



Voluntary Auditor's Report
40 Vermeer Avenue, Newnham, Tasmania

Prepared for:
Rocherlea Lands No 1 Pty Ltd

Prepared by:
Australian Environmental Auditors Pty Ltd

Date of Report:
31 January 2022

Project Number:
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Voluntary Auditor's Report

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Prepared for:

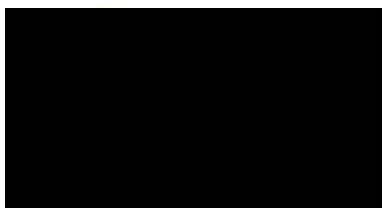
Rocherlea Lands No 1 Pty Ltd
PO Box 647
North Sydney, NSW 2059

Prepared by:

Australian Environmental Auditors Pty Ltd
335 Carrington Street
Adelaide SA 5000
T: 08 8223 3488

Date of Report:

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WA DWER Accredited Contaminated Sites Auditor (MR0030)

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Abbreviations

Abbreviation	Description
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)
AoEC	Areas of Environmental Concern
ASC NEPM	National Environmental Protection (Assessment of Site Contamination) Measure
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CEs	Chlorinated ethenes
CSM	Conceptual Site Model
DQO	Data Quality Objectives
ESA	Environmental Site Assessment
FWG	Fresh Water Guidelines
HHRA	Human Health Risk Assessment
HIL	Health Investigation Level
HSL	Health Screening Levels
LOR	Limits of reporting
MAH	Monocyclic Aromatic Hydrocarbons
mAHD	metres Australian Height Datum
mbgl	metres below ground level
NATA	National Association of Testing Authorities
NHMRC	National Health Medical Research Council
PAH	Polycyclic Aromatic Hydrocarbons
PFAS	Perfluorinated alkyl substances
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
RSL	Regional Screening Levels
SAQP	Sampling and Analysis Quality Plan
SMP	Site Management Plan
SPR	Source-pathway-receptor
SVRA	Soil Vapour Risk Assessment
TCE	Trichloro-ethene
TDS	Total Dissolved Solids
TRH	Total Recoverable Hydrocarbons
VAR	Voluntary Auditor's Report
VI	Vapour intrusion
VOC	Volatile Organic Compounds

Executive Statement

This Voluntary Auditor's Report (VAR) presents the findings of a Voluntary Contaminated Sites Audit (the Audit) undertaken by [REDACTED] in relation to 40 Vermeer Avenue, Newnham, Tasmania (the Site) (refer **Attachment 1**).

The (Audit) Site is currently used for agricultural purposes and is located to the west and down-hydraulic gradient of 253-293 George Town Road, Rocherlea (herein referred to as the 'ACL site'). The ACL site is known to have elevated concentrations of chlorinated ethenes (CEs) in groundwater. The ACL site has historically been used for bearing cutting and electroplating, metallurgy and powder production and continues to be so.

In 2021 an Environmental Site Assessment (ESA) was conducted which included groundwater and soil vapour investigations at the Site to assess the risk to current (agricultural) and future site users (residential), from chlorinated ethenes migrating via groundwater from the adjacent source site (ACL site). The works were conducted as a result of an EPA Tasmania Investigation Notice on the Site (10534/1 dated 7 January 2021) and included the installation of 9 groundwater wells and 13 soil vapour probes.

Based on the results of the ESA, the auditor does not consider that there is any beneficial use of groundwater on site due to the expected low yield of the aquifer and the results are summarised below:

- Elevated concentrations of TCE in groundwater and soil vapour are present on site as a result of the migration of the TCE groundwater plume from the adjacent ACL site. Due to the low risk posed by these concentrations the site is not identified as a 'contaminated site' as per the Environmental Management and Pollution Control Act 1994;
- Groundwater concentrations of TCE exceeding human health criteria for potable and recreational use were identified, although withdrawal of groundwater is unlikely given the expected low yield, no abstraction is recommended without prior testing of the water to confirm suitability; and
- Current soil vapour concentrations of TCE and 1,2,4-trimethylbenzene were found **not to present** a risk to current (agricultural) and potential site users (any residential land use) with a high margin of safety. Less sensitive uses such as commercial or industrial are also permitted. It is noted that habitable basement use has not been considered however the presence of shallow and competent bedrock renders this an unlikely future scenario, and given the levels of vapour found, the risk for this use is unlikely to be significant.

