI identified inhalation of gases and soil vapour to be the only complete pathway at this Site.	SAGE did not consider shallow or perched aquifers in the risk assessment. In their response to IA06, SAGE note that if such groundwater conditions are encountered, further risk assessments would be required to assess whether this constitutes a complete pathway for exposure via direct groundwater contact.
Have all potential receptors been identified?	Section 3.4 outlines the receptors considered in the HHRA: Current receptors: • On-Site commercial receptors working within the Former Kippax Health Centre, including patrons accessing this centre. • Maintenance workers (e.g. groundskeepers, utility/services workers, cleaners). • General public using the community areas on-Site (north-west corner of Site	The HHERA includes consideration of children, adults, flora, fauna and sensitive ecological receptors which are considered appropriate for the proposed development.

Requirement	Consultant Consideration	Auditor Comment
	where public seating, footpaths and a skate ramp exist). • Patrons passing through the Site to access the shopping centre on the western boundary of the Site (off-Site). • On-Site and off-Site recreational users of the Kippax playing fields. • Off-Site commercial receptors adjacent to the Site. • Off-Site residential receptors at the northern Site boundary. Potential future receptors: • Residential receptors, within ground floor dwellings located at the eastern Site boundary. • Residential receptors, in properties from the first floor with a single basement construction. • Commercial receptors, with and without an underlying basement. • Community use receptors, including child care facilities. • • Intrusive maintenance workers. • General public utilising the public spaces and roadways. • Employees of and patrons to commercial spaces.	
Have the estimates or measured exposure concentrations for each exposure route and chemical of potential concern been identified?	Section 4 presents the exposure assessment. Based on the transport mechanisms identified, SAGE indicated the potential for exposure via the inhalation pathway could occur due to upward vapour migration from the groundwater and through the overlying soil profile. Table 11 presents 5 exposure scenarios: • On-site commercial - Slab on Ground Construction • On-Site Commercial with child care – Slab on Ground Construction • On-Site Commercial – Basement Construction with commercial properties from the ground floor. • On-Site Medium Density Residential – Basement Construction with residential properties from the first floor. • On-Site Ground floor residential on slab (noting that this scenario is not currently planned as per Holt Precinct Code (EPSDD 2020) Recreational receptors were not assessed as part of the Tier 2 assessment as they are considered to have a lower risk profile than the sensitive residential and commercial receptors that have been considered (vapour-phase contaminants are unlikely to accumulate in outdoor environments). SAGE conservatively adopted the highest chemical concentrations reported anywhere on the site for their risk assessment.	The exposure scenarios and exposure point concentrations are considered to be conservative and appropriate as the basis of the risk assessment.
Risk Characterisation		

Requirement	Consultant Consideration	Auditor Comment
Has the acceptable risk level been identified and justified?	Section 6 provides risk characterisation and hazard index estimates, which indicate acceptable risk and hazard indices.	Requirement has been met.
Have all potential receptors and pathways been considered?	The three exposure scenarios and receptors have been considered.	Requirement has been met.
Has the relative significance of each exposure pathway, based on the risk analysis been discussed?	Table 19 presents each exposure pathway considered and the resulting risks. SAGE acknowledges that there is potential for off-Site impacts to continue to migrate towards the Site over time, which may result in future on-Site increases in concentrations of CoPC in environmental media. Section 7 indicated that to limit the potential exposure to vapour at the site, development should consider mitigation measures, like limiting the extent of the basement to areas where contamination levels are lower, or absent.	Requirement has been met.
Has a detailed sensitivity/uncertainty analysis been presented?	Section 6.5 presents a detailed discussion of uncertainty analysis, which considered the following: • Measured concentrations • Depths of impact • Geology • Air exchange rate • Advective flow	The Auditor considers that the HHERA calculations are appropriately conservative for the following reasons: • Consideration of maximum values of COPCs across the whole site • Conservate vapour measurement depths and maximum concentrations considered. • Considered sand and gravel geology which is expected to be conservative. • Assumption of all potential pathways
Equations		
Have all equations used in the risk assessment been presented in the report, dimensionally correct, with correct units and consistent? Have all parameters in each equation been clearly defined with unit conversion factors, where applicable, ~~been~~ included?	Section 6 presents risk characterisation equations. Appendix C presents vapour modelling equations.	Appropriate equations and parameters have been presented. This requirement has been met.
Has all pertinent information been provided to enable calculations to be checked through in a stepwise process?	Appendix E presents risk model calculations.	Requirement has been met.
Data Evaluation		
What were the data collection objectives and are they consistent with the requirements of the risk assessment?	The HHRA has considered soil, groundwater and soil vapour data as reported in investigations across the project area and reported in Lanterra (2022) DSI. Environmental data from these investigations has formed the basis of the risk assessment.	The objectives are consistent with the requirements of the risk assessment and SAR.
Were the laboratory analyses NATA accredited, and QA/QC reported and analysed, field QA/QC reported and analysed, indicated assessments of accuracy made in the risk assessment?	Assessments of QA/QC was discussed in Section 3.2 and within the Lanterra (2022) DSI.	The Auditor considers that this requirement has been met.

Requirement	Consultant Consideration	Auditor Comment
Assessment and Report Preparation		
Has in formation been presented coherently and in an appropriate sequence to enable efficient appraisal of the report?	Yes	The data has been provided in a form that is amenable to review and interpretation.
Have the objectives and scope been clearly indicated?	Section 1.2 indicated the purpose of the HHRA is to provide an assessment of potential human health risk as a result of exposure to site contamination for both current land users and potential future site users based on the Kippax Group Centre Master Plan: Scope of work is not outlined but refers to the Letter of Engagement. Section 1.4 outlines the Structure of the HHRA, considering the required steps	The objective and structure (or scope) is appropriate for the purposes of the audit.
Has the analysis been based on up-to-date literature?	Section 6 outlines the references of the HHRA and Section 6.1 indicated that risk estimates are based on available toxicological studies.	The requirement has been met.
Have all assumptions and default data been identified and justified?	Section 6.4 provides detail of data gaps and uncertainty assessment stating that the heal risk assessment process involves a number of assumptions based on site specific data. The assumptions used were selected to be conservative in nature to evaluate an assumed reasonable maximum exposure scenario and provide a deliberate margin of safety. The assumptions used and referred to in sub-sections of 6.4 have been reviewed. SAGE notes that limited temporal and seasonal soil vapour data is currently available but that the assessment considers the four stage DSI data collected between April 2021 and March 2022. The key uncertainties include the available data set, noting there is potential for off-Site impacts to continue to migrate towards the Site over time. Therefore, future increases in concentrations of CoPC in environmental media on-Site may affect the potential risk to human health.	All assumptions are appropriate.
Have all tables and figures been referred to correctly in the text of the report?	Tables and figures are presented in the SAGE report.	This requirement has been met.
Has adequate data been presented to support the conclusions?	The HHRA has utilised results from the previous investigations, and has acknowledged data gaps, and made appropriately conservative assumptions to account for data uncertainty.	The Auditor considers the data used in the risk characterisation (site-specific and published sources) was appropriate and suitable for the purpose of assessing the potential contamination risks to the most sensitive future land uses permissible under the zoning, including commercial, residential, child care facility, indicting tolerable concentrations not exceeded.

9.1 Auditor Comments on the HHRA

The table above presents an assessment of the key components of a risk assessment. Where the check reveals SAGE's assessment omitted key components, an evaluation has been made as to acceptability or otherwise.

The Auditor notes that the risk assessment was limited to consideration of health risks and excluded ecological risks. The soil investigation results indicated a negligible ecological risk. The closest likely receiving environment for contaminated groundwater is Ginninderra Creek approximately 500 m north of the site. There were no groundwater contamination issues identified to be attributable to the audit site, and it is expected that even the residual VCH concentrations present beneath the site from upgradient sources would significantly attenuate before reaching the creek and would be likely to pose a negligible risk to the aquatic ecology of the creek. Accordingly, the Auditor is satisfied with the exclusion of ecological risks from further consideration, and the focus on health risks.

It is considered that the risk assessment is appropriate for consideration of the proposed redevelopment of the site for multiple land uses, in particular CZ1: Core Zone and PRZ1: Urban Open Space which allow for both commercial and residential land uses. The five scenarios are appropriate:

- On-site commercial - Slab on Ground Construction
- On-Site Commercial with child care – Slab on Ground Construction
- On-Site Commercial – Basement Construction with commercial properties from the ground floor.
- On-Site Medium Density Residential – Basement Construction with residential properties from the first floor.
- On-Site Ground floor residential on slab (noting that this scenario is not currently planned as per Holt Precinct Code (EPSDD 2020)

Noting recreational receptors were not assessed as part of the Tier 2 assessment, as were considered to have a lower risk profile than the sensitive residential and commercial receptors that were considered.

The Auditor is satisfied with the conclusions of the Tier II HHRA, that the VCH concentrations in soil vapour and groundwater present a low risk (tolerable concentration not exceeded) of harm to the health of residents, commercial workers, and recreational receptors at the Site, considering the highest concentrations of the chemicals of concern identified anywhere on site. However, it is noted that the hazard index for Scenario 5 had the highest estimate of all scenarios (0.31 for adult receptors and 0.76 for child receptors), which was attributable to the smaller internal air volume of a residential structure and the absence of a ventilated basement carpark.

The Auditor notes that although there are no unacceptable contamination risks associated with the site in its current condition, the nature and extent of contamination and proximity to receptors must be re-evaluated as part of any future development of the land. This requirement is specified in the SMP, and the Auditor understands that compliance with the SMP will be a condition of approval for any future development applications for the land.

10 Evaluation of Site Management Plan

The Auditor has reviewed the Lanterra (2022c) Site Management Plan (SMP) with reference to the requirements in Sections 3.4.2, 3.4.5, 3.4.6, 4.3.3 and 4.3.4 of the EPA (2017) Guidelines for the NSW Site Auditor Scheme (3rd Edition) and NSW EPA (2020) Consultants Reporting on Contaminated Land - Contaminated Land Guidelines.

A summary of the key considerations is provided in Table 10.1. A copy of the SMP is attached to the SAS and is included as Appendix F in this report. .

Table 10.1: Review of Lanterra (2022b) SMP

Requirement	SMP	Auditor Comment
Title and Status	The title of document is: Site Management Plan, Blocks 22 and 71, Section 51, Holt (Ref: P22067_SMP_20222707_R07), dated 27 July 2022	Acceptable.
Purpose		
Objectives of the SMP	Section 1.2 states "The objective of this SMP is to identify the location of VCH contamination and provide management requirements for preventing unacceptable exposure to contamination for the land uses permitted under the CZ1: Core Zone and PRZ1: Urban Open Space.	The objective stated is acceptable.
Timeframe of the Implementation of SMP	Section 5 states that the SMP shall remain in perpetuity until such time that the following conditions have been met: • The known contamination on the site has been reduced to concentrations that are considered to be acceptable and no longer pose a risk to human health or the environment. • Any proposal to terminate the SMP must be prepared by a suitably qualified environmental consultant. The proposal must document the details for the request to terminate the SMP including a demonstration that contaminant concentrations are acceptable and ongoing management is not required. • The Auditor must agree that the requirements of the SMP are no longer required. • Written approval from the ACT Environment Protection Authority advising that the SMP is no longer required has been issued.	The timeframe identified is acceptable.
Is the SMP active/passive?	The SMP provides passive mitigation measures to manage activities such as maintenance work in service pits, future redevelopment, etc.	The passive management approach is considered to be appropriate for the purpose of the SMP
Mechanism to make SMP legally enforceable	The legal enforcement mechanism is referenced to the provisions of the Section 9.3.8 of the Contaminated Sites Environment Protection Policy (CSEPP). For sites requiring ongoing management on unleased Territory land, on leased land being managed by an ACT government agency or on leased land subject to interim development (for example, Greenfields developments, multi-unit developments or mixed use developments which are subject to interim development prior to the land's sale and/or the establishment of the Body Corporate) an Agreement under Section 38 of the Environment Protection Act should be entered into between the EPA and the land custodian. The Agreement will detail the nature of the substances remaining at the site (or off site), specific site details and the required management measures.	The mechanism stated is appropriate

Requirement	SMP	Auditor Comment
	The Agreement would include a requirement that the site be managed in accordance with the EPA/Auditor endorsed SMP and that management continues until the EPA and the Auditor agree in writing that the SMP is no longer required.	
Parties responsible for the review and implementation of the SMP	Section 4.1 states that TCCS and ACT Property Group are responsible for implementation of the SMP for Kippax Place Rd, Block 71 and Block 22. TCCS is the custodian for the playing fields and vacant land to the north. TCCS is also responsible for Kippax Place; however, Kippax Place is not a subject of this SMP. ACT Property Group is the custodian of the Kippax Health Building. Section 4 states that a suitably qualified environmental consultant is responsible for any proposal to amend or terminate the SMP, and any such proposal must be reviewed and endorsed by an ACT EPA approved environmental auditor and endorsed by the ACT EPA.	The parties identified to review and implement the SMP are acceptable,
Where will the SMP be recorded? How will this SMP be publicly notified?	Section 2 states that tor sites where land custodianship falls to business units within the ACT Government Directorates, the Agreement would also specify that these management requirements be recorded in the TCCS Integrated Asset Management System in accordance with its Procedure for the Management of Contaminated Assets Version 1.2 dated 31 May 2013 (as updated from time to time). The transfer of responsibility for SMPs subject to an Agreement (or Environment Protection Order) can only occur with the written acceptance of the EPA. Section 4.1 states that it is recognised that custodians may have their own management systems for managing health and safety risks on their properties and where appropriate, this SMP should be added to these risk systems.	The method of notification is appropriate.
Is the SMP to be registered with the DBYD database?	Section 4.1 states that TCCS are to record the site in their integrated asset management system to ensure that service providers or other contractors are notified of the SMP through the DBYD system.	Accepted.
Background		
Does the report provide adequate site background?	The site identification and background is presented in Section 3. Site layout is provided in Figure 2.	Sufficient detail of the site background is included in the SMP.
Description of existing/residual contamination		
The nature and location of the residual contamination on site	Described in Section 3.5, with extent of groundwater and soil vapour contamination presented in figures 3 and 4, respectively.	Residual contamination is appropriately documented.
Geology and hydrogeology (relevant to SMP)	Section 3.4 and 3.5 provide a brief review of geology and hydrogeology of the region.	The overview is accepted.
Management activities		
Activities and procedures to manage contamination	Section 6 outlines management requirements within the following scenarios: • General Surface Activities • Maintenance Works in Service Pits • Potential interactions with groundwater • Maintenance of playing field irrigation systems • Ongoing groundwater and soil vapour monitoring • Demolition of the health centre	Activities and procedures are clearly identified. The monitoring program is to commence upon the ACT EPA providing written endorsement of the SMP.

Requirement	SMP	Auditor Comment
	• Future use of the former Kippax Health Centre • Removal and Disposal of Soil from Site • Requirements for future development	
How is off site migration of contamination being managed?	Not specifically addressed. Section 6.3 states that no indications of migration of VCH vapours were detected within the Kippax Health Centre. Section 2 states that based on the results of the detailed site investigation, the ACT EPA has been notified of the contamination in accordance with the requirements of Section 23A of the Environment Protection Act 1997.	The VCH groundwater and soil vapour plumes are originating from an offsite source. Risks to current and future site users are managed through implementation of the SMP.
Management structure and responsibilities	Responsibilities of different parties are provided in Section 4	Management responsibilities documented are acceptable.
How the SMP sits within the environmental management system (EMS)	Not provided	The absence of the information is unlikely to affect the outcome of the Audit.
Monitoring of site conditions and site management measures	Section 6.5 states that monitoring of groundwater and soil vapour wells in Kippax Place and the perimeter of the Health centre will be required prior to any future development to assess seasonal contamination concentrations. The frequency of monitoring is to be quarterly for 2 years to assess the behaviour of groundwater and vapour as a function of seasonal variation and can be reduced to annual sampling to monitor stability of contaminants in groundwater and soil vapour. An SAQP must be prepared and reviewed by the site auditor prior to implementation. Section 4.1 states that the custodians have the responsibility to ensure ongoing monitoring programs are implemented and complete.	Accepted. The SMP refers to the SAQP and provides timeframe for this monitoring.
Approval and licensing requirements	Section 9 outlines references and legislations considered in the development of the SMP, including: • ACT EPA (2009) 'Contaminated Sites Environment Protection Policy' • ACT EPA (2019) 'Information Sheet 4 - Requirements for the Reuse and Disposal of Contaminated Soil in the ACT' • ACT EPA (2019) 'Information Sheet 5 – Requirements for the Transport and Disposal of Asbestos Contaminated Wastes' • ACT EPA (2019) 'Information Sheet 11 – Environment Protection Authority Report Submission Requirements' • ACT Government 'Work Health and Safety Act 2011' • ACT Government 'Work Health and Safety Regulation 2011' • Safe Work Australia (2018) 'Confined Space Code of Practice' • NEPM 1999 (amended 2013)	Assessment of approval and licencing conditions is acceptable.
How the SMP is consistent with conditions of consent (if applicable)	Not applicable	Not applicable
Reporting requirements for SMP implementation	The reporting requirements are summarised in Section 8 of the SMP and include the following: • Changes to the SMP • SAQP for the ongoing monitoring program • Monitoring reports following each monitoring event • Indoor air sampling report if the former health centre building is proposed to be reoccupied	The reporting outlined is acceptable.

Requirement	SMP	Auditor Comment
	• Validation reporting for the footprint of the former health centre building if it is demolished • Reporting related to on-site reuse or off-site disposal of soil • Verification report following completion of any future development of the land, documenting the implementation of the SMP and verification that the land remains suitable for the permissible land uses under the zoning.	
Communications protocols	Section 4 states the custodians are responsible for implementation and management of the SMP including ensuring all workers understand the requirements of the SMP and are inducted appropriately. The Confined spaces (Appendix B) protocol outlines specific communication procedures when working in confined spaces	The communication protocol is acceptable.
Emergency contacts and response	Not addressed in the SMP The confined spaces (Appendix B) protocol outlines specific emergency procedures when working in confined spaces	The lack of emergency contacts specific to the SMP are accepted given that all contractors and sub-contractors will have their own safety and emergency contact procedures in place.
Operating hours (if applicable)	Not applicable	Not applicable
Contingency plans (if applicable)	Not applicable	Not applicable
Monitor and review of SMP		
Schedule for SMP review	Section 5.2 states that the SMP must be reviewed annually to ensure that the requirements are current and relevant. The section provides a list of events that will require updates to the SMP: • Substantial new findings, including Section 3.8 – Nature of Contamination • Any modifications to roles and responsibilities • Updates to the management measures • Updates to reflect changes to relevant ACT legislation, policies or guidelines.	The schedule of SMP review is appropriate.
Notification to regulator and consent authority to amend or end management activities	Section 6.10 provides requirement to notify the relevant planning authority when revised version of the SMP has been approved by an accredited contaminated lands site auditor. The EPA must provide written support of the proposed changes.	Notification requirements are appropriate.
Communications and notifications		
List of stakeholders	List of stakeholders is provided in Section 4, and includes: • Current site owners / Land Custodians • Future site owner (subsequent registered proprietor) • Service providers • Environmental Consultant • Contractors, subcontractors, and their Employees • EPA Approved Environmental Auditor • ACT EPA	Stakeholders identified are appropriate.
Details for how stakeholders (and potential purchasers) will be informed of residual contamination and SMP	Section 4.1 states that the custodians are responsible for providing the SMP to any organisation or person including representatives of the site custodian, earthworks contractors, builders, utilities or communication workers of	The process of how stakeholders and future owners are informed is appropriate.

Requirement	SMP	Auditor Comment
	the SMP and maintain records related to inductions and understand the requirements of the SMP. Section 4.7 states that where there is a change in custodianship, then representatives of the new custodian must be inducted into the SMP. Section 5.2 states that the new custodian/lessee must acknowledge in writing that they will assume responsibility for the SMP which is to be supported in writing by the EPA.	
How SMP is communicated and made enforceable/implementation	Section 4.1 states that the custodians are responsible for the implementation and management of the SMP. They must ensure that all workers are inducted and understand the requirements of the SMP.	The process is appropriate
Details for informing stakeholders of changes to activities and responsible parties	Section 4 states that the custodians are responsible to ensure the SMP is maintained and updated. They are to keep records of changes to the SMP and subsequent approvals from the auditor and EPA must be maintained. They are to ensure that workers comply with the requirements and that it is provided to any organisation or person including representatives.	The process of how future stakeholders are informed of change to activities is appropriate
Is the SMP a stand alone document?	-	The SMP is a standalone document.

11 Compliance with Regulatory Guidelines

Guidelines currently approved by the ACT EPA under Section 105 of the CLM Act are listed in Section 1.2 of this audit report. Where relevant, the Auditor has used this guideline in assessing the works conducted by the consultants.

The consultant's departures from the above guidelines are discussed in the preceding sections of this audit report. The Auditor considers that these departures do not detract from the quality of the data set or any associated conclusions made for the purposes of this audit.

The Auditor considers that the work completed by Lanterra was of sufficient quality to achieve the objectives of the works completed and to assist the Auditor in preparing site audit documentation to form an opinion on site suitability.

12 Assessing Urban Redevelopment Sites

The NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition) describes that in assessing the suitability of a site for an existing or proposed land use in an urban context, Auditors should ensure that the contaminated land consultants have followed the decision process for assessing urban redevelopment sites (Appendix A of EPA 2017).

For the purposes of the following assessment, the proposed land use of the site is a mix of future commercial, high density residential and recreational/open space land use.

The Auditor provides the following comments:

- Lanterra's (2022a) DSI, SAGE's (2022) HHRA, and the Lanterra (2022b) SMP follow applicable guidelines listed in Section 1.3. The departures from the guidelines are listed in the preceding sections of the report. Where departures were noted, these results were discussed and either included considering the shortcomings or omitted from consideration. Notwithstanding these departures, there is sufficient information provided to enable a conclusion to be made on the suitability of the site.
- NSW EPA (2020) provides guidance on site contamination assessment and reporting requirements. Lanterra has identified contaminants of concern, with the appropriate sampling methodologies as outlined in NEPM (2013) and identified potential off-site sources. The Auditor considers that NSW EPA (2020) has been followed through the soil, groundwater and soil vapour investigations.
- Aesthetic inspections were carried out by the environmental consultant throughout investigation activities.
- The soils have been assessed against the health-based investigation levels for low density residential land use with access to soils (NEPM (2013) HIL/HSL A), being the most sensitive land use category. As well, the assessment of data considered the ecological criteria of EIL/ESL (for urban residential and open space) adopted from NEPM (2013). The Auditor is satisfied that suitable risk based assessment was conducted regarding residual fill materials and potential migration of contamination from on-site soils to groundwater has been considered.
- The groundwater was assessed against the NEPM (2013) HSL A for vapour intrusion and the ANZG (2018) 95% LoP for fresh receiving waters. Additionally, groundwater was assessed against the NHRMC 2011, Australian Drinking Water Guidelines, the ACT AQUA/4 (2005) for Urban Drains and Streams and PFAS NEMP 2.0 Human health and ecological water quality guideline values
- VCH soil vapour have been assessed against NEPM (2013) HSL A and D for vapour intrusion.
- Any issues relating to local area background soil concentrations that exceed appropriate site soil criteria have been addressed in the site assessment reports.
- To the extent practicable, human health impacts of chemical mixtures have been assessed.
- A site management plan is required. Refer to Section 13 of this SAR below.
- There is evidence of migration of contaminants onto and then potentially off of the site. The Auditor has advised EPSDD that the lessees of potentially affected land adjacent to the site should be notified of the potential contamination risk, and that ACT EPA should also be notified in accordance with the CSEPP.

13 Auditor's Assessment of Risk

13.1 Risk to human health, structures and the environment arising from the actual or potential contamination of the land

Lanterra (2022a) identified the risk from contact with contaminated groundwater is currently low given the depth to groundwater prevents direct contact and that the only reasonable exposure pathway on site is via inhalation of vapour-phase volatile contaminants derived from contaminated groundwater. ; An assessment of indoor air and sub slab sampling within the health centre confirmed the concentrations are currently low (acceptable).

SAGE (2022) concludes that the volatile chlorinated hydrocarbons (VCH) identified in soil vapour and groundwater at the site are likely to present a low risk (tolerable concentration not exceeded) of harm to potential future health of residents, commercial workers, and recreational receptors at the Site, based on Tier 1 and Tier 2 assessment of the highest concentrations of the chemicals of concern identified (Section 7).

Site workers and engaged sub-contractors or any of the service providers required to undertake work on utilities within the contaminated areas of the site will be required to comply with the Site Management Plan developed by Lanterra (2022b) to ensure unacceptable exposure to contamination is prevented through appropriate management measures for the permissible land uses at this site.

13.2 Potential for off-site migration of contamination and duty to report guidelines

Volatile chlorinated hydrocarbons (VCH) in soil vapour and groundwater have been identified at elevated concentrations both on and off of the audit site:

- Concentrations of Perchloroethylene (PCE) and its degradant products trichloroethene (TCE) and 1,2 cis dichloroethane (cis 1,2 DCE) exceeded the adopted ADWG 2011 criteria and the ACT AQUA/4 (2005) for Urban Drains and Streams in groundwater within the central western boundary of the site and to the south of the existing Kippax Health centre. The current conceptual model suggests that historical contaminant impacts to groundwater are generating a plume which is moving from the vicinity of the shopping centre to the north-east across the site.
- Concentrations of TCE exceeded the adopted ADWG 2011 criteria and the ACT AQUA/4 (2005) for Urban Drains and Streams in groundwater north of the existing Kippax Health centre within the north-west section of the site. Groundwater impacts generated from an off-Site dry cleaner.
- Concentrations PCE, TCE exceed the adopted NEMP (2013) HSL A and HSL D criteria in soil vapour sampled in areas to the north and south of the Kippax Health Centre, described above. It is inferred that the source of the vapour is the groundwater plumes, described above.

Based on the available data the Auditor agrees with SAGE (2022) that, the volatile chlorinated hydrocarbons (VCH) in soil vapour and groundwater at the Site are likely to present a low risk (tolerable concentration not exceeded) of harm to potential future health of residents, commercial workers, and recreational receptors at the Site, based on Tier 1 and Tier 2 assessment of the highest concentrations of the chemicals of concern identified anywhere on site but that a Site Management Plan is required to outline management requirements should access to underground services or soil disturbance be required.

The soil vapour investigations identified concentrations of VCH compounds above the HSL A and HSL D criteria for residential and commercial/industrial uses to the north and south of the old Kippax Health Centre. It is inferred that the source of the vapour in soil was VCH in groundwater.

The Auditor advised EPSDD of the duty to notify EPA of the existence of contaminated land in accordance with section 7.3.1 of the CSEPP.

13.3 Requirement for any ongoing management of residual contamination

Given the contamination encountered in soil vapour and groundwater on the site, the Auditor agrees that management is required should access to underground services or soil, and possibly groundwater disturbance be required.

As stated in Section 13.2, ongoing management of residual contamination must be managed in accordance with the Lanterra (2022b) SMP presented in Appendix F.

14 Site Audit Conclusions

The ACT Government Environment, Planning and Sustainable Development Directorate (EPSDD), commissioned this non statutory audit to provide an independent review of the appropriateness of environmental works completed at Block 22 and Block 71, Section 51 Holt, ACT 2615 ('the site'). The boundary of this Audit is shown in the attached Survey Plan.

This Audit provides an opinion on whether the site is suitable for the land uses permissible under the current Zoning CZ1 (Core Zone) and whether it is suitable to divest the site for a future Kippax Group Centre which may comprise a new mixed-use development (residential, commercial and open space).

The historical land uses identified potential contaminants of concern (COPC) including M8, TPH, BTEX, PAH, OCP, OPP, , PFAS and asbestos. The consultant has assessed the identified COPC in soil, groundwater and soil vapour.

Based on results of their multi staged detailed site investigation, Lanterra concluded that the soil has not been impacted by the historical or current activities. However, groundwater and soil vapour in the central-west and northwest portions of the site are impacted with VCHs, likely to originate from off-site locations to the west and / or southwest of the site. They conclude that although the exposure pathway between impacted groundwater and human receptors through dermal contact or ingestion is considered incomplete, the presence of VCH compounds at the measured concentrations in groundwater serve as a source for soil vapour beneath the site.

The measured concentration of VCH compounds in soil vapour at the site indicated that there may be an unacceptable risk to human health for future development. A conservative Tier II human health risk assessment was completed by SAGE to quantify the potential risk to future uses. The HHRA concluded that the VCHs in soil vapour and groundwater at the site are likely to present a low risk (tolerable concentration not exceeded) of harm to the health of residents, commercial workers, and recreational receptors at the Site, considering the highest concentrations of the chemicals of concern identified.

Lanterra (2022a) do state that based on the lateral extent of VCH compounds measured in groundwater and soil vapour, the elevated concentrations may pose a human health risk to the occupants of the adjacent properties, most notably the adjacent commercial properties located on Blocks 59, 61, 65 and 76 Section 51 Holt and the residential properties located to the north on Block 60 Section 51 Holt.

Lanterra (2022b) developed a Site Management Plan which summarises the distribution of contamination at the site and outlines the management measures required to prevent unacceptable exposure to contamination for the permissible land uses at this site. The SMP and its mitigation measures are to be considered in the re-development planning stages for the site.

The investigation, risk assessment and management reviewed are considered to have met the requirements of ACT EPA endorsed land contamination guidelines, the procedures outlined in the ACT EPP (November 2009), and the objectives of the Site Audit. Where the consultant's work deviated from the guidelines, the Auditor has discussed this within this audit report and is satisfied that these omissions do not affect the conclusions of the Audit.

On this basis a Section A SAS will be issued certifying that, in the opinion of the Auditor, the site is suitable for the permissible land uses within current Zoning CZ1 (Core Zone) for Block 22 and CZ1 and PRZ1 (Urban Open Space) for Block 71, subject to the implementation of the SMP (Lanterra 2022b).

The Auditor notes that although there are no unacceptable contamination risks associated with the site in its current condition, the nature and extent of contamination and proximity to receptors must be re-evaluated as part of any future development of the land. This requirement is specified in the

SMP, and the Auditor understands that compliance with the SMP will be a condition of approval for any future development applications for the land.

15 Other Relevant Information

This Audit relates only to those matters relevant to the EP Act 1997, which describes that “The general object of this Act is to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3”. The SAS and SAR do not seek to provide an opinion regarding other aspects of the environment not related to site contamination, to the suitability of the site in regard to the occupational health and safety legislation, or in regards to the suitability of the engineering design.

Not all environmental issues as stated in the EP Act 1997 have been audited, only soil, groundwater, soil vapour and odour issues. The SAS and SAR do not seek to provide an opinion regarding other aspects of the environment not related to site contamination, to the suitability of the site in regard to the occupational health and safety legislation, or in regard to the suitability of the engineering design.

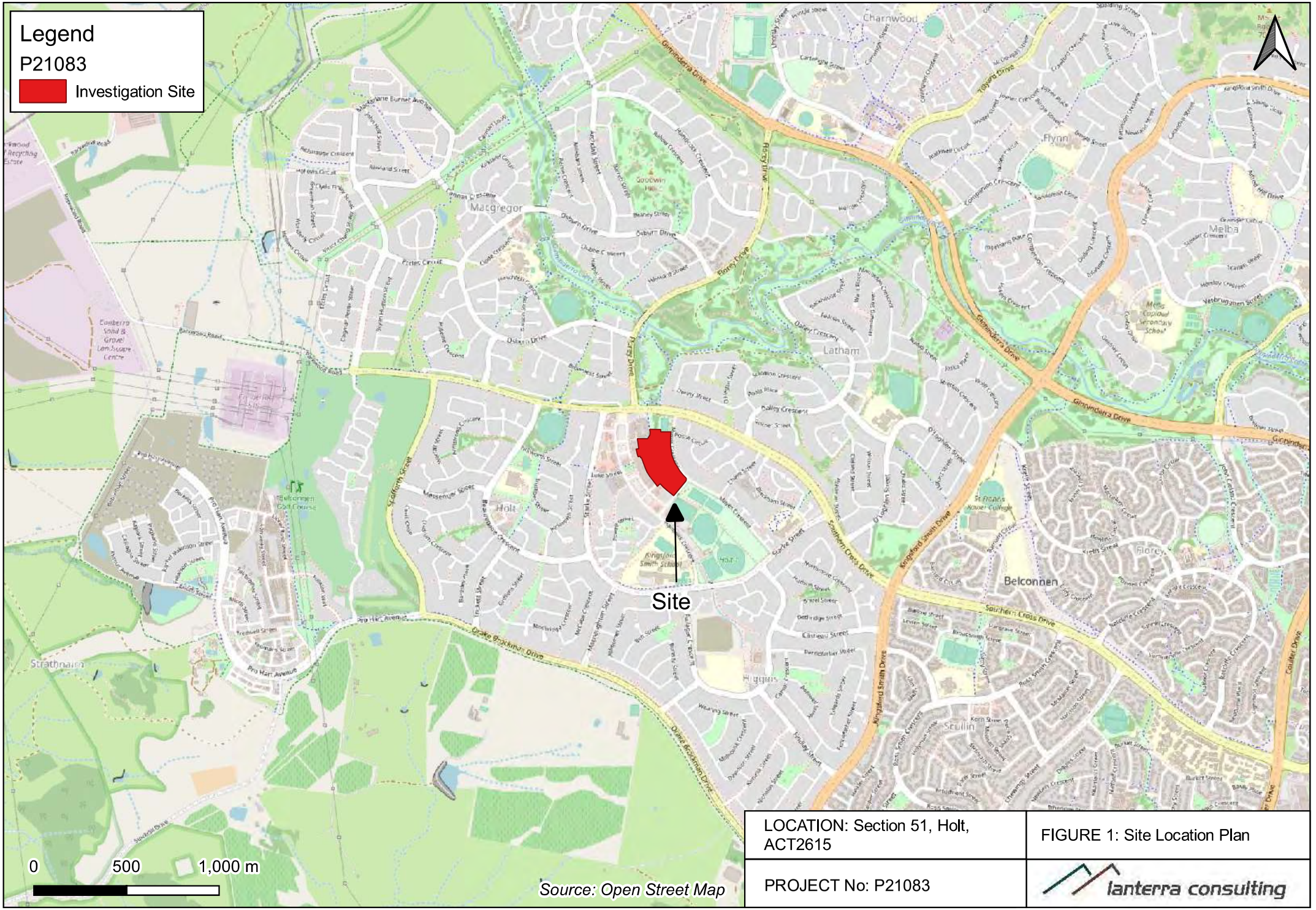
By definition, auditing involves the review and critique of Consultants’ work, including site histories, site surveys, subsurface investigations, chemical and physical analyses, risk assessments and modelling. Accordingly, the Auditor relies on the experience, expertise and integrity of the relevant organisations. The information sources referenced have been used to determine site history and local subsurface conditions. While the Auditor has used reasonable care to avoid reliance on data and information that is inaccurate or unsuitable, the Auditor is not able to verify the accuracy or completeness of all information and data made available.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants.

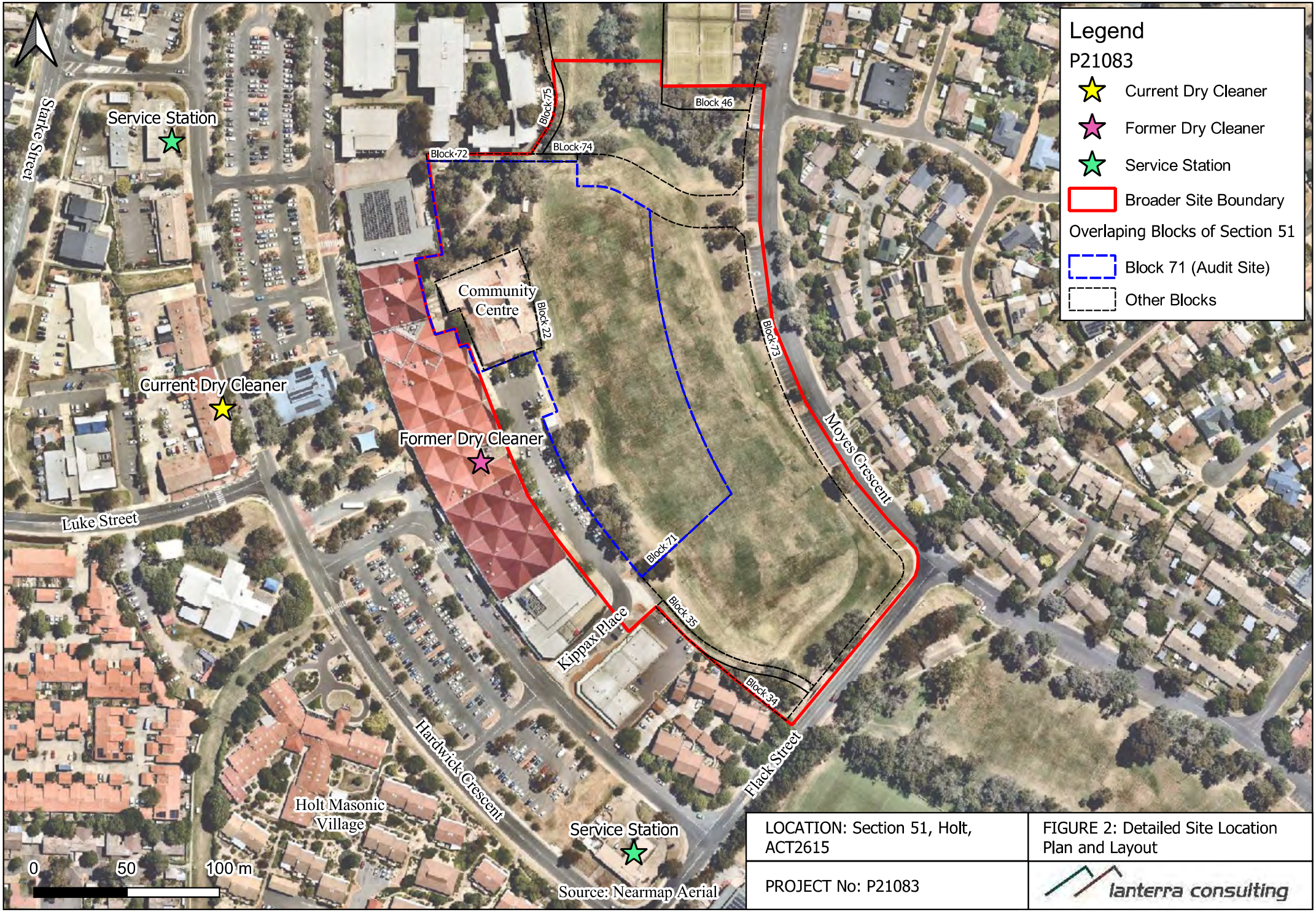
Environmental sampling and laboratory analyses were undertaken as part of the investigations reviewed by the Auditor, as described herein. Ground conditions between sampling locations may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site which was not identified in the site history.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this site audit are based on the information provided at the time of the investigations.

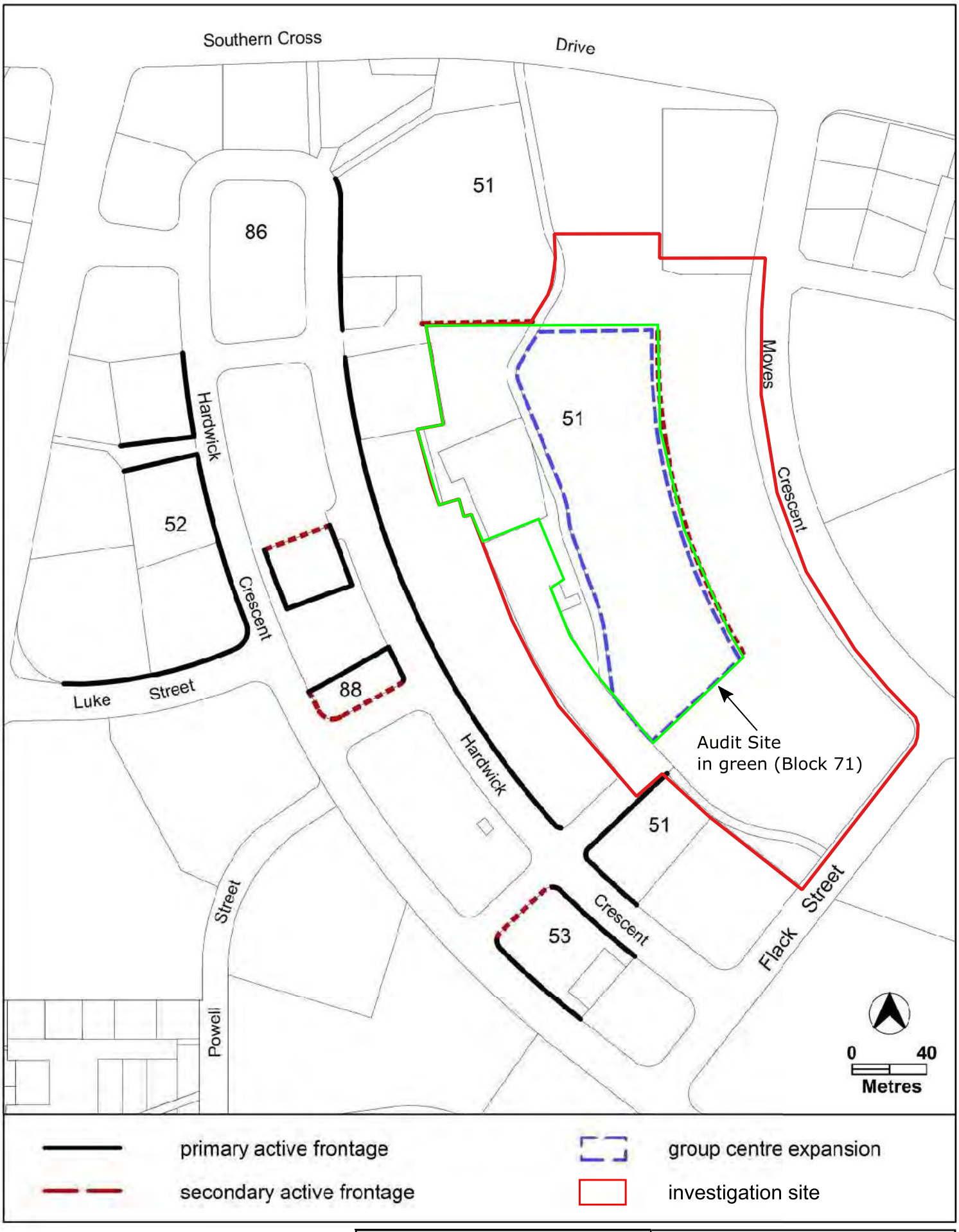
Appendix A Figures



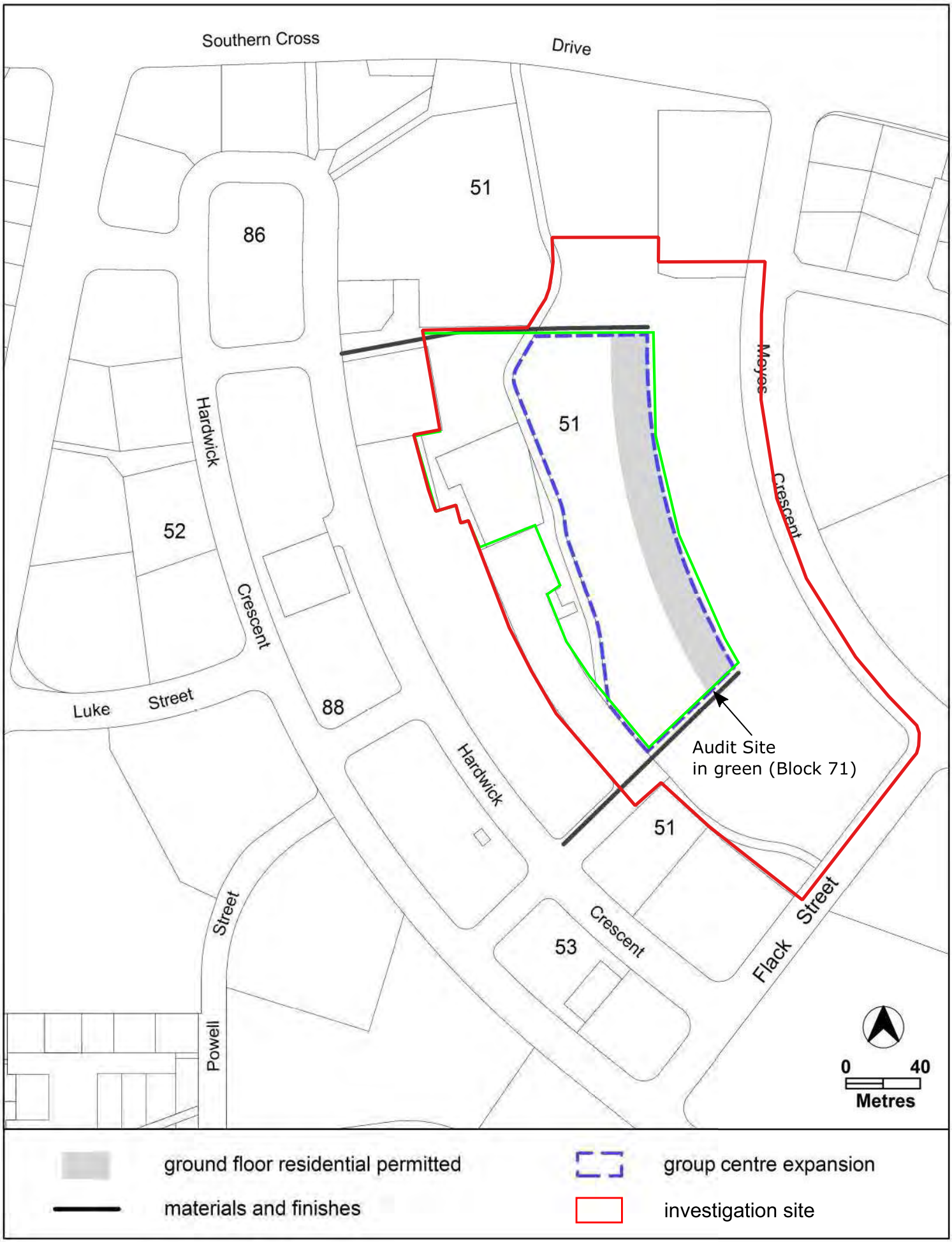
LOCATION: Section 51, Holt, ACT2615	FIGURE 1: Site Location Plan
PROJECT No: P21083	ianterra consulting



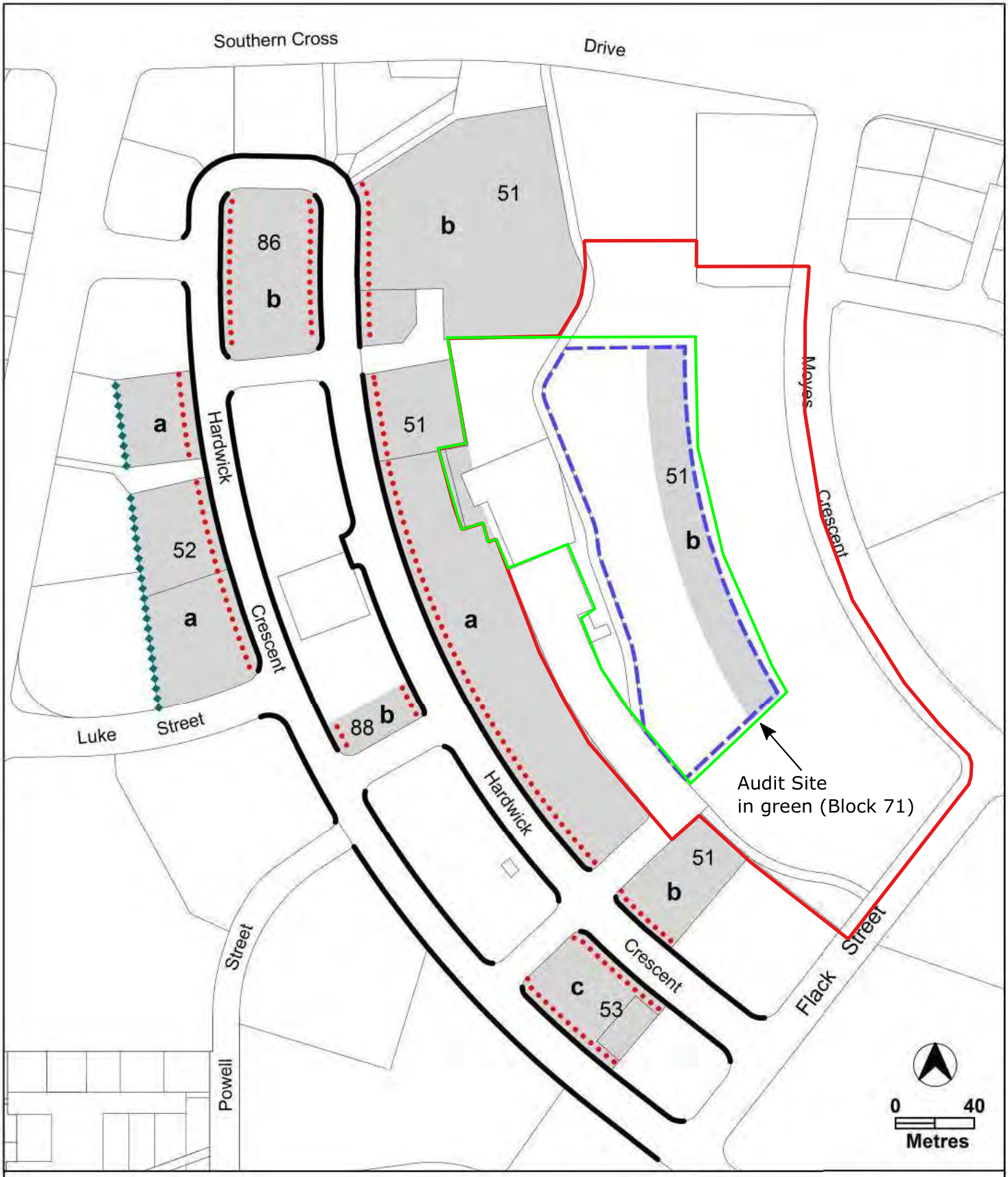
LOCATION: Section 51, Holt, ACT2615	FIGURE 2: Detailed Site Location Plan and Layout
PROJECT No: P21083	Ianterra consulting



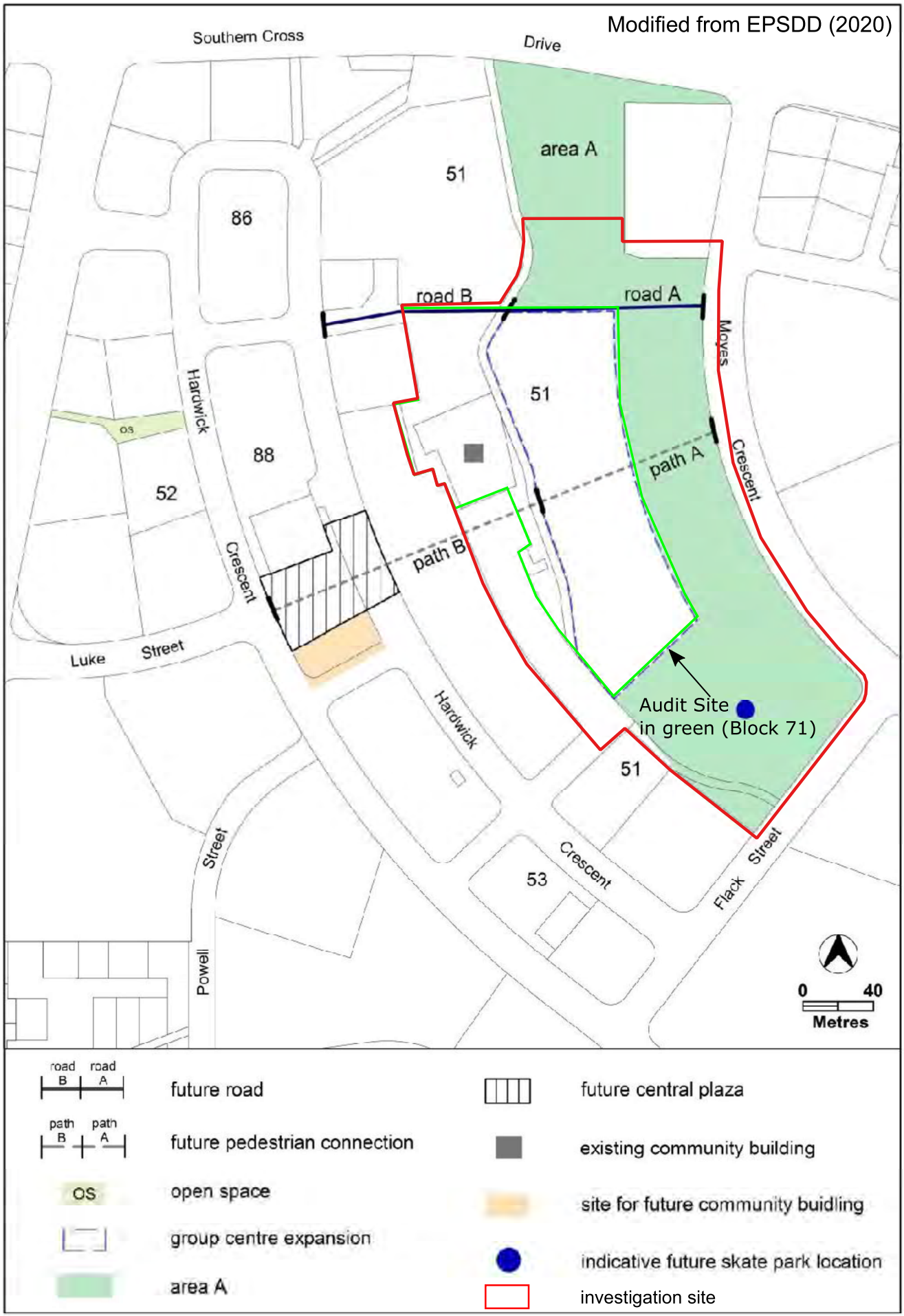
LOCATION: Section 51, Holt, ACT2615	FIGURE 3a: Active Frontages - modified from EPSDD (2020)
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 3b: Groundfloor uses and built form - modified from EPSDD (2020)
PROJECT No: P21083	lanterra consulting



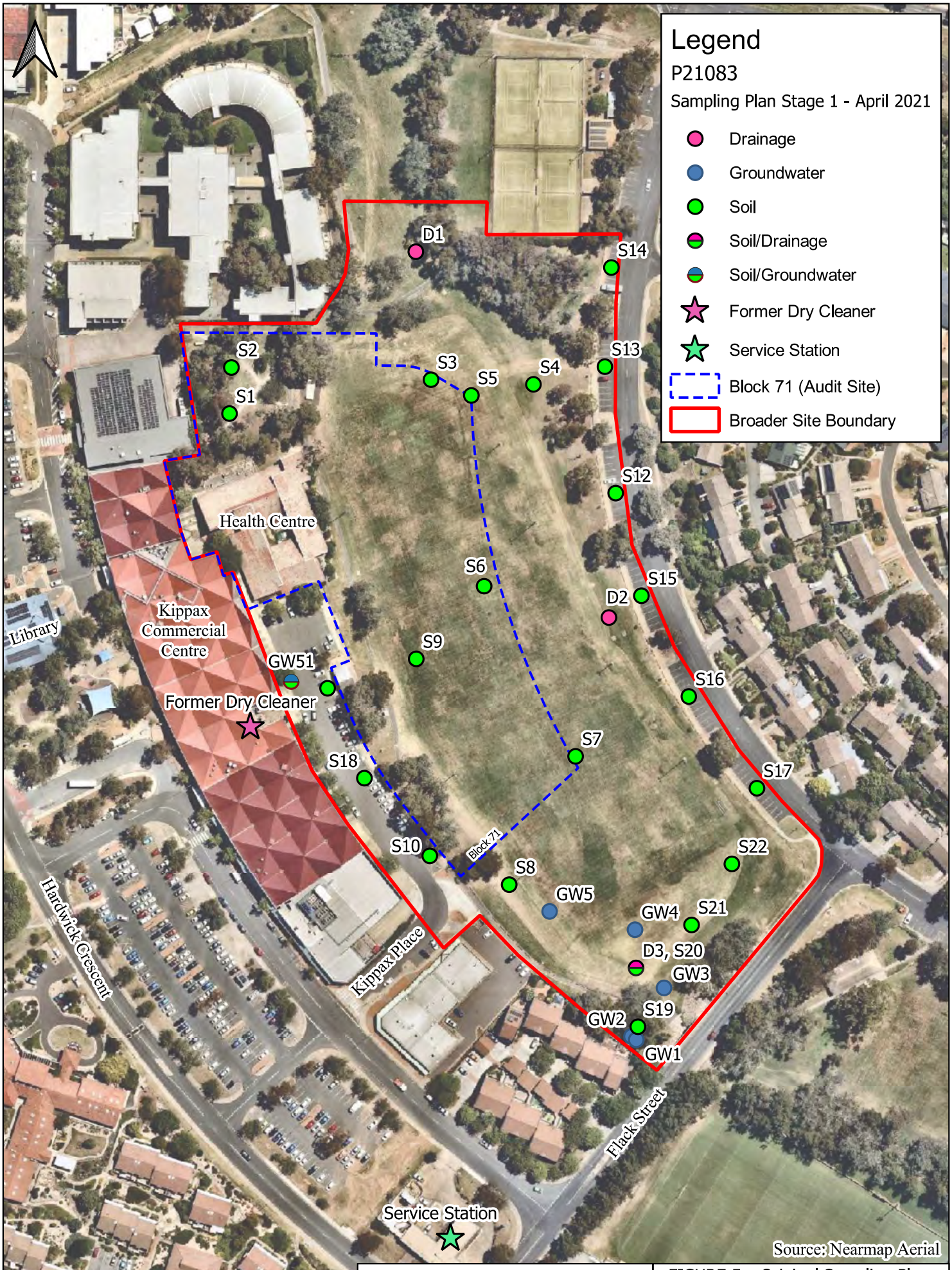
LOCATION: Section 51, Holt, ACT2615	FIGURE 3c: Building heights and set backs - modified from EPSDD (2020)
PROJECT No: P21083	lanterra consulting



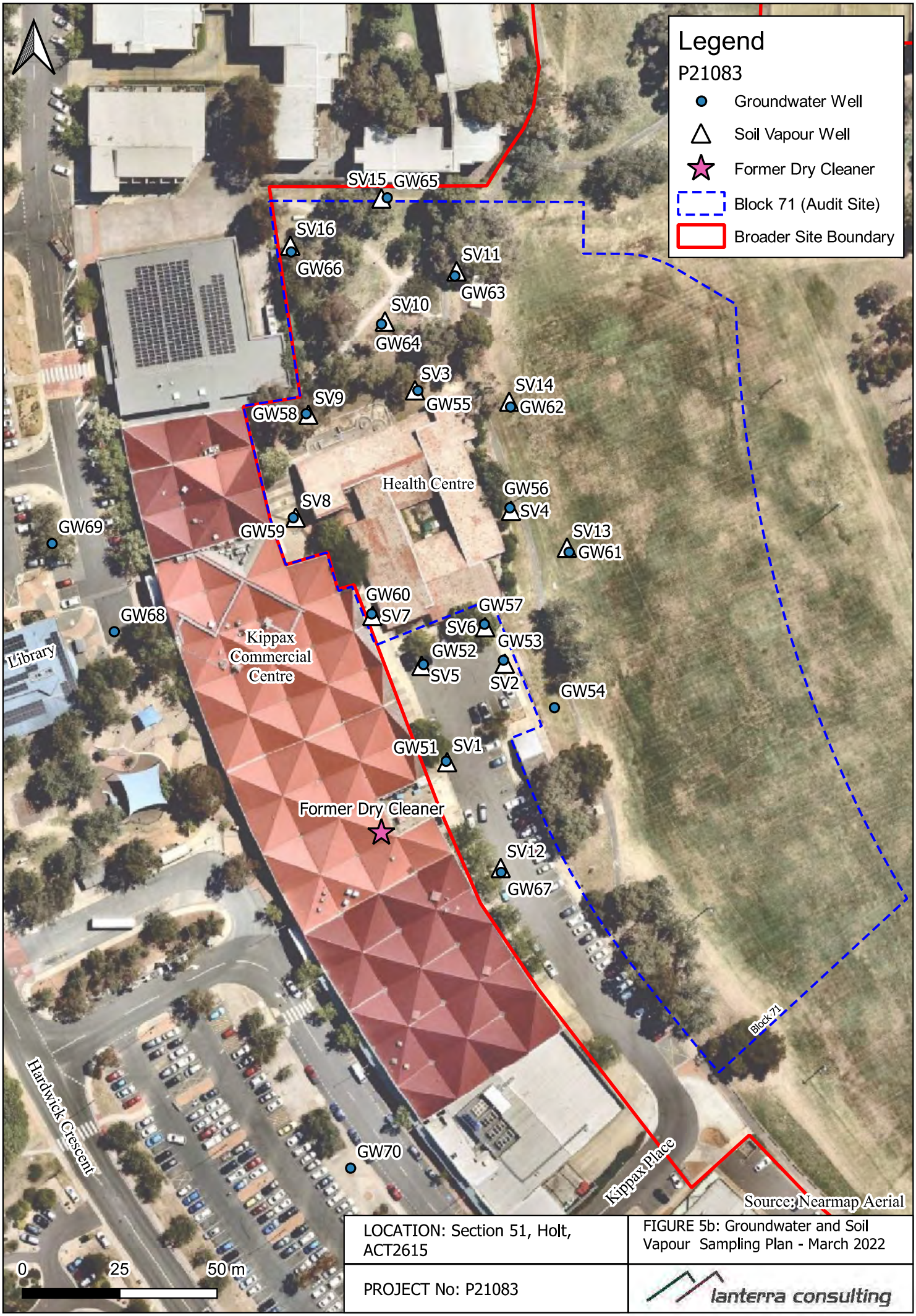
LOCATION: Section 51, Holt, ACT2615	FIGURE 3d: Future roads, paths, public open spaces, and community buildings
PROJECT No: P21083	lanterra consulting

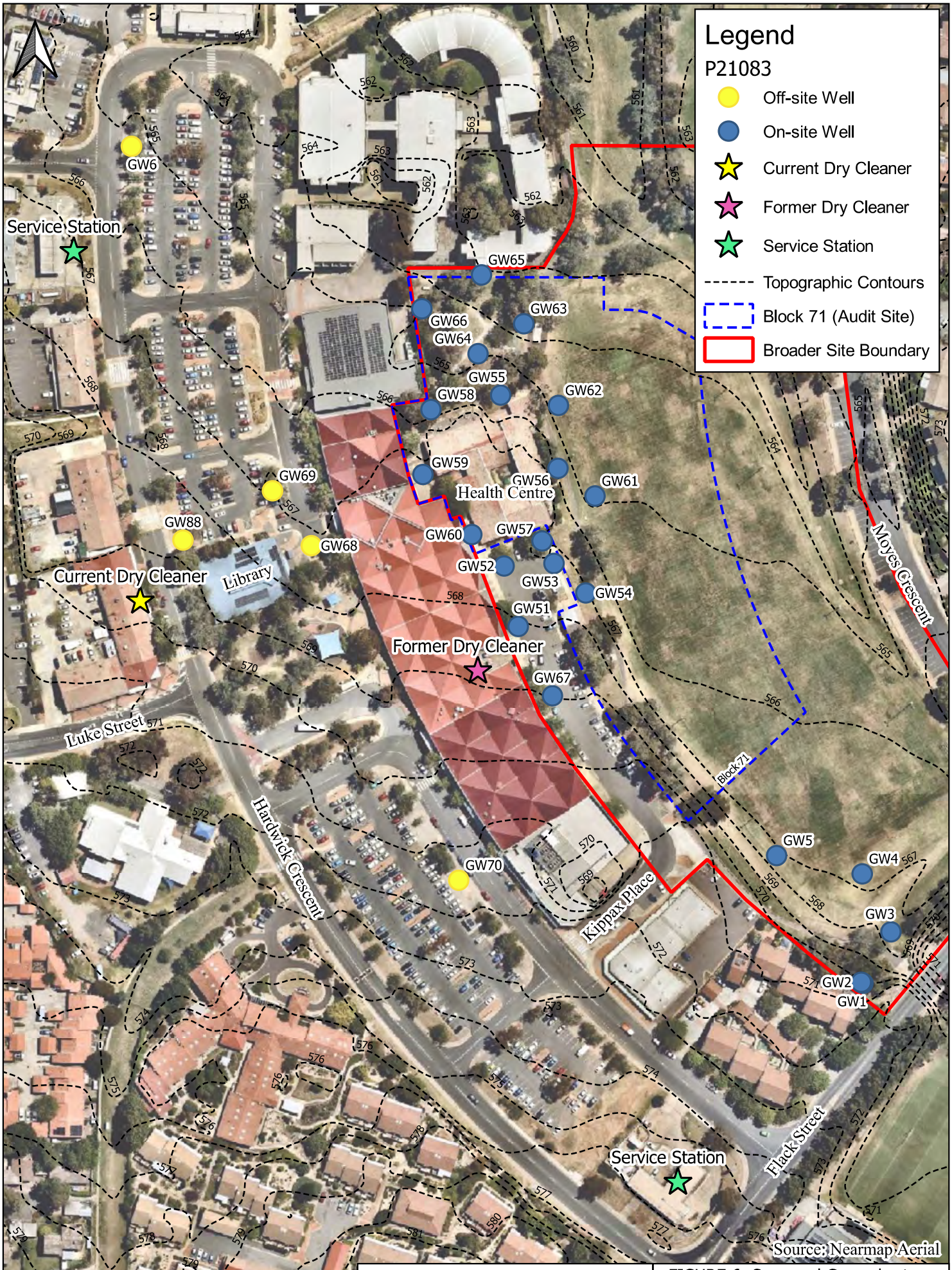


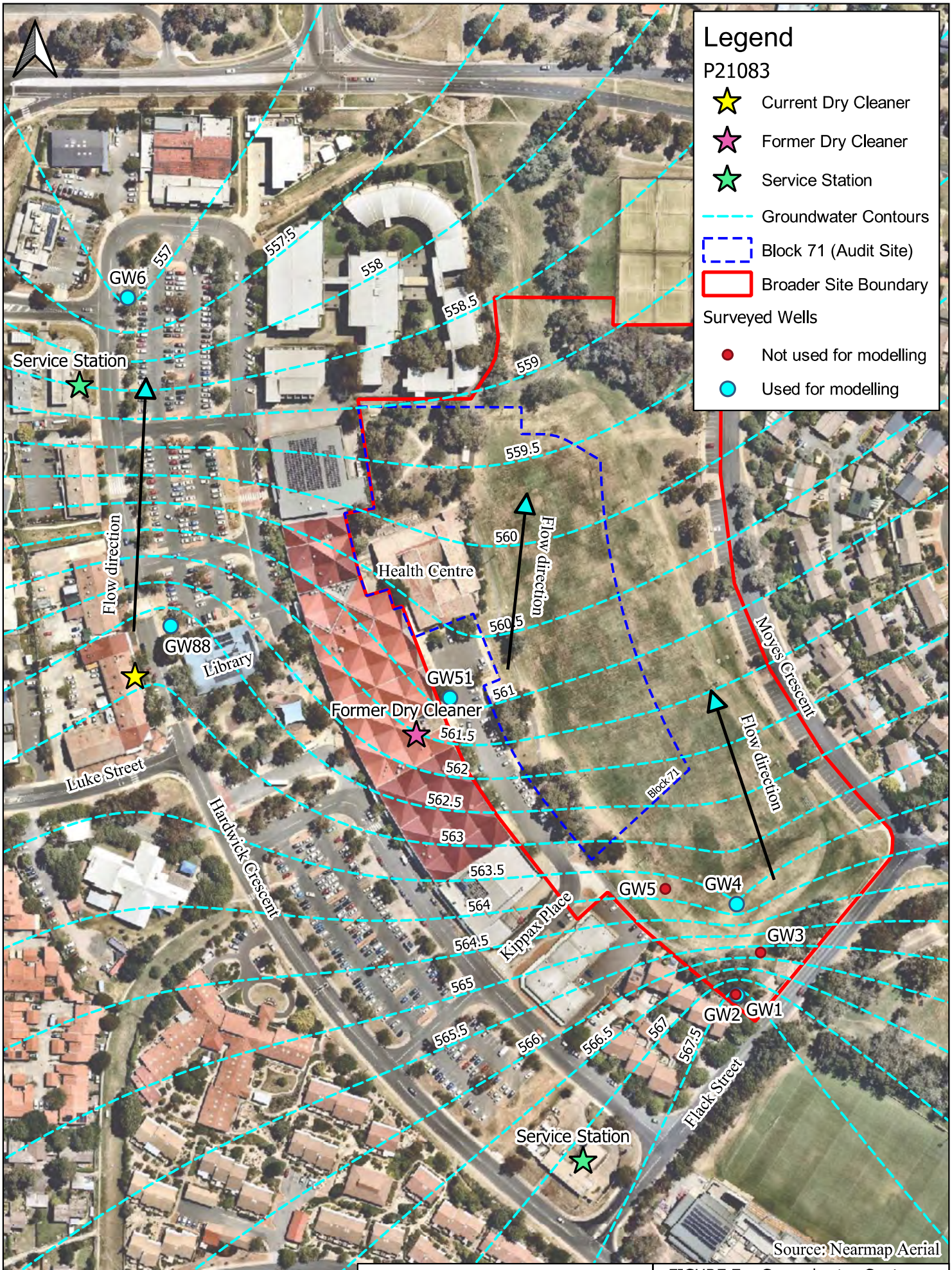
LOCATION: Section 51, Holt, ACT2615	FIGURE 4: Groundwater Boreholes and Hydrology
PROJECT No: P21083	Ianterra consulting



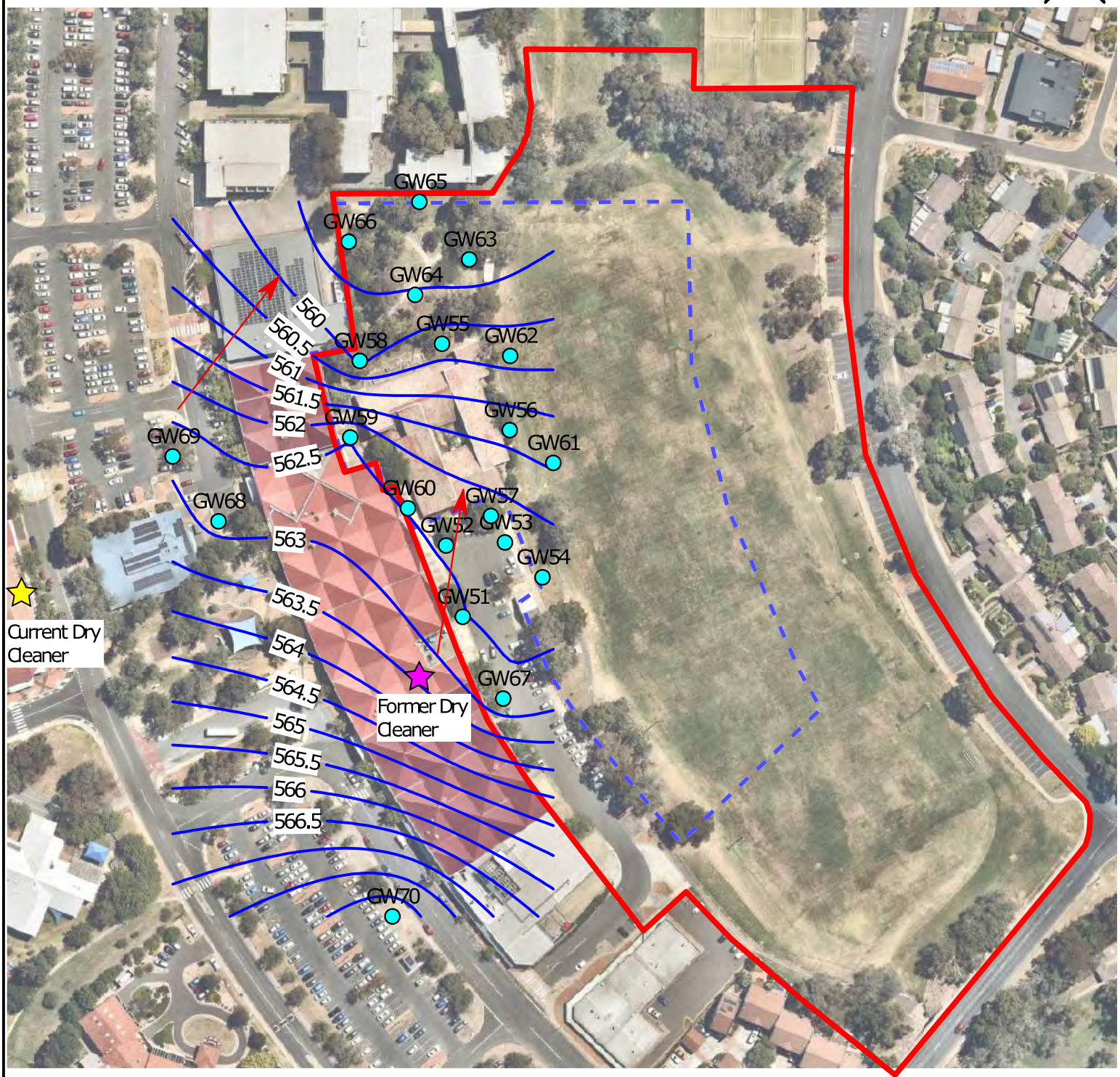
LOCATION: Section 51, Holt, ACT2615	FIGURE 5a: Original Sampling Plan - Stage 1 April 2021
PROJECT No: P21083	lanterra consulting


Legend
P21083
Groundwater Well
Soil Vapour Well
Former Dry Cleaner
Block 71 (Audit Site)
Broader Site Boundary
SV15
GW65
SV16
GW66
SV11
GW63
SV10
GW64
SV3
GW55
SV14
GW62
SV9
GW58
Health Centre
GW56
SV4
SV8
GW59
GW69
SV13
GW61
GW60
SV7
GW57
SV6
GW68
Kippax Commercial Centre
GW53
GW52
SV5
SV2
Library
GW54
GW51
SV1
Former Dry Cleaner
SV12
GW67
Block 71
Hardwick Crescent
GW70
Kippax Place
Source: Nearmap Aerial
0
25
50 m
LOCATION: Section 51, Holt, ACT2615
FIGURE 5b: Groundwater and Soil Vapour Sampling Plan - March 2022
PROJECT No: P21083
lanterra consulting


Legend
P21083
Off-site Well
On-site Well
Current Dry Cleaner
Former Dry Cleaner
Service Station
Topographic Contours
Block 71 (Audit Site)
Broader Site Boundary
GW6
Service Station
GW65
GW66
GW63
GW64
GW55
GW58
GW62
GW59
GW56
GW61
Health Centre
GW69
GW88
GW68
GW60
GW57
GW52
GW53
GW54
GW51
Current Dry Cleaner
Library
Former Dry Cleaner
GW67
Moyes Crescent
Luke Street
Block 71
Hardwick Crescent
GW70
GW5
GW4
GW3
GW2
GW1
Kippax Place
Flack Street
Service Station
Source: Nearmap Aerial
0
25
50 m
LOCATION: Section 51, Holt, ACT2615
FIGURE 6: Surveyed Groundwater Monitoring Wells
PROJECT No: P21083
lanterra consulting



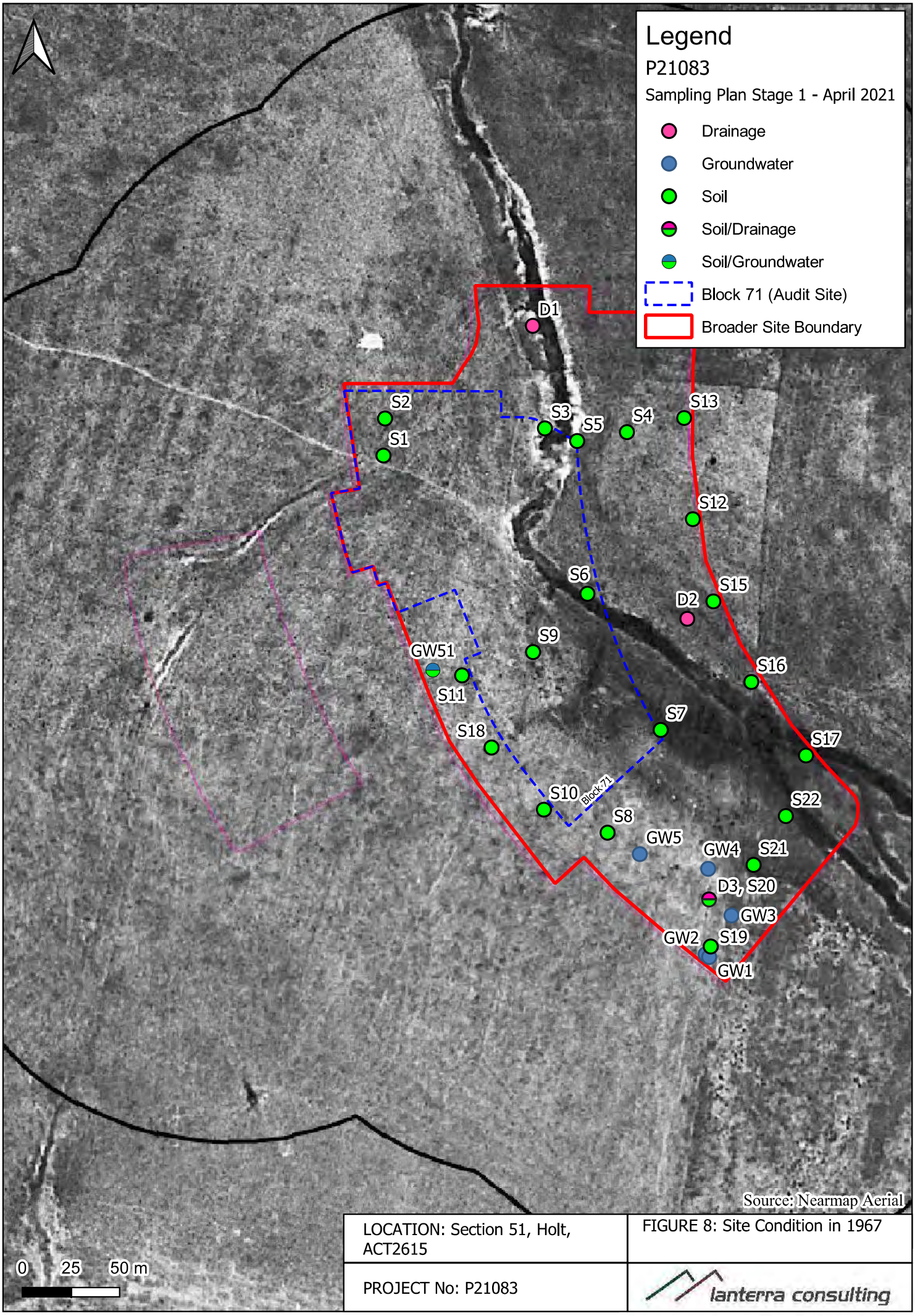
LOCATION: Section 51, Holt, ACT2615	FIGURE 7a: Groundwater Contours - Stage 1 April 2021
PROJECT No: P21083	lanterra consulting



Legend

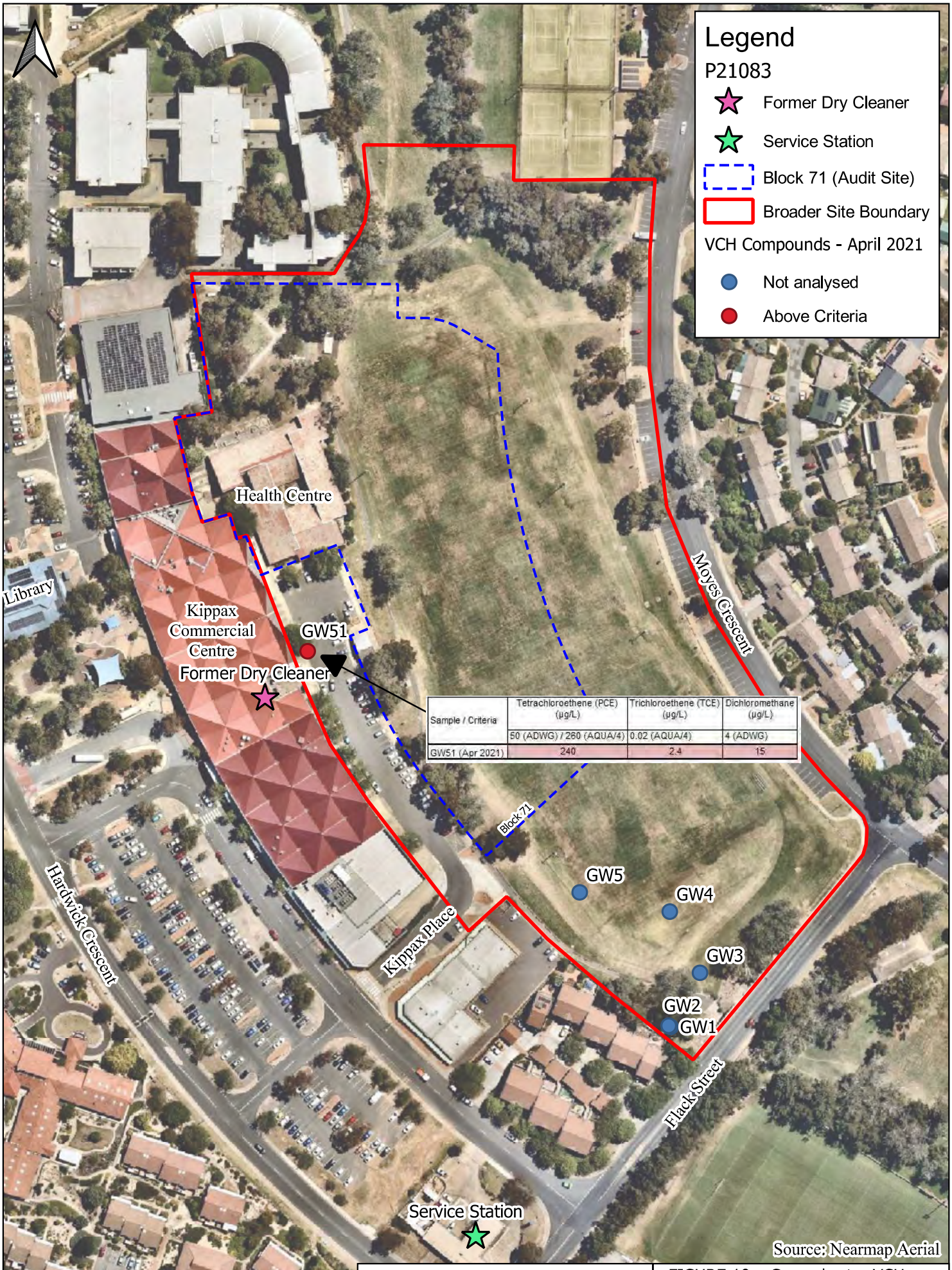
- Groundwater Monitoring Well
- Audit Site (Block 71)
- Current Dry Cleaner
- Former Dry Cleaner
- Broader Site Boundary
- Groundwater Contours
- Groundwater Flow Direction

LOCATION: Section 51, Holt, ACT2615	Figure 7b: Inferred Groundwater Contours - March 2022
PROJECT No: P21083	Ianterra consulting


Legend
P21083
Sampling Plan Stage 1 - April 2021
Drainage
Groundwater
Soil
Soil/Drainage
Soil/Groundwater
Block 71 (Audit Site)
Broader Site Boundary
D1
S2
S1
S3
S5
S4
S13
S12
S6
S15
D2
S9
GW51
S11
S16
S18
S7
S17
S10
Block 71
S22
S8
GW5
GW4
S21
D3, S20
GW3
GW2
S19
GW1
Source: Nearmap Aerial
0
25
50 m
LOCATION: Section 51, Holt, ACT2615
FIGURE 8: Site Condition in 1967
PROJECT No: P21083
lanterra consulting

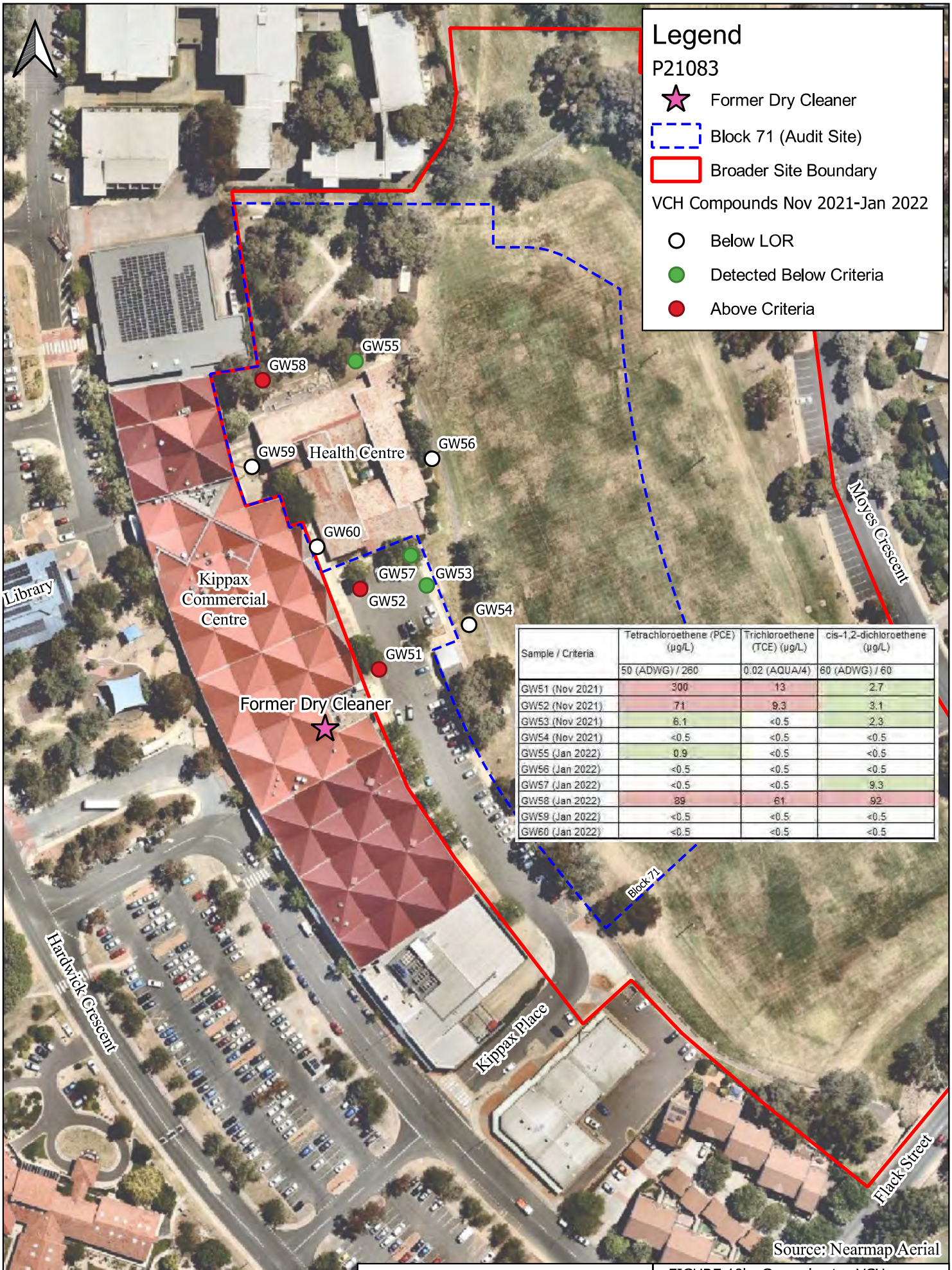


LOCATION: Section 51, Holt, ACT2615	FIGURE 9: Groundwater Benzene Concentration - Stage 1 April 2021
PROJECT No: P21083	lanterra consulting



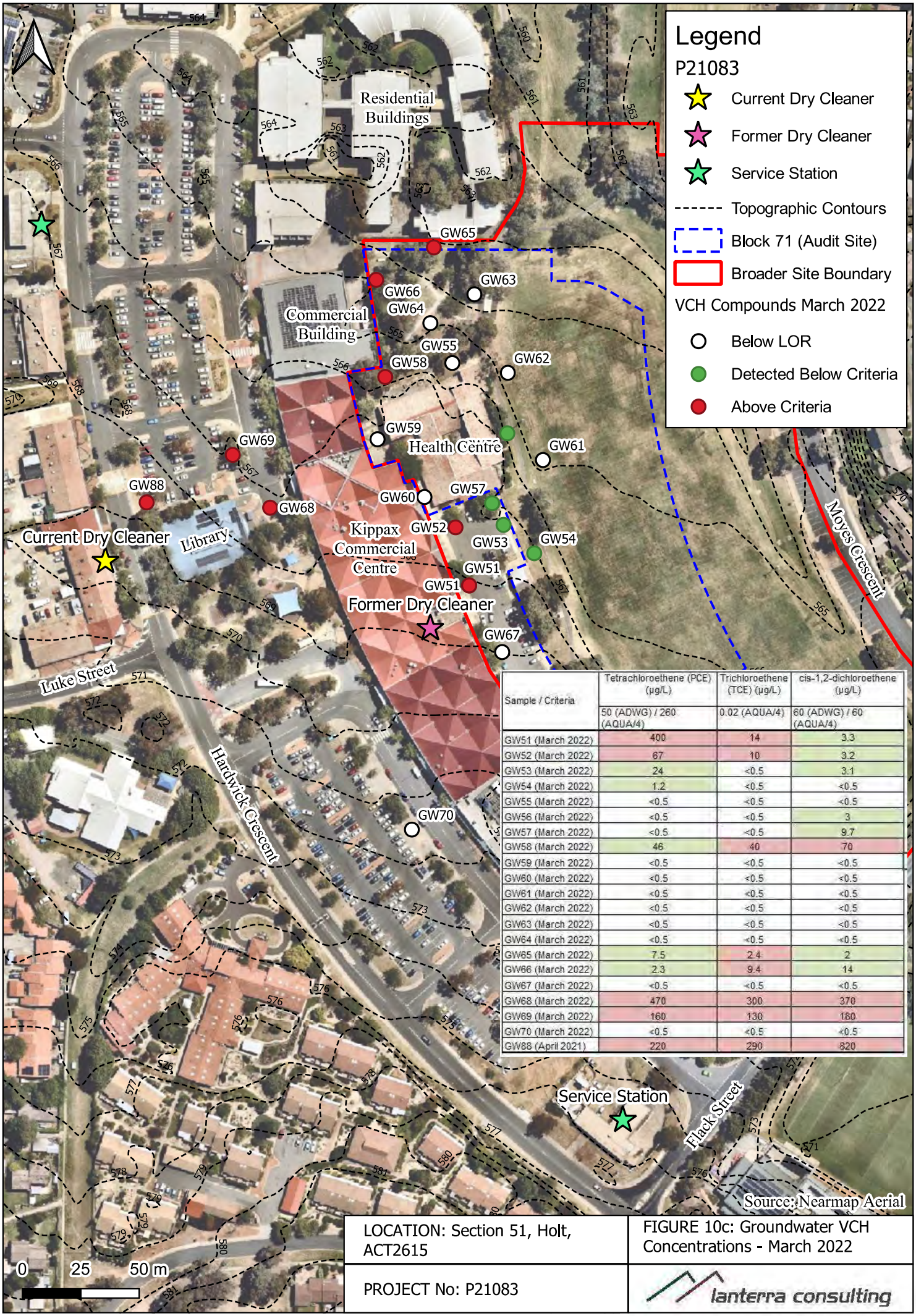
Sample / Criteria	Tetrachloroethene (PCE) (µg/L)	Trichloroethene (TCE) (µg/L)	Dichloromethane (µg/L)
	50 (ADWG) / 260 (AQUA/4)	0.02 (AQUA/4)	4 (ADWG)
GW51 (Apr 2021)	240	2.4	15

LOCATION: Section 51, Holt, ACT2615	FIGURE 10a: Groundwater VCH Concentrations - April 2021
PROJECT No: P21083	lanterra consulting



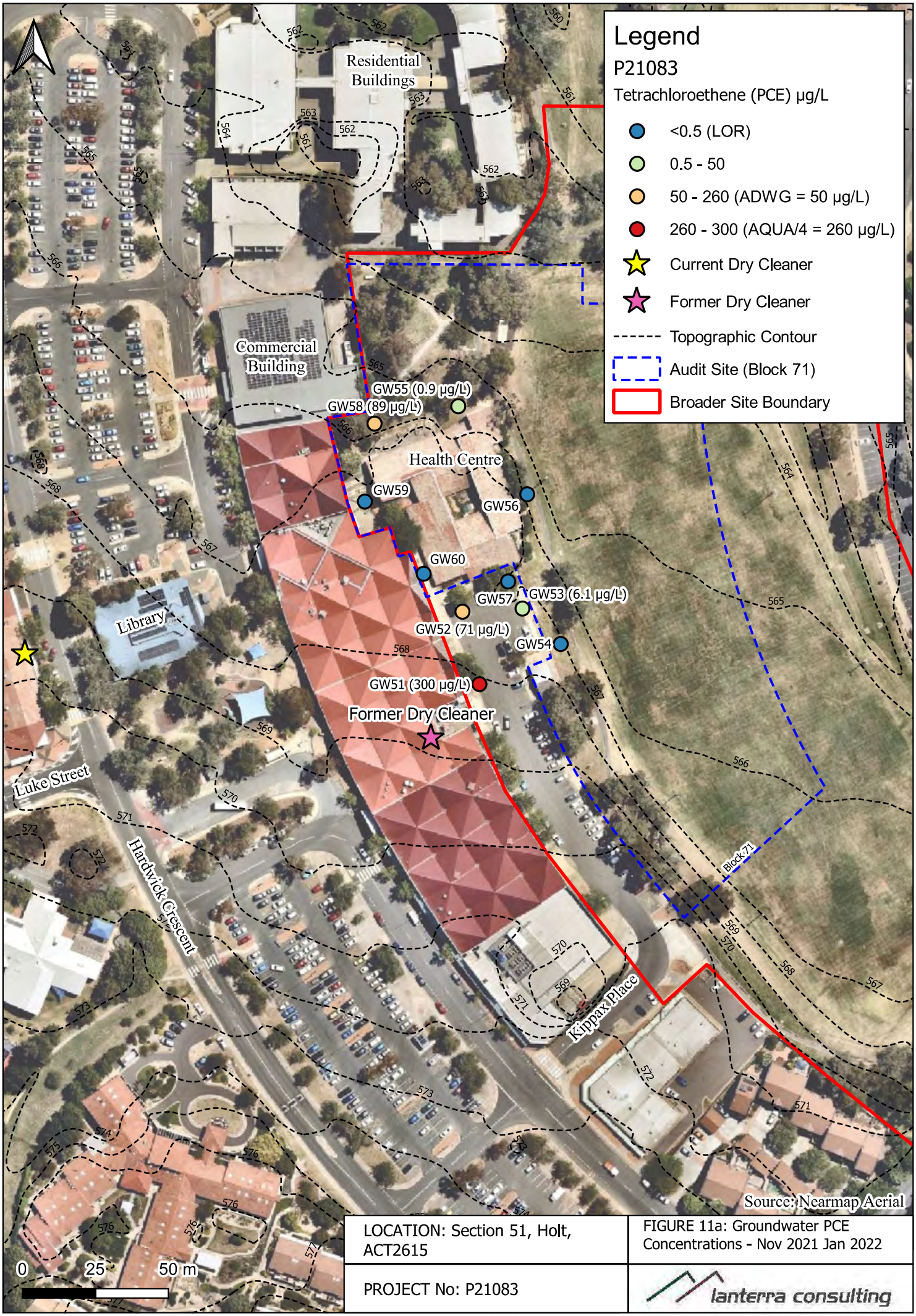
Sample / Criteria	Tetrachloroethene (PCE) (µg/L)	Trichloroethene (TCE) (µg/L)	cis-1,2-dichloroethene (µg/L)
	50 (ADWG) / 260	0.02 (AQUA/4)	60 (ADWG) / 60
GW51 (Nov 2021)	300	13	2.7
GW52 (Nov 2021)	71	9.3	3.1
GW53 (Nov 2021)	6.1	<0.5	2.3
GW54 (Nov 2021)	<0.5	<0.5	<0.5
GW55 (Jan 2022)	0.9	<0.5	<0.5
GW56 (Jan 2022)	<0.5	<0.5	<0.5
GW57 (Jan 2022)	<0.5	<0.5	9.3
GW58 (Jan 2022)	89	61	92
GW59 (Jan 2022)	<0.5	<0.5	<0.5
GW60 (Jan 2022)	<0.5	<0.5	<0.5

LOCATION: Section 51, Holt, ACT2615	FIGURE 10b: Groundwater VCH Concentrations - Nov 2021 Jan 2022
PROJECT No: P21083	ianterra consulting

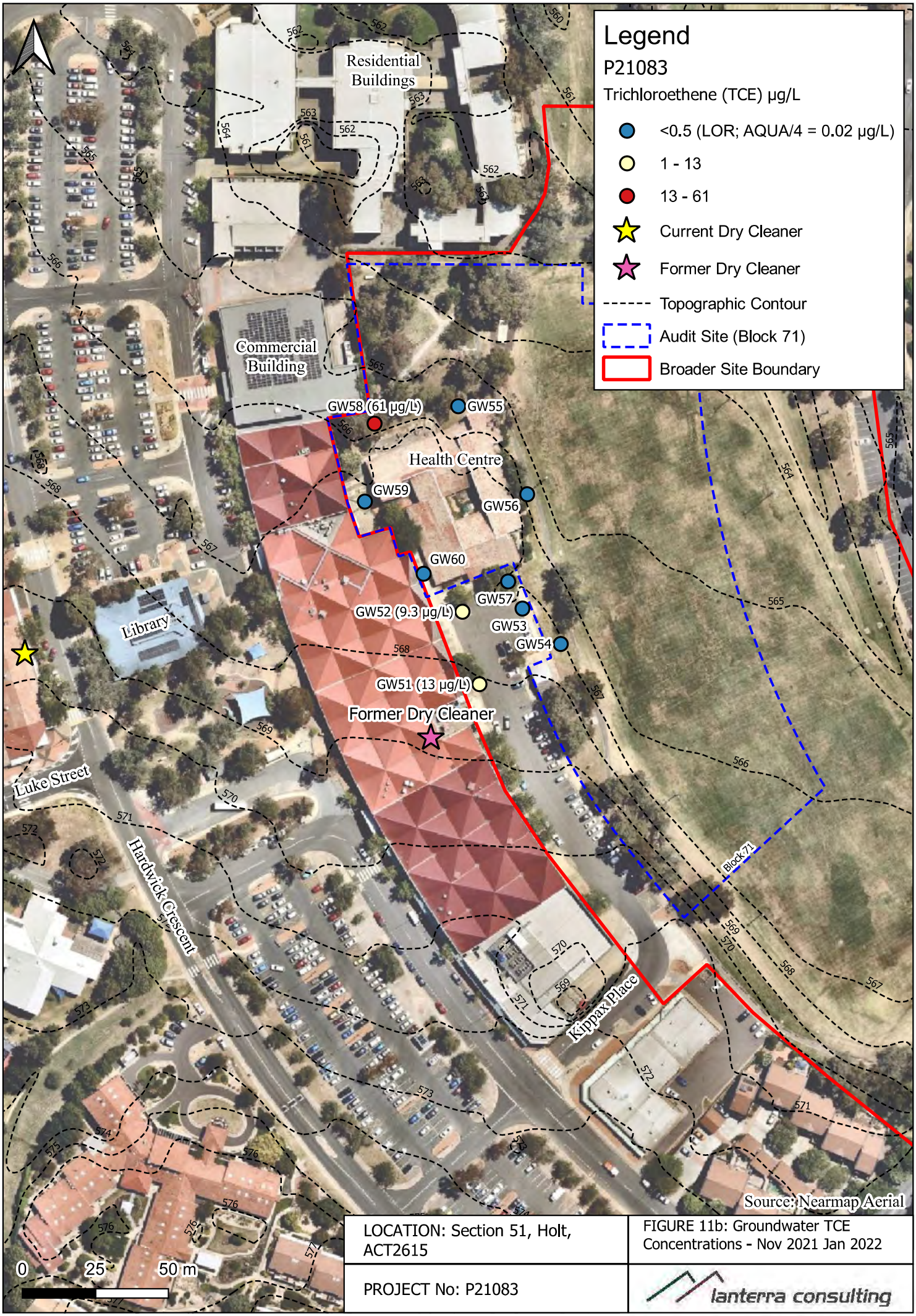


Sample / Criteria	Tetrachloroethene (PCE) (µg/L)	Trichloroethene (TCE) (µg/L)	cis-1,2-dichloroethene (µg/L)
	50 (ADWG) / 260 (AQUA/4)	0.02 (AQUA/4)	60 (ADWG) / 60 (AQUA/4)
GW51 (March 2022)	400	14	3.3
GW52 (March 2022)	67	10	3.2
GW53 (March 2022)	24	<0.5	3.1
GW54 (March 2022)	1.2	<0.5	<0.5
GW55 (March 2022)	<0.5	<0.5	<0.5
GW56 (March 2022)	<0.5	<0.5	3
GW57 (March 2022)	<0.5	<0.5	9.7
GW58 (March 2022)	46	40	70
GW59 (March 2022)	<0.5	<0.5	<0.5
GW60 (March 2022)	<0.5	<0.5	<0.5
GW61 (March 2022)	<0.5	<0.5	<0.5
GW62 (March 2022)	<0.5	<0.5	<0.5
GW63 (March 2022)	<0.5	<0.5	<0.5
GW64 (March 2022)	<0.5	<0.5	<0.5
GW65 (March 2022)	7.5	2.4	2
GW66 (March 2022)	2.3	9.4	14
GW67 (March 2022)	<0.5	<0.5	<0.5
GW68 (March 2022)	470	300	370
GW69 (March 2022)	160	130	180
GW70 (March 2022)	<0.5	<0.5	<0.5
GW88 (April 2021)	220	290	820

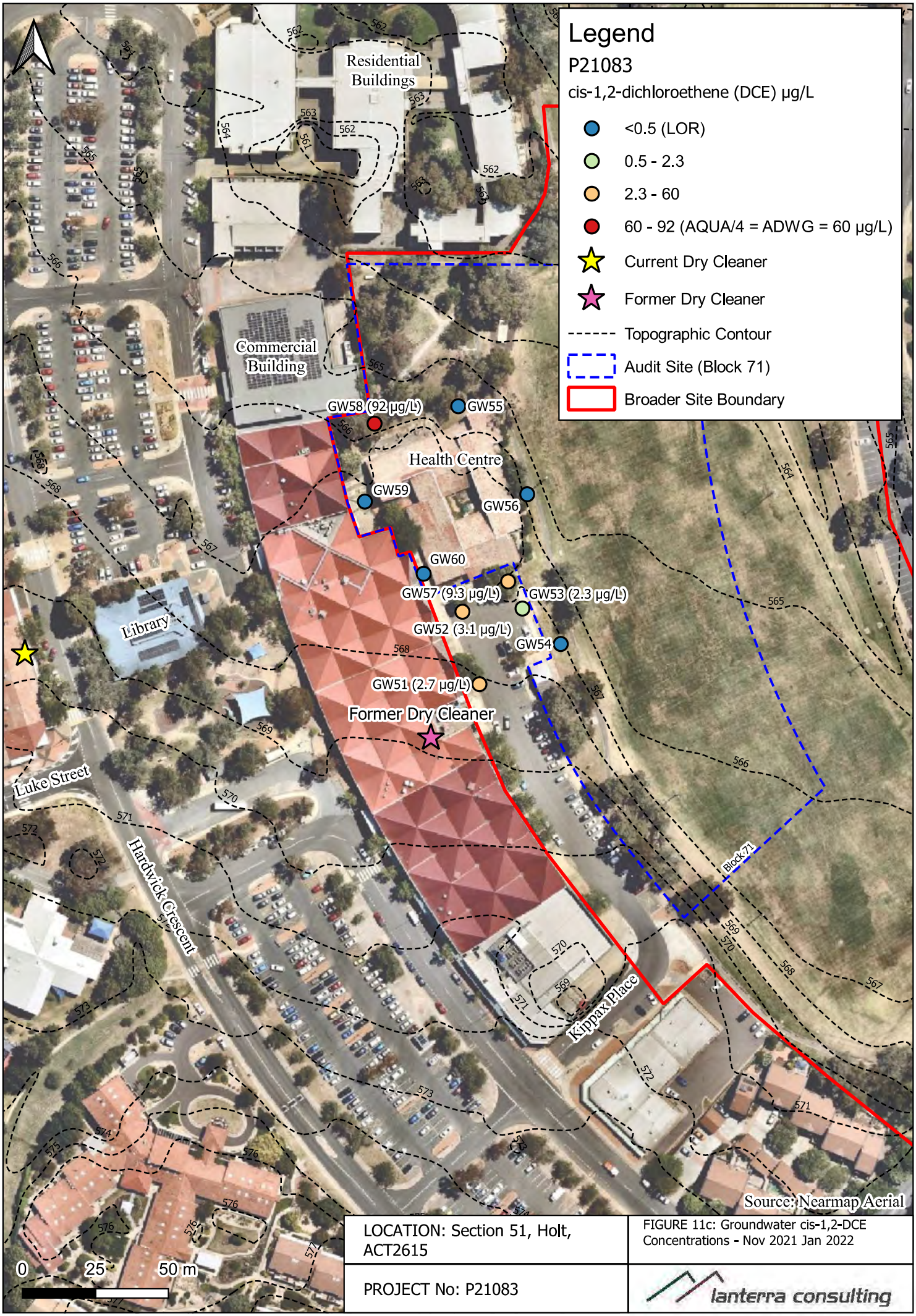
LOCATION: Section 51, Holt, ACT2615	FIGURE 10c: Groundwater VCH Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11a: Groundwater PCE Concentrations - Nov 2021 Jan 2022
PROJECT No: P21083	lanterra consulting

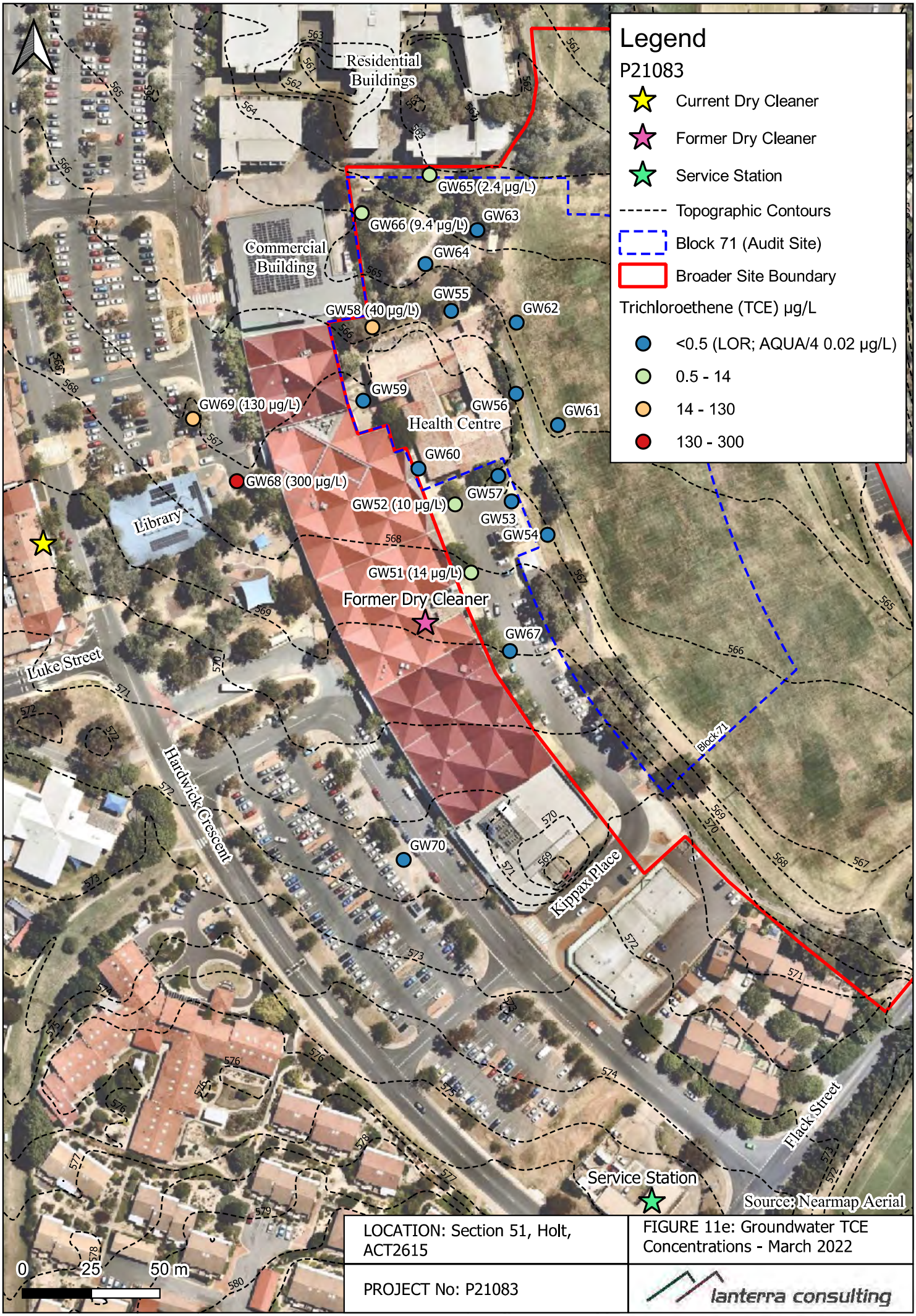


LOCATION: Section 51, Holt, ACT2615	FIGURE 11b: Groundwater TCE Concentrations - Nov 2021 Jan 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11c: Groundwater cis-1,2-DCE Concentrations - Nov 2021 Jan 2022
PROJECT No: P21083	lanterra consulting

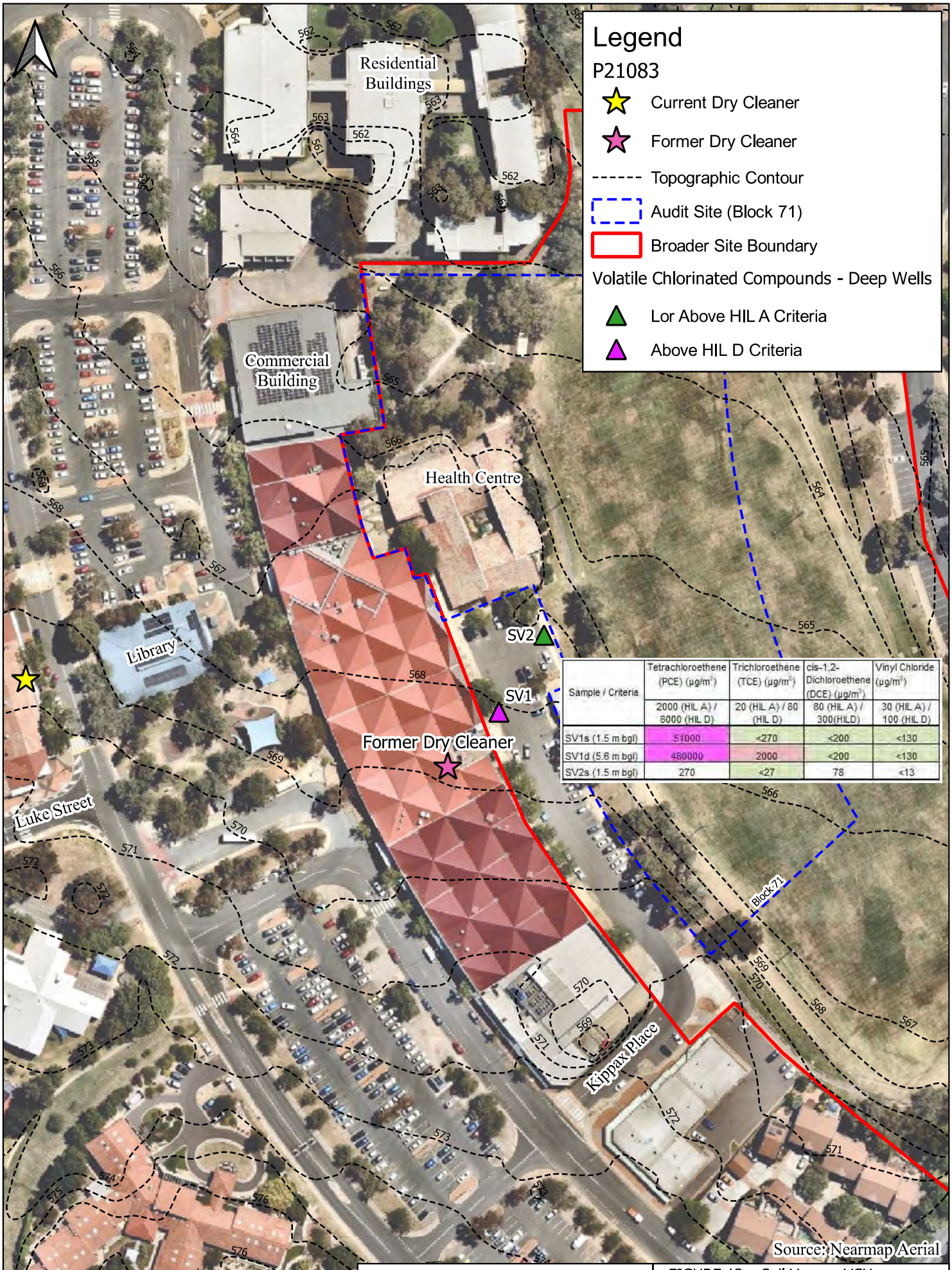

Legend
P21083
Current Dry Cleaner
Former Dry Cleaner
Service Station
Topographic Contours
Block 71 (Audit Site)
Broader Site Boundary
Tetrachloroethene (PCE) µg/L
<0.5 (LOR)
0.5 - 50
50 - 260 (ADWG = 50 µg/L)
260 - 470 (AQUA4 = 260 µg/L)
Residential Buildings
Commercial Building
Health Centre
Library
Former Dry Cleaner
Service Station
GW65 (7.5 µg/L)
GW66 (2.3 µg/L)
GW63
GW64
GW55
GW58 (46 µg/L)
GW62
GW59
GW56
GW61
GW69 (160 µg/L)
GW60
GW57
GW68 (470 µg/L)
GW53 (24 µg/L)
GW52 (67 µg/L)
GW54 (1.2 µg/L)
GW51 (420 µg/L)
GW67
GW70
Luke Street
Hardwick Crescent
Kippax Place
Flack Street
Block 71
0
25
50 m
Source: Nearmap Aerial
LOCATION: Section 51, Holt, ACT2615
FIGURE 11d: Groundwater PCE Concentrations - March 2022
PROJECT No: P21083
lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11e: Groundwater TCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11f: Groundwater cis-1,2-DCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



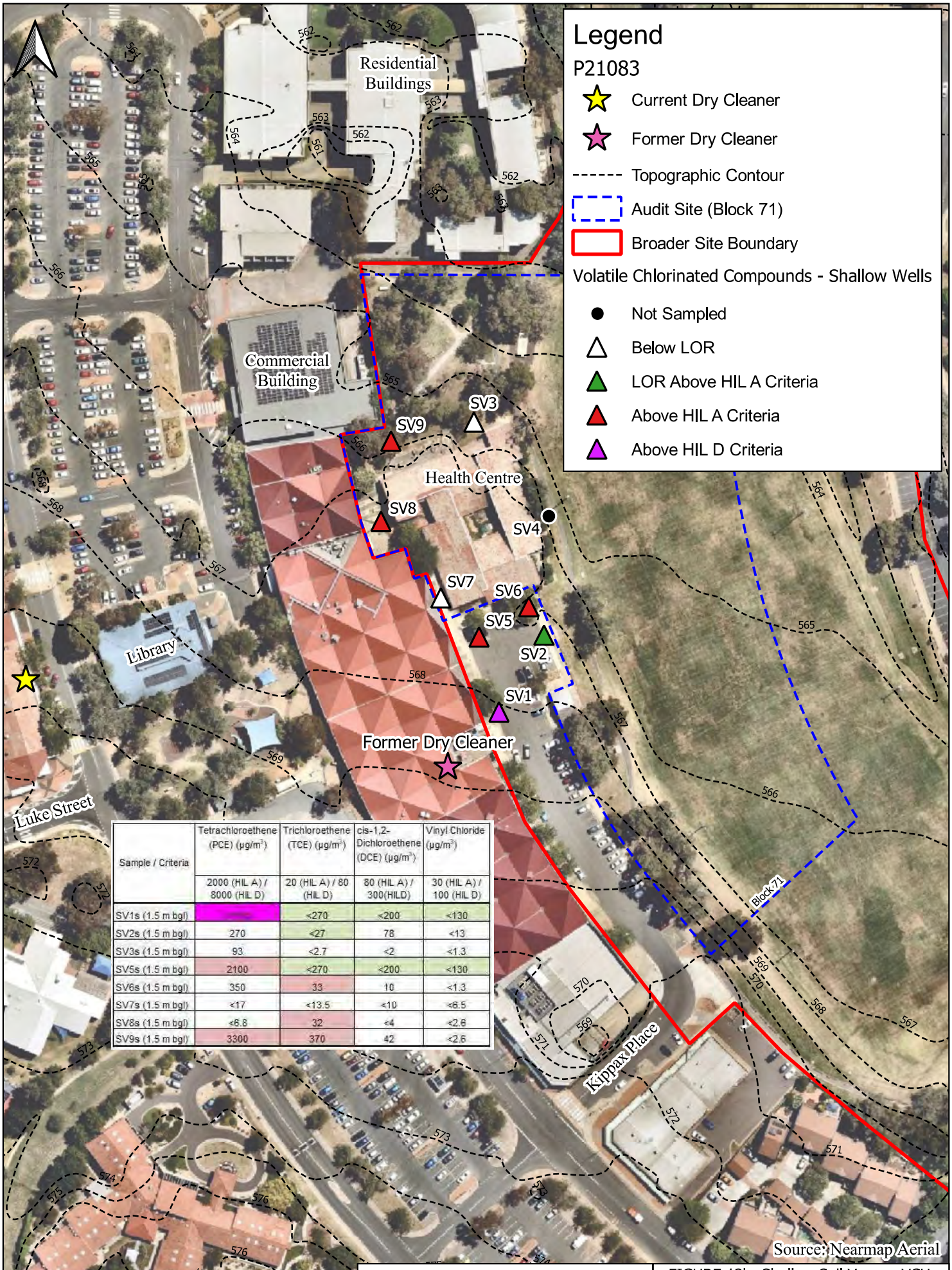
Sample / Criteria	Tetrachloroethene (PCE) (µg/m³)	Trichloroethene (TCE) (µg/m³)	cis-1,2-Dichloroethene (DCE) (µg/m³)	Vinyl Chloride (µg/m³)
	2000 (HIL A) / 8000 (HIL D)	20 (HIL A) / 80 (HIL D)	80 (HIL A) / 300(HILD)	30 (HIL A) / 100 (HIL D)
SV1s (1.5 m bgl)	51000	<270	<200	<130
SV1d (5.6 m bgl)	480000	2000	<200	<130
SV2s (1.5 m bgl)	270	<27	78	<13

LOCATION: Section 51, Holt, ACT2615

FIGURE 12a: Soil Vapour VCH Concentrations - Nov 2021

PROJECT No: P21083

lanterra consulting



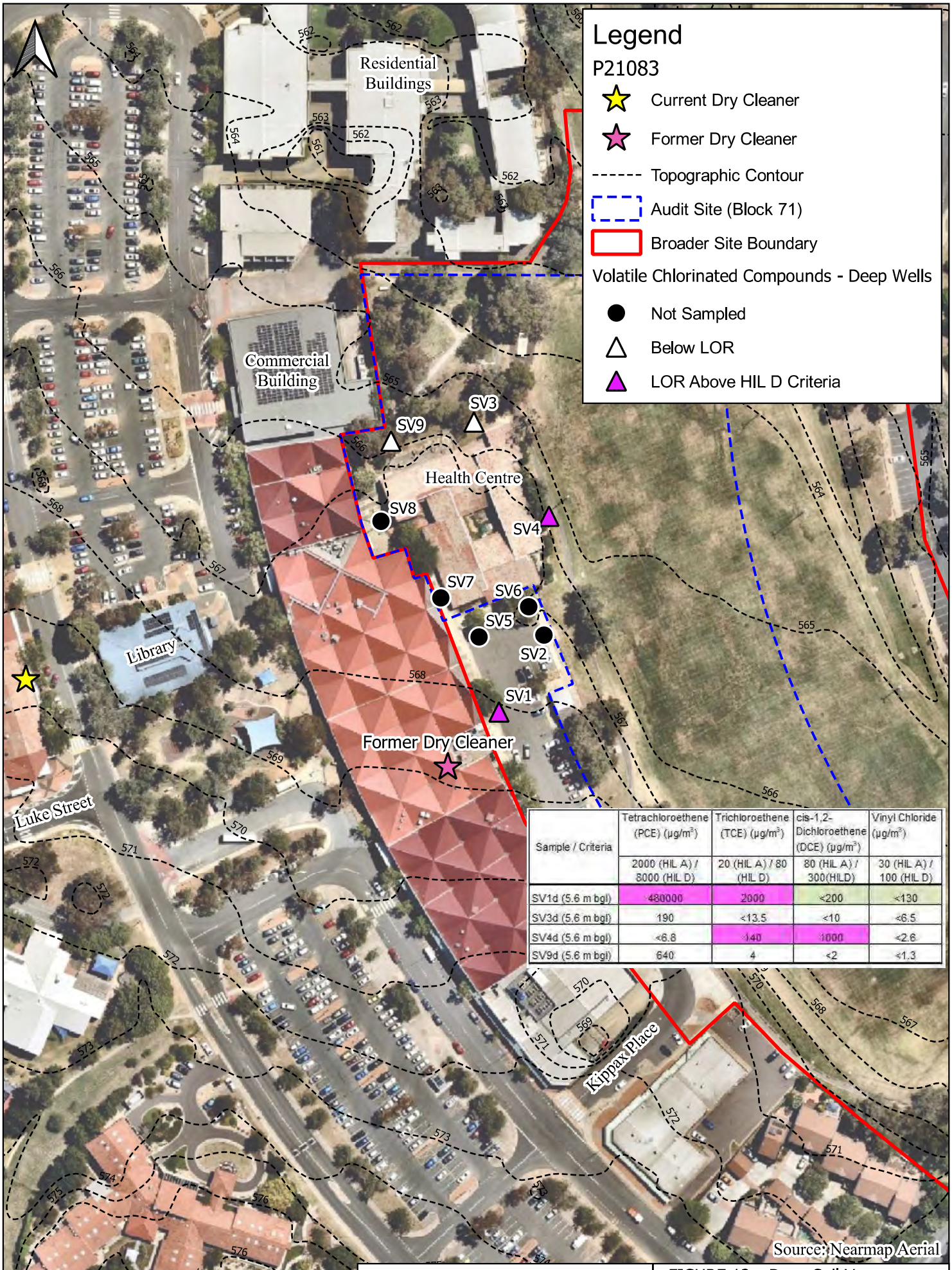
Sample / Criteria	Tetrachloroethene (PCE) (µg/m³)	Trichloroethene (TCE) (µg/m³)	cis-1,2-Dichloroethene (DCE) (µg/m³)	Vinyl Chloride (µg/m³)
	2000 (HIL A) / 8000 (HIL D)	20 (HIL A) / 80 (HIL D)	80 (HIL A) / 300(HILD)	30 (HIL A) / 100 (HIL D)
SV1s (1.5 m bgl)		<270	<200	<130
SV2s (1.5 m bgl)	270	<27	78	<13
SV3s (1.5 m bgl)	93	<2.7	<2	<1.3
SV5s (1.5 m bgl)	2100	<270	<200	<130
SV6s (1.5 m bgl)	350	33	10	<1.3
SV7s (1.5 m bgl)	<17	<13.5	<10	<6.5
SV8s (1.5 m bgl)	<6.8	32	<4	<2.6
SV9s (1.5 m bgl)	3300	370	42	<2.6

LOCATION: Section 51, Holt, ACT2615

FIGURE 12b: Shallow Soil Vapour VCH Concentrations - Jan 2022

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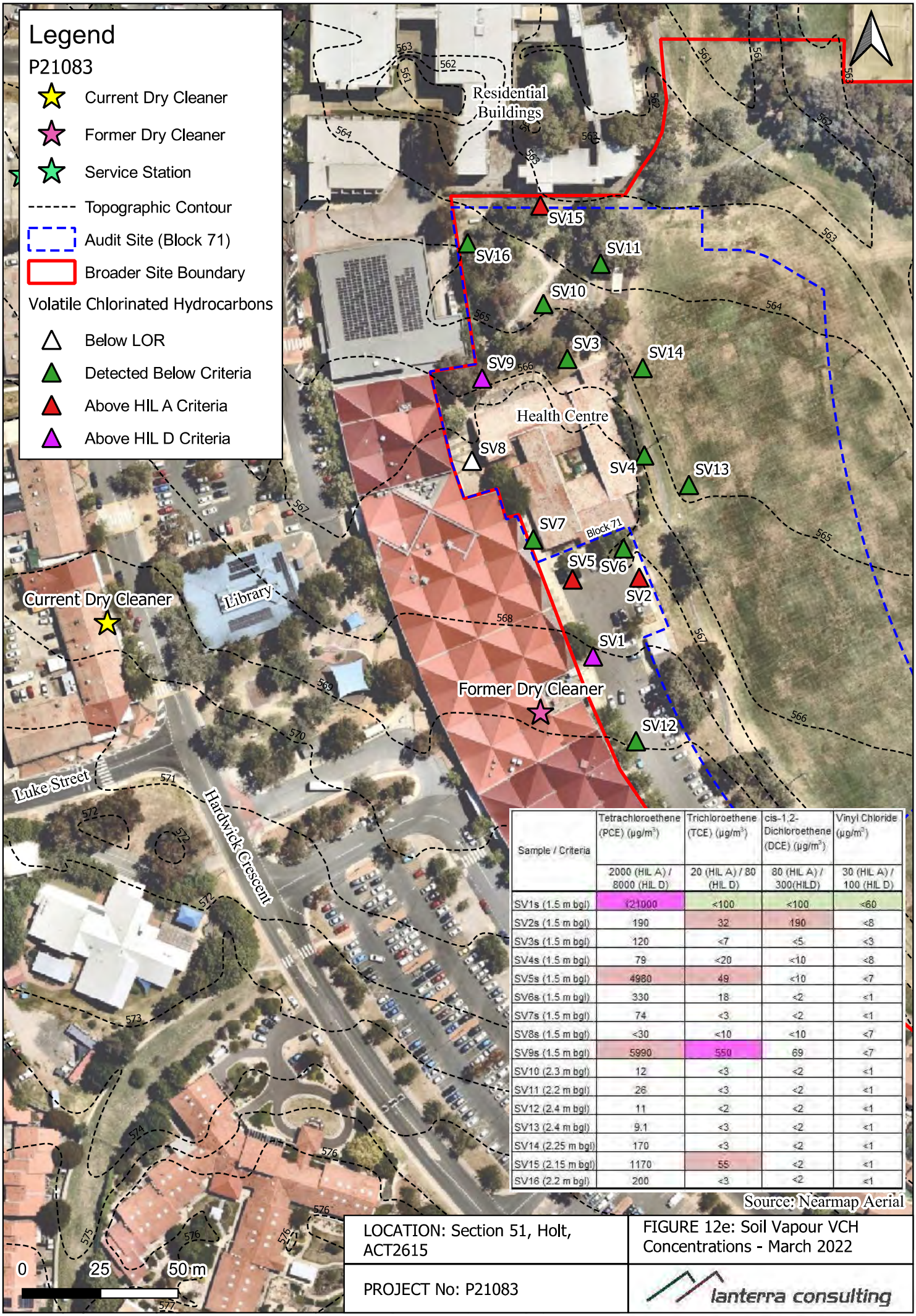


Sample / Criteria	Tetrachloroethene (PCE) (µg/m³)	Trichloroethene (TCE) (µg/m³)	cis-1,2-Dichloroethene (DCE) (µg/m³)	Vinyl Chloride (µg/m³)
	2000 (HIL A) / 8000 (HIL D)	20 (HIL A) / 80 (HIL D)	80 (HIL A) / 300(HILD)	30 (HIL A) / 100 (HIL D)
SV1d (5.6 m bgl)	480000	2000	<200	<130
SV3d (5.6 m bgl)	190	<13.5	<10	<6.5
SV4d (5.6 m bgl)	<6.8	140	1000	<2.6
SV9d (5.6 m bgl)	640	4	<2	<1.3

LOCATION: Section 51, Holt, ACT2615	FIGURE 12c: Deep Soil Vapour VCH Concentrations - Jan 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 12d: Soil Vapour Well Sampling Plan - March 2022
PROJECT No: P21083	lanterra consulting



Sample / Criteria	Tetrachloroethene (PCE) (µg/m³)	Trichloroethene (TCE) (µg/m³)	cis-1,2-Dichloroethene (DCE) (µg/m³)	Vinyl Chloride (µg/m³)
	2000 (HIL A) / 8000 (HIL D)	20 (HIL A) / 80 (HIL D)	80 (HIL A) / 300(HILD)	30 (HIL A) / 100 (HIL D)
SV1s (1.5 m bgl)	<21000	<100	<100	<60
SV2s (1.5 m bgl)	190	32	190	<8
SV3s (1.5 m bgl)	120	<7	<5	<3
SV4s (1.5 m bgl)	79	<20	<10	<8
SV5s (1.5 m bgl)	4980	49	<10	<7
SV6s (1.5 m bgl)	330	18	<2	<1
SV7s (1.5 m bgl)	74	<3	<2	<1
SV8s (1.5 m bgl)	<30	<10	<10	<7
SV9s (1.5 m bgl)	5990	550	69	<7
SV10 (2.3 m bgl)	12	<3	<2	<1
SV11 (2.2 m bgl)	26	<3	<2	<1
SV12 (2.4 m bgl)	11	<2	<2	<1
SV13 (2.4 m bgl)	9.1	<3	<2	<1
SV14 (2.25 m bgl)	170	<3	<2	<1
SV15 (2.15 m bgl)	1170	55	<2	<1
SV16 (2.2 m bgl)	200	<3	<2	<1

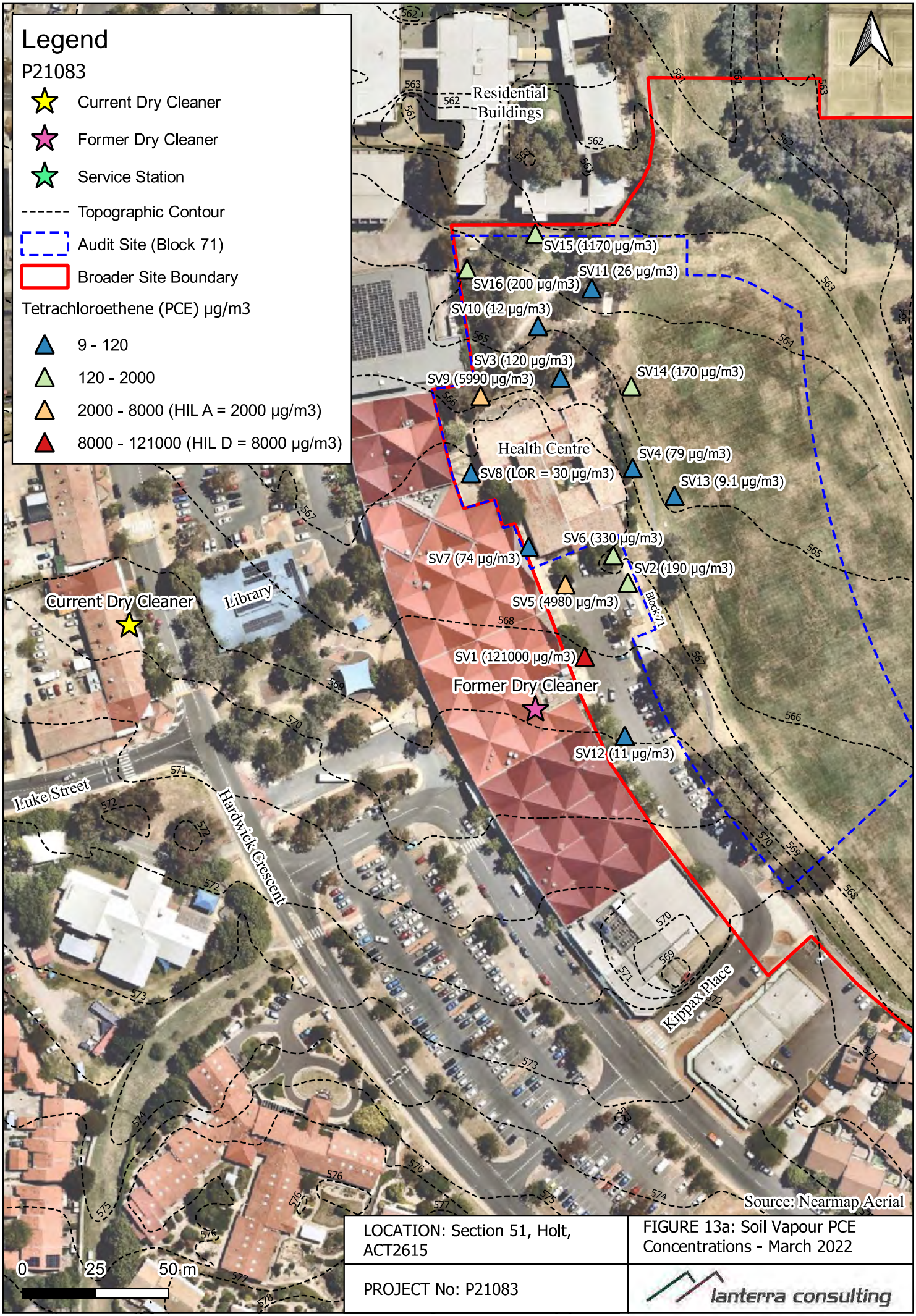
Source: Nearmap Aerial

LOCATION: Section 51, Holt, ACT2615

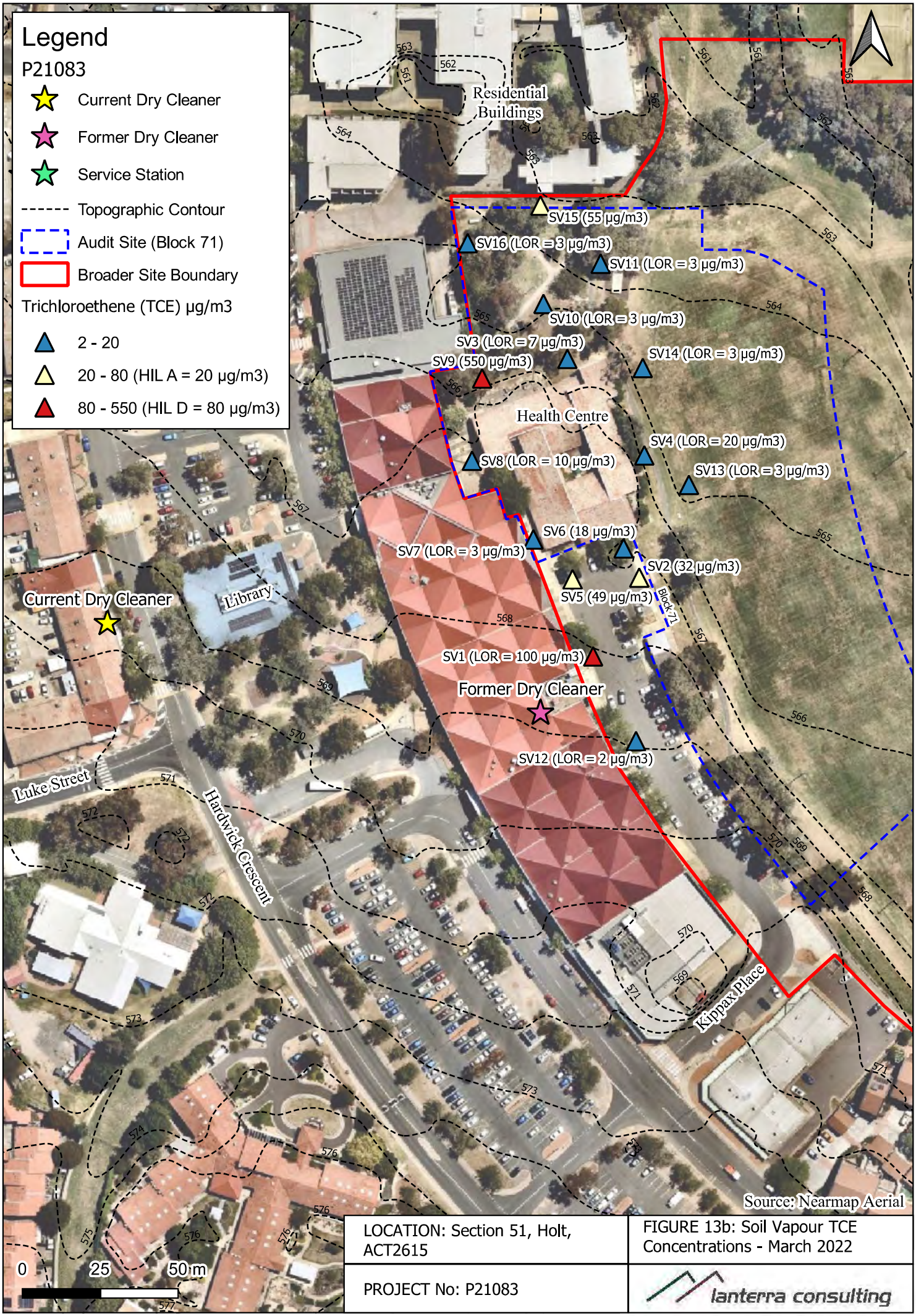
FIGURE 12e: Soil Vapour VCH Concentrations - March 2022

PROJECT No: P21083

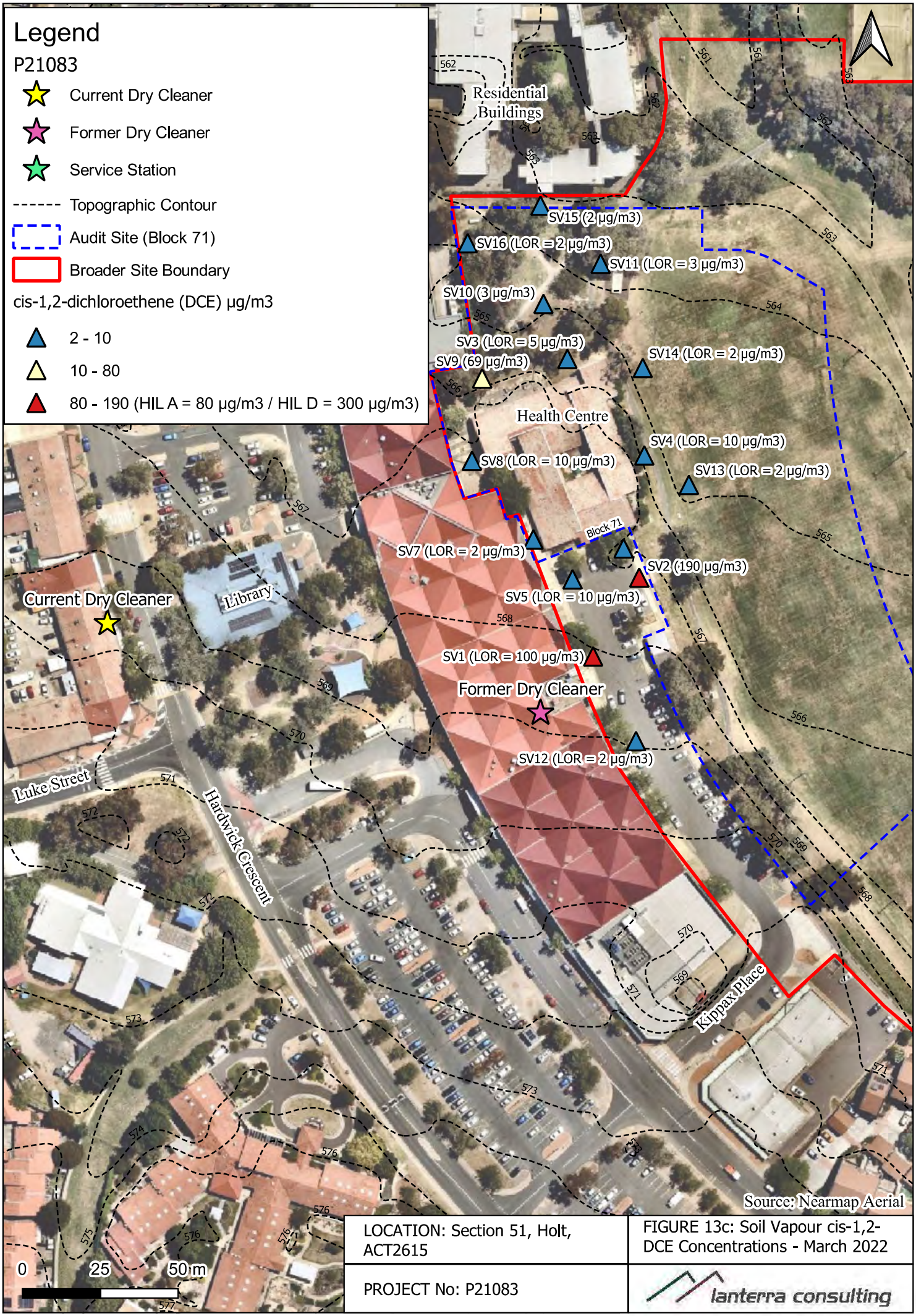
lanterra consulting



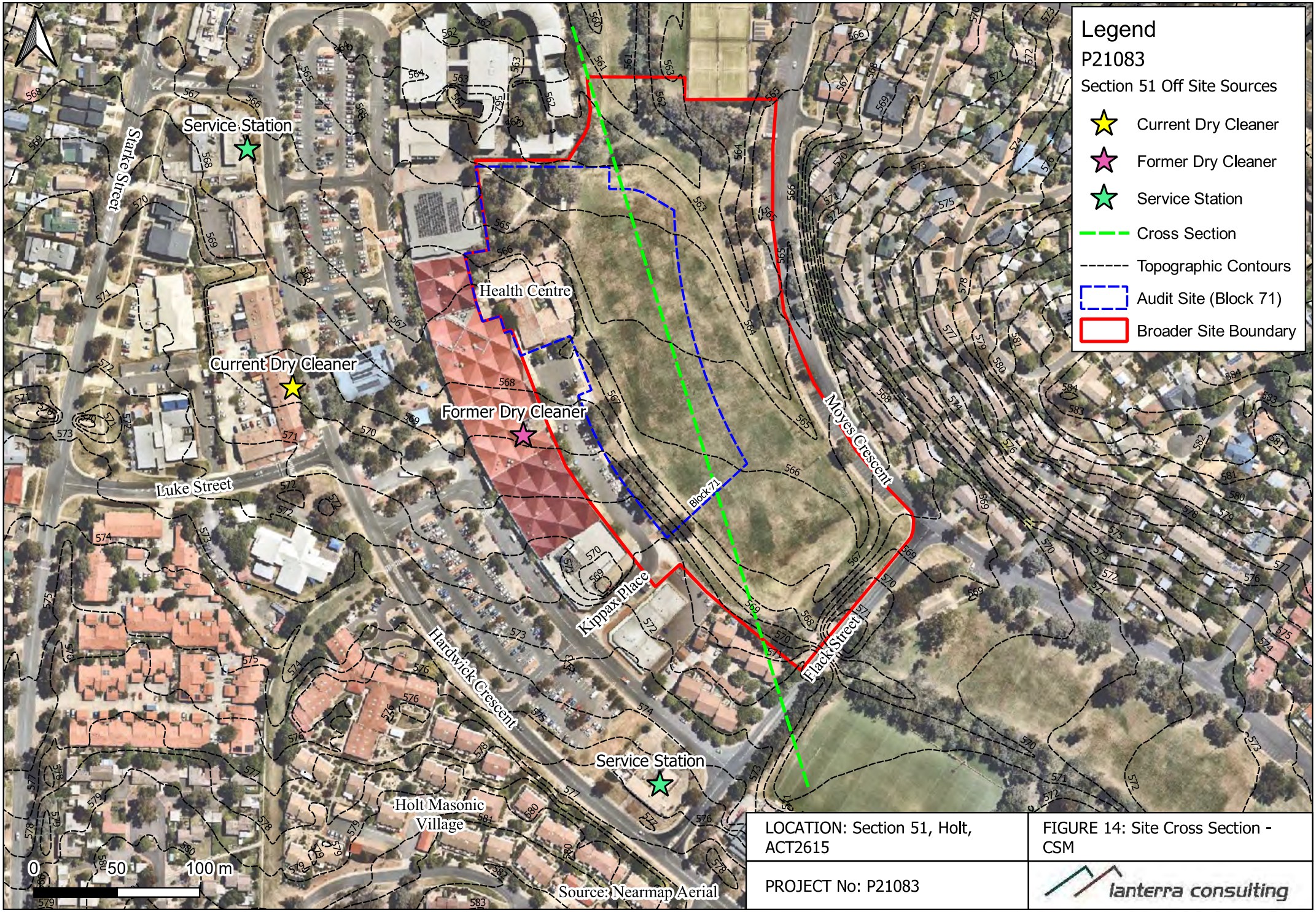
LOCATION: Section 51, Holt, ACT2615	FIGURE 13a: Soil Vapour PCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting

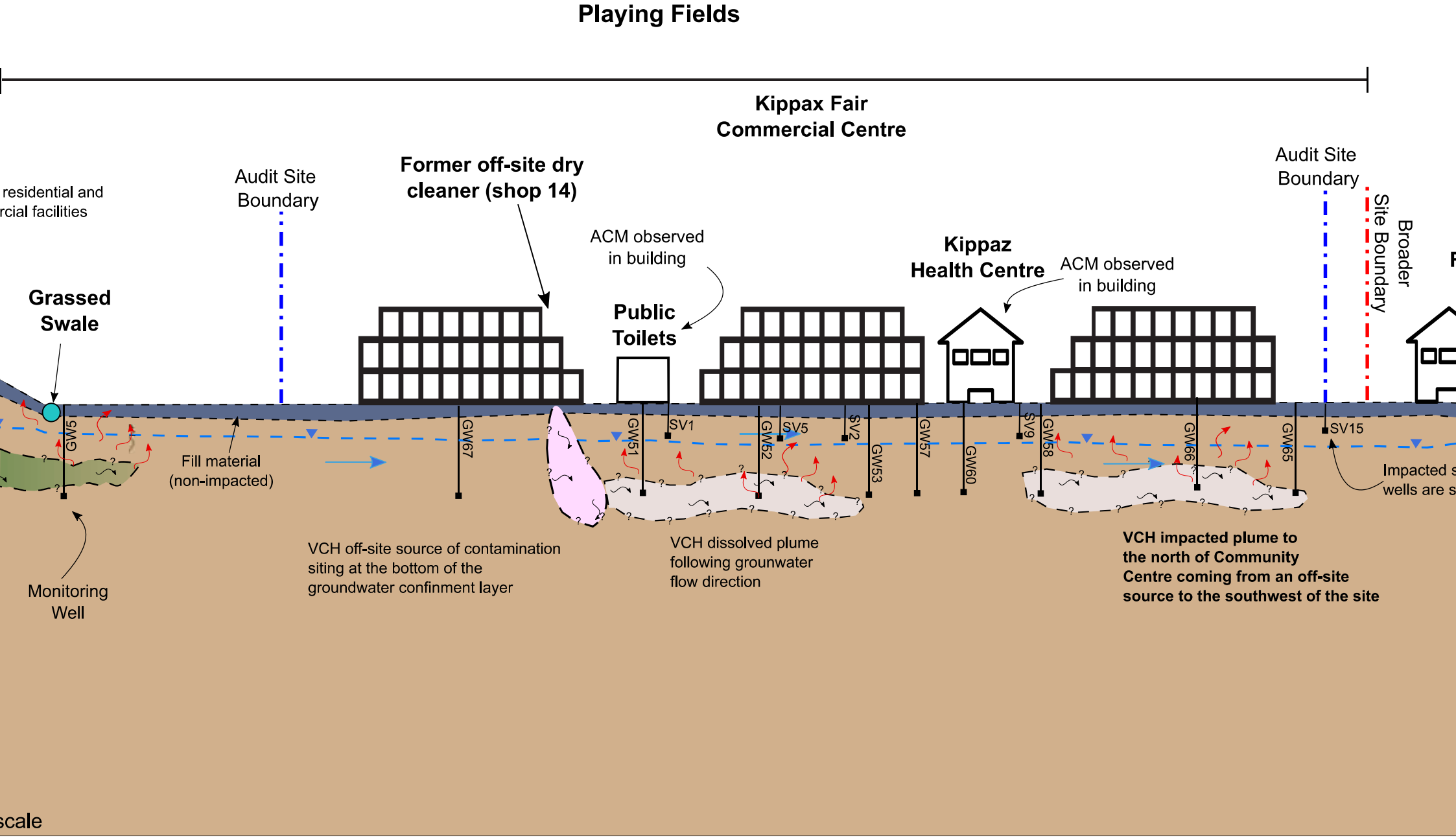


LOCATION: Section 51, Holt, ACT2615	FIGURE 13b: Soil Vapour TCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 13c: Soil Vapour cis-1,2-DCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting


Legend
P21083
Section 51 Off Site Sources
Current Dry Cleaner
Former Dry Cleaner
Service Station
Cross Section
Topographic Contours
Audit Site (Block 71)
Broader Site Boundary
Service Station
Starke Street
Health Centre
Current Dry Cleaner
Former Dry Cleaner
Luke Street
Block 71
Moyes Crescent
Kippax Place
Flack Street
Hardwick Crescent
Service Station
Holt Masonic Village
0
50
100 m
Source: Nearmap Aerial
LOCATION: Section 51, Holt, ACT2615
FIGURE 14: Site Cross Section - CSM
PROJECT No: P21083
lanterra consulting


Playing Fields
Kippax Fair
Commercial Centre
residential and
rcial facilities
Audit Site
Boundary
Former off-site dry
cleaner (shop 14)
ACM observed
in building
Public
Toilets
Kippaz
Health Centre
ACM observed
in building
Audit Site
Boundary
Site Boundary
Broader
Grassed
Swale
SW5
GW67
GW51
SV1
GW52
SV5
SV2
GW53
GW57
GW60
SV9
GW58
GW66
GW65
SV15
Fill material
(non-impacted)
Monitoring
Well
VCH off-site source of contamination
siting at the bottom of the
groundwater confinment layer
VCH dissolved plume
following grounwater
flow direction
VCH impacted plume to
the north of Community
Centre coming from an off-site
source to the southwest of the site
Impacted s
wells are s
scale
Flow

Appendix B Audit Correspondence

Geosyntec consultants

engineers | scientists | innovators

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GSY0165 IA01 □ippa□

0□ September 2021

Nyah Donaldson
Senior In□rastructure O□□icer
En□ironment□Planning and Sustainable De□elopment Directorate
ACT Go□ernment
Le□el 2□480 Northbourne A□enue
Dic□son ACT 2602

Via email: Nyah□Donaldson□ act□go□□au

Dear Nyah□

Re: Interim Advice 01: Review of Existing Information – Section 51 Kippax Centre, Holt, ACT

1 Introduction

The En□ironment□Planning and Sustainable De□elopment Directorate □EPSDD□has appointed Lange Jorstad o□Geosyntec Consultants Pty Ltd □Geosyntec□□a NSW EPA Auditor accredited □No□1001□under the Contaminated Land Management □CLM□Act 1□□□□to conduct an Audit at Section 51 - □ippa□Centre□Holt□ACT 2615 □□the site□□□

The audit area comprises a parcel o□land east o□□ippa□Centre which is earmar□ed □or commercial and mi□ed-use de□elopment□The site is located at the corner o□Flac□Street and Moyes Crescent in Holt and has an area o□appro□imately 5□26 hectares □ha□□The land is legally identi□ied as Section 51□

This is a non-statutory Site Audit conducted in accordance with ACT En□ironment Protection Authority Contaminated Sites En□ironment Protection Policy □EPP□201□□□and the re□uirements outlined in NSW EPA □201□□Contaminated Land Management Guidelines □or the NSW Site Auditor Scheme □3rd edition□□ The NSW guidance adopted is endorsed by the ACT En□ironment Protection Authority □EPA□□or use in the ACT as stated in Section 10□3 o□the *Contaminated Sites Environment Protection Policy* □201□□□

The aim o□the engagement is to enable a site audit statement □SAS□and associated site audit report □SAR□to be prepared that con□irms the suitability o□the site □or commercial and mi□ed-use de□elopment□in accordance with the NSW EPA □201□□Contaminated Land Management Guidelines □or the NSW Site Auditor Scheme □3rd edition□□

2 Scope of Audit and Nature of Interim Advice

NSW EPA □201□□□which is recognised by the ACT EPA□describes the site assessment and audit process as:

1. *Consultant is commissioned to assess contamination*. The contaminated site consultant designs and undertakes the site assessment and, where required, all remediation and validation activities to achieve the objectives specified by the owner or developer; and

2. *Site auditor reviews the consultant's work*. The site owner or developer commissions the Auditor to review the consultant's work. The Auditor then prepares a SAR and SAS at the conclusion of the review, which are given to the owner or developer.

Therefore, the contaminated land consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations, standards and guidelines and is suitable based on the site history and the proposed land use.

3 Current Interim Advice

In preparing this interim audit advice, the Auditor has reviewed the following reports related to land contamination assessment:

- Lanterra Consulting (Lanterra), 22 April 2021, Preliminary Site Investigation, Section 51, Holt, ACT 2615 (Ref: P21016, PSI Section 51 Philippa Group Centre, 20210325, R01);
- Lanterra, 12 May 2021, Detailed Site Investigation, Section 51 Philippa Group Centre, Holt, ACT 2615 (Ref: P21030, DSI Section 51 Philippa Centre, 20210512, R02); and
- Lanterra, 2 July 2021, Sampling and Analysis Quality Plan, Section 51 Philippa Group Centre, Holt, ACT 2615 (Ref: P21030, SAQP Section 51 Holt, 20210702).

The purpose of the current IA is to document Auditor findings following the review of existing information related to site conditions and contamination status. This advice also outlines any data gaps identified in the existing information which should be addressed by Lanterra as either part of any further investigation works or as part of any remedial or validation works that may be required at the site.

4 Summary of Investigations

4.1 Preliminary Site Investigation

The objectives of the report were to assess the potential risk of contamination and assess the suitability of the site for the proposed development and the land uses permitted under the CZ1: Core Zone, PRZ1: Urban Open Space and TSZ1: Transport Zone.

The scope of work included:

- Review of desktop documentation and associated historical information to assess whether there are any known contaminating activities either on the site or on neighbouring properties;
- Review of the environmental setting with regards to geology, topography, hydrology and hydrogeology;
- Site visit to characterise the property setting, which included the gauging of existing groundwater monitoring wells located on the site and inspection of the site surface for obvious and visible signs of potential contamination and/or contaminant sources;
- Evaluation of surrounding land uses to identify any neighbouring activities which may have affected or present a potential risk to the environmental quality of the site.

Lanterra considered the following contaminants of potential concern (COPC): Total recoverable hydrocarbons (TRH), Benzene, toluene, ethylbenzene, xylene (BTEX), Polycyclic aromatic hydrocarbons (PAH), Polychlorinated biphenyls (PCBs), Phenols, Organochlorine pesticides, organophosphorus pesticides (OCP/OPPs), metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), asbestos and volatile chlorinated hydrocarbons (VCHs).

The PSI identified the following areas of environmental concern:

On-site AECs

- AEC 1: Imported fill material used for the establishment of playing fields, the community centre and public toilet buildings, and beneath roads and their associated road reserve.
- AEC2: Imported fill material used for the construction of the Community Centre Building and Public Toilets. The presence of asbestos containing materials (ACM) was identified in these facilities. Based on the age and use of Community Centre building, the possibility of USTs and their associated infrastructure being present cannot be excluded.
- AEC3: Stormwater drainage across the site which receives potentially contaminant loads from off-site locations upstream. If contaminated, the drainage could act as a migration pathway for contaminants across the site.

Off-site AECs

- AEC4: Gippa Fair Commercial Centre has the potential to have USTs and related infrastructure underneath these facilities. It is understood that a dry cleaner was present in Unit 14 of the shopping centre, introducing the risk of contamination associated with this activity such as perchloroethylene (PCE) and trichloroethylene (TCE).
- AEC5: The service station located at the corner of Hardwicke Crescent and Flack Street. A groundwater monitoring network was observed from the service station to the south-eastern section of the site. It is possible that contaminants such as TRH, BTEX and lead are migrating onto the site from this source.

Lanterra conclude that there was insufficient information to assess whether the site is suitable for development and a detailed investigation was recommended to investigate the contamination risks associated with each area of environmental concern

4.2 Detailed Site Investigation

The objectives of the DSI were to assess the suitability of the site for the land uses permitted under the current zoning, which include residential use as the most sensitive use, and adequately characterise the condition of the site including groundwater and soil from a contamination perspective.

The scope of work included:

- An intrusive soil investigation consisting of 23 boreholes across the site and collection of representative soil samples.
- Collection of three surface soil samples from upstream, midstream and downstream locations in the stormwater drainage swale.
- Installation and sampling of one groundwater monitoring well
- Sampling of five existing groundwater monitoring wells.
- Soil and water analysis at a NATA accredited laboratory for the analyses of COPCs identified in the PSI.
- Assess laboratory results obtained from the investigation against the applicable land use criteria, considering low-density residential land use.
- Prepare a detailed investigation report

Fill materials were identified across the site corresponding with an imported road base layer used as a part of the establishment of the roads. The reworked materials were likely sourced from the site and surroundings. Fill was also identified for the construction of the playing fields where a creek was filled for levelling purposes. No anthropogenic material was observed except for borehole S3 on the playing field with traces of concrete and brick. No potential asbestos containing materials (ACM) were observed.

COPCs were below the adopted criteria in all soil samples analysed.

A perched body of water was observed in the locations of monitoring wells GW3 and GW5 at approximately 1 to 2 m bgl. A deeper aquifer at 6 to 10 m bgl was inferred based on the depths of existing wells and water strike at 5 m bgl observed while installing well GW51.

Concentrations of nickel and zinc were reported above the Australian Drinking Water Guideline (ADWG 2011) criteria in GW1, GW2, GW3 and GW5 and were inferred to be indicative of background concentrations associated with the natural rock mineralisation of the area.

Benzene was detected in GW1, GW2, GW3 and GW5 indicating that shallow groundwater in this area was likely impacted by the operating service station located approximately 100 m to the southwest of the site on Block 1 Section 53. The service station is currently listed on the Environmental Protection Authority (EPA) Register of Contaminated Land.

Concentrations of VCH and metals (copper, lead, nickel and zinc) were measured above the ADWG (2011) criteria in monitoring well GW51. The source of VCH was inferred to be a former drycleaner that was located inside the Lanterra Fair shopping centre. Lanterra suggested that the elevated concentrations of copper and zinc in GW51 could be a combination of natural background levels associated with mineralisation of the host rock or possible impact from the former drycleaner.

Concentrations of copper, lead, nickel and zinc exceeded the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) and Urban Drains and Streams: Pollutants entering Waterways taken to cause Environmental Harm Aquatic Habitat (AUA4 2005) criteria in groundwater samples collected from GW1, GW2, GW3, GW5 and GW51. It is noted that the AUA4 (2005) criteria are conservative values developed for the protection of sensitive aquatic ecosystems. Lanterra state that given that the nearest waterway is a stormwater channel located approximately 120m east of GW51, the contamination risk groundwater may pose to aquatic ecosystems is considered to be negligible.

4.3 Sampling, Analysis and Quality Plan

Lanterra state that the objective of the sampling, analysis and quality plan (SAQP) is to prepare a program that will characterise the impacted groundwater plume at the site and assess whether the potential migration of vapour to the surface would pose a risk for the human health and the environment and re-evaluate the suitability of the site for the proposed land uses.

The plume is associated with a former dry cleaner that used to operate in the Lanterra Fair Shopping Centre. It is possible that impacted groundwater may pose a vapour risk to future site developments. Therefore, additional groundwater and vapour soil sampling around this area has been recommended

The SAQP presents the following applicable assessment criteria for groundwater:

- ASC NEPM 2013 HSL-A criteria for Low and High-Density residential use for clay lithology and a depth of 2m to 4m and 4m to 8m. These values are the same for both ranges of depths.
- ANZG 2018 Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments. Canberra ACT. Toxicant Default Guideline Values for 95% species protection in freshwater.
- NHRMC 2011 Australian Drinking Water Guideline. Version 3.6. March 2021. (ADWG 2011).
- Environment Protection Regulation 2005 (ACT). AUA4. Urban Drains and Streams: Pollutants entering Waterways taken to cause Environmental Harm Aquatic Habitat.

The SAQP presents the following applicable assessment criteria for soil vapour:

- ASC NEPM 2013 Health screening le□els □HSLs□□or petroleum hydrocarbons □or residential use□

To assess potential migration o□impacted groundwater□Lanterra propose installation and sampling o□three new wells□downgradient o□GW51□as wells as sampling o□GW51□The new wells will be ad□anced to appro□imately 2 m below the water table □appro□□10- 15 m□and completed with a 3 m screen□

For soil □apour□one soil □apour bore will be drilled ad□acent to GW51 where dissol□ed VCH were detected□To characterise the □ertical migration o□□apour□the □apour well will target

- 8-□ m depth □or 2-3 m abo□e groundwater□□and
- 2 m depth

The soil □apour wells will be installed in a □5 mm diameter hole using 150mm screened mesh and two soil □apour implants will be connected to the sur□ace with Te□lon tubing□The implants will be targeting depths between 8-□ m bgl and 2-3 m bgl to characterise the potential □ertical migration o□□apour□The samples will be collected using a Summa canister□

5 Auditor Comments

The Auditor has re□iewed the Lanterra documents summarised abo□e against rele□ant guidelines made or appro□ed by ACT EPA□The reports largely meet the guideline re□uirements□howe□er□the Auditor pro□ides the □ollowing comments:

1□ PSI Section 2□1: Please con□rm current site ownership□

2□ PSI Section 2□2: Please pro□ide additional comment or pro□ide the □ollowing:

   a□ Regional soil conditions

   b□ Sewer □ ser□ices plans o□the site□location o□ser□ices and utilities□including on site septic systems□i□any□

   c□ Identi□ication o□electrical trans□ormers□substation□capacitors on site□

   d□ Is there a potential □or □ooding on the site□

   e□ Historical product spill and loss □nown to ha□e occurred on site□

3□ PSI Section 3□6: This section states that a □search o□the Wor□sa□e ACT Dangerous Substances Register□Dangerous Goods database and Mani□est □uality Noti□ication was not submitted by the time o□issuing the PSI□but that the search will be per□ormed □or the Community Centre and □ippa□Fair Commercial Centre once an appro□al letter is obtained □rom the current owner o□those buildings□The □uture results o□this search will be pro□ided in an addendum to this report□□Please con□rm whether appro□al has been granted and whether this search has been completed□

4□ PSI Section 3□2: Can you pro□ide any □urther detail relating to the timing and operations o□ the □ormer drycleaner in □ippa□Centre□ For e□ample□is there any a□ailable in□ormation on chemical use□storage and disposal practices□

5□ PSI Section 5: Please pro□ide a discussion relating to the potential o□per- and poly-□uoroal□yl substances □PFAS□use both on and o□site□□they are not rele□ant to the CSM □or this site□please directly state the □usti□ication □or e□clusion□□they are potentially rele□ant□please consider inclusion in □uture assessment□

6□ DSI Section 8: D□O Step 3 - This step should consider additional inputs i□e□□data criteria□

□□ DSI Section □2□1: Please pro□ide the rationale □or the sampling density selected□

8□ DSI Section 10:

a. A comment on the experience of the sampling team and whether the sampling team followed SAQP is required.

b. Water quality meter and PID calibration certificates should be provided.

c. Groundwater well GW4 was sampled with a bailer as opposed to low flow sampling with the other wells. Please include a discussion on how the difference in methods affected results.

d. Are borelogs available for the existing on-site wells. Or for the off-site wells that were used to calculate flow direction.

9. DSI Section 10.1: The soil investigation was completed using boreholes. the asbestos samples collected were less than 300g which does not meet appropriate asbestos characterisation. Please comment on appropriateness of asbestos sampling in respect to NEPM 2013 requirements and implications on the results.

10. DSI Section 12.1.2: Regarding the "perched water body" inferred to be present and represented by water levels in wells GW3 and GW5:

a. Wells GW3, GW4 and GW5 appear to be installed to similar depths and within ground of a similar RL (at least the screens are likely to overlap). I'd suggest the local topography and slightly variation in well depths (GW4 being ~1m deeper) might account for some of the water level variation. The term "perched water body" suggests a shallow water body that is physically separated from deeper groundwater by an aquitard, whereas I would have thought these wells represent slightly different screened depths within the same shallow groundwater zone.

b. Is the water bearing zone in which GW1-GW5 are screened considered to be different to where GW51 is screened.

11. DSI Section 13:

a. The discussion on heavy metals in groundwater presented in Section 12.2.2 and 13.2 are not consistent. Also, are dry cleaning operations really a likely source of metals impact to groundwater.

b. Lanterra summarised that a perched water body was observed in monitoring wells GW3 and GW5 which is not represented in the CSM. Is this perched system remnant of the previous creek or within the fill.

12. DSI Section 15:

a. The report concludes that groundwater beneath the site must not be used for beneficial purposes (e.g. as potable water supply or for irrigation purposes) unless it is demonstrated by further investigations that there is no risk associated with these uses. How does Lanterra consider this recommendation be enforced.

Lanterra concluded that the potential for VCH compounds to pose a vapour risk to the current site was considered to be low based on the depth to groundwater (6.6 m) and the clayey lithology. While it is noted that it is not proposed that there would be a change in use in the area of GW51. Section 2.4 states that the proposed development may include basement accessibility from Moyes Crescent (presumably basement parking levels beneath the ground floor residential area). The Auditor considers that the further delineation and vapour risk assessment should consider the potential for basement level development (i.e. a reduction in the depth to contaminated groundwater) and whether such development changes the vapour risk profile.

13. SAQP Section 4.1 states that other than AEC4, further environmental investigation was not considered to be necessary. The investigation density in the middle of the playing field is relatively low, the investigation methodology consisted of boreholes rather than test pits and the field was previously indicated to be a fill platform. Considering the frequent occurrence of ACM fragments in fill material in the ACT, how will potential unexpected finds be managed during construction and development.

14 SAP Section 4.2 and 5: The SAP should either include a consideration of PFAS or should provide justification for its omission.

15 SAP Section 8: A key consideration for the VCH plume delineation and vapour risk assessment is that the playing fields to the east of the investigation area are ~2-3 metres lower than the carpark level and the depth to groundwater may also be less and this is the proposed new development area. Hence if the VCH plume is found to extend into the playing fields then the vapour risk characterisation may be different than up in the carpark, especially since basement levels are proposed.

16 SAP Section 8.1.1:

a. Will all soil vapour locations be surveyed as well as the new groundwater wells.

b. Please confirm if testing will be completed to estimate site-specific hydrogeologic characteristics, e.g. hydraulic conductivity. Vertical assessment of groundwater flow.

c. Given that PCE is a dense non-aqueous phase liquid how will the vertical extent of the VCH plume be characterised.

d. Is there a chance that the proposed development will require dewatering. If so please consider how that might affect the VCH plume.

17 SAP Section 8.2.1:

a. Please comment on selection of one soil vapour probe at GW51. Will additional soil vapour locations be considered based on results of the investigation? The resulting investigation report will need to provide justification that one probe will be sufficient to characterise the vapour risk at the site or comment how this uncertainty will be managed by any proposed protection measures. Given the difficulty of getting drill rigs into the ACT under COVID restrictions it may be prudent to consider installing a second vapour probe adjacent to one of the downgradient wells while the rig is available just in case.

b. Please confirm the detection limits of the laboratory will be sensitive enough to determine appropriate soil vapour risk.

c. Please confirm if the soil vapour bore will be sealed to the surface.

d. How long will the soil vapour installation be allowed to equilibrate before sampling.

e. Please state what flow rate is proposed for to state in the resulting investigation report.

f. Please comment on soil vapour sample splitting techniques proposed.

g. Please provide details of training and experience of the sampling team in the resulting investigation report

h. Please comment on choice of placement and potential pathways for soil vapour at the site. Will vapour monitoring within local drains and sewers be completed while on site.

18 SAP General: Please include a section outlining reporting requirements.

We request that Lanterra provide responses to the above comments together with an amended copy of the SAP as appropriate.

6 Closure

This interim advice does not constitute a SAS or a SAR but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor's opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely



Lange Jorstad, PhD, CEnvP SC
NSW EPA Accredited Site Auditor (No. 1001)
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GSY0165 IA02 □ippa□

23 December 2021

Nyah Donaldson
Senior In□rastructure O□□icer
En□ironment□Planning and Sustainable De□elopment Directorate
ACT Go□ernment
Le□el 2□480 Northbourne A□enue
Dic□son ACT 2602

Via email: Nyah□Donaldson□ act□go□□au

Dear Nyah□

Re: Interim Advice 02: Review of Lanterra's Groundwater and Soil Vapour Investigations Letter – Kippax Place, Section 51, Holt, ACT

1 Introduction

The En□ironment□Planning and Sustainable De□elopment Directorate □EPSDD□has appointed Lange Jorstad o□Geosyntec Consultants Pty Ltd □Geosyntec□□a NSW EPA Auditor accredited □No□1001□under the Contaminated Land Management □CLM□Act 1□□□□to conduct an Audit at □ippa□Place□Section 51□Holt□ACT 2615 □□the site□□□

The audit area comprises a parcel o□land east o□□ippa□Centre which is earmar□ed □or commercial and mi□ed-use de□elopment□The site is located at the corner o□Flac□Street and Moyes Crescent in Holt and has an area o□appro□imately 5□26 hectares □ha□□The land is legally identi□ied as Section 51□

This is currently a non-statutory Site Audit conducted in accordance with ACT En□ironment Protection Authority Contaminated Sites En□ironment Protection Policy □EPP□201□□□and the re□uirements outlined in NSW EPA □201□□Contaminated Land Management Guidelines □or the NSW Site Auditor Scheme □3rd edition□□ The NSW guidance adopted is endorsed by the ACT En□ironment Protection Authority □EPA□□or use in the ACT as stated in Section 10□3 o□the *Contaminated Sites Environment Protection Policy* □201□□□

The aim o□the engagement is to enable a site audit statement □SAS□and associated site audit report □SAR□to be prepared that con□irms the suitability o□the site □or commercial and mi□ed-use de□elopment□in accordance with the NSW EPA □201□□Contaminated Land Management Guidelines □or the NSW Site Auditor Scheme □3rd edition□□

2 Scope of Audit and Nature of Interim Advice

NSW EPA □201□□□which is recognised by the ACT EPA□describes the site assessment and audit process as:

1. *Consultant is commissioned to assess contamination*—The contaminated site consultant designs and undertakes the site assessment and—where required—all remediation and validation activities to achieve the objectives specified by the owner or developer—and
2. *Site auditor reviews the consultant's work*—The site owner or developer commissions the Auditor to review the consultant's work—The Auditor then prepares a SAR and SAS at the conclusion of the review—which are given to the owner or developer—

Therefore—the contaminated land consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations—standards and guidelines and is suitable based on the site history and the proposed land use—

3 Current Interim Advice

In preparing this interim audit advice—the Auditor has reviewed the following reports related to land contamination assessment:

- Lanterra Consulting (Lanterra)—13 December 2021—P21083 —Results of Groundwater and Soil Vapour Investigations—ippa—Place—Section 51—Holt—ACT (revision a)—

The purpose of the current IA is to document Auditor findings following the review of existing information related to site conditions and contamination status— This advice also outlines any data gaps identified in the existing information which should be addressed by Lanterra as either part of any further investigation works—or as part of any remedial or validation works that may be required at the site—

4 Summary of Investigation

The objectives of the investigation were to:

- Further characterise VCH in groundwater to delineate the extent of the impact—
- Assess whether VCH poses a vapour risk in the vicinity of the impacted groundwater well (GW51)—

Lanterra's scope of work included:

- Groundwater:
  - Install 3 groundwater monitoring wells down gradient of GW51
  - Collect groundwater samples from existing and newly installed wells for laboratory analysis of TRH—BTEX—Heavy metals—CCH and PFAS
- Soil Vapour
  - Install two soil vapour bores next to GW51 and new well GW53—targeting 5-6 m depth which is the potential depth of the double basement in the future development
  - Collect vapour samples from the wells and submit them to a NATA accredited laboratory for analysis of TPH—BTEX— and VOCs—including VCHs—
- Indoor Air
  - Collect 3 indoor air samples from within the —ippa—Health Building—located down hydraulic gradient from where VHCs were detected in groundwater and soil vapour—and submit them to a NATA accredited laboratory for analysis of VOCs—including VCHs—

The VCH plume is believed to be associated with a former dry cleaner that used to operate in the —ippa—Fair Shopping Centre—It is possible that impacted groundwater may pose a vapour risk to future site developments—Therefore—additional groundwater and vapour soil sampling around this area was recommended on the basis of the initial investigation results—

5 Auditor Comments

The Auditor has reviewed Lanterra's Additional Groundwater and Soil Vapour Investigation Letter (2021) and associated lab results for indoor air sampling against relevant guidelines made or approved by ACT EPA. The reports largely meets the guideline requirements, noting the interim status of this letter and the statement that the results in this letter and future work results are to be added to a revised DSI. The following information will be required in the revised DSI for the Auditor to complete a formal assessment of the works in accordance with the guidelines:

1. Field methods:
   a. The third bullet under Methods - Groundwater Sampling states the wells were gauged with a HDPE bailer. Is this correct?
   b. Please describe sample splitting techniques for water and soil vapour samples.
   c. Please provide details of the field instruments used.
   d. Please state what type of tubing was used for soil vapour sampling (e.g. Teflon).
   e. Please comment on the adequacy of the equilibration period prior to sampling the soil vapour probes following installation.
   f. Please state the flow rate adopted for soil vapour sample collection.
2. Quality assurance and quality control:
   a. Please include an overall analysis or review as to whether the DQOs were met as presented in the SAQP.
   b. Please indicate if the sampling team was qualified and experienced for the tasks performed.
   c. Please provide calibration certificates for the PID, interface probe, and water quality meter
   d. Please provide details of duplicate and triplicate samples (parent, dup, trip identification) and associated RPDs.
   e. Please indicate if trip spike, trip blank samples were included with the groundwater samples.
   f. Please indicate if a soil vapour blank sample was analysed.
   g. Please comment on the laboratory limits of reporting (LOR) for soil vapour analyses relative to the assessment criteria.
3. Results:
   a. Please comment on whether NAPL was observed or detected in any of the wells.
   b. Please provide lithological and well construction logs for the newly installed wells and vapour probes.
   c. Envirolab certificates of analysis and QA/QC results are missing, only the sample receipt advice was attached, please provide.
   d. Please provide copies of field sampling forms documenting any observations during the field program.
   e. Please provide well survey and water level gauging data, and any updated potentiometric analysis.
4. Please consider the following issues when including the additional information in a revised DSI report:
   a. Is hydraulic testing warranted to assess the contaminant fate and transport potential of the VCH plume.

b. Given that PCE is a dense non-aqueous phase liquid please comment on vertical delineation of the VCH plume.

c. Is there a chance that the proposed development will require dewatering. If so please consider how that might affect the VCH plume.

d. Please consider the relationship (spatial and concentration) of the VCH plume to the proposed future development land uses.

e. Please consider if any preferential pathways for soil vapour exist at the site (for example stormwater drains utility pits and sewers).

We request that Lanterra provide responses to the above comments together with an amended copy of the SAP as appropriate.

6 Closure

This interim advice does not constitute a SAS or a SAR but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor's opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,



Lange Jorstad, PhD, CEnvP SC
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GSY0165 IA03 □ippa□

2□ April 2022

Nyah Donaldson
Senior In□rastructure O□□icer
En□ironment□Planning and Sustainable De□elopment Directorate
ACT Go□ernment
Le□el 2□480 Northbourne A□enue
Dic□son ACT 2602

Via email: Nyah□Donaldson□ act□go□□au

Dear Nyah□

Re: Interim Advice 03: Review of Additional Groundwater and Soil Vapour Investigation Data from January to April 2022 – Kippax Place, Section 51, Holt, ACT

1 Introduction

The En□ironment□Planning and Sustainable De□elopment Directorate □EPSDD□has appointed Lange Jorstad o□Geosyntec Consultants Pty Ltd □Geosyntec□□a NSW EPA Auditor accredited □No□1001□under the Contaminated Land Management □CLM□Act 1□□□□to conduct an Audit at □ippa□Place□Section 51□Holt□ACT 2615 □□the site□□□

The audit area comprises a parcel o□land east o□□ippa□Centre which is earmar□ed □or commercial and mi□ed-use de□elopment□The site is located at the corner o□Flac□Street and Moyes Crescent in Holt and has an area o□appro□imately 5□26 hectares □ha□□The land is legally identi□ied as Section 51□

This is currently a non-statutory Site Audit conducted in accordance with ACT En□ironment Protection Authority Contaminated Sites En□ironment Protection Policy □EPP□201□□□and the re□uirements outlined in NSW EPA □201□□Contaminated Land Management Guidelines □or the NSW Site Auditor Scheme □3rd edition□□ The NSW guidance adopted is endorsed by the ACT En□ironment Protection Authority □EPA□□or use in the ACT as stated in Section 10□3 o□the *Contaminated Sites Environment Protection Policy* □201□□□

The aim o□the engagement is to enable a site audit statement □SAS□and associated site audit report □SAR□to be prepared that con□irms the suitability o□the site □or commercial and mi□ed-use de□elopment□in accordance with the NSW EPA □201□□Contaminated Land Management Guidelines □or the NSW Site Auditor Scheme □3rd edition□□

2 Scope of Audit and Nature of Interim Advice

In preparing this interim audit ad□ice□the Auditor has re□iewed raw groundwater and soil □apour in□estigation data □abulated□and supported by preliminary □gures□□rom additional

in□estigations conducted □rom January to April 2022 in relation to the nature and e□tent o□ □olatile chlorinated hydrocarbons □VCH□pre□iously identi□ied at the site□The additional in□estigation □ollowing the issue o□pre□ious interim ad□ice letter IA02 on 23 December 2021□ was generally conducted in two stages: January□February 2022 and March□April 2022□

Pre□ious in□estigation in late 2021 identi□ied ele□ated VCH concentrations in groundwater and soil □apour close to a □ormer dry cleaner in the □ippa□Fair Shopping Centre□with the potential to pose a ris□ to current and □uture land uses□The additional groundwater and □apour soil sampling was intended to re□ine the delineation and ris□ characterisation posed by VCH in groundwater and soil □apour□

The purpose o□this IA is to pro□ide preliminary comments on the ade□uacy and completeness o□the in□estigation data □to date□□and audit considerations regarding potential ris□s to □uture land uses and ad□acent properties□

3 Summary of Additional Investigation

The broad ob□ecti□es o□the additional in□estigation were to:

- Delineate the nature and e□tent o□VCH in groundwater and soil gas□
- Pro□ide data to support a human health ris□ assessment □HHRA□□ocused on potential ris□s related to VCH in groundwater and soil gas□

Lanterra□s additional scope o□wor□ □rom additional in□estigations conducted in 2022 included:

- Groundwater:
  - Installation□de□elopment and sur□eying o□16 additional groundwater monitoring wells □GW55 to GW60 in January 2022□and GW61 to GW□0 in March 2022□□located:
    - Surrounding the Community Centre and in the open space to the north o□the Community Centre□□or VCH plume delineation
    - South and southwest o□GW51 □well with highest VCH concentrations□located close to a □ormer dry cleaner in the □ippa□Fair mall□to assess upgradient groundwater □uality
    - West o□□ippa□Fair Mall□between the mall and a current dry cleaner on Hardwic□ Crescent to assess the potential □or VCH release associated with this dry cleaner□and i□present□the potential □or this VCH to be contributing to VCH detected in the Section 51 in□estigation area□
  - Gauging o□static water le□els in new and e□isting wells to assess groundwater □ow directions across the study area
  - Collection groundwater samples □January and March 2022□□rom e□isting and newly installed wells and submission to a NATA accredited laboratory □or analysis o□VCH□
- Soil Vapour
  - Installation o□se□en new soil □apour bores □SV3 to SV□ in January 2022□SV10 to SV16 in March 2022□□either as paired probes targeting 1-2 and 5-6 m below ground le□el □mbgl□□SV3 to SV□□or shallow probes targeting 1-2 mbgl only □SV10 to SV16□
  - Collection o□□apour samples □rom the wells □January and March 2022□and submission to a NATA accredited laboratory □or analysis o□□olatile organic compounds □VOC□□ including VCH□

4 Auditor Comments

The Auditor has re□iewed the additional groundwater and soil □apour in□estigation results pro□ided in □raw□□ormat □i□e□without reported interpretation□□Hence□the interim ad□ice in this letter is limited to high-le□el consideration o□the e□tent to which the delineation was achie□ed□ and audit considerations arising □rom the in□estigation results to date□More detailed re□iew

comments will be pro□ided □ollowing re□iew o□the results in a re□ised DSI report□The Auditor□s obser□ations and comments are as □ollows:

- The groundwater contour plan pro□ided□based on water le□els measured across the □ull monitoring well networ□in March 2022□is broadly similar to pre□ious groundwater □ow interpretations and indicates a predominant NNE □ow direction □rom the west side o□□ippa□ Fair Shopping Centre across the VCH study area within the audit site boundary□Based solely on the □ow directions presented□there are plausible groundwater □ow paths between the current and □ormer dry cleaners and the audit site□
- From re□iew o□the groundwater VCH results:
  - One or more o□tetrachloroethene □PCE□□trichloroethene □TCE□and□or cis-1□2-dichloroethene □cDCE□e□ceeded the adopted water □uality criteria in eight monitoring wells□
  - VCH concentrations reported in wells GW51□GW52 and GW58□which were sampled in January and March 2022 and reported e□ceedances o□one or more VCH□reported similar concentrations between monitoring e□ents□
  - Regarding spatial distribution o□VCH concentrations in groundwater□there generally appears to be:
    - A cluster o□VCH detections immediately down hydraulic gradient □rom the □ormer dry cleaner in □ippa□Fair Shopping Centre□and generally south and east o□the Community Centre□O□these□water □uality criteria e□ceedances were reported □or the two wells closest to the □ormer dry cleaner □GW51 and GW52□□with diminishing concentrations reported in downgradient wells □GW53□GW54□GW56 and GW5□□□ This cluster o□VCH detections has generally been laterally delineated to the east o□ the shopping centre □noting the spatial constraints to in□estigation posed by the Community Centre□□
    - A cluster o□VCH detections in monitoring wells to the east o□the current dry cleaner on Hardwic□Crescent□between the dry cleaner and the shopping centre □GW88□ GW68 and GW6□□□PCE□TCE and cDCE all e□ceeded the adopted water □uality criteria in each well□This cluster o□detections has not been laterally delineated□
    - A cluster o□VCH detections in monitoring wells to the north o□the Community Centre □GW58□GW65 and GW66□with TCE and□or cDCE concentrations e□ceeding the adopted water □uality criteria in these wells□From consideration o□the groundwater contours□these wells could be interpreted as being down hydraulic gradient □rom the VCH detections to the east o□the current dry cleaner□with lower VCH concentrations reported in these three wells□These detections appear to be delineated laterally to the east□but there is no data a□ailable □rom beneath the shopping centre to the west□and the groundwater □ow direction suggests that this VCH plume could e□tend into the downgradient property to the north□
    - For ease o□re□erence□the VCH plume to the south o□the Community Centre is re□erred to as the □southern plume□and the VCH plume to the west o□the shopping centre and north o□the Community Centre is re□erred to as the □northern plume□ □noting that there is still a spatial data gap beneath the shopping centre between the western and northern VCH detections□□
    - The VCH plume to the south o□the Community Centre appears to be separate □rom the VCH plume to the north o□the Community Centre□with VCH reported below the limit o□reporting □LOR□in se□eral wells located between the two plumes□There also appears to be a slight di□erence in the relati□e VCH composition reported in the two plumes□with PCE and to a lesser e□tent TCE dominant in the southern plume and a roughly e□ual distribution o□PCE□TCE and cDCE concentrations in the northern plume□

    - VCH was reported below the LOR in wells GW6□ and GW□0□which are up hydraulic gradient o□the □ormer dry cleaner and southern plume□suggesting that the VCH source □or this plume is unli□ely to originate □rom the south or west o□the shopping centre and is li□ely to be beneath the shopping centre□

- From re□iew o□the soil □apour VCH results:
    - One or more o□PCE□TCE and□or cDCE were detected in 15 o□the 16 □apour probes □including shallow and deep probes □or the paired probes□□with one or more e□ceedances o□the interim HILs in □our □apour probes to the south o□the Community Centre □SV1□SV2□SV4 and SV5□□and two □apour probes to the north o□the Community Centre □SV□ and SV15□□
        - One or more o□the e□ceedances at SV1 □shallow and deep□□SV4 □deep□and SV□ □shallow□e□ceeded the interim HIL criteria □or all land uses□
    - The e□ceedances were separated by probes reporting lower VCH concentrations□ suggesting they are correlated with the northern and southern plumes□
    - Vinyl chloride □VC□concentrations were reported below the LOR in all probes□but the LOR was raised abo□e the corresponding interim HIL criterion □or VC in SV1□li□ely due to sample dilution resulting □rom the high PCE concentration in this sample□
    - Where shallow and deep □apour probes were sampled□VCH concentrations were higher in the deeper probes□suggesting that dissol□ed VCH in groundwater was the primary contributor to □apour-phase VCH□
    - VCH was reported in soil □apour at locations where the corresponding concentrations in groundwater were below the LOR□This could indicate that the □apour plumes are migrating in the unsaturated □one somewhat independently o□the underlying groundwater VCH plumes□and□or that there is a soil VCH source also contributing to the □apour-phase VCH□
    - Partial lateral delineation o□soil □apour e□ceedances was achie□ed□with the □ollowing obser□ations and data gaps:
        - SV1□SV5 and SV□ are located close to the property boundary o□the □ippa□Fair Shopping Centre□and there is no data a□ailable □rom beneath the shopping centre□ Hence□it is possible that VCH concentrations are present in soil □apour beneath the shopping centre at concentrations e□ceeding commercial land use criteria□
        - There is no soil □apour data a□ailable □rom the west o□the shopping centre □in the □icinity o□VCH detections in groundwater at GW88□GW68 and GW6□□□
        - The eastern e□tent o□soil □apour e□ceedances associated with the southern plume has not been delineated□
        - SV15 is located ad□acent to the northern site boundary and reported a TCE □apour concentration abo□e the interim HIL A criterion□The Auditor understands that the de□elopment to the north is a residential bloc□□Accordingly□it is possible that TCE □apour concentrations e□ceeding residential land use criteria e□tend into the residential bloc□□

Based on re□iew o□this initial data□the auditor pro□ides the □ollowing high-le□el comments □or consideration:

- Considering the land uses□groundwater □low directions and distribution o□VCH in groundwater and soil □apour□it is li□ely that the VCH impact beneath the audit site originates □rom o□-site sources□Accordingly□there may be limited options to eliminate or permanently reduce the VCH sources a□ecting the audit site□
- Gi□en that VCH concentrations in groundwater and soil □apour e□ceed health-based criteria □□or one or more land uses in the case o□soil □apour□at □arious locations within or close to the audit site□the presence o□the VCH will li□ely pose land use constraints □or □uture

redevelopment of the audit site. It is recommended that the magnitude and extent of the risk to human health and associated land use constraints are further informed by the HHRA currently being prepared.