Table A: Auditor Summary of Suitability and Restrictions, 40 Vermeer Avenue, Newnham Tasmania

Current Nature and Extent of Contamination					
Land Parcel	Soil	Groundwater	Soil Vapour	Surface Water	Sediments
40 Vermeer Avenue, Newnham Tasmania Lot 1 on Diagram 106901 (volume/folio: 106901/1)	Not Applicable (NA)	Copper, chromium, nickel, zinc > FWG TCE > WHO guidelines	None	NA	NA
Suitability for use					
40 Vermeer Avenue, Newnham Tasmania	The Site is considered suitable for any land use including low density residential as defined in the risk assessment.				

Lot 1 on Diagram 106901 (volume/folio: 106901/1)	
Restrictions on Use	
40 Vermeer Avenue, Newnham Tasmania Lot 1 on Diagram 106901 (volume/folio: 106901/1)	Groundwater should not be abstracted for any purpose other than environmental monitoring.

The ESA recommended the following additional works:

- Targeted remediation, or an appropriate barrier, at the ACL site to prevent potential migration of higher TCE groundwater concentrations currently present at the ACL site onto the Site;
- Development and implementation of a soil vapour and groundwater monitoring plan to ensure that there is no change to the risk profile;
- No extraction of groundwater for beneficial use at the Site, without adequate testing and confirmation of the suitability of groundwater for the proposed beneficial use; and
- Review of the HHRA on provision of a specific development plan for the Site.

The Auditor supports these suggestions and also recommends that:

- A monitoring plan (soil vapour and groundwater) be prepared for the audit site to ensure impacts from further migration of the TCE plume do not change the risk profile and the plume is further defined in the downgradient direction, and
- A groundwater plume stability assessment is undertaken to inform possible or likely future groundwater concentrations and what remediation is required at the ACL site.

The ESA and audit report are considered to address the requirements of the Investigation Notice IN10534/1 as summarised in **Section 14**.

1. Introduction

This Voluntary Auditor's Report (VAR) presents the findings of a Contaminated Sites Audit (the Audit) undertaken by Department of Water and Environmental Regulation (DWER) accredited contaminated site auditor [REDACTED] (the Auditor) in relation to 40 Vermeer Avenue, Newnham, Tasmania (the Site). The Site location is shown in **Attachment 1**.

Site background and the initiation of the Audit are detailed in **Section 1.1** and scope and objectives in **Section 1.2**.

The following table presents key VAR details.

Table 1: Site Audit Details	
Audit Identifier	Detail
Auditor	[REDACTED] Australian Environmental Auditors Pty Ltd 335 Carrington Street ADELAIDE SA 5000 T: 08 8223 3488 F: 08 8223 2523
DWER Auditor accreditation no. and date accredited	MR0030 13 December 2006 The Auditor's declaration is provided in Appendix A .
Person requesting audit	[REDACTED] Rocherlea Lands No. 1 Pty Ltd Authorisation to proceed is provided in Appendix A .
Requestor's relationship to site	Representative of the site owner
Property Owner	[REDACTED]
Site Address	40 Vermeer Avenue, Newnham Tasmania (Attachment 1).
Property identification	Certificate of Title 106901/1 The certificate of title are provided in Appendix B .
Date audit commenced	26 February 2021
Date audit completed	31 January 2022
Reason for audit	The Audit was initiated in response to Investigation Notice No. 10534/1 to assess the risks of the TCE plume to the Audit Site, and draft Remediation Notice No. 9775/1 relating to the source site.
Audit Support Team	The Auditor has referred to the following external Expert Support Team member <ul style="list-style-type: none"> [REDACTED] of EP Risk Management for Risk Assessment. The Expert Support declarations are provided in Appendix A . The following Australian Environmental Auditors Pty Ltd staff members were utilised on this project: <ul style="list-style-type: none"> [REDACTED], Senior Audit Support (Adelaide, SA office)

1.1 Background

The Site is located to the west and down-hydraulic gradient of 253-293 George Town Road, Rocherlea (herein referred to as the 'ACL site'), which is known to have elevated concentrations of chlorinated ethenes (CEs) in groundwater. The ACL site has historically been used for bearing cutting and electroplating, metallurgy and powder production and continues to be so. The (Audit) Site is currently used for agricultural purposes.