  - In considering potential constraints to future land uses, the potential to induce the movement of VCH contaminated groundwater and/or soil vapour during construction must also be considered (e.g. as a result of dewatering or installation of underground services with permeable backfill that could act as preferential flow paths).

- While the most recent investigation stages significantly improved the delineation of VCH in groundwater and soil vapour, the DSI will need to consider whether vertical delineation is warranted, and also consider areas that may require further lateral delineation (for example, soil vapour VCH exceedances to the south of the Community Centre).
- Based on the distribution of VCH exceedances in groundwater and soil vapour, it is possible that similar concentrations are present beneath adjacent properties at concentrations exceeding the land use criteria. Accordingly, it is recommended that this information is provided to the adjacent landowners and ACT EPA as soon as practicable to make them aware of the potential risk, so they can respond accordingly.
- To improve the data presentation and interpretation for the audit site, it is recommended that the site boundary (shown in red on the available figures) is modified to reflect the audit boundary, as some of the elevated VCH detections to the south of the Community Centre in particular are understood to be outside of the audit boundary, which could have non-trivial implications for the audit conclusions.

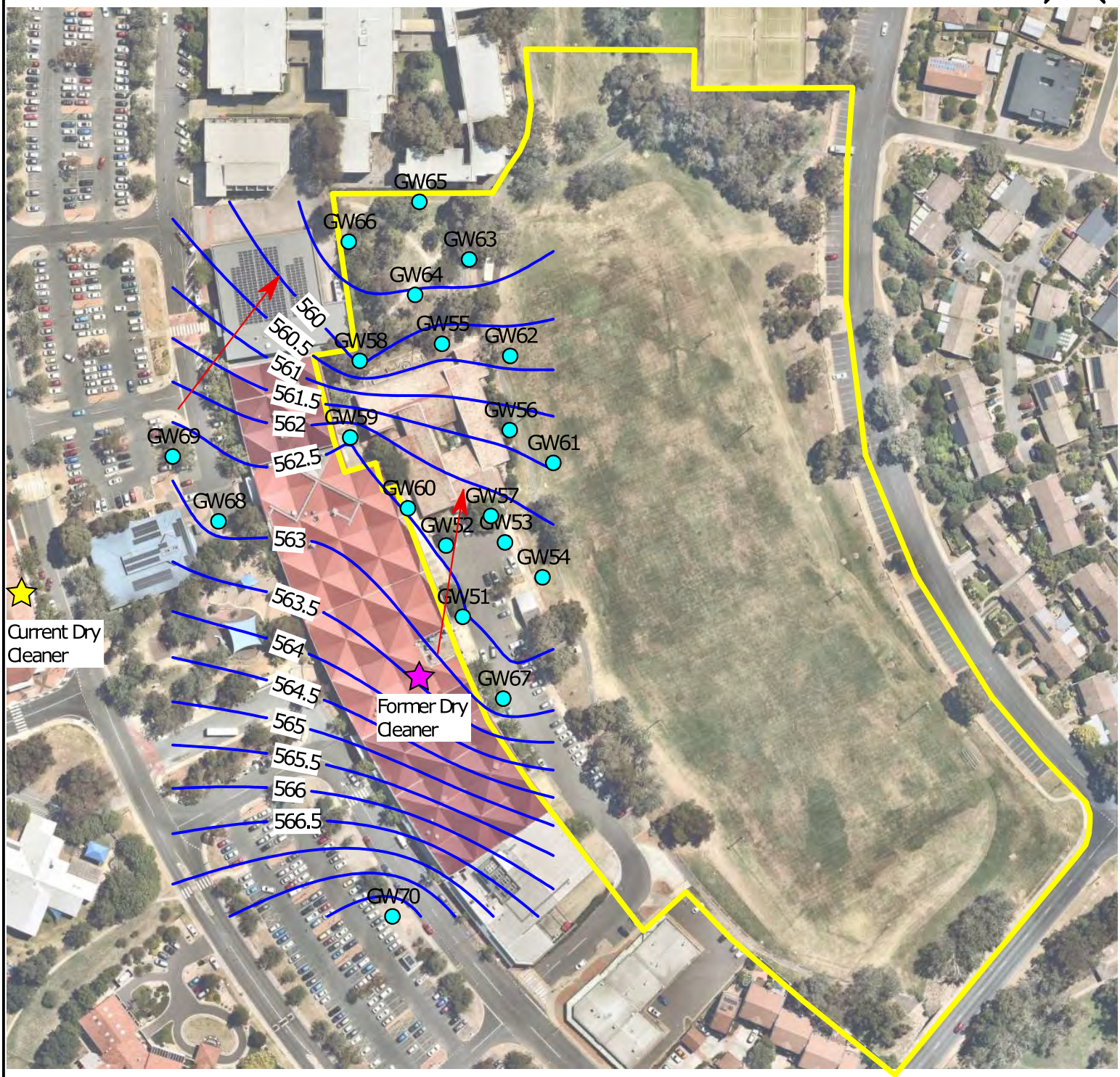
5 Closure

This interim advice does not constitute a SAS or a SAR, but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor's opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points, please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,

Lange Jorstad, PhD, CEnvP SC
NSW EPA Accredited Site Auditor (No. 1001)
Geosyntec Consultants Pty Ltd



0m 50m 100m

Legend

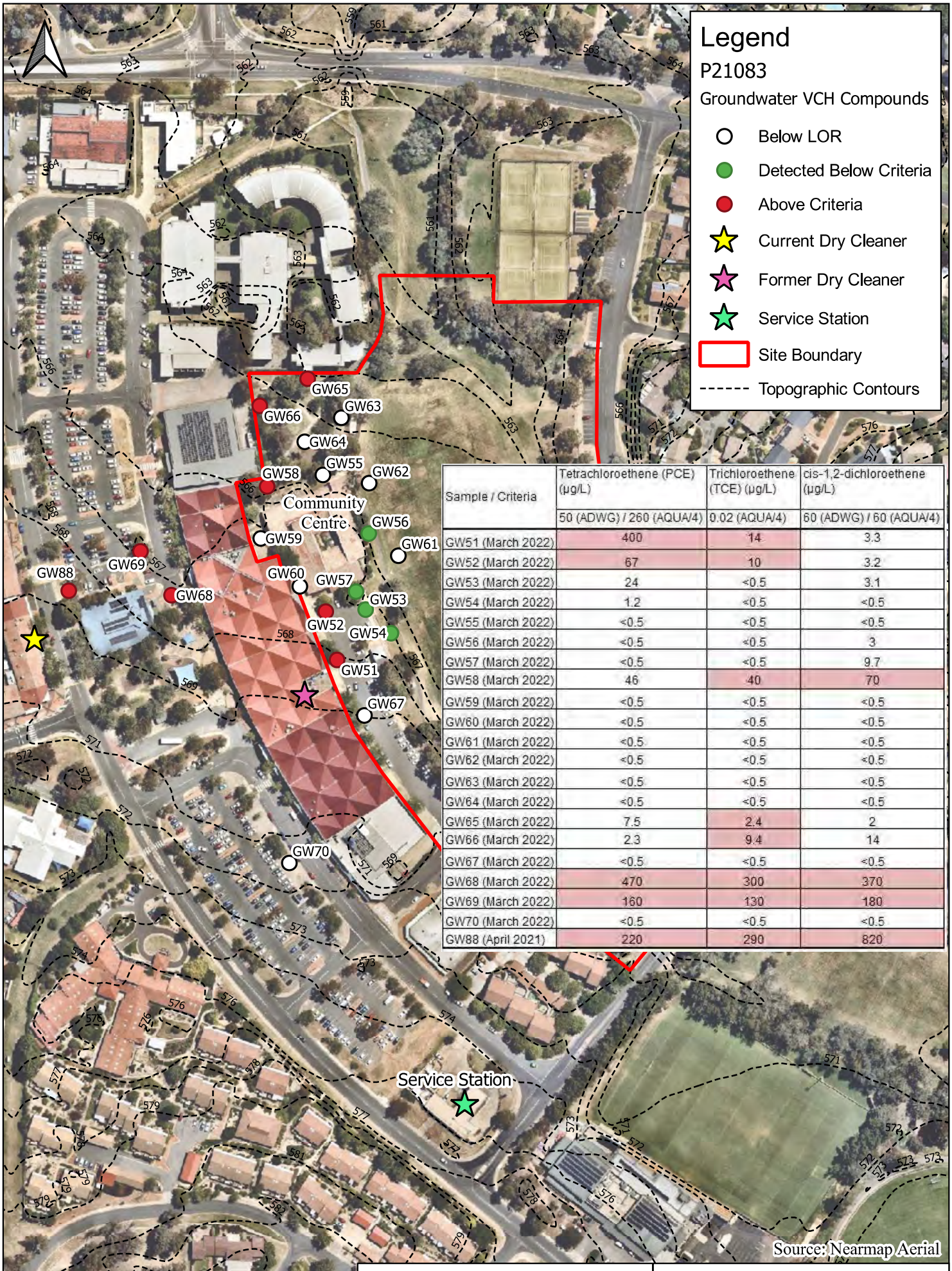
- Groundwater Monitoring Well
- Current Dry Cleaner
- Former Dry Cleaner
- Site Boundary
- Groundwater Contours
- Groundwater Flow Direction

LOCATION: Section 51, Holt, ACT2615	Figure 7b: Inferred Groundwater Contours - March 2022
PROJECT No: P21083	Ianterra consulting



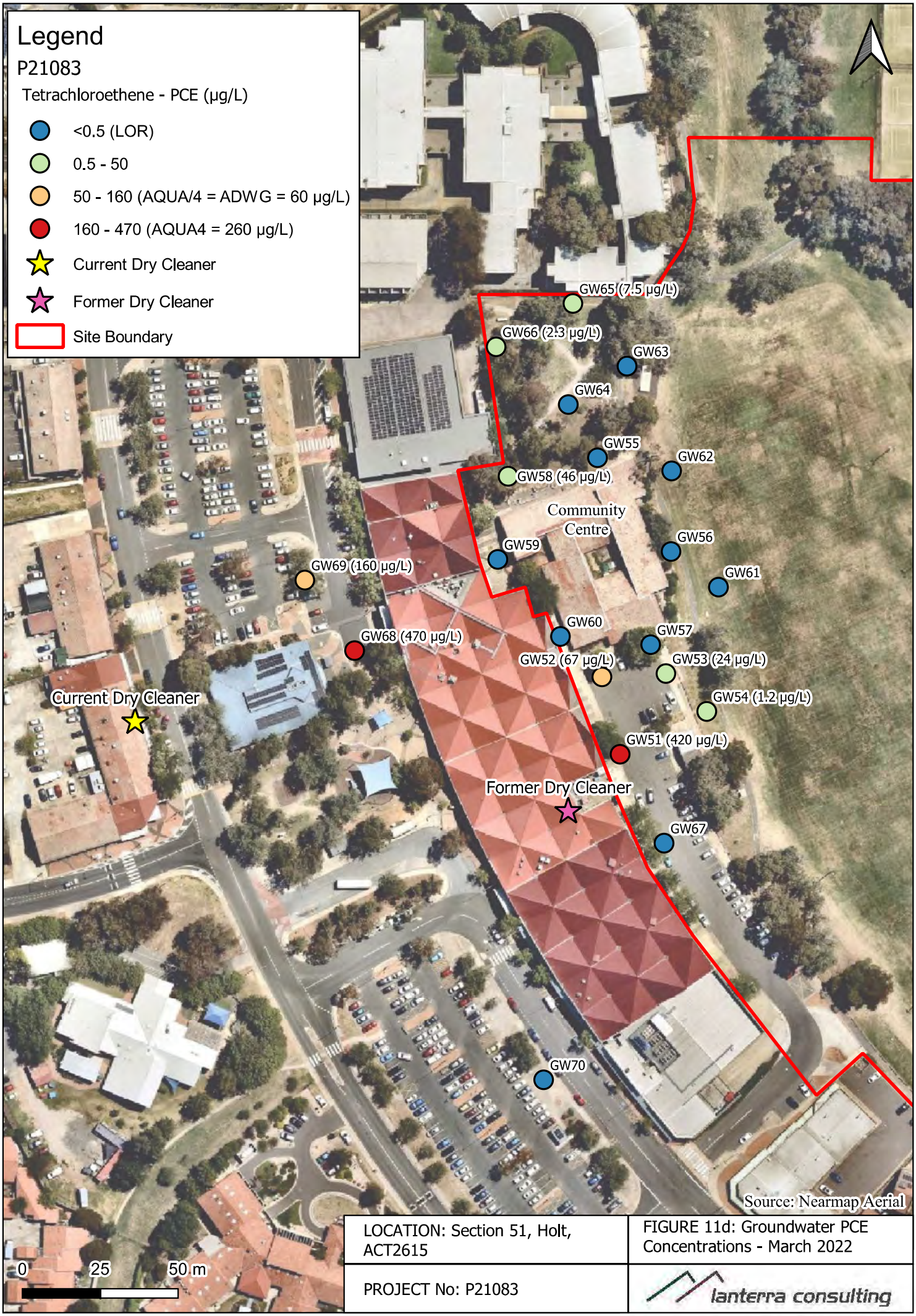
Sample / Criteria	Tetrachloroethene (PCE) (µg/L)	Trichloroethene (TCE) (µg/L)	cis-1,2-dichloroethene (µg/L)
	50 (ADWG) / 260 (AQUA/4)	0.02 (AQUA/4)	60 (ADWG) / 60 (AQUA/4)
GW51 (Nov 2021)	300	13	2.7
GW52 (Nov 2021)	71	9.3	3.1
GW53 (Nov 2021)	6.1	<0.5	2.3
GW54 (Nov 2021)	<0.5	<0.5	<0.5
GW55 (Jan 2022)	0.9	<0.5	<0.5
GW56 (Jan 2022)	<0.5	<0.5	<0.5
GW57 (Jan 2022)	<0.5	<0.5	9.3
GW58 (Jan 2022)	89	61	92
GW59 (Jan 2022)	<0.5	<0.5	<0.5
GW60 (Jan 2022)	<0.5	<0.5	<0.5

LOCATION: Section 51, Holt, ACT2615	Figure 10c: Groundwater Volatile Chlorinated Hydrocarbons - Jan 2022
PROJECT No: P21083	lanterra consulting

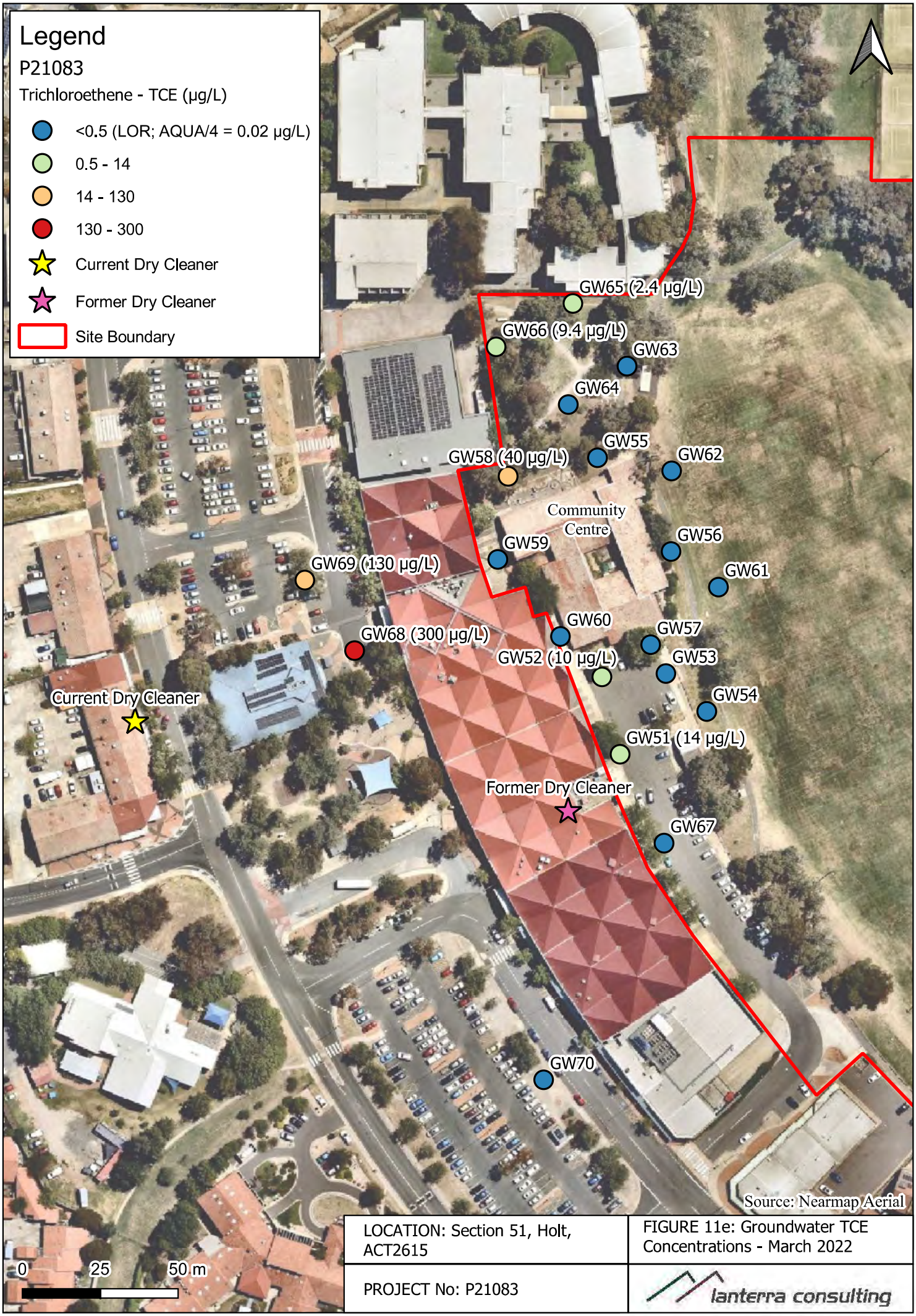


Sample / Criteria	Tetrachloroethene (PCE) (µg/L)	Trichloroethene (TCE) (µg/L)	cis-1,2-dichloroethene (µg/L)
	50 (ADWG) / 260 (AQUA/4)	0.02 (AQUA/4)	60 (ADWG) / 60 (AQUA/4)
GW51 (March 2022)	400	14	3.3
GW52 (March 2022)	67	10	3.2
GW53 (March 2022)	24	<0.5	3.1
GW54 (March 2022)	1.2	<0.5	<0.5
GW55 (March 2022)	<0.5	<0.5	<0.5
GW56 (March 2022)	<0.5	<0.5	3
GW57 (March 2022)	<0.5	<0.5	9.7
GW58 (March 2022)	46	40	70
GW59 (March 2022)	<0.5	<0.5	<0.5
GW60 (March 2022)	<0.5	<0.5	<0.5
GW61 (March 2022)	<0.5	<0.5	<0.5
GW62 (March 2022)	<0.5	<0.5	<0.5
GW63 (March 2022)	<0.5	<0.5	<0.5
GW64 (March 2022)	<0.5	<0.5	<0.5
GW65 (March 2022)	7.5	2.4	2
GW66 (March 2022)	2.3	9.4	14
GW67 (March 2022)	<0.5	<0.5	<0.5
GW68 (March 2022)	470	300	370
GW69 (March 2022)	160	130	180
GW70 (March 2022)	<0.5	<0.5	<0.5
GW88 (April 2021)	220	290	820

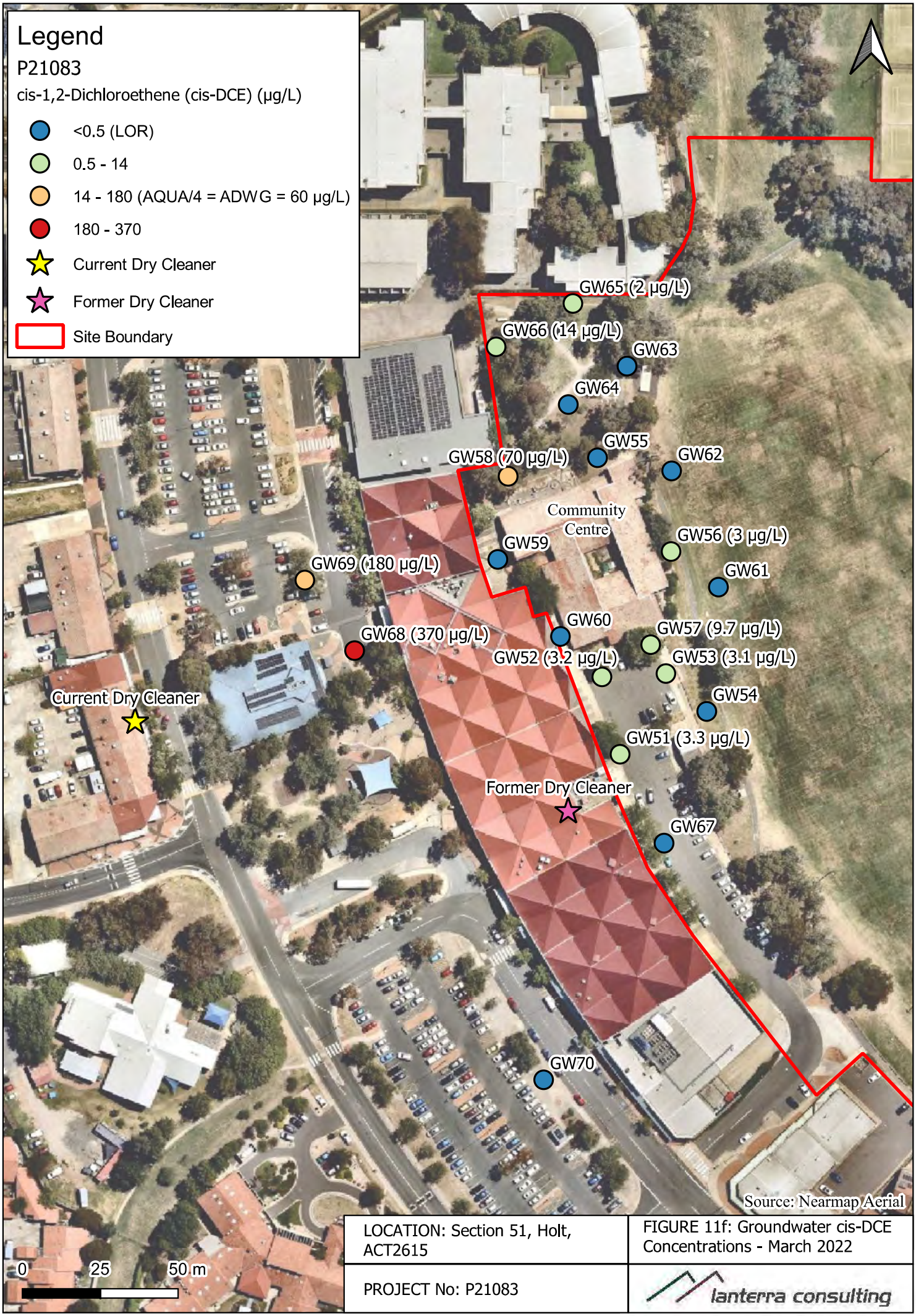
LOCATION: Section 51, Holt, ACT2615	FIGURE 10d: Groundwater Volatile Chlorinated Hydrocarbons - March 2022
PROJECT No: P21083	lanterra consulting



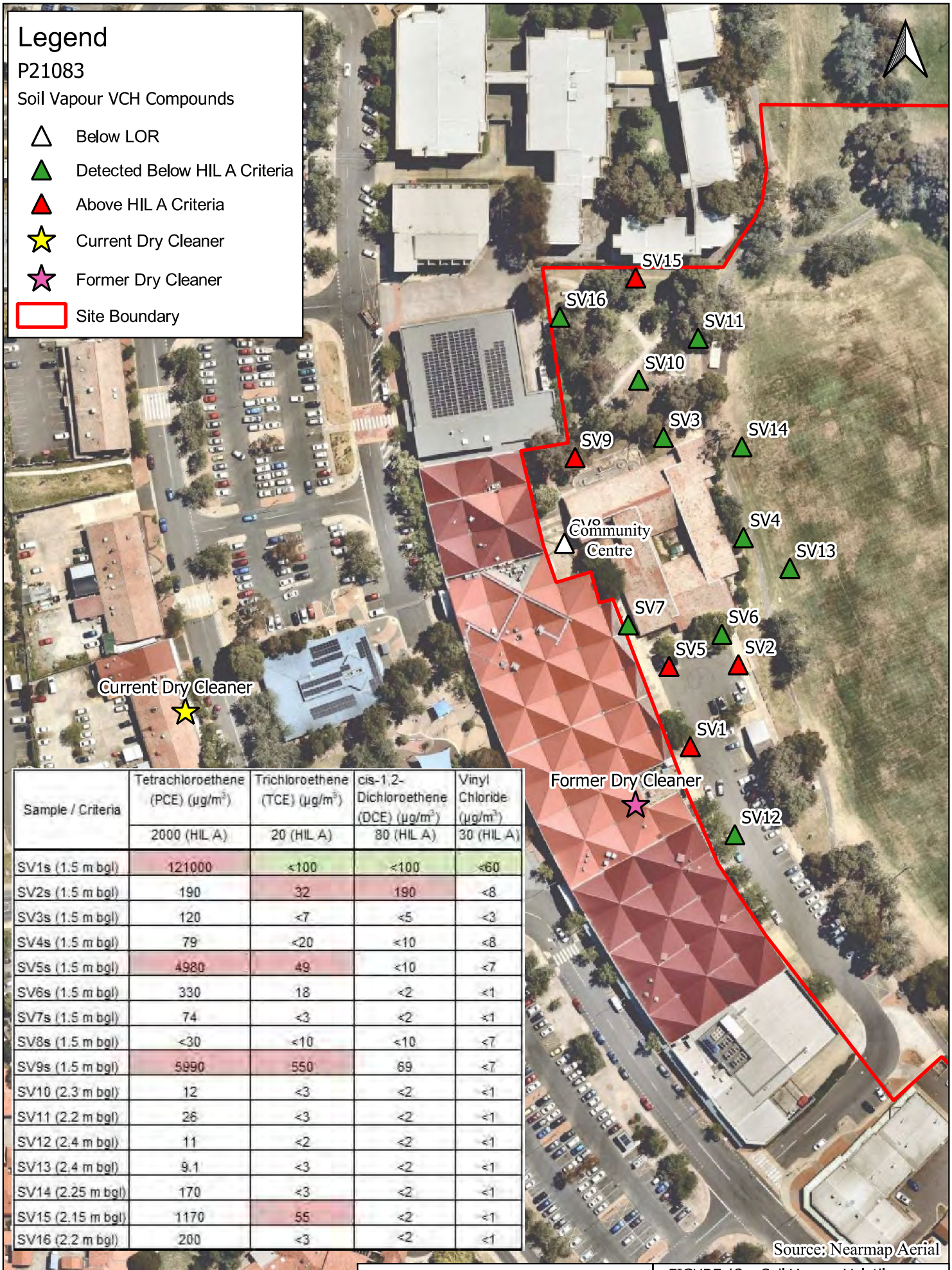
LOCATION: Section 51, Holt, ACT2615	FIGURE 11d: Groundwater PCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11e: Groundwater TCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 11f: Groundwater cis-DCE Concentrations - March 2022
PROJECT No: P21083	lanterra consulting



Sample / Criteria	Tetrachloroethene (PCE) (µg/m³)	Trichloroethene (TCE) (µg/m³)	cis-1,2-Dichloroethene (DCE) (µg/m³)	Vinyl Chloride (µg/m³)
	2000 (HIL A)	20 (HIL A)	80 (HIL A)	30 (HIL A)
SV1s (1.5 m bgl)	121000	<100	<100	<60
SV2s (1.5 m bgl)	190	32	190	<8
SV3s (1.5 m bgl)	120	<7	<5	<3
SV4s (1.5 m bgl)	79	<20	<10	<8
SV5s (1.5 m bgl)	4980	49	<10	<7
SV6s (1.5 m bgl)	330	18	<2	<1
SV7s (1.5 m bgl)	74	<3	<2	<1
SV8s (1.5 m bgl)	<30	<10	<10	<7
SV9s (1.5 m bgl)	5990	550	69	<7
SV10 (2.3 m bgl)	12	<3	<2	<1
SV11 (2.2 m bgl)	26	<3	<2	<1
SV12 (2.4 m bgl)	11	<2	<2	<1
SV13 (2.4 m bgl)	9.1	<3	<2	<1
SV14 (2.25 m bgl)	170	<3	<2	<1
SV15 (2.15 m bgl)	1170	55	<2	<1
SV16 (2.2 m bgl)	200	<3	<2	<1

LOCATION: Section 51, Holt, ACT2615

FIGURE 13e: Soil Vapour Volatile Chlorinated Hydrocarbons-March 2022

PROJECT No: P21083

lanterra consulting

Geosyntec consultants

engineers | scientists | innovators

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20 May 2022

Nyah Donaldson
Senior Infrastructure Officer
Environment, Planning and Sustainable Development Directorate
ACT Government
Level 2, 480 Northbourne Avenue
Dickson ACT 2602

Via email: Nyah.Donaldson@act.gov.au

Dear Nyah,

Re: Interim Advice 04: Review of Draft Detailed Site Investigation (12 May 2022) for Section 51 Kippax Group Centre, Holt ACT 2615

1 Introduction

The Environment, Planning and Sustainable Development Directorate (EPSDD) has appointed Lange Jorstad of Geosyntec Consultants Pty Ltd (Geosyntec), a NSW EPA Auditor accredited (No. 1001) under the Contaminated Land Management (CLM) Act 1997, to conduct an Audit at Kippax Place, Section 51, Holt, ACT 2615 ("the site").

The site is located at the corner of Flack Street and Moyes Crescent in Holt and has an area of approximately 5.26 hectares (ha). The audit area is legally identified as Section 51 Holt, Belconnen, and comprises a parcel of land east of Kippax Centre which is earmarked for commercial and mixed-use development.

This is currently a non-statutory Site Audit conducted in accordance with ACT Environment Protection Authority Contaminated Sites Environment Protection Policy (CSEPP, 2017), the requirements outlined in NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition), and other guidelines made or endorsed by the ACT Environment Protection Authority (EPA) for use in the ACT as stated in Section 10.3 of the CSEPP.

The aim of the engagement is to enable a site audit statement (SAS) and associated site audit report (SAR) to be prepared that confirms the suitability of the site for commercial and mixed-use development, in accordance with the NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition).

2 Scope of Audit and Nature of Interim Advice

In preparing this interim audit advice, the Auditor has reviewed the following reports related to land contamination assessment:

- Lanterra Consulting (Lanterra), 12 May 2022. Detailed Site Investigation (draft), Section 51 Kippax Group Centre, Holt ACT 2615 (Ref: R02); herein referred to as the DSI.

Previous interim advice comments were provided for an earlier version of the DSI (IA1, dated 7 September 2021), and for a Groundwater and Soil Vapour Letter prepared for communication with the EPA (IA2, dated 23 December 2021). The Auditor also reviewed the groundwater and soil vapour investigation raw data from additional investigations performed in early 2022 (tabulated and supported by preliminary figures) and provided high-level advice in IA3 (dated 29 April 2022).

The purpose of this IA is to provide preliminary comments on the adequacy and completeness of the investigation data (to date), and audit considerations regarding potential risks to future land uses and adjacent properties.

The Auditor notes that this review was performed on a version of the draft DSI report accessed from a file share site on Friday, 13 May 2022. Portions of the draft report were incomplete at the time of review and will be the subject of a second stage of review and IA comments. It is possible that that some comments in this IA will be revisited once the full draft DSI report is available for review.

3 Summary of Lanterra (2022) DSI

Lanterra stated that the objectives of the DSI were to assess the suitability of the site for the land uses permitted under the following zonings: CZ1: Core Zone, PRZ1: Urban Open Space, and TSZ1: Transport, and to adequately characterise the condition of the site including groundwater and soil from a contamination perspective.

The DSI considers results and findings from four investigation stages. A summary of the scope of work and results for each stage is provided in the following sections:

3.1 Stage 1 (April 2021)

- soil investigation in areas of environmental concern (AEC) 1 (imported fill for establishment of the playing fields, roads and buildings), AEC 2 (imported fill for construction of community centre and public toilets) and AEC 3 (potential contamination from stormwater drainage across the site).
- Sampling of existing groundwater monitoring wells (GW1 to GW5) located in the southwest corner of the site to assess potential groundwater contamination inferred to be migrating onto the site from a nearby (off-site) service station (AEC 5) at the Hardwick Crescent and Flack Street in Block 1 Section 53, currently listed on EPA Contaminated Land Register. Benzene was reported in samples from wells GW1, GW2 and GW5 ranging in concentration from 1 to 5.1 µg/L, likely impacted from the operating service station. Dissolved metals were also identified in groundwater, likely associated with mineralisation of the natural rock.
- Installation, development, and sampling of a groundwater monitoring well (GW51) to assess the potential for on-site contamination migration from off-site contamination source AEC 4 (former dry cleaner at Shop 14 of Kippax Fair Commercial Centre). Volatile chlorinated compounds (VCH) were reported in the sample from GW51 above the Australian Drinking Water Guidelines (ADWG, 2011) criteria, which were inferred to potentially be associated with the former dry cleaner.

3.2 Stage 2 (November 2021)

- Installation, development, and sampling of three groundwater monitoring wells (GW52 to GW54) down hydraulic gradient from GW51 and the former drycleaners to delineate the extent of the impact.

- Installation and sampling of two multi-level soil vapour probes (SV1 and SV2) to assess the presence of VCH in soil vapour in the vicinity of GW51 and GW53.
- Collection of 3 indoor air samples from the Kippax health building.
- Results of this investigation stage identified:
  - VCH in groundwater at GW51 and GW52 at concentrations exceeding the ADWG (2011) criteria, and
  - VCH in soil vapour in shallow and deeper probes at SV1 exceeding the residential and commercial health screening levels (HSLs), and in shallow and deeper probes at SV2 below the residential land use criteria.
  - Further delineation of VCH in groundwater and soil vapour was recommended.

3.3 Stage 3 (January 2022)

- Installation, development, and sampling of 6 groundwater monitoring wells (GW55 to GW60) and 7 soil vapour probes (SV3 to SV9) to delineate the nature and extent of VCH in soil vapour.
- Sampling of existing
- Results of this investigation stage identified:
  - VCH in groundwater at GW51 and GW52 at concentrations exceeding the ADWG (2011) criteria, and
  - VCH in soil vapour in shallow and deeper probes at SV1 exceeding the residential and commercial health screening levels (HSLs), and in shallow and deeper probes at SV2 below the residential land use criteria.
  - Further delineation of VCH in groundwater and soil vapour was recommended.

3.4 Stage 4 (March 2022)

- Installation, development, and sampling of 10 additional groundwater wells (GW61 to GW70) and 7 soil vapour probes () to further delineate the extent of the VHC plumes
- All previously installed groundwater wells (GW51 to GW70) and soil vapour wells (SV1 to SV16, shallow probes only) were also sampled.
- Groundwater was inferred to flow in an overall north-northeast direction, similar to the local topography.
- Groundwater concentrations for PCE, TCE and cis-1,2-DCE were observed above the assessment criteria in wells GW51, GW52, and GW58 and concentrations above the laboratory LOR but below the assessment criteria were reported in wells GW53, GW54, GW56, and GW57.
- Wells GW68 and GW69 were installed on the western side of the Kippax Fair Shopping Centre, in the vicinity of existing well GW88, to assess for potential contributing sources of VCH based on the presence of an operational drycleaner business on Hardwick Crescent. Based on the groundwater contour plot, these wells were located approximately up hydraulic gradient from GW58, GW65 and GW66. The reported concentrations of PCE, TCE and cis-1,2-DCE exceeded the relevant criteria in the three wells to the west of the shopping centre, and TCE and cis-1,2-DCE approximately 1-2 orders of magnitude lower but still exceeding the groundwater quality criteria in the downgradient wells to the east of the shopping centre.
  - The wells to the west of the shopping centre reported PCE concentrations of a similar magnitude to GW51, but TCE and cis-1,2-DCE concentrations were 1-2 orders of magnitude higher than in GW51. Based on the groundwater flow analysis and different relative concentrations of VCH species, Lanterra concluded that the VCH detections in

groundwater to the south of the Community Centre building were likely to be from a different source from the detections to the north of the building (supported by several “non-detect” wells between the two VCH plumes).

- PCE, TCE and cis-1,2-DCE exceeded the HIL A assessment criteria in wells SV1, SV2 and SV5 located in Kippax Place (the PCE vapour concentration in SV1 exceeded all land use criteria). PCE and TCE at SV9, and TCE only at SV15, exceeded the HIL A assessment criteria to the north of the Community Centre, which was consistent with previous sampling events.
  - SV15 is close to the inferred downgradient property boundary with a residential development to the north and is spatially correlated with monitoring well GW65 in which elevated VCH were also reported. Based on these observations it is possible that the groundwater and vapour VCH impacts could extend into the northern property.
- The highest concentrations of VCH compounds in soil vapour were reported close to the suspected contamination source (former Drycleaners) in well SV1, with exceedances also reported in SV2 and SV5 a short distance north, reducing to detectable VCH concentrations but below the criteria beyond. VCH exceedances were also reported in SV9 and SV15 located to the north of the Community Centre, separated from the southern vapour cluster by lower concentrations. Based on the spatial VCH vapour distribution, and correlation to the groundwater VCH spatial distribution, it was inferred that VCH in soil vapour is likely attributable to volatilisation from two separate VCH groundwater plumes.
- Per- and polyfluoroalkyl substances (PFAS) were detected above the laboratory LOR in groundwater samples GW55 to GW60. However, PFOA, PFOS, and PFHxS+PFOS were below the PFAS NEMP 2.0 assessment criteria with the exception of GW57 which recorded a concentration of 0.085 µg/L for the sum of PFHxS+PFOS (exceeding the drinking water criterion of 0.070 µg/L).

4 Auditor Comments on the Draft DSI

The Auditor provides the following comments for consideration:

1. The following sections were incomplete during this review of the draft DSI report and will be reviewed once completed: Executive Summary, Section 11.4 (Laboratory QAQC), Section 12.1 (Visual Observations / Field measurements), Section 14.2 (Potential Receptors and Exposure Pathways) and Section 15 (Summary and Conclusions).
2. Global comment:
   a. please use the terminology “upgradient” and “downgradient”, or “up hydraulic gradient” and “down hydraulic gradient”, rather than upstream and downstream, when referring to groundwater flow. Upstream and downstream relate to surface water flow.
   b. In all cases where vTRH or BTEX was reported at similar concentrations to the sum of VCH compounds, please clarify if this is indicative of a petroleum hydrocarbon source or if it could be attributable to analytical interference from the presence of the VCH.
   c. Lanterra has commented on the sampling results in a “per sampling event” format, but should also discuss any spatial or temporal observations across all sampling events (for example, are metals concentrations similar between sampling events and well locations? What does this mean with respect to the minor metals exceedances?).
3. Section 2.1 Site Location and Description:
   a. page 13 bullet 8 – the stormwater drainage channel is described as a “grassed swale” in a Kippax Group Centre Flood Study prepared by Calibre (2020), which may be a more accurate description.
   b. page 14, first bullet: northwest corner of site?

4. Section 2.2 Surrounding Land Uses: should the south and west discussions include observation of the service station and active drycleaners, respectively?
5. Section 2.3 (Sensitive Environments) and Section 5.3 (Hydrology) - These sections refer to the stormwater drainage channel or swale (as it is referred to in Calibre (2020) flood modelling study) located along the eastern investigation site boundary. Calibre 2020 states that this swale has limited hydraulic capacity and so is subject to flooding. The report recommended that this swale be regraded to limit flooding of the playing fields in the southern portion of the investigation area. The flooding potential should be considered with respect to development design and future management of the site.
6. There is a section number “3.0” at the end of Section 2 with no associated text. Presumably this is a redundant section header for section 3?
7. Section 5.2 Hydrogeology & Section 12.1.2 Groundwater Results:
    a. Please provide monitoring data (water levels) used to generate the Figure 7b contours, noting this may be in Table 4 (was not provided with the current draft report)
    b. Please discuss the steep hydraulic gradient to the northwest of the community centre at GW58/GW59. Is there an explanation for the apparent mounding at GW58?
    c. The report would benefit from a hydrogeological cross section(s) across the site to identify contamination in relation to the roads, source and the site boundaries.
8. Section 6.3 Table 4. Please consider that there is a potentially complete exposure pathway for the inhalation of vapours sourced from either soil and / or groundwater, not only soil.
9. Section 9.2.2 – Sampling Plan Table 12: Please clarify that GW70 was installed at a downgradient location.
10. Section 10.2.2 Methods, Groundwater sampling:
    a. were volatiles measured by the PID when opening the well covers?
    b. Please provide field sheets with field stabilisation parameters and notes.
11. Section 10.3.2 Soil Vapour Sampling – The section states that water was encountered in multiple soil vapour well locations, mostly associated with the implants installed at 5.5 m bgl and noted as a fieldwork observation.
    a. please provide soil vapour sampling field sheets.
    b. The report should include in the discussion how this impacts delineation and potential development of the site noting elevated concentrations were observed in several of the deep soil vapour wells during their initial monitoring round(s).
12. Section 12.2.2 – Groundwater Results
    a. Was NAPL (either DNAPL or LNAPL) observed in the wells? Was this measured? Do the dissolved VCH concentrations suggest the potential presence of DNAPL in any locations?
    b. Regarding the benzene detections in the southern part of the site, the Auditor agrees that the ingestion pathway is currently incomplete. Are there any potential future land use scenarios in which this pathway could become complete?
    c. Regarding the TRH C_6-C_{10} reported at GW51, please clarify if you consider this to be a hydrocarbon source associated with the former drycleaners, or the VCH compounds potentially being quantified by the TRH analysis.
    d. In the VCH discussions, please address vinyl chloride (VC), even if just initially to indicate that it is below the LOR. VC is particularly toxic and volatile and is the final toxic degradation product of chlorinated ethenes before benign end products, so is important to consider in any VCH contamination scenario.

e. Please comment on the elevated arsenic concentration reported in GW59 – is there a potential explanation for this result? Note that Table 37 reports the elevated arsenic concentration at GW59 and Table 38 assigns the exceedance to GW60.

13. Section 12.2.3 – Soil Vapour results.
    a. Lanterra indicated that the LOR exceeded the soil vapour VCH criteria for TCE, cis-1,2-DCE, and VC in soil vapour probes SV1s, SV1d and SV5s, and therefore assumed these compounds were present. Lanterra should provide further discussion on the laboratory LOR in relation to the screening criteria and implications for the reliability of the data, distribution of the soil vapour plume and related risks.
        i. Lanterra attributed the raised LORs to matrix interference. Could they potentially be attributable to sample dilution due to the high PCE concentrations in the samples?
14. Section 13.1: Discussion Soil
    a. Please comment on whether soil samples were collected and/or analysed for TRH and VHCs during installation of the Stage 3 and Stage 4 groundwater wells. Were there any visual or olfactory indications of contamination during drilling works?
15. Section 13.2: Discussion Groundwater
    a. Review of the borelogs show the wells are completed in various lithologies within the Deakin Volcanics, either the volcanic rock or sandy clay/silt. Please comment on whether the wells are screened in the same aquifer unit and are all representative of the same formation. It would be beneficial to include a well construction details table with well screen elevations for comparison.
    b. Per previous comment, please indicate whether the presence of benzene in groundwater downgradient from the offsite service station poses any potential risks to possible future land uses (if so, what scenarios?). Because this is an offsite source, there will be limited opportunity to prevent benzene migration onto the site in the future (unless the offsite source is remediated).
    c. Lanterra presented concentration ratios for PCE:TCE, TCE:1,2-DCE and PCE:1,2-DCE (based on the sampling conducted in March 2022). Two primary lines of evidence that of chlorinated ethene attenuation are 1) a decrease in contaminant mass, and 2) a proportional increase in breakdown products (daughter products) relative to parent compounds over time and/or with distance from the source. Can Lanterra comment on whether these lines of evidence are present? This should be considered separately for each source and plume.
    d. How would groundwater extraction (e.g. dewatering, or seepage from excavation faces) as part of future site development impact the groundwater and soil vapour plumes, and how would this influence or change risks to current and future site users?
    e. Is hydraulic testing warranted to assess the contaminant fate and transport potential of the plumes?
    f. Given that PCE is a DNAPL, please comment on vertical delineation of the VCH plume
16. Section 13.3: Discussion Soil Vapour (adequacy of delineation)
    a. As per previous comment, were the raised LOR for VCH in SV1s, SV1d and SV5s more likely to be attributable to matrix interference, or sample dilution by the laboratory due to the high PCE concentrations?
    b. Elevated TRH detections in early sampling events were not repeated in later sampling events. We note different laboratories were used to analyse the samples across the stages of work. Please consider whether or not there is a likelihood of a petroleum hydrocarbon source and provide a copy of the Envirolab quality reports for 282621 for the November 2021 sampling round.

c. Elevated PCE concentrations were reported at SV1s and SV1d in November 2021 and elevated TCE concentrations were detected at SV1d while non-detect at SV1s. SV1s results were replicated during the Stage 4 sampling round. Along with the comment above, please state the reasoning for excluding the deeper wells in Stage 4 and how this affects the interpretation of potential development and land use risks;

d. Lanterra states that it is possible that a second VCH soil vapour and groundwater plume may be affecting the north-western portion of the site. Lanterra stated that "The reasons for having higher VCH concentrations in shallow layers of soil compared to deeper profiles in SV9 is unclear". Please comment on whether additional sampling of the deeper soil vapour probe is warranted to confirm the pattern, and whether there is any other plausible explanation based on the CSM, noting this is also in the vicinity of the groundwater mounding at GW58.

e. Has Lanterra considered preferential pathways for plume migration such as underground services? A DBYD search indicates both water and underground electricity are located within the vicinity of the northern western wells installed on the site.

f. Section 13.2 states "Lanterra considers that as there are no abstraction bores in the vicinity of the site, the exposure pathway between the impacted groundwater and potential human receptors is considered to be incomplete and pose a negligible risk to human health via the ingestion pathway". Are there any plausible future land uses that could create a complete exposure pathway?

    i. This section should provide a separate discussion with relation to soil vapour receptors – source linkages and risks to the future development, for example the potential vapour intrusion risks may require a tanked basement construction or vapour mitigation system and long-term management.

17. Section 14: Revised Conceptual Site Model

    a. Section 14.1 – please be more specific – what impact is observed in the different areas of concern - VCHs? BTEX? Metals? As in Section 6, the updated CSM should differentiate the onsite and offsite areas of environmental concern.

    b. When completing Section 14.2 please consider that this section should demonstrate that:

        - the VCH and BTEX/TRH plumes impacting the site are not onsite sources.
        - Where are the areas of risk in different parts of the site? i.e. outline where these plumes are relative to the site boundaries.
        - How do those individual risks affect permissible land uses under the zoning, future development scenarios and what are the limitations to future land uses (land use restrictions) and management requirements in result?

18. Amended versions of the DSI should incorporate and considering the Auditor's other comments provided in IA3, specifically:

    a. Please consider previous comment relating to distinguishing between the site boundary and the audit boundary. An update to the figures would be appreciated with a clear audit boundary.

    b. The DSI should acknowledge the notification duty to adjacent landowners and ACT EPA of the potential soil vapour contamination risks.

We request that Lanterra provide responses to the above comments, together with an amended copy of the DSI, as appropriate.

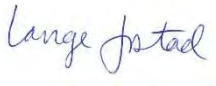
5 Closure

This interim advice does not constitute a SAS or a SAR, but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information

provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor's opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points, please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,



Lange Jorstad, PhD, CEnvP SC
NSW EPA Accredited Site Auditor (No. 1001)
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30 May 2022

Nyah Donaldson
Senior Infrastructure Officer
Environment, Planning and Sustainable Development Directorate
ACT Government
Level 2, 480 Northbourne Avenue
Dickson ACT 2602

Via email: Nyah.Donaldson@act.gov.au

Dear Nyah,

Re: Interim Advice 05: Review of Draft Detailed Site Investigation (24 May 2022) for Section 51 Kippax Group Centre, Holt ACT 2615

1 Introduction

The Environment, Planning and Sustainable Development Directorate (EPSDD) has appointed Lange Jorstad of Geosyntec Consultants Pty Ltd (Geosyntec), a NSW EPA Auditor accredited (No. 1001) under the Contaminated Land Management (CLM) Act 1997, to conduct an Audit at Kippax Place, Section 51, Holt, ACT 2615 ("the site").

The site is located at the corner of Flack Street and Moyes Crescent in Holt and has an area of approximately 5.26 hectares (ha). The audit area is legally identified as Section 51 Holt, Belconnen, and comprises a parcel of land east of Kippax Centre which is earmarked for commercial and mixed-use development.

This is currently a non-statutory Site Audit conducted in accordance with ACT Environment Protection Authority Contaminated Sites Environment Protection Policy (CSEPP, 2017), the requirements outlined in NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition), and other guidelines made or endorsed by the ACT Environment Protection Authority (EPA) for use in the ACT as stated in Section 10.3 of the CSEPP.

The aim of the engagement is to enable a site audit statement (SAS) and associated site audit report (SAR) to be prepared that confirms the suitability of the site for commercial and mixed-use development, in accordance with the NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition).

2 Scope of Audit and Nature of Interim Advice

In preparing this interim audit advice, the Auditor has reviewed the following reports related to land contamination assessment:

- Lanterra Consulting (Lanterra), 24 May 2022. Detailed Site Investigation (draft), Section 51 Kippax Group Centre, Holt ACT 2615 (Ref: R02); herein referred to as the DSI.

Previous interim advice comments were provided for a preliminary draft DSI that had a few incomplete sections (IA4, dated 20 May 2022). This IA is limited to review of the adequacy and completeness of the portions of the draft DSI report that were not complete in the previously reviewed version, including:

- Executive Summary
- Section 11.4 (Laboratory QAQC)
- Section 12.1 (Visual Observations / Field measurements)
- Section 14.2 (Potential Receptors and Exposure Pathways) and
- Section 15 (Summary and Conclusions).

3 Auditor Comments on the Draft DSI

The Auditor provides the following comments for consideration:

1. The Executive Summary will be reviewed once comments for the rest of the report have been addressed, and the exec summary is updated to reflect revisions to the various sections of the report.
2. Section 11.4:
    a. Table 18 is missing:
        i. a soil d5-phenol surrogate non-conformance from lab report SE227942.
        ii. a groundwater 13C2-8:2 FTS surrogate non-conformance from lab report SE228101.
        iii. groundwater 13C2-PFHxDA and bromofluorobenzene (x2) surrogate non-conformances from lab report SE230511.
    b. Table 19 is missing:
        i. a soil zinc matrix spike non-conformance from lab report SE218850.
        ii. a soil zinc matrix spike non-conformance from lab report SE227942.
    c. Table 20 is missing a soil copper lab duplicate non-conformance from lab report SE225622.
    d. A soil vapour extraction and analysis date non-conformance has not been document from lab report ME326046.
    e. It would be appropriate in this section to discuss the raised LOR for certain soil vapour samples where the LOR became higher than the assessment criteria for some analytes.
3. Section 12.1 does not appear to be updated to reflect field observations other than the original DSI
4. Section 14.2:
    a. For the “direct contact with groundwater” exposure pathway, the pathway is considered to be “incomplete”, but the supporting comments indicate potential scenarios where the pathway could become complete. Would it be preferable to indicate the pathway is “potentially complete”, or “could become complete” or some other designation that acknowledges potential future exposure scenarios?
    b. The supporting comments for “inhalation of gases and vapours” indicates that a HHRA is being completed to derive site-specific soil vapour screening criteria. Can you confirm with Sage whether they are indeed deriving site-specific screening levels?

5. Section 15:
    a. The bullets (letters) describing the conclusions for the various media analysed start with letter “d”, and should presumably start at “a”
    b. For the TRH F2 detection in soil that exceeded the ESL, which was collected from immediately beneath asphalt cover, is it possible that a component of the asphalt could have contributed to the TRH detection? Is there any other plausible source of TRH at this location?
    c. For the groundwater discussion:
        i. The description of where VCH was detected (and exceeded water quality criteria) should include greater detail. Where was it detected on site? Was it fully delineated? Was there a pattern? Was it detected in more than one distinct area on site? What about the off-site results? Where are those in relation to the site, and relative to the groundwater flow direction? What there a detection on the downgradient site boundary? Is there data available from the adjacent downgradient property?
            1. Since you have previously defined the acronyms for the main VCH of concern, probably best to just stick with the acronyms in this section.
            2. Based on the “1% of solubility” rule of thumb, did the groundwater VCH concentrations suggest the potential for DNAPL presence?[1]
            3. Given the nature of the inferred sources, are the concentrations likely to be increasing, stable or decreasing over time (or can you say)?
    d. The soil vapour VCH discussion requires more detail in the pattern and distribution of concentrations. Was it fully delineated? Did the pattern mirror the groundwater VCH pattern? Where did concentrations exceed residential criteria, and where did they exceed all land use criteria? Was there a difference between shallow and deep concentrations, where paired vapour probe data were available? Where are those detections relative to the investigation boundary, and the EPSDD land divestment boundary?
    e. While this is alluded to in the recommendations, it would be helpful to include a standalone discussion of data gaps between the results/conclusions and the recommendations, to provide justification for some of the recommendations.
    f. Is it possible to broadly comment on the ability to remediate the on-site VCH contamination if the sources are off-site?
    g. Is it possible to comment on the current location of groundwater and soil vapour contamination relative to the future development block being released by EPSDD, and whether there are any activities that could potentially induce migration of the contamination?
    h. Can you comment on regulatory requirements based on the findings? Specifically with reference to the environmental duties under Section 8.1 of the Contaminated Sites Environment Protection Policy (duty to notify, etc).

We request that Lanterra provide responses to the above comments, together with an amended copy of the DSI, as appropriate.

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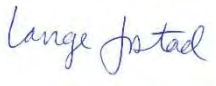
[1] The textbook Dense Chlorinated Solvents and other DNAPLs in Groundwater (Pankow and Cherry, 1996; Section 7.3.5) states: “the finding of dissolved concentrations that exceed 1% of the effective solubility should probably be cause for serious consideration of the presence of a DNAPL phase in the subsurface.” The book can be downloaded for free from: https://gw-project.org/books/dense-chlorinated-solvents-and-other-dnapls-in-groundwater/

4 Closure

This advice has been provided as interim advice and, in keeping with guidelines endorsed under the EP Act 1997, you are advised that this advice does not constitute a Site Audit Report or Site Audit Statement and does not pre-empt the conclusions that may be made at the end of the audit process.

Should you have any queries or wish to discuss any points, please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,



Lange Jorstad, PhD, CEnvP SC
NSW EPA Accredited Site Auditor (No. 1001)
Geosyntec Consultants Pty Ltd Lange Jorstad, PhD, CEnvP SC

From:	Lange Jorstad
To:	Donaldson, Nyah
Cc:	Chris Gunton; Leonardo Baeza; Sarah Silver
Subject:	Interim advice comments on final draft DSI
Date:	03 June 2022 14:34:48
Attachments:	P21083_DSI Section 51 Kippax Centre_20220601.docx
Importance:	High

Hello Nyah et al,

I've attached a copy of the final draft DSI with some notes and comments tracked, primarily in the conclusions and recommendations section. Since the Exec Summary includes a lot of info from the conclusions chapter, please make sure any edits are consistent across sections.

A key concept that should be clarified in the report is that the Site consists of the divestment land boundary (which can be referred to as the Audit Site) and the broader investigation boundary outside of the Audit Site boundary. The reason for this is that the DSI will support two purposes:

1. Supporting the audit process. The audit is specifically for the Audit Site, and while it will consider offsite contamination that is still within the audit boundary, it won't necessarily comment on risks to other properties (like the shopping centre)
2. Supporting the contaminated land reporting process under the EP Act. EPA will rely on information in the DSI to make regulatory decisions about risks to other properties. This is related to the audit, but also extends to matters beyond the audit scope.

The figures in Dropbox only start at Figure 7b so I'm not sure what the earlier figures are, but the site plan should clearly indicate both boundaries, and the audit boundary should be included in every other figure so it is clear which contamination is onsite, and which is offsite, with respect to the Audit site (which is important to the audit determination).

One global comment is to please check the formatting with respect to section headers. There are some anomalous headers, or headers missing text, in various places in the report (some of which are picked up in the table of contents as numbers with no text). There are also some section header numbers with no text at the end of chapters that, if deleted, change the numbering of every following section. Just beware the numbering/report formatting issues.

Some comments for the available figures:

- Global comment – do you have one site plan that includes all the investigation locations? I'm thinking something like 13d, but with vapour and groundwater wells plotted together so it's easy to see which ones are co-located.
- 10b – I'd suggest removing the vapour probes from this figure, as they aren't included in figures 10c or 10d. The issue is that the probe symbols are white (the "non detect" colour) which may give a misleading impression that VCH vapours were non-detect (whereas they were high!).
- Figures 11a to 11c – the corresponding date should be included in the figure title (like 11d-11f)
- Figures 13a-e: the figures have generally focused on residential land use criteria. While this is important, the range of permissible land uses include res, open space and commercial, and some contaminants exceed just res, and others exceed all land uses. It

would be good to list the other criteria in the results boxes (and in the legend, add the shading colours from the results boxes and indicate what they mean)

- Figures 14a-f: It would be good to link the symbol color codes to the HIL D criteria as well. For example, 14a, could the orange marker be 2000-8000, and red be >8000 to show exceedance of HIL D? The 3300 limit currently used doesn't correspond to a land use criterion and is a little ambiguous. Same comment applies for the rest of the contaminants – perhaps scale so the red marker means exceedance of HIL D in all cases – could probably achieve this with a basic text edit in the legends.
- Figs 12 and 15 – this is up to you, but I am usually a bit wary of interpolating concentration data unless it is very well delineated. Also, concentration interpolations of groundwater contaminants don't take groundwater flow into account, and therefore can give a skewed impression of concentration distribution outside of the data coverage boundary. Also, Figs 12 don't consider data from all the wells (GW61-GW70 are missing). Personally I think your other figures provide similar information without the risk of the contouring software making wild assumptions about data outside the limit of your data coverage. It is your report and your choice, but if you retain these figures then please include a discussion in the text somewhere about the kriging of data by the contouring software, and the uncertainty outside the data coverage zones.

I would appreciate if you could track any report text edits for ease of review. Please don't hesitate to contact me with any questions about this interim advice.

Kind regards,
Lange

This advice has been provided as interim advice and, in keeping with guidelines endorsed under the Environment Protection (EP) Act 1997, you are advised that this advice does not constitute a Site Audit Report or Site Audit Statement and does not pre-empt the conclusions that may be made at the end of the audit process.

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21 June 2022

Nyah Donaldson
Senior Infrastructure Officer
Environment, Planning and Sustainable Development Directorate
ACT Government
Level 2, 480 Northbourne Avenue
Dickson ACT 2602

Via email: Nyah.Donaldson@act.gov.au

Dear Nyah,

Re: Interim Advice 06-R: Review of Draft Human Health Risk Assessment for Block 71 Section 51 Holt, Belconnen ACT 2615

1 Introduction

The Environment, Planning and Sustainable Development Directorate (EPSDD) has appointed Lange Jorstad of Geosyntec Consultants Pty Ltd (Geosyntec), a NSW EPA Auditor accredited (No. 1001) under the Contaminated Land Management (CLM) Act 1997, to conduct an Audit of Block 71 Section 51 Holt, Belconnen ACT 2615 ("the site").

The audit site is adjacent to Kippax Place in Holt and has an area of approximately 1.96 hectares (ha). The land is intended for divestment by EPSDD and is zoned for CZ1: Core Zone which allows for commercial and residential land uses.

This is currently a non-statutory Site Audit conducted in accordance with ACT Environment Protection Authority Contaminated Sites Environment Protection Policy (CSEPP, 2017), the requirements outlined in NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition), and other guidelines made or endorsed by the ACT Environment Protection Authority (EPA) for use in the ACT as indicated in Section 10.3 of the CSEPP.

The aim of the engagement is to enable a site audit Statement (SAS) and associated site audit report (SAR) to be prepared that confirms the suitability of the site for commercial and mixed-use development, in accordance with the NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition).

2 Current Interim Advice

In preparing this interim audit advice, the Auditor has reviewed the following reports related to land contamination assessment:

- SAGE Environmental Services Pty Ltd (SAGE) (10 June 2022) Draft Human Health Risk Assessment, Section 51, Kippax Group Centre. Holt ACT (Ref: DRAFT REV1.0) herein referred to as the HHRA.

This advice also refers to the following document, which has previously reviewed and had comment provided in the Auditor's interim audit advice, IA04 through IA05:

- Lanterra Consulting (Lanterra), 24 May 2022. Detailed Site Investigation (draft), Section 51 Kippax Group Centre, Holt ACT 2615 (Ref: R02); herein referred to as the DSI.

The purpose of the current IA is to document Auditor findings following the review of existing information related to site conditions and contamination status. This advice also outlines any data gaps identified in the existing information which should be addressed by the appointed consultant as either part of any further investigation works, or as part of any remedial or validation works that may be required at the site.

3 Review of the Human Health and Ecological Risk Assessment

Lanterra (2022) determined that there is elevated VCH in groundwater and soil vapour at the site due to contaminated groundwater migration to the site from what were inferred to be off-Site sources. It is expected that a potential exposure pathway via the inhalation pathway could occur due to upward vapour migration from the groundwater and through the overlying soil profile.

SAGE Environmental (SAGE) prepared a Human Health and Ecological Risk Assessment (HHRA; SAGE, 2022) to characterise the risk from existing contamination at the audit site and quantify the risk it poses to current and potential future users. Sage states that this HHRA and the associated contamination investigations were conducted to support due diligence procedures for the divestment of the site.

The Auditor has reviewed the HHRA with reference to the checklist provided in Appendix E of the NSW EPA (2017) Guidelines for the NSW Auditor Scheme (3rd edition).

A summary of the document review is presented in the table in Attachment A.

SAGE's preliminary conceptual site model (CSM), derived from Lanterra (2022), considered various potential exposure scenarios and considered the only reasonable exposure pathway is via inhalation of vapour-phase volatile contaminants derived from contaminated groundwater.

SAGE consider the following current and potential future receptors at the site:

Current:

- On-Site employees and customers of the former Kippax Health Centre (the Auditor understands that this building is no longer occupied).
- Maintenance workers (e.g. groundskeepers, utility/services workers, cleaners).
- General public using the community areas on-Site. These areas are located in the north-west corner of Site where public seating, footpaths and a skate ramp exist.
- Patrons passing through the Site to access the shopping centre located to the west of the Site (off-Site).
- On-Site and off-Site recreational users of the Kippax playing fields.
- Off-Site commercial land uses adjacent to the Site.
- Off-Site residential land uses to the north of the Site boundary

Future:

- Residential land uses, within ground floor dwellings (slab on grade construction) located at the eastern Site boundary.

- Residential land uses, in properties from the first floor with a single basement level construction.
- Commercial receptors (slab on grade).
- Intrusive maintenance workers.
- General public utilising the public spaces and roadways.
- Employees and patrons of commercial businesses.

The HHRA considered three risk scenarios based on the CSM:

- Scenario 1: On-Site commercial – slab on grade construction.
- Scenario 2: On-Site commercial – basement construction with commercial land use on the ground floor.
- Scenario 3: On-Site medium density residential – basement construction with residential properties from the first floor.

The HHRA concluded that the volatile chlorinated hydrocarbons (VCH) in soil and groundwater at the Site are likely to present a low risk (tolerable concentration not exceeded) of harm to the health of residents, commercial workers, and recreational receptors at the Site, based on Tier 1 and Tier 2 assessment of the highest concentrations of the chemicals of concern identified anywhere on site.

However, SAGE qualified their risk characterisation with respect to various considerations and assumptions:

- Due to the VCH sources being off-site, contamination will likely continue to migrate into the site and the future development of the site should consider mitigation measures to limit potential exposure to vapour-phase contaminants, in addition to continuing to mitigate direct contact with groundwater which may include limiting the construction of basement to areas where dissolved VCH were not detected, basement tanking to prevent potential ingress of contaminated groundwater, and/or vapour mitigation techniques.
- The available VCH data is based on a limited data set over a short investigation duration (in some cases, a single sample. There is no information about temporal concentration variation, or variations in groundwater flow that could cause the VCH plumes to migrate further into the audit site.
- A development plan for the site is not currently available, so a broad range of potential development that is consistent with permissible land uses under the zoning was considered, as well as generic assumptions about the location of VCH contamination relative to different types of development.

Only a qualitative assessment of off-site risk is presented in the HHRA. SAGE indicated that off-site exceedances of Tier 1 screening criteria, especially in the vicinity of SV1 (shallow and deep) and SV5 (shallow) indicate that further assessment of risk to off-Site commercial land uses, and intrusive maintenance workers is recommended. However, the risk to off-Site receptors (adults and children) in off-Site open space areas (for example Kippax Place) is expected to be low, as recreational receptors and pedestrians are expected to spend limited time these areas (it is a roadway with parking), and significant vapour accumulation is unlikely to occur in outdoor areas.

Due to the identified presence of groundwater contamination, future construction and maintenance works should be undertaken in accordance with a Site Management Plan (to be prepared by Lanterra) that identifies the nature and extent of the contamination (to the extent characterised to date) and provides guidance for preventing unacceptable exposure to contamination for future land uses.

4 Auditor Comments

The Auditor has reviewed the SAGE (2022) HHRA in accordance with relevant guidelines made or approved by the ACT EPA. The report largely meets the guideline requirements. The Auditor provides the following comments for consideration:

1. The risk conclusion indicated in the Executive Summary refers only to contaminated groundwater. Should it refer to both soil vapour and groundwater?
2. Please review and update Section 2.1 (note: there are currently two sections 2.1: site identification and environmental setting – this comment refers to the environmental setting). The section refers to retired block names and should clarify what environmental features are on-site and off-site (with respect to Block 71).
3. Please note that the CZ1 zoning includes “Community Use” as a permissible land use, which is an umbrella term that includes residential and day care land uses (and hospitals, etc). Hence, risk characterisation and conclusions should consider the possibility of a day care being incorporated into future development.
4. Does the HHRA consider potential contact with shallow or perched groundwater? Shallow (potentially “perched”) groundwater was identified in the southwest of the site (in vicinity of GW1 to GW5) and the depth to groundwater is likely to be less in the playing fields than near to the community centre due to the elevation change (the surface elevation of Kippax Place is approximately 3m higher than the adjacent playing fields). Section 4.2.1 includes an assumption that the average depth to groundwater is 8 mbgl, and the Auditor acknowledges that the “water strikes” recorded in the borehole and well installation logs (the depth at which damp or moist soil was recorded) were generally between 8-11 mbgl. If the depth to groundwater beneath the playing fields in the eastern portion of the site is shallower, would this change the risk characterisation?
5. Please check the location of SV14 on Figure 3. It should be co-located with GW62. Does this change any risk conclusions in the HHRA?
6. Please confirm – title of Section 4.4.3 states residential properties from the ground floor yet the section considers residential receptors from the first floor. Which was modelled in the scenario? Note that Table 19 states first floor. Does the scenario consider commercial on the ground floor and residential first floor and above with basement car parking?
7. Section 8 of the report says “ILCR less than $1x10^{6}$”. This should state $1x10^{-5}$, as per Section 6.2.
8. GW54 is an on-site well (as per Figure 3 and first row in Table 6). Dissolved VCH concentrations have been measured above the AQUA guideline in this well. Should Table 6 and the risk assessment consider an off-site VCH source has caused both on-site and off-site impacts? There is no co-located on-site soil vapour probe in vicinity of GW54.
9. It is acknowledged that concept plans for future site development indicate residential land uses will be limited to the eastern portion of the site. Would the risk conclusions change if residential development occurred on the western portion of the site? Or if construction was slab on grade rather than with a basement?

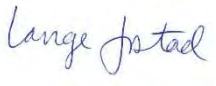
We request that SAGE provides responses to the above comments, together with an amended copy of the HHRA, as appropriate (a tracked edits version, along with a clean version, would be appreciated to expedite review).

5 Closure

This interim advice does not constitute a SAS or a SAR, but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor's opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points, please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,



Lange Jorstad, PhD, CEnvP SC
NSW EPA Accredited Site Auditor (No. 1001)
Geosyntec Consultants Pty Ltd Lange Jorstad, PhD, CEnvP SC

Attachments: Attachment A - Tables

Attachment A – Tables

Table A: Review of SAGE (2022) Draft Human Heath and Ecological Risk Assessment

Requirement	Consultant Consideration	Auditor Comment
Hazard Identification		
Have all appropriate sources of information regarding chemicals of potential concern been identified and assessed?	Section 1 identifies off site upgradient contamination sources and that the DSI noted no activities that may have introduced VCH on the site and inferred that the source of CoPC identified at the site had originated from off-site sources to the southwest of the site. Table 6 outlines the following sources of contamination and associated chemicals of potential concern have been identified: • VCH off site source - off-site groundwater impact at central western boundary south of the community centre; • VCH off site source - on and off-site impact to groundwater to the north of the community centre; • VCH off site source - on and off-site soil vapour impact to the north and south of community centre; and • Benzene off site source - off-site groundwater impact to southwest. (Note: The HHRA does not include consideration of this CoPC from an off-site source within the assessment)	The Auditor considers that the chemicals of potential concern have been identified and appraised, noting risk assessment was prepared in conjunction with use of Tier 1 Risk Based criteria. GW54 is an on-site well (as per Figure 3 and Table 6). Concentrations of VCHs have been reported above the AQUA guideline in this well. Soil vapour has not been characterised within this area (on-site). Should the first row in Table 6 identify the VCH source in the central western portion of the site to have resulting in both on-site and off-site impacts?
Has justification been given for the selection of the chemicals of potential concern?	Table 8 of the HHRA outlines the outcomes of the Tier 1 Screening on-site and a discussion of impacts in the relevant media. Table 9 outlines the results for off-site locations noting that SAGE do not provide a quantitative assessment of risk for off-site locations in this HHRA. Section 3.3 lists the COPCs in groundwater and soil vapour selected for HHRA include: • Tetrachloroethene or Perchloroethylene (PCE); • Trichloroethene (TCE); • Cis 1,2-dichloroethene (DCE); • Vinyl Chloride. SAGE acknowledge that as these off-Site sampling locations are hydraulically upgradient from the Site, there is potential for off-Site impacts to continue to migrate towards the Site over time, which may result in future on-Site increases in concentrations of CoPC in environmental media	Appropriate justification has been presented for selection of COPC for inclusion in the HHERA. The COPCs omitted have been justified.
Toxicological Assessment		
Have all critical toxic effects been identified? Have the effects on each body system (for example renal, hepatic, cardiovascular and developmental) and the types of effects (for example genotoxic and carcinogenic) been summarised?	Section 5 presents the toxicity assessment. Appendix D presents the toxicity profiles. The effects of COPC on body systems are discussed, where relevant, and all critical toxic effects are identified. SAGE acknowledge that PCE has the potential to be genotoxic, some PCE metabolites are mutagenic, and PCE is likely to be carcinogenic in humans by all routes of exposure. However, SAGE	Requirement has been met.

Requirement	Consultant Consideration	Auditor Comment
	assessed PCE based on threshold effects only, following NEPC (2013).	
Has the dose-response relationship for chemicals of potential concern been discussed?	Appendix D presents the toxicity profiles, which include discussion of the dose-response relationships for COPC.	Requirement has been met. Section 5 of the TCE toxicity profile refers to benzene and SAGE should amend this to refer to TCE.
Have all relevant toxicological data been considered and checked for accuracy?	Summary tables of available toxicological data from data source agencies are provided in the toxicity profiles in Appendix D.	The toxicological information relating to each COPC has been selected in accordance with prevailing guidelines at the time of preparation. The RfC used in the calculations for cis-1,2-dichloroethene (Table 18 and Appendix E) is the adopted value for trans-1,2-dichloroethene listed in Appendix D. SAGE should revise the calculations to use the adopted RfC for cis-1,2-dichloroethene, which is lower. SAGE should also revise the RfC value and associated reference listed in Table 18. The inhalation unit risk value listed in Appendix D and Table 18 for TCE is $4.0x10^{-6}$ $(\mu g/m^3)^{-1}$, with the source cited as USEPA, 2022. However, the value listed in USEPA, 2022 is $4.1x10^{-6}$ $(\mu g/m^3)^{-1}$. The value recommended by NEPC (2013) is $4x10^{-6}$ $(\mu g/m^3)^{-1}$ sourced from USEPA, 2011. SAGE should update either the value used or the reference cited and explain the update relative to the NEPC, 2013 recommendation if the newer value is used.
Have relevant primary toxicological resources been considered? Has the adequacy of available toxicological database been commented on? Have different toxicity data from different resources been assessed and discussed?	Appendix D presents a summary of data published by sources recognised and endorsed by enHealth, NEPC, and USEPA. Sources for inhalation dose response values include NEPC, RIVM, USEPA, ATSDR, Health Canada, IRIS, and CCME. Section 6.4.2 presents a discussion of uncertainties in the toxicity assessment, including the use of safety factors to account for animal to human extrapolation and other limitations.	The sources are appropriate and reliable. The toxicity data are considered adequate for the COPCs assessed. The discussion of uncertainties in Section 6.4.2 is generic. It would be helpful for SAGE to revise this section to make it specific to the data used in this HHRA.
Have the selected toxicity data been adequately justified?	Appendix D provides rationale for the adopted toxicity data.	Requirement has been met, subject to amendment of the RfC for cis-1,2-dichloroethene used in the calculations. Appendix D indicates that the values used were published and supported by NEPC (2013). Section 5.2 includes generic language about cases where values are not available in Australia, which does not apply, so SAGE should modify it for clarity. SAGE should add a note to Section 5.2 / Table 18 to indicate that the RfC values presented are adjusted for background following NEPC (2013). E.g. the USEPA RfC for TCE is 0.002 mg/m^3, while the value of 0.0018 mg/m^3 listed is the adjusted value. SAGE should revise the RfC for cis-1,2-dichloroethene in Table 18 to 0.007 mg/m^3 and revise the associated reference.
Exposure Assessment		

Requirement	Consultant Consideration	Auditor Comment
Has a comprehensive and appropriate conceptual site model been presented that indicates all potential pathways and receptors?	Section 3.4 provides a preliminary conceptual site model of the site. SAGE indicated that the DSI identified inhalation of gases and soil vapour to be the only complete pathway at this Site.	Did SAGE consider the potential for contact with shallow / perched groundwater during basement construction in the future development?
Have all potential receptors been identified?	Section 3.4 outlines the receptors considered in the HHRA: Current receptors: • On-Site commercial receptors working within the community centre, and patrons accessing the community centre. • Maintenance workers (e.g. groundskeepers, utility/services workers, cleaners). • General public using the community areas on-Site (north-west corner of Site where public seating, footpaths and a skate ramp exist). • Patrons passing through the Site to access the shopping centre on the western boundary of the Site (off-Site). • On-Site and off-Site recreational users of the Kippax playing fields. • Off-Site commercial receptors adjacent to the Site. • Off-Site residential receptors at the northern Site boundary. Potential future receptors: • Residential receptors, within ground floor dwellings located at the eastern Site boundary. • Residential receptors, in properties from the first floor with a single basement construction. • Commercial receptors (slab on ground) • Intrusive maintenance workers. • General public utilising the public spaces and roadways. • Employees of and patrons to commercial spaces.	The HHERA includes consideration of children, adults, flora, fauna and sensitive ecological receptors which are considered appropriate for the proposed development. SAGE should clarify if the presence of a child care centre within commercial developments (permitted under the zoning) would change the risk conclusions.
Have the estimates or measured exposure concentrations for each exposure route and chemical of potential concern been identified?	Section 4 presents the exposure assessment. Based on the transport mechanisms identified, SAGE indicated the potential for exposure via the inhalation pathway could occur due to upward vapour migration from the groundwater and through the overlying soil profile. Table 11 presents 3 exposure scenarios: • On-site commercial - Slab on Ground Construction • On-Site Commercial – Basement Construction with commercial properties from the ground floor. • On-Site Medium Density Residential – Basement Construction with residential properties from the first floor. Recreational receptors were not assessed as part of the Tier 2 assessment as they are considered to have a lower risk profile than the sensitive residential and commercial receptors that have been considered	The exposure scenarios and exposure point concentrations are considered to be conservative and appropriate as the basis of the risk assessment.

Requirement	Consultant Consideration	Auditor Comment
	(vapour-phase contaminants are unlikely to accumulate in outdoor environments). SAGE conservatively adopted the highest chemical concentrations reported anywhere on the site for their risk assessment.	
Risk Characterisation		
Has the acceptable risk level been identified and justified?	Section 6 provides risk characterisation and hazard index estimates, which indicate acceptable risk and hazard indices.	Requirement has been met.
Have all potential receptors and pathways been considered?	The three exposure scenarios and receptors have been considered.	Requirement has been met.
Has the relative significance of each exposure pathway, based on the risk analysis been discussed?	Table 19 presents each exposure pathway considered and the resulting risks. SAGE acknowledges that there is potential for off-Site impacts to continue to migrate towards the Site over time, which may result in future on-Site increases in concentrations of CoPC in environmental media. Section 7 indicated that to limit the potential exposure to vapour at the site, development should consider mitigation measures, like limiting the extent of the basement to areas where contamination levels are lower, or absent.	Requirement has been met.
Has a detailed sensitivity/uncertainty analysis been presented?	Section 6.5 presents a detailed discussion of uncertainty analysis, which considered the following: • Measured concentrations • Depths of impact • Geology • Air exchange rate • Advective flow	The Auditor considers that the HHERA calculations are appropriately conservative for the following reasons: • Consideration of maximum values of COPCs across the whole site • Conservate vapour measurement depths and maximum concentrations considered. • Considered sand and gravel geology which is expected to be conservative. • Assumption of all potential pathways
Equations		
Have all equations used in the risk assessment been presented in the report, dimensionally correct, with correct units and consistent? Have all parameters in each equation been clearly defined with unit conversion factors, where applicable, included?	Section 6 presents risk characterisation equations. Appendix C presents vapour modelling equations.	Edits are recommended for clarity and to address inconsistencies and/or missing information. • SAGE should revise the Hazard Index equation in Section 6.1 to indicate that the sum is over chemicals and pathways • SAGE should revise Appendix C to address the following: - Inconsistent terminology (e.g. C_{source} and $C_{vapour(m)}$ appear to refer to the same parameter) - Undefined terms (e.g. PSH, h_{cap}, h_v) - Terms used in equations that are not listed in Table 1 (e.g. r_{crack}) - Incorrect or missing units (e.g. units of ΔP should be g/cm-s^2; units of U should be cm/s; units of VF_{wamb} and conversion factor in Equation 14 should be defined) - The third term in the denominator of Equation 6 should be deleted

Requirement	Consultant Consideration	Auditor Comment
		- The sentence before Equation 14 should refer to *groundwater* to outdoor air - It would be helpful to list the parameters in alphabetical order in Table 1 It would be helpful to simplify Appendix C by including only the equations used for this HHRA
Has all pertinent information been provided to enable calculations to be checked through in a stepwise process?	Appendix E presents risk model calculations.	Requirement has been met.
Data Evaluation		
What were the data collection objectives and are they consistent with the requirements of the risk assessment?	The HHRA has considered soil, groundwater and soil vapour data as reported in investigations across the project area and reported in Lanterra (2022) DSI. Environmental data from these investigations has formed the basis of the risk assessment.	The objectives are consistent with the requirements of the risk assessment and SAR.
Were the laboratory analyses NATA accredited, and QA/QC reported and analysed, field QA/QC reported and analysed, indicated assessments of accuracy made in the risk assessment?	Assessments of QA/QC was discussed in Section 3.2 and within the Lanterra (2022) DSI.	The Auditor considers that this requirement has been met.
Assessment and Report Preparation		
Has in formation been presented coherently and in an appropriate sequence to enable efficient appraisal of the report?	Yes	The data has been provided in a form that is amenable to review and interpretation.
Have the objectives and scope been clearly indicated?	Section 1.2 indicated the purpose of the HHRA is to provide an assessment of potential human health risk as a result of exposure to site contamination for both current land users and potential future site users based on the Kippax Group Centre Master Plan: Scope of work is not outlined but refers to the Letter of Engagement. Section 1.4 outlines the Structure of the HHRA, considering the required steps	The objective and structure (or scope) is appropriate for the purposes of the audit.
Has the analysis been based on up-to-date literature?	Section 6 outlines the references of the HHRA and Section 6.1 indicated that risk estimates are based on available toxicological studies.	Please confirm that the review was based on the most current available information published by the toxicological data source agencies.
Have all assumptions and default data been identified and justified?	Section 6.4 provides detail of data gaps and uncertainty assessment stating that the heal risk assessment process involves a number of assumptions based on site specific data. The assumptions used were selected to be conservative in nature to evaluate an assumed reasonable maximum exposure scenario and provide a deliberate margin of safety.	All assumptions are appropriate.

Requirement	Consultant Consideration	Auditor Comment
	The assumptions used and referred to in sub-sections of 6.4 have been reviewed. SAGE notes that limited temporal and seasonal soil vapour data is currently available but that the assessment considers the four stage DSI data collected between April 2021 and March 2022. The key uncertainties include the available data set, noting there is potential for off-Site impacts to continue to migrate towards the Site over time. Therefore, future increases in concentrations of CoPC in environmental media on-Site may affect the potential risk to human health.	
Have all tables and figures been referred to correctly in the text of the report?	Tables and figures are presented in the SAGE report.	This requirement has been met.
Has adequate data been presented to support the conclusions?	The HHRA has utilised results from the previous investigations, and has acknowledged data gaps, and made appropriately conservative assumptions to account for data uncertainty.	The Auditor considers the data used in the risk characterisation (site-specific and published sources) was appropriate and suitable for the purpose of assessing the potential contamination risks to the most sensitive future land uses permissible under the zoning. However, SAGE should clarify if the presence of a child care centre within commercial developments (permitted under the zoning) would change the risk conclusions.

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17 June 2022

Nyah Donaldson
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ACT Government
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Dickson ACT 2602

Via email: Nyah.Donaldson@act.gov.au

Dear Nyah,

Re: Interim Advice 07: Review of Draft Site Management Plan for Block 71 Section 51 Holt, Belconnen ACT 2615

1 Introduction

The Environment, Planning and Sustainable Development Directorate (EPSDD) has appointed Lange Jorstad of Geosyntec Consultants Pty Ltd (Geosyntec), a NSW EPA Auditor accredited (No. 1001) under the Contaminated Land Management (CLM) Act 1997, to conduct an Audit of Block 71 Section 51 Holt, Belconnen ACT 2615 ("the site").

The audit site is located east-adjacent to Kippax Place in Holt and has an area of approximately 1.96 hectares (ha). The land is intended for divestment by EPSDD and is zoned CZ1: Core Zone which allows for commercial and residential land uses.

This is currently a non-statutory Site Audit conducted in accordance with ACT Environment Protection Authority Contaminated Sites Environment Protection Policy (CSEPP, 2017), the requirements outlined in NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition), and other guidelines made or endorsed by the ACT Environment Protection Authority (EPA) for use in the ACT as indicated in Section 10.3 of the CSEPP.

The aim of the engagement is to enable a site audit statement (SAS) and associated site audit report (SAR) to be prepared that confirms the suitability of the site for commercial and mixed-use development, in accordance with the NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition).

2 Current Interim Advice

In preparing this interim audit advice, the Auditor has reviewed the following reports related to land contamination assessment:

- Lanterra Consulting (Lanterra), 24 May 2022. Site Management Plan, Blocks 22 and 71, Section 51, Holt (Ref: P22067_SMP_20220614, R00); herein referred to as the SMP.

The purpose of the current IA is to assess the adequacy of the SMP for identifying the presence of contamination and associated risks and providing guidance to prevent unacceptable exposure to contamination for the permissible land uses under the zoning.

3 Auditor Comments

The Auditor has reviewed the Lanterra (2022) SMP in accordance with relevant guidelines made or approved by the ACT EPA. The report largely meets the guideline requirements. The Auditor provides the following comments for consideration:

1. General:
    a. Where will the existence of the SMP be recorded, and how will those who perform work in the areas covered by the SMP be notified of its existence? Section 4.2 says “service providers must be notified”, but it is not clear how they would be notified if they were performing work that does not require a work authorisation by one of the custodians of the SMP. The Auditor considers that a notation should be added to Dial-Before-You-Dig searches for the relevant blocks and Kippax Place Rd, and the following provision of section 9.3.8 of the CSEPP would apply: “*For sites where land custodianship falls to business units within the ACT Government Directorates the Agreement would also specify that these management requirements be recorded in the TCCS Integrated Asset Management System in accordance with its Procedure for the Management of Contaminated Assets Version 1.2 dated 31 May 2013 (as updated from time to time).*”
2. Section 1.1: Please indicate that the contamination that is the subject of the SMP has been the subject of a site audit report and statement and has been notified to ACT EPA.
3. Section 1.2: The objective should be expanded to include guidance for preventing unacceptable exposure to contamination for the permissible land uses under the zoning – that is a little broader than just focusing on services and soil disturbance.
4. Section 2:
    a. With respect to legal enforcement mechanisms, the appropriate reference is no longer the ACT EPA (2015) policy document. Rather, reference should be made to Section 9.3.8 of the Contaminated Sites Environment Protection Policy (CSEPP). The appropriate enforcement pathway, considering that the land is currently government leased land and will then be “leased land – subject to interim development” before it becomes private leased land”, will be the provisions under section 9.3.8 of the CSEPP. Please update accordingly.
    b. Also under regulatory requirements, please refer to the duty to notify contamination in the CSEPP, and that although the results of the DSI have been notified to the EPA and were assessed by the auditor in preparing the SAR/SAS, any new information on the nature and extent of contamination, particularly if it differs from the DSI and HHRA results, must be notified to the EPA.
5. Section 3:
    a. a brief description of the geology and hydrogeology of the site is required, as these are relevant to the nature of the contamination. It is acknowledged that limited hydrogeological information is summarised in Section 3.5.1, but the larger context should be briefly described.
    b. It would be useful to include a brief description what VCH are, and what the typical exposure pathways are to these chemicals (i.e. direct contact or incidental ingestion of VCH-contaminated groundwater, or inhalation of vapour-phase chemicals). Perhaps preceding 3.5.1, so the significance of the groundwater and soil vapour impacts are more easily understood.

6. Section 4: it is noted that three agencies will act as custodians for different areas within the overarching land to which the SMP applies. Based on past experience with a similar situation, this raises the following issues:
    a. A site plan showing the jurisdictions of each custodian must be included with the SMP, and if there is overlap then the roles and responsibilities of the overlapping custodians must be clearly described.
    b. Each agency will need to review and endorse the SMP before the SMP can be relied on to complete the audit.
    c. Because the enforcement of the SMP will require the custodians to enter into an environment protection agreement with the EPA, I will also need a letter from each indicating that they understand and accept this requirement (this is in lieu of the actual agreement being signed, a letter of intent will suffice).
    d. Please be aware that, from prior experience, each custodian agency may have specific requests and requirements for how their obligations are presented in the SMP, identification of specific responsibilities within their agency, etc. Gaining consensus can be time consuming, but to complete the audit a final draft SMP will be required that has been endorsed by the various custodians.
    e. If certain custodian agencies only conduct above ground tasks in open spaces (i.e. mowing the grass) for which there is no contamination risk mitigation required, it is recommended that the SMP explicitly excludes these tasks from the scope of the SMP. This may significantly reduce the SMP burden for certain custodians (for example, TCCS).
7. Section 5: The duration of SMP implementation identified is appropriate, although it would be preferable if the opening sentence stated that the SMP shall remain in effect “in perpetuity” until such time…
8. Section 6:
    a. consider including a section that addresses scenarios that could involve exposure to contaminated groundwater. This could include dewatering or excavation that encounters groundwater and should include advice for mitigating exposure to contaminated groundwater (also including handling, classifying and disposal of potentially contaminated groundwater, and preventing the induced migration of contaminated groundwater). Most likely to relate to future development works, but if there were excavation in the playing fields for any reason that encounters groundwater.
    b. The various management activities under Section 6 should also have reporting requirements specified, similar to the reporting requirement for waste disposal in Section 7.7. Consider specifying the reporting requirement generically for any activity involving work with contaminated material, rather than on an activity-by-activity basis. Please include details on what should be included in the reporting, who should undertake the reporting, and who reports should be submitted to (i.e. the land custodian should be responsible for retaining a copy of any contamination reports produced in their area of responsibility).
9. Section 6.1:
    a. Consider expanding this section to include any trenching or excavation works in the vicinity of contamination, or works that involve penetration or removal of hardstand, beneath which VCH vapours may have accumulated. For example, if someone needed to install additional services beneath Kippax Place Rd, that work would be subject to a similar safety protocol but is not strictly described as “maintenance work in service pits”. Likewise, demolition of the former health centre and removal of foundation slabs could potentially result in release of high concentrations of VCH vapours that may have accumulated under the hardstand.

b. is there really an explosive hazard associated with chlorinated hydrocarbon vapours? Consider this carefully, as if the nature of the contamination presents a potential explosive hazard, then the acuteness of the risk to current land uses would be significantly higher.

c. It would be useful to identify the workplace exposure standards for the chemicals of concern, and link management responses to those standards.

d. Please provide a figure that identifies the existing services in relation to the contamination.

10. Section 6.2: existing wells should be preserved for future sampling or replaced if they are destroyed during future development activities. Construction details for the groundwater wells and soil vapour probes are included as an appendix to the Detailed Site Investigation report (Lanterra, 2022).

11. Section 6.4: I believe the current reference for waste classification in the ACT is: ACT Government (July 2021) *Environmental Standards: Assessment and Classification of Liquid and Non-Liquid Wastes*. The criteria in Information Sheet 4 should still be applicable for reuse.

12. Section 6.5: please include the following additional requirements:

    a. The objective of future investigation will be to understand the potential impact the contamination may have on future land uses and specific building designs.

    b. An ACT EPA approved environmental auditor must be engaged to independently review any future environmental investigation and mitigation/remediation work at the site, and a site audit statement must be obtained indicating the suitability of the land for the permissible land uses with specific reference to the final development plan.

    c. If residual contamination is present at the site following completion of future development, this SMP must be updated, or a new SMP prepared, that documents the nature and extent of residual contamination, and any ongoing monitoring and/or mitigation measures required to prevent unacceptable exposure to contamination by future occupants of the site. The revised or new SMP is subject to the review and endorsement process specified in Section 5.

13. Section 7: please include a description of the “duty to notify the existence of contamination” obligations under the CSEPP (section 8.1.3). If an unexpected find meets the notification criteria, it is the responsibility of the lessee to notify EPA.

14. Section 7.5: please indicate that if a stockpile of contaminated material is placed on unsealed ground, then following removal of the stockpile validation samples must be collected from the footprint of the stockpile to demonstrate that contamination has not been transferred to the ground surface.

15. Section 7.6: Final bullet: is there really a scenario where disposal of asbestos contaminated soil does not require approval from the EPA prior to disposal?

16. Section 7.7: please indicate that the written approval for waste disposal from the EPA must be retained on file by the relevant custodian of the land on which the work was performed.

We request that Lanterra provides responses to the above comments, together with an amended copy of the HHRA, as appropriate (a tracked edits version, along with a clean version, would be appreciated to expedite review).

4 Closure

This interim advice does not constitute a SAS or a SAR, but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor’s opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points, please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,



Lange Jorstad, PhD, CEnvP SC
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GSY0165 IA08 HHRA endorse

11 July 2022

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Via email: Nyah.Donaldson@act.gov.au

Dear Nyah,

Re: Interim Advice 08: Endorsement of Human Health Risk Assessment for Block 71 Section 51 Holt, Belconnen ACT 2615

1 Introduction

The Environment, Planning and Sustainable Development Directorate (EPSDD) has appointed Lange Jorstad of Geosyntec Consultants Pty Ltd (Geosyntec), a NSW EPA Auditor accredited (No. 1001) under the Contaminated Land Management (CLM) Act 1997, to conduct an Audit of Block 71 Section 51 Holt, Belconnen ACT 2615 ("the site").

The audit site is adjacent to Kippax Place in Holt and has an area of approximately 1.96 hectares (ha). The land is intended for divestment by EPSDD and is zoned for CZ1: Core Zone which allows for commercial and residential land uses.

This is currently a non-statutory Site Audit conducted in accordance with ACT Environment Protection Authority Contaminated Sites Environment Protection Policy (CSEPP, 2017), the requirements outlined in NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition), and other guidelines made or endorsed by the ACT Environment Protection Authority (EPA) for use in the ACT as indicated in Section 10.3 of the CSEPP.

The aim of the engagement is to enable a site audit Statement (SAS) and associated site audit report (SAR) to be prepared that confirms the suitability of the site for commercial and mixed-use development, in accordance with the NSW EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition).

2 Current Interim Advice

In preparing this interim audit advice, the Auditor has reviewed the following reports related to land contamination assessment:

- SAGE Environmental Services Pty Ltd (SAGE) (28 June 2022) Draft Human Health Risk Assessment, Section 51, Kippax Group Centre. Holt ACT (Ref: DRAFT REV2.0) herein referred to as the HHRA.

Comments on the draft HHRA (dated 10 June 2022) was provided in the Auditor's interim audit advice IA06, dated 21 June 2022. Comments and responses are provided in a table in the Attachment A of this IA.

3 Endorsement of the Human Health and Ecological Risk Assessment

The Auditor has reviewed the Human Health and Ecological Risk Assessment (HHRA; SAGE 28 June 2022) against the checklist provided in Appendix E of the NSW EPA (2017) Guidelines for the NSW Auditor Scheme (3rd edition).

The Auditor is satisfied with the conclusions of the Tier II HHRA, that the VCH concentrations in soil vapour and groundwater present a low risk (tolerable concentration not exceeded) of harm to the health of residents, commercial workers, and recreational receptors at the Site, considering the highest concentrations of the chemicals of concern identified anywhere on site

The risk assessment is appropriate for consideration of the proposed redevelopment for multiple land uses, in particular CZ1: Core Zone which allows for both commercial and residential land uses. The five scenarios are appropriate:

- On-site commercial - Slab on Ground Construction
- On-Site Commercial with child care – Slab on Ground Construction
- On-Site Commercial – Basement Construction with commercial properties from the ground floor.
- On-Site Medium Density Residential – Basement Construction with residential properties from the first floor.
- On-Site Ground floor residential on slab (noting that this scenario is not currently planned as per Holt Precinct Code (EPSDD 2020)

Noting recreational receptors were not assessed as part of the Tier 2 assessment, as were considered to have a lower risk profile than the sensitive residential and commercial receptors that were considered.

4 Closure

This interim advice does not constitute a SAS or a SAR, but rather is provided to assist the Client in the assessment and management of contamination issues at the site. The information provided herein should not be considered pre-emptive of the final Audit conclusions. It represents the Auditor's opinion based on the review of currently available information.

Should you have any queries or wish to discuss any points, please do not hesitate to contact Sarah Silver or the undersigned.

Yours sincerely,



Lange Jorstad, PhD, CEnvP SC
NSW EPA Accredited Site Auditor (No. 1001)
Geosyntec Consultants Pty Ltd Lange Jorstad, PhD, CEnvP SC
Attachments: Attachment A - Tables

Attachment A – Tables

IA06 Comments	Consultant Consideration	Auditor Comment
1. The risk conclusion indicated in the Executive Summary refers only to contaminated groundwater. Should it refer to both soil vapour and groundwater?	SAGE has edited the executive summary to reflect that contamination occurs in both groundwater and soil vapour.	Accepted
2. Please review and update Section 2.1 (note: there are currently two sections 2.1: site identification and environmental setting – this comment refers to the environmental setting). The section refers to retired block names and should clarify what environmental features are on-site and off-site (with respect to Block 71).	Thank you for identifying that error, Section headings have been updated so there is only one Section 2.1. In response to the comment regarding the Environmental Setting section (now Section 2.2), SAGE has removed references to old block names and added text to identify which environmental features are on- and off-Site in relation to Block 71.	Accepted
3. Please note that the CZ1 zoning includes "Community Use" as a permissible land use, which is an umbrella term that includes residential and day care land uses (and hospitals, etc). Hence, risk characterisation and conclusions should consider the possibility of a day care being incorporated into future development.	Noted. Text relating to the permissible uses of CZ1 have been updated to reflect the possibility of childcare facilities as per the "Community Use" classification. An additional scenario (Scenario 2) has been included in the revised report to evaluate the risk posed for a commercial slab-on-ground land use that includes a child care facility.	Additional scenario considered. Accepted
4. Does the HHRA consider potential contact with shallow or perched groundwater? Shallow (potentially "perched") groundwater was identified in the southwest of the site (in vicinity of GW1 to GW5) and the depth to groundwater is likely to be less in the playing fields than near to the community centre due to the elevation change (the surface elevation of Kippax Place is approximately 3m higher than the adjacent playing fields). Section 4.2.1 includes an assumption that the average depth to groundwater is 8 mbgl, and the Auditor acknowledges that the "water strikes" recorded in the borehole and well installation logs (the depth at which damp or moist soil was recorded) were generally between 8-11 mbgl. If the depth to groundwater beneath the playing fields in the eastern portion of the site is shallower, would this change the risk characterisation?	SAGE has amended the report to include statements indicating the HHRA has assumed groundwater depths are 8-11mbgl. Shallow or perched aquifers were not considered in this risk assessment. However, SAGE has revised the report to note that if such groundwater conditions are encountered, further risk assessment is required to assess whether this constitutes a complete pathway for exposure via direct groundwater contact	Accepted. Ongoing requirement of SMP.
5. Please check the location of SV14 on Figure 3. It should be co-located with GW62. Does this change any risk conclusions in the HHRA?	The location of all monitoring locations has been reviewed and issues amended. SV14 now in correct location (co-located with GW62). SAGE does not consider this to change any risk conclusions as SV14 was considered within the on-Site data set and all on-Site data was screened to identify the data to be input to the risk model	Accepted
6. Please confirm – title of Section 4.4.3 states residential properties from the ground floor yet the section considers residential receptors from the first floor. Which was modelled in the scenario? Note that Table 19 states first floor. Does the scenario consider commercial on the ground floor and residential first floor and above with basement car parking?	The text has been modified to confirm that the modelling for Scenario 3 assumes ground floor residential receptors, and provides further justification for this conservative assumption.	Accepted
7. Section 8 of the report says "ILCR less than $1x10^{6}$". This should state $1x10^{-5}$, as per Section 6.2.	Noted, this has been amended.	Accepted
8. GW54 is an on-site well (as per Figure 3 and first row in Table 6). Dissolved VCH concentrations have been measured above the AQUA guideline in this well. Should Table 6 and the risk assessment consider an off-site VCH source has caused both on-site and off-site impacts? There is no co-located on-site soil vapour probe in vicinity of GW54.	Table 6 has been updated to reflect that an off-site groundwater source has led to impacts in both on- and off-site locations. SAGE notes that the data for GW54 provided in the DSI (Lanterra, 2022) only indicated exceedances of Tier 1 criteria for heavy metals, and not VCH.	Accepted.
9. It is acknowledged that concept plans for future site development indicate residential land uses will be limited to the eastern portion of the site. Would the risk conclusions change if residential development occurred on the western portion of the site? Or if construction was slab on grade rather than with a basement?	A sensitivity assessment scenario has been undertaken to consider this and included in the revised report. The modelling from this scenario is indicated that tolerable concentrations have not been exceeded, therefore, this scenario has not changed the risk conclusions.	Accepted.

Requirement	Consultant Consideration	Auditor Comment (21/06/2022)	SAGE Comment (28/06/2022)	Auditor Comment
Hazard Identification				
Have all appropriate sources of information regarding chemicals of potential concern been identified and assessed?	Section 1 identifies off site upgradient contamination sources and that the DSI noted no activities that may have introduced VCH on the site and inferred that the source of CoPC identified at the site had originated from off-site sources to the southwest of the site.	The Auditor considers that the chemicals of potential concern have been identified and appraised, noting risk assessment was prepared in conjunction with use of Tier 1 Risk Based criteria.	Table 6 has been updated to reflect that an off-site groundwater source has led to impacts in both on- and off-site locations. SAGE notes that the data for GW54 provided in the DSI (Lanterra, 2022) only indicated exceedances of Tier 1 criteria for heavy metals, and not VCH.	Confirmed and accepted
	Table 6 outlines the following sources of contamination and associated chemicals of potential concern have been identified: · VCH off site source - off-site groundwater impact at central western boundary south of the community centre; · VCH off site source - on and off-site impact to groundwater to the north of the community centre; · VCH off site source - on and off-site soil vapour impact to the north and south of community centre; and · Benzene off site source - off-site groundwater impact to southwest. (Note: The HHRA does not include consideration of this CoPC from an off-site source within the assessment)	GW54 is an on-site well (as per Figure 3 and Table 6). Concentrations of VCHs have been reported above the AQUA guideline in this well. Soil vapour has not been characterised within this area (on-site). Should the first row in Table 6 identify the VCH source in the central western portion of the site to have resulting in both on-site and off-site impacts?		
Has justification been given for the selection of the chemicals of potential concern?	Table 8 of the HHRA outlines the outcomes of the Tier 1 Screening on-site and a discussion of impacts in the relevant media. Table 9 outlines the results for off-site locations noting that SAGE do not provide a quantitative assessment of risk for off-site locations in this HHRA.	Appropriate justification has been presented for selection of COPC for inclusion in the HHERA.	Noted, no amendments made to the report.	Noted
	Section 3.3 lists the COPCs in groundwater and soil vapour selected for HHRA include: · Tetrachloroethene or Perchloroethylene (PCE); · Trichloroethene (TCE); · Cis 1,2-dichloroethene (DCE); · Vinyl Chloride. SAGE acknowledge that as these off-Site sampling locations are hydraulically upgradient from the Site, there is potential for off-Site impacts to continue to migrate towards the Site over time, which may result in future on-Site increases in concentrations of CoPC in environmental media	The COPCs omitted have been justified.		
Toxicological Assessment				
Have all critical toxic effects been identified?	Section 5 presents the toxicity assessment. Appendix D presents the toxicity profiles. The effects of COPC on body systems are discussed, where relevant, and all critical toxic effects are identified.	Requirement has been met.	Noted, no amendments made to the report.	Noted
Have the effects on each body system (for example renal, hepatic, cardiovascular and developmental) and the types of effects (for example genotoxic and carcinogenic) been summarised?	SAGE acknowledge that PCE has the potential to be genotoxic, some PCE metabolites are mutagenic, and PCE is likely to be carcinogenic in humans by all routes of exposure. However, SAGE assessed PCE based on threshold effects only, following NEPC (2013).			
Has the dose-response relationship for chemicals of potential concern been discussed?	Appendix D presents the toxicity profiles, which include discussion of the dose-response relationships for COPC.	Requirement has been met.	Noted, TCE toxicity profile has been amended in response to Auditor's comment.	Noted
		Section 5 of the TCE toxicity profile refers to benzene and SAGE should amend this to refer to TCE.		
Have all relevant toxicological data been considered and checked for accuracy?	Summary tables of available toxicological data from data source agencies are provided in the toxicity profiles in Appendix D.	The toxicological information relating to each COPC has been selected in accordance with prevailing guidelines at the time of preparation.	The RfC concentration referenced for DCE has been updated to reflect the value for cis-1,2-DCE. The IUR value used for TCE was 4.1x10-5 (µg/m3)-1, and the table (now Table 19) has been updated to reflect this.	Accepted
		The RfC used in the calculations for cis-1,2-dichloroethene (Table 18 and Appendix E) is the adopted value for trans-1,2-dichloroethene listed in Appendix D. SAGE should revise the calculations to use the adopted RfC for cis-1,2-dichloroethene, which		
		The inhalation unit risk value listed in Appendix D and Table 18 for TCE is $4.0x10^{-6}$ $(\mu g/m^3)^{-1}$, with the source cited as USEPA, 2022. However, the value listed in USEPA, 2022 is $4.1x10^{-6}$ $(\mu g/m^3)^{-1}$. The value recommended by NEPC (2013) is $4x10^{-6}$ $(\mu g/m^3)^{-1}$ sourced from USEPA, 2011. SAGE should update either the value used or the reference cited and explain		
Have relevant primary toxicological resources been considered?	Appendix D presents a summary of data published by sources recognised and endorsed by enHealth, NEPC, and USEPA. Sources for inhalation dose response values include NEPC, RIVM, USEPA, ATSDR, Health Canada, IRIS, and CCME.	The sources are appropriate and reliable.	Noted, SAGE have updated Section 6.4.2 to include site specific information relevant to the uncertainties involved in the toxicity assessment.	Accepted
Has the adequacy of available toxicological database been commented on?	Section 6.4.2 presents a discussion of uncertainties in the toxicity assessment, including the use of safety factors to account for animal to human extrapolation and other limitations.	The toxicity data are considered adequate for the COPCs assessed.		
Have different toxicity data from different resources been assessed and discussed?		The discussion of uncertainties in Section 6.4.2 is generic. It would be helpful for SAGE to revise this section to make it specific to the data used in this HHRA.		

Requirement	Consultant Consideration	Auditor Comment (21/06/2022)	SAGE Comment (28/06/2022)	Auditor Comment (10/07/2022)
Have the selected toxicity data been adequately justified?	Appendix D provides rationale for the adopted toxicity data.	Requirement has been met, subject to amendment of the RfC for cis-1,2-dichloroethene used in the calculations. Appendix D indicates that the values used were published and supported by NEPC (2013). Section 5.2 includes generic language about cases where values are not available in Australia, which does not apply, so SAGE should add a note to Section 5.2 / Table 18 to indicate that the RfC values presented are adjusted for background following NEPC (2013). E.g. the USEPA RfC for TCE is 0.002 mg/m^3, while the value of 0.0018 SAGE should revise the RfC for cis-1,2-dichloroethene in Table 18 to 0.007 mg/m^3 and revise the associated	RfC for DCE has been revised to reflect cis-1,2-DCE. Statement added to Section 5.2 to clarify selection of toxicity criteria, indicating process for selecting more recent data while being compliant with published Australian guidelines. Footnote added below Table 19 (formerly 18) to indicate that RfC values have been adjusted for background. RfC for cis-1,2-DCE and referenced amended as	Accepted
Exposure Assessment				
Has a comprehensive and appropriate conceptual site model been presented that indicates all potential pathways and receptors?	Section 3.4 provides a preliminary conceptual site model of the site. SAGE indicated that the DSI identified inhalation of gases and soil vapour to be the only complete pathway at this Site.	Did SAGE consider the potential for contact with shallow / perched groundwater during basement construction in the future development?	Shallow or perched aquifers were not considered in this risk assessment. SAGE has revised the report to note that if such groundwater conditions are encountered, further risk assessment is required to assess whether this constitutes a complete pathway for exposure via direct groundwater contact	Accepted. Ongoing requirements outlined in SMP.
Have all potential receptors been identified?	Section 3.4 outlines the receptors considered in the HHRA: Current receptors: · On-Site commercial receptors working within the community centre, and patrons accessing the community centre. · Maintenance workers (e.g. groundskeepers, utility/services workers, cleaners). · General public using the community areas on-Site (north-west corner of Site where public seating, footpaths and a skate ramp exist). · Patrons passing through the Site to access the shopping centre on the western boundary of the Site (off-Site). · On-Site and off-Site recreational users of the Kippax playing fields. · Off-Site commercial receptors adjacent to the Site. · Off-Site residential receptors at the northern Site boundary. Potential future receptors: · Residential receptors, within ground floor dwellings located at the eastern Site boundary. · Residential receptors, in properties from the first floor with a single basement construction. · Commercial receptors (slab on ground) · Intrusive maintenance workers. · General public utilising the public spaces and roadways. · Employees of and patrons to commercial spaces.	The HHERA includes consideration of children, adults, flora, fauna and sensitive ecological receptors which are considered appropriate for the proposed SAGE should clarify if the presence of a child care centre within commercial developments (permitted under the zoning) would change the risk conclusions.	An additional scenario was included in the revised report that assessed the risk associated with a child care facility on-Site (commercial, slab-on-grade). The modelling from this scenario is indicated that tolerable concentrations have not been exceeded, therefore, this scenario has not changed the risk conclusions.	Agreed
Have the estimates or measured exposure concentrations for each exposure route and chemical of potential concern been identified?	Section 4 presents the exposure assessment. Based on the transport mechanisms identified, SAGE indicated the potential for exposure via the inhalation pathway could occur due to upward vapour migration from the groundwater and through the overlying soil profile. Table 11 presents 3 exposure scenarios: · On-site commercial - Slab on Ground Construction · On-Site Commercial – Basement Construction with commercial properties from the ground floor. · On-Site Medium Density Residential – Basement Construction with residential properties from the first floor. Recreational receptors were not assessed as part of the Tier 2 assessment as they are considered to have a lower risk profile than the sensitive residential and commercial receptors that have been considered (vapour-phase contaminants are unlikely to accumulate in outdoor environments). SAGE conservatively adopted the highest chemical concentrations reported anywhere on the site for their risk assessment.	The exposure scenarios and exposure point concentrations are considered to be conservative and appropriate as the basis of the risk assessment.	Noted, no amendments made to the report.	Noted
Risk Characterisation				
Has the acceptable risk level been identified and justified?	Section 6 provides risk characterisation and hazard index estimates, which indicate acceptable risk and hazard indices.	Requirement has been met.	Noted, no amendments made to the report.	Noted
Have all potential receptors and pathways been considered?	The three exposure scenarios and receptors have been considered.	Requirement has been met.	Noted, no amendments made to the report.	Noted
Has the relative significance of each exposure pathway, based on the risk analysis been discussed?	Table 19 presents each exposure pathway considered and the resulting risks. SAGE acknowledges that there is potential for off-Site impacts to continue to migrate towards the Site over time, which may result in future on-Site increases in concentrations of CoPC in environmental media. Section 7 indicated that to limit the potential exposure to vapour at the site, development should consider mitigation measures, like limiting the extent of the basement to areas where contamination levels are lower, or absent.	Requirement has been met.	Noted, no amendments made to the report.	Noted
Has a detailed sensitivity/uncertainty analysis been presented?	Section 6.5 presents a detailed discussion of uncertainty analysis, which considered the following: · Measured concentrations · Depths of impact · Geology · Air exchange rate · Advective flow	The Auditor considers that the HHERA calculations are appropriately conservative for the following reasons: · Consideration of maximum values of COPCs across · Conservate vapour measurement depths and maximum concentrations considered. · Considered sand and gravel geology which is expected to be conservative. · Assumption of all potential pathways	Noted, no amendments made to the report.	Noted
Equations				
Have all equations used in the risk assessment been presented in the report, dimensionally correct, with correct units and consistent?	Section 6 presents risk characterisation equations. Appendix C presents vapour modelling equations.	Edits are recommended for clarity and to address inconsistencies and/or missing information.	The suggested edits have been considered and SAGE has revised Appendix C accordingly	Accepted
Have all parameters in each equation been clearly defined with unit conversion factors, where applicable, included?		· SAGE should revise the Hazard Index equation in Section 6.1 to indicate that the sum is over chemicals · SAGE should revise Appendix C to address the - Inconsistent terminology (e.g. C_{source} and $C_{vapour(m)}$ appear to refer to the same parameter) - Undefined terms (e.g. PSH, h_{cap}, h_v) - Terms used in equations that are not listed in Table - Incorrect or missing units (e.g. units of ΔP should be g/cm-s^2; units of U should be cm/s; units of VF_{wamb} and conversion factor in Equation 14 should be - The third term in the denominator of Equation 6 - The sentence before Equation 14 should refer to *groundwater* to outdoor air - It would be helpful to list the parameters in alphabetical order in Table 1 It would be helpful to simplify Appendix C by including only the equations used for this HHRA		
Has all pertinent information been provided to enable calculations to be checked through in a stepwise process?	Appendix E presents risk model calculations.	Requirement has been met.	Noted, no amendments made to the report.	Noted
Data Evaluation				
What were the data collection objectives and are they consistent with the requirements of the risk assessment?	The HHRA has considered soil, groundwater and soil vapour data as reported in investigations across the project area and reported in Lanterra (2022) DSI. Environmental data from these investigations has formed the basis of the risk assessment.	The objectives are consistent with the requirements of the risk assessment and SAR.	Noted, no amendments made to the report.	Noted
Were the laboratory analyses NATA accredited, and QA/QC reported and analysed, field QA/QC reported and analysed, indicated assessments of accuracy made in the risk assessment?	Assessments of QA/QC was discussed in Section 3.2 and within the Lanterra (2022) DSI.	The Auditor considers that this requirement has been met.	Noted, no amendments made to the report.	Noted
Assessment and Report Preparation				
Has in formation been presented coherently and in an appropriate sequence to enable efficient appraisal of the report?	Yes	The data has been provided in a form that is amenable to review and interpretation.	Noted, no amendments made to the report.	Noted
Have the objectives and scope been clearly indicated?	Section 1.2 indicated the purpose of the HHRA is to provide an assessment of potential human health risk as a result of exposure to site contamination for both current land users and potential future site users based on the Kippax Group Centre Master Plan:	The objective and structure (or scope) is appropriate for the purposes of the audit.	Noted, no amendments made to the report.	Noted

	Scope of work is not outlined but refers to the Letter of Engagement. Section 1.4 outlines the Structure of the HHRA, considering the required steps			
Requirement	**Consultant Consideration**	**Auditor Comment (21/06/2022)**	**SAGE Comment (28/06/2022)**	**Auditor Comment (10/07/2022)**
Has the analysis been based on up-to-date literature?	Section 6 outlines the references of the HHRA and Section 6.1 indicated that risk estimates are based on available toxicological studies.	Please confirm that the review was based on the most current available information published by the toxicological data source agencies.	Noted, statement added to this effect in Section 6.	Noted
Have all assumptions and default data been identified and justified?	Section 6.4 provides detail of data gaps and uncertainty assessment stating that the heal risk assessment process involves a number of assumptions based on site specific data. The assumptions used were selected to be conservative in nature to evaluate an assumed reasonable maximum exposure scenario and provide a deliberate margin of safety.	All assumptions are appropriate.	Noted, no amendments made to the report.	Noted
	The assumptions used and referred to in sub-sections of 6.4 have been reviewed.			
	SAGE notes that limited temporal and seasonal soil vapour data is currently available but that the assessment considers the four stage DSI data collected between April 2021 and March 2022.			
	The key uncertainties include the available data set, noting there is potential for off-Site impacts to continue to migrate towards the Site over time. Therefore, future increases in concentrations of CoPC in environmental media on-Site may affect the potential risk to human health			
Have all tables and figures been referred to correctly in the text of the report?	Tables and figures are presented in the SAGE report.	This requirement has been met.	Noted, no amendments made to the report.	Noted
Has adequate data been presented to support the conclusions?	The HHRA has utilised results from the previous investigations, and has acknowledged data gaps, and made appropriately conservative assumptions to account for data uncertainty.	The Auditor considers the data used in the risk characterisation (site-specific and published sources) was appropriate and suitable for the purpose of assessing the potential contamination risks to the most sensitive future land uses permissible under the zoning. However, SAGE should clarify if the presence of a child care centre within commercial developments (permitted under the zoning) would change the risk conclusions.	An additional scenario was included in the revised report that assessed the risk associated with a child care facility on-Site (commercial, slab-on-grade). The modelling from this scenario is indicated that tolerable concentrations have not been exceeded, therefore, this scenario has not changed the risk conclusions.	Agreed

From:	Lange Jorstad
To:	Donaldson, Nyah
Cc:	Chris Gunton; Sarah Silver
Subject:	Interim advice from review of revised SMP issued 18 July 2022
Date:	20 July 2022 15:26:39
Importance:	High

Dear Nyah and Chris,

We have reviewed the updated SMP issued on 18 July 2022, and provide the following comments for your consideration:

1. Section 1:
    a. it would be helpful to provide a statement in the Introduction that this SMP only applies to Blocks 22 and 71, and that a separate SMP will be prepared for Kippax Place. Then any management recommendations pertaining to works in Kippax Place can be removed from this SMP (there are only a few, and references to Kippax Place in the context of investigation results are fine to retain).

2. Sections 1.1, 1.2 and Table 1:
    a. The zoning for Blocks 22 and 71 are limited to CZ1: Core Zone.

3. Section 4.1:
    a. Please include the responsibility of the custodian to notify any organisation or person(s) including representatives of the site custodian, earthworks contractors, builders, utilities or communication workers of any updates or changes to the SMP.

4. Section 5.2:
    a. Can this section please include a statement of what would trigger modification of the SMP:
        i. Any substantial new findings that should be documented in the "nature of contamination" (Section 3.8) description
        ii. Any modifications to roles and responsibilities
        iii. Any updates to management measures
        iv. Updates to reflect changes in relevant ACT legislation, policies and guidelines
    b. Also, it would be helpful to indicate how often the SMP must be reviewed for currency and adequacy

5. Section 6.5 Ongoing groundwater and soil vapour monitoring – further clarity required:
    a. Please indicate whose responsibility it is to implement the monitoring program, and when would this monitoring program commence.
    b. Please include a comment that the reporting of monitoring results must include an interpretation of temporal concentration trends and the ongoing suitability of the land, and significant increases in contaminant concentrations identified during monitoring will trigger a requirement to confirm of the validity of the HHRA results
    c. Is there a sunset clause for the monitoring program? Will monitoring continue indefinitely, or is there an option to request termination of monitoring if stable or decreasing trends are confirmed?
    d. In the event that a future SMP custodian does not have access to the DSI report, it

would be helpful to attach the well construction logs from the DSI to the SMP for ease of reference (i.e. in case wells/probes need to be replaced, as alluded to in the final paragraph of this section).

6. Section 6.6
    a. Is it the responsibility of the custodian to engage the consultant to prepare an indoor air report in the case that health centre is reoccupied? Please state for clarity.

7. Section 7.8 – this section only refers to "soil assessment" reporting, however it should summarise all the various reporting requirements documented throughout the SMP for ease of reference, including:
    a. Section 4.1 states that the SMP is to be maintained and updated as required, and records of changes to the SMP and subsequent approvals from an auditor and the ACT EPA must be maintained by the site custodian.
    b. Section 6.5 states that a report will be prepared at after each seasonal variation monitoring event, which must be reviewed by the site auditor.
    c. Section 6.6 states that if Kippax Health Centre is re-occupied (instead of the current plan to be demolished), indoor air monitoring must be completed and a report must be reviewed by an ACT EPA approved environmental auditor and the ACT EPA must provide written approval that the building may be tenanted prior to occupation.
    d. In addition to the various stated reporting requirements, please include a requirement for a validation or verification report at the completion of development that confirms the ongoing suitability of the developed land, from a contamination perspective, which should include consideration of any monitoring or targeted investigation results, and consideration of the nature of the development relative to the assumptions in the HHRA.

Please don't hesitate to contact us with any questions about this interim advice.

Kind regards,
Lange

Lange Jorstad, PhD, CEnvP SC
Principal
NSW EPA Accredited Site Auditor

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Appendix C Result Summary Tables

Table 1: Soil Analytical Results

							Field_ID	S1 0.0-0.1	S1 1.0-1.1	S2 1.0-1.1	S3 1.0-1.1	S4 0.0-0.1	S5 0.5-0.6	S5 5.0-5.1	S6 1.9-1.1	S6 4.9-5.1	S7 0.0-0.1
							Depth m	0.0-0.1	1.0-1.1	1.0-1.1	1.9-1.1	0.0-0.1	0.5-0.6	5.0-5.1	1.0-1.1	4.9-5.1	0.0-0.1
							Sampled date	7/04/2020	7/04/2020	13/04/2021	13/04/2021	13/04/2021	7/04/2020	7/04/2020	8/04/2020	8/04/2020	7/04/2020
							Fill/Natural										
				ASC NEPM (2013) ESL/EIL Urban Residential and Public Open Space	ASC NEPM (2013) HILA (mg/kg) 0-0.1/m/1.0-2.0m/2.0-4.0m	ASC NEPM (2013) HILA												
Method_Type	ChemName	Units	EQL														
Metals in soil	Arsenic, As	mg/kg	1	100		100	4	N.A.	4	4	3	6	7	6	2	2	
	Cadmium, Cd	mg/kg	0.3			20	<0.3	N.A.	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	
	Chromium, Cr	mg/kg	0.3	540		100	13	N.A.	17	9.7	13	12	23	22	15	6.6	
	Copper, Cu	mg/kg	0.5	220		6000	5.2	N.A.	4.3	5.6	5.8	7.3	7.4	7.9	8.2	3.1	
	Lead, Pb	mg/kg	1	1100		300	24	N.A.	14	21	12	24	32	21	12	8	
	Nickel, Ni	mg/kg	0.5	150		400	4.3	N.A.	2.8	3.7	7.9	6.7	6.9	7.4	6.1	4.2	
	Zinc, Zn	mg/kg	2	460		7400	32	N.A.	8.3	17	26	26	23	20	23	17	
	Mercury	mg/kg	0.05			40	0.15	N.A.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Organochlorine Pesticides	Hexachlorobenzene (HCB)	mg/kg	0.1			10	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Alpha BHC	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Lindane	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Heptachlor	mg/kg	0.1			6	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Aldrin	mg/kg	0.1			6	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Beta BHC	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Delta BHC	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Heptachlor epoxide	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	o,p' DDE	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Alpha Endosulfan	mg/kg	0.2			270	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Gamma Chlordane	mg/kg	0.1			50	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Alpha Chlordane	mg/kg	0.1			50	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	trans-Nonachlor	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	p,p' DDE	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Dieldrin	mg/kg	0.2			6	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Endrin	mg/kg	0.2			10	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	o,p' DDD	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	o,p' DDT	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Beta Endosulfan	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	p,p' DDD	mg/kg	0.1			240	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	p,p' DDT	mg/kg	0.1	180		240	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Endosulfan sulphate	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Endrin Aldehyde	mg/kg	0.1			10	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Methoxychlor	mg/kg	0.1			300	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Endrin Ketone	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Isodrin	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Mirex	mg/kg	0.1			10	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Organophosphorus Pesticides	Dichlorvos	mg/kg	0.5				<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	Dimethoate	mg/kg	0.5				<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	Diazinon (Dimpylate)	mg/kg	0.5				<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	Fenthrothion	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Malathion	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2			160	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Parathion ethyl (Parathion)	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Bromophos Ethyl	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Methidathion	mg/kg	0.5				<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	Ethion	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Azinphos-methyl (Guthion)	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
PAHs in Soil	Naphthalene	mg/kg	0.1	170	5/95/95		<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	2-methylnaphthalene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	1-methylnaphthalene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Acenaphthylene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Acenaphthene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Fluorene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Phenanthrene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Anthracene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Fluoranthene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Pyrene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Benzo(a)anthracene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Chrysene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Benzo(b&j)fluoranthene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Benzo(k)fluoranthene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Benzo(a)pyrene	mg/kg	0.1	0.7			<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Indeno(1,2,3-cd)pyrene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Dibenz(a,h)anthracene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Benzo(ghi)perylene	mg/kg	0.1				<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
	Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ (mg/kg)	0.2			3	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.3			3	<0.3	N.A.	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	
	Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2			3	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
	Total PAH (18)	mg/kg	0.8			300	<0.8	N.A.	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	
PCBs in Soil	Aroclor 1260	mg/kg	0.2				<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	

Table 1: Soil Analytical Results

							Field_ID	S1 0.0-0.1	S1 1.0-1.1	S21 0-1.1	S3 1.0-1.1	S4 0.0-0.1	S5 0.5-0.6	S5 3.0-3.1	S6 1.9-2.1	S6 4.3-4.1	S7 0.0-0.1
							Depth m	0.0-0.1	1.0-1.1	1.0-1.1	1.0-1.1	0.0-0.1	0.5-0.6	3.0-3.1	1.9-2.1	4.3-4.1	0.0-0.1
							Sampled date	7/04/2020	7/04/2020	13/04/2021	13/04/2021	13/04/2021	7/04/2020	7/04/2020	8/04/2020	8/04/2020	7/04/2020
							Fill/Natural										
				ASC NEPM (2013) ESL/DL Urban Residential and Public Open Space	ASC NEPM (2013) HILA (mg/kg) 0-1.0m/1.0-2.0m/2.0-4.0m	ASC NEPM (2013) HILA													
Method_Type	ChemName	Units	EQL																
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arsenite (+3)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Total PCBs (Aroclors)	mg/kg	1			1		<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
TRH Sat C10-C40 NEPM	TRH C10-C14	mg/kg	20					<20	N.A.	<20	<20	<20	<20	<20	<20	<20	<20
	TRH C15-C28	mg/kg	45					<45	N.A.	<45	<45	<45	<45	<45	<45	<45	<45
	TRH C29-C36	mg/kg	45					<45	N.A.	<45	<45	<45	<45	<45	<45	<45	<45
	TRH >C10-C16	mg/kg	100					<100	N.A.	<100	<100	<100	<100	<100	<100	<100	<100
	TRH >C10-C16 less Naphthalene (F2)	mg/kg	25					<25	N.A.	<25	<25	<25	<25	<25	<25	<25	<25
	TRH >C16-C34 (F3)	mg/kg	100	120	2800/4,NL			<25	N.A.	<25	<25	<25	<25	<25	<25	<25	<25
	TRH >C34-C40 (F4)	mg/kg	100	5600				<100	N.A.	<100	<100	<100	<100	<100	<100	<100	<100
	TRH C15-C28 Total	mg/kg	110					<110	N.A.	<110	<110	<110	<110	<110	<110	<110	<110
	TRH >C10-C40 Total (F bands)	mg/kg	210					<210	N.A.	<210	<210	<210	<210	<210	<210	<210	<210
BTEX + VOC	Benzene	mg/kg	0.1	65	0.7/1/3			<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Toluene	mg/kg	0.1	135	480/4,NL/4,NL			<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Ethylbenzene	mg/kg	0.1	125	NL/4,NL			<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Xylenes(m)	mg/kg	0.2					<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Xylene	mg/kg	0.1					<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Total Xylenes	mg/kg	0.3	45	110/310/NL			<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Total BTEX	mg/kg	0.6					<0.6	N.A.	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
	Benzene (F0)	mg/kg	20		0.7/1/2			<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	TRH C6-C9	mg/kg	0.1					<20	N.A.	<20	<20	<20	<20	<20	<20	<20	<20
	TRH C6-C10	mg/kg	25					<25	N.A.	<25	<25	<25	<25	<25	<25	<25	<25
	TRH (C6-C10 minus BTEX (F1)	mg/kg	25	180	700/10/150			<25	N.A.	<25	<25	<25	<25	<25	<25	<25	<25
Speciated Phenol	Phenol	mg/kg	0.5			3000		<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-methyl phenol (o-cresol)	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	3/4-methyl phenol (m/p-cresol)	mg/kg	1					<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
	Total Cresol	mg/kg	1.5			400		<1.5	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	2-chlorophenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dimethylphenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,6-dichlorophenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dichlorophenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4,6-trichlorophenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-nitrophenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4-nitrophenol	mg/kg	1					<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
	2,4,5-trichlorophenol	mg/kg	0.5					<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,3,4,6-/2,3,5,6-tetrachlorophenol	mg/kg	1					<1	N.A.	<1	<1	<1	<1	<1	<1	<1	<1
	Pentachlorophenol	mg/kg	0.5			100		<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dinitrophenol	mg/kg	2					<2	N.A.	<2	<2	<2	<2	<2	<2	<2	<2
	4-chloro-3-methylphenol	mg/kg	2					<2	N.A.	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Chlorinated Hydrocarbons	Bichloradifluoromethane (CFC-12)	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloromethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Vinyl chloride (Chloroethene)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloroethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Trichlorofluoromethane	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dichloromethane (Methylene chloride)	mg/kg	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Allyl chloride	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	trans-1,2-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1-dichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	cis-1,2-dichloroethene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromochloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chloroform	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2,2-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,1-trichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1-dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Carbon tetrachloride	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibromomethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Trichloroethene (Trichloroethylene, TCE)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromodichloromethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	cis-1,3-Dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	trans-1,3-Dichloropropene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,2-trichloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,3-dichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chlorodibromomethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dibromoethane (EDB)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Tetrachloroethene (Perchloroethylene,PCE)	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,1,2-tetrachloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	cis-1,4-dichloro-2-butene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromoform	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,1,2,2-tetrachloroethane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2,3-trichloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	trans-1,4-dichloro-2-butene	mg/kg	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Bromobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-chlorotoluene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	4-chlorotoluene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,3-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,4-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2-dibromo-3-chloropropane	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2,4-trichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Hexachlorobutadiene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1,2,3-trichlorobenzene	mg/kg	0.1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Naphthalene	mg/kg	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total Chlorinated VOC	mg/kg	3					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Physicochemical Properties	pH	pH	0.1					N.A.	6.5	N.A.	N.A.	N.A.	N.A.	N.A.	7.2	N.A.	N.A.
	Cation Exchange Capacity	meq/100g	0.02					N.A.	6.7	N.A.	N.A.	N.A.	N.A.	N.A.	12	N.A.	N.A.
	Clay (<0.002mm)	%w/w	0.1					N.A.	26	N.A.	N.A.	N.A.	N.A.	N.A.	22	N.A.	N.A.
Asbestos in Soil	Asbestos Detected	No unit	-			Non detected		No	N.A.	No	No	No	No	No	No	No	No
	Estimated (+/- 0.05)	%w/w	0.05			0.001		<0.01	N.A.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 1: Soil Analytical Results

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P21083 - Detailed Site Investigation, Section 51 Kippax Group Centre, Holt, ACT2615

Table 1: Soil Analytical Results

	Field_ID	57.2.0-2.1	58 1.0-1.1	59 0.0-0.1	QC1 (Duplicate)	RPD	QC2 (triplicate)	RPD	59 1.0-1.1	510 0.0-0.1	511 0.0-0.1	512 0.5-0.8	QC3 (Duplicate)	RPD	QC4 (triplicate)	RPD	513 0.0-0.1	514 0.0-0.1	515 0.0-0.1	516 0.5-0.6	517 0.0-0.1	518 0.5-0.6	519 0.0-0.1	520 0.5-0.6	521 1.0-1.1	522 0.5-0.6	GW51 0.0-0.1	GW51 4.0-4.1
	Depth m	2.2-2.1	1.0-1.1	0.0-0.1					1.0-1.1	0.0-0.1	0.0-0.1	0.5-0.6					0.0-0.1	0.0-0.1	0.0-0.1	0.5-0.6	0.0-0.1	0.5-0.6	0.0-0.1	0.5-0.6	1.0-1.1	0.5-0.6	0.0-0.1	4.0-4.1
	Sampled date	7/04/2020	8/04/2020	7/04/2020	7/04/2020		7/04/2020		7/04/2020	20/04/2021	20/04/2021	20/04/2021	20/04/2021		20/04/2021		20/04/2021	20/04/2021	20/04/2021	20/04/2021	20/04/2021	21/04/2021	21/04/2021	21/04/2021	21/04/2021	21/04/2021	15/04/2021	15/04/2021
	Fill/Natural																											
			ASC NEPM (2013) DL/DL Urban Residential and Public Open Space	ASC NEPM (2013) HILA (mg/kg) 0.0-1.0m's 1.0-2.0m's 2.0-4.0m	ASC NEPM (2013) HILA	Stage 1 - April 2021																								
Method_Type	Chemform	Units	EQL																									
	Arochlor 1221	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1232	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1242	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1248	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1254	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1260	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1262	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Arochlor 1268	mg/kg	0.2			<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Total PCBs (Arochlors)	mg/kg	1		1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRH Soil C10-C40 NEPM	TRH C10-C14	mg/kg	20			<20	<20	<20	<20	0%	<20	0%	<20	<20	<20	<20	<20	0%	<20	0%	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	TRH C15-C28	mg/kg	45			<45	<45	55	<45	N.A.	<230	N.A.	<45	<45	<45	<45	<45	0%	<230	0%	<45	<45	<45	<45	<45	<45	<45	<45	81	<45
	TRH C29-C36	mg/kg	45			47	<45	68	51	29%	120	75%	56	<45	<45	<45	<45	0%	<230	0%	<45	<45	<45	<45	59	<45	<45	<45	100	<45
	TRH C37-C50	mg/kg	100			<100	<100	<100	<100	0%	N.A.	N.A.	<100	<100	<100	<100	<100	0%	N.A.	N.A.	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	TRH >C10-C16	mg/kg	25			<25	<25	<25	<25	0%	<50	0%	<25	<25	<25	<25	<25	0%	<50	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	TRH >C10-C16 (F1)	mg/kg	35	133	280/NL/NL	<35	<35	<35	<35	0%	<70	0%	<35	<35	<35	<35	<35	0%	<70	0%	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35
	TRH >C16-C34 (F2)	mg/kg	90	1300		<90	<90	90	<90	N.A.	1490	90%	<90	<90	<90	<90	<90	0%	<220	0%	<90	<90	<90	<90	<90	<90	<90	<90	<90	<90
	TRH >C34-C40 (F3)	mg/kg	120	1600		<120	<120	<120	<120	0%	<330	0%	<120	<120	<120	<120	<120	0%	<330	0%	<120	<120	<120	<120	<120	<120	<120	<120	200	<120
	TRH C15-C28 Total	mg/kg	110			<110	<110	120	<110	N.A.	<110	N.A.	<110	<110	<110	<110	<110	0%	N.A.	N.A.	<110	<110	<110	<110	<110	<110	<110	<110	240	<110
	TRH >C10-C40 Total (F bands)	mg/kg	210			<210	<210	<210	<210	0%	1490	N.A.	<210	<210	<210	<210	<210	0%	<550	0%	<210	<210	<210	<210	<210	<210	<210	<210	<210	<210
BTEX + VOC	Benzene	mg/kg	0.1	65	2/7/10	<0.1	<0.1	<0.1	<0.1	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.2	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Toluene	mg/kg	0.1	135	430/NL/NL	<0.1	<0.1	<0.1	<0.1	0%	<0.5	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.5	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Ethylbenzene	mg/kg	0.1	135	NL/NL/NL	<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	m+p-xylene	mg/kg	0.2			<0.2	<0.2	<0.2	<0.2	0%	<2	0%	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<2	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	o-xylene	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Total Xylenes	mg/kg	0.3	45	110/213/NL	<0.3	<0.3	<0.3	<0.3	0%	<3	0%	<0.3	<0.3	<0.3	<0.3	<0.3	0%	<3	0%	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Total BTEX	mg/kg	0.6			<0.6	<0.6	<0.6	<0.6	0%	N.A.	N.A.	<0.6	<0.6	<0.6	<0.6	<0.6	0%	N.A.	N.A.	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
	Benzene (PD)	mg/kg	39		2/7/17	<0.1	<0.1	<0.1	<0.1	0%	N.A.	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	0%	N.A.	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	TRH (C6-C)	mg/kg	0.1			<20	<20	<20	<20	0%	<25	0%	<20	<20	<20	<20	<20	0%	<25	0%	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	TRH (C6-C10)	mg/kg	35			<35	<35	<35	<35	0%	<35	0%	<35	<35	<35	<35	<35	0%	<35	0%	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35
	TRH (C6-C10 minus BTEX (F1)	mg/kg	25	180	50/90/150	<25	<25	<25	<25	0%	<25	0%	<25	<25	<25	<25	<25	0%	<25	0%	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Speciated Phenol	Phenol	mg/kg	0.5		3000	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-methyl phenol (o-cresol)	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	3+4-methyl phenol (m/p-cresol)	mg/kg	1			<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Total Cresol	mg/kg	1.5		400	<1.5	<1.5	<1.5	N.A.	N.A.	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	N.A.	N.A.	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	2-nitrophenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dimethylphenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dichlorophenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,6-dichlorophenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4,6-trichlorophenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4,5-trichlorophenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2-methylphenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4-nitrophenol	mg/kg	1			<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	2,4,5-trichlorophenol	mg/kg	0.5			<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,3,4,6-/2,3,5,6-tetrachlorophenol	mg/kg	1			<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	N.A.	N.A.	N.A.	N.A.	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Pentachlorophenol	mg/kg	0.5		100	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2,4-dichlorophenol	mg/kg	2			<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	4-chloro-3-methylphenol	mg/kg	2			<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	N.A.	N.A.	N.A.	N.A.	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Chlorinated Hydrocarbons	Bromodichloromethane (DFC12)	mg/kg	1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Chloromethane	mg/kg	1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Vinyl chloride (Chloroethene)	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chloroethane	mg/kg	1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Trichlorofluoromethane	mg/kg	1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	1,1-dichloroethene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Dichloromethane (Methylene chloride)	mg/kg	0.5			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.5
	Allyl chloride	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	trans-1,2-dichloroethene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1-dichloroethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	cis-1,2-dichloroethene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Bromochloromethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chloroform	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	2,2-dichloropropane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dichloroethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,1-trichloroethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1-dichloropropene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Carbon tetrachloride	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Dibromomethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dichloropropane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Trichloroethene (Trichloroethylene, TCE)	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Bromodichloromethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	dis-1,3-dichloropropene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	trans-1,3-dichloropropene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,2-trichloroethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,3-dichloropropane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chlorodibromomethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dibromoethane (EDB)	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Tetrachloroethene (Perchloroethylene, PCE)	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,1,2-tetrachloroethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Chlorobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	cis-1,4-dichloro-2-butene	mg/kg	1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Bromoform	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,1,2,2-tetrachloroethane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2,3-trichloropropane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	trans-1,4-dichloro-2-butene	mg/kg	1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<1
	Bromobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	n-propylbenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	2-chlorotoluene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	4-chlorotoluene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,3-dichlorobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,4-dichlorobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dichlorobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2-dibromo-3-chloropropane	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2,4-trichlorobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Hexachlorobutadiene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	1,2,3-trichlorobenzene	mg/kg	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<0.1
	Naphthalene	mg/kg	5			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<5
	Total Chlorinated VOC	mg/kg	2			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A

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Table 1: Soil Analytical Results

						Field_ID	01	02	03	SW2 0.0-0.1	SW2 1.0-1.1	GW52 0.0-0.1	GW52 2.0-2.1	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	GW53 0.0-0.1	GW53 1.0-1.1	GW54 0.0-0.1	GW54 1.0-1.1	GW55 0.0-0.1	GW55 2.0-2.1	GW56 0.5-0.6	GW56 2.0-2.1	GW59 1.0-1.1	GW59 0.5-0.6				
						Depth m	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	1.0-1.1	0.0-0.1	2.0-2.1					0.0-0.1	1.0-1.1	0.0-0.1	1.0-1.1	0.0-0.1	2.0-2.1								
						Sample date	7/04/2020	7/04/2020	7/04/2020	2/11/2021	2/11/2021	3/11/2021	3/11/2021	3/11/2021		3/11/2021		2/11/2021	2/11/2021	3/11/2021	3/11/2021	11/01/2022	11/01/2022	19/01/2022	19/01/2022	12/01/2022	12/01/2022				
						Fill/Natural																									
				ASC NEPM 2013 (HIL/ESL) Value Residential and Public Open Space	ASC NEPM 2013 (HSL-A (mg/kg) 0.0-1.0m/1.0-2.0m/2.0-4.0m	ASC NEPM 2013 (HIL-A	Stage 2 - November 2021																		Stage 3 - January 2022					
Method_Type	ChemName	Units	EQL																												
Metals in soil	Arsenic, As	mg/kg	1	100		100	4	3	5	2	7	2	6	3	67%	4	40%	2	4	3	6	3	6	4	6	4	3				
	Cadmium, Cd	mg/kg	0.3			20	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0%	<0.3	0%	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3				
	Chromium, Cr	mg/kg	0.3	500		100	14	15	31	5.8	17	5	22	10	75%	20	105%	8.2	8.5	11	24	13	21	17	27	13	14				
	Copper, Cu	mg/kg	0.5	200		6000	5.2	6.7	9	3.3	9.2	5.1	8	4.9	48%	8	0%	2.6	3.9	6.1	8.3	8.2	7.7	8	8.2	2.9	5.2				
	Lead, Pb	mg/kg	1	1100		300	12	13	28	13	28	14	31	16	64%	29	7%	4	12	8	31	9	19	22	43	12	8				
	Nickel, Ni	mg/kg	0.5	150		600	7.8	8.2	9.7	1.8	8.8	4.1	8	4.6	54%	8	0%	4.5	3	7.3	7.8	9.6	8.4	8.8	8.5	5.3	5.3				
	Zinc, Zn	mg/kg	2	400		7400	30	34	15	27	19	40	16	10	48%	12	28%	23	7.7	35	37	38	31	17	14	15	31				
	Mercury	mg/kg	0.05			40	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0%	<0.1	0%	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Organochlorine Pesticides	Hexachlorobenzene (HCB)	mg/kg	0.1			10	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Alpha BHC	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Lindane	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Heptachlor	mg/kg	0.1			6	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Aldrin	mg/kg	0.1			6	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Beta BHC	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Delta BHC	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Heptachlor epoxide	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	cis- DDE	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Alpha Endosulfan	mg/kg	0.2			270	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Gamma Chlordane	mg/kg	0.1			50	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Alpha Chlordane	mg/kg	0.1			50	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	trans-Nonachlor	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	cis- DDE	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Dieldrin	mg/kg	0.2			6	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Endrin	mg/kg	0.2			10	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	cis- DDD	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	cis- DDT	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Beta Endosulfan	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	cis- DDD	mg/kg	0.1			240	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	cis- DDT	mg/kg	0.1	180		240	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Endosulfan sulphate	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Endrin Aldehyde	mg/kg	0.1			10	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	trans-nonachlor	mg/kg	0.1			300	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Endrin Ketone	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Isodrin	mg/kg	0.1				<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Mirex	mg/kg	0.1			10	<0.1	<0.1	<0.1	N.A.	<0.1	N.A.	<0.1	<0.1	N.A.	N.A.	N.A.	N.A.	<0.1	N.A.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Organophosphorus Pesticides	Dichlorvos	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
	Dimethoate	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
	Diazinon (Dimpylate)	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
	Fenitrothion	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Malathion	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2			160	<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Parathion ethyl (Parathion)	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Bromophos-Ethyl	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Ronnel(fenchlorfos)	mg/kg	0.5				<0.5	<0.5	<0.5	N.A.	<0.5	N.A.	<0.5	<0.5	N.A.	N.A.	N.A.	N.A.	<0.5	N.A.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
	Ethion	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Azinphos-methyl (Guthion)	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
PAHs in Soil	Naphthalene	mg/kg	0.1	170	5/NL/NL		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	2-methylnaphthalene	mg/kg	0.1				<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0%		N.A.	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	1-methylnaphthalene	mg/kg	0.1				<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0%	-	N.A.	0.4	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Acenaphthylene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Acenaphthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Fluorene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Phenanthrene	mg/kg	0.1				<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Anthracene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Fluoranthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Pyrene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Benzo(a)anthracene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Chrysene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Benzo(b&j)fluoranthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	0%	<0.2	0%	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Benzo(k)fluoranthene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Benzo(a)pyrene	mg/kg	0.1	0.7			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	0%	<0.1	0%	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Indeno(1,2,3-cd)pyrene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Dibenz(a,h)anthracene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Benzo(g,h)perylene	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ (mg/kg)	0.5			3	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<0.5	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.5			3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0%	<0.5	0%	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3				
	Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.5			3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0%	<0.5	0%	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
	Total PAH (16)	mg/kg	0.8			300	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	0%	<0.05	0%	1.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8				
PCBs in Soil	Aroclor 1016	mg/kg	0.2				<0.2	<0.2	<0.2	N.A.	<0.2	N.A.	<0.2	<0.2	N.A.	N.A.	N.A.	N.A.	<0.2	N.A.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				

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Table 1: Soil Analytical Results

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							Sampled-date	22/04/2021	22/04/2021		22/04/2021		22/04/2021	22/04/2021	23/04/2
							Sample type	water	water		water		water	water	wate
			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	ANZG 2018 - 95% Protection for Freshwater Species	Groundwater Sampling Event 1 (Stage								
	ChemName	Units	EQL												
	Arsenic, As	µg/L	1	10	50		24	<1	<1	0%	<1	0%	<1	1	<1
	Cadmium, Cd	µg/L	0.1	2	0.2		0.2	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1	<0.
	Chromium, Cr	µg/L	1	50	2		1	<1	<1	0%	<1	0%	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		1.4	1	<1	N.A	<1	N.A	1	<1	2
	Lead, Pb	µg/L	1	10	1		3.4	<1	<1	0%	<1	0%	<1	<1	<1
	Nickel, Ni	µg/L	1	20	25		11	14	11	24%	11	24%	47	27	4
	Zinc, Zn	µg/L	5	3000**	5		8	11	9	20%	8	32%	6	8	<5
	Mercury	mg/L	0.0001	1	0.1		0.06	<0.0001	<0.0001	0%	<0.05	0%	<0.0001	<0.0001	<0.00
	Naphthalene	µg/L	0.5			NL/NL	16	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5
	2-methylnaphthalene	µg/L	0.1					<0.1	<0.1	0%	N.A.	0%	<0.1	<0.1	<0.
	1-methylnaphthalene	µg/L	0.1					<0.1	<0.1	0%	N.A.	0%	<0.1	<0.1	<0.
	Acenaphthylene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Acenaphthene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Fluorene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Phenanthrene	µg/L	0.1				2	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Anthracene	µg/L	0.1				0.4	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Fluoranthene	µg/L	0.1				1.4	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Pyrene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Benzo(a)anthracene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Chrysene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Benzo(b&j)fluoranthene	µg/L	0.1					<0.1	<0.1	0%	<2	0%	<0.1	<0.1	<0.
	Benzo(k)fluoranthene	µg/L	0.1					<0.1	<0.1	0%	<2	0%	<0.1	<0.1	<0.
	Benzo(a)pyrene	µg/L	0.1	0.01			0.2	<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Dibenzo(ah)anthracene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Benzo(ghi)perylene	µg/L	0.1					<0.1	<0.1	0%	<1	0%	<0.1	<0.1	<0.
	Total PAH (18)	µg/L	1		3		20	<1	<1	0%	N.A.	0%	<1	<1	<1
	TRH C10-C14	µg/L	50					<50	<50	0%	<50	0%	<50	<50	<50
	TRH C15-C28	µg/L	200					<200	<200	0%	<100	0%	<200	<200	<20
	TRH C29-C36	µg/L	200					<200	<200	0%	<100	0%	<200	<200	<20
	TRH C37-C40	µg/L	200					<200	<200	0%	N.A.	N.A.	<200	<200	<20
	TRH >C10-C16	µg/L	60					<60	<60	0%	<50	0%	<60	<60	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL		<60	<60	0%	<50	0%	<60	<60	<60
	TRH >C16-C34 (F3)	µg/L	500					<500	<500	0%	<100	0%	<500	<500	<50
	TRH >C34-C40 (F4)	µg/L	500					<500	<500	0%	<100	0%	<500	<500	<50
	TRH C10-C40	µg/L	320					<320	<320	0%	N.A.	N.A.	<320	<320	<32
	Benzene	µg/L	0.5	1	300	5000 / 5000	950	5.1	3.4	40%	1	134%	1.6	<0.5	<0.5
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	180	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	80	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5
	m/p-xylene	µg/L	1				75 / 200	<1	<1	0%	<2	0%	<1	<1	<1
	o-xylene	µg/L	0.5				350	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5
	Naphthalene (VOC)	µg/L	0.5			NL/NL	16	<0.5	<0.5	0%	<1	0%	<0.5	<0.5	<0.5
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	625	<1.5	<1.5	0%	N.A.	N.A.	<1.5	<1.5	<1.5
	Total BTEX	µg/L	3					5	3	50%	N.A.	N.A.	<3	<3	<3
	Benzene (F0)	µg/L	0.5			5000 / 5000		5.1	3.4	40%	N.A.	N.A.	1.6	<0.5	<0.5
	TRH C6-C9	µg/L	40					<40	<40	0%	<10	0%	<40	<40	<40
	TRH C6-C10	µg/L	50					<50	<50	0%	<10	0%	<50	<50	<50
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL		<50	<50	0%	<10	0%	<50	<50	<50
	Dichlorodifluoromethane (CFC-12)	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Chloromethane	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Chloroethane	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Trichlorofluoromethane	µg/L	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1-dichloroethene	µg/L	0.5	30	30			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		4000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Allyl chloride	µg/L	2					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	trans-1,2-dichloroethene	µg/L	0.5	60	60			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1-dichloroethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A

				Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	ANZG 2018 - 95% Protection for Freshwater Species	Groundwater Sampling Event 1 (Stage							
	ChemName	Units	EQL												
	cis-1,2-dichloroethene	µg/L	0.5	60	60			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Bromochloromethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Chloroform (THM)	µg/L	0.5	250	2		770	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	2,2-dichloropropane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2-dichloroethane	µg/L	0.5	3			1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1,1-trichloroethane	µg/L	0.5				270	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1-dichloropropene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Carbon tetrachloride	µg/L	0.5	3	13		240	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Dibromomethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2-dichloropropane	µg/L	0.5				900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Bromodichloromethane (THM)	µg/L	0.5	250	50			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	cis-1,3-dichloropropene	µg/L	0.5	100				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	trans-1,3-dichloropropene	µg/L	0.5	100				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1,2-trichloroethane	µg/L	0.5				6500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,3-dichloropropane	µg/L	0.5				1100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Dibromochloromethane (THM)	µg/L	0.5	250	50			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2-dibromoethane (EDB)	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1,1,2-tetrachloroethane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Chlorobenzene	µg/L	0.5	300/10**				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	cis-1,4-dichloro-2-butene	µg/L	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Bromoform (THM)	µg/L	0.5	250	50			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,1,2,2-tetrachloroethane	µg/L	0.5				400	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2,3-trichloropropane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	trans-1,4-dichloro-2-butene	µg/L	1					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Bromobenzene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	2-chlorotoluene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	4-chlorotoluene	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		260	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		60	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		160	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2-dibromo-3-chloropropane	µg/L	0.5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		170	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		10	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Iodomethane	µg/L	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Total Chlorinated Hydrocarbons	µg/L	10					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorobutanoic acid (PFBA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			220	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorononanoic acid (PFNA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorodecanoic acid (PFDA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				0.13	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorononane sulfonate (PFNS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A

						22/04/2021	22/04/2021	9/11/2021	9/11/2021		9/11/2021		9/11/2021	9/11/2021	9/11/2021	9/11/2021
						water	water	water	water		water		water	water	water	wat
			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m			Groundwater Sampling Event 2 (Stage 2)								
	ChemName	**Units**	**EQL**													
	Arsenic, As	µg/L	1	10	50		<1	N.A.	**1**	**1**	**0%**	**2**	**67%**	**1**	**1**	<1	<1
	Cadmium, Cd	µg/L	0.1	2	0.2		<0.1	N.A.	<0.1	<0.1	**0%**	<0.1	**0%**	<0.1	<0.1	<0.1	<0.
	Chromium, Cr	µg/L	1	50	2		<1	N.A.	<1	<1	**0%**	<1	**0%**	**1**	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		<1	N.A.	**6**	**3**	**67%**	**3**	**67%**	**12**	**4**	**2**	<1
	Lead, Pb	µg/L	1	10	1		<1	N.A.	<1	<1	**0%**	<1	**0%**	<1	<1	<1	<1
	Nickel, Ni	µg/L	1	20	25		<1	N.A.	**3**	**3**	**0%**	**3**	**0%**	**4**	**4**	**36**	<1
	Zinc, Zn	µg/L	5	3000**	5		<5	N.A.	**20**	**18**	**11%**	**16**	**22%**	**17**	**8**	<5	<5
	Mercury	mg/L	0.0001	1	0.1		<0.0001	N.A.	<0.0001	<0.0001	**0%**	<0.05	**0%**	<0.0001	<0.0001	<0.0001	<0.0
	Naphthalene	µg/L	0.5			NL/NL	<0.5	<0.5	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	2-methylnaphthalene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	1-methylnaphthalene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Acenaphthylene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Acenaphthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Fluorene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Phenanthrene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Anthracene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Fluoranthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Pyrene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Benzo(a)anthracene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Chrysene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Benzo(b&j)fluoranthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Benzo(k)fluoranthene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Benzo(a)pyrene	µg/L	0.1	0.01			<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Indeno(1,2,3-cd)pyrene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Dibenzo(ah)anthracene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Benzo(ghi)perylene	µg/L	0.1				<0.1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	Total PAH (18)	µg/L	1		3		<1	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	N.A
	TRH C10-C14	µg/L	50				<50	N.A.	<50	<50	**0%**	<50	**0%**	<50	<50	<50	<5
	TRH C15-C28	µg/L	200				<200	N.A.	<200	<200	**0%**	<100	**0%**	<200	<200	<200	<20
	TRH C29-C36	µg/L	200				<200	N.A.	<200	<200	**0%**	<100	**0%**	<200	<200	<200	<20
	TRH C37-C40	µg/L	200				<200	N.A.	<200	<200	**0%**	N.A.	**N.A.**	<200	<200	<200	<20
	TRH >C10-C16	µg/L	60				<60	N.A.	<60	<60	**0%**	<50	**0%**	<60	<60	<60	<6
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL	<60	N.A.	<60	<60	**0%**	<50	**0%**	<60	<60	<60	<6
	TRH >C16-C34 (F3)	µg/L	500				<500	N.A.	<500	<500	**0%**	<100	**0%**	<500	<500	<500	<50
	TRH >C34-C40 (F4)	µg/L	500				<500	N.A.	<500	<500	**0%**	<100	**0%**	<500	<500	<500	<50
	TRH C10-C40	µg/L	320				<320	N.A.	<320	<320	**0%**	N.A.	**N.A.**	<320	<320	<320	<32
	Benzene	µg/L	0.5	1	300	5000 / 5000	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
	m/p-xylene	µg/L	1				<1	<1	<5	<5	**0%**	<2	**0%**	<1	<1	<1	<1
	o-xylene	µg/L	0.5				<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
	Naphthalene (VOC)	µg/L	0.5			NL/NL	<0.5	<0.5	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	<1.5	<1.5	<7.5	<7.5	**0%**	N.A.	**N.A.**	<1.5	<1.5	<1.5	<1.
	Total BTEX	µg/L	3				<3	<3	<15	<15	**0%**	N.A.	**N.A.**	<3	<3	<3	<3
	Benzene (F0)	µg/L	0.5			5000 / 5000	<0.5	N.A.	<2.5	<2.5	**0%**	N.A.	**N.A.**	<0.5	<0.5	<0.5	<0.
	TRH C6-C9	µg/L	40				<40	N.A.	**630**	**590**	**7%**	**420**	**40%**	**150**	<40	<40	<4
	TRH C6-C10	µg/L	50				<50	N.A.	**650**	**610**	**6%**	**570**	**13%**	**160**	<50	<50	<5
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL	<50	N.A.	**650**	**610**	**6%**	**570**	**13%**	**160**	<50	<50	<5
	Dichlorodifluoromethane (CFC-12)	µg/L	5				N.A.	N.A.	<25	<25	**0%**	<10	**0%**	<5	<5	<5	<5
	Chloromethane	µg/L	5				N.A.	N.A.	<25	<25	**0%**	<10	**0%**	<5	<5	<5	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3			N.A.	N.A.	<1.5	<1.5	**0%**	<10	**0%**	<0.3	<0.3	<0.3	<0.
	Chloroethane	µg/L	5				N.A.	N.A.	<25	<25	**0%**	<10	**0%**	<5	<5	<5	<5
	Trichlorofluoromethane	µg/L	1				N.A.	N.A.	<5	<5	**0%**	<10	**0%**	<1	<1	<1	<1
	1,1-dichloroethene	µg/L	0.5	30	30		N.A.	N.A.	<2.5	<2.5	**0%**	<10	**0%**	<0.5	<0.5	<0.5	<0.
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		N.A.	N.A.	<25	<25	**0%**	N.A.	**N.A.**	<5	<5	<5	<5
	Allyl chloride	µg/L	2				N.A.	N.A.	<10	<10	**0%**	N.A.	**N.A.**	<2	<2	<2	<2
	trans-1,2-dichloroethene	µg/L	0.5	60	60		N.A.	N.A.	<2.5	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
	1,1-dichloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.

			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m			Groundwater Sampling Event 2 (Stage 2)								
ChemName	Units	EQL														
cis-1,2-dichloroethene	µg/L	0.5	60	60		N.A.	N.A.	**2.7**	**2.6**	**4%**	**2**	**30%**	**3.1**	**2.3**	<0.5	<0.
Bromochloromethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Chloroform (THM)	µg/L	0.5	250	2		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
2,2-dichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2-dichloroethane	µg/L	0.5	3			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,1,1-trichloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,1-dichloropropene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Carbon tetrachloride	µg/L	0.5	3	13		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Dibromomethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2-dichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		N.A.	N.A.	**13**	**12**	**8%**	**12**	**8%**	**9.3**	<0.5	<0.5	<0.
Bromodichloromethane (THM)	µg/L	0.5	250	50		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
cis-1,3-dichloropropene	µg/L	0.5	100			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
trans-1,3-dichloropropene	µg/L	0.5	100			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,1,2-trichloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,3-dichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Dibromochloromethane (THM)	µg/L	0.5	250	50		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2-dibromoethane (EDB)	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		N.A.	N.A.	**300**	**280**	**7%**	**400**	**29%**	**71**	**6.1**	<0.5	<0.
1,1,1,2-tetrachloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Chlorobenzene	µg/L	0.5	300/10**			N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
cis-1,4-dichloro-2-butene	µg/L	1				N.A.	N.A.	<5	<5	**0%**	N.A.	**N.A.**	<1	<1	<1	<1
Bromoform (THM)	µg/L	0.5	250	50		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,1,2,2-tetrachloroethane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2,3-trichloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
trans-1,4-dichloro-2-butene	µg/L	1				N.A.	N.A.	<5	<5	**0%**	N.A.	**N.A.**	<1	<1	<1	<1
Bromobenzene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
2-chlorotoluene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
4-chlorotoluene	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		N.A.	N.A.	<1.5	<1.5	**0%**	<1	**0%**	<0.3	<0.3	<0.3	<0.
1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2-dibromo-3-chloropropane	µg/L	0.5				N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Hexachlorobutadiene	µg/L	0.5	0.7	0.1		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		N.A.	N.A.	<2.5	<2.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.
Iodomethane	µg/L	5				N.A.	N.A.	<25	<25	**0%**	N.A.	N.A.	<5	<5	<5	<5
Total Chlorinated Hydrocarbons	µg/L	10				N.A.	N.A.	**310**	**300**	**3%**	N.A.	N.A.	**83**	<10	<10	<1
Perfluorobutanoic acid (PFBA)	µg/L	0.002				N.A.	N.A.	**0.008**	**0.007**	**13%**	**0.03**	**116%**	**0.008**	<0.002	<0.002	<0.0
Perfluoropentanoic acid (PFPeA)	µg/L	0.002				N.A.	N.A.	**0.008**	**0.008**	**0%**	**0.02**	**86%**	**0.041**	<0.002	<0.002	<0.0
Perfluorohexanoic acid (PFHxA)	µg/L	0.002				N.A.	N.A.	**0.005**	**0.004**	**22%**	**0.02**	**120%**	**0.023**	<0.002	<0.002	<0.0
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.01	**0%**	**0.002**	<0.002	<0.002	<0.0
Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			N.A.	N.A.	**0.006**	**0.005**	**18%**	**0.02**	**108%**	**0.022**	<0.002	<0.002	<0.0
Perfluorononanoic acid (PFNA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.01	**0%**	<0.004	<0.004	<0.004	<0.0
Perfluorodecanoic acid (PFDA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.02	**0%**	<0.004	<0.004	<0.004	<0.0
Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.02	**0%**	<0.004	<0.004	<0.004	<0.0
Perfluorododecanoic acid (PFDoA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.05	**0%**	<0.004	<0.004	<0.004	<0.0
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.1	**0%**	<0.004	<0.004	<0.004	<0.0
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	<0.5	**0%**	<0.004	<0.004	<0.004	<0.0
Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				N.A.	N.A.	<0.008	<0.008	**0%**	N.A.	N.A.	<0.008	<0.008	<0.008	<0.0
Perfluorobutane sulfonate (PFBS)	µg/L	0.004				N.A.	N.A.	**0.005**	**0.005**	**0%**	N.A.	N.A.	**0.008**	<0.004	<0.004	<0.0
Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				N.A.	N.A.	<0.004	<0.004	**0%**	N.A.	N.A.	<0.004	<0.004	<0.004	<0.0
Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				N.A.	N.A.	**0.004**	**0.004**	**0%**	**0.02**	**133%**	**0.006**	**0.003**	<0.002	<0.0
Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.01	**0%**	<0.002	<0.002	<0.002	<0.0
Perfluorooctane sulfonate (PFOS)	µg/L	0.002				N.A.	N.A.	**0.003**	**0.002**	**40%**	**0.03**	**164%**	**0.009**	<0.002	<0.002	<0.0
Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			N.A.	N.A.	**0.007**	**0.007**	**0%**	**0.05**	**151%**	**0.015**	**0.003**	<0.002	<0.0
Perfluorononane sulfonate (PFNS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002	<0.0
Perfluorodecane sulfonate (PFDS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002	<0.0
Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	N.A.	N.A.	<0.002	<0.002	<0.002	<0.0
1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.01	**0%**	<0.002	<0.002	<0.002	<0.0
1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				N.A.	N.A.	**0.01**	**0.009**	**11%**	**0.02**	**67%**	<0.002	<0.002	<0.002	<0.0
1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				N.A.	N.A.	<0.002	<0.002	**0%**	<0.02	**0%**	<0.002	<0.002	<0.002	<0.0
Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				N.A.	N.A.	<0.008	<0.008	**0%**	N.A.	N.A.	<0.008	<0.008	<0.008	<0.0
N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.05	**0%**	<0.01	<0.01	<0.01	<0.0
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.1	**0%**	<0.01	<0.01	<0.01	<0.0
2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.05	**0%**	<0.01	<0.01	<0.01	<0.0
2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				N.A.	N.A.	<0.01	<0.01	**0%**	<0.5	**0%**	<0.01	<0.01	<0.01	<0.0

						19/1/2022		19/1/2022		19/1/2022	19/1/2022	19/1/2022	19/1/2022	20/1/2022	29/3/2022
						water		water		water	water	water	water	water	water
			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	Groundwater Sampling Event 3 (Stage 3)									
	ChemName	**Units**	**EQL**												
	Arsenic, As	µg/L	1	10	50	**2**	**67%**	**1**	**0%**	**2**	**3**	**3**	<1	N.A.	**1**
	Cadmium, Cd	µg/L	0.1	2	0.2	<0.1	**N.A.**	<0.1	**N.A.**	**0.1**	**1**	<0.1	<0.1	N.A.	<0.1
	Chromium, Cr	µg/L	1	50	2	<1	**0%**	<1	**0%**	<1	<1	**2**	<1	N.A.	<1
	Copper, Cu	µg/L	1	2000	2	**1**	**173%**	<1	**N.A.**	**47**	**17**	**61**	<1	N.A.	**2**
	Lead, Pb	µg/L	1	10	1	<1	**0%**	<1	**0%**	<1	<1	<1	<1	N.A.	<1
	Nickel, Ni	µg/L	1	20	25	**2**	**173%**	**2**	**173%**	**7**	**100**	**65**	<1	N.A.	**32**
	Zinc, Zn	µg/L	5	3000**	5	<5	**N.A.**	**2**	**153%**	**67**	**220**	**640**	<5	N.A.	**11**
	Mercury	mg/L	0.0001	1	0.1	<0.0001	**0%**	<0.05	**0%**	<0.0001	<0.0001	<0.0001	<0.0001	N.A.	<0.0001
	Naphthalene	µg/L	0.5		NL/NL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-methylnaphthalene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1-methylnaphthalene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthylene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluorene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Phenanthrene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Anthracene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluoranthene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Pyrene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)anthracene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chrysene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(b&j)fluoranthene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(k)fluoranthene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)pyrene	µg/L	0.1	0.01		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibenzo(ah)anthracene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(ghi)perylene	µg/L	0.1			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total PAH (18)	µg/L	1		3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TRH C10-C14	µg/L	50			<50	**0%**	<50	**0%**	<50	<50	<50	<50	N.A.	<50
	TRH C15-C28	µg/L	200			<200	**0%**	<100	**0%**	<200	<200	<200	<200	N.A.	<200
	TRH C29-C36	µg/L	200			<200	**0%**	<100	**0%**	<200	<200	<200	<200	N.A.	<200
	TRH C37-C40	µg/L	200			<200	**0%**	N.A.	N.A.	<200	<200	<200	<200	N.A.	<200
	TRH >C10-C16	µg/L	60			<60	**0%**	<50	**0%**	<60	<60	<60	<60	N.A.	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60		NL/NL	<60	**0%**	<50	**0%**	<60	<60	<60	<60	N.A.	<60
	TRH >C16-C34 (F3)	µg/L	500			<500	**0%**	<100	**0%**	<500	<500	<500	<500	N.A.	<500
	TRH >C34-C40 (F4)	µg/L	500			<500	**0%**	<100	**0%**	<500	<500	<500	<500	N.A.	<500
	TRH C10-C40	µg/L	320			<320	**0%**	N.A.	N.A.	<320	<320	<320	<320	N.A.	<320
	Benzene	µg/L	0.5	1	300	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	µg/L	0.5	800 / 25**	300	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	m/p-xylene	µg/L	1			<1	**0%**	<2	**0%**	<1	<1	<1	<1	<1	<1
	o-xylene	µg/L	0.5			<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Naphthalene (VOC)	µg/L	0.5		NL/NL	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Total Xylenes	µg/L	1.5	600 / 20**	NL/NL	<1.5	**0%**	N.A.	N.A.	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	Total BTEX	µg/L	3			<3	**0%**	N.A.	N.A.	<3	<3	<3	<3	<3	<3
	Benzene (F0)	µg/L	0.5		5000 / 5000	<0.5	**0%**	N.A.	N.A.	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
	TRH C6-C9	µg/L	40			<40	**0%**	<10	**0%**	**360**	<40	<40	<40	N.A.	**690**
	TRH C6-C10	µg/L	50			<50	**0%**	<10	**0%**	**360**	<50	<50	<50	N.A.	**690**
	TRH C6-C10 minus BTEX (F1)	µg/L	50		NL/NL	<50	**0%**	<10	**0%**	**360**	<50	<50	<50	N.A.	**690**
	Dichlorodifluoromethane (CFC-12)	µg/L	5			<5	**0%**	<10	**0%**	<5	<5	<5	<5	N.A.	<5
	Chloromethane	µg/L	5			<5	**0%**	<10	**0%**	<5	<5	<5	<5	N.A.	<5
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3		<0.3	**0%**	<10	**0%**	<0.3	<0.3	<0.3	<0.3	N.A.	<0.3
	Chloroethane	µg/L	5			<5	**0%**	<10	**0%**	<5	<5	<5	<5	N.A.	<5
	Trichlorofluoromethane	µg/L	1			<1	**0%**	<10	**0%**	<1	<1	<1	<1	N.A.	<1
	1,1-dichloroethene	µg/L	0.5	30	30	<0.5	**0%**	<10	**0%**	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
	Dichloromethane (Methylene chloride)	µg/L	5	4	98	<5	**0%**	N.A.	N.A.	<5	<5	<5	<5	N.A.	<5
	Allyl chloride	µg/L	2			<2	**0%**	N.A.	N.A.	<2	<2	<2	<2	N.A.	<2
	trans-1,2-dichloroethene	µg/L	0.5	60	60	<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
	1,1-dichloroethane	µg/L	0.5			<0.5	**0%**	<1	**0%**	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5

			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m	Groundwater Sampling Event 3 (Stage 3)									
ChemName	Units	EQL													
cis-1,2-dichloroethene	µg/L	0.5	60	60		9.9	6%	8	15%	92	<0.5	<0.5	<0.5	N.A.	3.3
Bromochloromethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Chloroform (THM)	µg/L	0.5	250	2		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
2,2-dichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2-dichloroethane	µg/L	0.5	3			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,1,1-trichloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,1-dichloropropene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Carbon tetrachloride	µg/L	0.5	3	13		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Dibromomethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2-dichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		<0.5	0%	<1	0%	61	<0.5	<0.5	<0.5	N.A.	14
Bromodichloromethane (THM)	µg/L	0.5	250	50		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
cis-1,3-dichloropropene	µg/L	0.5	100			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
trans-1,3-dichloropropene	µg/L	0.5	100			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,1,2-trichloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,3-dichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Dibromochloromethane (THM)	µg/L	0.5	250	50		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2-dibromoethane (EDB)	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		<0.5	0%	<1	0%	89	<0.5	<0.5	<0.5	N.A.	420
1,1,1,2-tetrachloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Chlorobenzene	µg/L	0.5	300/10**			<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
cis-1,4-dichloro-2-butene	µg/L	1				<1	0%	N.A.	N.A.	<1	<1	<1	<1	N.A.	<1
Bromoform (THM)	µg/L	0.5	250	50		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,1,2,2-tetrachloroethane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2,3-trichloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
trans-1,4-dichloro-2-butene	µg/L	1				<1	0%	N.A.	N.A.	<1	<1	<1	<1	N.A.	<1
Bromobenzene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
2-chlorotoluene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
4-chlorotoluene	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		<0.3	0%	<1	0%	<0.3	<0.3	<0.3	<0.3	N.A.	<0.3
1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2-dibromo-3-chloropropane	µg/L	0.5				<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Hexachlorobutadiene	µg/L	0.5	0.7	0.1		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		<0.5	0%	<1	0%	<0.5	<0.5	<0.5	<0.5	N.A.	<0.5
Iodomethane	µg/L	5				<5	0%	N.A.	N.A.	<5	<5	<5	<5	N.A.	<5
Total Chlorinated Hydrocarbons	µg/L	10				<10	0%	N.A.	N.A.	240	<10	<10	<10	N.A.	440
Perfluorobutanoic acid (PFBA)	µg/L	0.002				<0.002	N.A.	<0.02	0%	0.003	0.32	<0.002	<0.002	N.A.	0.013
Perfluoropentanoic acid (PFPeA)	µg/L	0.002				0.027	4%	0.04	42%	0.015	2.4	0.011	<0.002	N.A.	0.011
Perfluorohexanoic acid (PFHxA)	µg/L	0.002				0.028	11%	0.04	46%	0.013	4.1	0.018	<0.002	N.A.	0.009
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				0.008	13%	0.02	96%	0.005	0.22	0.004	<0.002	N.A.	0.003
Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			0.017	21%	0.04	62%	0.018	0.009	0.011	<0.002	N.A.	0.013
Perfluorononanoic acid (PFNA)	µg/L	0.004				<0.004	0%	<0.01	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004
Perfluorodecanoic acid (PFDA)	µg/L	0.004				<0.004	0%	<0.02	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004
Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				<0.004	0%	<0.02	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004
Perfluorododecanoic acid (PFDoA)	µg/L	0.004				<0.004	0%	<0.05	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				<0.004	0%	<0.1	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				<0.004	0%	<0.5	0%	<0.004	<0.004	<0.004	<0.004	N.A.	<0.004
Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				<0.008	0%	N.A.	0%	<0.008	<0.008	<0.008	<0.008	N.A.	<0.008
Perfluorobutane sulfonate (PFBS)	µg/L	0.004				0.01	0%	N.A.	0%	0.008	0.11	0.006	<0.004	N.A.	0.004
Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				<0.004	0%	N.A.	0%	<0.004	0.013	<0.004	<0.004	N.A.	<0.004
Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				0.021	32%	0.04	32%	0.019	<0.002	<0.002	<0.002	N.A.	0.019
Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				<0.002	0%	<0.01	0%	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002
Perfluorooctane sulfonate (PFOS)	µg/L	0.002				0.057	71%	0.05	60%	0.005	<0.002	0.017	<0.002	N.A.	0.025
Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			0.078	33%	0.09	47%	0.024	<0.002	0.017	<0.002	N.A.	0.044
Perfluorononane sulfonate (PFNS)	µg/L	0.002				<0.002	0%	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002
Perfluorodecane sulfonate (PFDS)	µg/L	0.002				<0.002	0%	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002
Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				<0.002	0%	N.A.	N.A.	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002
1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				<0.002	0%	<0.01	0%	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002
1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				<0.002	0%	<0.01	0%	<0.002	<0.002	<0.002	<0.002	N.A.	0.11
1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				<0.002	0%	<0.02	0%	<0.002	<0.002	<0.002	<0.002	N.A.	<0.002
Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				<0.008	0%	N.A.	N.A.	<0.008	<0.008	<0.008	<0.008	N.A.	<0.008
N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				<0.01	0%	<0.05	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				<0.01	0%	<0.1	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01
2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				<0.01	0%	<0.05	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01
2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				<0.01	0%	<0.5	0%	<0.01	<0.01	<0.01	<0.01	N.A.	<0.01

						29/3/2022	30/3/2022	30/3/2022	29/3/2022	28/3/2022	28/3/2022		31/3/2022				
						water	Water	water	water	water	water		water				
			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m												Ground
	ChemName	**Units**	**EQL**														
	Arsenic, As	µg/L	1	10	50		**1**	<1	<1	<1	**2**	**2**	**0%**	**2**	**0%**		
	Cadmium, Cd	µg/L	0.1	2	0.2		<0.1	**0.3**	<0.1	<0.1	<0.1	<0.1	**0%**	<0.1	**0%**		
	Chromium, Cr	µg/L	1	50	2		<1	<1	<1	<1	<1	<1	**0%**	<1	**0%**		
	Copper, Cu	µg/L	1	2000	2		**2**	**28**	<1	**2**	**1**	<1	**N.A.**	<1	**N.A.**		
	Lead, Pb	µg/L	1	10	1		<1	<1	<1	<1	<1	<1	**0%**	<1	**0%**		
	Nickel, Ni	µg/L	1	20	25		**35**	**140**	<1	**23**	**2**	**2**	**0%**	**2**	**0%**		
	Zinc, Zn	µg/L	5	3000**	5		<5	**310**	<5	**7**	<5	<5	**0%**	**2**	**N.A.**		
	Mercury	mg/L	0.0001	1	0.1		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	**0%**	<0.05	**0%**		
	Naphthalene	µg/L	0.5			NL/NL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	2-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	1-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Acenaphthylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Acenaphthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Fluorene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Phenanthrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Benzo(a)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Chrysene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Benzo(b&j)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Benzo(k)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Benzo(a)pyrene	µg/L	0.1	0.01			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Indeno(1,2,3-cd)pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Dibenzo(ah)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Benzo(ghi)perylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	Total PAH (18)	µg/L	1		3		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
	TRH C10-C14	µg/L	50				<50	<50	<50	<50	<50	<50	**0%**	<50	**0%**		
	TRH C15-C28	µg/L	200				<200	<200	<200	<200	<200	<200	**0%**	<100	**0%**		
	TRH C29-C36	µg/L	200				<200	<200	<200	<200	<200	<200	**0%**	<100	**0%**		
	TRH C37-C40	µg/L	200				<200	<200	<200	<200	<200	<200	**0%**	N.A.	N.A.		
	TRH >C10-C16	µg/L	60				<60	<60	<60	<60	<60	<60	**0%**	<50	**0%**		
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL	<60	<60	<60	<60	<60	<60	**0%**	<50	**0%**		
	TRH >C16-C34 (F3)	µg/L	500				<500	<500	<500	<500	<500	<500	**0%**	<100	**0%**		
	TRH >C34-C40 (F4)	µg/L	500				<500	<500	<500	<500	<500	<500	**0%**	<100	**0%**		
	TRH C10-C40	µg/L	320				<320	<320	<320	<320	<320	<320	**0%**	N.A.	N.A.		
	Benzene	µg/L	0.5	1	300	5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		
	m/p-xylene	µg/L	1				<1	<1	<1	<1	<1	<1	**0%**	<2	**0%**		
	o-xylene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		
	Naphthalene (VOC)	µg/L	0.5			NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	**0%**	N.A.	N.A.		
	Total BTEX	µg/L	3				<3	<3	<3	<3	<3	<3	**0%**	N.A.	N.A.		
	Benzene (F0)	µg/L	0.5			5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	N.A.	N.A.		
	TRH C6-C9	µg/L	40				<40	<40	<40	<40	<40	<40	**0%**	**15**	N.A.		
	TRH C6-C10	µg/L	50				<50	<50	<50	<50	<50	<50	**0%**	**15**	N.A.		
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL	<50	<50	<50	<50	<50	<50	**0%**	**15**	N.A.		
	Dichlorodifluoromethane (CFC-12)	µg/L	5				<5	<5	<5	<5	<5	<5	**0%**	<10	**0%**		
	Chloromethane	µg/L	5				<5	<5	<5	<5	<5	<5	**0%**	<10	**0%**		
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3			<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0%**	<10	**0%**		
	Chloroethane	µg/L	5				<5	<5	<5	<5	<5	<5	**0%**	<10	**0%**		
	Trichlorofluoromethane	µg/L	1				<1	<1	<1	<1	<1	<1	**0%**	<10	**0%**		
	1,1-dichloroethene	µg/L	0.5	30	30		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<10	**0%**		
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		<5	<5	<5	<5	<5	<5	**0%**	N.A.	N.A.		
	Allyl chloride	µg/L	2				<2	<2	<2	<2	<2	<2	**0%**	N.A.	N.A.		
	trans-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		
	1,1-dichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**		

	ChemName	Units	EQL	Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m									Ground
	cis-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	**3**	**9.7**	**9.8**	**1%**	**10**	**3%**
	Bromochloromethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Chloroform (THM)	µg/L	0.5	250	2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	2,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2-dichloroethane	µg/L	0.5	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,1,1-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,1-dichloropropene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Carbon tetrachloride	µg/L	0.5	3	13		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Dibromomethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Bromodichloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	cis-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	trans-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,1,2-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,3-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Dibromochloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2-dibromoethane (EDB)	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		**1.2**	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,1,1,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Chlorobenzene	µg/L	0.5	300/10**			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	cis-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	**0%**	N.A.	N.A.
	Bromoform (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,1,2,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2,3-trichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	trans-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	**0%**	N.A.	N.A.
	Bromobenzene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	2-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	4-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**0%**	<1	**0%**
	1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2-dibromo-3-chloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Hexachlorobutadiene	µg/L	0.5	0.7	0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0%**	<1	**0%**
	Iodomethane	µg/L	5				<5	<5	<5	<5	<5	<5	**0%**	N.A.	N.A.
	Total Chlorinated Hydrocarbons	µg/L	10				<10	<10	<10	<10	<10	**10**	**N.A.**	N.A.	N.A.
	Perfluorobutanoic acid (PFBA)	µg/L	0.002				**0.003**	<0.002	<0.002	**0.01**	**0.015**	**0.013**	**14%**	<0.02	N.A.
	Perfluoropentanoic acid (PFPeA)	µg/L	0.002				<0.002	<0.002	<0.002	**0.009**	**0.042**	**0.044**	**5%**	**0.05**	**17%**
	Perfluorohexanoic acid (PFHxA)	µg/L	0.002				<0.002	<0.002	<0.002	**0.007**	**0.04**	**0.038**	**5%**	**0.05**	**22%**
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				<0.002	<0.002	<0.002	**0.003**	**0.012**	**0.013**	**8%**	**0.02**	**50%**
	Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			**0.003**	<0.002	<0.002	**0.009**	**0.035**	**0.036**	**3%**	**0.04**	**13%**
	Perfluorononanoic acid (PFNA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.01	**0%**
	Perfluorodecanoic acid (PFDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.02	**0%**
	Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.02	**0%**
	Perfluorododecanoic acid (PFDoA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.05	**0%**
	Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.1	**0%**
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0%**	<0.5	**0%**
	Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	**0%**	N.A.	N.A.
	Perfluorobutane sulfonate (PFBS)	µg/L	0.004				<0.004	<0.004	<0.004	**0.022**	**0.013**	**0.011**	**17%**	**0.02**	**42%**
	Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				<0.004	<0.004	<0.004	**0.01**	**0.006**	**0.005**	**18%**	<0.01	N.A.
	Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				**0.01**	**0.004**	<0.002	**0.02**	**0.038**	**0.031**	**0%**	**0.05**	**27%**
	Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.01	**0%**
	Perfluorooctane sulfonate (PFOS)	µg/L	0.002				**0.013**	<0.002	<0.002	**0.01**	**0.047**	**0.043**	**0%**	**0.06**	**24%**
	Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			**0.023**	**0.004**	<0.002	**0.03**	**0.085**	**0.073**	**15%**	**0.11**	**26%**
	Perfluorononane sulfonate (PFNS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	N.A.	N.A.
	Perfluorodecane sulfonate (PFDS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.02	**0%**
	Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	N.A.	N.A.
	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.01	**0%**
	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				**0.028**	**0.064**	<0.002	**0.059**	**0.019**	**0.021**	**10%**	**0.05**	**90%**
	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0%**	<0.02	**0%**
	Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	**0%**	<0.1	**0%**
	N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.05	**0%**
	N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.1	**0%**
	2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.05	**0%**
	2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0%**	<0.5	**0%**

						29/3/2022	1/4/2022	30/3/2022	30/3/2022	30/3/2022	30/3/2022	28/3/2022	28/3/2022	31/3/2022
						water	water	water	water	water	water	water	water	water
	ChemName	Units	EQL	Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m								
	Arsenic, As	µg/L	1	10	50		**1**	<1	<1	<1	<1	<1	**1**	<1	<1
	Cadmium, Cd	µg/L	0.1	2	0.2		<0.1	**0.3**	<0.1	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1
	Chromium, Cr	µg/L	1	50	2		<1	<1	<1	<1	**3**	<1	<1	<1	<1
	Copper, Cu	µg/L	1	2000	2		**1**	**49**	<1	**2**	**3**	**4**	**3**	<1	**2**
	Lead, Pb	µg/L	1	10	1		<1	**2**	<1	<1	<1	<1	<1	<1	<1
	Nickel, Ni	µg/L	1	20	25		**48**	**59**	**24**	**35**	**180**	**69**	**110**	<1	**59**
	Zinc, Zn	µg/L	5	3000**	5		**41**	**180**	**10**	**54**	**29**	**110**	**38**	<5	**15**
	Mercury	mg/L	0.0001	1	0.1		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Naphthalene	µg/L	0.5			NL/NL	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	2-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	1-methylnaphthalene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Acenaphthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluorene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Phenanthrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Chrysene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(b&j)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(k)fluoranthene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(a)pyrene	µg/L	0.1	0.01			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Indeno(1,2,3-cd)pyrene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Dibenzo(ah)anthracene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Benzo(ghi)perylene	µg/L	0.1				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Total PAH (18)	µg/L	1		3		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TRH C10-C14	µg/L	50				<50	<50	<50	<50	<50	<50	<50	<50	<50
	TRH C15-C28	µg/L	200				<200	<200	<200	<200	<200	<200	<200	<200	<200
	TRH C29-C36	µg/L	200				<200	<200	<200	<200	<200	<200	<200	<200	<200
	TRH C37-C40	µg/L	200				<200	<200	<200	<200	<200	<200	<200	<200	<200
	TRH >C10-C16	µg/L	60				<60	<60	<60	<60	<60	<60	<60	<60	<60
	TRH >C10-C16 - Naphthalene (F2)	µg/L	60			NL/NL	<60	<60	<60	<60	<60	<60	<60	<60	<60
	TRH >C16-C34 (F3)	µg/L	500				<500	<500	<500	<500	<500	<500	<500	<500	<500
	TRH >C34-C40 (F4)	µg/L	500				<500	<500	<500	<500	<500	<500	<500	<500	<500
	TRH C10-C40	µg/L	320				<320	<320	<320	<320	<320	<320	<320	<320	<320
	Benzene	µg/L	0.5	1	300	5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	Toluene	µg/L	0.5	800 / 25**	300	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	Ethylbenzene	µg/L	0.5	300 / 3 **	140	NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	m/p-xylene	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10
	o-xylene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	Naphthalene (VOC)	µg/L	0.5			NL/NL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	Total Xylenes	µg/L	1.5	600 / 20**		NL/NL	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<15
	Total BTEX	µg/L	3				<3	<3	<3	<3	<3	<3	<3	<3	<30
	Benzene (F0)	µg/L	0.5			5000 / 5000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	TRH C6-C9	µg/L	40				<40	<40	<40	<40	<40	**66**	<40	<40	**1500**
	TRH C6-C10	µg/L	50				<50	<50	<50	<50	<50	**70**	<50	<50	**1600**
	TRH C6-C10 minus BTEX (F1)	µg/L	50			NL/NL	<50	<50	<50	<50	<50	**70**	<50	<50	**1600**
	Dichlorodifluoromethane (CFC-12)	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50
	Chloromethane	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50
	Vinyl chloride (Chloroethene)	µg/L	0.3	0.3			<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<3
	Chloroethane	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50
	Trichlorofluoromethane	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10
	1,1-dichloroethene	µg/L	0.5	30	30		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	Dichloromethane (Methylene chloride)	µg/L	5	4	98		<5	<5	<5	<5	<5	<5	<5	<5	<50
	Allyl chloride	µg/L	2				<2	<2	<2	<2	<2	<2	<2	<2	<20
	trans-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
	1,1-dichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5