1.2 Audit Scope and Objectives

There is no statutory requirement, so accordingly the Audit is voluntary. Note that there is an EPA Tasmania Investigation Notice on the Site (IN 10534/1 dated 7 January 2021) requiring an Environmental Site Assessment (ESA) to be completed. Details are provided in Schedule 2 of the notice and the covering letter (Refer to **Appendix C**). The scope of the ESA must include *'whether an actual adverse effect on the health and safety of human beings that is not negligible and/or an actual adverse effect on the environment which is not negligible is occurring or is likely to occur taking into account:*

- 1.1 current and intended land uses(s) including residential use. The ESA must include but not be limited to vapour risk posed by chlorinated ethenes in groundwater and direct contact with groundwater; and*
- 1.2 environmental values of groundwater and the use of groundwater (taking into consideration suitability for current and realistic future uses).'*

The Remediation Notice for the ACL site (253-293 George Town Road, Rocherlea, Tasmania; 9775/1 dated 25 July 2018) outlines the expectations of an audit to assess the risks of the TCE plume. As such, the purpose of this voluntary audit is to provide a suitability statement for the Audit Site (40 Vermeer Avenue, Newnham).

Based on the above, the Auditor's objectives include:

- To provide a VAR to EPA Tasmania, detailing the works that have been completed;
- To determine the suitability of the Site for the current/proposed use; and
- To determine if any restrictions on the use of the Site are required.

To this end, it is the opinion of the Auditor that the Site has been satisfactorily assessed as to form a recommendation on site suitability.

This report has been prepared by the Auditor in accordance with the *Contaminated Sites Act 2003* and the *Contaminated Sites Regulations 2006*.

2. Site Identification

The following table presents key site identification details.

Table 2: Key Site Identification Details	
Item	Detail
Owner & Site Street Address	<div style="background-color: black; width: 100px; height: 15px; margin-bottom: 5px;"></div> The site address is: 40 Vermeer Avenue, Newnham Tasmania See Attachment 1 , Site Location Plan.
Source Site Certificate of Title Description	Certificate of Title 106901/1 Lot 1 on Diagram 106901 See Appendix B for Certificate of Title (CoT). The ACL site and Audit Site areas are shown in Attachment 1 .
Site Plan	Attachment 1
Site Area	Approximately 167,500 m ²
Local Government Authority and Zoning	City of Launceston Zoning: 26.0 Rural Resource

Auditor's Opinion

The Auditor considers that site identification is complete, accurate and compliant with DWER requirements.

3. Audit Methodology and Audited Documentation

3.1 Methodology

The Audit was undertaken in accordance with DWER's *The Western Australian Contaminated Sites Auditor Scheme* (DER 2016c). The Audit included site inspections by the Auditor, review and comment on contaminated sites consultant reports and preparation of this VAR.

The VAR has been prepared based upon the framework recommended in DWER's *Contaminated Sites Guidelines, Requirements for Mandatory Auditors Reports* (DER 2016a).

The conformance of the works undertaken by JBS&G with respect to relevant Commonwealth and DWER Contaminated Sites Guidelines is assessed by stage of contaminated site works in the sections below.

3.2 Non-Audited Documentation

Not Applicable.

3.3 Audited Documentation

The following report has been reviewed by the Auditor:

1. JBS&G (2021) Environmental Assessment Works Required Under Investigation Notice 10534/1 – 40 Vermeer Avenue, Newnham, Tasmania. Dated 16 June 2021.

A copy of the above listed final report is included as **Appendix D**. Correspondence relating to the report reviews is presented as **Appendix C**.

3.4 Audit Team Site Visits

To ensure that the environmental Consultant's field practices (sampling, logging etc.) and site descriptions (potential sources, pathways and receptors) are sound, the Site was visited by the audit team on the following occasion.

Table 3: Site Inspections	
Date	Personnel & Purpose of Inspection
11 March 2021	Auditor – Site and surrounds inspected and groundwater and soil vapour investigations

4. Site Characteristics

4.1 Site Land Uses and Potential Sources

4.1.1 Site History and Land Uses

The Site is located adjacent the ACL site which is considered to be the source of a groundwater chlorinated ethene (CE) plume which has migrated off site to the east beneath the Audit Site. The ACL site has historically been used for bearing cutting and electroplating, metallurgy and powder production and continues to be so. The Audit Site is used for agricultural purposes.

No other historical activities have been identified on the Audit Site.

4.1.2 Proposed Land Use

The Site is currently agricultural and is proposed to be developed for residential land use.

4.1.3 Surrounding Environment

The surrounding land use is summarised in the table below and shown in **Attachment 2**.

Table 4: Surrounding Land Use Summary	
Direction from Site	Site Use (Nature of Activity)
North	Agricultural land
East	ACL site and other commercial/industrial uses along George Town Road
South	Residential properties
West	Agricultural land

Auditor's Opinion

The Auditor considers that the site characteristics, land use and surrounding land use were adequately described.