			Australian Drinking Water Guideline 2011 (version 3.7 updated January 2022)	AQUA/4 Environment Protection Regulation 2005	ASC NEPM (2013) HSL A 2m to <4m / 4m to <8m									
ChemName	Units	EQL												
cis-1,2-dichloroethene	µg/L	0.5	60	60		<0.5	<0.5	<0.5	<0.5	**2**	**14**	<0.5	<0.5	**370**
Bromochloromethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Chloroform (THM)	µg/L	0.5	250	2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
2,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2-dichloroethane	µg/L	0.5	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,1,1-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,1-dichloropropene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Carbon tetrachloride	µg/L	0.5	3	13		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Dibromomethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5		0.02		<0.5	<0.5	<0.5	<0.5	**2.4**	**9.4**	<0.5	<0.5	**300**
Bromodichloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
cis-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
trans-1,3-dichloropropene	µg/L	0.5	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,1,2-trichloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,3-dichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Dibromochloromethane (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2-dibromoethane (EDB)	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	50	260		<0.5	<0.5	<0.5	<0.5	**7.5**	**23**	<0.5	<0.5	**470**
1,1,1,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Chlorobenzene	µg/L	0.5	300/10**			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
cis-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10
Bromoform (THM)	µg/L	0.5	250	50		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,1,2,2-tetrachloroethane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2,3-trichloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
trans-1,4-dichloro-2-butene	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<10
Bromobenzene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
2-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
4-chlorotoluene	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,3-dichlorobenzene	µg/L	0.5	20 **	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,4-dichlorobenzene	µg/L	0.3	40 / 0.3**	4		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<3
1,2-dichlorobenzene	µg/L	0.5	1,500 / 1**	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2-dibromo-3-chloropropane	µg/L	0.5				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2,4-trichlorobenzene	µg/L	0.5	30 / 5**	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Hexachlorobutadiene	µg/L	0.5	0.7	0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
1,2,3-trichlorobenzene	µg/L	0.5	30 / 5**	0.9		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5
Iodomethane	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<50
Total Chlorinated Hydrocarbons	µg/L	10				<10	<10	<10	<10	**12**	**47**	<10	<10	**1200**
Perfluorobutanoic acid (PFBA)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	**0.002**	**0.033**	<0.002	**0.003**
Perfluoropentanoic acid (PFPeA)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	**0.002**	**0.032**	<0.002	**0.007**
Perfluorohexanoic acid (PFHxA)	µg/L	0.002				<0.002	**0.005**	<0.002	<0.002	<0.002	**0.002**	**0.033**	<0.002	**0.006**
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.014	<0.002	<0.002
Perfluorooctanoic Acid (PFOA)	µg/L	0.001	0.56 / 10*			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.1**	<0.002	<0.002
Perfluorononanoic acid (PFNA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Perfluorodecanoic acid (PFDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Perfluoroundecanoic acid (PFUnA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Perfluorododecanoic acid (PFDoA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Perfluorohexadecanoic acid (PFHxDA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Perfluorobutane sulfonate (PFBS)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0.01**	<0.004	<0.004
Perfluoropentane sulfonate (PFPeS)	µg/L	0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.01	<0.004	<0.004
Perfluorohexane sulfonate (PFHxS)	µg/L	0.002				**0.005**	**0.008**	**0.006**	**0.004**	**0.006**	**0.005**	**0.087**	<0.002	**0.014**
Perfluoroheptane sulfonate (PFHpS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonate (PFOS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.068**	<0.002	<0.002
Sum of PFHxS and PFOS	µg/L	0.002	0.07 / 2*			**0.005**	**0.008**	**0.006**	**0.004**	**0.006**	**0.005**	**0.15**	<0.002	**0.014**
Perfluorononane sulfonate (PFNS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorodecane sulfonate (PFDS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorododecane sulfonate (PFDoS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1H,1H,2H,2H-Perfluorohexane sulfonate (4:2) (4:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1H,1H,2H,2H-Perfluorooctane sulfonate (6:2) (6:2 FTS)	µg/L	0.002				**0.018**	**0.056**	**0.019**	**0.006**	**0.11**	**0.035**	**0.018**	<0.002	**0.016**
1H,1H,2H,2H-Perfluorodecane sulfonate (8:2) (8:2 FTS)	µg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonamide (PFOSA)	µg/L	0.008				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
N-Methylperfluorooctane sulfonamide (N-MeFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-(N-Methylperfluorooctane sulfonamido)-ethanol (N-MeFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-(N-Ethylperfluorooctane sulfonamido)-ethanol (N-EtFOSE)	µg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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Table 3: Soil Vapour Analytical Results

								Field_ID	SV01s	SV01d	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	SV02s	Carbon Tube 1
								Sampled-date	09/11/2021	09/11/2021	09/11/2021		09/11/2021		09/11/2021	09/11/2021
								Sample type	vapour	vapour	vapour		vapour		vapour	
				ASC NEPM (2013) HSLD (µg/m³) 0.0-1.0m / 1.0-2.0m / 2.0-4.0m / 4.0-8.0m	ASC NEPM (2013) HSL A (µg/m³) 0.0-1.0m / 1.0-2.0m / 2.0-4.0m / 4.0-8.0m	ASC NEPM (2013) HIL D (µg/m³) 0.0-1.0m	ASC NEPM (2013) HIL A (µg/m³) 0.0-1.0m	Soil Vapour Sampling Event 1 (Stage 2)								
Method_Type	ChemName	Units	EQL													
US EPA Compendium Methods TO-14a/TO-15	Propylene	µg/m³	0.9					3700	1200	900	29%	N.A.	N.A.	5000	N.A.
	Dichlorodifluoromethane	µg/m³	2.5					<250	<250	<250	0%	N.A.	N.A.	<25	N.A.
	Chloromethane	µg/m³	1.0					<100	<100	<100	0%	<2900	N.A.	<10	N.A.
	1,2-Dichlorotetrafluoroethane	µg/m³	2.5					<250	<250	<250	0%	N.A.	N.A.	<25	N.A.
	Vinyl chloride	µg/m³	1.3			100	30	<130	<130	<130	0%	<1600	N.A.	<13	N.A.
	1,3-Butadiene	µg/m³	1.1					<110	<110	<110	0%	<1200	N.A.	<11	N.A.
	Bromomethane	µg/m³	1.9					<190	<190	<190	0%	<3700	N.A.	<19	N.A.
	Chloroethane	µg/m³	1.3					<130	<130	<130	0%	<2500	N.A.	<13	N.A.
	Acrolein	µg/m³	11					<1100	<1100	<1100	0%	<2900	N.A.	<110	N.A.
	Acetone	µg/m³	11.9					<1190	<1190	<1190	0%	N.A.	N.A.	<119	N.A.
	Ethanol	µg/m³	9					<900	<900	<900	0%	N.A.	N.A.	<90	N.A.
	Isopropyl Alcohol (2-propanol)	µg/m³	12					<1200	<1200	<1200	0%	N.A.	N.A.	<120	N.A.
	Isopropyl Alcohol* (tube)	µg/m3	5					N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	120000000
	Trichlorofluoromethane(Freon 11)	µg/m³	2.8					<280	<280	<280	0%	N.A.	N.A.	<28	N.A.
	1,1-Dichloroethene (DCE)	µg/m³	2.0					<200	<200	<200	0%	<2500	N.A.	<20	N.A.
	Methylene chloride(Dichloromethane)	µg/m³	17					<1700	<1700	<1700	0%	N.A.	N.A.	<170	N.A.
	1,1,2-Trichlorotrifluoroethane	µg/m³	3.8					<380	<380	<380	0%	N.A.	N.A.	<38	N.A.
	Carbon Disulfide	µg/m³	16					<1600	<1600	<1600	0%	N.A.	N.A.	<160	N.A.
	trans-1,2-dichloroethene (DCE)	µg/m³	2.0					<200	<200	<200	0%	<2500	N.A.	<20	N.A.
	1,1-Dichloroethane	µg/m³	2.0					<200	<200	<200	0%	<2900	N.A.	<20	N.A.
	Methyl-tert-butylether (MTBE)	µg/m³	1.8					<180	<180	<180	0%	<2500	N.A.	<18	N.A.
	Vinyl Acetate	µg/m³	1.8					<180	<180	<180	0%	<2900	N.A.	<18	N.A.
	2-Butanone (MEK)	µg/m³	15					<1500	<1500	<1500	0%	<2100	N.A.	**360**	N.A.
	cis-1,2-Dichloroethene (DCE)	µg/m³	2.0			300	80	<200	<200	<200	0%	<3300	N.A.	**78**	N.A.
	Hexane	µg/m³	1.8					**400**	**190**	<180	N.A.	<2500	N.A.	**410**	N.A.
	Chloroform	µg/m³	2.4					<240	<240	<240	0%	<3700	N.A.	**100**	N.A.
	Ethyl Acetate	µg/m³	1.8					<180	<180	<180	0%	<3300	N.A.	<18	N.A.
	Tetrahydrofuran	µg/m³	1.5					**4800**	**6900**	**5700**	19%	<1600	N.A.	**27000**	N.A.
	1,2-Dichloroethane	µg/m³	2.0					<200	<200	<200	0%	<4100	N.A.	<20	N.A.
	1,1,1-Trichloroethane	µg/m³	2.7			230000	60000	<270	<270	<270	0%	<3300	N.A.	<27	N.A.
	Benzene	µg/m³	1.6		1000 / 15000 / 40000 / 90000			<160	<160	<160	0%	<2100	N.A.	**23**	N.A.
	Carbon tetrachloride	µg/m³	3.1					<310	<310	<310	0%	<4100	N.A.	<31	N.A.
	Cyclohexane	µg/m³	1.7					<170	<170	<170	0%	<1600	N.A.	<17	N.A.
	1,2-Dichloropropane	µg/m³	2.3					<230	<230	<230	0%	<7400	N.A.	<23	N.A.
	Bromodichloromethane	µg/m³	3.4					<340	<340	<340	0%	<4100	N.A.	<34	N.A.
	Trichloroethene (TCE)	µg/m³	2.7			80	20	<270	**2000**	**1400**	35%	<3700	N.A.	<27	N.A.
	1,4-Dioxane	µg/m³	1.8					<180	<180	<180	0%	<2500	N.A.	<18	N.A.
	Heptane	µg/m³	2.0					<200	<200	<200	0%	<2900	N.A.	**130**	N.A.
	Methyl Methacrylate	µg/m³	2.0					<200	<200	<200	0%	<2900	N.A.	<20	N.A.
	cis-1,3-Dichloropropene	µg/m³	2.3					<230	<230	<230	0%	<2500	N.A.	<23	N.A.
	4-Methyl-2-pentanone (MIBK)	µg/m³	20					<2000	<2000	<2000	0%	<2500	N.A.	<200	N.A.
	trans-1,3-Dichloropropene	µg/m³	2.3					<230	<230	<230	0%	<2900	N.A.	<23	N.A.
	1,1,2-Trichloroethane	µg/m³	2.7					<270	<270	<270	0%	<3300	N.A.	<27	N.A.
	Toluene	µg/m³	1.9		1600000 / 23000000 / 53000000 / 110000000			<190	<190	<190	0%	<2500	N.A.	**48**	N.A.
	2-Hexanone (MBK)	µg/m³	2.0					<50	<50	<50	0%	<2500	N.A.	<5	N.A.
	Dibromochloromethane	µg/m³	1.6					<160	<160	<160	0%	<4900	N.A.	<16	N.A.
	1,2-Dibromoethane (EDB)	µg/m³	3.8					<380	<380	<380	0%	<4900	N.A.	<38	N.A.
	Tetrachloroethene (PCE)	µg/m³	3.4			8000	2000	**51000**	**480000**	**360000**	29%	**890000**	60%	**270**	N.A.
	Chlorobenzene	µg/m³	2.3					<230	<230	<230	0%	<2500	N.A.	<23	N.A.
	Ethylbenzene	µg/m³	2.2		420000 / 6800000 / 16000000 / 35000000			<220	<220	<220	0%	<2500	N.A.	**61**	N.A.
	Bromoform	µg/m³	5.2					<520	<520	<520	0%	<4900	N.A.	<52	N.A.
	m-& p-Xylene	µg/m³	4.3					<430	<430	<430	0%	<5400	N.A.	**260**	N.A.
	Styrene	µg/m³	2.1					<210	<210	<210	0%	<2500	N.A.	<21	N.A.
	1,1,2,2-Tetrachloroethane	µg/m³	3.4					<340	<340	<340	0%	<2900	N.A.	<34	N.A.
	o-Xylene	µg/m³	2.2					<220	<220	<220	0%	<2500	N.A.	**180**	N.A.
	4-ethyl toluene	µg/m³	2.5					<250	<250	<250	0%	<2500	N.A.	<25	N.A.
	1,3,5-Trimethylbenzene	µg/m³	2.5					<250	<250	<250	0%	<2500	N.A.	<25	N.A.
	1,2,4-Trimethylbenzene	µg/m³	2.5					<250	<250	<250	0%	<3300	N.A.	<25	N.A.
	Benzyl chloride	µg/m³	2.6					<260	<260	<260	0%	N.A.	N.A.	<26	N.A.
	1,3-Dichlorobenzene	µg/m³	3.0					<300	<300	<300	0%	<5400	N.A.	<30	N.A.
	1,4-Dichlorobenzene	µg/m³	3.0					<300	<300	<300	0%	<5400	N.A.	<30	N.A.
	1,2-Dichlorobenzene	µg/m³	3.0					<300	<300	<300	0%	<5400	N.A.	<30	N.A.
	1,2,4-Trichlorobenzene	µg/m³	3.7					<370	<370	<370	0%	<15000	N.A.	<37	N.A.
	Hexachloro-1,3-butadiene	µg/m³	5.3					<530	<530	<530	0%	<8200	N.A.	<53	N.A.
	Naphthalene	µg/m³	2.6		1000 / 20000 / 45000 / 95000			<260	<260	<260	0%	<8600	N.A.	<26	N.A.
	TPH C5 - C8 aliphatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C8 - C8 aliphatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C8 - C10 aliphatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C10 - C12 aliphatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C6 - C8 aromatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C8 - C10 aromatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C10 - C12 aromatic	µg/m³						N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH >C10 - C12 Naphthalene (F2)	µg/m³	40		180000 / 3800000 / NL / NL			<4000	<4000	<4000	0%	N.A.	N.A.	<400	N.A.
	TPH C5 - C8 Aliphatic	µg/m³	200					**64000**	**330000**	**240000**	32%	N.A.	N.A.	**30000**	N.A.
	TPH C6 - C10 - BTEX (F1)	µg/m³	700		230000 / 4200000 / 9900000 / 21000000			**45000**	**340000**	**240000**	34%	N.A.	N.A.	**27000**	N.A.
	TPH C9 - C10 Aromatic	µg/m³	100					<10000	<10000	<10000	0%	N.A.	N.A.	<1000	N.A.
	TPH C9 - C12 Aliphatic	µg/m³	50					<5000	<5000	<5000	0%	N.A.	N.A.	<500	N.A.
	Xylenes Total	µg/m³	6.6		280000 / 4800000 / 11000000 / 24000000			N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**440**	N.A.

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Table 3: Soil Vapour Analytical Results

				SV3s	SV3d	SV4d	SV5s	SV6s	SV7s	SV8s	SV9s	QC1 (duplicate)	RPD	QC2 (triplicate)	RPD	SV9d	Carbon Tube 2	SV1s	SV7s	Carbon Tube 8	SV3s	Carbon Tube 5	SV4s	SV5s
				21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022	21/01/2022		21/01/2022		21/01/2022	21/01/2022	24/03/2022	28/03/2022	28/03/2022	25/03/2022	25/03/2022	29/03/2022	28/03/2022
				vapour	vapour	vapour	vapour	vapour	vapour	vapour	vapour	vapour		vapour		vapour	vapour	vapour	vapour		vapour		vapour	vapour
				Soil Vapour Sampling Event 2 (Stage 3)																				
Method_Type	ChemName	Units	EQL																					
US EPA Compendium Methods TO-14a/TO-15	Propylene	µg/m³	0.9	**270**	**1000**	**3600**	**39000**	**1900**	**10000**	**700**	**5400**	**5900**	**9%**	**5700**	**5%**	**880**	N.A.	<40	<5	N.A.	<2	N.A.	<5	<5
	Dichlorodifluoromethane	µg/m³	2.5	**3**	<12.5	<5	<250	**3**	<12.5	<5	<5	<5	**0%**	N.A.	**N.A.**	<2.5	N.A.	<100	<20	N.A.	<6	N.A.	<20	<10
	Chloromethane	µg/m³	1.0	<1	<5	<2	<100	<1	<5	<2	<2	<2	**0%**	<11	**N.A.**	<1	N.A.	<100	<20	N.A.	<6	N.A.	<20	<20
	1,2-Dichlorotetrafluoroethane	µg/m³	2.5	<2.5	<12.5	<5	<250	<2.5	<12.5	<5	<5	<5	**0%**	N.A.	**N.A.**	<2.5	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Vinyl chloride	µg/m³	1.3	<1.3	<6.5	<2.6	<130	<1.3	<6.5	<2.6	<2.6	<2.6	**0%**	<6.2	**N.A.**	<1.3	N.A.	<60	<8	N.A.	<3	N.A.	<8	<7
	1,3-Butadiene	µg/m³	1.1	<1.1	<5.5	<2.2	<110	<1.1	<5.5	<2.2	<2.2	<2.2	**0%**	<4.6	**N.A.**	<1.1	N.A.	<50	<7	N.A.	<3	N.A.	<7	<6
	Bromomethane	µg/m³	1.9	<1.9	<9.5	<3.8	<190	<1.9	<9.5	<3.8	<3.8	<3.8	**0%**	<14	**N.A.**	<1.9	N.A.	<500	<60	N.A.	<20	N.A.	<60	<60
	Chloroethane	µg/m³	1.3	<1.3	<6.5	<2.6	<130	<1.3	<6.5	<2.6	<2.6	<2.6	**0%**	<9.3	**N.A.**	<1.3	N.A.	<60	<8	N.A.	<3	N.A.	<8	<8
	Acrolein	µg/m³	11	<11	<55	<22	<1100	<11	<55	<22	<22	<22	**0%**	<11	**N.A.**	<11	N.A.	<60	<7	N.A.	<3	N.A.	<7	<7
	Acetone	µg/m³	11.9	**70**	<59.5	**40**	<1190	**20**	<59.5	<23.8	**40**	**50**	**22%**	N.A.	**N.A.**	**40**	N.A.	<100	<20	N.A.	**11**	N.A.	**34**	<20
	Ethanol	µg/m³	9	**10**	<45	**20**	<900	**10**	<45	<18	**20**	**30**	**40%**	N.A.	**N.A.**	**30**	N.A.	<100	<20	N.A.	**6.6**	N.A.	<10	<10
	Isopropyl Alcohol (2-propanol)	µg/m³	12	**50**	<60	<24	<1200	**20**	<60	**140**	<24	<24	**0%**	N.A.	**N.A.**	**20**	N.A.	**370**	**1650**	N.A.	**9**	N.A.	**80**	**340**
	Isopropyl Alcohol* (tube)	µg/m3	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	**110000**	N.A.	N.A.	**11000000**	N.A.	**25000000**	N.A.
	Trichlorofluoromethane(Freon 11)	µg/m³	2.8	<2.8	<14	<5.6	<280	<2.8	<14	<5.6	<5.6	<5.6	**0%**	<4.6	**N.A.**	<2.8	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,1-Dichloroethene (DCE)	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<9.3	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	Methylene chloride(Dichloromethane)	µg/m³	17	<17	<85	<34	<1700	<17	<85	<34	<34	<34	**0%**	N.A.	**N.A.**	<17	N.A.	<200	<30	N.A.	<10	N.A.	<30	<30
	1,1,2-Trichlorotrifluoroethane	µg/m³	3.8	<3.8	<19	<7.6	<380	<3.8	<19	<7.6	<7.6	<7.6	**0%**	N.A.	**N.A.**	<3.8	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Carbon Disulfide	µg/m³	16	**30**	<80	**50**	<1600	<16	<80	<32	<32	<32	**0%**	N.A.	**N.A.**	<16	N.A.	<80	**19**	N.A.	**29**	N.A.	<9	<9
	trans-1,2-dichloroethene (DCE)	µg/m³	2.0	<2	<10	**110**	<200	<2	<10	<4	<4	<4	**0%**	<9.3	**N.A.**	<2	N.A.	<100	**45**	N.A.	<5	N.A.	<10	<10
	1,1-Dichloroethane	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<11	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	Methyl tert-butylether (MTBE)	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<9.3	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	Vinyl Acetate	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<11	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	2-Butanone (MEK)	µg/m³	15	<15	**280**	**170**	<1500	**87**	<75	**59**	**110**	**120**	**9%**	<7.7	**N.A.**	**18**	N.A.	<70	<9	N.A.	<4	N.A.	<9	<9
	cis-1,2-Dichloroethene (DCE)	µg/m³	2.0	<2	<10	**1000**	<200	**10**	<10	<4	**42**	**43**	**2%**	**57**	**30%**	<2	N.A.	<100	**190**	N.A.	<5	N.A.	<10	<10
	Hexane	µg/m³	1.8	**88**	**98**	**570**	**4300**	**410**	**790**	**24**	**1300**	**1300**	**0%**	**880**	**39%**	**360**	N.A.	<90	**4060**	N.A.	<4	N.A.	**43**	**45**
	Chloroform	µg/m³	2.4	**20**	**52**	**7**	<240	**75**	**95**	**44**	**20**	**20**	**0%**	<14	**N.A.**	**20**	N.A.	<100	<20	N.A.	<6	N.A.	<10	<10
	Ethyl Acetate	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<12	**N.A.**	<1.8	N.A.	<90	<10	N.A.	<4	N.A.	<10	<10
	Tetrahydrofuran	µg/m³	1.5	**940**	**16000**	**5100**	**5500**	**4900**	**3200**	**4700**	**9000**	**9900**	**10%**	**5500**	**48%**	**1100**	N.A.	**1100**	**710**	N.A.	**530**	N.A.	**2520**	**1150**
	1,2-Dichloroethane	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<15	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	1,1,1-Trichloroethane	µg/m³	2.7	<2.7	<13.5	<5.4	<270	<2.7	<13.5	<5.4	<5.4	<5.4	**0%**	<12	**N.A.**	<2.7	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	Benzene	µg/m³	1.6	**10**	**19**	**36**	<160	**28**	**10**	<3.2	**30**	**31**	**3%**	**34**	**13%**	**10**	N.A.	<200	<60	N.A.	<10	N.A.	<20	<20
	Carbon tetrachloride	µg/m³	3.1	<3.1	<15.5	<6.2	<310	<3.1	<15.5	<6.2	<6.2	<6.2	**0%**	<15	**N.A.**	<3.1	N.A.	<200	<20	N.A.	<8	N.A.	<20	<20
	Cyclohexane	µg/m³	1.7	**18**	<8.5	**6**	<170	<1.7	**10**	**21**	<3.4	<3.4	**0%**	<6.2	**N.A.**	<1.7	N.A.	<80	<10	N.A.	<4	N.A.	<10	**22**
	1,2-Dichloropropane	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<28	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	Bromodichloromethane	µg/m³	3.4	<3.4	<17	<6.8	<340	**8**	<17	<6.8	<6.8	<6.8	**0%**	<15	**N.A.**	<3.4	N.A.	<200	<20	N.A.	<8	N.A.	<20	<20
	Trichloroethene (TCE)	µg/m³	2.7	<2.7	<13.5	**140**	<270	**33**	<13.5	**32**	**370**	**370**	**0%**	**500**	**30%**	**4**	N.A.	<100	**32**	N.A.	<7	N.A.	<20	**49**
	1,4-Dioxane	µg/m³	1.8	<1.8	<9	<3.6	<180	<1.8	<9	<3.6	<3.6	<3.6	**0%**	<9.3	**N.A.**	<1.8	N.A.	<90	N.A.	N.A.	<4	N.A.	<10	<10
	Heptane	µg/m³	2.0	**23**	**10**	**39**	**2200**	**26**	**120**	<4	**370**	**380**	**3%**	**320**	**14%**	**120**	N.A.	<100	**980**	N.A.	<5	N.A.	<10	<10
	Methyl Methacrylate	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<11	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	cis-1,3-Dichloropropene	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<9.3	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	4-Methyl-2-pentanone (MIBK)	µg/m³	20	<20	<100	<40	<2000	<20	<100	<40	<40	<40	**0%**	N.A.	**N.A.**	<20	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	trans-1,3-Dichloropropene	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<11	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	1,1,2-Trichloroethane	µg/m³	2.7	<2.7	<13.5	<5.4	<270	<2.7	<13.5	<5.4	<5.4	<5.4	**0%**	<12	**N.A.**	<2.7	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	Toluene	µg/m³	1.9	**160**	**37**	**28**	<190	**37**	**33**	**10**	**64**	**66**	**3%**	**81**	**23%**	**23**	N.A.	<90	**32**	N.A.	**15**	N.A.	<10	**21**
	2-Hexanone (MBK)	µg/m³	2.0	<2	<10	<4	<200	<2	<10	<4	<4	<4	**0%**	<9.3	**N.A.**	<2	N.A.	<100	<10	N.A.	<5	N.A.	<10	<10
	Dibromochloromethane	µg/m³	1.6	<1.6	<8	<3.2	<160	<1.6	<8	<3.2	<3.2	<3.2	**0%**	<19	**N.A.**	<1.6	N.A.	<200	<30	N.A.	<10	N.A.	<30	<20
	1,2-Dibromoethane (EDB)	µg/m³	3.8	<3.8	<19	<7.6	<380	<3.8	<19	<7.6	<7.6	<7.6	**0%**	<19	**N.A.**	<3.8	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Tetrachloroethene (PCE)	µg/m³	3.4	**93**	**190**	<6.8	**2100**	**350**	<17	<6.8	**3300**	**3300**	**0%**	**4700**	**35%**	**640**	N.A.	**121000**	**190**	N.A.	**120**	N.A.	**79**	**4980**
	Chlorobenzene	µg/m³	2.3	<2.3	<11.5	<4.6	<230	<2.3	<11.5	<4.6	<4.6	<4.6	**0%**	<9.3	**N.A.**	<2.3	N.A.	<100	<10	N.A.	<6	N.A.	<10	<10
	Ethylbenzene	µg/m³	2.2	**61**	**10**	**520**	<220	**22**	**43**	**10**	**30**	**31**	**3%**	**32**	**6%**	**99**	N.A.	<100	**250**	N.A.	**16**	N.A.	**25**	**50**
	Bromoform	µg/m³	5.2	<5.2	<26	<10.4	<520	<5.2	<26	<10.4	<10.4	<10.4	**0%**	<19	**N.A.**	<5.2	N.A.	<300	<30	N.A.	<10	N.A.	<30	<30
	m-& p-Xylene	µg/m³	4.3	**230**	**30**	**1700**	<430	**50**	**120**	**40**	**68**	**70**	**3%**	**61**	**11%**	**400**	N.A.	<300	**1170**	N.A.	**60**	N.A.	**98**	**270**
	Styrene	µg/m³	2.3	**9**	<10.5	<4.2	<210	**3**	<10.5	<4.2	<4.2	<4.2	**0%**	<9.3	**N.A.**	**2**	N.A.	<100	<30	N.A.	<5	N.A.	<10	<10
	1,1,2,2-Tetrachloroethane	µg/m³	3.4	<3.4	<17	<6.8	<340	<3.4	<17	<6.8	<6.8	<6.8	**0%**	<15	**N.A.**	<3.4	N.A.	<200	<20	N.A.	<8	N.A.	<20	<20
	o-Xylene	µg/m³	2.2	**140**	**20**	**450**	<220	**25**	**60**	**24**	**24**	**24**	**0%**	**20**	**18%**	**140**	N.A.	**240**	**1060**	N.A.	**44**	N.A.	**50**	**200**
	4-ethyl toluene	µg/m³	2.5	**5**	<12.5	<5	<250	<2.5	<12.5	<5	<5	<5	**0%**	**14**	**N.A.**	<2.5	N.A.	<100	<20	N.A.	<6	N.A.	<10	<10
	1,3,5-Trimethylbenzene	µg/m³	2.5	**6**	<12.5	<5	<250	**4**	<12.5	<5	<5	<5	**0%**	<9.3	**N.A.**	**3**	N.A.	<100	**39**	N.A.	<6	N.A.	<10	<10
	1,2,4-Trimethylbenzene	µg/m³	2.5	**10**	<12.5	<5	<250	**8**	<12.5	<5	<5	<5	**0%**	<12	**N.A.**	**5**	N.A.	<100	**110**	N.A.	<6	N.A.	<10	<10
	Benzyl chloride	µg/m³	2.6	<2.6	<13	<5.2	<260	<2.6	<13	<5.2	<5.2	<5.2	**0%**	N.A.	**N.A.**	<2.6	N.A.	<100	<20	N.A.	<6	N.A.	<20	<20
	1,3-Dichlorobenzene	µg/m³	3.0	<3	<15	<6	<300	<3	<15	<6	<6	<6	**0%**	<20	**N.A.**	<3	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,4-Dichlorobenzene	µg/m³	3.0	<3	<15	<6	<300	<3	<15	<6	<6	<6	**0%**	<20	**N.A.**	<3	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,2-Dichlorobenzene	µg/m³	3.0	<3.0	<15	<6	<300	<3	<15	<6	<6	<6	**0%**	<20	**N.A.**	<3	N.A.	<100	<20	N.A.	<7	N.A.	<20	<20
	1,2,4-Trichlorobenzene	µg/m³	3.7	<3.7	<18.5	<7.4	<370	<3.7	<18.5	<7.4	<7.4	<7.4	**0%**	<56	**N.A.**	<3.7	N.A.	<200	<20	N.A.	<9	N.A.	<20	<20
	Hexachloro-1,3-butadiene	µg/m³	5.3	<5.3	<26.5	<10.6	<530	<5.3	<26.5	<10.6	<10.6	<10.6	**0%**	<31	**N.A.**	<5.3	N.A.	<300	<30	N.A.	<10	N.A.	<30	<30
	Naphthalene	µg/m³	2.6	<2.6	<13	<5.2	<260	**6**	<13	<5.2	<5.2	<5.2	**0%**	<37	**N.A.**	<2.6	N.A.	<100	<20	N.A.	<6	N.A.	<20	<20
	TPH C5 - C6 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	N.A.	**17200**	N.A.	<40	N.A.	<100	**5200**
	TPH >C6 - C8 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<800	**13900**	N.A.	<40	N.A.	<100	<100
	TPH >C8 - C10 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	<200	N.A.	<50	N.A.	<200	<200
	TPH >C10 - C12 aliphatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	<700	N.A.	<60	N.A.	<400	<600
	TPH C6 - C8 aromatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<800	**130**	N.A.	<40	N.A.	<100	<100
	TPH >C8 - C10 aromatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	**2890**	N.A.	**140**	N.A.	**240**	**620**
	TPH >C10 - C12 aromatic	µg/m³		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**N.A.**	N.A.	**N.A.**	N.A.	N.A.	<1000	<200	N.A.	<50	N.A.	<200	<200
	TPH >C10 - C12 - Naphthalene (F2)	µg/m³	40	**410**	<1000	**250**	<8000	**2000**	<2000	**400**	**1100**	**1000**	**10%**	N.A.	**N.A.**	**2500**	N.A.	<1000	<700	N.A.	<60	N.A.	<400	<600
	TPH C5 - C8 Aliphatic	µg/m³	200	**6500**	**18000**	**16000**	**88000**	**11000**	**15000**	**8700**	**26000**	**27000**	**4%**	N.A.	**N.A.**	**8600**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C6 - C10 - BTEX (F1)	µg/m³	200	**3900**	**16000**	**12000**	**37000**	**9300**	**8500**	**7500**	**19000**	**20000**	**5%**	N.A.	**N.A.**	**7300**	N.A.	<1000	**18500**	N.A.	<50	N.A.	<200	<200
	TPH C9 - C10 Aromatic	µg/m³	100	**100**	<500	<200	<10000	**180**	<500	<200	**580**	**570**	**2%**	N.A.	**N.A.**	**1200**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C9 - C12 Aliphatic	µg/m³	50	**570**	**290**	**370**	<5000	**2100**	**410**	**400**	**580**	**530**	**9%**	N.A.	**N.A.**	**1500**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Xylenes Total	µg/m³	6.6	**370**	**50**	**2150**	N.A.	**75**	**180**	**64**	**92**	**94**	**2%**	**81**	**13%**	**540**	N.A.	**240**	**2230**	N.A.	**104**	N.A.	**148**	**470**

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Table 3: Soil Vapour Analytical Results

				Carbon Tube 7	SV6s	Carbon Tube 9	SV7s	Carbon Tube 10	SV8s	SV9s	QC1 [duplicate]	RPD	QC2 [triplicate]	RPD	SV10	Carbon Tube 3	SV11	Carbon Tube 4	SV12	Carbon Tube 6	SV13	SV14	SV15	Carbon Tube 1	SV16	Carbon tube 2
				28/03/2022	28/03/2022	28/03/2022	28/03/2022	28/03/2022	29/03/2022	24/03/2022	24/03/2022		29/03/2022		25/03/2022	25/03/2022	25/03/2022	25/03/2022	28/03/2022	28/03/2022	24/03/2022	24/03/2022	25/03/2022	25/03/2022	25/03/2022	25/03/2022
					vapour		vapour		vapour	vapour	vapour		vapour		vapour		vapour		vapour		vapour	vapour	vapour		vapour	
				Soil Vapour Sampling Event 3 (Stage 4)																						
Method_Type	**ChemName**	**Units**	**EQL**																							
US EPA Compendium Methods TO-14a/TO-15	Propylene	µg/m³	0.9	N.A.	<0.9	N.A.	<0.9	N.A.	<5	<5	<5	0%	<32	N.A.	<0.9	N.A.	<0.8	N.A.	<0.7	N.A.	<0.9	<0.9	<0.9	N.A.	<0.9	N.A.
	Dichlorodifluoromethane	µg/m³	2.5	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	N.A.	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Chloromethane	µg/m³	1.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,2-Dichlorotetrafluoroethane	µg/m³	2.5	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	N.A.	N.A.	<4	N.A.	<3	N.A.	<3	N.A.	<3	<4	<3	N.A.	<3	N.A.
	Vinyl chloride	µg/m³	1.3	N.A.	<1	N.A.	<1	N.A.	<7	<7	<7	0%	<13	N.A.	<1	N.A.	<1	N.A.	<1	N.A.	<1	<1	<1	N.A.	<1	N.A.
	1,3-Butadiene	µg/m³	1.1	N.A.	<1	N.A.	<1	N.A.	<6	<6	<6	0%	<9.7	N.A.	<1	N.A.	<1	N.A.	<0.9	N.A.	<1	<1	<1	N.A.	<1	N.A.
	Bromomethane	µg/m³	1.9	N.A.	<8	N.A.	<8	N.A.	<50	<60	<50	0%	<29	N.A.	<10	N.A.	<10	N.A.	<8	N.A.	<8	<10	<8	N.A.	<8	N.A.
	Chloroethane	µg/m³	1.3	N.A.	<1	N.A.	<1	N.A.	<7	<8	<7	0%	<19	N.A.	<1	N.A.	<1	N.A.	<1	N.A.	<1	<1	<1	N.A.	<1	N.A.
	Acrolein	µg/m³	11	N.A.	<1	N.A.	<1	N.A.	<6	<7	<6	0%	<23	N.A.	<1	N.A.	<1	N.A.	<1	N.A.	<1	<1	<1	N.A.	<1	N.A.
	Acetone	µg/m³	11.9	N.A.	**300**	N.A.	**15**	N.A.	<20	<20	<20	0%	N.A.	N.A.	**22**	N.A.	**24**	N.A.	**25**	N.A.	**16**	**8**	**29**	N.A.	**40**	N.A.
	Ethanol	µg/m³	9	N.A.	**13**	N.A.	**5.8**	N.A.	<10	<10	<10	0%	N.A.	N.A.	**26**	N.A.	**23**	N.A.	**27**	N.A.	**43**	**18**	**14**	N.A.	**24**	N.A.
	Isopropyl Alcohol (2-propanol)	µg/m³	12	N.A.	**390**	N.A.	**7.3**	N.A.	**19**	**23**	<7	N.A.	N.A.	N.A.	**29**	N.A.	**8.9**	N.A.	<1	N.A.	**43**	**3.9**	**8.4**	N.A.	**8.4**	N.A.
	Isopropyl Alcohol* (tube)	µg/m3	5	**25000000**	N.A.	**16000000**	N.A.	**37000000**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	**8300000**	N.A.	**30000000**	N.A.	**37000000**	N.A.	N.A.	N.A.	**2800000**	N.A.	**9700000**
	Trichlorofluoromethane(Freon 11)	µg/m³	2.8	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<9.7	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,1-Dichloroethene (DCE)	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Methylene chloride(Dichloromethane)	µg/m³	17	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	N.A.	N.A.	<3	N.A.	<3	N.A.	<4	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,1,2-Trichlorotrifluoroethane	µg/m³	3.8	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	N.A.	N.A.	<4	N.A.	<4	N.A.	<3	N.A.	<4	<4	<4	N.A.	<4	N.A.
	Carbon Disulfide	µg/m³	16	N.A.	<2	N.A.	**9.2**	N.A.	<9	**18**	<9	0%	N.A.	N.A.	<2	N.A.	<2	N.A.	<1	N.A.	**2.1**	**3.3**	**2.6**	N.A.	<2	N.A.
	trans-1,2-dichloroethene (DCE)	µg/m³	2.0	N.A.	**2.6**	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,1-Dichloroethane	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Methyl-tert-butylether (MTBE)	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Vinyl Acetate	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<1	N.A.	<2	<2	<2	N.A.	<2	N.A.
	2-Butanone (MEK)	µg/m³	15	N.A.	**21**	N.A.	**7.6**	N.A.	<8	**12**	**11**	9%	<16	N.A.	**4.5**	N.A.	**3.8**	N.A.	**7.1**	N.A.	**3**	**2.4**	**85**	N.A.	**60**	N.A.
	cis-1,2-Dichloroethene (DCE)	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	**69**	**62**	11%	**56**	21%	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Hexane	µg/m³	1.8	N.A.	<2	N.A.	**42**	N.A.	<10	**19**	**13**	38%	<19	N.A.	<2	N.A.	<2	N.A.	**3.5**	N.A.	**3.5**	<2	<2	N.A.	<2	N.A.
	Chloroform	µg/m³	2.4	N.A.	**4**	N.A.	**42**	N.A.	<10	<10	<10	0%	<29	N.A.	**44**	N.A.	<2	N.A.	**15**	N.A.	**35**	**8.8**	**40**	N.A.	**7.7**	N.A.
	Ethyl Acetate	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<26	N.A.	**3.9**	N.A.	**6.6**	N.A.	<2	N.A.	**30**	<2	**3.3**	N.A.	**5.8**	N.A.
	Tetrahydrofuran	µg/m³	1.5	N.A.	**1430**	N.A.	**1250**	N.A.	**1730**	**1330**	**1230**	8%	**740**	57%	**300**	N.A.	**260**	N.A.	**370**	N.A.	**280**	**160**	**8220**	N.A.	**7810**	N.A.
	1,2-Dichloroethane	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<32	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,1,1-Trichloroethane	µg/m³	2.7	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<26	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Benzene	µg/m³	1.6	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<16	N.A.	<3	N.A.	<3	N.A.	<6	N.A.	<4	<3	<4	N.A.	<3	N.A.
	Carbon tetrachloride	µg/m³	3.1	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<32	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Cyclohexane	µg/m³	1.7	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<13	N.A.	<2	N.A.	<2	N.A.	<1	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,2-Dichloropropane	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<58	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Bromodichloromethane	µg/m³	3.4	N.A.	<3	N.A.	**4.8**	N.A.	<20	<20	<20	0%	<32	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Trichloroethene (TCE)	µg/m³	2.7	N.A.	**18**	N.A.	<3	N.A.	<10	**550**	**520**	6%	**480**	14%	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	**55**	N.A.	<3	N.A.
	1,4-Dioxane	µg/m³	1.8	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<18	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Heptane	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Methyl Methacrylate	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	cis-1,3-Dichloropropene	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	4-Methyl-2-pentanone (MIBK)	µg/m³	20	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	N.A.	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	trans-1,3-Dichloropropene	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<23	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	1,1,2-Trichloroethane	µg/m³	2.7	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<26	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	Toluene	µg/m³	1.9	N.A.	**4.7**	N.A.	**8.6**	N.A.	<10	**14**	<10	N.A.	<19	N.A.	**24**	N.A.	**22**	N.A.	**56**	N.A.	**37**	**17**	**38**	N.A.	**25**	N.A.
	2-Hexanone (MBK)	µg/m³	2.0	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Dibromochloromethane	µg/m³	1.6	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	<38	N.A.	<4	N.A.	<4	N.A.	<4	N.A.	<4	<4	<4	N.A.	<4	N.A.
	1,2-Dibromoethane (EDB)	µg/m³	3.8	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	<39	N.A.	<4	N.A.	<4	N.A.	<3	N.A.	<4	<4	<4	N.A.	<4	N.A.
	Tetrachloroethene (PCE)	µg/m³	3.4	N.A.	**330**	N.A.	**74**	N.A.	<30	**5990**	**5760**	4%	**6400**	7%	**12**	N.A.	**26**	N.A.	**11**	N.A.	**9.1**	**170**	**1170**	N.A.	**200**	N.A.
	Chlorobenzene	µg/m³	2.3	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	<2	N.A.	<2	<2	<2	N.A.	<2	N.A.
	Ethylbenzene	µg/m³	2.2	N.A.	**13**	N.A.	**95**	N.A.	<10	**35**	**16**	75%	<19	N.A.	**7.2**	N.A.	**7.5**	N.A.	**22**	N.A.	**6.9**	**5.6**	**9**	N.A.	**8.2**	N.A.
	Bromoform	µg/m³	5.2	N.A.	<5	N.A.	<5	N.A.	<30	<30	<30	0%	<39	N.A.	<5	N.A.	<5	N.A.	<4	N.A.	<5	<5	<5	N.A.	<5	N.A.
	m- & p-Xylene	µg/m³	4.3	N.A.	**51**	N.A.	**400**	N.A.	<30	**100**	**55**	58%	<42	N.A.	**18**	N.A.	**23**	N.A.	**87**	N.A.	**15**	**14**	**9.6**	N.A.	**34**	N.A.
	Styrene	µg/m³	2.1	N.A.	<4	N.A.	<4	N.A.	<20	<30	<10	0%	<19	N.A.	<5	N.A.	<5	N.A.	<7	N.A.	<5	<4	<5	N.A.	<5	N.A.
	1,1,2,2-Tetrachloroethane	µg/m³	3.4	N.A.	<3	N.A.	<3	N.A.	<20	**44**	<20	N.A.	<23	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	o-Xylene	µg/m³	2.2	N.A.	**37**	N.A.	**230**	N.A.	<20	**66**	**38**	54%	<19	N.A.	**10**	N.A.	**17**	N.A.	**49**	N.A.	**10**	**10**	**6.2**	N.A.	**16**	N.A.
	4-ethyl toluene	µg/m³	2.5	N.A.	<2	N.A.	**2.6**	N.A.	<10	<10	<10	0%	<19	N.A.	**2.8**	N.A.	**2.5**	N.A.	**10**	N.A.	<2	<2	<2	N.A.	**9.4**	N.A.
	1,3,5-Trimethylbenzene	µg/m³	2.5	N.A.	<2	N.A.	<2	N.A.	<10	<10	<10	0%	<19	N.A.	<2	N.A.	<2	N.A.	**8.1**	N.A.	<2	<2	<2	N.A.	**19**	N.A.
	1,2,4-Trimethylbenzene	µg/m³	2.5	N.A.	<2	N.A.	**5.2**	N.A.	<10	<10	<10	0%	<26	N.A.	**3.5**	N.A.	**2.9**	N.A.	**10**	N.A.	**2.9**	<2	<2	N.A.	**57**	N.A.
	Benzyl chloride	µg/m³	2.6	N.A.	<3	N.A.	<3	N.A.	<10	<20	<10	0%	N.A.	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	**19**	N.A.
	1,3-Dichlorobenzene	µg/m³	3.0	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<42	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,4-Dichlorobenzene	µg/m³	3.0	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<42	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<3	N.A.	<3	N.A.
	1,2-Dichlorobenzene	µg/m³	3.0	N.A.	<3	N.A.	<3	N.A.	<20	<20	<20	0%	<42	N.A.	<3	N.A.	<3	N.A.	<3	N.A.	<3	<3	<6	N.A.	**3.7**	N.A.
	1,2,4-Trichlorobenzene	µg/m³	3.7	N.A.	<4	N.A.	<4	N.A.	<20	<20	<20	0%	<120	N.A.	<4	N.A.	<4	N.A.	<3	N.A.	<4	<4	<4	N.A.	<4	N.A.
	Hexachloro-1,3-butadiene	µg/m³	5.3	N.A.	<5	N.A.	<5	N.A.	<40	<30	<30	0%	<64	N.A.	<5	N.A.	<5	N.A.	<4	N.A.	<5	<5	<5	N.A.	<5	N.A.
	Naphthalene	µg/m³	2.6	N.A.	<3	N.A.	<3	N.A.	<10	<20	<10	0%	<68	N.A.	<3	N.A.	<3	N.A.	<2	N.A.	<3	<3	<3	N.A.	<3	N.A.
	TPH C5 - C6 aliphatic	µg/m³		N.A.	<40	N.A.	**540**	N.A.	<300	<100	<100	0%	N.A.	N.A.	<40	N.A.	<40	N.A.	<40	N.A.	<40	<40	<40	N.A.	<40	N.A.
	TPH >C6 - C8 aliphatic	µg/m³		N.A.	<40	N.A.	<40	N.A.	<100	<100	<100	0%	N.A.	N.A.	<40	N.A.	<40	N.A.	<40	N.A.	<40	<40	<40	N.A.	<40	N.A.
	TPH >C8 - C10 aliphatic	µg/m³		N.A.	<50	N.A.	<50	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	<50	N.A.	<50	<50	<50	N.A.	<50	N.A.
	TPH >C10 - C12 aliphatic	µg/m³		N.A.	<100	N.A.	<300	N.A.	<200	<200	<200	0%	N.A.	N.A.	<200	N.A.	<100	N.A.	<200	N.A.	<100	<300	<200	N.A.	**310**	N.A.
	TPH C6 - C8 aromatic	µg/m³		N.A.	<40	N.A.	<40	N.A.	<100	<100	<100	0%	N.A.	N.A.	<40	N.A.	<40	N.A.	**62**	N.A.	**42**	<40	**42**	N.A.	<40	N.A.
	TPH >C8 - C10 aromatic	µg/m³		N.A.	**120**	N.A.	**830**	N.A.	<100	<300	<200	0%	N.A.	N.A.	<50	N.A.	**63**	N.A.	**200**	N.A.	<50	<50	<50	N.A.	**98**	N.A.
	TPH >C10 - C12 aromatic	µg/m³		N.A.	<50	N.A.	<50	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	<50	N.A.	<50	<50	<50	N.A.	**66**	N.A.
	TPH >C10 - C12 Naphthalene (F2)	µg/m³	40	N.A.	<50	N.A.	<50	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	<50	N.A.	<50	<50	<50	N.A.	**376**	N.A.
	TPH C5 - C8 Aliphatic	µg/m³	200	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C6 - C10 - BTEX (F1)	µg/m³	200	N.A.	<50	N.A.	**140**	N.A.	<200	<200	<200	0%	N.A.	N.A.	<50	N.A.	<50	N.A.	**51**	N.A.	<50	<50	<50	N.A.	<50	N.A.
	TPH C9 - C10 Aromatic	µg/m³	100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	TPH C9 - C12 Aliphatic	µg/m³	50	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Xylenes Total	µg/m³	6.6	N.A.	**88**	N.A.	**630**	N.A.	N.A.	**166**	**93**	56%	N.A.	N.A.	**28**	N.A.	**40**	N.A.	**136**	N.A.	**25**	**24**	**15.8**	N.A.	**50**	N.A.

Appendix D Borelogs

lanterra consulting	**BORE LOG** **GW51**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,859.928 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,444.976 mN
DIAMETER:	150 mm	**ELEVATION:**	568.123 AHD
HOLE DEPTH:	12.5 m	**DATE DRILLED:**	21/04/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill*	GW51 0.0-0.1	0.1	Y		GP	**(0.0) Gravelly silty SAND:** brown-grey, dry, hard	Road base. Asphalt on surface	Cement
0.5			0			GC			
1.0			0			SC-CM	**(0.2) Gravelly sandy CLAY:** dark brown-brown, dry-moist, plastic	Reworked fill (0.2-0.7 m)	
1.5							**(0.7) Sandy silty CLAY:** dark brown to brown to yellow, dry-moist, plastic		
2.0			0					Natural residual soil (0.7-4.0 m)	
2.5									Backfill
3.0			0.2					Abundant fragments of weathered volcanics	PVC Collar
3.5									
4.0		GW51 4.0-4.1	0	Y				Airdrilling from 4.0 m	
4.5									
5.0									
5.5									Bentonite
6.0									
6.5									
7.0									
7.5									
8.0	*Deakin Volcanics*					tuff	**(8.0) Weathered Volcanics:** Drilling of weathered volcanosedimentary unit. Cristals in air-hammer powder, yellow-grey in colour		
8.5									
9.0									
9.5								Moist powder at 9.5 m	Sand Slotted Screen
10.0									
10.5									
11.0									
11.5									
12.0									
12.5									

Air-drilled from 4 m (bgl) until 12.5 m
Moisture detected at 10.5 m

LOGGED BY	L.B
CHECKED BY	C.G

BORE LOG
GW52

lanterra consulting

PROJECT NUMBER: P21083
CLIENT NAME: ACT EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME: Kippax Centre DSI
CONTRACTOR: Terratest Pty Ltd
DRILL METHOD: Geoprobe 7822DT
DIAMETER: 150 mm
HOLE DEPTH: 12.5 m

COORDINATE SYSTEM: GDA2020 / MGA zone 55
EASTING: 683,854.106 mE
NORTHING: 6,100,469.839 mN
ELEVATION: 567.393 AHD
DATE DRILLED: 03/11/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	Fill	GW52 0.0-0.1	0.1	Y		GP	**(0.0) Sandy GRAVEL:** grey-redish, dry-moist, losse and hard	Road base. Asphalt on surface	Cement
0.5			0			GC			
1.0			0			SC-CM	**(0.2) Gravelly sandy SILT:** brown, dry-moist, soft-hard	Reworked fill (0.2-0.7 m)	
1.5							**(0.7) Sandy CLAY:** dark brown to brown to yellow, dry-moist, plastic		
2.0		GW52 2.0-2.1	2.2	Y				Natural residual soil (0.7-3.8 m)	
2.5									
3.0			0					Weathered volcanics from 3.8 m	
3.5									
4.0			0						Backfill
4.5									PVC Collar
5.0	Deakin Volcanics		0			tuff	**(4.8) Silty clayey SAND:** brown, moist, soft-hard	Airdrilling from 5.0 m	
5.5									
6.0									
6.5									
7.0									
7.5									
8.0									
8.5									Bentonite
9.0									
9.5									
10.0									
10.5								Moist powder at 10.5 m (water hit)	
11.0									Sand
11.5									Slotted Screen
12.0									
12.5									

Air-drilled from 5 m (bgl) until 12.5 m
Moisture detected at 10.5 m

LOGGED BY L.B
CHECKED BY C.G

lanterra consulting

BORE LOG
GW53

PROJECT NUMBER: P21083
CLIENT NAME: ACT EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,874.647 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,470.916 mN
DIAMETER:	150 mm	**ELEVATION:**	567.076 AHD
HOLE DEPTH:	12.7 m	**DATE DRILLED:**	02/11/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill*	GW53 0.0-0.1	2.3	Y		GP	**(0.0) Sandy GRAVEL:** grey, dry, losse	Road base. Asphalt on surface	Cement
0.5						GC			
1.0		GW53 1.0-1.1	0.3	Y		SC-CM	**(0.2) Clayey Sandy SILT:** brown, moist, firm	Reworked fill (0.2-0.7 m)	
1.5							**(0.7) Sandy CLAY:** dark brown to brown to yellow, dry-moist, plastic		
2.0			0.2				**(1.5) CLAY:** brown-dark brown, moist, soft-firm and plastic	Mottled 95% clay (residual soil)	
2.5									
3.0			0						
3.5									Backfill
4.0			0				**(3.8) Sandy CLAY:** brown-yellow brown, moist, firm-hard, low plasticity		PVC Collar
4.5							**(4.5) Clayey SAND:** yellow-brown, moist, soft	Extremely weathered bedrock	
5.0			0.6						
5.5									
6.0	*Deakin Volcanics*		0			tuff-sed	**(6.1) Clayey SAND:** yellow-brown, moist, soft	Airdrilling from 6.0 m	
6.5									
7.0									
7.5									Bentonite
8.0								Bedrock appears to be a volcanosedimentary unit	
8.5									
9.0									
9.5									
10.0									Sand
10.5									Slotted Screen
11.0									
11.5								Moist powder at 11.5 m (water hit)	
12.0									Caving
12.5									

Air-drilled from 6 m (bgl) until 12.7 m
Moisture detected at 11.5 m
well installed at 11.6 m due to caving

LOGGED BY C.G
CHECKED BY L.B

BORE LOG
GW54

lanterra consulting

PROJECT NUMBER: P21083
CLIENT NAME: ACT EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,887.748 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,458.746 mN
DIAMETER:	150 mm	**ELEVATION:**	567.309 AHD
HOLE DEPTH:	12.7 m	**DATE DRILLED:**	03/11/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0–0.5	Deakin Volcanics	GW54 0.0-0.1	0	Y		SM	**(0.0) Sandy SILT:** pale brown, dry, soft	Topsoil. Grass on surface
0.5–1.5		GW54 1.0-1.1	0	Y		GC	**(0.1) Gravelly sandy CLAY:** brown, dry-moist, hard-plastic	
1.5–4.5			0			SP-SC	**(1.5) Sandy silty CLAY:** dark brown-brown, moist and plastic	Traces of rounded oxidised volcanics (2.0-3.5 m)
4.5–8.0			0			tuff-sed	**(4.5) Gravelly sandy SILT:** pale brown-yellow, dry-moist, soft-hard	Weathered volcanic bedrock Airdrilling from 5.5 m
8.0–12.5			0			tuff-sed	**(8.0) Gravelly silty SAND:** pale brown-light grey, dry, hard	Abundant felsic minerals observed in material from air strata Moist powder at 11.0 m (water hit)



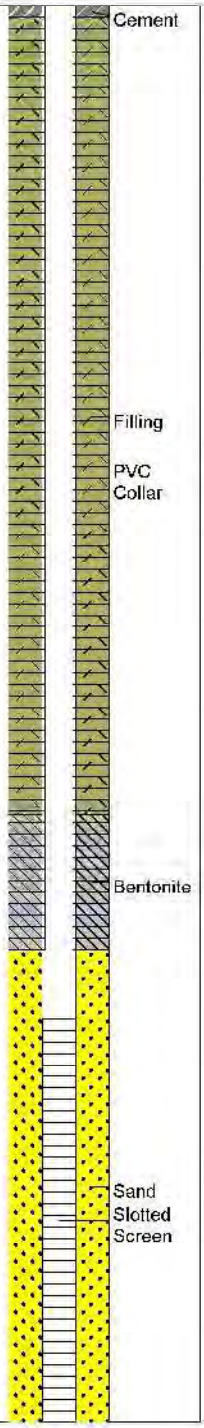
Air-drilled from 6 m (bgl) until 12.7 m
Moisture detected at 11.0 m
well installed at 12.3 m due to caving

LOGGED BY L.B
CHECKED BY C.G

lanterra consulting	**BORE LOG** **GW55**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,852.688 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,540.219 mN
DIAMETER:	150 mm	**ELEVATION:**	565.774 AHD
HOLE DEPTH:	10.5 m	**DATE DRILLED:**	11/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill*	GW55 0.0-0.1	0.6	Y		PT	**(0.0) Sandy SILT:** dark brown, moist-wet, soft	Topsoil. Grass on surface
0.5			0.6			SM	**(0.5) Sandy SILT:** brown, moist-wet, soft	Fill
1.0			0.6			GM	**(1.0) Sandy Gravelly SILT:** brown, moist, loose	Reworked fill
1.5								
2.0	*Deakin Volcanics*	GW55 2.0-2.1	0.7	Y		SM	**(2.0) Sandy Silt:** light brown, dry-moist, soft	Residual natural soil
2.5								Natural. Abundant lumps of clay material from 2 m to 6 m
3.0			0.7			SC	**(3.0) Sandy Clay:** brown-grey, moist, soft, some plasticity	
3.5								
4.0			0.5				**(4.0) Sandy Clay:** red-brown, dry-moist, soft-firm	
4.5								
5.0			0.5					
5.5								
6.0			0.8				**(6.0) Air Drilling:** air-drilling dust (red-brown, dry-moist, soft-loose)	Airdrilling from 6 m. Weathered rhyodacitic tuff observed
6.5								
7.0								
7.5								
8.0								
8.5								
9.0								
9.5								
10.0								Moist powder at 10.3 m (water
10.5								



Air-drilled from 6 m (bgl) until 10.5 m
Groundwater detected at 10.3 m, after 40 min water level rose to 8.3 m

LOGGED BY A.P
CHECKED BY L.B

lanterra consulting	**BORE LOG** **GW56**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,876.292 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,510.096 mN
DIAMETER:	150 mm	**ELEVATION:**	565.845 AHD
HOLE DEPTH:	9.1 m	**DATE DRILLED:**	10/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0.6			SM	**(0.0) Sandy SILT:** brown-dark grey, moist-wet, soft	Topsoil (0.0-0.5 m). Grass on surface.
0.5		GW56 0.5-0.6	0.2	Y			**(0.5) Gravelly sandy SILT:** brown-dark grey, moist to wet and soft	
1.0			0.1					
1.5								
2.0		GW56 2.0-2.1	1.7	Y		CS	**(2.0) Sandy clayey SILT:** brown, moist, loose	Reworked Material from 0.5-3.0 m
2.5								
3.0	*Deakin Volcanics*		0.7				**(3.0) Gravelly Sandy CLAY:** brown-light brown, dry, soft to hard	Natural
3.5								
4.0			0.5					
4.5								
5.0			0.9				**(5.0) Sandy CLAY:** brown-light brown, moist, soft to firm and plastic	
5.5								
6.0			0.1				**(6.0) Gravelly Clayey SAND:** brown-pale brown, dry, loose	
6.5								
7.0			0.1					
7.5								
8.0			0.6					Groundwater hit between 8.0-8.5 m
8.5								
9.0			0.4					

Well Diagram: Backfill; Bentonite; Sand; Slotted Screen

Groundwater found at 8-8.5m but rose up to 6-6.5m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting

BORE LOG
GW57

PROJECT NUMBER: P21083
CLIENT NAME: EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME: Kippax Centre DSI
CONTRACTOR: Terratest
DRILL METHOD: Drill rig - Geoprobe
DIAMETER: 150mm
HOLE DEPTH: 10.0 m

COORDINATE SYSTEM: GDA2020 / MGA zone 55
EASTING: 683,869.757 mE
NORTHING: 6,100,480.165 mN
ELEVATION: 566.755 AHD
DATE DRILLED: 11/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		0.2			GM	**(0.0) Gravelly Sandy SILT:** dark brown, dry-moist, hard	Road base, some pebbles present	Cement
0.5			0.2				**(0.3) Gravelly Sandy SILT:** dark brown, moist, soft to hard	Reworked material from 0.3-1.5 m	
1.0			0.2						
1.5						GC	**(1.5) Gravelly Sandy CLAY:** brown, moist, hard	Residual soil. Rounded fragments of oldized volcanics.	
2.0			0.3						
2.5									Backfill
3.0			0.2				**(3.0) Gravelly Sandy CLAY:** brown, moist, loose and hard	Natural material	
3.5									
4.0			0						
4.5									
5.0	*Deakin Volcanics*		0			SC	**(5.0) Sandy CLAY:** brown, dry-moist, soft-hard		
5.5									
6.0			0						Bentonite
6.5						GC	**(6.5) Gravelly clayey SAND:** brown, dry-moist, hard		
7.0			0.4					Volcanic bedrock	
7.5									
8.0			0.8						Sand
8.5								Goundwater hit at 8.5 m approx	Slotted Screen
9.0			1.8						
9.5									
10.0									

Comments

LOGGED BY A.P
CHECKED BY L.B

lanterra consulting	**BORE LOG** **GW58**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,823.985 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,534.27 mN
DIAMETER:	150mm	**ELEVATION:**	565.84 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	12/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	Fill Mat		0.3			SP	**(0.0) Gracelly sandy SILT:** dark brown, soft, dry	Topsoil (fill)	Cement
0.5			0.5			GM	**(0.2) Gracelly sandy SILT:** light brown, dry, soft to hard	Residual soil (0.2-2.0 m)	
1.0			1.8						
1.5									
2.0			0.8			SM	**(2.0) Sandy clayey SILT:** light brown, dry, soft	Natural. Layer of clay observed. Weathered bedrock.	
2.5									Backfill
3.0			0.1						
3.5									
4.0	Deakin Volcanics		0.4			SC	**(4.0) Sandy CLAY:** light brown yellow, mois, soft, plastic	Natural weathered bedrock	
4.5									
5.0			0.3						
5.5									
6.0			0.5						Bentonite
6.5									
7.0			0.2						
7.5									
8.0			1.3						Sand
8.5									Slotted Screen
9.0			1.8						
9.5									
10.0									

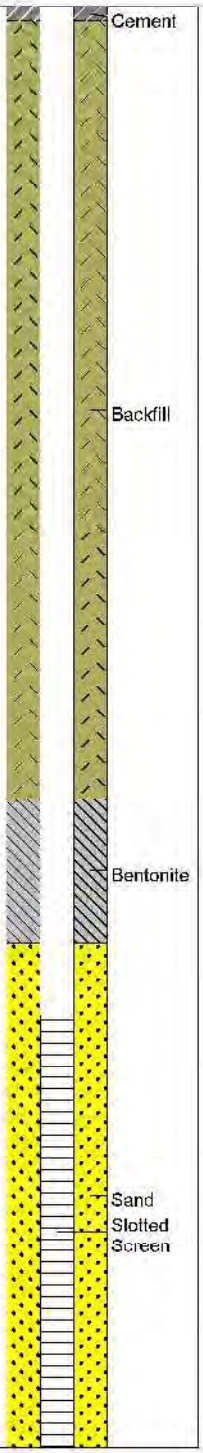
Comments	**LOGGED BY** A.P **CHECKED BY** L.B

BORE LOG
GW59

PROJECT NUMBER: P21083
CLIENT NAME: EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,820.666 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,507.548 mN
DIAMETER:	150mm	**ELEVATION:**	567.148 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	12/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*	GW59 0.0-0.1	0.1	Y		SP	**(0.0) Gravelly SAND:** dark borwn, dry, loose	Topsoil
0.5		GW59 0.5-0.6	0.6	Y		GP	**(0.5) Gravelly Sandy Silt:** brown-light brown, moist, soft-hard	Reworked fill (0.5-1.7 m)
1.0			0.4					
1.5								
2.0	*Deakin Volcanics*		0.5			GC	**(1.7) Gravelly sandy SILT:** light brown, moist, soft-hard	Residual soil (1.7-3 m)
2.5								
3.0			0.3			SC	**(3.0) Sandy CLAY:** light brown t corange-yellow, dry-moist, soft and medium plasticity	Natural Material
3.5								
4.0			0.3					
4.5								
5.0			0.5					
5.5								
6.0			0.2			GC	**(6.0) Gravelly sandy CLAY:** brown, moist, soft, plastic	
6.5								
7.0			0.2					
7.5						SC	**(7.5) Sandy CLAY:** brown, moist, soft	
8.0			0.5					Groundwater hit 8.0-8.5 m approx
8.5								
9.0			0.4					
9.5								
10.0								



Comments

LOGGED BY A.P
CHECKED BY L.B

lanterra consulting	**BORE LOG** **GW60**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,840.798 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,482.826 mN
DIAMETER:	150mm	**ELEVATION:**	567.065 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	11/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		0.3			GP	**(0.0) Sandy GRAVEL:** grey-reddish, dry-moist, loose and hard	Road base. Sidewalk on surface. Fragments of weathered volcanics observed. Reworked fill (0.3-2.0 m)	Cement
0.5			0.3			GM	**(0.3) Gravelly sandy SILT:** dark brown-brown, dry, soft-hard-loose		
1.0			0.5						
1.5									
2.0	*Deakin Volcanics*		0.7			SM	**(2.0) Sandy SILT:** brown-light brown, moist, soft-firm	Residual soil	Backfill
2.5									
3.0			0.8						
3.5									
4.0			0.6			GC	**(4.0) Gravelly sandy CLAY:** grey brown, dry moist, soft	Natural weathered volcanosedimentary unit	
4.5									
5.0			0.8			SC	**(5.0) Sandy CLAY:** dry-brown, moist, medium plasticity		
5.5									
6.0			0.8			GC	**(6.0) Gravelly clayey SAND:** brown, moist, soft-hard		Bentonite
6.5									
7.0			1.1						
7.5									
8.0			1.0						Sand
8.5								Groundwater hit at 8.0-8.5 m approx	Slotted Screen
9.0			1.3						
9.5									
10.0									

Moist soil observed around 8.5 m, moist soil then continued to 10m

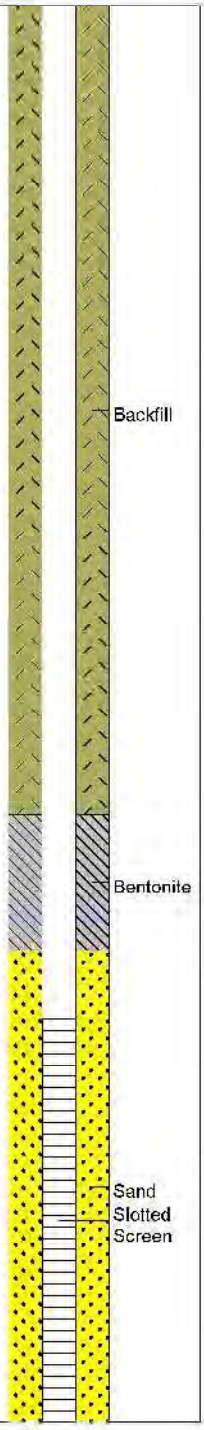
LOGGED BY	A.P
CHECKED BY	L.B

BORE LOG
GW61

PROJECT NUMBER: P21083
CLIENT NAME: EPSDD
ADDRESS: Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,891.523 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,498.682 mN
DIAMETER:	150 mm	**ELEVATION:**	564.946 AHD
HOLE DEPTH:	10.5 m	**DATE DRILLED:**	15/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		4.5			SS	**(0.0) Sandy SILT:** brown, dry-moist, soft	Topsoil
0.5			3.5			SC	**(0.3) Sandy silty CLAY:** brown-pale brown, dry-moist, soft-plastic	Traces of poorly sorted angular gravel. Reworked material (0.3-1.5m)
1.0			2.7					
1.5	*Deakin Volcanics*					SC	**(1.5) Sandy silty CLAY:** light brown, moist, soft, less plastic than previous layer	Traces of rounded volcanics. Residual soil
2.0			4.7					
2.5								
3.0			2.7					
3.5								
4.0			7.6					
4.5						GM	**(4.5) Gravelly clayey SAND:** pale brown, dry-moist, loose-hard	Natural weathered bedrock, abundant felsic grains
5.0			3.7					
5.5								
6.0			3.5					
6.5								
7.0			9.5			GM	**(7.0) Gravelly sandy SILT:** pale brown, dry-moist, loose-hard	
7.5								
8.0								
8.5								Groundwater hit at 8.5 m approx
9.0								
9.5								
10.0								
10.5								



Air-drilled to 10.5 m, moisture detected at 8.5 m

LOGGED BY L.B
CHECKED BY C.G

lanterra consulting	**BORE LOG** **GW62**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,876.476 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,535.992 mN
DIAMETER:	150 mm	**ELEVATION:**	564.562 AHD
HOLE DEPTH:	12.5 m	**DATE DRILLED:**	15/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0 – 1.2	*Fill Material*		31.0 35.0 29.2			SS SC	**(0.0) Sandy SILT:** brown, dry-moist, soft **(0.2) Sandy silty CLAY:** brown-pale brown, dry-moist, soft	Topsoil. Grass on surface Reworked material (0.2-1.2 m). Traces of gravel	
1.2 – 4.5			3.0 2.4 10.2			SC	**(1.2) Sandy silty CLAY:** light brown, dry-moist, soft and low plasticity	Residual soil (rounded oxidised fragments observed)	
4.5 – 12.5	*Deakin Volcanics*					tuff	**(4.5) Clayey Silty SAND:** light brown (lighter than previous layer above), dry-moist, soft	Groundwater hit at 10 m approx	Backfill Bentonite Sand Slotted Screen

Air drilling from 4.5m (hard rock) up to 12.5m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	BORE LOG GW63	PROJECT NUMBER: P21083 CLIENT NAME: EPSDD ADDRESS: Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	COORDINATE SYSTEM:	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	EASTING:	683,862.158 mE
DRILL METHOD:	Geoprobe 7822DT	NORTHING:	6,100,569.648 mN
DIAMETER:	150 mm	ELEVATION:	563.756 AHD
HOLE DEPTH:	10.0 m	DATE DRILLED:	15/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	Fill Material		6.6			SP	**(0.0) Sandy clayey SILT:** brown, dry-moist, soft and loose	Topsoil. Grass on surface	
0.5			5.8			SC	**(0.3) Sandy silty CLAY:** brown-light brown, dry-moist, soft and loose	Reworked material (0.3-0.7m)	
1.0			5.1			CLS	**(0.7) Silty CLAY:** light brown, dry-moist, plastic and soft	Natural material (weathered bedrock)	
1.5									
2.0			0						
2.5									Backfill
3.0			0			CLS	**(3.0) Clay and Silt:** grey-brown, dry-moist, soft and plastic		
3.5									
4.0			0						
4.5									
5.0	Deakin Volcanics		0						
5.5						Tuff	**(5.5) Silty SAND:** grey-brown, dry-moist, hard	Air drilling from 5.5m on harder fresher bedrock	Bentonite
6.0									
6.5									
7.0									
7.5									
8.0									Washed Sand
8.5								Groundwater hit at 8.5 m approx	Slotted Screen
9.0									
9.5									
10.0									

Air drilling from 5.5m (hard rock) down to 10m

LOGGED BY	A.P
CHECKED BY	L.B

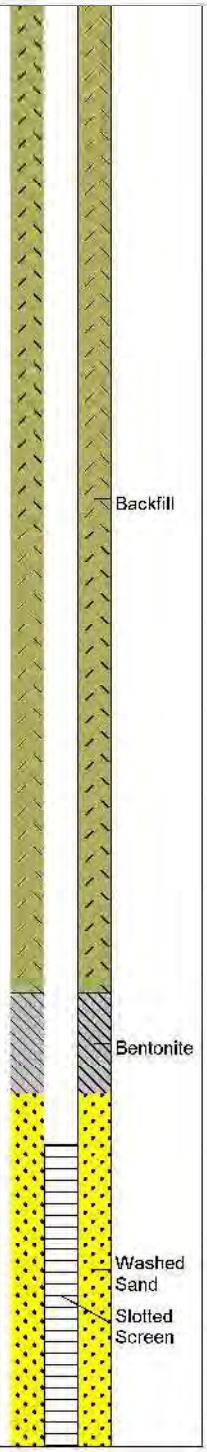
BORE LOG
GW64

PROJECT NUMBER: P21083
CLIENT NAME: EPSDD
ADDRESS: Section 51, Holt, ACT

PROJECT NAME: Kippax Centre DSI
CONTRACTOR: Terratest Pty Ltd
DRILL METHOD: Geoprobe 7822DT
DIAMETER: 150 mm
HOLE DEPTH: 14.3 m

COORDINATE SYSTEM: GDA2020 / MGA zone 55
EASTING: 683,843.304 mE
NORTHING: 6,100,557.304 mN
ELEVATION: 564.716 AHD
DATE DRILLED: 16/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		100			SP	**(0.0) Gravelly sandy SILT:** brown, dry-moist, soft, loose	Topsoil, grass on surface, poorly sorted gravel
0.5			25.6			SC	**(0.2) Sandy silty CLAY:** brown-light brown, dry-moist, soft, loose	Reworked material (0.2-1.5m). Traces of gravel observed
1.0			26.5					
1.5						CLS	**(1.5) Silty CLAY:** light brown, dry-moist, plastic and soft	Natural material
2.0			1.5					
2.5								
3.0			2.4					
3.5	*Deakin Volcanics*					SP	**(3.5) Sandy SILT:** light brown, dry-moist, soft	Traces of gravel observed
4.0			3.5					
4.5								
5.0			2.6					
5.5								
6.0			3.7					
6.5								
7.0			5.0					
7.5								
8.0			2.0					
8.5								
9.0			1.7					
9.5						CLS	**(9.5) Sandy silty CLAY:** brown, moist, soft	
10.0			1.5					
10.5								
11.0								
11.5								
12.0								Groundwater hit at 12-12.5 m approx
12.5								
13.0								
13.5								
14.0								



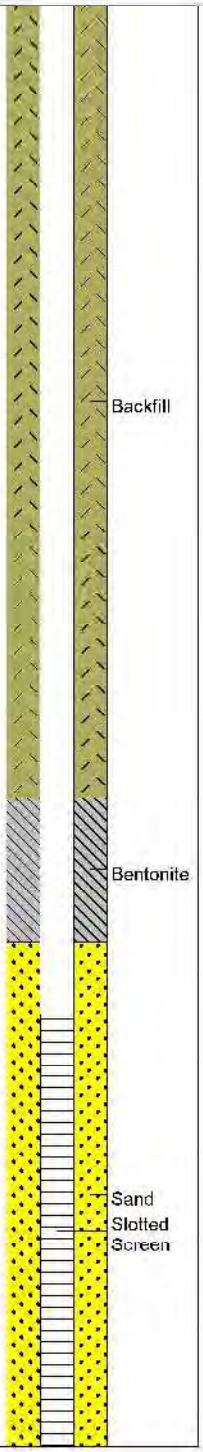
Comments

LOGGED BY A.P
CHECKED BY L.B

lanterra consulting	**BORE LOG** **GW65**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,844.795 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,589.75 mN
DIAMETER:	150 mm	**ELEVATION:**	563.344 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	16/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0			SS	**(0.0) Sandy silty CLAY:** brown, dry-moist, soft	Topsoil. Grassed surface
0.5			0			SC	**(0.2) Sandy silty CLAY:** brown-pale brown, dry-moist, soft	Reworked material
1.0			0			SC	**(0.9) Sandy silty CLAY:** light brown, dry-moist, soft, moderately plastic	Natural material
1.5								
2.0			0					
2.5								
3.0			0					
3.5								
4.0	*Deakin Volcanics*		0			SC	**(4.0) Sandy silty CLAY:** light brown, dry moist, soft to hard	Presence of weathered volcanics. Mix of soft and hard material (weathered bedrock)
4.5								
5.0			0					
5.5								
6.0			0					
6.5								
7.0								
7.5								
8.0								
8.5								Groundwater hit at 8.5m approx
9.0								
9.5								
10.0								

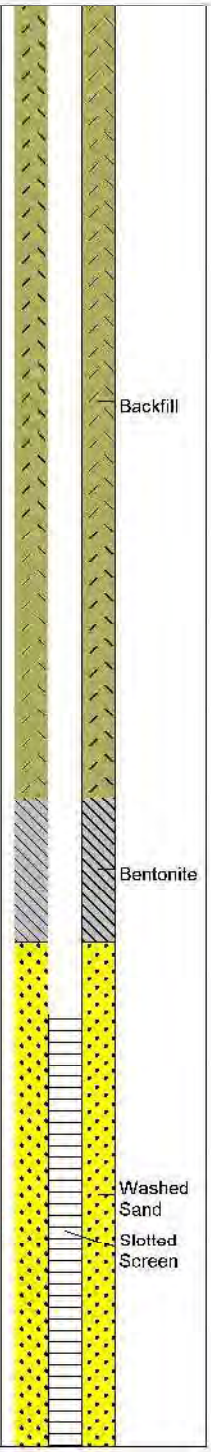


Comments	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW66**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,820.131 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,575.841 mN
DIAMETER:	150 mm	**ELEVATION:**	564.836 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	16/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0			SM	**(0.0) Sandy SILT:** dark brown-brown, dry-moist, soft	Topsoil Reworked material (0.2-1.0m)
0.5			0			SC	**(0.2) Sandy Clayey SILT:** brown, dry-moist, soft	
1.0			0				**(1.0) Sandy Clayey SILT:** brown-light brown, dry-moist	Natural material
1.5								
2.0			0					
2.5						SM	**(2.5) Sandy SILT:** light brown, drai, soft-hard	Traces of gravel
3.0			0					
3.5								
4.0			0					
4.5	*Deakin Volcanics*					GM	**(4.5) Gravelly sandy SILT:** light brown, dry, soft-hard	
5.0			0					Air drilling after 5m
5.5								
6.0								
6.5								
7.0								
7.5								
8.0								
8.5								Groundwater hit at 8.5 m approx
9.0								
9.5								
10.0								



Airdrilling from 5 to 10 m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW67**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,874.049 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,416.423 mN
DIAMETER:	150 mm	**ELEVATION:**	569.046 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	17/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		9.6			GM	**(0.0) Gravelly silty SAND:** brown-grey, dry, hard	Road base. Asphalt on surface.	
0.5			7.0			GC	**(0.2) Gravelly sandy CLAY:** brown, dry-moist, soft and loose	Reworked material (0.2-0.8m)	
1.0			5.6			SC	**(0.8) Sandy silty CLAY:** light brown, dry-moist, soft and slightly plastic clay	Natural material	
1.5									
2.0			9.5						
2.5						GM	**(2.5) Gravelly silty SAND:** brown, dry, soft to hard		Backfill
3.0			3.8						
3.5							**(3.5) Gravelly sandy SILT:** light brown, dry, hard		
4.0	*Deakin Volcanics*		8.0			GM		Air drilling from 4m	
4.5									
5.0									
5.5									
6.0								Weathered volcanic unit	Bentonite
6.5									
7.0									
7.5									
8.0									Washed Sand
8.5								Groundwater hit at 8.5-9.0 m approx	Slotted Screen
9.0									
9.5									
10.0									

Comments	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW68**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,774.69 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,478.27 mN
DIAMETER:	150 mm	**ELEVATION:**	567.344 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	17/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		68.6			GM	**(0.0) Gravelly sandy SILT:** grey-brown, dry, hard	Road base. Asphalt on surface.	
0.5			68.4			SM	**(0.3) Sandy SILT:** brown, dry, hard	Reworked material (0.3-1.0m)	
1.0			68.1			SC	**(1.0) Sandy clayey SILT:** brown, dry-moist, soft	Natural material (weathered volcanic)	
1.5									
2.0			57.4						
2.5						SM	**(2.5) Sandy SILT:** light brown, dry-moist, soft to hard		Backfill
3.0			67.8						
3.5									
4.0			45.3						
4.5									
5.0	*Deakin Volcanics*		85.5						
5.5									
6.0			98.2						Bentonite
6.5									
7.0						SM	**(7.0) Sandy SILT:** light brown, dry-moist, soft to hard	Air drilling from 7m	
7.5									
8.0									Washed Sand
8.5								Groundwater hit at 8.5-9.0 m approx	Slotted Screen
9.0									
9.5									
10.0									

Airdrilling from 7 m down to 10 m	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW69**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,758.718 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,500.912 mN
DIAMETER:	150 mm	**ELEVATION:**	567.138 AHD
HOLE DEPTH:	11.0 m	**DATE DRILLED:**	17/03/2022

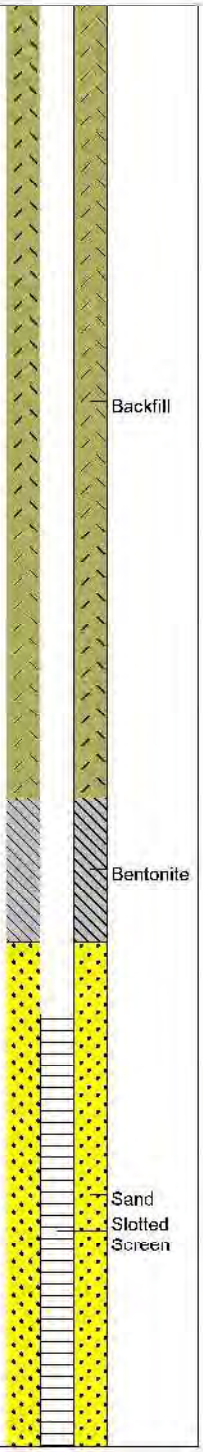
Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		0			SM	**(0.0) Sandy SILT:** brown, dry, soft, hard, loose	Topsoil. Traces of gravel	
0.5			0			SM	**(0.3) Sandy SILT:** brown-pale brown, dry, soft-hard	Reworked material (0.2-2.0m)	
1.0			0						
1.5									
2.0			0						
2.5	*Deakin Volcanics*					SM	**(2.2) Sandy SILT:** brown, dry, hard	Natural material, weathered volcanics	
3.0			0						Backfill
3.5									
4.0			0						
4.5									
5.0			0						
5.5									
6.0						SC	**(6.0) Sandy clayey SILT:** dark brown, moist, hard	Air drilling from 6m	Bentonite
6.5									
7.0									
7.5									
8.0									
8.5									
9.0								Groundwater hit at 8.5-9.0 approx	Washed Sand
9.5									Slotted Screen
10.0									
10.5									
11.0									

Airdrilling from 6 m onwards	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW70**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,835.387 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,340.422 mN
DIAMETER:	150 mm	**ELEVATION:**	571.634 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	18/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		50.7			SM	**(0.0) Sandy SILT:** grey-brown, dry, soft-hard	Topsoil
0.5			56.7			SC-SM	**(0.3) Sandy clayey SILT:** dark brown-brown, dry-moist, soft	Reworked material (0.3-2.0 m)
1.0			50.7					
1.5								
2.0	*Deakin Volcanics*		53.5			SM	**(2.0) Sandy SILT:** brown-light brown, dry-moist, soft	Natural residual soil
2.5								
3.0			50.7					
3.5								
4.0			56.5					
4.5						SM	**(4.5) Sandy SILT:** light brown-yellow brown, dry, soft-hard	Weathered volcanic rock with orange-black oxidised minerals in hard rock
5.0			34.6					
5.5								
6.0								
6.5								
7.0								Air drilling from 7m
7.5								
8.0								
8.5								Groundwater hit at 8.5-9.0m approx
9.0								
9.5								
10.0								



Airdrilling from 7 m onwards

LOGGED BY A.P
CHECKED BY L.B

lanterra consulting

BOREHOLE LOG SV1

PROJECT NUMBER P21083
PROJECT NAME Ground water Investigation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

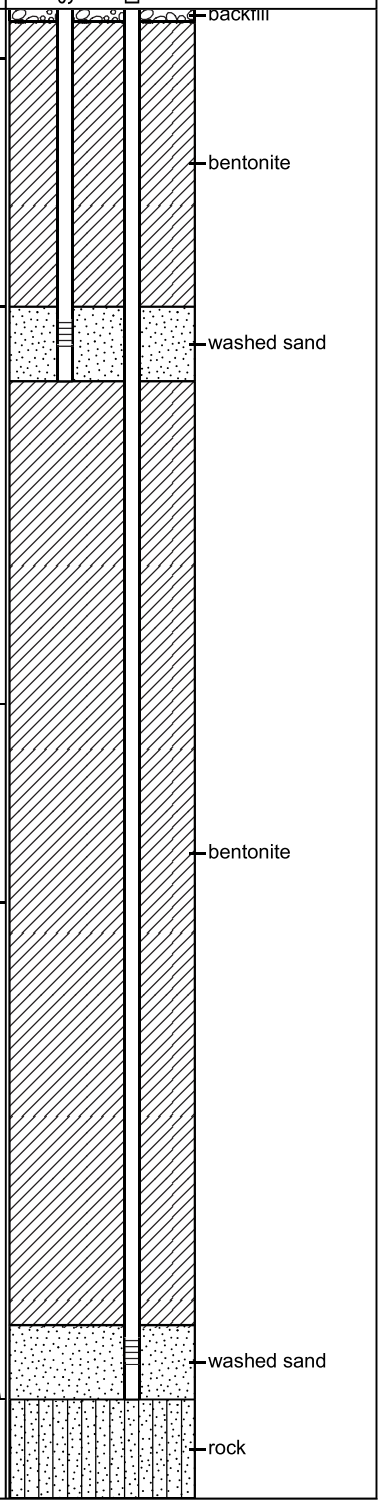
DRILLING DATE 2/11/2021
TOTAL DEPTH 5.6
SAMPLE METHOD
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683861 N: 6100446
COORD SYS MGA 55 / GDA 2020
SURFACE ELEVATION 568 m (AHD)

COMMENTS

LOGGED BY K. Lockwood
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.2	0		GP	Sandy GRAVEL, grey, dry, loose, angular medium grained gravel.	Road base.
	0.5		SC-SM	Clayey, silty, SAND, brown, dry, soft.	Reworked Fill.
0.2	1				
	1.5		SC-SM	Sandy, silty CLAY, brown, moist, soft, moderate plastic.	95% Clay.
0.2	2				
	2.5				
	3		CL	Silty, CLAY, brown-pale brown, moist, firm, low-moderate plastic.	
0.0	3.5				
	4		GC	Clayey, gravelly, SAND, pale brown-yellow brown, loose.	Extremely weathered rock.
0.0	4.5				
	5				
0.0	5.5				Hole cored to 5.6 m.



Disclaimer This bore log is intended for environmental not geotechnical purposes.

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BOREHOLE LOG SV2

PROJECT NUMBER P21083
PROJECT NAME Ground water Investigation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

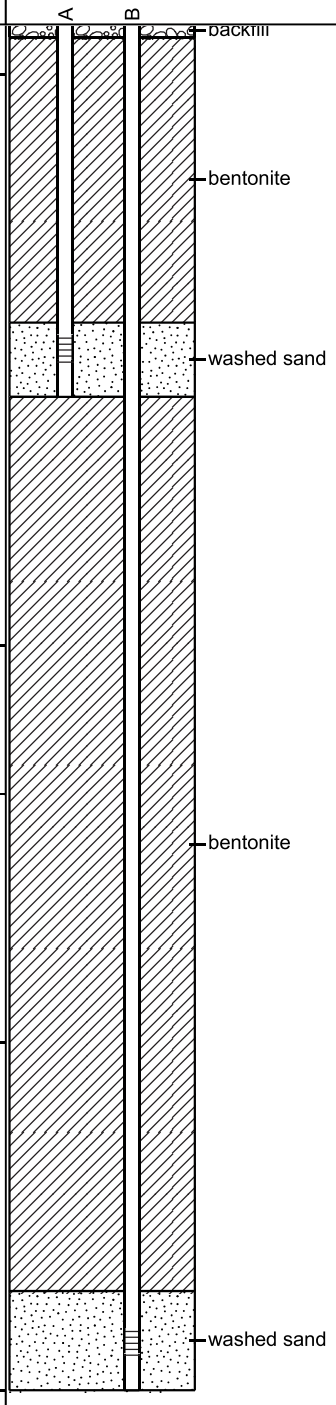
DRILLING DATE 2/11/2021
TOTAL DEPTH 5.5
SAMPLE METHOD
DIAMETER 150 mm
CONTRACTOR Terratest

COORDINATES E: 679982 N: 6100470
COORD SYS MGA 55 / GDA 2020
SURFACE ELEVATION 568 m (AHD)

COMMENTS

LOGGED BY K. Lockwood
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.4	0			Asphalt, Sandy, GRAVEL, loose.	Road base.
	0.5		CL	Sandy, clayey, SILT, brown.	Fill.
0.0	1		CL	Brown, medium CLAY, yellow mottle, plastic, mixed with gravel and rock.	
	1.5				
0.2	2				
	2.5		CL	Grey medium CLAY (mixed with brown), moist, anaerobic odour.	
0.0	3		CL	Brown, medium CLAY, plastic.	
	3.5		CL	Yellow, pale brown CLAY with grey mottle	Traces of weathered rock
0.0	4				
	4.5		MLS	Sandy CLAY, yellow, soft, moist	Extremely weathered rock.
0.0	5				
	5.5				



BOREHOLE LOG SV3

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

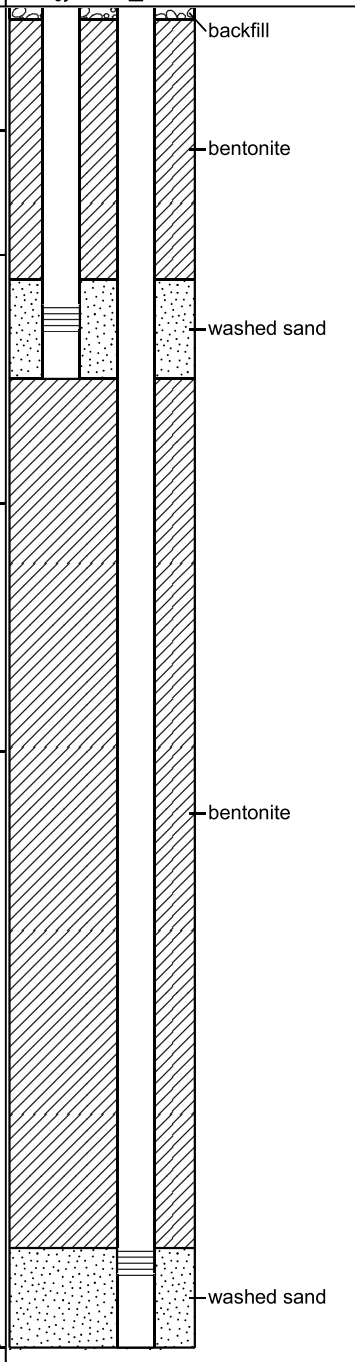
DRILLING DATE 11/01/2022
TOTAL DEPTH 5.4 m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

COORDINATES E: 683851.9 N: 6100540.3
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 565.7 m ADH

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW55).

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	USCS	Material Description	Additional Observations
0.6	0.5	SS	Sandy SILT, dark brown, moist-wet, soft	Topsoil. Biological material present (roots & grass)
0.6	1	SM	Sandy, SILT, brown, moist-wet	Fill
0.6	1.5	GM	Sandy, gravelly, SILT, brown, moist	Reworked fill
0.7	2	SM	Sandy, SILT, light brown, dry to moist	Residual natural soil
0.7	3	CS	Sandy, CLAY, brown-grey, soft and plastic	Natural. Abundant lumps of clay material.
0.5	4		Sandy, CLAY, red-brown, moist, lumps of clay	
0.5	5			End of hole
	5.5			



BOREHOLE LOG SV4

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

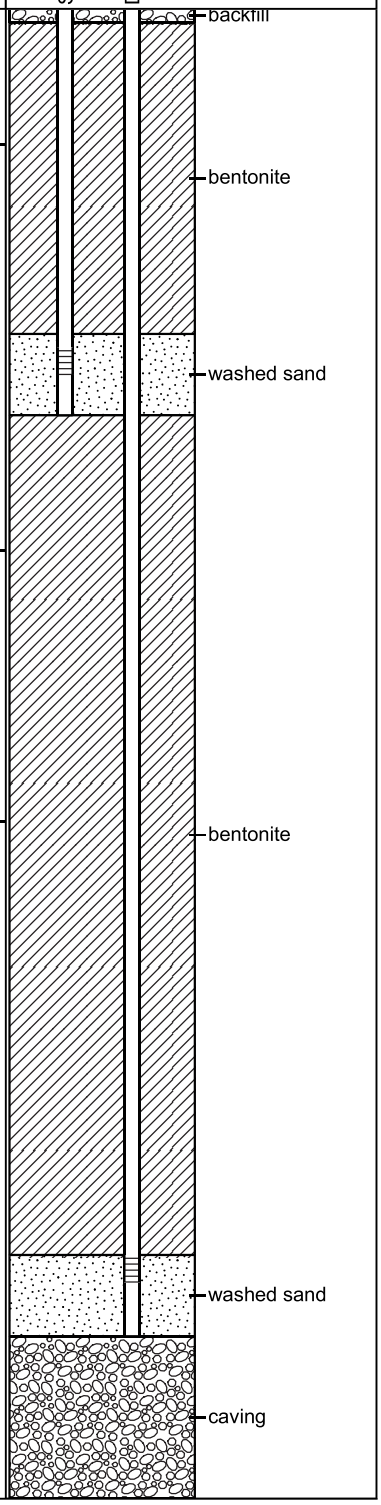
DRILLING DATE 10/01/2022
TOTAL DEPTH 5.5 m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 m
CONTRACTOR Terratest

COORDINATES E: 683876.6 N: 6100509.3
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 565.8 m (AHD)

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW56).

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.6	0.2		SM	Sandy SILT, loose, brown, moist	Fill material. Biological material present (roots & grass)
0.2	0.6			Sandy SILT,moist to wert, brown-dark grey	
0.1	1			Gravelly sandy SILT, moist-wet, slightly clayey at places, brown-dark grey	
1.7	2		CS	Sandy clayey SILT loose, moist, brown	Appears to be reworked material
0.7	3		GC	Gravelly sandy CLAY, brown to light brown, dry and soft to hard	Natural
0.5	4				
0.9	5		CS	Sandy CLAY, brown to light brown, soft to hard and slightly plastic, moist	



Vapour Well Diagram

lanterra consulting

BOREHOLE LOG SV5

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

DRILLING DATE 10/01/2022
TOTAL DEPTH 5.5 m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

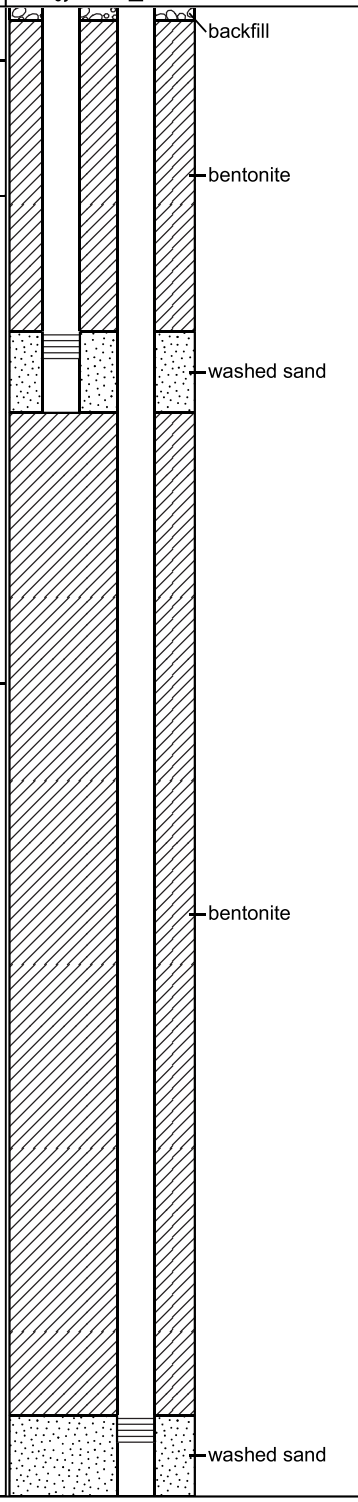
COORDINATES E: 683853.6 N: 6100469.5
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 567.4 m ADH

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW52)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.1	0.2		GP	Sandy GRAVEL, grey-reddish, dry-moist, loose	Road base. Asphalt on surface.
	0.4		GM	Gravelly sandy SILT, brown, dry-moist, soft to hard	Reworked fill
0	0.6				
	0.8		CS	Sandy CLAY, brown, moist, plastic	Natural residual. Traces of rounded oxidized volcanic rocks observed
0	1				
	1.2				
	1.4				
	1.6				
	1.8				
0	2				
	2.2				
	2.4				
	2.6		CS-CM	Silty clayey SAND, brown, moist, soft to hard	Natural weathered bedrock
	2.8				
0	3				
	3.2				
	3.4				
	3.6				
	3.8				
0	4				
	4.2				
	4.4				
	4.6				
	4.8				
0	5				
	5.2				
	5.4				

Vapour Well Diagram



Disclaimer This bore log is intended for environmental not geotechnical purposes.

produced by ESlog.ESdat.net on 04 May 2022

lanterra consulting

BOREHOLE LOG SV6

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

DRILLING DATE 11/01/2022
TOTAL DEPTH 5.5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

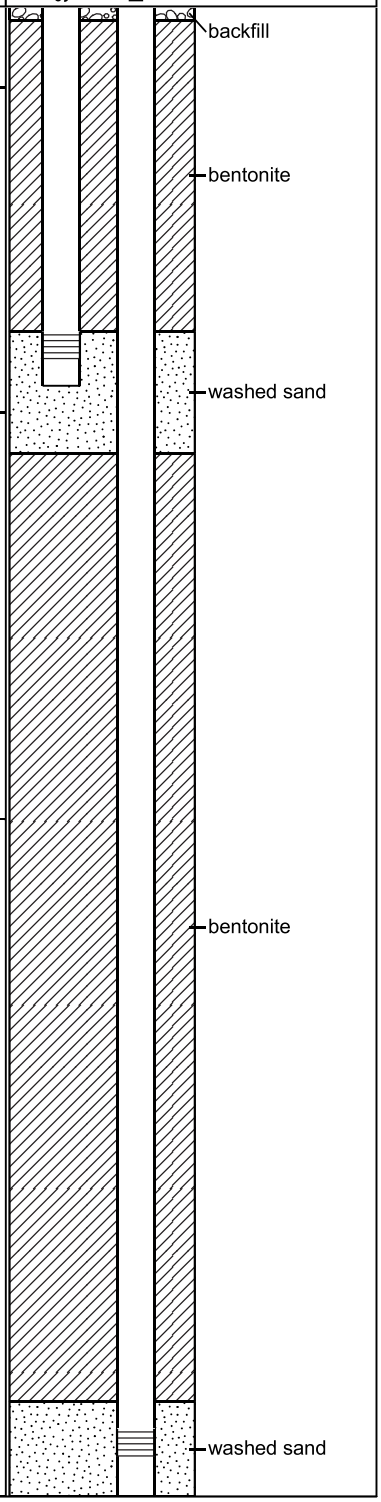
COORDINATES E: 683869.9 N: 6100479.5
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 566.8 m ADH

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW57)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.2	0.2		GM	Gravelly, sandy, SILT, dark brown, dry-moist	Road base, some pebbles present
	0.4			Gravelly, sandy, SILT, dark brown, moist	Fill reworked material
0.2	0.6				
	0.8				
0.2	1				
	1.2				
	1.4				
	1.6		GC	Gravelly, sandy, CLAY, brown, moist, and hard	Oxidized rounded fragments of volcanics. Residual soil
	1.8				
0.3	2				
	2.2				
	2.4				
	2.6				
	2.8				
	3				
0.2	3.2		GC	Gravelly, sandy, CLAY, brown, moist, loose and hard	Natural material
	3.4				
	3.6				
	3.8				
0	4				
	4.2				
	4.4				
	4.6				
	4.8				
0	5		SC	Sandy CLAY, brown, dry to moist, soft to hard	
	5.2				
	5.4				

Vapour Well Diagram



lanterra consulting

BOREHOLE LOG SV7

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

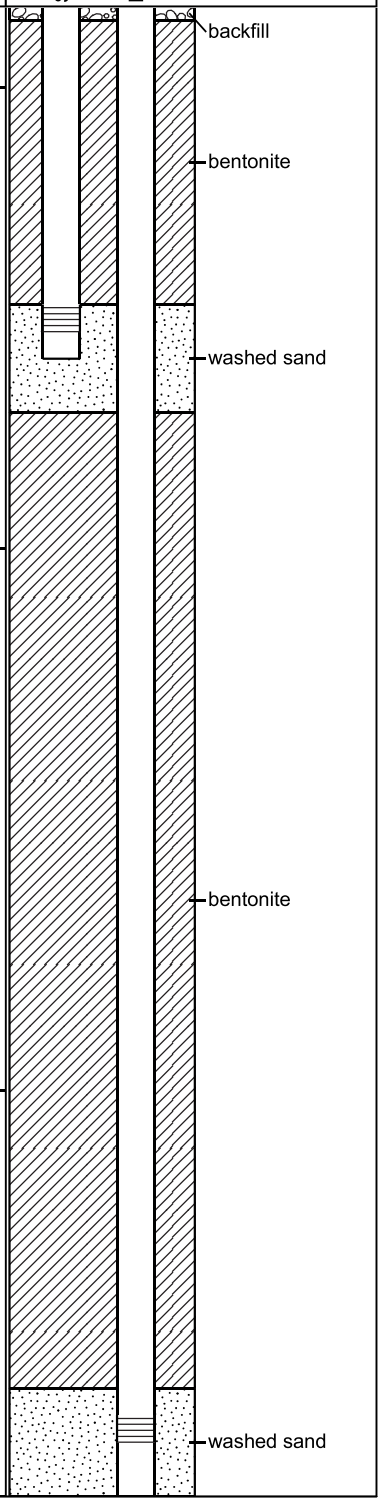
DRILLING DATE 11/01/2022
TOTAL DEPTH 5.5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

COORDINATES E: 683840.9 N: 6100482.4
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 566.7m ADH

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW60)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.3	0.2		GP	Sandy GRAVEL, grey-reddish, dry-moist, loose	Road base
0.3	0.4 – 1.8		GM	Gravelly, sandy, SILT, dark brown-brown, dry, soft to hard and loose	Fragments of weathered volcanics. Reworked fill
0.7	2 – 4		SM	Sandy, SILT, brown- light brown, moist, soft & crumbly	Residual soil
0.6	4.2 – 4.8		GC	Gravelly, sandy, CLAY, grey-brown, soft	Natural material
0.8	5 – 5.4			Sandy, CLAY, grey-brown, moist-wet, medium plasticity	



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BOREHOLE LOG SV8

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

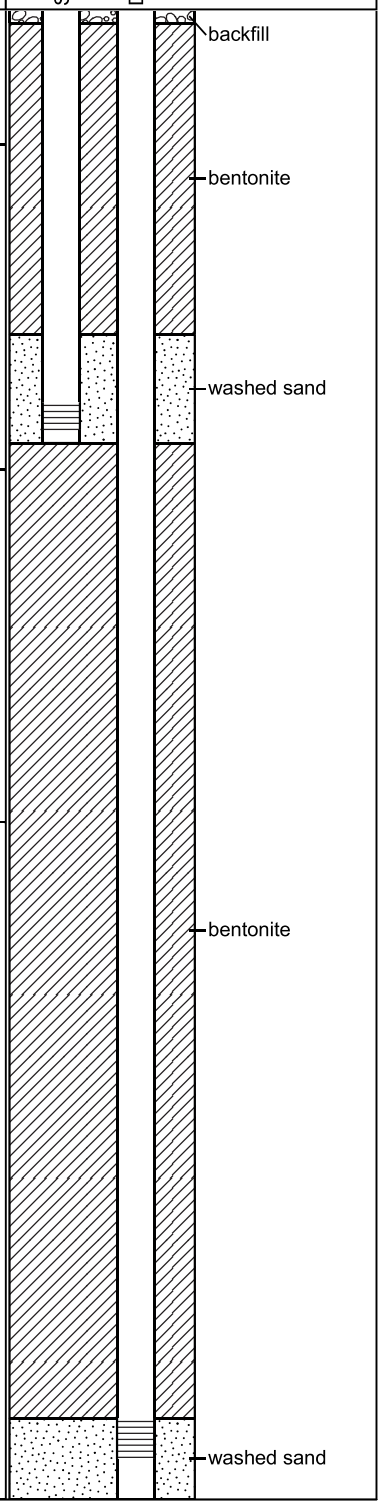
DRILLING DATE 12/01/2022
TOTAL DEPTH 5.5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683821.3 N: 6100507.6
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 567.1 m (ADH)

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW59)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.1	0.2		SP	Gravelly, SAND, dark brown, dry, loose	Top soil. Roots and grass.
	0.4				
0.6	0.6		GP	Gravelly sandy SILT, brown to light brown, moist, soft to hard	Reworked fill
	0.8				
0.4	1				
	1.2				
	1.4				
	1.6				
	1.8		GC	Gravelly clayey SILT, light brown, moist, soft to hard	Residual soil
0.5	2				
	2.2				
	2.4				
	2.6				
	2.8				
	3				
0.3	3.2		SC	Sandy, CLAY, light brown to orange-yellow, dry-moist, soft and medium plasticity	Natural material
	3.4				
	3.6				
	3.8				
	4				
0.3	4.2				
	4.4				
	4.6				
	4.8				
	5				
0.5	5.2				
	5.4				



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BOREHOLE LOG SV9

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

DRILLING DATE 12/01/22
TOTAL DEPTH 5.5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683824.6 N: 6100534.0
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 565.8 m ADH

COMMENTS SHALLOW = Shallow Soil Implant Probe, DEEP = Deep Soil Implant Probe. PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW58)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.3	0.2		SP	Gravelly sandy SILT, dark brown, soft , dry	Topsoil
0.5	2		GM	Gravelly, sandy, SILT, light brown, dry, soft to hard	Residual soil
0.8	4		SM	Sandy clayey SILT, light brown, dry, soft	Layers of clay material. Natural.
0.4	5.4		SC	Sandy CLAY, light brown-yelowish, moist, soft and plastic	Natural weathered bedrock

Vapour Well Diagram: SHALLOW, DEEP — backfill, bentonite, washed sand, bentonite, washed sand

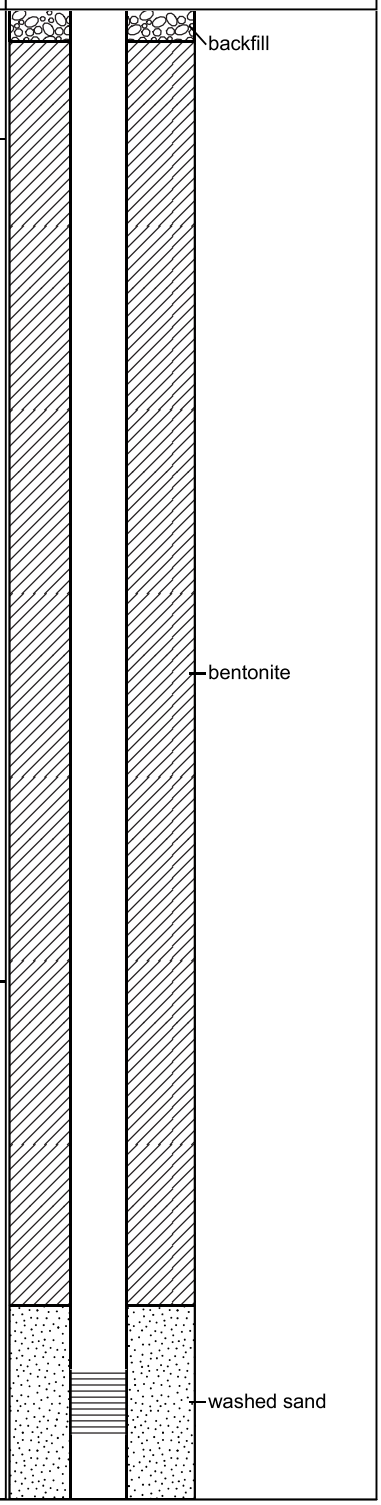
BOREHOLE LOG SV10

PROJECT NUMBER P21083	**DRILLING DATE** 16/03/22	**COORDINATES** E: 683844.2 N: 6100558.0
PROJECT NAME GW & SV Well Installation	**TOTAL DEPTH** 2.3m	**COORD SYS** MGA 55/GDA 2020
CLIENT EPSDD	**SAMPLE METHOD** Drill rig - Geoprobe	**SURFACE ELEVATION** 564.7 m ADH
ADDRESS Section 51, Holt, ACT 2615	**DIAMETER** 150mm	
	CONTRACTOR Terratest	

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW64)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
100	0.1		SP	Gravelly sandy SILT, brown, dry-moist, soft and loose	Topsoil. Poorly sorted gravel observed.
	0.2		SC	Sandy silty CLAY, brown-light brown, dry-moist, soft and loose	Reworked material. Traces of gravel observed.
25.6	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
26.5	1				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5		CLS	Silty CLAY, light brown, dry-moist, plastic and soft	Natural material.
	1.6				
	1.7				
	1.8				
	1.9				
1.5	2				
	2.1				
	2.2				



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BOREHOLE LOG SV11

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

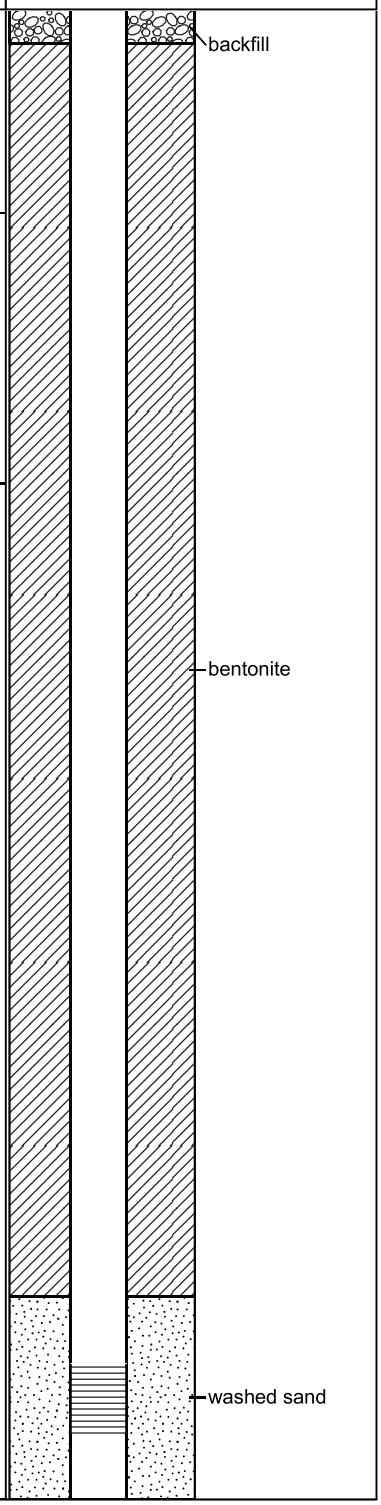
DRILLING DATE 15/03/22
TOTAL DEPTH 2.2m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683862.6 N: 6100570.9.6
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 563.8 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW63)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
6.6	0.1		SP	Sandy clayey SILT, brown, dry-moist, soft and loose	Topsoil. Traces of gravel observed.
	0.2				
	0.3		SC	Sandy silty CLAY, brown-light brown, dry-moist, soft and loose	Reworked material.
5.8	0.4				
	0.5				
	0.6				
	0.7		CLS	Silty CLAY, light brown, dry-moist, plastic and soft	Natural material.
	0.8				
	0.9				
	1				
5.1	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				
	2				
0	2.1				



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BOREHOLE LOG SV12

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

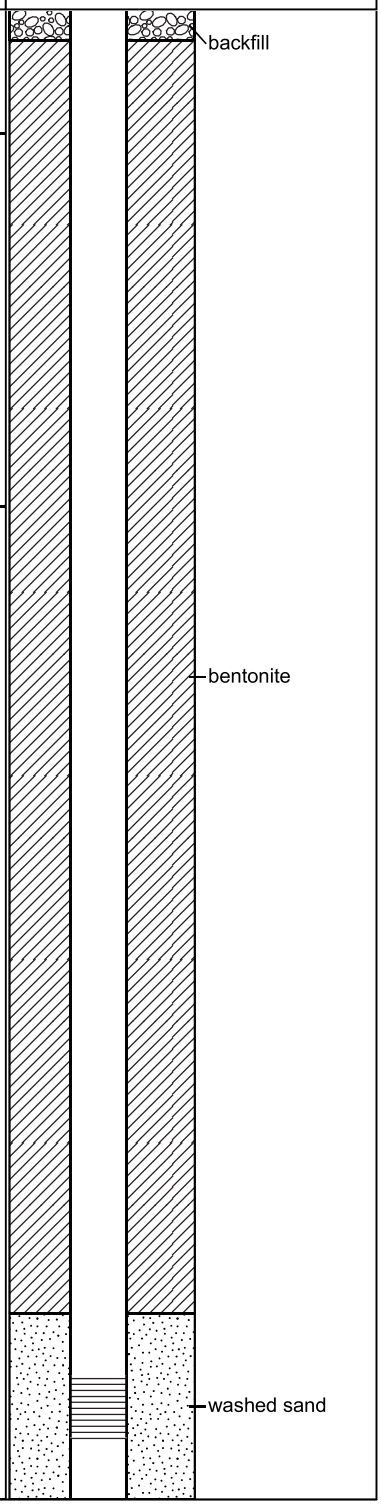
DRILLING DATE 15/03/22
TOTAL DEPTH 2.4m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683873.9 N: 6100417.6
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 569.0 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW67)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
9.6	0.1		GM	Gravelly silty sand, brown-grey, dry, hard	Road base. Asphalt on surface.
	0.2		SC	Gravelly sandy CLAY, brown, dry-moist, soft and loose	Reworked material.
7.0	0.8		SC	Sandy silty CLAY, light brown, dry-moist, soft and plasticity observed	Natural material.
5.6	1				
9.5	2				
	2.3				



BOREHOLE LOG SV13

PROJECT NUMBER P21083	**DRILLING DATE** 15/03/22	**COORDINATES** E: 683890.9 N: 6100499.9
PROJECT NAME GW & SV Well Installation	**TOTAL DEPTH** 2.4m	**COORD SYS** MGA 55/GDA 2020
CLIENT EPSDD	**SAMPLE METHOD** Drill rig - Geoprobe	**SURFACE ELEVATION** 564.9 m ADH
ADDRESS Section 51, Holt, ACT 2615	**DIAMETER** 150mm	
	CONTRACTOR Terratest	

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW61)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations	Soil Vapour Well Diagram
4.5	0.1		SS	Sandy SILT, brown, dry-moist, soft	Topsoil. Grass on surface.	backfill
	0.2		SC	Sandy silty CLAY, brown-pale brown, dry-moist, soft and plastic	Reworked material. Traces of angular poorly sorted gravel.	
3.5	0.5					
	0.6					
	0.7					
	0.8					
	0.9					
2.7	1					bentonite
	1.1					
	1.2					
	1.3					
	1.4					
	1.5			Sandy silty CLAY, light brown, moist, soft and low plasticity	Natural residual soil.	
	1.6					
	1.7					
	1.8					
	1.9					
4.7	2					
	2.1					
	2.2					washed sand
	2.3					

BOREHOLE LOG SV14

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

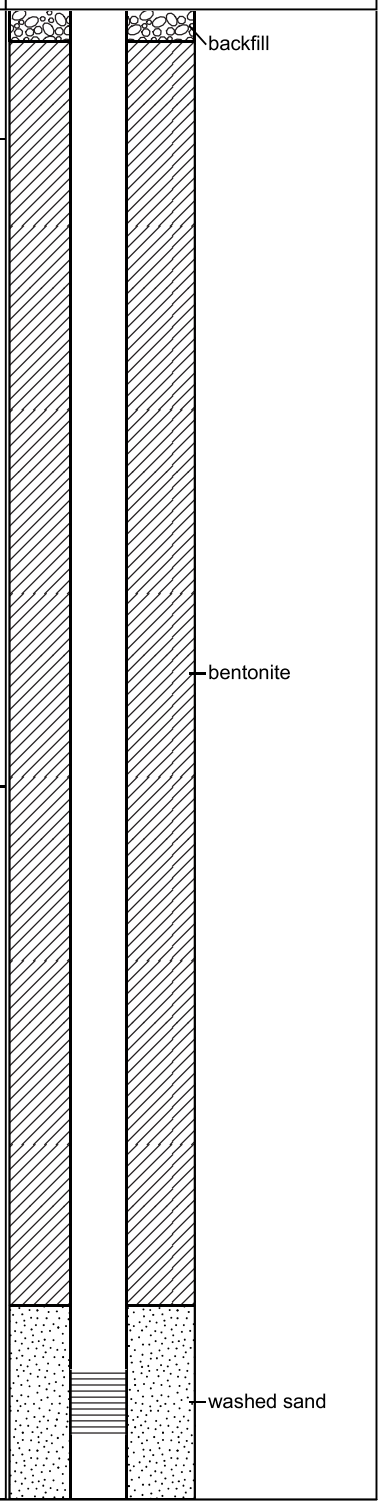
DRILLING DATE 15/03/22
TOTAL DEPTH 2.3m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683876.1N: 6100589.4
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 564.6 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW62)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
31	0.1		SS	Sandy SILT, brown, dry-moist, soft	Topsoil. Grass on surface.
	0.2		SC	Sandy silty CLAY, brown-pale brown, dry-moist, soft	Reworked material. Traces of angular gravel.
35	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
29.2	1				
	1.1				
	1.2			Sandy silty CLAY, light brown, dry-moist, soft and low plasticity	Natural residual soil. Rounded fragments of sorted gravel observed.
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				
3.0	2				
	2.1				
	2.2				



Soil Vapour Well Diagram

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BOREHOLE LOG SV15

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

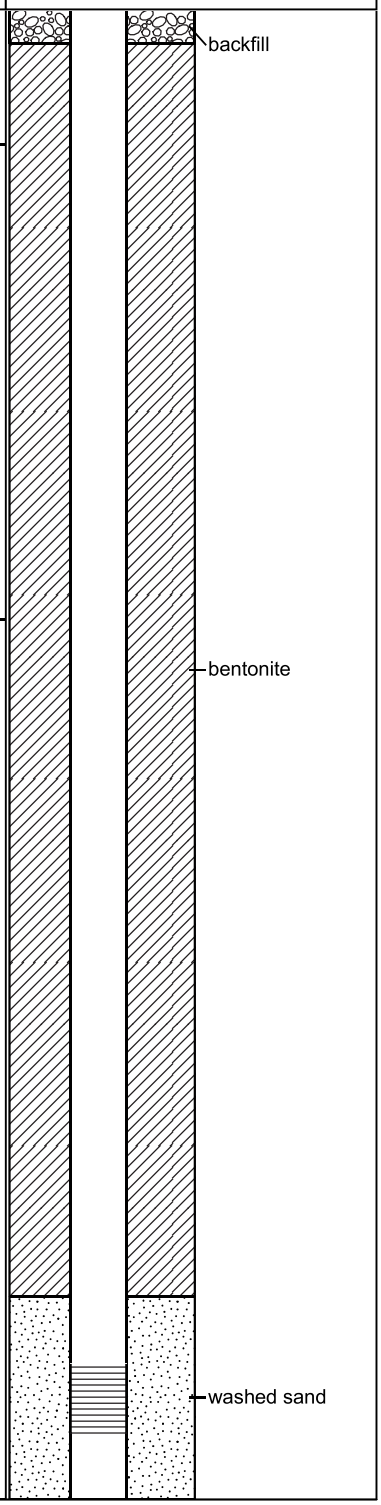
DRILLING DATE 16/03/22
TOTAL DEPTH 2.2m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683843.3 N: 6100589.6
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 563.5 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW65)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0	0.1		SS	Sandy silty CLAY, brown, dry-moist, soft	Topsoil. Grass on surface.
	0.2		SC	Sandy silty CLAY, brown-pale brown, dry-moist, soft	Reworked material or potential residual soil.
0	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9			Sandy silty CLAY, light brown, dry-moist, soft and moderately plastic	Natural material
0	1				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				
0	2				
	2.1				



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produced by ESlog.ESdat.net on 04 May 2022

lanterra consulting

BOREHOLE LOG SV16

PROJECT NUMBER P21083
PROJECT NAME GW & SV Well Installation
CLIENT EPSDD
ADDRESS Section 51, Holt, ACT 2615

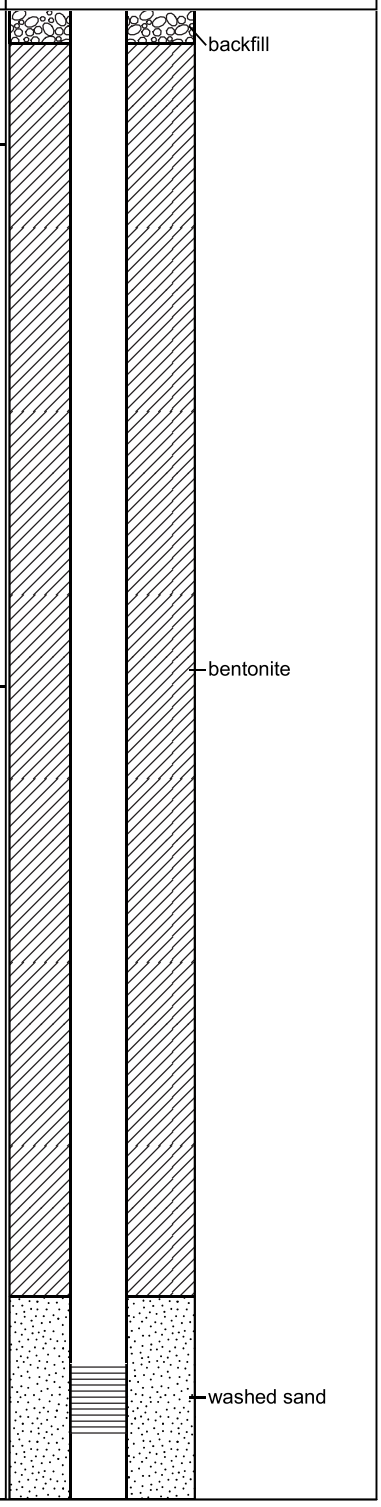
DRILLING DATE 16/03/22
TOTAL DEPTH 2.2m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683819.9 N: 6100577.5
COORD SYS MGA 55/GDA 2020
SURFACE ELEVATION 564.9 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW66)

LOGGED BY A.P
CHECKED BY L.B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0	0.1		SS	Sandy SILT, dark brown-brown, dry-moist, soft	Topsoil. Grass on surface.
	0.2		SC	Sandy clayey SILT, brown, dry-moist, soft	Reworked fill material. Traces of gravel.
0	0.6				
	1			Sandy clayey SILT, brown-light brown, dry-moist	Natural residual soil.
0	2.1				



Appendix E QA/QC Summary

Table E1: Sampling and Analysis Plan Methodology

Sampling Item	EPA Guidelines	Lanterra (2022a) DSI	Auditor Comment
Data Quality Objectives (DQOs)	"Data Quality Objectives: Outline of the DQO Process" in Schedule B2 of NEPM (2013).	The 7 step DQOs for investigation, as summarised in Section 8 are as follows: Step 1: potential contamination identified with the fill, impact along the grass swale, potential USTs, and offsite sources of contamination. Step 2: Decisions are: characterise the contamination to assess suitability of the site for land uses permitted under the Territory Plan zoning. Step 3: Inputs are: existing data, land use permissions, and assessment criteria. Step 4: lateral boundary as shown in figures. Vertical boundary is approx.12.6 m below ground level Step 5: Decision rules are meeting adopted criteria, exceedance would prompt further investigation; QAQC must be suitable. Step 6: Decision error limits based on AS4482.1-1995 for number of samples to make a decision. Step 7: meeting the design as detailed in the DSI to characterise contamination at the site. Summary of 23 boreholes and 1 new groundwater well, sampling of 5 existing wells. n for optimising data	The DQOs are adequate.
Sampling Pattern Rationale	The EPA (1995) Sampling Design Guidelines (Section 2.3) provides details on judgmental, random, systematic and stratified sampling pattern.	Section 9.2.1 states a judgemental sampling plan was preferred, with rationale provided for each location. .	The sampling pattern to be appropriate for the conceptual site model identified.
Sampling Density Rationale:	EPA (1995) Sampling Design Guidelines	Section 9.2 states that considering the area of the site (52,594 m2) which would have meant installation of more than fifty-five boreholes in a grid pattern, a judgemental soil sampling plan was preferred in order to characterise the potential contamination status of on-site soil. Table 11 in the DSI provides a rationale for the soil sampling locations selected.	Considering the audit area, the selected sampling plan was appropriate. The Audit area is 19,000 m2 requiring a minimum of ~30 sampling points. Considering all media, 4 soil bores, 11 soil vapour and 13 groundwater bores were advanced within the boundaries of the Audit site.
Locations Shown on Site Plan:	The NSW EPA (2020a) Consultants Reporting on Contaminated Land – Contaminated Land Guidelines requires that sampling locations are shown on a site plan.	The locations are shown on the consultant's figures.	The locations are included on a plan.

Sampling Item	EPA Guidelines	Lanterra (2022a) DSI	Auditor Comment
Sampling Depths	The NSW EPA (2020a) Consultants Reporting on Contaminated Land – Contaminated Land Guidelines requires information on the depths of samples that were collected. NEPM (2013) Schedule B2.	Section 10.1 states that borehole samples were collected at the surface (0.0-0.1 m), 0.5m below ground level, 1.0 m bgl and at every metre thereafter to a maximum depth of 3.1 m bgl or until bedrock materials are encountered, or at changes in lithology or from lenses of gross contamination. Groundwater wells were advanced to a maximum depth of 14.3 m. Soil vapour wells were advanced to a maximum depth of 5.5 m.	The sampling depths are appropriate for the contaminants of concern and the conceptual site model identified.
Selection of Samples for Analysis:	The NSW EPA (2020a) Consultants Reporting on Contaminated Land – Contaminated Land Guidelines. NEPM (2013) Schedule B2	Section 13.1 provides rationale of the sampling selections for analysis, considering the three kinds of fill identified. Based on the results of the early state results, the soil within the site did not show indications that there had been impact by historical or current activities thus no further soil investigations were considered.	The selection of samples for analysis was appropriate.
Sample Splitting Techniques and Statement of QA/QC Sample Frequencies	NEPM (2013) Schedule B3 EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme NSW EPA (2020a) Consultants Reporting on Contaminated Land – Contaminated Land Guidelines	No comment was made regarding sample splitting techniques. Section 9.2.4 states that one field duplicate sample for each twenty (20) primary soil samples; one (1) groundwater duplicate, and one (1) soil vapour duplicate per sampling event were analysed by the primary laboratory to assess the precision of the results.	The QA/QC sampling frequencies for the investigations comply with NEPM (2013) requirements.
Analytical Methods:	EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme	Lanterra indicate that all analysis was performed in NATA accredited laboratories: • SGS Australia Pty Ltd (NATA accreditation No. 2562) • Envirolab Services Pty Ltd (NATA accreditation No. 2901) • National Measurement Institute (NATA accreditation No. 198)	The analytical methods to be appropriate for the contaminants identified.
Sample Container Selection:	NEPM (2013) Schedule B2 and B3	Soil: A sample corresponded to soil placed in a laboratory prepared 250 millilitre (mL) glass jar with a Teflon lined screw top lid and approximately 300 grams of soil in a zip lock bag for asbestos analysis. Groundwater: samples were collected by transferring water from the HDPE tubing directly into each sample container. Soil vapour: sampling was conducted using 1L Summa canisters	The sample container selection is appropriate for the contaminants of concern.

Sampling Item	EPA Guidelines	Lanterra (2022a) DSI	Auditor Comment
Sampling Devices / Techniques	NEPM (2013) Schedule B2 and B3 DEC (2007) Groundwater Guidelines	Soil samples were collected from directly from soil blocks recovered from the auger with care taken to not collect soil that was in contact with the auger. Groundwater and soil vapour samples were collected as described in separate sections of the tables below.	The sampling devices / techniques adopted are appropriate for the contaminants of concern and the conceptual site model identified.
Decontamination Procedures:	Australian Standard AS4482.1 – 2005 NEPM (2013) Schedule B2 and B3	Section 9.4 states single-use disposable nitrile gloves were used to extract the samples from each sampling location to prevent cross-contamination. For groundwater, sampling equipment to be reused at each location is decontaminated prior to sampling the next location (interface probe, water quality probe and bladder pump)by rinsing the equipment with a Decon 90 (Liquinox reagent if PFAS was being analysed in groundwater), followed by a secondary rinse with PFAS free deionised water.	The decontamination procedures meet the nominated guidelines.
Sample Handling and Preservation Procedures:	NEPM (2013) Schedule B3 AS4482.1 and AS 4482.2	Section 10.1 states that soil and groundwater samples were placed and stored in an ice filled esky to keep them chilled, ready for transport.	The sampling and handling procedures are appropriate for the contaminants of concern and the conceptual site model identified.
Field Calibration and Screening Protocols	NEPM (2013) B2	Field water quality parameters (Temp. EC, pH, DO and redox) were measured during groundwater purging and at sampling with field water quality meter. Field observations regarding sheen, odour and discoloration were recorded Screening of potential volatile compounds using a PID immediately after opening the well cover was completed. . PID measurements were collected from the implants prior to sampling and after SV sampling Calibration certificates are provided.	The field calibration and screening protocols to be appropriate for the contaminants of concern and the conceptual site model identified.
Groundwater Monitoring Well Installation	NEPM (2013) Schedule B2 DEC (2007)	Lanterra reports that the groundwater monitoring wells were installed using a rubber track mounted geoprobe drill rig. The wells were installed to a maximum depth of 14.3 m bgs. The wells were constructed from 50 mm UPVC screen and casing, combined with an encased gatic cover flush to grade.	The method of construction are appropriate for the contaminants of concern and the conceptual site model identified
Groundwater Monitoring Well Development & Sampling	NEPM (2013) Schedule B2 DEC (2007) AS5667.11 (1998)	The depth to groundwater in each well was then measured prior to sampling. Wells were purged using a bladder pump connected to a low flow micropurge. The drawdown of water was constantly measured with an interface probe. Water quality parameters were measured with a calibrated water quality meter and when parameters stabilise to within 10% over successive measurements, purging will be complete. Purged water was stored in drums for disposal Groundwater samples were obtained using a low flow peristaltic pump. New disposable Low Density Polyethylene (HDPE) tubing and silicon tubing were used at each monitoring well	The well development and sampling meet the nominated guidelines

Sampling Item	EPA Guidelines	Lanterra (2022a) DSI	Auditor Comment
Consideration of existing production, residential and other monitoring wells when determining groundwater well locations	NSW EPA (2020a)	Well locations were selected considering the outcomes of the previous stages of the investigation and the monitoring program utilised existing monitoring wells (GW1-GW5)	The location of the wells has considered existing production, residential and other monitoring wells.

Table E2: Quality Assessment and Quality Control Summary

Requirement	DQI	Lanterra (2022b) DSI	Auditor Comment
Completeness		**DQI Range**	
Appropriate field sampling, sample documentation & description	AS4482.2 (1999) Parts 1&2	Details shown on borelogs and tables. Groundwater field sampling forms and soil vapour monitoring sheets are provided.	
Records detailing samples & conditions	Recorded on Borehole logs	Details shown on borelogs	Acceptable
All critical samples analysed for COCs and compared to criteria	All Samples.	Yes	Acceptable
Comparability			
Experienced sampling team followed SAQP/SOP	Comment made in report	Section 10.1 states a suitably qualified and experienced environmental scientist from Lanterra was mobilised to the site.	Acceptable
Climatic Conditions Recorded & Discussed	Recorded on Borehole logs or in Report	Section 10.3.2 states that soil vapour sampling was undertaken following 3 days of dry weather. Barometric pressure and soil vapour monitoring sheets were not provided.	Acceptable
Primary Laboratory	NATA Accredited to 17025	SGS (NATA 2562) National Measurement Institute (NATA accreditation No. 198) during Stage 4.	Acceptable
Secondary Laboratory	NATA Accredited to 17025	Envirolab (NATA 9797) SGS (NATA 2562) during Stage 4	Acceptable
Appropriate Analytical Methods	NEPM	All NEPM	Acceptable
Chain of custody	Includes sampler, sample nature, date, analyses, preservation, departure time, courier	Appropriate COCs provided in the Appendices	Acceptable

Requirement	DQI	Lanterra (2022b) DSI	Auditor Comment
LOR, PQL Appropriate & Consistent	LOR<criteria	LOR< criteria except for the following: Groundwater GW51 during Stage 2: • Dichloromethane (Stage 2) Soil Vapour, select wells during Stage 2, Stage 3 or Stage 4: • TCE (SV1s, SV2s, SV5s) • DCE (SV1s, SV1d, SV5s) • Vinyl chloride (SV1s, SV1d, SV5s) • Naphthalene (SV1s, SV1d, SV5s)	These exceedances of the criteria are considered acceptable as the sample locations are not located on the site and were not considered within the Tier II HHRA.
Representativeness			
Sample Handling Appropriate & Received by Lab in Good Condition under correct Preservation Conditions	Compliant SRN	Sample handling appropriate and received by lab under correct preservation conditions	Acceptable
Field Screening Method Calibration	Field Instrumentation calibrated in accordance with manufacturers instruction	Field water quality parameters (Temp. EC, pH, DO and redox) were measured during groundwater purging and at sampling with field water quality meter. Field observations regarding sheen, odour and discoloration were recorded Screening of potential volatile compounds using a PID immediately after opening the well cover was completed. . PID measurements were collected from the implants prior to sampling and after SV sampling Calibration certificates are provided.	Acceptable
Primary Lab Holding Times	All samples comply with NEPM (2013)	All samples comply	Acceptable
Secondary Lab Holding Times	All samples comply with NEPM (2013)	All samples comply noting the lab reports state QC2 was not extracted within the recommended hold time however Lanterra acknowledge that this was due to a typo in the COC sent to the laboratory.	Acceptable
Trip Spike	(per sampling event) 70-130%R	Not completed.	Not completed, given the lack of TRH volatiles in the results, this is considered acceptable.

Requirement	DQI	Lanterra (2022b) DSI	Auditor Comment
Trip Blank	70-130%R	<LOR	Acceptable
Rinsate Blank	(per sampling event)	<LOR with the exception of 43 µg/L of copper and 51 µg/L of chloroform detected in Rinsate 4 collected after sampling GW68 in 31/03/2022	The Rinsate detections do not match primary sample. Lanterra state tap water may have been used but that the detections is unlikely to have impacted the outcome of the investigation.
Precision			
Primary Lab Duplicates (D)	(1/20 sample batch)	Soil: 0-55%R GW: 0-67%R SV:0-19%R	Acceptable, noting some %RPD exceedances for TRH and heavy metals in soil, likely attributable to soil heterogeneity.
Field Duplicate Samples by Primary (intra-laboratory duplicates)	<5xPQL = any %RPD	Soil: 0-29%R GW: 0-173%R	Acceptable, noting groundwater %RPD exceedances for heavy metals, likely attributable to soil heterogeneity. Lanterra do not comment on the groundwater RPD exceedances
Field Duplicate Samples by Secondary (inter-laboratory duplicates)	>5xPQL = <50% RPD	Soil: 0-48%R GW: 0-173%R	
Accuracy			
Primary Lab Matrix Spikes (MS)	(1/20 sample batch) 70-130%R Soil	5-138%R with TRH and metal outliers	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level
Primary Lab Surrogate Spikes (S)	(1/20 sample batch) 70-130%R Soil	Soil: 36-120%R GW: 50-135%R	Acceptable
Primary Lab Control Spikes (LCS)	(1/20 sample batch) 70-130%R Soil	Soil: 80-125%R GW: 99-120%R	Acceptable

Requirement	DQI	Lanterra (2022b) DSI	Auditor Comment
Primary Lab Method Blanks (MB)	<LOR	<LOR	Acceptable
Secondary Laboratory QA/QC Data (Soil and Water)	0-100%R 70-130%R 70-140%R 70-140%R <LOR	D: 0-67%RPD MS: - S: 75-106%R LCS: 80-138%R MB: <LOR	Acceptable when the data set is considered in its entirety

Table E3: SAQP and QA/QC Summary for Soil Vapour Sampling

Requirement	Guideline	Consultant Information	Auditor Comment
Location and number of sampling points	Section 9.4.1 NEPM B2 (2013)	Lanterra installed 16 soil vapour monitoring wells both on and off the site	The location of the soil vapour monitoring wells is appropriate to determine the potential vapour risk from impacted groundwater.
Depth of sampling point	Section 9.4.1 NEPM B2 (2013)	Lanterra installed both shallow and deep soil vapour monitoring wells – deep wells to a maximum depth of 5.5 m and shallow wells to a depth of 1.2 to 2.25 mbgl	The depth is appropriate to minimise atmospheric interference noting that water ingress to the response zone of the soil vapour probe occurred in the deeper wells
Frequency of sampling	Section 9.4.1 NEPM B2 (2013) CRC Care Technical Report 13 (2009)	The consultant conducted soil vapour sampling in November 2021 (2 new wells), January 2022 (7 new wells), and March 2022 (7 new wells) with sampling of all 16 wells.	The DSI and SMP acknowledge that additional sampling of wells would benefit the conceptual site model to assess any potential for seasonal variations that may occur.
Sampling installation method	Section 9.4.2.2 NEPM B2 (2013)	Lanterra placed a 150mm screened mesh soil vapour implant at the target depths: • SV1 to SV9 – at 1.5 m and 5.5 m bgl. • SV10 to SV16 –between 2.2 m and 2.4 m bgl. The vapour implants were connected with Nylon tubing to the ground surface and performed with care to ensure the implant are not in direct contact with the bottom of the drilled borehole. A 300 mm sand pack was placed around the implant and tubing, followed with a bentonite backfill to surface.	The sampling installation method is appropriate.
Equilibration period	Section 9.4.2.2 & 9.4.2.4 NEPM B2 (2013)	The first sampling event was conducted 24 hours after installation.	There was sufficient time for well equilibration to occur.
Sampling method	Section 9.5.1 & 9.5.2 NEPM B2 (2013)	Section 10.3.2 provides the following summary on sampling methods: • certified Summa canisters and flow regulator serial numbers were recorded. • all tubing and connectors were checked to ensure secure connections. • PID measurements collected from the implants prior to and after sampling for all sampling events (Stage 2 to Stage 4). Landfill gas analyser (i.e., GA5000) measurements were collected from the implants prior to sampling and after sampling during Stage 4 – March 2022. • A minimum of one (1) volume of gas was purged using the PID (Stage 2 and Stage 3) and the GA5000 (Stage 4). The PID and land fill analyser levels were stabilised prior to sampling. • Leak detection was undertaken for the vapour well using the Isopropyl alcohol (IPA) leak testing procedure in accordance with the USEPA (2020) Soil Gas Sampling, whereby a paper towel soaked with isopropyl	The sampling method is considered to be appropriate

Requirement	Guideline	Consultant Information	Auditor Comment
		alcohol (IPA) is inserted into the sampling shroud with the canister for the entire sampling period. • A sample of the IPA shroud concentration was collected on a carbon absorbent tube to assess for leaks, with a syringe used to draw air (100 ml) from the absorbent tube in the shroud. The carbon absorbent tubes are then tested for IPA, with results compared with the IPA results obtained from the soil vapour results to verify if an unacceptable leak has occurred. • Sampling was conducted using 1L Summa canisters attached with quick connectors to connect to the tubing with soil vapour implant. • Flow regulators used from Stage 2 to Stage 3 were calibrated to 50mL/min and approximately 17mL/min during Stage 4. • The Summa canister vacuum readings were recorded prior to and following the sampling period. • During sampling, indications of vacuum (scavenging) were observed within the sampling train to ensure there is no restriction of soil vapour through the formation of soil matrix/pipe network. • At the end of sampling, the Summa canister was closed and disconnected from the tubing, ceasing the flow. The Summa canister and the flow regulator were subsequently disconnected. • At the conclusion of sampling, Summa canisters were dispatched to NATA accredited laboratory under chain of custody procedures for analysis.	
Probe integrity / seal	Section 9.4.2.4 NEPM B2 (2013)	Leak detection was undertaken for the vapour well using the Isopropyl alcohol (IPA) leak testing procedure in accordance with the USEPA (2020) Soil Gas Sampling, whereby a paper towel soaked with IPA is inserted into the sampling shroud with the canister for the entire sampling period. A sample of the IPA shroud concentration was collected on a carbon absorbent tube to assess the significance of any leaks detected, with a syringe used to draw air (100 ml) from the absorbent tube in the shroud. The carbon absorbent tubes are then tested for IPA, with results compared with the IPA results obtained from the soil vapour results to verify if an unacceptable leak has occurred.	The installation logs indicate that the soil vapour wells were installed in an appropriate manner including a 200mm bentonite seal and backfilled with as dug materials with a concrete security cover. A maximum concentration of <0.1% IPA was recorded during sampling which is acceptable.
Tubing type	Section 9.4.2.4 NEPM B2 (2013)	Nylon tubing	The tubing type is appropriate
Sample flow rate 0.1-100L/min	Section 9.4.2.4 NEPM B2 (2013)	Flow regulators used from Stage 2 to Stage 3 were calibrated to 50mL/min and approximately 17mL/min during Stage 4.	The flow rate was appropriate given the lithology.
Sample volume and duration	Section 9.4.2.4 NEPM B2 (2013)	Sampling were collected into 1 litre canisters and sample collected over a period of approximately 20 min +/-.	The sampling volume and duration is appropriate for the methods employed.

Requirement	Guideline	Consultant Information	Auditor Comment
Purge method and volume/	CRC Care Technical Report 13 (2009) Section 9.4.2.4 NEPM B2 (2013)	Not specifically stated. The report states that one volume of gas was purged using the PID/GA5000 and allowed levels to stabilise prior to sampling	This method of purging is considered to be a non-conformance. . The flow rate of a landfill gas analyser is typically 300cm3/min or 0.3L/min. A sampling train and installation volume is typically less than 300ml and it usually take 1 minute for gas readings to stabilise. Consequently, the Auditor is satisfied that the soil vapour sample wells were sufficiently purged prior to sampling.
Sampling team	Section 19.10 NEPM B2 (2013)	Detail of sampler provided on COC (Leo Baezas)	The field records should state detail of the person conducting the sampling.
Decontamination procedures	Section 19.10 NEPM B2 (2013)	No information provided. Dedicated sampling equipment was used.	Given that the sampling train and wells were purged prior to sampling, the lack of decontamination information is not considered to affect the outcome of the results.
Chain of custody	Section 19.10 NEPM B2 (2013)	A signed chain of custody provided	Not acceptable
Sample splitting and Duplicate frequency	Section 19.10 NEPM B2 (2013)	A duplicate and triplicate sample were collected for every sampling event however the methods are not outlined.	An appropriate duplicate frequency was selected. It is assumed that duplicates were collected using a supplied T piece.
Field blank	Section 19.10 NEPM B2 (2013)	Not completed	The absence of field blanks are considered to be a non-compliance of NEPM (2013) requirements
Background samples	Section 19.10 NEPM B2 (2013)	Not conducted	Not applicable as no background samples were obtained.
Field instruments	Section 19.10 NEPM B2 (2013)	Landfill Gas Meter (1 x cal) PID (3 x calibration)	Accepted.
Holding times	Section 19.10 NEPM B2 (2013)	Sample receipts state samples were provided within adequate time to meet relevant holding time.	The samples were analysed within the holding time. The laboratory certificate stated that an attempt to chill the sample was evident
Analytical methods	Section 19.10 NEPM B2 (2013)	USEPA TO-15 and hydrocarbons	The analytical method is appropriate
Lab and method accreditation	Section 19.10 NEPM B2 (2013)	SGS (NATA 2562) National Measurement Institute (NATA 198) during Stage 4. Envirolab (NATA 9797)	The labs and methods are appropriate.
Detection limit	Section 19.10 NEPM B2 (2013)	Analytical LORs for specific analytes were higher than the accepted criteria in multiple soil vapour samples: • TCE (SV1s, SV2s, SV5s) • DCE (SV1s, SV1d, SV5s) • Vinyl chloride (SV1s, SV1d, SV5s) • Naphthalene (SV1s, SV1d, SV5s)	Stated as a non-conformance but noting these locations are not within the Audit site boundary and were not considered in the Tier II assessment.

Appendix F Site Management Plan

Site Management Plan

Blocks 22 and 71, Section 51, Holt

27 July 2022

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1 Introduction

This Site Management Plan (SMP) has been prepared for Block 22 and Block 71 Section 51, Holt for the management of volatile chlorinated hydrocarbons (VCH) in groundwater and the soil vapour phase.

This SMP applies to Blocks 22 and 71 Section 51 Holt. While VCH compounds have been identified beneath the road reserve of Kippax Place, contamination beneath Kippax Place will be managed under a site specific management plan.

The location of the site is shown on **Figure 1, Appendix A**.

1.1 Background

A detailed site investigation (DSI) was completed for Blocks 22 and 71, Section 51 Holt to assess the suitability of the site for the land uses permitted under the CZ1: Core Zone and PRZ1: Urban Open Space. The investigation included the collection and analysis of samples from soil, groundwater and soil vapour.

Through the investigation process, the following site conditions were identified:

- No contamination was identified in soil with the exception of one sample recovered from beneath the asphalt of Kippax Place.
- VCH compounds were present in groundwater wells located in the north-western section of the site in the vicinity of the old Kippax Health Centre. Concentrations of tetrachloroethene (PCE) and trichloroethene (TCE) and/or cis-1,2-dichloroethene were measured at concentrations above the adopted Australian Drinking Water Guidelines 2011.
- The inferred direction of groundwater flow is in a north to north-westerly direction.
- Based on the groundwater flow direction and locations where the contaminants were detected, it was inferred that two (2) separate contaminant plumes may be migrating onto the site.
- Soil vapour sampling identified concentrations of VCH compounds above the Tier 1 screening criteria for residential and commercial / industrial use to the north and south of the former Health Centre. It was inferred that these concentrations are related to the presence of VCH in groundwater to the north and south of the Health Centre.

Further details regarding the contamination are presented in Section 3.5 below.

Based on the results, it was concluded that contamination may pose a potential risk to the site, particularly from the soil vapour phase. To further assess this risk, a quantitative human health risk assessment (HHRA) was completed. The results of the HHRA indicated that the exposure to contaminants of concern was less than the tolerable concentrations and therefore the risk of harm to human health for residents, commercial workers and recreational receptors at the site was low.

However, it was recognised that several data gaps and uncertainties exist which could alter the outcomes of the HHRA, particularly where future building designs may directly interact or alter the characteristics of contamination (e.g. lateral and vertical extents or concentrations of contaminants of concern.

Given the persistent presence of contaminants of concern in groundwater and the soil vapour phases, this SMP has been prepared to assist the land custodians, their contractors and utility providers with the managing works that may be affected by contaminants on the site.

The site has been the subject of a contaminated site audit by Dr Lange Jorstad of Geosyntec Consultants and a Site Audit Report and Site Audit Statement are to be provided to the ACT Environment Protection Authority (EPA).

1.2 Objectives

The objective of this SMP is to identify the location of VCH contamination and provide guidance and management requirements for preventing unacceptable exposure to contamination for the land uses permitted under the CZ1: Core Zone and PRZ1: Urban Open Space.

1.3 Limitations

Lanterra has perform services in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties express or implied, are made.

The assessment was limited strictly to identifying typical environmental conditions associated with the subject property area and does not include evaluation of any other issues.

The absence of any identified hazardous or toxic materials on the subject property should not be interpreted as a guarantee that such materials do not exist on the site.

The results of this assessment are based upon the site inspection and the sampling specified above conducted by Lanterra personnel and information from the Client or regulatory agencies. All conclusions and recommendations regarding the property area will be the professional opinions of the Lanterra personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability are made, Lanterra will not assume responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of Lanterra.

2 Regulatory Requirements

In accordance with Section 9.3.8 of the ACT EPA (2019) '*Contaminated Sites Environment Protection Policy*'.

For sites requiring ongoing management on unleased Territory land, on leased land being managed by an ACT government agency or on leased land subject to interim development (for example, Greenfields developments, multi-unit developments or mixed use developments which are subject to interim development prior to the land's sale and/or the establishment of the Body Corporate) an Agreement under Section 38 of the Environment Protection Act should be entered into between the EPA and the land custodian. The Agreement will detail the nature of the substances remaining at the site (or off site), specific site details and the required management measures.

The Agreement would include a requirement that the site be managed in accordance with the EPA/Auditor endorsed SMP and that management continues until the EPA and the Auditor agree in writing that the SMP is no longer required.

Should the Agreement not be complied with, an Environment Protection Order under Section 125 (3) of the Environment Protection Act could be issued on the land custodian to ensure the site continues to be managed appropriately.

For sites where land custodianship falls to business units within the ACT Government Directorates, the Agreement would also specify that these management requirements be recorded in the TCCS Integrated Asset Management System in accordance with its Procedure for the Management of Contaminated Assets Version 1.2 dated 31 May 2013 (as updated from time to time). The transfer of responsibility for SMPs subject to an Agreement (or Environment Protection Order) can only occur with the written acceptance of the EPA

Based on the results of the detailed site investigation, the ACT EPA has been notified of the contamination in accordance with the requirements of Section 23A of the Environment Protection Act 1997.

In the event that contamination that differs from that characterised as a part of the detailed site investigation and human health risk assessment, then there will be a duty to notify the ACT EPA of the new and/or change in contamination on the site.

3 Site Characteristics

3.1 Site Location

The site location and a detailed site plan are presented as **Figure 1** and **Figure 2**, **Appendix A**.

Table 1: Summary of Site Details

Site Characteristics	Detail
Street Address	Kippax Place, Holt, ACT
Approximate Easting and Northing (centre of site)	Easting: 683856.7 Northing: 6100501.8
Block, Section, Division	Blocks 22 and 71 Section 51, Holt Kippix Place Road Reserve
Land Zoning	Block 71: CZ1: Core Zone, PRZ1: Urban Open Space Block 22: CZ1: Core Zone
Current Land Use	Mixed use commercial, Open Space and Sports Playing Fields
Proposed Use	Potential for land uses permitted under the CZ1: Core Zone and PRZ1: Urban Open Space including residential use
Block Area	19,645 m^2

3.2 Site Description

The following description is based on observations made during a site visit conducted on 28 - 29 March 2022 by a suitably qualified environmental scientist from Lanterra:

- The site is adjacent to Kippax Shopping Centre to the west, Flack Street to the south, Moyes Crescent to the west and open public area to the north.
- The Kippax Health Centre is located on Block 22 Section 51 Holt is a brick public building that was formerly used as offices for medical practitioners. More recently the building was tenanted by an environmental group. It is understood that the building is currently vacant and may be demolished in the future.
- The site is publicly accessible from each front.
- Overall topography across the site slopes gently from south to north with the exception of the area between Kippax Place and the sporting fields located to the east, where a moderate to steep embankment is present connecting Kippax Place to the lower lying ovals.
- Areas sealed with asphalt/bitumen including Kippax Place, bike paths, pedestrian roads, and Moyes Crescent appear in good condition and no significant cracks and/or fuel/oil staining was observed.
- The ovals are well maintained with no significant anthropogenic materials observed.
- The eastern and northern sides of the Kippax Health Centre are surrounded by retaining walls that have been used as garden beds. Fill material has been used in these areas. Air conditioning units are also observed to the north and east of the centre.
- A grassed swale channel originating in the southern corner of the site and running through the playing fields is present. This channel runs towards the northeast in the southern portion of the site and towards the northwest in the eastern portion of the site. No surface water was observed at the time of the walkover.

- Adjacent to the site, gas infrastructure for the shopping was observed behind supermarket facilities to the north of the Health Centre . These systems appear in good condition.
- An area containing rubbish bins, gas infrastructure, and air conditioning systems associated with Kippax Fair Shopping Centre was observed adjacent to northeast boundary the site.
- A public toilet building is located to the south-east of the Kippax Health Centre. This facility appeared to be in good condition.

3.3 Surrounding Land Uses

A summary of the land uses that surround the site are as follows:

- **North:** Northern boundary is adjacent to commercial buildings, public open space, and a tennis club. Southern Cross Drive and residential dwellings are observed beyond.
- **South:** Immediately south of the site, commercial and residential facilities and Flack Street are observed. Open public space and private sport facilities are observed further south. A service station located at the corner of Hardwick Crescent and Flack Street is observed to the south of the site. The service station is currently listed on EPA Register of Contaminated Land
- **East:** Moyes Crescent is located on the eastern boundary of the site. Residential dwellings and Southern Cross Drive are observed further east.
- **West:** Commercial buildings of the Kippax Group Centre are observed to the west of the site. Hardwick Crescent and more commercial facilities are observed further west, including an active dry-cleaner in front of the Public Library.

3.4 Geology

The 1:100,000 Geological Series, Canberra, New South Wales and Australian Capital Territory, Sheet 8727 (Bureau of Mineral Resources, 1992) shows that the site is underlain by the Deakin Volcanics of the late Silurian comprising of Rhyodacitic ignimbrite and minor volcaniclastic and argillaceous sediments.

3.5 Hydrogeology

Four (4) groundwater abstraction bores are located within 2,000 m, the nearest of which is located approximately 1,684 m to the north of the site. These are unlikely to be adversely affected by contaminants on the site.

A review of the Bureau of Mineral Resources (1984) Hydrogeology of the Australian Capital Territory and Environs indicates that groundwater beneath the site is hosted in fractured aquifers with higher yielding zones associated with the upper and lower portions of the individual ash-flow tuffs and interbedded sediments of the late Silurian. The quality of groundwater is expected to be variable, the total dissolved solids (TDS) anticipated to vary between 500 - 1000 milligrams per litre (mg/l) and the yield is estimated to be between 0.5 and 1.0 litres per second (l/sec).

Based on the installation of groundwater monitoring wells during the Detailed Site Investigation (Lanterra, 2022), groundwater was encountered between 8 m and 12 m below ground level (bgl), while the standing water levels were measured between 3.1 m and 6.4 m bgl.

The groundwater direction of groundwater flow appears to follow the site topography and flow in a north to north-easterly direction.

3.6 Hydrology

Surface water that is anticipated to infiltrate into the subsurface where the surface is unsealed, while sealed surface are anticipated to divert water to the stormwater system and eventually into Ginninderra Creek approximately 560 m to the north.

3.7 Sensitive Environments

The following sensitive environment receptors were identified:

- A grassed swale channel originating in the southern portion of the site, parallel with Flack Street, which then runs along the eastern section of the site beyond the northern boundary. The stormwater load eventually drains into Ginninderra Creek to the north.
- Childcare centre located approximately 100 m towards the northwest of the site.
- Residential areas located to the east of the site beyond Moyes Crescent, adjacent to the southern corner of the site and adjacent to the north of the northwest corner of the site.

It is noted that the grassed swale across the site was part of a flood modelling study (Calibre, 2020) which stated its limited hydraulic capacity, therefore, subject to flooding. Calibre (2020) recommended the swale to be regraded to limit flooding of the playing fields in the southern portion of the site.

3.8 Nature of Contamination

Through the previous investigations that have been completed across the site, contamination has been identified in groundwater and soil vapour. Results of soil samples collected across the site did not identify contaminants of concern in soil that would pose a risk to human health.

Volatile chlorinated hydrocarbons, which in the context of Block 71 Section 51, Kippax relates to a group of compounds comprising of the following:

- Perchloroethlyene (PCE)
- Trichloroethylene (TCE)
- Dichloroethylene (DCE)
- Vinyl chloride

Perchloroethylene is the primary solvent used in the dry cleaning of clothes and is a volatile compound that produces a vapour which may reside in soil, or under some circumstances migrate into indoor spaces of buildings where it may pose a risk to the occupants of the building. The other compounds are common daughter products produced from the degradation of the parent where TCE is the result from the degradation of PCE, DCE from the degradation of TCE and vinyl chloride from the degradation of DCE.

A summary of the contamination in groundwater and soil vapour is summarised below.

3.8.1 Groundwater

In total, seventeen (17) groundwater monitoring wells have been constructed and retained across the site. Based on the measured groundwater elevations, the depth to groundwater varies from 3.09 m below ground level (bgl) to 6.36 m bgl while the calculated direction of flow is north to north-easterly. This is based on data recorded in March 2022.

A general description of groundwater contamination is presented below:

- VCH compounds were present in groundwater in the vicinity of the Kippax Health Centre building and beneath the northern portion of Kippax Place between the toilet building and the Kippax Health Centre. The concentrations of various VCH compounds including perchloroethylene (PCE), trichloroethene (TCE) and 1,2 cis dichloroethane (cis 1,2 DCE) exceeded the adopted ADWG 2011 criteria and the *Environment Protection Regulation 2005 (ACT) – AQUA/4 – Urban Drains and Streams: Pollutants entering Waterways taken to cause Environmental Harm Aquatic Habitat* criteria.
- Concentrations of heavy metals that exceeded the adopted criteria (arsenic, cadmium, chromium, lead, nickel and zinc) were relatively consistent across the site and sampling events and attributed to background concentrations associated to the geology of the site and potential seasonal variation.

A plan showing the location of the groundwater plume for VCH compounds is presented on **Figure 3, Appendix A**.

3.8.2 Soil Vapour

Sixteen (16) soil vapour wells were constructed in the northern section of the site in the Kippax Place carpark between the toilet building and Kippax Health Centre, around the perimeter of the Kippax Health Centre and in the vacant grass area to the north of the Kippax Health Centre.

The soil vapour investigations identified concentrations of VCH compounds above the HSL A and HSL D criteria for residential and commercial/industrial uses to the north and south of the old Kippax Health Centre. It is inferred that the source of the vapour in soil was VCH in groundwater.

The location of the soil vapour contamination is presented in **Figure 4, Appendix A**.

The locations of the groundwater and soil vapour plume are herein referenced as the impacted area.

4 Roles and Responsibilities

A guide to the roles and responsibilities of stakeholders during construction are outlined in the following sections. Blocks 71 and 22 Section 51 Holt have multiple custodians (as described below) and **Figure 3, Appendix A** outlines the area for which each custodian will be responsible for the implementation of the SMP.

4.1 Land Custodians

Contamination is present within Blocks 71 and 22 Section 51, Holt. It is understood that two (2) ACT Government directorates will have custodianship across the site:

- Transport Canberra and City Services (TCCS) who are the custodians of the playing fields and vacant land to the north within Block 71 Section 51 Holt.
- ACT Property Group who has custodianship of the former Kippax Health Building on Block 22 Section 71, Holt.

It is recognised that custodians will have their own management systems for managing health and safety risks on their properties and where appropriate, this SMP must be added to these risk systems. TCCS are to record the site in their Integrated Asset Management System to ensure that service providers or other contractors are notified of the SMP through the Dial Before you Dig system.

Block 71 Section 51 Holt is on the ACT Governments future land release program and it is anticipated that custodianship will be transferred from TCCS to the Suburban Land Agency (SLA) in the future. When this occurs, the SMP will have to be transferred to the SLA and modified to reflect the change in custodianship.

The custodians of each area will be responsible for the implementation and management of this SMP. Custodians will be responsible for the following:

- That this SMP is provided to any organisation or person(s) including representatives of the site custodian, earthworks contractors, builders, utilities or communication workers who are required to:
    - Disturb soil on the site.
    - Break through the asphalt layer of Kippax Place.
    - Access any service utilities located within the contaminated area.
- Ensure that all workers who are to conduct works for one of the above activities understand the requirements of the SMP and are inducted to this SMP.
- Notify any organisation or person(s) including representatives of the site custodian, earthworks contractors, builders, utilities or communication workers of any updates or changes to the SMP.
- Maintain records related to inductions for work that is conducted on the site.
- Ensure that this SMP is maintained and updated as required. Records of changes to the SMP and subsequent approvals from the Site Auditor and ACT EPA must be maintained by the site custodian.
- Ensure that all workers on the site comply with the requirements of the SMP.
- Ensure that ongoing monitoring programs are implemented and completed.

4.2 Service Providers

A dial before you dig search of the site has identified the following providers who have assets in the contaminated area:

- TPG
- Evoenergy
- Icon Water
- Telstra
- Department of Finance
- NBN Co

Service providers who require access to any service pits or access to services through soil will be required to:

- Ensure that all contractors who will undertake work on the site are inducted into and understand the requirements of this SMP;
- Ensure that works on the site comply with the requirements of this SMP;
- Ensure that copies of the following records are kept at the completion of the project:
    - Inducted personnel approved to undertake work on the site. An example of an induction record form is attached as **Appendix B**;
    - EPA approvals for the disposal of soil;
    - Records of soil movement for reuse purposes or waste in accordance with any EPA approvals; and
    - Records of unexpected finds that may be encountered during work on the site.
    - Ensure that copies of all records are provided to the lease holder by the completion of the project.

The service providers must be notified of the presence of contamination in the area and nominate personnel who are to be inducted into the SMP. The requirements of the SMP must be explained to all site workers as a part of an induction process and a copy of the SMP is to be maintained on site during the course of site works.

4.3 Site Workers / Sub-Contractors

Site workers and engaged sub-contractors engaged by TCCS, SLA, ACT Property Group or any of the service providers and exposed to soil or are required to undertake work on utilities within the contaminated zone will be required to comply with the SMP as follows:

- Ensuring they are inducted and understand the requirements of this SMP.
- Have a copy of the SMP available on site during the required works.
- Ensure that the information in this SMP is incorporated into job specific environment and work health and safety systems.
- Report any occurrences of suspected contamination to the service provider or land custodian.

Where activities are limited to surface activities only and do not require the disturbance of soil or access to sub-surface infrastructure (e.g. grass mowing), then the requirements of this SMP are not necessary.

4.4 Suitably Qualified Environmental Consultant

A Suitably Qualified Environmental Consultant (SQEC) must be engaged to provide contaminated land support where there is uncertainty regarding the impact contamination may have on the required work. The primary responsibilities of the environmental consultant would be:

- Induct senior personnel of the custodians, service providers or any subsequent site workers or contractors required to undertake work in the contaminated area.
- Undertake appropriate monitoring (e.g. air monitoring for volatile compounds using a photoioniation detector [PID], groundwater or soil vapour sampling for ongoing monitoring programs) or sampling as required for the classification of contaminated material in accordance with the relevant ACT legislation and guidelines;
- Preparing, implementing and validating remedial actions, where necessary, to manage contamination identified under the unexpected finds protocol, or as necessary in relation to future land uses.
- Prepare correspondence for submission to the ACT EPA seeking approval for the removal of soil from the site.

The Suitably Qualified Environmental consultant will be required to induct the senior staff of the land custodians into the requirements of the SMP.

4.5 EPA Approved Environmental Auditor

An EPA approved environmental auditor will be required to review any further environmental investigations or changes made to the SMP. These will include, but not necessarily limited to:

- Any further environmental investigations completed across the site. This will include any dewatering plans that may be necessary for bulk earthworks.
- Any proposed remedial action plan, including contaminant mitigation, management and/or monitoring requirements.
- Review and endorsement of proposed changes or requests to terminate this SMP.
- Review and endorsement of any future SMP that may be required after the development of the site.

4.6 Environment Protection Authority

The EPA will need to be notified of any changes to the understanding of contamination across the site and will be responsible for the following:

- Provide support in writing of any proposed changes or the termination of this SMP based on the recommendations of the EPA approved Environmental Auditor.
- Provide written support for the transferral of responsibility of this SMP between land custodians.
- Provide written support for any future SMP that may be required after the site has been developed.
- Review and endorse any future site audit statement and site audit report prepared by an EPA approved environmental auditor following any further contamination investigations on the site.
- Review and endorsement of soil disposal applications that have been prepared by a suitably qualified environmental consultant.

4.7 Induction Procedures

Prior to any work that requires the interaction with soil, all personnel who may interact with the soil must be inducted into this SMP. The following inductions requirements must be followed:

- Senior personnel of the land custodians (i.e. ACTPG and TCCS) must be inducted into the SMP by a Suitably Qualified Environmental Consultant. Where there is a change in custodianship, then representatives of the new custodian must be inducted into the SMP.
- Subsequent personnel (e.g. site workers / sub-contractors) must be inducted into the SMP by one of the following:
  - A Suitably Qualified Environmental Consultant.
  - Personnel who were inducted into the SMP by the Suitably Qualified Environmental Consultant.
- All personnel inducted into the SMP must acknowledge that they understand the requirements of plan and sign an induction register that must be maintained on the site.
- Upon transfer of this SMP to another entity, a Suitably Qualified Environmental Consultant must induct representative of the new entity into this SMP.
- Any workers / contractors who undertake work that requires interaction with soil or access to underground services must be inducted into the SMP prior to commencing work by either a suitably qualified environmental consultant, or personnel inducted into the SMP by a suitably qualified environmental consultant. All workers / contractors must acknowledge that they understand the requirements of plan and sign an induction register that must be maintained on the site for the duration of the work. An example induction register is presented in **Appendix C**.

5 Duration and Modifications of SMP

5.1 Termination of the SMP

This SMP shall remain in perpetuity until the known contamination on the site has been reduced to concentrations that are considered to no longer pose a risk to human health or the environment and EPA has advised in writing that the SMP is no longer required.

Any proposal to terminate the SMP must be prepared by a Suitably Qualified Environmental Consultant. The proposal must document the details for the request to terminate the SMP including a demonstration that contaminant concentrations are acceptable and ongoing management is not required.

The Auditor must agree that the requirements of the SMP are no longer required and the EPA must provide written support.

5.2 Modification of the SMP

Any proposed changes to the SMP must be prepared by a Suitably Qualified Environmental Consultant. Any changes must be reviewed and endorsed by the Auditor and written advice from the Auditor endorsing the changes must be forwarded to the ACT EPA. Before the changes take effect, the EPA must provide written support of the proposed changes.

Events that will require a change to the SMP are (but not necessarily limited to) the following:

- Any substantial new findings that need to be documented in Section 3.8 – Nature of Contamination of this SMP.
- Any modifications to the roles and responsibilities.
- Any updates to the management measures.
- Updates to reflect changes in relevant ACT legislation, policies or guidelines.

In the event that a change of custodianship or a new lessee takes control of the site, then the new custodian/lessee must acknowledge in writing that they will assume responsibility for this SMP which is to be supported in writing by the EPA.

This SMP must be reviewed annually by a Suitably Qualified Environmental Consultant to ensure that the requirements of the SMP are current and relevant.

6 Management Requirements

The following management requirements that must be implemented prior to any work that disturbs the soil.

6.1 General Surface Activities

General surface activities that do not disturb the soil or require access to sub-surface infrastructure (e.g. grass mowing, general landscaping, building or above ground lighting maintenance) are not subject to the requirements of the SMP.

6.2 Potential Interactions with Groundwater

The likelihood for workers to be exposed to groundwater is considered low in the day to day works of the current site. However, a possible risk has been identified should excavation works be undertaken in the oval area at depths greater than 2.0 m (note that this is a conservative estimate to allow for possible seasonal variation).

Where groundwater is encountered in excavations, the following process must be followed:

- Suitable containers (e.g. intermediate bulk containers [IBC]) are to be available onsite and groundwater is to be transferred to the container should it be encountered.
- Until sampled, it is unclear as to whether concentrations of contaminants may pose a risk to site workers. Therefore, contact with the water must be minimised and appropriate personal protective equipment (PPE) including waterproof gloves and safety glasses should be worn when handling or transferring water.
- A Suitably Qualified Environmental Consultant is to be engaged to collect a sample of water from the container and analysed for the following contaminants of concern:
    - Total Recoverable Hydrocarbons (TRH)
    - Benzene, toluene, ethylbenzene and xylenes (BTEX)
    - Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.
    - VCH.
    - pH.
    - Suspended Solids.
- Where concentrations of contaminants of concern are identified above background concentrations, the water is to be disposed as liquid waste in accordance with the ACT EPA (2021) '*Environmental Standards: Assessment and Classification of Liquid and Non-liquid wastes*'.
- Where concentrations of contaminants of concern (i.e. TRH, BTEX, heavy metals and VCH) are indicative of background concentrations, the water may be discharged into the stormwater system if:
    - The Suspended solids concentration is less than 60 mg/L.
    - pH is between 6 and 9.
    - Concentrations of TRH, BTEX and VCH are below the laboratory limit of reporting.
    - Dissolved metal concentrations are less than the Ambient Environmental Standards for Urban Drains and Streams as defined in Schedule 4 of the '*Environment Protection Regulation 2005*'.

In the event that future dewatering may be necessary (e.g. for basement excavations) then a detailed hydrogeological investigation will be required and must include details of the:

- Potential contaminant concentrations in groundwater that is to be abstracted.
- Potential options for the treatment of contaminated groundwater that is abstracted.
- If treatment is not possible or feasible, then available disposal methods.
- Effect that dewatering will have on the contaminant plumes and whether these activities may change the plume characteristics such as concentrations, plume size and flow directions.
- Disposal of all groundwater from site requires approval of the ACT EPA.

Any future development of the site will be subject to further environmental investigation that is to be reviewed by the EPA approved environmental auditor. This includes a hydrogeological assessment and dewatering plan that must be endorsed by the site Auditor prior to any dewatering process. It is understood that any major dewatering works are likely to be conducted by a future developer and further detailed investigation of the impact the contaminant plumes may have on the proposed building design will be completed.

All findings as a part of the audit process into the suitability of the site must be endorsed by the EPA.

6.3 Maintenance Works

Maintenance works which disturb soil, hardstand areas or require access to service pits may be affected by VCH vapours as any barrier layer (such as concrete or asphalt) is disturbed thereby exposing workers to vapours that may have accumulated beneath the surface. Examples of work that may be impacted include:

- Access to service pits or excavations around underground services by service providers.
- Any works that penetrate the concrete footpaths or asphalt surface of Kippax Place.
- Demolition of the Kippax Health Centre building, particularly where concrete slabs or footings are removed.

Where work is required within a service pit, it has been assumed that this may constitute a confined space as defined in the Safe Work Australia Confined Spaces Code of Practice which states:

A confined space means an enclosed or partially enclosed space that:

- Is not designed or intended to be occupied by a person
- Is or is designed to be at normal atmospheric pressure while any person is in the space; and
- Is or is likely to be a risk to health and safety from:
    - An atmosphere that does not have a safe oxygen level, or
    - Contaminants, including airborne gasses, vapours and dusts that may cause injury from fire or explosion, or
    - Harmful concentrations of any airborne contaminants, or
    - Engulfment.

The locations of known service pits are provided on **Figure 6, Appendix A**. To manage the risk of contaminants in the vapour phase in service pits, the following will be required:

- A Suitably Qualified Environmental Consultant is to be engaged to assess the site for potential vapours in service pits prior to any access by workers.
- A PID is to be used to screen service pits. The PID measurement should be 10 parts per million or less to be considered suitable for work to commence.

- Where either of the above values are exceeded, then entry into the confined space is not permitted and mitigation measures in accordance with the Confined Spaces Code of Practice are to be adopted. Where there is any uncertainty, then an occupational hygienist is to be engaged to provide the relevant advice. A copy of the code of practice is attached as **Appendix B**.
- Appropriate safety documentation such as safe work method statements (SWMS) which highlight the risk vapour may pose to the required works must be prepared prior to commencement and should be done in consultation with the hygienist.
- All measurements from service pits are to be recorded and details of the VOC measurements including the location, time of measurement, concentration of VOC and any actions taken are to be submitted to the relevant site custodian as detailed in Section 4.1.

6.4 Maintenance of Playing Field Irrigation Systems

The maintenance of the irrigation system across the playing fields located in the eastern portion of the site may be required from time to time. The depths of specific sections of the irrigation system are understood to be:

- Irrigation Sprinklers to 0.3 m across the playing field.
- Irrigation Pipework to 0.3 m across the playing field.
- A meter pit located along Moyes Street (approximately 60 m from the corner of Flack Street) to 1.0 m.
- Goal Post Sleeves to 0.5 m.

As irrigation infrastructure located in the playing fields is currently considered outside the impacted area and the risk of contamination at these depths is considered to be low, the requirements as outlined above in Section 6.4 are not necessary.

As the contamination status can change over time, all workers who may perform maintenance on the irrigation system must still be inducted into the SMP, understand the requirements of the unexpected finds protocol (Section 7) and must report any potential indications of contamination (e.g. odorous soil) to TCCS.

6.5 Ongoing Groundwater and Soil Vapour Monitoring

The effect of seasonal variation on the groundwater and soil vapour plumes is still poorly understood. Therefore, ongoing monitoring of groundwater and soil vapour wells located in Kippax Place and around the perimeter of the Kippax Health Centre will be required prior to any future development to assess the effect of seasonal variation on contaminant concentrations. The monitoring program shall commence upon the ACT EPA providing written support of this SMP.

It is the responsibility of the land custodian to engage a Suitably Qualified Environmental Consultant to undertake the required monitoring.

The frequency of monitoring is to be quarterly for a period of two (2) years to assess the behaviour of groundwater and vapour-phase COPCs as a function of seasonal variation, and to assess the stability of the concentration trends. Subject to the initial monitoring results, the sampling frequency may then be reduced to annual sampling to monitor the long-term stability of contaminants in groundwater and soil vapour. Any proposed change to the monitoring frequency must be supported by the ACT EPA approved environmental auditor in writing.

Prior to monitoring, a sampling and analysis quality plan (SAQP) that outlines the sample locations, frequency of sampling and the criteria for assessment must be prepared by a suitably qualified environmental consultant. The SAQP is to be reviewed and approved by the ACT EPA approved environmental auditor prior to implementation.

Monitoring must be completed by a Suitably Qualified Environmental Consultant. After each monitoring event has been completed, the subsequent monitoring report must be reviewed by the ACT EPA approved environmental auditor.

The monitoring report must include an interpretation of the temporal concentration trends and ongoing suitability of the land and whether there are any significant increases in contaminant concentrations that will trigger a requirement to confirm the validity of the HHRA.

Any monitoring program that is endorsed by the ACT EPA approved environmental auditor and supported by the ACT EPA must remain in effect until it is demonstrated that the contaminant concentrations have decreased or stabilised such that there is no unacceptable risk to the environment or human health. Any proposal to modify or terminate the monitoring program must be endorsed by the ACT EPA approved environmental auditor and supported by the ACT EPA in writing.

Any future development design must incorporate any ongoing monitoring requirements. As future sampling of soil vapour and groundwater will likely be required, all of the existing wells are to be preserved for future sampling or replaced if they are destroyed during future development activities. Construction details for the groundwater wells and soil vapour probes installed as a part of the Detailed Site Investigation (Lanterra, 2022) are presented in **Appendix D**.

6.6 Future Use of the Former Kippax Health Centre

At present the Kippax Health Centre is unoccupied. Indoor air monitoring at the time the building was tenanted in December 2021 and March 2022 was completed and no indications of the migration of VCH vapours into the building were detected.

However, should the building be tenanted again in the future, then further indoor air monitoring must be completed. The land custodian of Block 22 Section 51 shall engage a Suitably Qualified Environmental Consultant to complete the indoor air sampling before the tenant occupies the building. It must be demonstrated that there is no intrusion of VCH vapours into the indoor environment.

The resultant indoor air monitoring report must be reviewed by an ACT EPA approved environmental auditor and the ACT EPA must provide written approval that the building may be re-tenanted prior to occupation.

6.7 Demolition of the Kippax Health Centre

It is understood that there is a proposal to demolish the Kippax Health Centre building. Hazardous materials reports for the building have identified the presence of asbestos containing materials in the building.

Known asbestos containing materials are to be removed and appropriately disposed prior to demolition. Licensed asbestos removalists are to be engaged for any asbestos removal work within the building, while a clearance certificate from a licensed asbestos assessor to confirm that the asbestos has been removed will be require before demolition.

Upon completion of the demolition works, a licensed asbestos assessor must complete an inspection of the demolition footprint to confirm that no visible fragments of ACM are present. Should friable asbestos be identified in the building, then soil validation sampling for asbestos may be warranted.

Validation sampling of the building footprint will be required after demolition to assess the building footprint for its suitability for future land uses. The validation report must be prepared by a Suitably Qualified Environmental Consultant and reviewed by an ACT EPA approved environmental auditor and supported by the ACT EPA in writing.

6.8 On-site Reuse of Soil

In accordance with the hierarchy for waste management outlined in the ACT EPA '*Information Sheet 4 – Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*', onsite reuse of soil, where possible is the preferred management strategy for soil.

Where there is uncertainty regarding the suitability of the soil to be reused on the site, the soil must be assessed by a Suitably Qualified Environmental Consultant. The results of sampling shall be compared against the ASC NEPM (2013) criteria for the protection of human health and ecological investigation levels to assess whether the soil is suitable to remain on the site.

Where the assessment of soil is assessed as unsuitable for reuse on the site, or material is surplus to the requirements of the site, then the soil will require assessment for disposal from the site in accordance with Section 6.9.

6.9 Requirements for the Removal and Disposal of Soil

Any works that require the removal of soil from the site will require the soil to be assessed in accordance with the ACT EPA '*Information Sheet 4 – Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*'. Given the nature of the contamination present, the soil is not suitable for classification as virgin excavated natural material (VENM).

- Any soil that requires removal from the site must be assessed by a Suitably Qualified Environmental Consultant in accordance with the ACT EPA '*Information Sheet 4 – Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*'.
- Where soil is not considered suitable for reuse, it must be classified as waste in accordance with the ACT EPA (2021) '*Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes*'.
- The soil classification report must be submitted to the ACT EPA prior to the removal of soil from the site in accordance with the requirements of the ACT EPA '*Information Sheet 10 – Environment Protection Authority Report Submission Requirements*'.
- No soil may be removed from the site without written approval from the ACT EPA.

The following records must be made and passed onto the relevant land custodian regarding soil movement:

- Copies of soil classification reports for material originating on the site.
- Approvals from the ACT EPA for the disposal of soil.
- Copies of VENM approvals (including any sampling completed at the source site) from the EPA where material imported onto the site.

- Details of the volume of soil removed and the details of the disposal site, including any weighbridge dockets issued by the receiving facility to confirm the receipt of the disposed material.

6.10 Requirements for Future Development

The detailed site investigation assessed the suitability of the site in its current condition. Given the potential impact the contamination may have on any future development, further investigation will be required by the developer.

The objective of any future investigation will be to assess the potential impact contaminants, whether they are in soil, groundwater or soil vapour, may have on future land uses as wells as the specific building design.

An ACT EPA approved environmental auditor must be engaged to independently review any future environmental investigation and mitigation/remediation work at the site. An ACT EPA endorsed site audit statement must be obtained indicating the suitability of the land for the permissible land uses with reference to the final development plan prior to any construction work.

Should residual contamination still be present following the completion of the future development, then this SMP must be either updated or a new SMP prepared that documents the nature and extent of the residual contamination at the completion of the development. The SMP must also provide details of any ongoing monitoring and/or mitigation measures necessary to prevent unacceptable exposure to the contamination by future occupants of the site.

The revised or new SMP must be prepared by a Suitably Qualified Environmental Consultant and must be reviewed and endorsed by an ACT EPA approved environmental auditor and written advice from the auditor endorsing the SMP must be forwarded to the ACT EPA. The ACT EPA must also provide written support for the SMP.

6.11 Verification Assessment

Upon completion of any development on the site, a verification assessment report must be prepared to confirm the ongoing suitability of the developed land, from a contamination perspective, for the permissible land uses under the zoning.

The verification assessment must include consideration of any monitoring or targeted investigation results and consideration of the development relative to the assumptions made in the HHRA. If land use suitability is subject to specific outcomes of the HHRA, the relevance of all key assumptions included in the risk characterisation in the HHRA must be confirmed.

The verification report must be prepared by a Suitably Qualified Environmental Consultant and must be reviewed by the ACT EPA approved auditor and supported by the ACT EPA in writing.

7 Unexpected Finds Protocol

This unexpected finds protocol presents details to assist site workers with the identification and management of contamination at the site material.

7.1 Duty to Notify

Where an unexpected find is encountered, it is to be assessed by a suitably qualified environmental consultant. Should the unexpected find meet the criteria for the duty to notify the existence of contaminated land (in accordance with Section 8.1.3 of the *Contaminated Sites Environment Protection Policy*), then the lessee, sub-lessee or occupier of the site must notify the EPA under Section 23A of the Environment Protection Act in writing when:

- They become aware of the contaminated land; and
- The land is contaminated in such a way as to present or likely present a significant risk of harm to human health and/or significant risk of material or serious environmental harm.

7.2 Identification of Potentially Contaminated Material

Material that is suspected of containing contamination may be identified by one or more of the following characteristics:

- Soil has visible rubbish material such as plastic, brick, concrete, metal etc. which may indicate the material is uncontrolled fill. Soil that contains such material could have asbestos containing material (ACM) even if it is not visible and must be assessed by a suitably qualified environmental consultant.
- Soil has significantly different properties from naturally occurring material such as colour or composition (e.g. clay, sand or gravel) which may indicate the presence of uncontrolled fill;
- Soil has visible staining or discolouration which may be an indication of the presence of chemical contaminants such as hydrocarbons and/or oil.
- Soil has a noticeable odour which may be an indicator of chemical contamination.
- Water that has infiltrated into excavations that exhibits an odour or has a visible surface sheen present.

Should one or more of the above properties be encountered, then work must stop immediately, and the land custodian informed of the indicators of contamination as soon as practicable.

Contamination that occurs in the vapour phase may only exhibit an odour with no other identifiable characteristics.

7.3 Assessment of Potentially Contaminated Material

After material that is suspected of being contaminated has been identified, a Suitably Qualified Environmental Consultant should be engaged to undertake an assessment of the material. The environmental consultant may be required to undertake one or more of the following tasks:

- Undertake a visual assessment of the material and provide recommendations for the management of the material. This may include sampling for asbestos should it be considered a risk or screening and removal of rubbish should it be present.
- If asbestos is identified, then a licensed asbestos assessor should be consulted for the managing the handling and disposal of asbestos contaminated material and a licensed

asbestos removalist engaged for the physical removal of asbestos impacted material from the site.

- Undertake soil sampling to assess whether the material may pose a risk to the current land use. Sampling would be required to assess the concentration of possible contaminants within the unexpected find.
- Prepare documentation for waste disposal purposes to remove material that is assessed as unsuitable for use on the site.
- Complete a validation assessment of the remaining soil in the impacted area after the contamination has been removed to assess whether the remedial actions have been successful.

The environmental consultant is to advise the land custodian of the management or disposal requirements of material that is assessed as being contaminated.

7.4 Interim Management of Contaminated Material

Where soil is suspected of containing contamination, it must be isolated from other material to prevent possible cross-contamination from occurring. The Environmental Consultant may make recommendations in addition to those outlined below depending upon the nature of the contamination (e.g. should asbestos be suspected, then airborne fibre monitoring may be required around the impacted area to assess the potential risk of exposure of workers to respirable asbestos).

7.5 Excavations Containing Contaminated Material

Areas that have been excavated and are suspected of containing contaminated material should be managed using the following interim controls:

- The area must be isolated and barricaded to prevent unauthorised access. If required, appropriate signage indicating the presence of contamination should be placed on the barricade (e.g. a 'Danger - Asbestos' sign should be used if possible ACM or non-bonded asbestos is identified).
- A suitably qualified Environmental Consultant must assess and provide recommendations (if required) for appropriate management and/or remedial actions.
- Work may not resume until approval to do so has been given by the Environmental Consultant.

7.6 Stockpiles with Contaminated Material

Stockpiles established on the site are to be managed in accordance with the ACT EPA '*Guideline for Stockpile Management*'. The following interim management procedures should be implemented for contaminated material that has been stockpiled:

- The stockpile must be isolated and not combined with uncontaminated material. Should contaminated material be accidently mixed with uncontaminated soil, then a conservative approach must be adopted and all material is to be considered contaminated until proven otherwise.
- Stockpiles of contaminated material must not be placed adjacent to sensitive receptors such as creeks or bodies of water.
- Sediment and erosion controls (e.g. hay bales or sediment fences) must be placed around the low side of the stockpile. Drainage channels or soil bunds must be placed around the high side of the stockpiled material to divert surface flows around the stockpiled soil.

- If ACM or friable asbestos material is present in the contaminated soil, then the stockpile must be covered with a heavy-duty plastic or a geofabric to prevent the possibility of respirable fibres from being generated.
- Contaminated material should be placed on an impermeable surface such as concrete or heavy-duty plastic.
- Where stockpiled material is placed on an unsealed surface (e.g. soil or grass), then validation samples must be collected from the stockpile footprint following removal of the stockpile to demonstrate that contamination has not been transferred to the ground surface. The validation of the stockpile footprint:
    - Must be completed by a Suitably Qualified Environmental Consultant.
    - The results of the validation sampling must be presented in a validation assessment report.
    - The validation report must be reviewed by an EPA approved environmental auditor.
    - The ACT EPA must provide written support of the validation report outcomes.
- Should the soil contain odours that may be a nuisance, then an odour suppressant may be applied or the stockpiled covered with heavy duty plastic to minimise the odour.
- A Suitably Qualified Environmental Consultant must be engaged to assess the material and provide recommendations for the management or removal of material (e.g. suitability for disposal).
- Work in the area of the contaminated stockpile can not resume until approval from the Environmental Consultant to do so has been received.

The material must be assessed for its suitability to be reused on-site in accordance with Section 6.8.

The above interim management controls should remain in place until the material has been assessed as suitable for reuse on the site or approval from the ACT EPA has been obtained and the material can be removed from the site.

7.7 Procedures for the Disposal of Contaminated Material

Any soil excavated must be assessed for it suitability to be reused on the site in accordance with the hierarchy for waste management outlined in the ACT EPA '*Information Sheet 4 – Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*'. Material that is surplus to the requirements of the site or is assessed as unsuitable for use on the site may require disposal mustbe assessed for off-site reuse where possible. Where the soil is unsuitable for reuse, then the material must be assessed and disposed as waste soil to a landfill licensed to accept the contaminated material.

Procedures for the assessment and classification of contaminated material are presented below.

- The Environmental Consultant must collect samples of the contaminated material in accordance with the requirements of the ACT EPA '*Information Sheet 4 – Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*'.
- Samples would require analysis for contaminants of potential concern as identified by the environmental consultant at a National Association of Testing Authorities (NATA) accredited laboratory.
- Laboratory results must be assessed against the reuse criteria specified in Table 1 of the ACT EPA '*Information Sheet 4 – Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*'.

- Where the soil is unsuitable for reuse, it must be assessed against the relevant criteria listed in the Environment ACT (2021) '*Environmental Standards: Assessment and Classification of Liquid and Non-Liquid Wastes*'.
- A soil reuse or waste classification report must be prepared by the Suitably Qualified Environmental Consultant for submission to the ACT EPA in accordance with the requirements of the ACT EPA '*Information Sheet 11 – Environment Protection Authority Report Submission Requirements*'.
- Soil impacted with asbestos may not require written approval from the EPA, however guidance from the licensed asbestos removalist must be obtained for the disposal of asbestos waste.

8 Reporting Requirements

The results of any assessment must be presented in a report prepared by the environmental consultant and forwarded to the Auditor for review, with the exception of any request to remove soil from the site which is to be provided to the ACT EPA for review. A summary of the reporting requirements and who must review and support each report is presented in Table 2 below.

Table 2: Summary of Reporting Requirements

Report	Comments	Prepared By	Review and Endorsement Requirements	
			Auditor	EPA
Site Management Plan	Any changes or request to terminate the SMP as outlined in Section 5.	SQEC	**Yes**	**Yes**
	Annual review of SMP	SQEC	No[1]	No[1]
Sampling and Analysis Quality Plan	Sampling requirements for ongoing monitoring as outlined in Section 6.5.	SQEC	**Yes**	No
Groundwater and Soil Vapour Monitoring Reports	Reporting of monitoring results as required in Section 6.5.	SQEC	**Yes**	**Yes[2]**
Indoor Air Sampling Report	Air monitoring results acquired prior to the reoccupation of the Kippax Health Building as required in Section 6.6.	SQEC	**Yes**	**Yes[2]**
Validation Reports (e.g. after building demolition or stockpile footprint sampling)	Validation of building footprint after demolition of the Kippax Health Centre or any stockpiles that are placed on unsealed surfaces	SQEC	**Yes**	**Yes[2]**
On-site reuse of soil	Assessment of soil that is to remain on-site	SQEC	No	No
Off-site reuse or disposal of soil	Assessment of soil that requires removal from the site	SQEC	No	**Yes**
Verification Report	Upon completion of any development on the site a verification report that confirms the ongoing suitability of the land at the completion of construction	SQEC	**Yes**	**Yes**

[1]where there are no amendments to the SMP, then no further review is required by the Auditor or EPA. However, where amendments to the SMP are required, then the revised SMP must be reviewed by the Auditor and supported by the ACT EPA in writing as outlined in Section 5.2.

[2]Submission of a letter of endorsement from the Auditor to the ACT EPA would be suitable.

Any soil classification report must be prepared in accordance with the requirements of the following Information Sheets:

- *Information Sheet 4 - Requirements for the reuse and disposal of contaminated soil in the ACT*
- *Information sheet 11 - EPA Report Submission Requirements*.

Prior to the soil being removed from the site as waste, the ACT EPA must provide written approval for the off-site reuse or disposal of the soil.

9 Conclusions

Implementation of this SMP will provide any persons who are required to disturb soil in the Impacted Area with the appropriate guidance for completing the work safely. Should there be any concerns or questions regarding safe work associated with the asbestos conduit or the Impacted Area, then it is recommended that a Suitably Qualified Environmental Consultant.

10 References

ACT EPA (2009) '*Contaminated Sites Environment Protection Policy*'

ACT EPA (2021) '*Environmental Standards: Assessment and Classification of Liquid and Non-liquid wastes*'

ACT EPA (2022) '*Information Sheet 4 - Requirements for the Reuse and Disposal of Contaminated Soil in the ACT*'

ACT EPA (2022) 'Information Sheet 5 – Requirements for the Transport and Disposal of Asbestos Contaminated Wastes'

ACT EPA (2022) 'Information Sheet 11 – Environment Protection Authority Report Submission Requirements'

ACT Government '*Work Health and Safety Act 2011*'

ACT Government '*Work Health and Safety Regulation 2011*'

Lanterra Consulting Pty Ltd (2022) '*Detailed Site Investigation, Section 51 Kippax Group Centre, Holt 2615*'

National Environment Protection Council (1999) '*National Environment Protection (Assessment of Site Contamination) Measure 1999*' (amended 2013).

Safe Work Australia (2018) 'Confined Space Code of Practice'

SAGE Environmental Services (2022) 'Human Health Risk Assessment, *Section 51 Kippax Group Centre, Holt ACT 2615*'

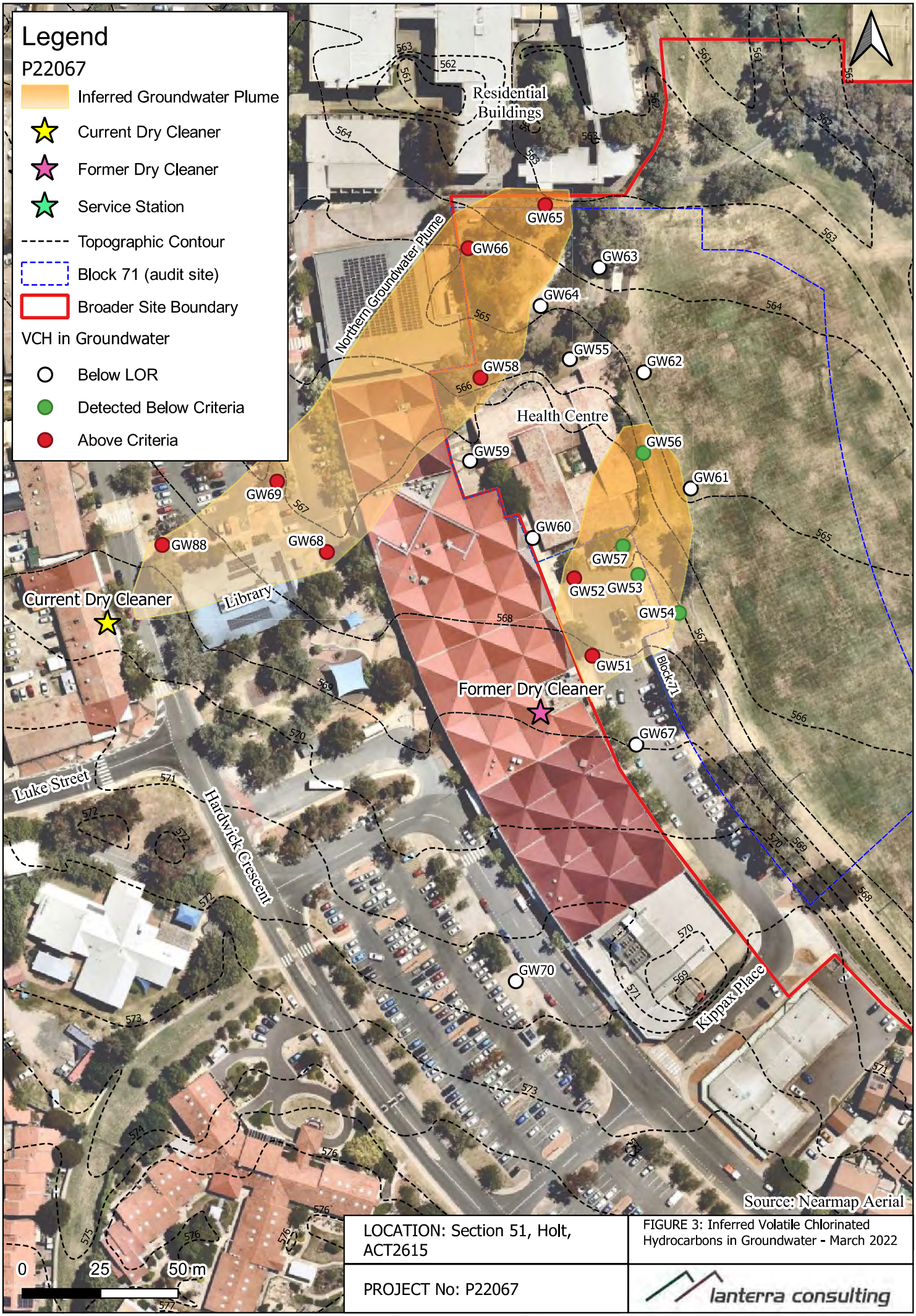
Appendix A

Figures

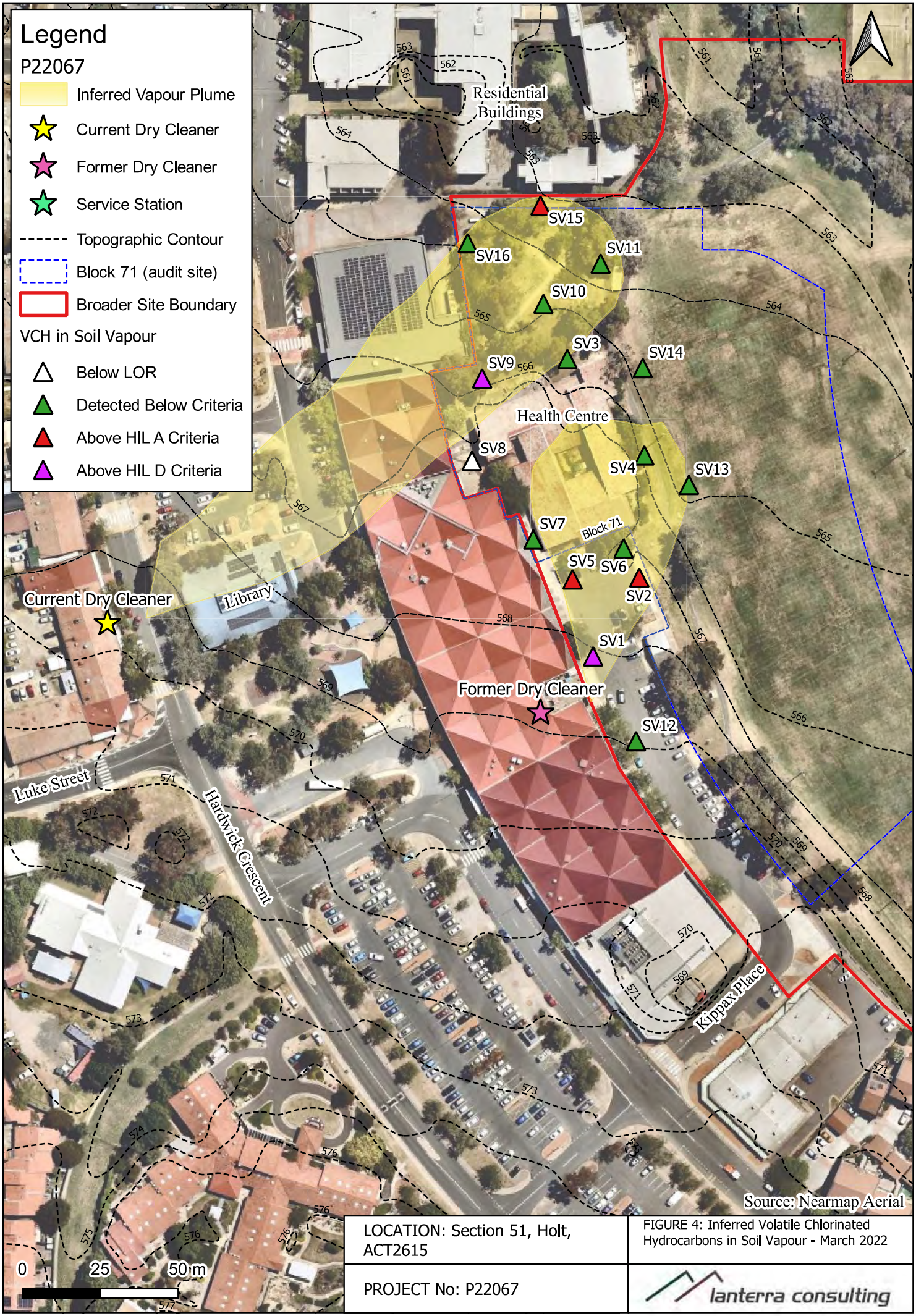


LOCATION: Section 51, Holt, ACT2615	FIGURE 1: Site Location Plan
PROJECT No: P22067	lanterra consulting

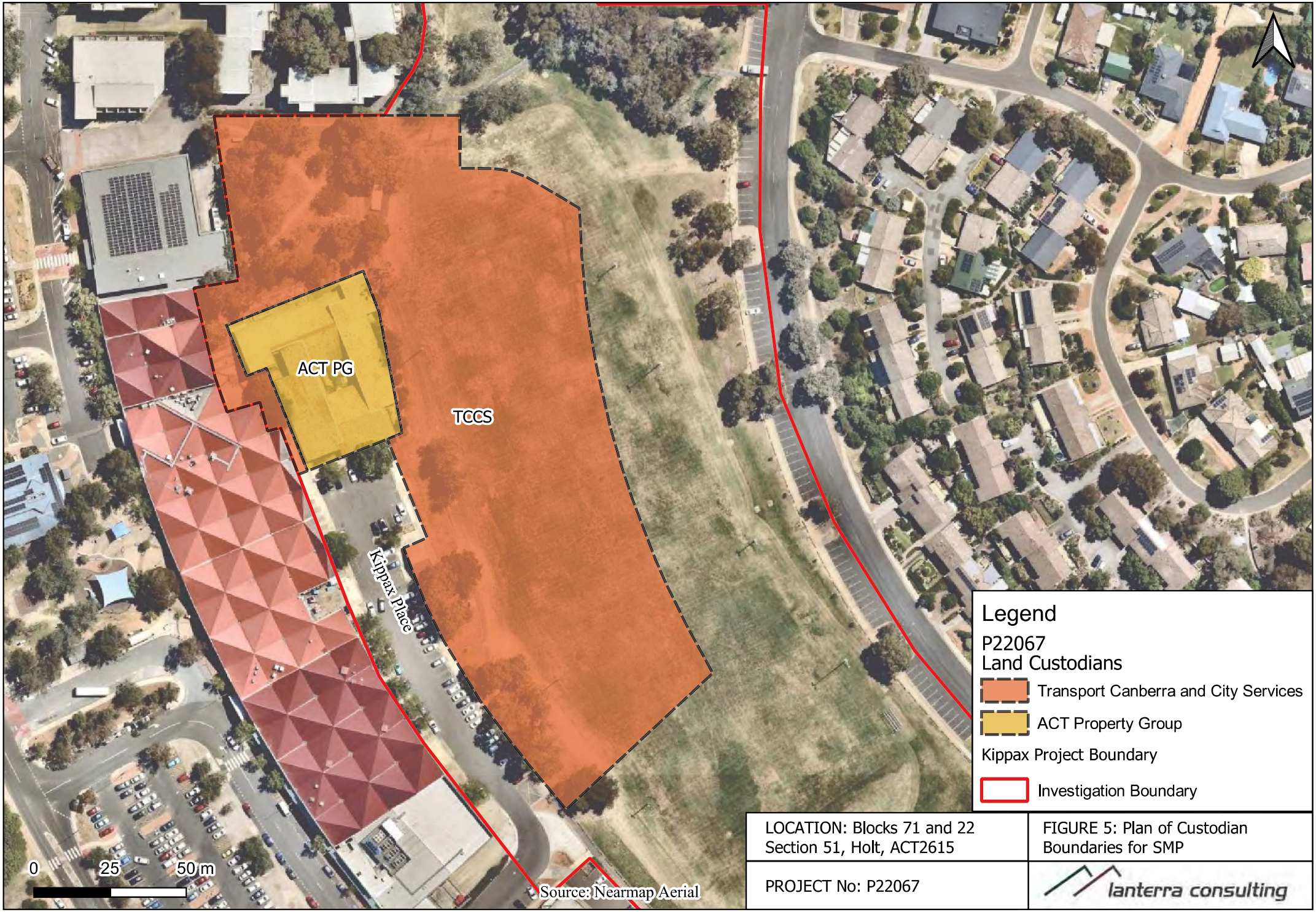

Legend
P22067
Current Dry Cleaner
Former Dry Cleaner
Service Station
Broader Site Boundary
Overlaping Blocks in Section 51
Block 71 (audit site)
Other Blocks
Service Station
Stark Street
Block 75
Block 46
Block 72
BLock 74
Health Centre
Block 22
Block 73
Moyes Crescent
Current Dry Cleaner
Former Dry Cleaner
Luke Street
Block 71
Block 35
Kippax Place
Block 34
Flack Street
Hardwick Crescent
Holt Masonic Village
Service Station
0
50
100 m
Source: Nearmap Aerial
LOCATION: Section 51, Holt, ACT2615
FIGURE 2: Detailed Site Location Plan and Layout
PROJECT No: P22067
lanterra consulting



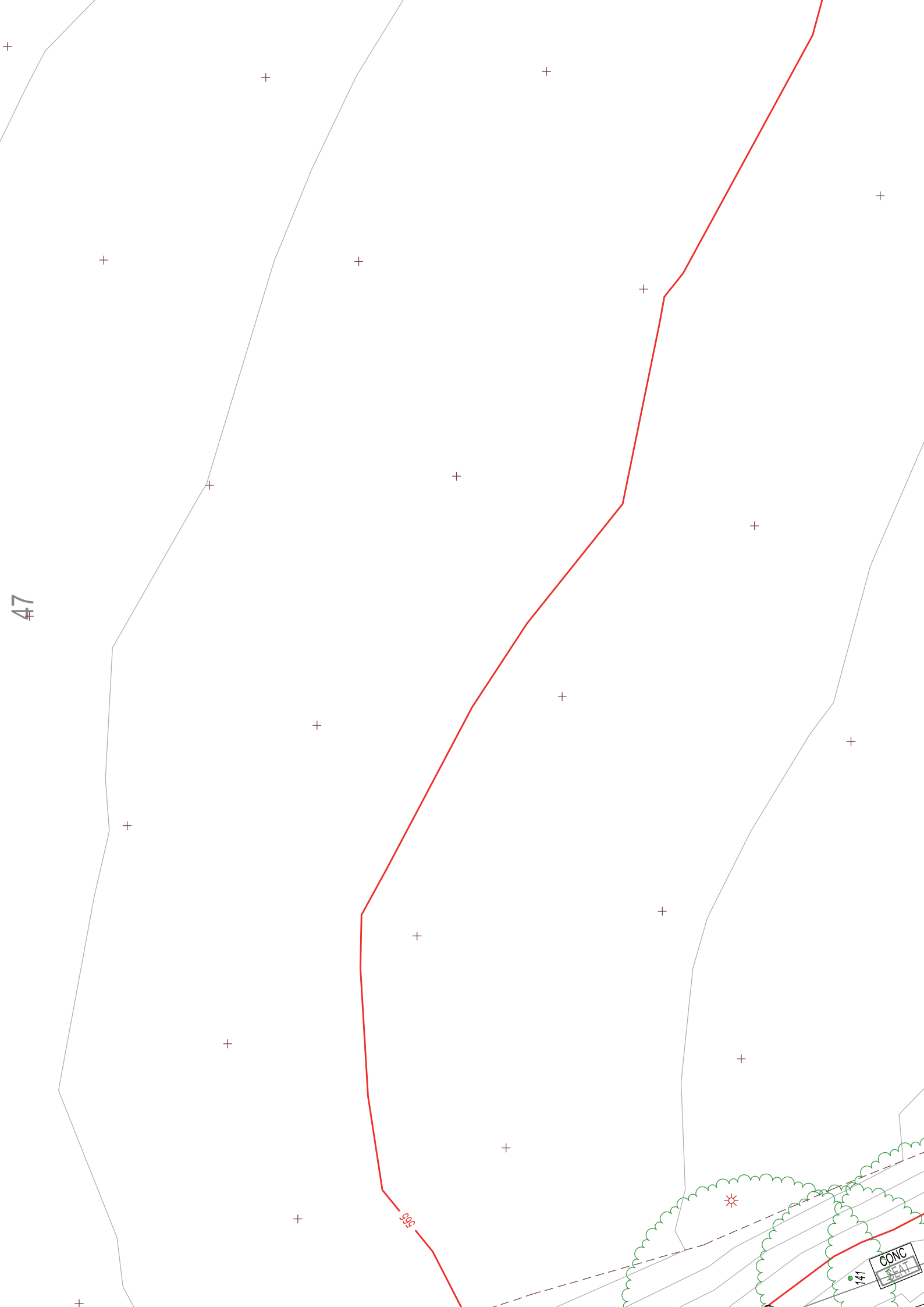
LOCATION: Section 51, Holt, ACT2615	FIGURE 3: Inferred Volatile Chlorinated Hydrocarbons in Groundwater - March 2022
PROJECT No: P22067	lanterra consulting



LOCATION: Section 51, Holt, ACT2615	FIGURE 4: Inferred Volatile Chlorinated Hydrocarbons in Soil Vapour - March 2022
PROJECT No: P22067	lanterra consulting



LOCATION: Blocks 71 and 22 Section 51, Holt, ACT2615	FIGURE 5: Plan of Custodian Boundaries for SMP
PROJECT No: P22067	lanterra consulting


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SEAT
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Appendix B

safe work australia

Confined spaces

Code of Practice

OCTOBER 2018

Disclaimer

Safe Work Australia is an Australian Government statutory agency established in 2009. Safe Work Australia includes Members from the Commonwealth, and each state and territory. Members representing the interests of workers and Members representing the interests of employers.

Safe Work Australia works with the Commonwealth, state and territory governments to improve work health and safety and workers' compensation arrangements. Safe Work Australia is a national policy body, not a regulator of work health and safety. The Commonwealth, states and territories have responsibility for regulating and enforcing work health and safety laws in their jurisdiction.

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Foreword

This Code o Practice on how to manage the ris s associated with con ined spaces in the wor place is an appro ed code o practice under section 2 4 o the *Work Health and Safety Act* WHS Act

An appro ed code o practice pro ides practical guidance on how to achie e the standards o wor health and sa ety re uired under the WHS Act and the *Work Health and Safety Regulations* the WHS Regulations and e ecti e ways to identi y and manage ris s

A code o practice can assist anyone who has a duty o care in the circumstances described in the code o practice Following an appro ed code o practice will assist the duty holder to achie e compliance with the health and sa ety duties in the WHS Act and WHS Regulations in relation to the sub ect matter o the code o practice Li e regulations codes o practice deal with particular issues and may not co er all rele ant ha ards or ris s The health and sa ety duties re uire duty holders to consider all ris s associated with wor not only those or which regulations and codes o practice e ist

Codes o practice are admissible in court proceedings under the WHS Act and WHS Regulations Courts may regard a code o practice as e idence o what is nown about a ha ard ris ris assessment or ris control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code o practice relates For urther in ormation see the Interpreti e Guideline: *The meaning of 'reasonably practicable'*

Compliance with the WHS Act and WHS Regulations may be achie ed by ollowing another method i it pro ides an e ui alent or higher standard o wor health and sa ety than the code

An inspector may re er to an appro ed code o practice when issuing an impro ement or prohibition notice

Scope and application

This Code is intended to be read by a person conducting a business or underta ing PCBU It pro ides practical guidance to PCBUs on how to manage health and sa ety ris s associated with wor carried out in a con ined space

This Code may be a use ul re erence or other persons interested in the duties under the WHS Act and WHS Regulations

This Code applies to all wor places co ered by the WHS Act where wor is carried out in con ined spaces

How to use this Code of Practice

This Code includes re erences to the legal re uirements under the WHS Act and WHS Regulations These are included or con enience only and should not be relied on in place o the ull te t o the WHS Act or WHS Regulations The words must re uires or mandatory indicate a legal re uirement e ists that must be complied with

The word should is used in this Code to indicate a recommended course o action while may is used to indicate an optional course o action

1 Introduction

Confined spaces pose dangers because they are usually not designed to be areas where people work. Confined spaces often have poor ventilation which allows hazardous atmospheres to quickly develop, especially if the space is small. The hazards are not always obvious and may change from one entry into the confined space to the next.

The risks of working in confined spaces include loss of consciousness, impairment, injury or death from:

- the immediate effects of airborne contaminants
- fire or explosion from the ignition of flammable contaminants
- difficulty rescuing and treating an injured or unconscious person
- oxygen deficiency or immersion in a free-flowing material such as grain, sand, fertiliser, water or other liquids
- falls from a height
- environmental factors, for example extremes in temperature
- poor lighting, and
- manual handling.

1.1 What is a confined space?

WHS Regulation 5

Definitions

A 'confined space' means an enclosed or partially enclosed space that:

- is not designed or intended to be occupied by a person
- is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space, and
- is or is likely to be a risk to health and safety from:
  - an atmosphere that does not have a safe oxygen level, or
  - contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion, or
  - harmful concentrations of any airborne contaminants, or
  - engulfment.

A confined space is determined by the hazards associated with a set of specific circumstances and not just because work is performed in a small space.

Entry into a confined space means a person's head or upper body is in the confined space or within the boundary of the confined space.

Confined spaces are commonly found in: 'vats, tanks, pits, pipes, ducts, flues, chimneys, silos, containers, pressure vessels, underground sewers, wet or dry wells, shafts, trenches, tunnels or other similar enclosed or partially enclosed structures' when these examples meet the definition of a confined space in the WHS Regulations.

What is not a con□ined space □or the purposes o□the WHS Regulations□

A con□ined space does not include a mine sha□t or the wor□ings o□a mine□

The □ollowing □inds o□wor□places are also generally not con□ined spaces □or the purposes o□ the WHS Regulations:

– places that are intended □or human occupancy and ha□e ade□uate □entilation□lighting and sa□e means o□entry and e□it□such as o□□ices and wor□shops
– some enclosed or partially enclosed spaces that at particular times ha□e harm□ul airborne contaminants but are designed □or a person to occupy□□or e□ample abrasi□e blasting or spray painting booths□and
– enclosed or partially enclosed spaces that are designed to be occasionally occupied by a person i□the space has a readily and con□eniently accessible means o□entry and e□it □ia a doorway at ground le□el□□or e□ample:
    - a cool store accessed by a LPG powered □or□li□t to mo□e stoc□□ although the use o□ a LPG powered □or□li□t in a cool store can be ha□ardous□the door at ground le□el means that once the alarm is raised□escape and rescue can happen □uic□ly□or
    - a □umigated shipping container with a large ground le□el opening that will □acilitate escape and rescue□

Trenches are not considered con□ined spaces based on the ris□ o□structural collapse alone□ but will be con□ined spaces i□they potentially contain concentrations o□airborne contaminants that may cause impairment□loss o□consciousness or asphy□iation□

How to determine whether a space is a con□ined space

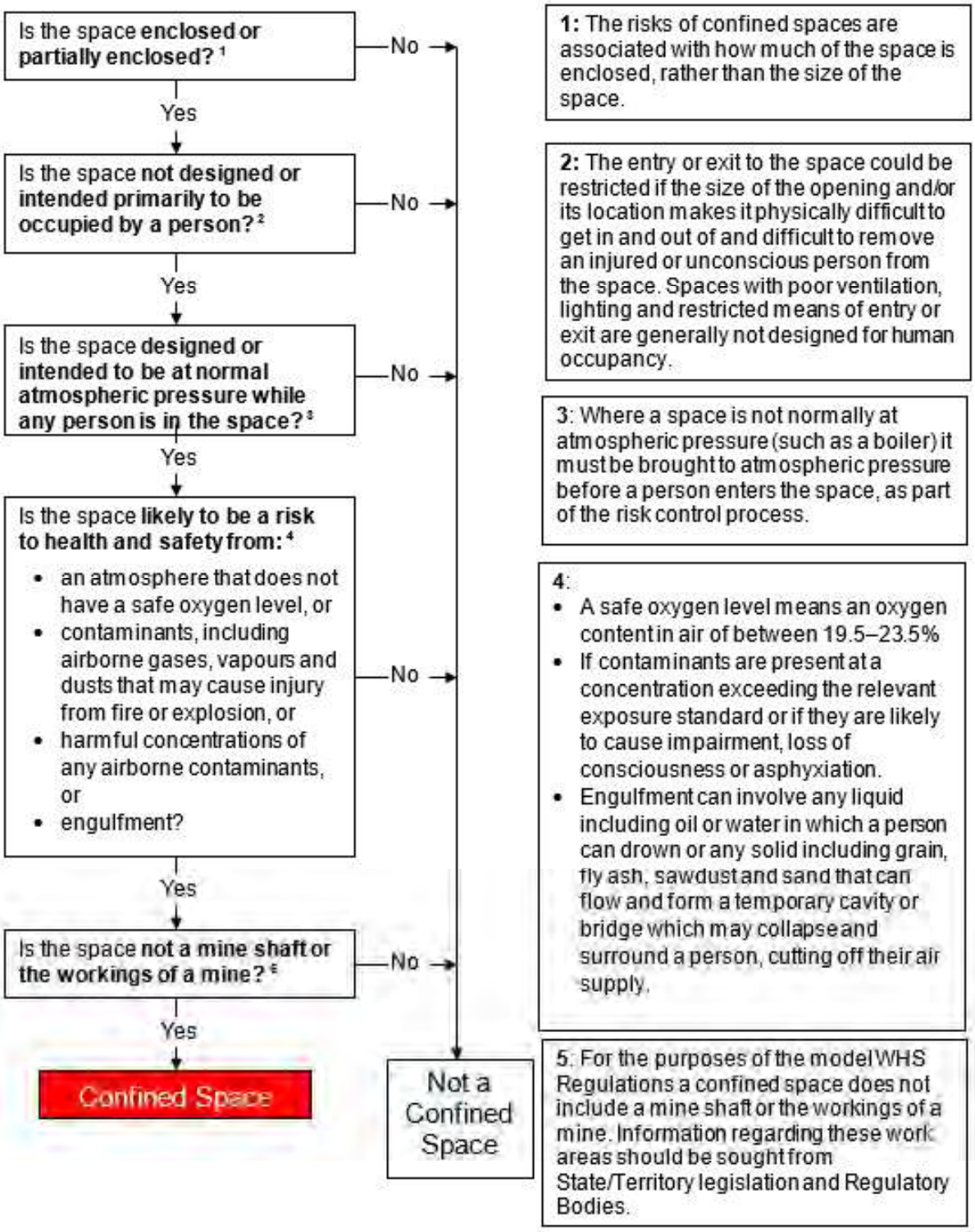
A con□ined space is determined by the structure and a speci□ic set o□circumstances□The same structure may or may not be a con□ined space depending on the circumstances when the space is entered□Entry to a con□ined space is considered to ha□e occurred when a person□s head or upper body enters the space□

A space may become a con□ined space i□wor□ that is to be carried out in the space would generate harm□ul concentrations o□airborne contaminants□

Temporary control measures such as pro□iding temporary □entilation or achie□ing a satis□actory pre-entry gas test will not cause a con□ined space to be declassi□ied□For a con□ined space to be declassi□ied as a non-con□ined space□it needs to ha□e undergone su□□icient changes in structure and use to eliminate all inherent ha□ards that de□ine a con□ined space□

The □ollowing □lowchart will help to determine whether a space is a □con□ined space□□or the purposes o□the WHS Regulations□

Appendi□B pro□ides e□amples to illustrate how a con□ined space is determined□



1.2 Who has health and safety duties in relation to confined spaces

Duty holders who have a role in managing the risks of working in confined spaces include:

– persons conducting a business or undertaking (PCBUs)

– designers□manu□acturers□importers□suppliers□installers and constructors o□plant□ substances or structures□and
– o□icers□

Wor□ers and other persons at the wor□place also ha□e duties under the WHS Act□such as the duty to ta□e reasonable care □or their own health and sa□ety at the wor□place□

A person can ha□e more than one duty and more than one person can ha□e the same duty at the same time□

Early consultation and identi□ication o□ris□s can allow □or more options to eliminate or minimise ris□s and reduce the associated costs□

Person conducting a business or underta□ing

WHS Act section 19

Primary duty o□care

A PCBU must eliminate ris□s arising □rom wor□ing in con□ined spaces□or i□that is not reasonably practicable□minimise the ris□s so □ar as is reasonably practicable□

The WHS Regulations include more speci□ic re□uirements □or PCBUs to manage the ris□s o□ ha□ardous chemicals□airborne contaminants and plant□as well as other ha□ards associated with con□ined spaces□

PCBUs ha□e a duty to consult wor□ers about wor□health and sa□ety and may also ha□e duties to consult□cooperate and coordinate with other duty holders□

Designers□manu□acturers□importers□suppliers□installers and constructors o□plant□substances or structures

WHS Act Part 2 Division 3

Further duties o□persons conducting businesses or underta□ings

Designers□manu□acturers□importers□suppliers□installers and constructors o□plant□ substances or structures that include a space that is intended□or is li□ely to become a con□ined space must ensure□so □ar as is reasonably practicable□the plant□substance or structure they design□manu□acture□import□supply or install is without ris□s to health and sa□ety□This duty includes carrying out testing and analysis as well as pro□iding speci□ic in□ormation about the plant□substance or structure□

To carry out this duty they must:

– eliminate the need □or any person to enter a con□ined space and eliminate the ris□o□ inad□ertent entry□so □ar as is reasonably practicable□or
– i□it is not reasonably practicable to eliminate the need to enter or the ris□o□inad□ertent entry:
  - the need or ris□is minimised so □ar as is reasonably practicable
  - the space is designed with sa□e means o□entry and e□it□and
  - the ris□to health and sa□ety o□any person who enters the space is eliminated so □ar as is reasonably practicable□and i□this is not possible□the ris□is minimised so □ar as is reasonably practicable□

To assist in meeting these duties□the WHS Regulations re□uire:

- manufacturers to consult with designers of plant
- importers to consult with designers and manufacturers of plant and
- the person who commissions construction work to consult with the designer of the structure.

Please refer to AS 2865–2009: *Confined spaces* for specific obligations of designers.

Officers

WHS Act section 27

Duty of officers

Officers (for example company directors) have a duty to exercise due diligence to ensure the PCBU complies with the WHS Act and WHS Regulations. This includes taking reasonable steps to ensure the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks to health and safety from work carried out as part of the conduct of the business or undertaking, including those arising from working in confined spaces. Further information on who is an officer and their duties is available in the Interpretive Guideline: *The health and safety duty of an officer under section 27*.

Workers

WHS Act section 28

Duties of workers

Workers have a duty to take reasonable care for their own health and safety and to not adversely affect the health and safety of other persons. Workers must comply with reasonable instructions, as far as they are reasonably able, and cooperate with reasonable health and safety policies or procedures that has been notified to workers, including information, instructions and training in relation to work carried out by the worker in a confined space. If personal protective equipment (PPE) is provided, the worker must so far as they are reasonably able, use or wear it in accordance with the information, instructions and training provided.

WHS Regulation 63

Confined spaces: Application to emergency service workers

WHS Regulation 67

Confined space entry permit

WHS Regulation 68

Confined spaces: Signage

Some requirements for entry permits and signage do not apply to entry into a confined space by an emergency service worker if the worker is rescuing or providing first aid to a person in a confined space at the direction of the emergency service organisation.

Other persons at the workplace

WHS Act section 29

Duties o□other persons at the wor□place

Other persons at the wor□place□li□e □isitors□must ta□e reasonable care □or their own health and sa□ety and must ta□e care not to ad□ersely a□ect other people□s health and sa□ety□They must comply□so □ar as they are reasonably able□with reasonable instructions gi□en by the PCBU to allow that person to comply with the WHS Act□

1□3□What is in□ol□ed in managing ris□s associated with wor□ing in con□ined spaces□

WHS Regulations Part 3.1 Regulations 32–38

Managing ris□s to health and sa□ety

This Code pro□ides guidance on how to manage the ris□s associated with con□ined spaces in the wor□place using the □ollowing systematic process:

– Identi□y ha□ards□ □ind out what could cause harm□
– Assess ris□s i□necessary□ understand the nature o□the harm that could be caused by the ha□ard□how serious the harm could be and the li□elihood o□it happening□This step may not be necessary i□you are dealing with a □nown ris□with □nown controls□
– Eliminate ris□s to health and sa□ety so □ar as is reasonably practicable
– Control ris□s□ i□it is not reasonably practicable to eliminate the ris□□implement the most e□ecti□e control measures that are reasonably practicable in the circumstances in accordance with the hierarchy o□control measures□and ensure they remain e□ecti□e o□er time□
– Re□iew control measures to ensure they are wor□ing as planned□

Duties in relation to con□ined spaces include:

– managing health and sa□ety ris□s associated with a con□ined space□including ris□s when entering□wor□ing in□on or near a con□ined space□and the ris□o□inad□ertent entry□in accordance with re□uirements □or managing ris□s to health and sa□ety set out in Part 3□1 o□the WHS Regulations
– ensuring a ris□assessment is conducted□re□iewed and as necessary re□ised by a competent person
– not directing a wor□er to enter a con□ined space unless the wor□er has an entry permit
– erecting signs ne□t to each entry to the con□ined space
– ensuring□so □ar as is reasonably practicable□that a wor□er does not enter a con□ined space until all the duties in relation to the con□ined space ha□e been complied with□□or e□ample meeting entry permit re□uirements
– establishing □irst aid and rescue procedures to be □ollowed in the e□ent o□an emergency in the con□ined space and ensuring these procedures are practised as necessary□and
– pro□iding suitable and ade□uate in□ormation□training and instruction to wor□ers□

The WHS Regulations set out re□uirements □or speci□ic control measures within the con□ined space including communication and sa□ety monitoring□signs□isolation o□connected plant and ser□ices□and controls to maintain a sa□e atmosphere□

Further guidance on the ris□management process is a□ailable in the Code o□Practice: *How to manage work health and safety risks*.

Consulting wor□ers

WHS Act section 47

Duty to consult wor□ers

WHS Act section 48

Nature o□consultation

A PCBU must consult□so □ar as is reasonably practicable□with wor□ers who carry out wor□ □or the business or underta□ing and who are □or are li□ely to be□directly a□□ected by a health and sa□ety matter□

This duty to consult is based on the recognition that wor□er input and participation impro□es decision-ma□ing about health and sa□ety matters and assists in reducing wor□-related in□uries and disease□

The broad de□inition o□a □wor□er□under the WHS Act means a PCBU must consult□so □ar as is reasonably practicable□with contractors and sub-contractors and their employees□on-hire wor□ers□outwor□ers□apprentices□trainees□wor□ e□perience students□□olunteers and other people who are wor□ing □or the PCBU and who are□or are li□ely to be□directly a□□ected by a health and sa□ety matter□

Wor□ers are entitled to ta□e part in consultations and to be represented in consultations by a health and sa□ety representati□e □HSR□who has been elected to represent their wor□group□

It is o□ten more e□□ecti□e to in□ol□e a team o□people in the ris□ management process to draw on a range o□□nowledge and e□perience□□or e□ample □nowledge o□:

– the particular con□ined space under assessment
– any wor□ methods that will be used in or near the con□ined space□and
– con□ined space ha□ards and control measures□

Consulting□cooperating and coordinating acti□ities with other duty holders

WHS Act section 46

Duty to consult with other duty holders

The WHS Act re□uires a PCBU to consult□cooperate and coordinate acti□ities with all other persons who ha□e a wor□ health or sa□ety duty in relation to the same matter□so □ar as is reasonably practicable□

There is o□ten more than one business or underta□ing in□ol□ed in relation to a con□ined space□that may each ha□e responsibility □or the same health and sa□ety matters□either because they are in□ol□ed in the same acti□ities or share the same wor□place□

In these situations□each duty holder should e□change in□ormation to □ind out who is doing what and wor□ together in a cooperati□e and coordinated way so ris□s are eliminated or minimised so □ar as is reasonably practicable□For e□ample□a person who owns the plant or structure that contains the con□ined space will ha□e management or control o□the con□ined space□A contractor engaged to carry out wor□ in the same space will also ha□e management or control o□the con□ined space at the time that wor□ is being carried out□In these situations□e□□ecti□e communication□cooperation and coordination o□acti□ities between duty holders is essential to ensure that ris□s associated with the con□ined space are eliminated or minimised as □ar as is reasonably practicable□

Further guidance on consultation is a□ailable in the Code o□Practice: *Work health and safety consultation, cooperation and coordination*□

Principal contractors

WHS Regulation 309

WHS management plan□ preparation

The principal contractor □or a construction pro□ect has a speci□ic duty under the WHS Regulations to document□in their WHS Management Plan □or the pro□ect□the arrangements in place □or consultation□cooperation and coordination between the PCBUs at the site□

14□In□ormation□training□instruction and super□ision

WHS Act section 19

Primary duty o□care

WHS Regulation 39

Pro□ision o□in□ormation□training and instruction

The WHS Act re□uires that a PCBU ensure□so □ar as is reasonably practicable□the pro□ision o□any in□ormation□training□instruction or super□ision that is necessary to protect all persons □rom ris□s to their health and sa□ety arising □rom wor□ carried out as part o□the conduct o□ the business or underta□ing□

The PCBU must ensure that in□ormation□training or instruction pro□ided to a wor□er are suitable and ade□uate ha□ing regard to:

– the nature o□the wor□ carried out by the wor□er
– the nature o□the ris□s associated with the wor□ at the time o□the in□ormation□training and instruction□and
– the control measures implemented□

The PCBU must also ensure□so □ar as is reasonably practicable□that the in□ormation□ training and instruction are pro□ided in a way that is readily understandable □or the person to whom it is pro□ided□

Wor□ers must be trained and ha□e the appropriate s□ills to carry out a particular tas□ sa□ely□ Training should be pro□ided to wor□ers by a competent person□

WHS Regulation 76

Con□ined spaces□ In□ormation□training and instruction □or wor□ers

The in□ormation□training and instruction pro□ided to rele□ant wor□ers must co□er:

– the nature o□all ha□ards associated with a con□ined space
– the need □or□and appropriate use o□ris□ control measures
– the selection□it□use□wearing□testing□storage and maintenance o□any PPE
– the contents o□any rele□ant con□ined space entry permit□and

– emergency procedures□

A □rele□ant□wor□er means a wor□er who could enter or wor□in a con□ined space□or other wor□ers who are not re□uired to enter the con□ined space but could carry out related □unctions or emergency procedures□such as:

– underta□e ha□ard identi□ication or ris□assessment in relation to a con□ined space
– implement ris□control measures
– complete entry permits
– act as a stand-by person or communicate with wor□ers in a con□ined space
– monitor conditions while wor□is being carried out
– purchase e□uipment □or con□ined space wor□□and
– design or lay out a wor□area that includes a con□ined space□

The super□isors o□these wor□ers are also rele□ant wor□ers□

Retraining or re□resher training should be pro□ided as appropriate □or a particular wor□place□ The □re□uency o□this training should depend on how o□ten wor□ers are re□uired to carry out tas□s associated with entry to or wor□in con□ined spaces□

Records o□all training pro□ided to wor□ers in relation to con□ined space wor□must be □ept □or two years□

In addition to the PCBU□s general duty to pro□ide any super□ision necessary to protect all persons □rom wor□health and sa□ety ris□s□the WHS Regulations also impose speci□ic duties to pro□ide super□ision necessary to protect a wor□er □rom ris□s to health and sa□ety in certain circumstances□□or e□ample□where the wor□er:

– uses□handles or generates ha□ardous chemicals
– operates□tests□maintains□repairs or decommissions a storage or handling system □or a ha□ardous chemical□or
– is li□ely to be e□posed to a ha□ardous chemical□

Wor□ers and their super□isors must be pro□ided with suitable and ade□uate in□ormation□ training and instruction so they ha□e the s□ills and □nowledge to understand the ha□ards associated with wor□ing in the con□ined space□the contents o□any con□ined space entry permit□and the control measures implemented □or their protection□

2 Duty o designers manu acturers importers suppliers installers and constructors

The design manu acture or modi ication o any plant or structure that includes a con ined space can signi icantly a ect the ris s associated with con ined spaces Thought ul design can eliminate the need to enter a con ined space or eliminate the ris o inad ertent entry The design stage should consider the whole li e cycle o the plant or structure rom manu acture and use through to demolition and disposal

2 1 Eliminating or minimising the need to enter a con ined space

WHS Regulation 64

Con ined spaces Duty to eliminate or minimise ris

A designer manu acturer importer or supplier o a plant or structure and a person who installs or constructs a plant or structure must eliminate the need to enter a con ined space and eliminate the ris o inad ertent entry so ar as is reasonably practicable I this is not reasonably practicable then:

– the need or any person to enter the space and the ris o a person inad ertently entering the space must be minimised so ar as is reasonably practicable
– the space must be designed with a sa e means o entry and e it and
– ris to the health and sa ety o any person who enters the space must be eliminated or minimised so ar as is reasonably practicable

The ollowing eatures should be incorporated in the design and manu acturing stages:

– pro ision o outlets and acilities or cleaning to eliminate the need or entry
– use o lining materials that are durable re uire minimal cleaning and do not react with materials contained in the con ined space and
– design o the structure and mechanical parts to pro ide or sa e and easy maintenance to reduce the need or persons to enter

2 2 Entry and e it

I it is not reasonably practicable to eliminate the need to enter the con ined space or the ris o inad ertent entry then any ris associated with entry to and e it rom the space must be minimised Entry to and e it rom a con ined space are sa er when openings access points are large and located in a position that persons and e uipment can pass through easily

Where rele ant the ollowing eatures should be incorporated at the design manu acture and installation stages:

– Access points including those within the con ined space through di isions partitions or obstructions should be large enough to allow people wearing the necessary protecti e

clothing and e□uipment to pass through □and to permit the rescue o□all people who may enter the con□ined space□

– A sa□e means o□access to and within the con□ined space□such as □i□ed ladders□ plat□orms and wal□ways□should be pro□ided□Further guidance is a□ailable in AS 165□□ 2018: *Fixed platforms, walkways, stairways and ladders – Design, construction and installation*□
– Access points should be unobstructed by □ittings or e□uipment that could impede rescue and should also be □ept □ree o□any obstructions during wor□in the con□ined space□I□ there is a re□uirement to pass e□uipment such as electrical cables□leads□hoses and □entilation ducts through an access hole□a second access point may be needed□
– There should be enough access points to pro□ide sa□e entry to and e□it □rom the con□ined space□For e□ample□the spacing o□access holes on sewers □or in the case o□ large gas mains□the absence o□such access holes o□er considerable lengths□may a□□ect both the degree o□natural □entilation and the ease with which persons can be rescued□

For □urther guidance please re□er to AS 2865□200□: *Confined spaces.*

3 The risk management process

WHS Regulation 66

Confined spaces: Managing risks to health and safety

A risk assessment is mandatory for confined spaces under the WHS Regulations. As a person conducting a business or undertaking (PCBU), you must ensure that a risk assessment is conducted by a competent person and recorded in writing.

A risk assessment will determine the measures that should be implemented to control risks. It will help to:

- identify which workers are at risk of exposure
- determine what sources and processes are causing that risk
- identify and what kind of control measures should be implemented, and
- check the effectiveness of existing control measures.

Risk management is a systematic process to eliminate or minimise the potential for harm to people.

3.1 Identifying the hazards

The first step in the risk management process is to identify all hazards associated with confined spaces. This involves finding things and situations which could potentially cause harm to people. Hazards generally arise from the following aspects of work and their interaction:

- physical work environment
- equipment, materials and substances used
- work tasks and how they are performed, and
- work design and management.

Hazards may be identified by looking at the workplace and how work is carried out. It is also useful to talk to workers, manufacturers, suppliers and health and safety specialists and review relevant information, records and incident reports.

WHS Regulation 34

Duty to identify hazards

In managing the risks associated with a confined space the duty holder must identify reasonably foreseeable hazards that could give rise to health and safety risks.

The types of substances previously stored in a confined space (however briefly) will indicate the sorts of hazards that may be present. Substances stored in a confined space may result in a lack of oxygen, airborne contaminants or a flammable atmosphere within the confined space. Other hazards may arise from work activities, products or by-products in or around the confined space.

Many confined spaces hazards are invisible to the naked eye or not visible from outside the space, for example toxic gases, smaller spaces within a space and concealed electrical or mechanical parts.

3.2 What hazards are associated with a confined space?

Restricted entry or exit

Small entrances and exits make it difficult to rescue injured workers or to get equipment in or out of the confined space. In some cases, entrances and exits may be very large but their location can make them difficult to access. For example, accessing pits or openings high up in silos may require the use of ladders, hoists or other devices, and escape and rescue from such spaces may be difficult in emergency situations.

Harmful airborne contaminants

The following table illustrates the kinds of harmful atmospheres that may be present in a confined space, and how they may be created.

Table 1 Sources of contaminants

Source of contaminant	Examples
Substance stored in the confined space or its by-product(s)	– release of toxic substances eg hydrogen sulphide in tanks of decomposing organic material, especially when the material is disturbed – build-up of hydrogen sulphide in sewers and pits
Work performed in the confined space	– use of paints, adhesives, solvents or cleaning solutions – welding or brazing with metals capable of producing toxic vapours or gases – exhaust vapours or gases from engines used in the confined space – painting or moulding glass-reinforced plastics
Entry of natural contaminants, e.g. groundwater and gases, into the confined space from the surrounding land, soil or strata	– acid groundwater acting on limestone with the potential to produce dangerous accumulations of carbon dioxide – methane released from groundwater and from decay of organic matter
Release of airborne contaminants	– when sludge, slurry or other deposits are disturbed or when scale is removed
Manufacturing process	– residues left in tanks, vessels etc or remaining on internal surfaces can evaporate into a vapour or gas
Entry and accumulation of gases and liquids from adjacent plant, installations, services or processes	– the contamination of underground confined spaces by substances from plant in the vicinity of the confined space – carbon monoxide from the exhaust of LPG-powered forklifts operating in or in the vicinity of the confined space

Unsafe oxygen level

Air normally contains 21 per cent oxygen by volume, although oxygen levels of 19.5 per cent to 23.5 per cent by volume are considered to be safe.

Some situations can cause the le□el o□o□ygen to dramatically decrease□leading to an o□ygen-de□icient atmosphere and possible asphy□iation□This may occur i□o□ygen in the atmosphere is:

– displaced by gases produced during biological processes□□or e□ample methane in a sewer
– displaced during purging o□a con□ined space with an inert gas to remo□e □lammable or to□ic □apours or gases
– depleted inside metal tan□s and □essels through sur□ace o□idation □□or e□ample when rust □orms□
– consumed during combustion o□□lammable substances□or
– absorbed or reacts with grains□wood chips□soil or chemicals in sealed silos□

Too much o□ygen can increase the ris□ o□□ire or e□plosion□O□ygen-enriched atmospheres may occur i□:

– chemical reactions cause the production o□o□ygen□□or e□ample certain reactions with hydrogen pero□ide□or
– there is a lea□ o□o□ygen □rom an o□ygen tan□ or □itting while using o□y-acetylene e□uipment□

Re□er to AS 16□4 □Series□[1]: *Safety in welding and allied processes* to co□er circumstances where ignition source is cutting□grinding or welding□

Fire and e□plosion

A □ire or e□plosion re□uires the presence o□three elements:
– an ignition source
– air□and
– a □uel □gas□□apour or mist□capable o□igniting□

A □lammable atmosphere is one in which the □lammable gas□□apour or mist is li□ely to e□ceed 5 per cent o□its lower e□plosi□e limit □LEL□□

Flammable atmospheres in con□ined spaces may result □rom the e□aporation o□a □lammable residue□□lammable materials used in the space□a chemical reaction □such as the □ormation o□methane in sewers□□or □rom the presence o□combustible dust □such as that in □our and other grain silos and coal handling areas□□

I□an ignition source□such as a spar□ing electrical tool or static on a person□is introduced into a space containing a □lammable atmosphere□an e□plosion is li□ely to result□

Engul□ment

Engul□ment means to be swallowed up in or immersed by material□which may result in asphy□iation□E□amples o□materials that may pose a ris□ o□engul□ment include plastics□ sand□li□uids□□ertiliser□grain□coal□coal products□□y ash□animal □eed and sewage□

Stored materials such as sand and grain can □orm a crust or bridge when a container is emptied □rom below□lea□ing the top layer in place□Wor□ers wal□ing on the crust or bridge or wor□ing below the bridge on the □oor o□the container may be engul□ed i□the crust cra□s or dislodges and a bridge collapses □see Figure 1□□

[1] *AS 1674 (Series):* Sa□ety in welding and allied processes *includes AS 1674.1:1997:* Sa□ety in welding and allied processes □ Fire precautions *and AS 1674.2:2007:* Sa□ety in welding and allied processes □ Electrical.

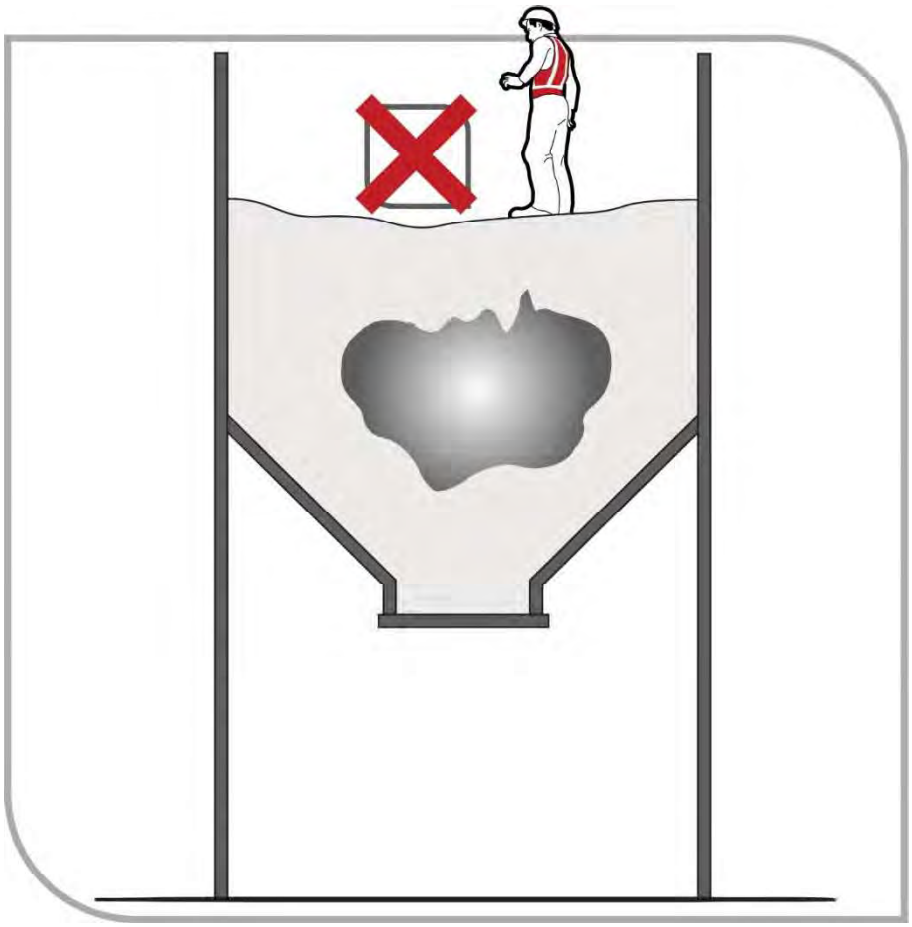


Figure 1 E□ample o□bridging□which may result in engul□ment

3□3□Other ha□ards

Uncontrolled introduction o□substances

The uncontrolled introduction o□substances such as steam□water or other li□uids□gases or solids may result in drowning□immersion□being o□ercome by □umes □□or e□ample □ision and odour impairment □rom hydrogen sulphide □H_2S□□inability to breathe due to □ine grain or ceramic dust□□or other harm depending on the nature o□the substance□

Combustible engines□□ehicles and li□uid petroleum gas □LPG□□or□li□ts operating close to the opening o□the con□ined space can cause a build-up o□e□haust gases□including carbon mono□ide□in the space□

Biological ha□ards

Contact with micro-organisms□such as □iruses□bacteria or □ungi□may result in in□ectious diseases□dermatitis or lung conditions such as hypersensiti□ity pneumonitis□Sewers□grain silos and manure pits are e□amples o□con□ined spaces where biological ha□ards may be present□

Mechanical ha□ards

E□posure to mechanical ha□ards associated with plant may result in entanglement□crushing□ cutting□piercing or shearing o□parts o□a person□s body□Sources o□mechanical ha□ards include plant such as augers□agitators□blenders□mi□ers and stirrers□

Electrical ha□ards

Electrical ha□ards may cause electrocution□shoc□s or burns□and can arise □rom cables□ trans□ormers□capacitors□relays□e□posed terminals and wet sur□aces where electrical circuits and electrically powered plant are used□

Further guidance is a□ailable in the Code o□Practice: *Managing electrical risks in the workplace*□

S□in contact with ha□ardous substances

The nature o□a con□ined space could gi□e rise to an increased li□elihood o□s□in contact with sur□ace contaminants□S□in contact with ha□ardous substances may result in immediate health e□□ects such as burns□irritation or allergic dermatitis□or longer-term systemic e□□ects□

Noise

Noise generated in a con□ined space □rom the use o□plant□the wor□ method or process may be ampli□ied due to re□lections o□□hard sur□aces□E□posure to ha□ardous noise may result in hearing loss□tinnitus and other non-auditory health e□□ects□Ha□ardous noise may also pre□ent wor□ers □rom hearing warning signals and distract wor□ers □rom their wor□□

Further guidance is a□ailable in the Code o□Practice: *Managing noise and preventing hearing loss at work*.

Manual tas□s

Ha□ards arising □rom manual tas□s may be e□acerbated by physical constraints associated with wor□ing in a con□ined space□Additional ha□ards may arise □rom the use o□personal protecti□e e□uipment □PPE□that restricts mo□ement□grip and mobility□

Further guidance is a□ailable in the Code o□Practice: *Hazardous manual tasks*.

Radiation

The health e□□ects associated with radiation depend on the type o□radiation in□ol□ed□ Sources o□radiation include radioacti□e sources□□-rays□lasers□welding □lash□radio □re□uency and microwa□es□

En□ironmental ha□ards

En□ironmental ha□ards associated with wor□ in a con□ined space may cause or contribute to harm□E□amples o□en□ironmental ha□ards include:

– heat or cold stress arising □rom the wor□□process or conditions
– slips□trips and □alls arising □rom slippery sur□aces or obstacles□and
– inade□uate lighting□

Further guidance is a□ailable in the Code o□Practice: *Managing the work environment and facilities.*

Ha□ards outside the con□ined space

Where the con□ined space has a □ertical opening□there is a ris□that people could □all in□

Tra□ic ha□ards are a concern where con□ined space entrances or e□its are located on □ootpaths or roads□There is the potential □or wor□ers entering or e□iting the space to be struc□and in□ured by □ehicle tra□ic□

Wor□done outside the space□but near openings to it□can contaminate the atmosphere inside the space□A common e□ample is the e□haust gases □rom an internal combustion engine□There may also be potential □or □re or e□plosion where hot wor□is done in areas ne□t to con□ined spaces that contain □ammable atmospheres□

Additional physiological and psychological demands

Wor□ing in a con□ined space may impose additional physiological and psychological demands o□er and abo□e those encountered in a normal wor□ing en□ironment□ Consideration should be gi□en to a wor□er's:

– physical ability
– ability to wor□in a restricti□e space □□or e□ample claustrophobia□□and
– ability to wear the PPE re□uired to do the wor□ □□or e□ample respirators□□

3□4 □Assessing the ris□s

A ris□assessment in□ol□es considering what could happen i□someone is e□posed to a ha□ard and the li□elihood o□it happening□A ris□assessment can help you determine:

– how se□ere a ris□is
– whether any e□isting control measures are e□□ecti□e
– what action you should ta□e to control the ris□□and
– how urgently the action needs to be ta□en□

Ha□ards ha□e the potential to cause di□□erent types and se□erities o□harm□ranging □rom minor discom□ort to a serious in□ury or death□

Many ha□ards and their associated ris□s are well □nown and ha□e well established and accepted control measures□In these situations□the second step in the process outlined in section 1□3 o□this Code □to □ormally assess the ris□□is not re□uired□□a□ter identi□ying a ha□ard you already □now the ris□and how to control it e□□ecti□ely□you may simply implement the controls□

In some circumstances□a ris□assessment will assist to:

– identi□y which wor□ers are at ris□o□e□posure
– determine what sources and processes are causing the ris□
– identi□y i□and what □ind o□control measures should be implemented□and
– chec□the e□□ecti□eness o□e□isting control measures□

WHS Regulation 66

Con□ined spaces □Managing ris□s to health and sa□ety

WHS Regulation 77

Con□ined spaces □Con□ined space entry permit and ris□assessment must be □ept

As a PCBU you must ensure a competent person conducts a risk assessment to assess health and safety risks associated with the identified hazards of the confined space.

The risk assessment for a confined space must be undertaken by a competent person and be recorded in writing. The risk assessment must be reviewed and revised by a competent person whenever any risks change.

A copy must be kept until at least 28 days after the work to which it relates is completed or if a notifiable incident occurs in connection with the work to which the assessment relates, for at least two years after the incident occurs. A copy of the risk assessment must be available to any relevant worker on request.

To manage risk and ensure a risk assessment is carried out by a competent person, you must take into account all relevant matters, including:

- whether the work can be carried out without the need to enter the confined space
- the nature of the confined space
- if the hazard is associated with the concentration of oxygen or the concentration of airborne contaminants in the confined space, any change that may occur in that concentration
- the work required to be carried out in the confined space, the range of methods by which the work can be carried out and the proposed method of working, and
- the type of emergency procedures, including rescue procedures, required.

When undertaking a risk assessment to determine the risks requiring control, the following factors should be considered:

- the risk of engulfment of a person
- the number of persons occupying the space
- the soundness and security of the overall structure and the need for lighting and visibility
- the identity and nature of the substances last contained in the confined space
- any risk control measures needed to bring the confined space to atmospheric pressure
- the number of persons required outside the space:
  - to maintain equipment essential for the task being undertaken within the confined space
  - to provide continuous communication with the persons within the confined space, and
  - to properly initiate emergency response procedures.
- risks associated with other hazards, such as noise or electricity
- arrangements for emergency response, for example first aid and resuscitation
- the physiological and psychological demands of the task and the competency of persons involved in the tasks or emergency response duties
- the adequate instruction of persons in any required procedure, particularly those that are unusual or non-typical, including the use and limitations of any PPE and other equipment to be used
- the availability and adequacy of appropriate PPE and emergency equipment for all persons likely to enter the confined space
- the need for additional risk control measures, including:
  - prohibiting hot work in adjacent areas
  - prohibiting smoking and naked flames within the confined space and adjacent areas
  - avoiding contamination of breathing air from operations or sources outside the confined space, for example from the exhaust of an internal combustion engine
  - prohibiting movement of equipment in adjacent areas, for example forklifts
  - prohibiting spark-generating equipment, clothing and footwear.
- whether purging or cleaning in the confined space is necessary

– whether hot wor is necessary and
– conditions that could impede entry and e it or the conduct o the tas s in the con ined space or e ample plant layout dimensions manual handling and ergonomic aspects o the tas

Further guidance on the ris management process and the hierarchy o control measures is a ailable in the Code o Practice: *How to manage work health and safety risks.*

Atmospheric testing and monitoring

Testing and monitoring the atmosphere in a con ined space are routine parts o determining appropriate control measures or con ined spaces

WHS Regulation 50

Monitoring airborne contaminant le els

WHS Regulation 71

Con ined spaces Speci ic control atmosphere

WHS Regulation 72

Con ined spaces Speci ic control lammable gases and apours

As a PCBU you must ensure that air monitoring is carried out to determine the airborne concentration o a substance or mi ture at the wor place to which an e posure standard applies i :

– the person is not certain on reasonable grounds whether or not the airborne concentration o the substance or mi ture e ceeds the rele ant e posure standard or
– monitoring is necessary to determine whether there is a ris to health

Any air monitoring in a con ined space should be carried out by a competent person using a suitable correctly calibrated gas detector You must ensure that while wor is being carried out in a con ined space to test the atmosphere or:

– o ygen content
– airborne concentration o lammable contaminants and
– airborne concentration o potentially harm ul contaminants or e ample hydrogen sulphide and carbon mono ide

A person s senses should ne er be used to determine i the air in a con ined space is sa e Many to ic or lammable gases and unsa e o ygen le els cannot be detected using one s senses

Initial testing should be done rom outside the con ined space by inserting a sample probe and or portable gas detection de ice at appropriately selected access holes no les and openings Because contaminants can settle at di erent le els each part o the con ined space should be tested side to side and top to bottom see Figure 2

For e ample some gases such as hydrogen sulphide are hea ier than air and in un entilated areas will settle to the bottom o the space while other gases such as methane are lighter than air and will collect at the top o the space Testing should be carried out on a su icient number o points to accurately re ect areas o the space that are li ely to be accessed

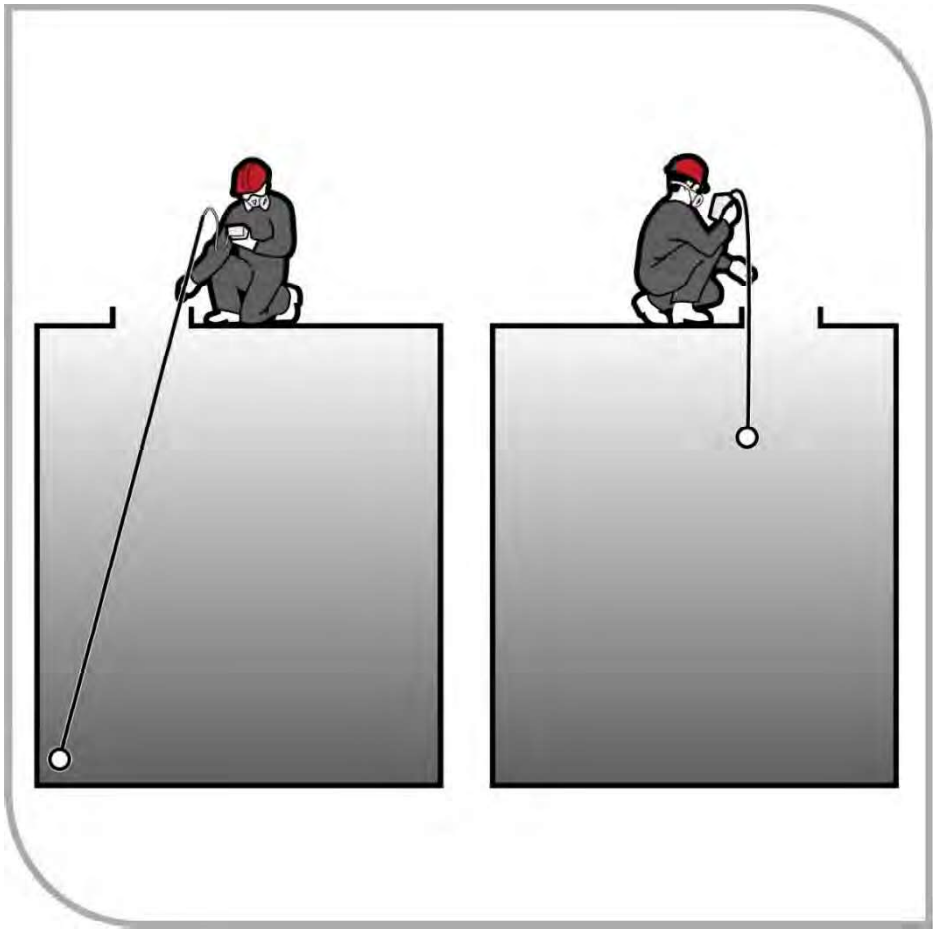


Figure 2 Atmospheric testing o remote regions and di erent le els within the con ined space

Lighter gases may be ented into the breathing one o the person conducting the tests Some gases may be dissol ed in li uids and released when the li uid is disturbed or a crust o er the li uid is bro en so it may be necessary to agitate li uids be ore monitoring

I it is necessary to enter the space to test remote regions away rom entrances or access holes air-supplied respiratory e uipment should be worn and the entry must be underta en in accordance with the WHS Regulations using a con ined space entry permit

Re-testing and continuous monitoring o the air may be necessary i the ris assessment indicates that conditions may change due to the wor being done or the disturbance o ha ardous material in the con ined space

Generic ris assessment

A single or generic ris assessment may be carried out or a class o con ined spaces in a number o di erent wor areas or wor places where the con ined spaces are the same This will only be appropriate i all o the ha ards tas s and circumstances co ered by the ris assessment are the same A ris assessment must be carried out on indi idual con ined spaces i the ha ards tas s or circumstances are di erent and a wor er may be e posed to greater additional or di erent ris s

A con ined space entry permit may be used as a record o the ris assessment

4 Controlling the risks

Hierarchy of control measures

The WHS Regulations require duty holders to work through the hierarchy of control measures when managing certain risks however it can be applied to any risk The hierarchy ranks control measures from the highest level of protection and reliability to the lowest Further guidance on the risk management process and the hierarchy of control measures is in the Code of Practice: *How to manage work health and safety risks*.

As a person conducting a business or undertaking PCBU you should as far as is reasonably practicable ensure health and safety by taking into account and weighing up all relevant matters to control risk For example putting in place control measures when confined space entry is a relatively infrequent activity for most workplaces

Eliminating the risk

You must always aim to **eliminate the risk** for example by eliminating the need to enter a confined space If eliminating the hazards and associated risks is not reasonably practicable you must minimise the risk by one or more of the following:

- **Substitution** minimise the risk by substituting or replacing a hazard or hazardous work practice with something that gives rise to a lesser risk For example changing work methods to minimise time inside the confined space therefore reducing likelihood of heat stress
- **Isolation** minimise the risk by isolating or separating the hazard or hazardous work practice from any person exposed to it for example by isolating moving or electric parts
- **Engineering controls** engineering controls are physical control measures to minimise risk for example forced extraction ventilation for large spaces tanks vessels

If risk remains it must be minimised by implementing **administrative controls** so far as is reasonably practicable For example providing training relevant to working in confined spaces

Any remaining risk must be minimised with suitable **personal protective equipment** PPE For example respiratory protective equipment when oxygen levels are outside the safe range

Administrative control measures and PPE do not control the hazard at the source They rely on human behaviour and supervision and used on their own tend to be the least effective in minimising risks

The WHS Regulations require a PCBU to consider certain relevant matters when managing risks which will help to inform decisions about the most effective and appropriate risk control measures in the circumstances

WHS Regulation 66

Confined spaces Managing risks to health and safety

In managing risks associated with a confined space such risks associated with working in or in the vicinity of the confined space all relevant matters must be considered including:

- whether the work can be carried out without the need to enter the confined space
- the nature of the confined space

– if the hazard is associated with any airborne contaminant or unsafe level of oxygen
– the work to be carried out in the confined space, the range of methods by which the work can be carried out, and the proposed method of working, and
– the type of emergency procedures, including rescue procedures, required.

4.1 Eliminate the need to enter a confined space

Risks associated with work in a confined space must be eliminated so far as is reasonably practicable, and therefore the first question is: can the work be carried out without entering the confined space?

Work could be carried out from outside the confined space, for example by:

– installing fixed or temporary cleaning devices, for example spray balls using high-pressure hoses inserted through an access hatch to clean the inside of a tank
– using remote cameras or a mirror attached to a probe for internal inspection of vessels
– using remotely operated rotating flail devices, vibrators or air purgers to clear blockages in silos, and
– using a hook, long-handled clasp or magnet on a string to retrieve an object dropped into a confined space.

4.2 Minimise the risks

If entering a confined space cannot be avoided, then a safe system for working inside the space must be implemented. A risk assessment carried out by a competent person will help determine what controls are needed to minimise any risk associated with work in the confined space. You must take all relevant matters into account when managing the risks associated with working in a confined space and ensure a risk assessment is conducted which includes the following considerations.

The nature of the space

The nature of a confined space may contribute to the risks associated with it, for example:

– whether the number, size and location of entrances and exits may make the rapid exit and rescue of workers from the space difficult
– the temperature of the space may cause heat stress, and
– lack of adequate lighting may mean poor visibility.

The concentration of oxygen or airborne contaminants

The level of oxygen and airborne contaminants is a significant contributor to the risk of working in a confined space. The WHS Regulations contain specific risk control measures for managing these risks, such as:

– the atmosphere of the confined space must have a safe level of oxygen, or if this is not reasonably practicable, any worker carrying out work in a space with an oxygen level less than 19.5 per cent by volume must be provided with air supplied respiratory equipment
– purging or ventilation of any contaminant in the atmosphere of the space must be carried out so far as is reasonably practicable. The gas mixture used for ventilation or purging must not have an oxygen concentration exceeding 21 per cent by volume, and

– air monitoring must be carried out to determine the airborne concentration o a substance or mi ture to which an e posure standard applies i it is not certain on reasonable grounds whether the concentration e ceeds the standard or i monitoring is necessary to determine i there is a ris to health

The wor and wor method

Consideration must be gi en to whether the proposed wor or wor process will introduce any new ha ards or contribute to the ris s o wor ing in the con ined space The WHS Regulations set out some speci ic control measures or ris s associated with wor in con ined spaces in certain circumstances:

– ignition sources must not be introduced into a space i there is a possibility o ire or e plosion
– while wor is being carried out the concentration o flammable gas apour or mist must be less than i e per cent o its lower e plosi e limit LEL so ar as is reasonably practicable At LEL o between i e per cent and 10 per cent the wor er must be remo ed unless a gas detector is used and the wor er must be immediately remo ed i the LEL is e ual to or greater than 10 per cent
– ris s associated with the introduction o any substance or condition into the space rom plant or ser ices connected to the space must be eliminated so ar as is reasonably practicable and
– ensure a person does not enter a con ined space to carry out wor unless there is a system o wor that includes communication with the wor er rom outside the space and monitoring o conditions within the space by a stand-by person in the icinity o the space and i practicable obser ing the wor being carried out

Wor processes should:

– minimise the release o harm ul airborne contaminants into the space
– reduce the time spent in the space or the number o people that ha e to enter the space and
– eliminate the ris o engul ment

Consider any ris s associated with the use o PPE in a con ined space Using PPE may introduce new ris s or those wor ing in the space or e ample the weight or discom ort o protecti e clothing and hearing protection

Emergency procedures

When things go wrong in a con ined space people may be e posed to serious and immediate danger E ecti e arrangements or raising the alarm and carrying out rescue operations in an emergency are essential re er to Chapter 5 o this Code

4 3 Entry permits

A con ined space entry permit pro ides a ormal chec to ensure all elements o a sa e system o wor are in place be ore people are allowed to enter the con ined space It also pro ides a means o communication between site management super isors and those carrying out the wor and ensures that the PCBU has chec ed and authorised the entry to the con ined space and it is sa e to proceed

WHS Regulation 65

Entry into con ined space must comply with this Di ision

WHS Regulation 67

Con□ined space entry permit

WHS Regulation 77

Con□ined space entry permit and ris□ assessment must be □ept

A PCBU must not allow or direct a wor□er to enter a con□ined space to carry out wor□ unless the wor□er has been issued a con□ined space entry permit □or the wor□□

The permit must be completed in writing by a competent person and:

– speci□y the con□ined space to which the permit relates
– record the names o□ persons permitted to enter the con□ined space and the period o□ time that the wor□ in the space will be carried out
– set out ris□ control measures based on the ris□ assessment and include control measures □or sa□e entry and details about the systems o□ wor□□ and
– contain space □or an ac□nowledgement that wor□ in the con□ined space has been completed and all persons ha□e le□t the space□

A copy o□ the permit must be □ept at least until the wor□ is completed or□ i□ a noti□iable incident occurs□□ or at least two years a□ter the con□ined space wor□ to which the permit relates is completed□

A competent person is one who has ac□uired through training□□uali□ication or e□perience the □nowledge and s□ills to carry out the tas□□

A con□ined space entry permit must be issued □or each time wor□ is to be carried out in a con□ined space□ Each permit only applies to one con□ined space and allows one or more wor□ers to enter that space□ A competent person who directs and super□ises the wor□ should be nominated and authorised to complete the permit on behal□ o□ the business or underta□ing□

A con□ined space entry permit is also re□uired when a person enters a con□ined space to conduct the initial ha□ard identi□ication or ris□ assessment□ The permit may need to be re□ised a□ter the ris□ assessment is completed□ The con□ined space entry permit must list the in□ormation set out in Table 2□

Table 2 Re□uirements o□ a con□ined space entry permit

	Requirements
Confined space to which the permit relates	– The permit □orm should be designed and completed in such a way as to enable clear identi□ication and recording o□ the space that each permit applies to□ – A single permit can be used □or multiple entries into a space and can be used where there is more than one access point into a single space□
Name of any worker permitted to enter the space	– Full name o□ each wor□er
Period of time during which work in the space will be carried out	– A permit may be re□uired □or □arying periods o□ time depending on the time re□uired to complete the wor□ being carried out in a con□ined space□ – The permit must be re-□alidated i□ the person with direct management or control o□ wor□ in the space changes□ a brea□ in wor□ continuity occurs□ changes are made to the wor□ that introduce ha□ards not addressed by the current permit□ or new control measures are needed□

	Requirements
Measures to control the risk	– List the control measures that must be implemented before work commences (for example the isolation of plant and services, purging, ventilation, atmospheric testing, cleaning and signage) – List the control measures that must be implemented or continued while work is being done in the space (for example ventilation, continuous monitoring, respiratory protective equipment and PPE) – List any equipment to be taken into the confined space, and any exclusions such as ignition sources – List any specialist emergency rescue equipment required

The entry permit must be used as a written record that all workers have exited the confined space on completion of the work. It should be displayed in a prominent place to facilitate signing and clearance. Workers carrying out work in confined spaces must be provided with suitable and adequate information, training and instruction about the contents of the confined space entry permit in a way that is readily understandable.

The information on the entry permit may be used as a suitable record of the risk assessment that has been carried out. An example of an entry permit is provided at Appendix B.

4.4 Isolation

All potentially hazardous plant and services should be isolated prior to any person entering the confined space. Refer to AS 2865:2009: *Confined spaces* for further information on isolation requirements.

Isolate to prevent the:

– introduction of hazardous contaminants or conditions through piping, ducts, vents, drains, conveyors, service pipes and fire protection equipment
– activation or energising of machinery in the confined space
– activation of plant or services outside the confined space that could adversely affect the space (for example heating or refrigerating methods)
– release of any stored or potential energy in plant, and
– inadvertent use of electrical equipment.

Pipe work

If liquids, gases or vapours could enter the confined space, pipe work should be physically isolated.

Isolation measures (for example physically locking, tagging, closing and blanking (see Figure 3)) should be supervised or checked at each isolation point. Isolation measures should be supported by systems to ensure that the isolation measures are not removed until all work is complete and all workers have left the space.



Figure 3 E□ample o□tag and loc□out with padloc□s

Methods o□isolation □rom materials□contaminants or conditions include isolating in accordance with one o□the methods described below or by an alternati□e method ensuring at least an e□ui□alent le□el o□sa□ety:

– Remo□ing a □al□e□spool piece or e□pansion □oint in piping leading to the con□ined space □as close as practicable to the space□and blan□ing or capping the open end o□the piping □see Figure 4□□The blan□ or cap should be tagged to indicate its purpose□Blan□s or caps should be made o□a material that is compatible with the li□uid□□apour or gas with which they are in contact□The material should also ha□e su□icient strength to withstand the ma□imum operating pressure□□or e□ample surges□which can build up in the piping□

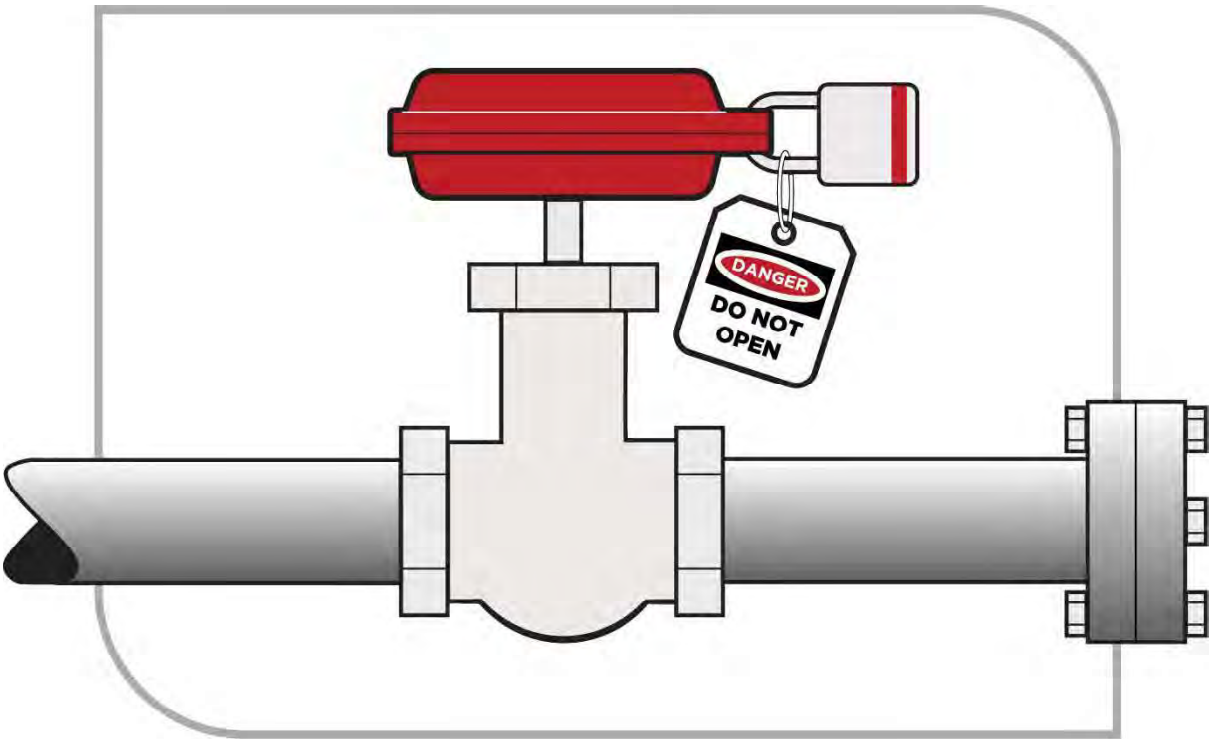


Figure 4 Open end of pipe capped with the nearest valve closed locked and tagged

– Inserting a suitable full-pressure spade or blank in piping between the flanges as close as practicable to the confined space (see Figure 5). The full-pressure spade or blank should be tagged to indicate its purpose.

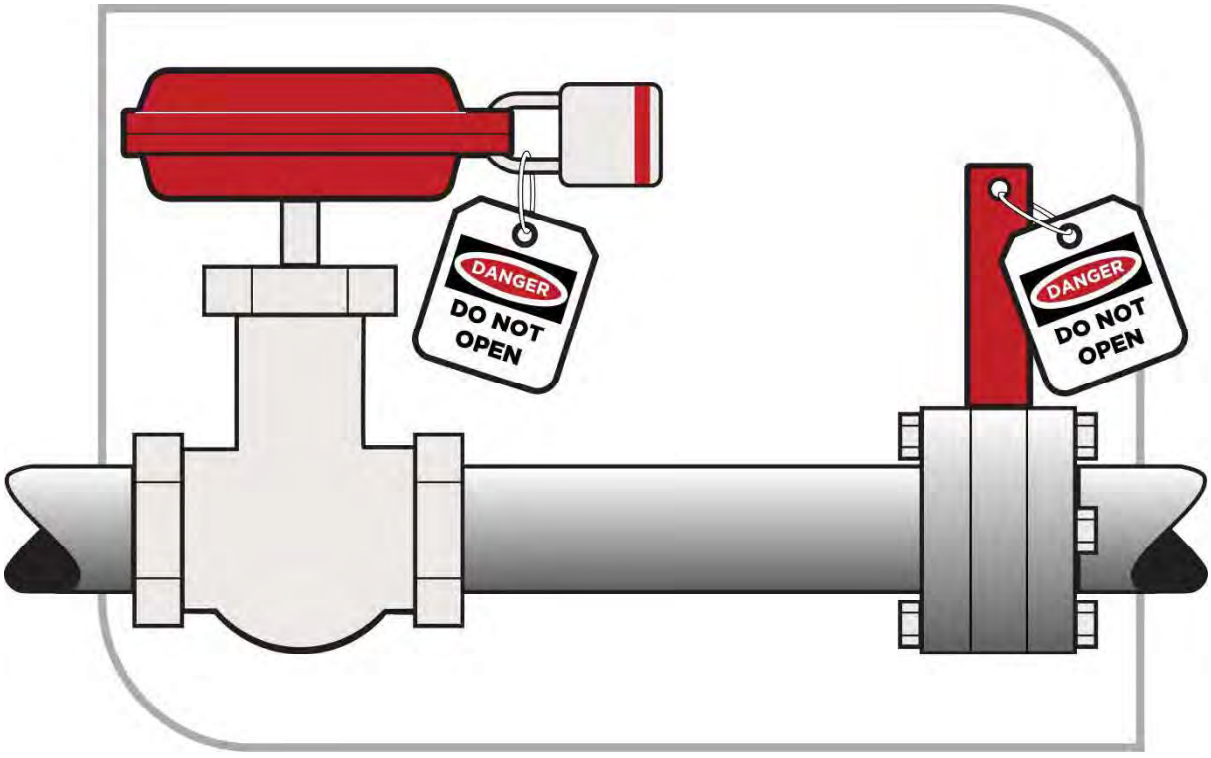


Figure 5 Insertion of full pressure spade or blank

– Closing□loc□ing and tagging at least two □al□es in the piping leading to the con□ined space □see Figure 6□□A drain or □ent □al□e between the two closed □al□es should be loc□ed open to atmosphere as part o□this method□

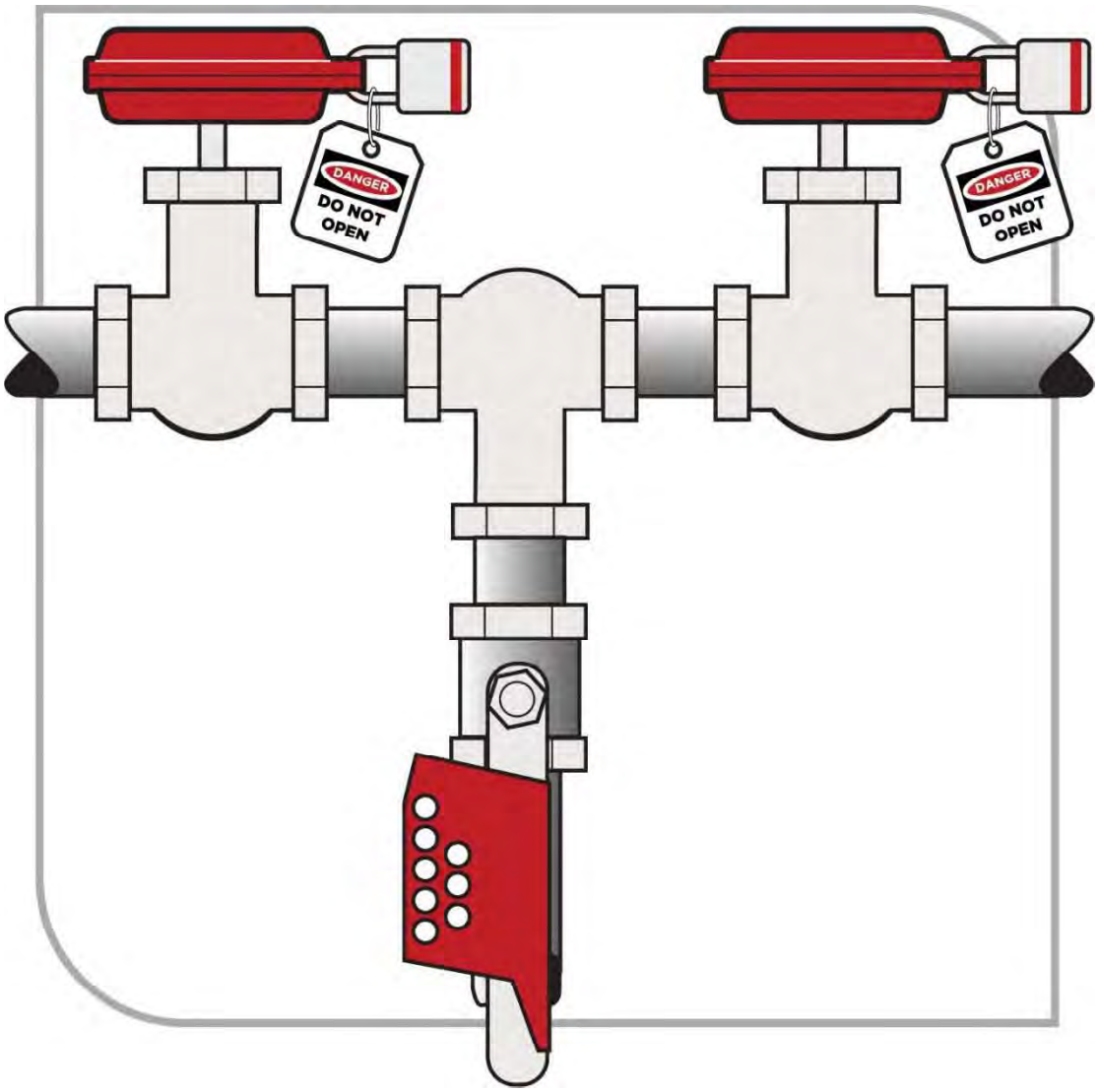


Figure 6 Closing□loc□ing and tagging at least two □al□es

Mo□ing parts and stored energy

Be□ore entry is permitted to any con□ined space that can mo□e□or in which agitators□□ans or other mo□ing parts that may pose a ris□to wor□ers are present□the possibility o□mo□ement should be eliminated□

E□uipment or de□ices with stored energy□including hydraulic□pneumatic□electrical□ chemical□mechanical□thermal or other types o□energy□should be reduced to a □ero energy condition so that no energy is le□t in de□ices and systems that could cause in□ury or illness□

I□the con□ined space has agitators□blades and other mo□ing e□uipment□consider choc□ing□ wedging□chaining or remo□ing these parts□Alternati□ely de-energise the e□uipment□loc□out and tag out machinery□mi□ers□agitators and other e□uipment containing mo□ing parts in the con□ined space□This may re□uire additional isolation□bloc□ing or de-energising o□the machinery itsel□to guard against the release o□stored energy□

Using a loc□

When a loc□ is used□the □ey should be □ept in the possession o□the person placing the loc□□Spare □eys should not be accessible e□cept in emergencies□The tag should indicate that a person is in the con□ined space and that such isolation should not be remo□ed until all people ha□e le□t the con□ined space□

E□amples where this procedure may be used include:

– an open circuit brea□er or open isolating switch supplying electrical power to e□uipment with ha□ardous mo□ing parts□and
– where a power source cannot be controlled readily or e□ecti□ely□re□uiring a belt or other mechanical lin□age to be disconnected and tagged□

4□5□Atmosphere

As a PCBU□you must eliminate or minimise ris□s associated with the atmosphere in a con□ined space□so □ar as is reasonably practicable□A sa□e atmosphere in a con□ined space is one that:

– has a sa□e o□ygen le□el
– is □ee o□airborne contaminants or any airborne contaminants are in concentrations below their allowable e□posure standard □i□any□□and
– any □ammable gas□□apour or mist in the atmosphere is at concentrations below 5 per cent o□its lower e□plosi□e le□el □LEL□□

A sa□e atmosphere can be achie□ed within the con□ined space using methods such as cleaning□purging and □entilation□

WHS Regulation 71(1)(b)

Speci□ic control□ □ammable gases and □apours

The WHS Regulations prohibit pure o□ygen or gas mi□tures with o□ygen in a concentration greater than 21 per cent by □olume being used □or purging or □entilating a con□ined space because o□the ris□o□increased □ammability□

Consideration should be gi□en to engaging the ser□ices o□a specialist in □entilation or a hygienist□

Purging

Purging is the method used to displace any contaminant □rom a con□ined space□Purging is usually done using an inert gas□such as nitrogen□to clear □ammable gases or □apours be□ore wor□in the con□ined space begins□

Purging must be carried out□so □ar as is reasonably practicable□where a ris□assessment identi□ies the potential □or the con□ined space to contain an unacceptable le□el o□ contaminants□

A□ter purging□the con□ined space should be ade□uately □entilated with su□□icient □resh air to ensure that o□ygen has returned to a normal le□el o□21 per cent□Purging should be done in a way that ensures any contaminants remo□ed □rom the con□ined space are e□pelled to a location where they present no □urther ris□□Atmospheric testing should be carried out be□ore entry to chec□that the purging and □entilation ha□e been e□ecti□e□

When flammable contaminants are to be purged purging and ventilation equipment designed for use in hazardous areas must be used A hazardous area is an area in which an explosive atmosphere is present or may be expected to be present in quantities that require special precautions during the construction installation and use of potential ignition sources

Ventilation

Ventilation of a confined space with fresh air by natural forced or mechanical means may be necessary to establish and maintain a safe atmosphere and temperature for as long as anyone is in the confined space

If the confined space has sufficient openings then natural ventilation may be adequate but in most cases mechanical ventilation is likely to be needed

Consideration should also be given to where the fresh air is drawn from and where the exhaust air is finally vented to so that the fresh air is not contaminated either by exhaust air or by other pollutants and the exhaust air does not cause other risks

Mechanical ventilation may be either local exhaust ventilation LEV or dilution ventilation LEV is effective where the source of contaminant generation is localised the extraction point can be located close to the source and adequate make-up air is available for example in the capture or extraction of welding fumes

Where dilution ventilation is used air needs to be introduced in a way that will ensure effective circulation throughout the confined space taking account of the configuration of the space the position of the openings and the properties of the contaminants The source point of the air must be such that the air is fresh breathable and free of contaminants such as gases arising from the operation of plant and equipment for example combustible engines

During operations likely to generate contaminants mechanical ventilation equipment may not be adequate or sufficiently reliable to maintain contaminants at acceptable levels or to ensure a safe oxygen level Where mechanical ventilation equipment is likely to be necessary to maintain acceptable contaminant levels in a confined space the equipment should:

- be monitored to ensure continuous operation while the confined space is occupied and
- have the controls including any remote power supply clearly identified tagged and protected to guard against unauthorised interference

Flammable gases and vapours

WHS Regulation 72

Confined spaces Specific control flammable gases and vapours

A PCBU must while work is being carried out in a confined space ensure that the concentration of any flammable gas vapour or mist in the atmosphere of the space is less than 5 per cent of its LEL so far as is reasonably practicable

If this is not reasonably practicable and the concentration of any flammable gas vapour or mist in the atmosphere of the confined space:

- is equal to or greater than 5 per cent but less than 10 per cent of its LEL the PCBU must ensure that any worker is immediately removed from the space unless a suitably calibrated continuous-monitoring flammable gas detector is used in the space or
- is equal to or greater than 10 per cent of its LEL the PCBU must ensure that any worker is immediately removed from the space

Where a flammable atmosphere may exist in a confined space and there is a risk of fire and explosion all ignition sources in the vicinity must be eliminated.

Examples of potential ignition sources both inside and outside the space include:

- open flames and hot surfaces
- electrical equipment
- internal combustion engines
- metal tools striking metal surfaces
- spark-producing equipment (for example grinding wheels) and
- welding, grinding, oxy acetylene cutting, combustion engines and battery-operated equipment.

Respiratory protective equipment (RPE)

If it is not reasonably practicable to ensure the confined space contains a safe oxygen level or safe levels of airborne contaminants then appropriate air-supplied respiratory equipment (RPE) must be provided. RPE should also be provided and worn in situations where there is no exposure standard for a substance or where the substance is present in an unknown concentration.

'Respiratory protective equipment' refers to a range of breathing equipment including air-supplied and self-contained breathing apparatus. The appropriate RPE should be based on the level and type of contaminants and the work to be done. Whenever there is any doubt about the airborne contaminant and/or type of RPE required, a conservative approach should be adopted (for instance, use air-supplied respiratory equipment).

Further guidance is available in AS/NZS 1715:2009: *Selection, use and maintenance of respiratory protective equipment*.

4.6 Communication and safety monitoring

WHS Regulation 69

Confined spaces: Communication and safety monitoring

As a PCBU, you must ensure that a system of work is provided that includes:

- continuous communication with the worker from outside the confined space, and
- monitoring of conditions within the confined space by a stand-by person who is in the vicinity of the confined space and, if practicable, observing the work being carried out.

A communication system is needed to enable communication between people inside and outside the confined space and to summon help in an emergency.

Depending on the conditions in the confined space, communication can be achieved by voice, radio, hand signals or other suitable methods.

Before a worker enters a confined space, a stand-by person must be assigned to continuously monitor the wellbeing of those inside the space, if practicable observe the work being carried out, and initiate appropriate emergency procedures when necessary (see Figure 1).

The stand-by person should:

- understand the nature of the hazards inside the confined space and be able to recognise signs and symptoms that workers in the confined space may experience

- remain outside the con□ined space and do no other wor□ which may inter□ere with their primary role o□monitoring the wor□ers inside the space
- ha□e all re□uired rescue e□uipment □□or e□ample sa□ety harnesses□li□ting e□uipment□ a li□eline□immediately a□ailable
- ha□e the authority to order wor□ers to e□it the space i□any ha□ardous situation arises□ and
- ne□er enter the space to attempt rescue□



Figure 7 Stand-by person monitoring the con□ined space with rescue e□uipment and sign in place

4□□□Entry and e□it procedures

For the entire period □or which the con□ined space entry permit is □alid□procedures should be in place to indicate when any wor□er is in the space□□or e□ample by using tags□a system o□ signing in and out on the entry permit□or ha□ing a stand-by person record who is in the space□

4□8□Signs and barricades

Be□ore any wor□ in relation to a con□ined space starts□signs must be erected to pre□ent entry o□persons not in□ol□ed in the wor□□

Signs must warn against entry by people other than those who are listed on the con ined space entry permit and must be placed at each entrance to the con ined space Signs must be in place while the con ined space is accessible including when preparing to wor in the space during wor in the space and when pac ing up on completion o the wor

Signposting alone should not be relied on to pre ent unauthorised entry to a potential con ined space Security de ices or e ample loc s and i ed barriers should be installed

4 Maintaining and re iewing control measures

WHS Regulation 37

Maintenance o control measures

Control measures must be maintained so they remain it or purpose suitable or the nature and duration o the wor and be installed set up and used correctly

To allow the chosen control measures to operate e ecti ely you should de elop wor procedures on how to correctly install use and maintain the control measures The procedures should include a planned program o inspections and maintenance or the control measures The inspection regime should include details o :

- the e uipment to be inspected including its uni ue identi ication
- the re uency and type o inspection or e ample pre-use chec s detailed inspections
- action to be ta en on inding de ecti e e uipment
- means o recording the inspections
- training o users and
- the system o monitoring the inspection regime to eri y inspections are carried out appropriately

The manu acturer or supplier o the e uipment should be consulted or product speci ic re uirements I signs o e cessi e wear or other de ects are ound during the inspection the de ecti e e uipment must be withdrawn rom use

WHS Regulation 38

Re iew o control measures

The control measures put in place to protect health and sa ety should be regularly re iewed to ma e sure they are e ecti e I the control measure is not wor ing e ecti ely it must be re ised to ensure it is e ecti e in controlling the ris

You must re iew and as necessary re ise control measures so as to maintain so ar as is reasonably practicable a wor en ironment that is without ris s to health or sa ety For e ample:

- when the control measure does not control the ris so ar as is reasonably practicable
- be ore a change at the wor place that is li ely to gi e rise to a new or di erent ris to health and sa ety that the measure may not e ecti ely control
- a new or rele ant ha ard or ris is identi ied
- the results o consultation indicate a re iew is necessary or
- a health and sa ety representati e HSR re uests a re iew i that person reasonably belie es that:

- a circumstance in any o□the abo□e points a□ects or may a□ect the health and sa□ety o□a member o□the wor□group represented by the HSR□or
- the control measure has not been ade□uately re□iewed in response to the circumstance□

Common re□iew methods include wor□place inspection□consultation□testing and analysing records and data□E□uipment that should be regularly inspected includes:

– atmospheric testing and sampling e□uipment
– PPE including respirators
– □entilation e□uipment
– sa□ety harness and lines
– emergency rescue e□uipment
– gas detectors
– respirator □ilters□and
– sa□ety harnesses□lines and rescue retrie□al e□uipment□

You can use the same methods as in the initial ha□ard identi□ication step to chec□control measures□You must consult your wor□ers in□ol□ed in the con□ined spaces wor□and their health and sa□ety representati□e □HSR□and consider the □ollowing □uestions:

– Are the control measures wor□ing e□ecti□ely in both their design and operation□
– How e□ecti□e is the ris□assessment process□Are all ha□ards being identi□ied□
– Are wor□ers acti□ely in□ol□ed in the ris□management process□Are they openly raising health and sa□ety concerns and reporting problems promptly□
– Ha□e new wor□methods or new e□uipment made the □ob sa□er□
– Are sa□ety procedures being □ollowed□
– Ha□e instruction and training pro□ided to wor□ers been success□ul□
– I□new legislation or new in□ormation becomes a□ailable□does it indicate that current controls may no longer be the most e□ecti□e□
– Is any change planned to any plant or structure that may create a con□ined space or change the nature o□an e□isting con□ined space□
– Has an incident occurred as a result o□wor□carried out in a con□ined space□

I□problems are □ound□go bac□through the ris□management steps□re□iew your in□ormation and ma□e □urther decisions about ris□control□

5 Emergency procedures

WHS Regulation 74

Confined spaces: Emergency procedures

A person conducting a business or undertaking (PCBU) must establish first aid and rescue procedures to be followed in an emergency and ensure that workers practise those procedures to ensure that they are efficient and effective. First aid and rescue procedures must be initiated from outside the confined space as soon as practicable in an emergency.

As a PCBU, you must also ensure that openings for entry and exit are of a sufficient size to allow emergency access, openings are not obstructed, and any plant, equipment and personal protective equipment (PPE) provided for first aid or emergency rescue are maintained in good working order.

When establishing emergency procedures, the following factors must be taken into account to manage risks associated with confined spaces:

- whether the work can be carried out without the need to enter the confined space
- the nature of the confined space
- any changes in hazards associated with the concentration of oxygen or the concentration of airborne contaminants in the confined space
- the work to be carried out in the confined space, the range of methods by which the work can be carried out and the proposed method of working, and
- the type of emergency and rescue procedures required.

You should also take into account the considerations in Table 3.

Table 3 Considerations when establishing emergency procedures for confined spaces

Relevant consideration	Questions
Location of the confined space	– What is the geographic location of the space? – How accessible is it in an emergency, and – How far away is it from appropriate medical facilities?
Communications	– How can workers working inside the space communicate to people outside in an emergency? – Exactly how will the alarm be raised and by whom? – Has planning been done to ensure that rescue and emergency personnel can access the workplace during night shift, weekends and holiday periods?
Rescue and resuscitation equipment	– What kinds of emergencies are contemplated? – Have you identified and provided suitable rescue and resuscitation equipment dependent on the potential emergencies? For example, taking into account: ▪ the nature of the work being carried out at the workplace ▪ the size and location of the workplace, and ▪ the number and composition of the workers and other persons at the workplace. – Is the selected rescue equipment kept in close proximity to the confined space so that it can be used immediately?

Relevant consideration	Questions
Capabilities of rescuers	– Are rescuers properly trained□su□iciently □it to carry out their tas□and capable o□using any e□uipment pro□ided □or rescue □e□g□breathing apparatus□li□elines and □ire□ighting e□uipment□□ – How will rescuers be protected during the emergency operation□
First aid	– Is appropriate □irst aid a□ailable □or immediate use□ – Are trained □irst aid personnel a□ailable to ma□e proper use o□ any necessary □irst aid e□uipment□
Local emergency services—if they are to be relied on for rescue	– How will the local emergency ser□ices □e□g□□ire brigade□be noti□ied o□an incident□ – What in□ormation about the particular dangers in the con□ined space will be gi□en to them on their arri□al□ – Ha□e prior arrangements been made with local emergency ser□ices to ensure they are able to respond in a reasonable time and ha□e the specialist con□ined space retrie□al e□uipment readily a□ailable□

First aid and rescue procedures should be rehearsed with rele□ant wor□ers to ensure that they are e□□icient and e□□ecti□e□

Rescue should be per□ormed □rom outside the con□ined space□i□possible□Wor□ers per□orming a rescue must be ade□uately trained□and must be pro□ided with air-supplied respiratory protecti□e e□uipment i□they enter a con□ined space in an emergency in which:

– the atmosphere in the con□ined space does not ha□e a sa□e o□ygen le□el□or
– the atmosphere in the space has a harm□ul concentration o□an airborne contaminant□or
– there is a serious ris□ o□the atmosphere in the space becoming a□□ected in the way re□erred to abo□e while the wor□er is in the space□

I□a person inside a con□ined space has been o□ercome by lac□ o□o□ygen or by airborne contaminants□it should always be assumed that entry □or rescue is unsa□e unless air-supplied respiratory protecti□e e□uipment is used□

Potential problems with the si□e o□entrances and e□its must be addressed when de□eloping emergency and rescue procedures□Where openings are □ound to be inade□uate□their si□e should be increased□or an alternati□e sa□e means o□entry and e□it should be pro□ided□

Appendi□A□ Glossary

Term	Description
Airborne contaminant	A chemical or substance in the □orm o□a □ume□mist□gas□□apour or dust□including micro-organisms□
Competent person	A person who has ac□uired through training□□uali□ication or e□perience the □nowledge and s□ills to carry out the tas□□
Duty holder	Any person who owes a wor□ health and sa□ety duty under the WHS Act including a person conducting a business or underta□ing □PCBU□□a designer□manu□acturer□importer□supplier□installer o□products or plant used at wor□ □upstream duty holder□□o□icer or a wor□er□
Hazard	A situation or thing that has the potential to harm a person□Ha□ards at wor□may include: noisy machinery□a mo□ing □or□li□t□chemicals□ electricity□wor□ing at heights□a repetiti□e □ob□bullying and □iolence at the wor□place□
Hazardous chemical	A substance□mi□ture or article that satis□ies the criteria □or a ha□ard class in the GHS □including a classi□ication re□erred to in Schedule 6 o□ the WHS Regulations□□but does not include a substance□mi□ture or article that satis□ies the criteria solely □or one o□the □ollowing ha□ard classes: a□ acute to□icity□ oral□ category 5 b□ acute to□icity□ dermal□ category 5 c□ acute to□icity□ inhalation□ category 5 d□ s□in corrosion□irritation□ category 3 e□ serious eye damage□eye irritation□ category 2B □□ aspiration ha□ard□ category 2 g□ □lammable gas□ category 2 h□ acute ha□ard to the a□uatic en□ironment□ category 1□2 or 3 i□ chronic ha□ard to the a□uatic en□ironment□ category 1□2□ 3 or 4 □□ ha□ardous to the o□one layer□ Note: The Schedule 6 tables replace some tables in the GHS□
LEL	Lower e□plosi□e limit
LEV	Local e□haust □entilation
May	□May□indicates an optional course o□action□
Must	□Must□indicates a legal re□uirement e□ists that must be complied with□
Officer	An o□icer under the WHS Act includes: – an o□icer under section □o□the *Corporations Act 2001* □Cth□ – an o□icer o□the Crown within the meaning o□section 24□o□the WHS Act□and

Term	Description
	– an o□icer o□a public authority within the meaning o□section 252 o□ the WHS Act□ A partner in a partnership or an elected member o□a local authority is not an o□icer while acting in that capacity.
Person conducting a business or undertaking (PCBU)	PCBU is an umbrella concept which intends to capture all types o□ wor□ing arrangements or relationships□A PCBU includes a: – company – unincorporated body or association□and – sole trader or sel□-employed person□ Indi□iduals who are in a partnership that is conducting a business will indi□idually and collecti□ely be a PCBU□ A □olunteer association □de□ined under the WHS Act□see below□or elected members o□a local authority will not be a PCBU□
Plant	Plant includes machinery□e□uipment□appliance□container□implement and tool components or anything □itted or connected to those things□ Plant includes items as di□erse as li□ts□cranes□computers□machinery□ con□eyors□□or□li□ts□□ehicles□power tools□□uad bi□es□mobile plant and amusement de□ices□ Plant that relies e□clusi□ely on manual power □or its operation and is designed to be primarily supported by hand□□or e□ample a screwdri□er□ is not co□ered by the WHS Regulations□The general duty o□care under the WHS Act applies to this type o□plant□ Certain □inds o□plant□□or e□ample □or□li□ts□cranes and some pressure e□uipment□re□uire a licence □rom the regulator to operate and some high-ris□ plant must also be registered with the regulator□
Relevant worker	A wor□er who could enter or wor□ in a con□ined space□or other wor□ers who are not re□uired to enter the con□ined space but could carry out related □unctions or emergency procedures□
Risk	The possibility harm □death□in□ury or illness□might occur when e□posed to a ha□ard□
Should	□Should□indicates a recommended course o□action□
Substance	A chemical element or compound in its natural state or obtained or generated by a process: – including any additi□e necessary to preser□e the stability o□the element or compound and any impurities deri□ing □rom the process□ but – e□cluding any sol□ent that may be separated without a□ecting the stability o□the element or compound□or changing its composition□
Volunteer association	**A group of volunteers working together for one or more community purposes where none of the volunteers, whether alone or jointly with any other volunteers, employs any person to carry out work for the volunteer association.**

Appendi B Con ined space criteria

	Confined space criteria						Confined space?
	A	B	C	D			
E ample o the space and acti ity	Is the space enclosed or partially enclosed	Is the space not designed or intended to be occupied by a person	Is the space designed or intended to be at normal atmospheric pressure while any person is in the space	Does the space present a ris rom:			I the answer to A B C and at least one o D is yes then the space is a con ined space
				Harm ul airborne or lammable contaminants	An unsa e o ygen le el	Engul ment	
Sewer with access ia a ertical ladder	✓	✓	✓	✓	✓	✓	Yes
Dislodging grain rom a silo with sole access through a manhole at the top	✓	✓	✓	✓	×	✓	Yes
Cleaning spilled cadmium pigment powder in a shipping container	✓	✓	✓	✓	×	×	Yes
Inspecting a uel tan in the wing o an aircra t	✓	✓	✓	✓	×	×	Yes
Dislodging a sludge bloc age in a drain pit	✓	✓	✓	✓	✓	✓	Yes
Internal inspection o a new clean tan prior to commissioning	✓	✓	✓	×	×	×	No
Internal inspection o an empty cement silo through a door at ground le el	✓	×	✓	×	×	×	No
Stoc ta e using an LPG or li t in a uit cool store	✓	×	✓	✓	×	×	No
Installing insulation in a roo ca ity	✓	✓	✓	×	×	×	No

Appendi C Sample con ined space entry permit

General

Location o Wor :

Description o Wor :

Control measures

Isolation

Space needs to be isolated from:

Water/gas/steam/chemicals:

Mechanical/electrical drives:

Auto fire extinguishing systems:

Hydraulic/electric/gas/power:

***Sludge/deposits/wastes*:**

Locks and/or tags have been affixed to isolation points: ❑ Yes ❑ No

Atmosphere

The atmosphere in the confined space has been tested: ❑ Yes ❑ No

Results of tests:

Oxygen:

Flammable gases:

LEL

Other gases:

LEL

Other airborne contaminants:

□□□

Type of appropriate fire prevention equipment available:

Suitable access and exit: ❑ Yes ❑ No

Hot work is permitted: ❑ Yes ❑ No

< 5% LEL: ❑ Yes ❑ No

Personal protecti□e e□uipment

The □ollowing sa□ety e□uipment must be worn:

Type:

Respiratory protection:

Harness/lifelines:

Eye protection:

Hand protection:

Footwear:

Protective clothing:

Hearing protectors:

Safety helmet:

Communication equipment:

Other:

Other Precautions

Warning notices/barricades: ❑ Yes ❑ No

All persons have been trained: ❑ Yes ❑ No

Is continual air monitoring required: ❑ Yes ❑ No

Emergency response

Procedures Equipment

□□□

Authority to enter

The control measures and precautions appropriate for the safe entry and execution of the work in the confined space have been implemented and persons required to work in the confined space have been advised of and understand the requirements of this written authority.

Signed □person in direct control□

□□□

Person authorised to enter con□ined space

I have been advised of and understand the control measures and precautions to be observed with the entry and work in the confined space.

Entry			**Exit**		
Name	**Date**	**Time**	Name	**Date**	**Time**

Withdrawal o□written authority

All persons and equipment accounted for: ❑ Yes ❑ No

Equipment checked and stored correctly: ❑ Yes ❑ No

Signed □person in direct control□

Date:

□□□□□□□□□□ Time:

Remar□s or comments about the wor□:

Amendments

The model Code o□Practice: *Confined spaces* has been amended since its publication in December 2011□including a number o□amendments agreed to in 2018 as part o□a technical and usability re□iew o□the model Code□The current □ersion□dated October 2018□ incorporates all o□those amendments□

Appendix C

Example Induction Register

Site Management Plan Induction Record

Date	Name	Company	Role	Signature	Induction by	Company	Signature

By signing this induction record, I understand the contents of the Site Management Plan

Appendix D

Borelogs of Groundwater and Soil Vapour Monitoring Wells

BORE LOG
GW51

PROJECT NUMBER: P21083
CLIENT NAME: ACT EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME: Kippax Centre DSI
CONTRACTOR: Terratest Pty Ltd
DRILL METHOD: Geoprobe 7822DT
DIAMETER: 150 mm
HOLE DEPTH: 12.5 m

COORDINATE SYSTEM: GDA2020 / MGA zone 55
EASTING: 683,859.928 mE
NORTHING: 6,100,444.976 mN
ELEVATION: 568.123 AHD
DATE DRILLED: 21/04/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	Fill	GW51 0.0-0.1	0.1	Y		GP	**(0.0) Gravelly silty SAND:** brown-grey, dry, hard	Road base. Asphalt on surface	Cement
0.5			0			GC			
1.0			0			SC-CM	**(0.2) Gravelly sandy CLAY:** dark brown-brown, dry-moist, plastic	Reworked fill (0.2-0.7 m)	
1.5							**(0.7) Sandy silty CLAY:** dark brown to brown to yellow, dry-moist, plastic		
2.0			0					Natural residual soil (0.7-4.0 m)	
2.5									Backfill
3.0			0.2					Abundant fragments of weathered volcanics	PVC Collar
3.5									
4.0		GW51 4.0-4.1	0	Y				Airdrilling from 4.0 m	
4.5									
5.0									
5.5									Bentonite
6.0	Deakin Volcanics								
6.5									
7.0									
7.5									
8.0						tuff	**(8.0) Weathered Volcanics:** Drilling of weathered volcanosedimentary unit. Cristals in air-hammer powder, yellow-grey in colour		
8.5									
9.0									Sand
9.5								Moist powder at 9.5 m	Slotted Screen
10.0									
10.5									
11.0									
11.5									
12.0									
12.5									

Air-drilled from 4 m (bgl) until 12.5 m
Moisture detected at 10.5 m

LOGGED BY L.B
CHECKED BY C.G

lanterra consulting	**BORE LOG** **GW52**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,854.106 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,469.839 mN
DIAMETER:	150 mm	**ELEVATION:**	567.393 AHD
HOLE DEPTH:	12.5 m	**DATE DRILLED:**	03/11/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill*	GW52 0.0-0.1	0.1	Y		GP	**(0.0) Sandy GRAVEL:** grey-redish, dry-moist, losse and hard	Road base. Asphalt on surface	Cement
0.5			0			GC			
1.0			0			SC-CM	**(0.2) Gravelly sandy SILT:** brown, dry-moist, soft-hard	Reworked fill (0.2-0.7 m)	
1.5							**(0.7) Sandy CLAY:** dark brown to brown to yellow, dry-moist, plastic		
2.0		GW52 2.0-2.1	2.2	Y				Natural residual soil (0.7-3.8 m)	
2.5									
3.0			0					Weathered volcanics from 3.8 m	
3.5									
4.0			0						Backfill
4.5									PVC Collar
5.0	*Deakin Volcanics*		0			tuff	**(4.8) Silty clayey SAND:** brown, moist, soft-hard	Airdrilling from 5.0 m	
5.5									
6.0									
6.5									
7.0									
7.5									
8.0									
8.5									Bentonite
9.0									
9.5									
10.0									
10.5								Moist powder at 10.5 m (water hit)	Sand
11.0									Slotted Screen
11.5									
12.0									
12.5									

Air-drilled from 5 m (bgl) until 12.5 m
Moisture detected at 10.5 m

LOGGED BY	L.B
CHECKED BY	C.G

lanterra consulting	**BORE LOG** **GW53**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,874.647 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,470.916 mN
DIAMETER:	150 mm	**ELEVATION:**	567.076 AHD
HOLE DEPTH:	12.7 m	**DATE DRILLED:**	02/11/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCs	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill*	GW53 0.0-0.1	2.3	Y		GP	**(0.0) Sandy GRAVEL:** grey, dry, losse	Road base. Asphalt on surface	Cement
0.5						GC			
1.0		GW53 1.0-1.1	0.3	Y		SC-CM	**(0.2) Clayey Sandy SILT:** brown, moist, firm	Reworked fill (0.2-0.7 m)	
1.5							**(0.7) Sandy CLAY:** dark brown to brown to yellow, dry-moist, plastic		
2.0			0.2				**(1.5) CLAY:** brown-dark brown, moist, soft-firm and plastic	Mottled 95% clay (residual soil)	
2.5									
3.0			0						
3.5									Backfill
4.0			0				**(3.8) Sandy CLAY:** brown-yellow brown, moist, firm-hard, low plasticity		PVC Collar
4.5							**(4.5) Clayey SAND:** yellow-brown, moist, soft	Extremely weathered bedrock	
5.0			0.6						
5.5									
6.0	*Deakin Volcanics*		0			tuff-sed	**(6.1) Clayey SAND:** yellow-brown, moist, soft	Airdrilling from 6.0 m	
6.5									
7.0									
7.5									Bentonite
8.0								Bedrock appears to be a volcanosedimentary unit	
8.5									
9.0									
9.5									
10.0									Sand
10.5									Slotted Screen
11.0									
11.5								Moist powder at 11.5 m (water hit)	
12.0									Caving
12.5									

Air-drilled from 6 m (bgl) until 12.7 m
Moisture detected at 11.5 m
well installed at 11.6 m due to caving

LOGGED BY	C.G
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW54**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,887.748 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,458.746 mN
DIAMETER:	150 mm	**ELEVATION:**	567.309 AHD
HOLE DEPTH:	12.7 m	**DATE DRILLED:**	03/11/2021

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	Deakin Volcanics	GW54 0.0-0.1	0	Y		SM	**(0.0) Sandy SILT:** pale brown, dry, soft	Topsoil. Grass on surface	Cement
0.5						GC	**(0.1) Gravelly sandy CLAY:** brown, dry-moist, hard-plastic		
1.0		GW54 1.0-1.1	0	Y					
1.5						SP-SC	**(1.5) Sandy silty CLAY:** dark brown-brown, moist and plastic		
2.0			0					Traces of rounded oxidised volcanics (2.0-3.5 m)	
2.5									
3.0			0						
3.5									
4.0			0						Backfill
4.5						tuff-sed	**(4.5) Gravelly sandy SILT:** pale brown-yellow, dry-moist, soft-hard		PVC Collar
5.0			0					Weathered volcanic bedrock	
5.5								Airdrilling from 5.5 m	
6.0									
6.5									
7.0									
7.5									
8.0						tuff-sed	**(8.0) Gravelly silty SAND:** pale brown-light grey, dry, hard	Abundant felsic minerals observed in material from air strata	Bentonite
8.5									
9.0									
9.5									
10.0									
10.5									Sand
11.0									Slotted Screen
11.5								Moist powder at 11.0 m (water hit)	
12.0									
12.5									Caving

Air-drilled from 6 m (bgl) until 12.7 m
Moisture detected at 11.0 m
well installed at 12.3 m due to caving

LOGGED BY	L.B
CHECKED BY	C.G

lanterra consulting	**BORE LOG** **GW55**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** ACT EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,852.688 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,540.219 mN
DIAMETER:	150 mm	**ELEVATION:**	565.774 AHD
HOLE DEPTH:	10.5 m	**DATE DRILLED:**	11/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill*	GW55 0.0-0.1	0.6	Y		PT	**(0.0) Sandy SILT:** dark brown, moist-wet, soft	Topsoil. Grass on surface
0.5			0.6			SM	**(0.5) Sandy SILT:** brown, moist-wet, soft	Fill
1.0			0.6			GM	**(1.0) Sandy Gravelly SILT:** brown, moist, loose	Reworked fill
2.0	*Deakin Volcanics*	GW55 2.0-2.1	0.7	Y		SM	**(2.0) Sandy Silt:** light brown, dry-moist, soft	Residual natural soil Natural. Abundant lumps of clay material from 2 m to 6 m
3.0			0.7			SC	**(3.0) Sandy Clay:** brown-grey, moist, soft, some plasticity	
4.0			0.5				**(4.0) Sandy Clay:** red-brown, dry-moist, soft-firm	
5.0			0.5					
6.0			0.8				**(6.0) Air Drilling:** air-drilling dust (red-brown, dry-moist, soft-loose)	Airdrilling from 6 m. Weathered rhyodacitic tuff observed
10.5								Moist powder at 10.3 m (water ~~bit~~)



Air-drilled from 6 m (bgl) until 10.5 m
Groundwater detected at 10.3 m, after 40 min water level rose to 8.3 m

LOGGED BY	A.P
CHECKED BY	L.B

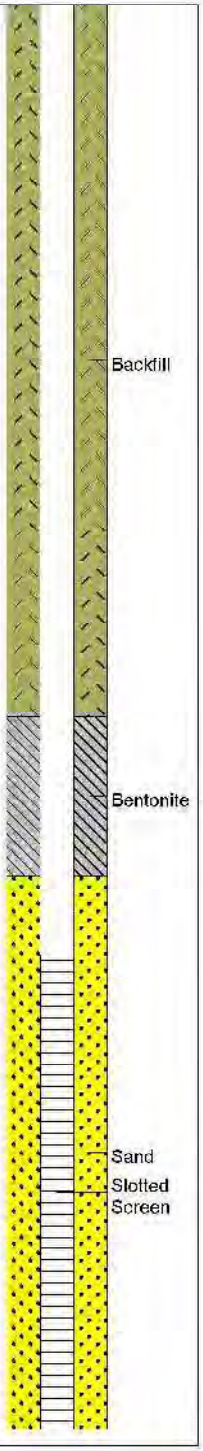
BORE LOG
GW56

PROJECT NUMBER: P21083
CLIENT NAME: ACT EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME: Kippax Centre DSI
CONTRACTOR: Terratest Pty Ltd
DRILL METHOD: Geoprobe 7822DT
DIAMETER: 150 mm
HOLE DEPTH: 9.1 m

COORDINATE SYSTEM: GDA2020 / MGA zone 55
EASTING: 683,876.292 mE
NORTHING: 6,100,510.096 mN
ELEVATION: 565.845 AHD
DATE DRILLED: 10/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	Fill Material		0.6			SM	**(0.0) Sandy SILT:** brown-dark grey, moist-wet, soft	Topsoil (0.0-0.5 m). Grass on surface.
0.5		GW56 0.5-0.6	0.2	Y			**(0.5) Gravelly sandy SILT:** brown-dark grey, moist to wet and soft	
1.0			0.1					
1.5								
2.0		GW56 2.0-2.1	1.7	Y		CS	**(2.0) Sandy clayey SILT:** brown, moist, loose	Reworked Material from 0.5-3.0 m
2.5								
3.0	Deakin Volcanics		0.7				**(3.0) Gravelly Sandy CLAY:** brown-light brown, dry, soft to hard	Natural
3.5								
4.0			0.5					
4.5								
5.0			0.9				**(5.0) Sandy CLAY:** brown-light brown, moist, soft to firm and plastic	
5.5								
6.0			0.1				**(6.0) Gravelly Clayey SAND:** brown-pale brown, dry, loose	
6.5								
7.0			0.1					
7.5								
8.0			0.6					Groundwater hit between 8.0-8.5 m
8.5								
9.0			0.4					



Groundwater found at 8-8.5m but rose up to 6-6.5m

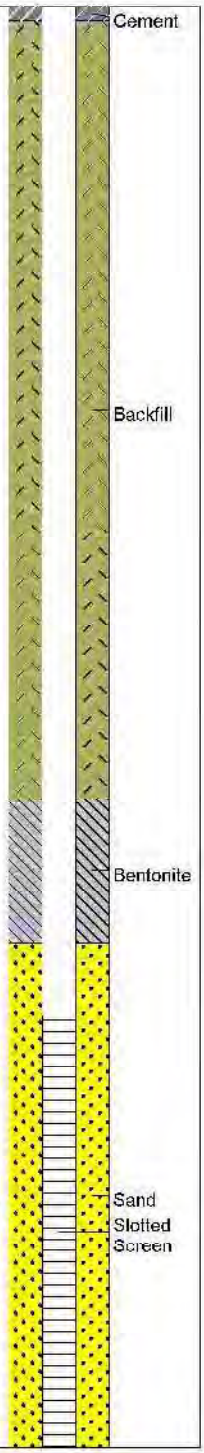
LOGGED BY A.P
CHECKED BY L.B

BORE LOG
GW57

PROJECT NUMBER: P21083
CLIENT NAME: EPSDD
ADDRESS: Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,869.757 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,480.165 mN
DIAMETER:	150mm	**ELEVATION:**	566.755 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	11/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0.2			GM	**(0.0) Gravelly Sandy SILT:** dark brown, dry-moist, hard	Road base, some pebbles present
0.5			0.2				**(0.3) Gravelly Sandy SILT:** dark brown, moist, soft to hard	Reworked material from 0.3-1.5 m
1.0			0.2					
1.5						GC	**(1.5) Gravelly Sandy CLAY:** brown, moist, hard	Residual soil. Rounded fragments of oldized volcanics.
2.0			0.3					
2.5								
3.0			0.2				**(3.0) Gravelly Sandy CLAY:** brown, moist, loose and hard	Natural material
3.5								
4.0			0					
4.5								
5.0	*Deakin Volcanics*		0			SC	**(5.0) Sandy CLAY:** brown, dry-moist, soft-hard	
5.5								
6.0			0					
6.5						GC	**(6.5) Gravelly clayey SAND:** brown, dry-moist, hard	
7.0			0.4					Volcanic bedrock
7.5								
8.0			0.8					
8.5								Goundwater hit at 8.5 m approx
9.0			1.8					
9.5								
10.0								



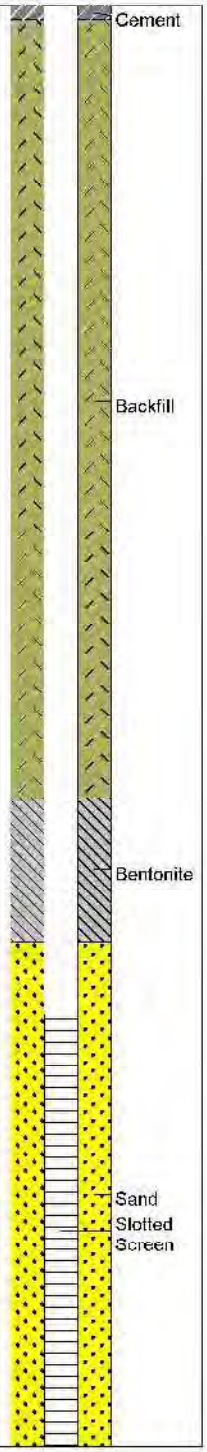
Comments

LOGGED BY A.P
CHECKED BY L.B

lanterra consulting	**BORE LOG** **GW58**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,823.985 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,534.27 mN
DIAMETER:	150mm	**ELEVATION:**	565.84 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	12/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Mat*		0.3			SP	**(0.0) Gracelly sandy SILT:** dark brown, soft, dry	Topsoil (fill)
0.5			0.5			GM	**(0.2) Gracelly sandy SILT:** light brown, dry, soft to hard	Residual soil (0.2-2.0 m)
1.0			1.8					
1.5								
2.0			0.8			SM	**(2.0) Sandy clayey SILT:** light brown, dry, soft	Natural. Layer of clay observed. Weathered bedrock.
2.5								
3.0			0.1					
3.5								
4.0	*Deakin Volcanics*		0.4			SC	**(4.0) Sandy CLAY:** light brown yellow, mois, soft, plastic	Natural weathered bedrock
4.5								
5.0			0.3					
5.5								
6.0			0.5					
6.5								
7.0			0.2					
7.5								
8.0			1.3					
8.5								
9.0			1.8					
9.5								
10.0								



Comments		
	LOGGED BY	A.P
	CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW59**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,820.666 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,507.548 mN
DIAMETER:	150mm	**ELEVATION:**	567.148 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	12/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCs	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*	GW59 0.0-0.1	0.1	Y		SP	**(0.0) Gravelly SAND:** dark borwn, dry, loose	Topsoil	Cement
0.5		GW59 0.5-0.6	0.6	Y		GP	**(0.5) Gravelly Sandy Silt:** brown-light brown, moist, soft-hard	Reworked fill (0.5-1.7 m)	
1.0			0.4						
1.5									
2.0			0.5			GC	**(1.7) Gravelly sandy SILT:** light brown, moist, soft-hard	Residual soil (1.7-3 m)	
2.5									Backfill
3.0	*Deakin Volcanics*		0.3			SC	**(3.0) Sandy CLAY:** light brown t corange-yellow, dry-moist, soft and medium plasticity	Natural Material	
3.5									
4.0			0.3						
4.5									
5.0			0.5						
5.5									
6.0			0.2			GC	**(6.0) Gravelly sandy CLAY:** brown, moist, soft, plastic		Bentonite
6.5									
7.0			0.2						
7.5						SC	**(7.5) Sandy CLAY:** brown, moist, soft		
8.0			0.5					Groundwater hit 8.0-8.5 m approx	Sand
8.5									Slotted Screen
9.0			0.4						
9.5									
10.0									

Comments	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW60**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT 2615

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest	**EASTING:**	683,840.798 mE
DRILL METHOD:	Drill rig - Geoprobe	**NORTHING:**	6,100,482.826 mN
DIAMETER:	150mm	**ELEVATION:**	567.065 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	11/01/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		0.3			GP	**(0.0) Sandy GRAVEL:** grey-reddish, dry-moist, loose and hard	Road base. Sidewalk on surface. Fragments of weathered volcanics observed. Reworked fill (0.3-2.0 m)	Cement
0.5			0.3			GM	**(0.3) Gravelly sandy SILT:** dark brown-brown, dry, soft-hard-loose		
1.0			0.5						
1.5									
2.0	*Deakin Volcanics*		0.7			SM	**(2.0) Sandy SILT:** brown-light brown, moist, soft-firm	Residual soil	Backfill
2.5									
3.0			0.8						
3.5									
4.0			0.6			GC	**(4.0) Gravelly sandy CLAY:** grey brown, dry moist, soft	Natural weathered volcanosedimentary unit	
4.5									
5.0			0.8			SC	**(5.0) Sandy CLAY:** dry-brown, moist, medium plasticity		
5.5									
6.0			0.8			GC	**(6.0) Gravelly clayey SAND:** brown, moist, soft-hard		Bentonite
6.5									
7.0			1.1						
7.5									
8.0			1.0						Sand
8.5								Groundwater hit at 8.0-8.5 m approx	Slotted Screen
9.0			1.3						
9.5									
10.0									

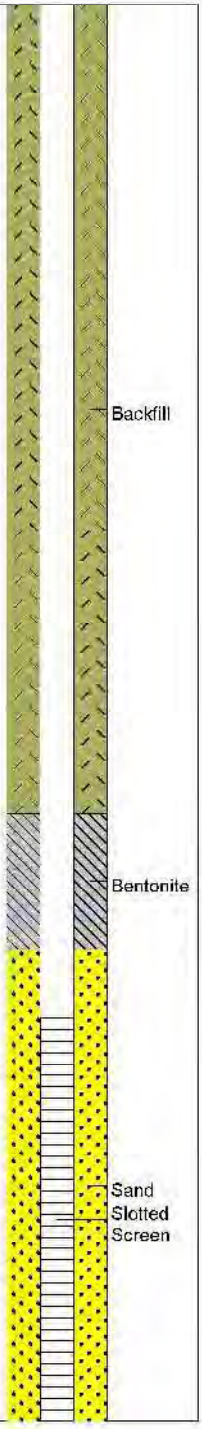
Moist soil observed around 8.5 m, moist soil then continued to 10m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW61**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,891.523 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,498.682 mN
DIAMETER:	150 mm	**ELEVATION:**	564.946 AHD
HOLE DEPTH:	10.5 m	**DATE DRILLED:**	15/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		4.5			SS	**(0.0) Sandy SILT:** brown, dry-moist, soft	Topsoil
0.5			3.5			SC	**(0.3) Sandy silty CLAY:** brown-pale brown, dry-moist, soft-plastic	Traces of poorly sorted angular gravel. Reworked material (0.3-1.5m)
1.0			2.7					
1.5	*Deakin Volcanics*					SC	**(1.5) Sandy silty CLAY:** light brown, moist, soft, less plastic than previous layer	Traces of rounded volcanics. Residual soil
2.0			4.7					
2.5								
3.0			2.7					
3.5								
4.0			7.6					
4.5						GM	**(4.5) Gravelly clayey SAND:** pale brown, dry-moist, loose-hard	Natural weathered bedrock, abundant felsic grains
5.0			3.7					
5.5								
6.0			3.5					
6.5								
7.0			9.5			GM	**(7.0) Gravelly sandy SILT:** pale brown, dry-moist, loose-hard	
7.5								
8.0								
8.5								Groundwater hit at 8.5 m approx
9.0								
9.5								
10.0								
10.5								



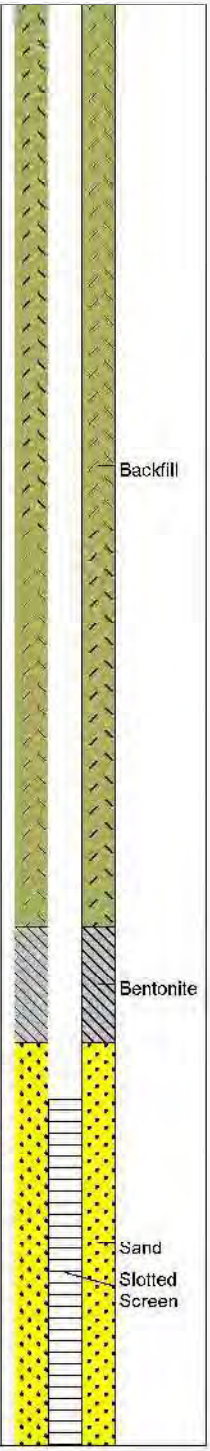
Air-drilled to 10.5 m, moisture detected at 8.5 m

LOGGED BY L.B
CHECKED BY C.G

lanterra consulting	**BORE LOG** **GW62**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,876.476 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,535.992 mN
DIAMETER:	150 mm	**ELEVATION:**	564.562 AHD
HOLE DEPTH:	12.5 m	**DATE DRILLED:**	15/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		31.0			SS	**(0.0) Sandy SILT:** brown, dry-moist, soft	Topsoil. Grass on surface Reworked material (0.2-1.2 m). Traces of gravel
0.5			35.0			SC	**(0.2) Sandy silty CLAY:** brown-pale brown, dry-moist, soft	
1.0			29.2					
1.5	*Deakin Volcanics*					SC	**(1.2) Sandy silty CLAY:** light brown, dry-moist, soft and low plasticity	Residual soil (rounded oxidised fragments observed)
2.0			3.0					
2.5								
3.0			2.4					
3.5								
4.0			10.2					
4.5						tuff	**(4.5) Clayey Silty SAND:** light brown (lighter than previous layer above), dry-moist, soft	
5.0								
5.5								
6.0								
6.5								
7.0								
7.5								
8.0								
8.5								
9.0								
9.5								
10.0								Groundwater hit at 10 m approx
10.5								
11.0								
11.5								
12.0								
12.5								



Air drilling from 4.5m (hard rock) up to 12.5m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW63**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,862.158 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,569.648 mN
DIAMETER:	150 mm	**ELEVATION:**	563.756 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	15/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	Fill Material		6.6			SP	**(0.0) Sandy clayey SILT:** brown, dry-moist, soft and loose	Topsoil. Grass on surface	Backfill
0.5			5.8			SC	**(0.3) Sandy silty CLAY:** brown-light brown, dry-moist, soft and loose	Reworked material (0.3-0.7m)	
1.0			5.1			CLS	**(0.7) Silty CLAY:** light brown, dry-moist, plastic and soft	Natural material (weathered bedrock)	
1.5									
2.0			0						
2.5									
3.0			0			CLS	**(3.0) Clay and Silt:** grey-brown, dry-moist, soft and plastic		
3.5									
4.0			0						
4.5									
5.0	Deakin Volcanics		0						
5.5						Tuff	**(5.5) Silty SAND:** grey-brown, dry-moist, hard	Air drilling from 5.5m on harder fresher bedrock	Bentonite
6.0									
6.5									
7.0									
7.5									
8.0									Washed Sand
8.5								Groundwater hit at 8.5 m approx	Slotted Screen
9.0									
9.5									
10.0									

Air drilling from 5.5m (hard rock) down to 10m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW64**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,843.304 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,557.304 mN
DIAMETER:	150 mm	**ELEVATION:**	564.716 AHD
HOLE DEPTH:	14.3 m	**DATE DRILLED:**	16/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		100			SP	**(0.0) Gravelly sandy SILT:** brown, dry-moist, soft, loose	Topsoil, grass on surface, poorly sorted gravel
0.5			26.6			SC	**(0.2) Sandy silty CLAY:** brown-light brown, dry-moist, soft, loose	Reworked material (0.2-1.5m). Traces of gravel observed
1.0			26.5					
1.5						CLS	**(1.5) Silty CLAY:** light brown, dry-moist, plastic and soft	Natural material
2.0			1.5					
2.5								
3.0			2.4					
3.5	*Deakin Volcanics*					SP	**(3.5) Sandy SILT:** light brown, dry-moist, soft	Traces of gravel observed
4.0			3.5					
4.5								
5.0			2.6					
5.5								
6.0			3.7					
6.5								
7.0			5.0					
7.5								
8.0			2.0					
8.5								
9.0			1.7					
9.5						CLS	**(9.5) Sandy silty CLAY:** brown, moist, soft	
10.0			1.5					
10.5								
11.0								
11.5								
12.0								Groundwater hit at 12-12.5 m approx
12.5								
13.0								
13.5								
14.0								

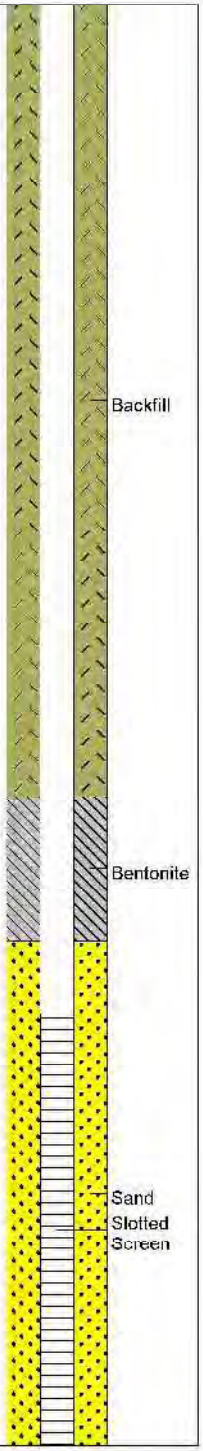
Well Diagram: Backfill; Bentonite; Washed Sand; Slotted Screen

Comments		
	LOGGED BY	A.P
	CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW65**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,844.795 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,589.75 mN
DIAMETER:	150 mm	**ELEVATION:**	563.344 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	16/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0			SS	**(0.0) Sandy silty CLAY:** brown, dry-moist, soft	Topsoil. Grassed surface
0.5			0			SC	**(0.2) Sandy silty CLAY:** brown-pale brown, dry-moist, soft	Reworked material
1.0			0			SC	**(0.9) Sandy silty CLAY:** light brown, dry-moist, soft, moderately plastic	Natural material
1.5								
2.0			0					
2.5								
3.0			0					
3.5								
4.0	*Deakin Volcanics*		0			SC	**(4.0) Sandy silty CLAY:** light brown, dry moist, soft to hard	Presence of weathered volcanics. Mix of soft and hard material (weathered bedrock)
4.5								
5.0			0					
5.5								
6.0			0					
6.5								
7.0								
7.5								
8.0								
8.5								Groundwater hit at 8.5m approx
9.0								
9.5								
10.0								

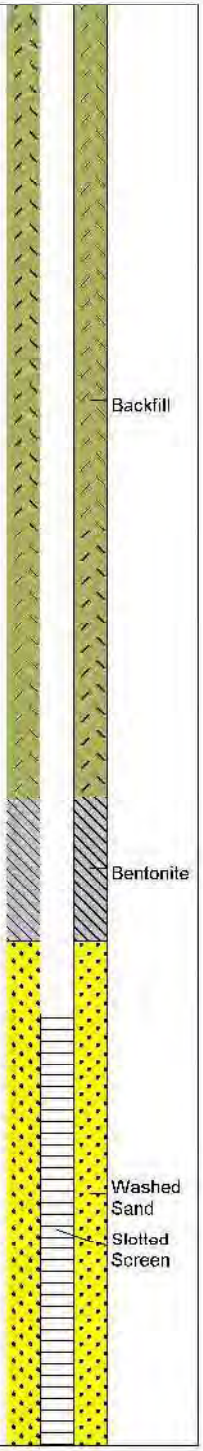


Comments	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW66**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,820.131 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,575.841 mN
DIAMETER:	150 mm	**ELEVATION:**	564.836 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	16/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0			SM	**(0.0) Sandy SILT:** dark brown-brown, dry-moist, soft	Topsoil Reworked material (0.2-1.0m)
0.5			0			SC	**(0.2) Sandy Clayey SILT:** brown, dry-moist, soft	
1.0			0				**(1.0) Sandy Clayey SILT:** brown-light brown, dry-moist	Natural material
1.5								
2.0			0					
2.5						SM	**(2.5) Sandy SILT:** light brown, drai, soft-hard	Traces of gravel
3.0			0					
3.5								
4.0			0					
4.5	*Deakin Volcanics*					GM	**(4.5) Gravelly sandy SILT:** light brown, dry, soft-hard	
5.0			0					Air drilling after 5m
5.5								
6.0								
6.5								
7.0								
7.5								
8.0								
8.5								Groundwater hit at 8.5 m approx
9.0								
9.5								
10.0								



Airdrilling from 5 to 10 m	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW67**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,874.049 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,416.423 mN
DIAMETER:	150 mm	**ELEVATION:**	569.046 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	17/03/2022

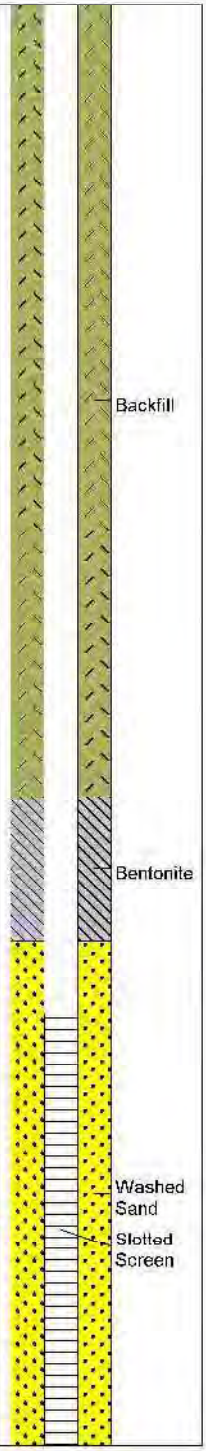
Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations	Well Diagram
0.0	*Fill Material*		9.6			GM	**(0.0) Gravelly silty SAND:** brown-grey, dry, hard	Road base. Asphalt on surface.	
0.5			7.0			GC	**(0.2) Gravelly sandy CLAY:** brown, dry-moist, soft and loose	Reworked material (0.2-0.8m)	
1.0			5.6			SC	**(0.8) Sandy silty CLAY:** light brown, dry-moist, soft and slightly plastic clay	Natural material	
1.5									
2.0			9.5						
2.5						GM	**(2.5) Gravelly silty SAND:** brown, dry, soft to hard		Backfill
3.0			3.8						
3.5							**(3.5) Gravelly sandy SILT:** light brown, dry, hard		
4.0	*Deakin Volcanics*		8.0			GM		Air drilling from 4m	
4.5									
5.0									
5.5									
6.0								Weathered volcanic unit	Bentonite
6.5									
7.0									
7.5									
8.0									Washed Sand
8.5								Groundwater hit at 8.5-9.0 m approx	Slotted Screen
9.0									
9.5									
10.0									

Comments	**LOGGED BY** A.P **CHECKED BY** L.B

lanterra consulting	**BORE LOG** **GW68**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,774.69 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,478.27 mN
DIAMETER:	150 mm	**ELEVATION:**	567.344 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	17/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		68.6			GM	**(0.0) Gravelly sandy SILT:** grey-brown, dry, hard	Road base. Asphalt on surface. Reworked material (0.3-1.0m)
0.5			68.4			SM	**(0.3) Sandy SILT:** brown, dry, hard	
1.0			68.1			SC	**(1.0) Sandy clayey SILT:** brown, dry-moist, soft	Natural material (weathered volcanic)
1.5								
2.0			57.4					
2.5	*Deakin Volcanics*					SM	**(2.5) Sandy SILT:** light brown, dry-moist, soft to hard	
3.0			67.8					
3.5								
4.0			45.3					
4.5								
5.0			85.5					
5.5								
6.0			98.2					
6.5								
7.0						SM	**(7.0) Sandy SILT:** light brown, dry-moist, soft to hard	Air drilling from 7m
7.5								
8.0								
8.5								Groundwater hit at 8.5-9.0 m approx
9.0								
9.5								
10.0								



Airdrilling from 7 m down to 10 m

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW69**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,758.718 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,500.912 mN
DIAMETER:	150 mm	**ELEVATION:**	567.138 AHD
HOLE DEPTH:	11.0 m	**DATE DRILLED:**	17/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		0			SM	**(0.0) Sandy SILT:** brown, dry, soft, hard, loose	Topsoil. Traces of gravel
0.5			0			SM	**(0.3) Sandy SILT:** brown-pale brown, dry, soft-hard	Reworked material (0.2-2.0m)
1.0			0					
1.5								
2.0			0					
2.5	*Deakin Volcanics*					SM	**(2.2) Sandy SILT:** brown, dry, hard	Natural material, weathered volcanics
3.0			0					
3.5								
4.0			0					
4.5								
5.0			0					
5.5								
6.0						SC	**(6.0) Sandy clayey SILT:** dark brown, moist, hard	Air drilling from 6m
6.5								
7.0								
7.5								
8.0								
8.5								
9.0								Groundwater hit at 8.5-9.0 approx
9.5								
10.0								
10.5								
11.0								

Well Diagram: Backfill; Bentonite; Washed Sand; Slotted Screen

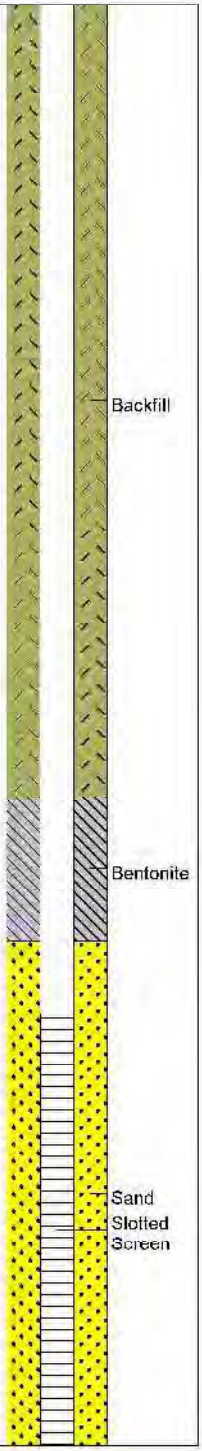
Airdrilling from 6 m onwards

LOGGED BY	A.P
CHECKED BY	L.B

lanterra consulting	**BORE LOG** **GW70**	**PROJECT NUMBER:** P21083 **CLIENT NAME:** EPSDD **ADDRESS:** Section 51, Holt, ACT

PROJECT NAME:	Kippax Centre DSI	**COORDINATE SYSTEM:**	GDA2020 / MGA zone 55
CONTRACTOR:	Terratest Pty Ltd	**EASTING:**	683,835.387 mE
DRILL METHOD:	Geoprobe 7822DT	**NORTHING:**	6,100,340.422 mN
DIAMETER:	150 mm	**ELEVATION:**	571.634 AHD
HOLE DEPTH:	10.0 m	**DATE DRILLED:**	18/03/2022

Depth (m)	Geological Unit	Sample Name	PID (ppm)	Analysed	Graphic	USCS	(Depth) Lithological Description	Additional Observations
0.0	*Fill Material*		50.7			SM	**(0.0) Sandy SILT:** grey-brown, dry, soft-hard	Topsoil
0.5			56.7			SC-SM	**(0.3) Sandy clayey SILT:** dark brown-brown, dry-moist, soft	Reworked material (0.3-2.0 m)
1.0			50.7					
1.5								
2.0	*Deakin Volcanics*		53.5			SM	**(2.0) Sandy SILT:** brown-light brown, dry-moist, soft	Natural residual soil
2.5								
3.0			50.7					
3.5								
4.0			56.5					
4.5						SM	**(4.5) Sandy SILT:** light brown-yellow brown, dry, soft-hard	Weathered volcanic rock with orange-black oxidised minerals in hard rock
5.0			34.6					
5.5								
6.0								
6.5								
7.0								Air drilling from 7m
7.5								
8.0								
8.5								Groundwater hit at 8.5-9.0m approx
9.0								
9.5								
10.0								



Airdrilling from 7 m onwards	**LOGGED BY** A.P **CHECKED BY** L.B

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BOREHOLE LOG SV1

PROJECT NUMBER P21083
PROJECT NAME Ground water In□estigation
CLIENT EPSDD
ADDRESS Section 51□Holt□ACT 2615

DRILLING DATE 2□11□2021
TOTAL DEPTH 5□6
SAMPLE METHOD
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683861 N: 6100446
COORD SYS MGA 55 □GDA 2020
SURFACE ELEVATION 568 m □AHD□

COMMENTS

LOGGED BY □□Loc□wood
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations	Well Diagram
0□2	0		GP	Sandy GRAVEL□grey□dry□loose□ angular medium grained gra□el□	Road base□	bac□fill
	0□5		SC-SM	Clayey□silty□SAND□brown□dry□so□t□	Rewor□ed Fill□	bentonite
0□2	1		SC-SM	Sandy□silty CLAY□brown□moist□so□t□ moderate plastic□	□5□ Clay□	washed sand
	1□5					
0□2	2					
	2□5					
0□0	3		CL	Silty□CLAY□brown-pale brown□moist□ □rm□low-moderate plastic□		bentonite
	3□5					
0□0	4		GC	Clayey□gra□elly□SAND□pale brown-yellow brown□loose□	E□tremely weathered roc□□	
	4□5					
0□0	5				Hole cored to 5□6 m□	washed sand
	5□5					roc□

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BOREHOLE LOG SV2

PROJECT NUMBER P21083
PROJECT NAME Ground water In□estigation
CLIENT EPSDD
ADDRESS Section 51□Holt□ACT 2615

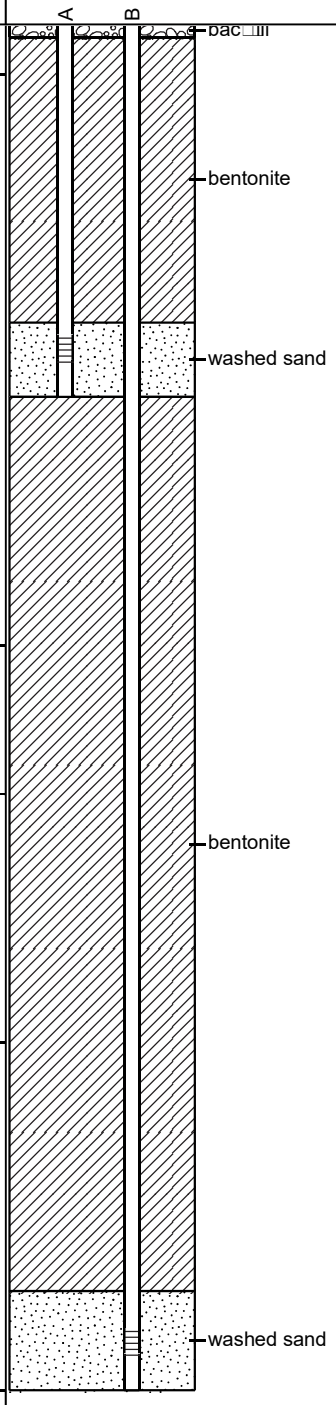
DRILLING DATE 2□11□2021
TOTAL DEPTH 5□5
SAMPLE METHOD
DIAMETER 150 mm
CONTRACTOR Terratest

COORDINATES E: 6□□□82 N: 61004□0
COORD SYS MGA 55 □GDA 2020
SURFACE ELEVATION 568 m □AHD□

COMMENTS

LOGGED BY □□Loc□wood
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0□4				Asphalt□Sandy□GRAVEL□loose□	Road base□
	0□5		CL	Sandy□clayey□SILT□brown□	Fill□
0□0	1		CL	Brown□medium CLAY□yellow mottle□ plastic□mi□ed with gra□el and roc□□	
	1□5				
0□2	2				
			CL	Grey medium CLAY □mi□ed with brown□□moist□anaerobic odour□	
	2□5		CL	Brown□medium CLAY□plastic□	
0□0	3				
			CL	Yellow□pale brown CLAY with grey mottle	Traces o□ weathered roc□
	3□5				
0□0	4				
			MLS	Sandy CLAY□yellow□so□t□moist	E□tremely weathered roc□□
	4□5				
0□0	5				
	5□5				



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BOREHOLE LOG SV3

PROJECT NUMBER P21083
PROJECT NAME GW □ SV Well Installation
CLIENT EPSDD
ADDRESS Section 51□Holt□ACT 2615

DRILLING DATE 11□01□2022
TOTAL DEPTH 5□4 m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

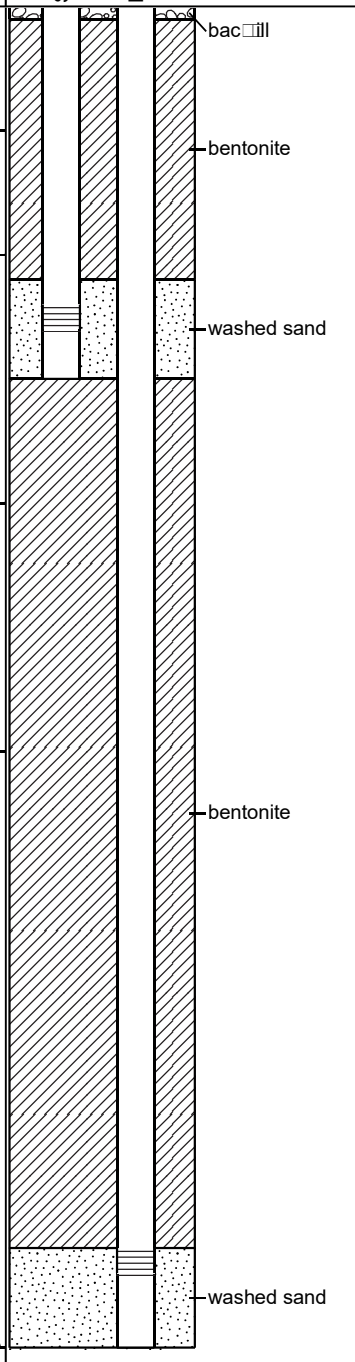
COORDINATES E: 683851□□ N: 6100540□3
COORD SYS MGA 55□GDA 2020
SURFACE ELEVATION 565□□ m ADH

COMMENTS SHALLOW □ Shallow Soil Implant Probe□DEEP □ Deep Soil Implant Probe□PID numbers are based on measurements undertaⅽen during the instalation oⅽthe closest groundwater monitoring well □GW55□□

LOGGED BY A□P
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0□6	0		SS	Sandy SILTⅽdarⅽbrownⅽmoist-wetⅽsoⅽt	Topsoilⅽ Biological material present ⅽroots ⅽ grassⅽ
0□6	0□5		SM	Sandyⅽ SILTⅽbrownⅽmoist-wet	Fill
0□6	1		GM	SandyⅽgraⅽellyⅽSILTⅽbrownⅽmoist	Reworⅽed ⅽill
	1□5				
0□□	2		SM	Sandyⅽ SILTⅽlight brownⅽdry to moist	Residual natural soil
	2□5				
0□□	3		CS	Sandyⅽ CLAYⅽbrown-greyⅽsoⅽt and plastic	Naturalⅽ Abundant lumps oⅽclay materialⅽ
	3□5				
0□5	4			Sandyⅽ CLAYⅽred-brownⅽmoistⅽlumps oⅽ clay	
	4□5				
0□5	5				End oⅽhole
	5□5				

Vapour Well Diagram



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BOREHOLE LOG SV4

PROJECT NUMBER P21083
PROJECT NAME GW □ SV Well Installation
CLIENT EPSDD
ADDRESS Section 51□Holt□ACT 2615

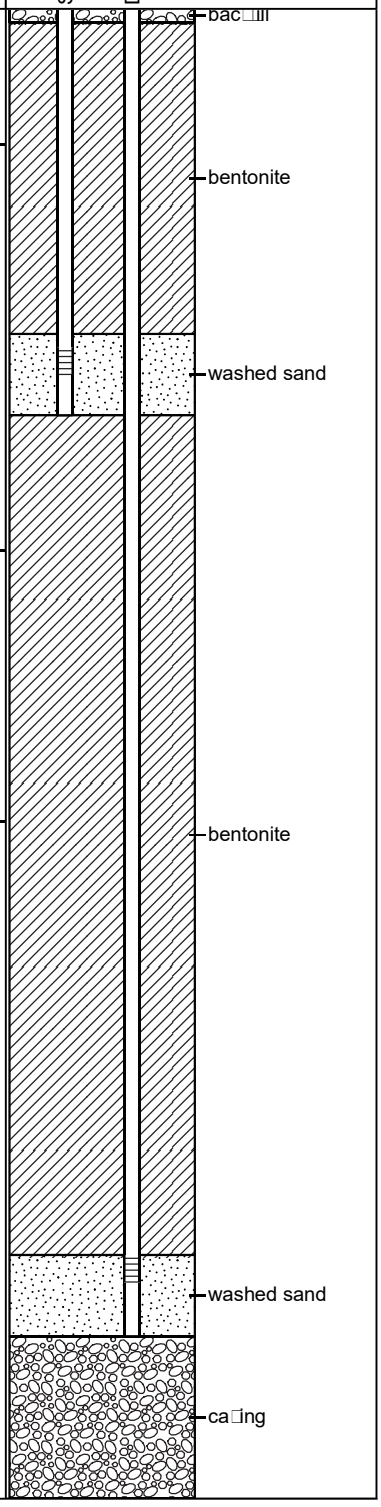
DRILLING DATE 10□01□2022
TOTAL DEPTH 5□5 m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 m
CONTRACTOR Terratest

COORDINATES E: 6838□6□6 N: 610050□□3
COORD SYS MGA 55□GDA 2020
SURFACE ELEVATION 565□8 m □AHD□

COMMENTS SHALLOW □ Shallow Soil Implant Probe□DEEP □ Deep Soil Implant Probe□PID numbers are based on measurements underta□en during the instalation o□the closest groundwater monitoring well □GW56□□

LOGGED BY A□P
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0□6	0□2		SM	Sandy SILT□loose□brown□moist	Fill material□ Biological material present □roots □ grass□
	0□4				
0□2	0□6			Sandy SILT□moist to wert□brown-dar□ grey	
	0□8				
	1				
0□1	1□2			Gra□elly sandy SILT□moist-wet□slightly clayey at places□brown-dar□grey	
	1□4				
	1□6				
	1□8				
1□□	2		CS	Sandy clayey SILT loose□moist□brown	Appears to be rewor□ed material
	2□2				
	2□4				
	2□6				
	2□8				
0□□	3		GC	Gra□elly sandy CLAY□brown to light brown□dry and so□t to hard	Natural
	3□2				
	3□4				
	3□6				
	3□8				
0□5	4				
	4□2				
	4□4				
	4□6				
	4□8				
0□□	5		CS	Sandy CLAY□brown to light brown□so□t to hard and slightly plastic□moist	
	5□2				
	5□4				



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produced by ESlog□ESdat□net on 04 May 2022

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BOREHOLE LOG SV5

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

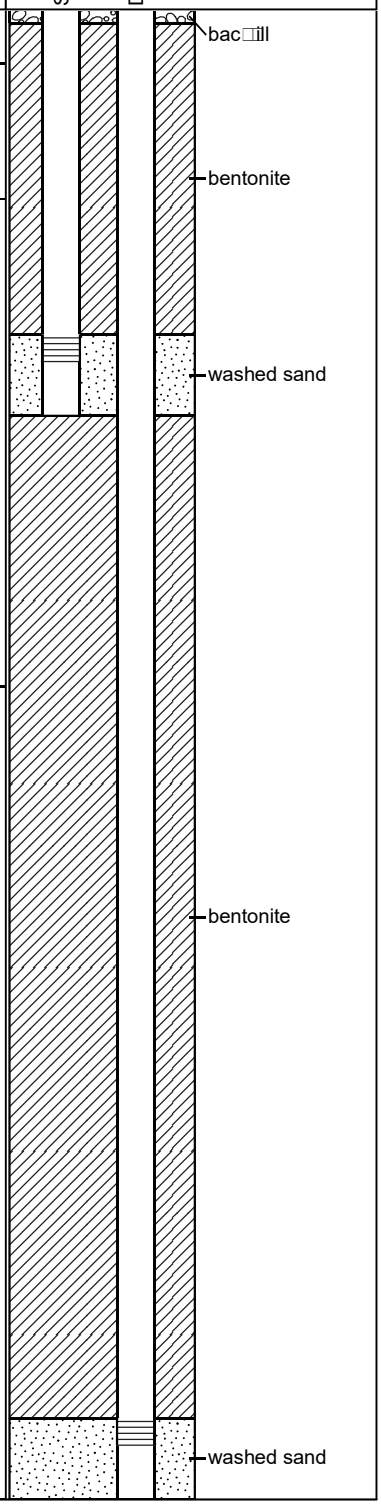
DRILLING DATE 10/01/2022
TOTAL DEPTH 5.5 m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

COORDINATES E: 683853.6 N: 6100465.5
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 561.4 m ADH

COMMENTS SHALLOW – Shallow Soil Implant Probe DEEP – Deep Soil Implant Probe PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well GW52

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.1	0.2		GP	Sandy GRAVEL grey-reddish dry-moist loose	Road base Asphalt on surface
	0.4		GM	Gravelly sandy SILT brown dry-moist soft to hard	Reworked till
0	0.6				
	0.8		CS	Sandy CLAY brown moist plastic	Natural residual Traces of rounded to edified volcanic rocks observed
0	1				
	1.2				
	1.4				
	1.6				
	1.8				
0	2				
	2.2				
	2.4				
	2.6		CS-CM	Silty clayey SAND brown moist soft to hard	Natural weathered bedrock
	2.8				
0	3				
	3.2				
	3.4				
	3.6				
	3.8				
0	4				
	4.2				
	4.4				
	4.6				
	4.8				
0	5				
	5.2				
	5.4				



Vapour Well Diagram

BOREHOLE LOG SV6

PROJECT NUMBER P21083
PROJECT NAME GW □ SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

DRILLING DATE 11 01 2022
TOTAL DEPTH 5 5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

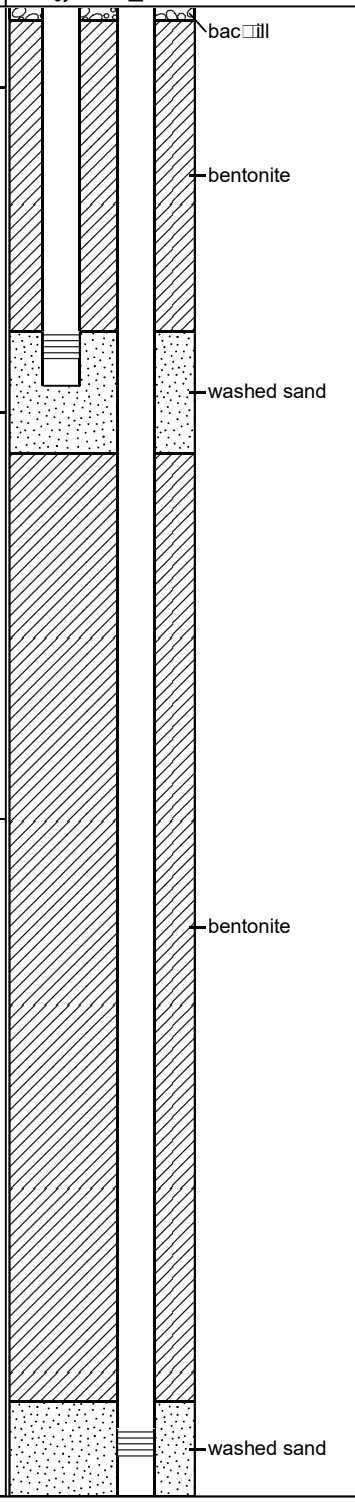
COORDINATES E: 68386 N: 61004 5
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 566 8 m ADH

COMMENTS SHALLOW □ Shallow Soil Implant Probe DEEP □ Deep Soil Implant Probe PID numbers are based on measurements undertaen during the instalation o the closest groundwater monitoring well GW5

LOGGED BY A P
CHECKED BY L B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0 2	0 2		GM	Gra elly sandy SILT dar brown dry-moist	Road base some pebbles present
	0 4			Gra elly sandy SILT dar brown moist	Fill rewor ed material
0 2	0 6				
	0 8				
	1				
0 2	1 2				
	1 4				
	1 6		GC	Gra elly sandy CLAY brown moist and hard	O idi ed rounded ragments o olcanics Residual soil
	1 8				
	2				
0 3	2 2				
	2 4				
	2 6				
	2 8				
	3				
0 2	3 2		GC	Gra elly sandy CLAY brown moist loose and hard	Natural material
	3 4				
	3 6				
	3 8				
	4				
0	4 2				
	4 4				
	4 6				
	4 8				
	5				
0	5 2		SC	Sandy CLAY brown dry to moist soft to hard	
	5 4				

Vapour Well Diagram



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BOREHOLE LOG SV□

PROJECT NUMBER P21083
PROJECT NAME GW □ SV Well Installation
CLIENT EPSDD
ADDRESS Section 51□Holt□ACT 2615

DRILLING DATE 11□01□2022
TOTAL DEPTH 5□5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150 mm
CONTRACTOR Terratest

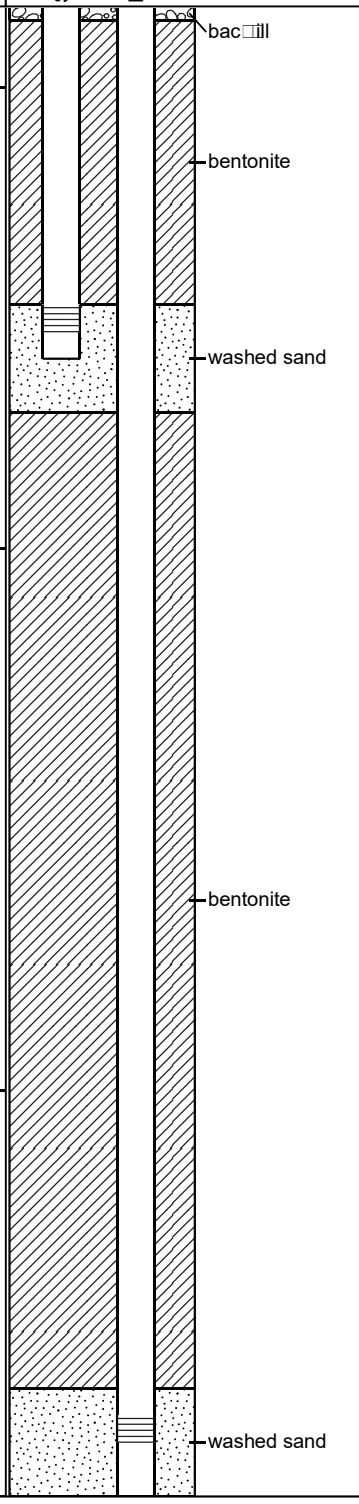
COORDINATES E: 683840□□ N: 6100482□4
COORD SYS MGA 55□GDA 2020
SURFACE ELEVATION 566□□m ADH

COMMENTS SHALLOW □ Shallow Soil Implant Probe□DEEP □ Deep Soil Implant Probe□PID numbers are based on measurements undertaⅽen during the instalation o□the closest groundwater monitoring well □GW60□

LOGGED BY A□P
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0□3	0□2		GP	Sandy GRAVEL□grey-reddish□dry-moist□ loose	Road base
	0□4		GM	Graⅾelly□sandy□SILT□darⅽ brown-brown□ dry□soⅼt to hard and loose	Fragments o□ weathered □olcanics□Reworⅽed ⅲll
0□3	0□6				
	0□8				
0□5	1				
	1□2				
	1□4				
	1□6				
	1□8				
0□□	2		SM	Sandy□SILT□brown- light brown□moist□ soⅼt □ crumbly	Residual soil
	2□2				
	2□4				
	2□6				
	2□8				
0□8	3				
	3□2				
	3□4				
	3□6				
	3□8				
0□6	4		GC	Graⅾelly□sandy□CLAY□grey-brown□soⅼt	Natural material
	4□2				
	4□4				
	4□6				
	4□8				
0□8	5			Sandy□CLAY□grey-brown□moist-wet□ medium plasticity	
	5□2				
	5□4				

Vapour Well Diagram



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BOREHOLE LOG SV8

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

DRILLING DATE 12/01/2022
TOTAL DEPTH 5.5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

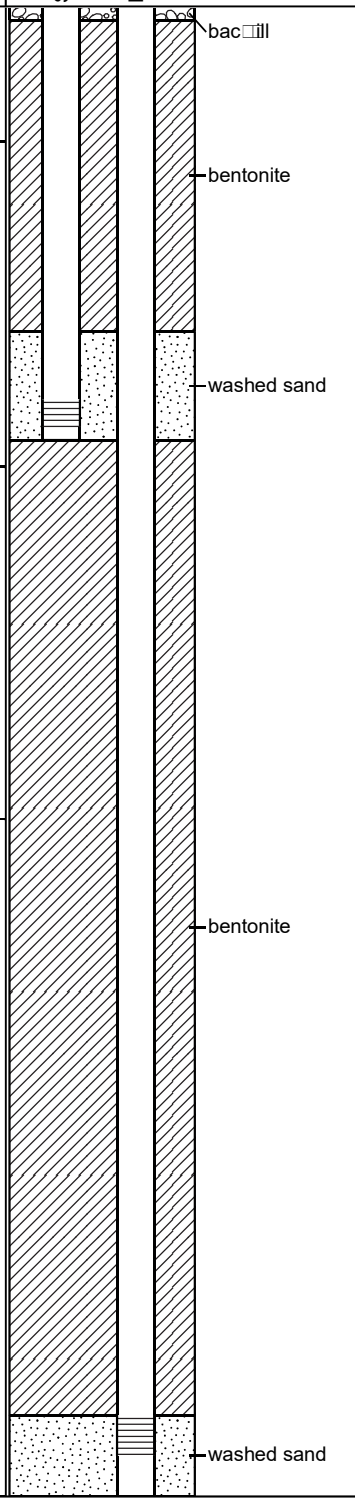
COORDINATES E: 683821.3 N: 6100506
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 561.1 m ADH

COMMENTS SHALLOW – Shallow Soil Implant Probe DEEP – Deep Soil Implant Probe PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well GW5

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0.1	0.2		SP	Gravelly SAND dark brown dry loose	Top soil Roots and grass
	0.4				
0.6	0.6		GP	Gravelly sandy SILT brown to light brown moist soft to hard	Reworked till
	0.8				
0.4	1				
	1.2				
	1.4				
	1.6				
	1.8		GC	Gravelly clayey SILT light brown moist soft to hard	Residual soil
0.5	2				
	2.2				
	2.4				
	2.6				
	2.8				
0.3	3		SC	Sandy CLAY light brown to orange-yellow dry-moist soft and medium plasticity	Natural material
	3.2				
	3.4				
	3.6				
	3.8				
0.3	4				
	4.2				
	4.4				
	4.6				
	4.8				
0.5	5				
	5.2				
	5.4				

Vapour Well Diagram



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BOREHOLE LOG SV□

PROJECT NUMBER P21083
PROJECT NAME GW □ SV Well Installation
CLIENT EPSDD
ADDRESS Section 51□Holt□ACT 2615

DRILLING DATE 12□01□22
TOTAL DEPTH 5□5m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

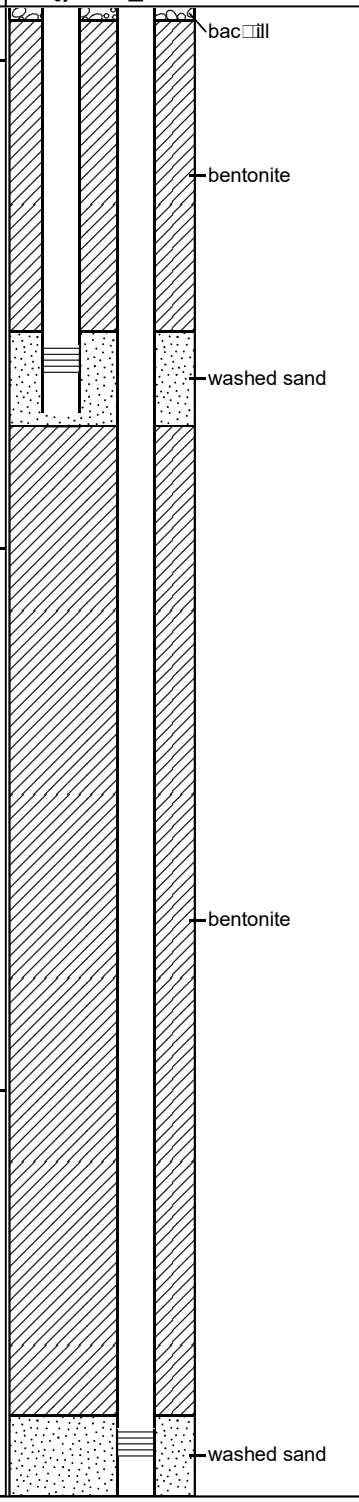
COORDINATES E: 683824□6 N: 6100534□0
COORD SYS MGA 55□GDA 2020
SURFACE ELEVATION 565□8 m ADH

COMMENTS SHALLOW □ Shallow Soil Implant Probe□DEEP □ Deep Soil Implant Probe□PID numbers are based on measurements undertaⅽen during the instalation o□the closest groundwater monitoring well □GW58□

LOGGED BY A□P
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0□3	0□2		SP	Graⅽelly sandy SILT□dar□brown□soⅰt □ dry	Topsoil
	0□4		GM	Graⅽelly□sandy□SILT□light brown□dry□soⅰt to hard	Residual soil
0□5	0□6				
	0□8				
1□8	1				
	1□2				
	1□4				
	1□6				
	1□8				
0□8	2		SM	Sandy clayey SILT□light brown□dry□soⅰt	Layers o□clay material□Natural□
	2□2				
	2□4				
	2□6				
	2□8				
0□1	3				
	3□2				
	3□4				
	3□6				
	3□8				
0□4	4		SC	Sandy CLAY□light brown-yelowish□moist□soⅰt and plastic	Natural weathered bedroⅽ□
	4□2				
	4□4				
	4□6				
	4□8				
0□3	5				
	5□2				
	5□4				

Vapour Well Diagram



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produced by ESlog□ESdat□net on 04 May 2022

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BOREHOLE LOG SV10

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

DRILLING DATE 16/03/22
TOTAL DEPTH 2.3m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683844.2 N: 6100558.0
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 564.– m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW64)

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
100	0.1		SP	Gravelly sandy SILT brown dry-moist soft and loose	Topsoil Poorly sorted gravel observed
	0.2		SC	Sandy silty CLAY brown-light brown dry-moist soft and loose	Reworked material Traces of gravel observed
25.6	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
26.5	1				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5		CLS	Silty CLAY light brown dry-moist plastic and soft	Natural material
	1.6				
	1.7				
	1.8				
	1.9				
1.5	2				
	2.1				
	2.2				

Soil Vapour Well Diagram: backfill; bentonite; washed sand

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BOREHOLE LOG SV11

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

DRILLING DATE 15/03/22
TOTAL DEPTH 2.2m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683862.6 N: 6100500.6
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 563.8 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW63)

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
6.6	0.1		SP	Sandy clayey SILT, brown, dry-moist, soft and loose	Topsoil, Traces of gravel observed.
	0.2				
	0.3		SC	Sandy silty CLAY, brown-light brown, dry-moist, soft and loose	Reworked material.
5.8	0.4				
	0.5				
	0.6				
	0.7		CLS	Silty CLAY, light brown, dry-moist, plastic and soft	Natural material.
	0.8				
	0.9				
5.1	1				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				
0	2				
	2.1				

Soil Vapour Well Diagram: backfill; bentonite; washed sand

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BOREHOLE LOG SV12

PROJECT NUMBER P21083
PROJECT NAME GW □ SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 □Holt □ACT 2615

DRILLING DATE 15□03□22
TOTAL DEPTH 2□4m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 6838□3□□ N: 610041□6
COORD SYS MGA 55□GDA 2020
SURFACE ELEVATION 56□□0 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well □GW6□□

LOGGED BY A□P
CHECKED BY L□B

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations	Soil Vapour Well Diagram
□6	0□1		GM	Gra□elly silty sand□brown-grey□dry□hard	Road base□Asphalt on sur□ace□	bac□fill
	0□2		SC	Gra□elly sandy CLAY□brown□dry-moist□ so□t and loose	Rewor□ed material□	
□0	0□3					
	0□4					
	0□5					
	0□6					
	0□□					
	0□8		SC	Sandy silty CLAY□light brown□dry-moist□ so□t and plasticity obser□ed	Natural material□	
	0□□					
	1					
5□6	1□1					bentonite
	1□2					
	1□3					
	1□4					
	1□5					
	1□6					
	1□□					
	1□8					
	1□□					
	2					
□5	2□1					
	2□2					washed sand
	2□3					

Disclaimer This bore log is intended □or en□ironmental not geotechnical purposes□

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BOREHOLE LOG SV13

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

DRILLING DATE 15/03/22
TOTAL DEPTH 2.4m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683800 N: 6100400
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 564.0 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW61)

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations	Soil Vapour Well Diagram
4.5	0.1		SS	Sandy SILT brown dry-moist soft	Topsoil Grass on surface	backfill
	0.2		SC	Sandy silty CLAY brown-pale brown dry-moist soft and plastic	Reworked material Traces of angular poorly sorted gravel	
	0.3					
	0.4					
	0.5					
3.5	0.6					
	0.7					
	0.8					
	0.9					
	1					
2.0	1.1					bentonite
	1.2					
	1.3					
	1.4					
	1.5			Sandy silty CLAY light brown moist soft and low plasticity	Natural residual soil	
	1.6					
	1.7					
	1.8					
	1.9					
4.0	2					
	2.1					washed sand
	2.2					
	2.3					

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BOREHOLE LOG SV14

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

DRILLING DATE 15/03/22
TOTAL DEPTH 2.3m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683861 N: 6100584
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 564.6 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW62)

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations	Soil Vapour Well Diagram
31	0.1		SS	Sandy SILT brown dry-moist soft	Topsoil Grass on surface	backfill
	0.2		SC	Sandy silty CLAY brown-pale brown dry-moist soft	Reworked material Traces of angular gravel	
	0.3					
	0.4					
	0.5					
35	0.6					
	0.7					
	0.8					
	0.9					
	1					bentonite
2.2	1.1					
	1.2			Sandy silty CLAY light brown dry-moist soft and low plasticity	Natural residual soil Rounded fragments of sorted gravel observed	
	1.3					
	1.4					
	1.5					
	1.6					
	1.7					
	1.8					
	1.9					
	2					
3.0	2.1					washed sand
	2.2					

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BOREHOLE LOG SV15

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

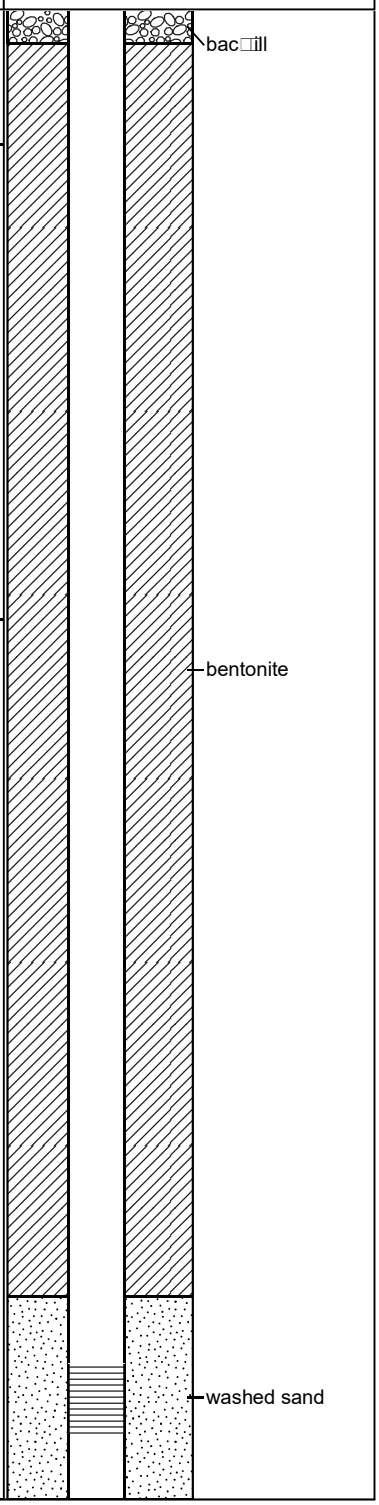
DRILLING DATE 16/03/22
TOTAL DEPTH 2.2m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683843.3 N: 6100586
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 563.5 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW65)

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0	0.1		SS	Sandy silty CLAY, brown, dry-moist, soft	Topsoil, Grass on surface
	0.2		SC	Sandy silty CLAY, brown-pale brown, dry-moist, soft	Reworked material or potential residual soil
	0.3				
	0.4				
	0.5				
0	0.6				
	0.7				
	0.8				
	0.9			Sandy silty CLAY, light brown, dry-moist, soft and moderately plastic	Natural material
	1				
0	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				
	2				
0	2.1				



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BOREHOLE LOG SV16

PROJECT NUMBER P21083
PROJECT NAME GW – SV Well Installation
CLIENT EPSDD
ADDRESS Section 51 Holt ACT 2615

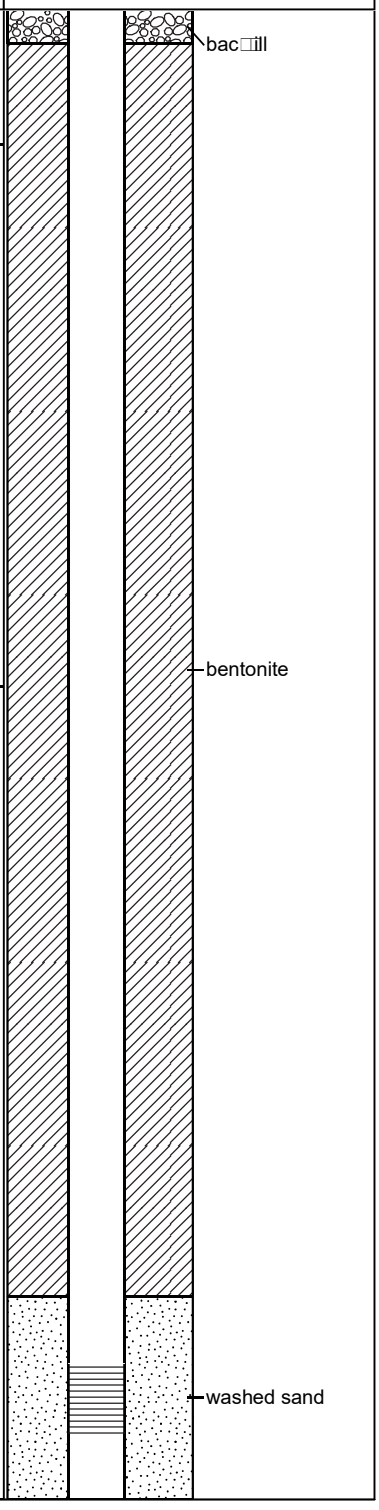
DRILLING DATE 16/03/22
TOTAL DEPTH 2.2m
SAMPLE METHOD Drill rig - Geoprobe
DIAMETER 150mm
CONTRACTOR Terratest

COORDINATES E: 683810 N: 6100555
COORD SYS MGA 55 GDA 2020
SURFACE ELEVATION 564 m ADH

COMMENTS PID numbers are based on measurements undertaken during the instalation of the closest groundwater monitoring well (GW66)

LOGGED BY AP
CHECKED BY LB

PID	Depth (m)	Graphic Log	USCS	Material Description	Additional Observations
0	0.1		SS	Sandy SILT dark brown-brown dry-moist soft	Topsoil Grass on surface
	0.2		SC	Sandy clayey SILT brown dry-moist soft	Reworked fill material Traces of gravel
	0.3				
	0.4				
	0.5				
0	0.6				
	0.7				
	0.8				
	0.9				
	1				
0	1.1			Sandy clayey SILT brown-light brown dry-moist	Natural residual soil
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				
	2				
0	2.1				



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