4.2 Potential Pathways

The following table summarises the relevant pathways for the Site and surrounding area.

Table 5: Summary of Potential Pathway Data	
Aspect	Summary
Surface coverings	The Site is vacant and heavily grassed.
Topography	The Site slopes downwards from the ACL Site to the west. The highest point is the northern corner of the Site and the lowest point is the drain in the southern portion of the Site, 80 to 39 mAHD over a distance of approximately 500 m. A topographic survey of the surface contours is provided as Attachment 5 .

Table 5: Summary of Potential Pathway Data	
Aspect	Summary
Geology	<p>The Tasmania landslide Hazard Series (12005) 1:250,000 Launceston Geology map (map 3 of 5) describes the underlying geology as Tertiary aged moderately consolidated, dolerite-derived conglomerate with some sandstone and rare siltstone.</p> <p>JBS&G reported the following typical profile:</p> <ul style="list-style-type: none"> • 0-1 metres below ground level (mbgl): silty clays/sandy clays/gravelly clays/clays of low to medium plasticity • 1-25 mbgl: weathered dolerite <p>Fill material was minimal, with no fill recorded at any of the investigation locations.</p>
Groundwater Conditions	The Site is underlain by an unconfined aquifer or low permeability noting that dolerite is known for its hardness, limited fracturing (being an igneous intrusive rock) and low permeability.
Depth to Groundwater	<p>Depth to groundwater ranged from approximately 2 to 19 mbgl. The range is due to the change in topography with the shallow water levels occurring in an incised gully.</p> <p>The groundwater monitoring wells are shown in Attachment 3.</p>
Groundwater Flow Direction	Groundwater flow is to the south west.
Groundwater Flow Rate	This was not provided in the background ACL reports but based on the results of 17 slug tests conducted on the ACL site (and an assumed porosity of 5% and the hydraulic gradient presented on Attachment 3) the mean (geomean) flow rate was calculated to be about 0.5m/day and range from 0.05 – 38 m/day. The wide range of flow rates is considered typical of fractured rock aquifers where fractures, although not likely to be well connected, provide localised areas of higher flow rates. When considering flow as a whole the mean is considered more appropriate to use when considering contaminant transport from the source to the affected suite.
Groundwater Quality	The groundwater quality on site was neutral (~pH 6.6 to 8.5), and total dissolved solids (TDS) ranged up to 660 mg/L.
Local Usage of Groundwater	<p>JBS&G reported no licenced bores within a 2 km radius of the Site. The closest licenced bore is approximately 2.6 km south east of the Site, and the closest licenced bore to the south west (inferred groundwater flow direction) is approximately 3 km from the Site.</p> <p>Unregistered bores may be present in proximity to the Site.</p>
Proximity to Public Drinking Water Supplies	No licenced public drinking wells were identified within a 2 km radius of the Site. It is considered unlikely that the groundwater would be extracted for use as drinking water given the low yield, the presence of a municipal water system and the likely utilisation of rainwater.
Proximity to Aquatic Ecosystems	<p>The nearest surface water bodies are:</p> <ul style="list-style-type: none"> • The drain/creek – located on site (this is not considered an ecological ecosystem) • Landfall Lake – approximately 680 m north east of the Site • Barnards Creek – approximately 1 km north east of the Site • Tamar River – approximately 1.5 km west of the Site • Newnham Creek – approximately 1.8 km south of the Site • Dams on agricultural land – three dams within 2 km; the closest dam is 90 m south west of the Site
Potential Beneficial Usage of Groundwater	<p>The Site is within an agricultural area, the unconfined aquifer has potential to be used as an irrigation source, recreational use or potable source (based on the low salinity). However, these uses are highly unlikely give the mean hydraulic conductivity is low at 3×10^{-6} m/s and the likely low specific yield (related to porosity). Potable and recreational use values are used later in this report just to benchmark the contaminant levels.</p> <p>The Tamar River is down-hydraulic gradient of the Site and is considered to potentially be used for aquaculture and recreation.</p>

Auditor's Opinion

The Auditor considers that:

- **The quality and completeness of the site history information is acceptable;**
- **The beneficial use of groundwater is unlikely, and**
- **Potential pathways and beneficial uses were generally well defined.**

4.3 Potential Receptors

Potential receptors (human and ecological) included the following.

4.3.1 Human Health

The following potential receptors were identified by JBS&G:

- Future excavation/maintenance workers (including development workers);
- Future residents and visitors;
- Off-site human receptors including residents; and
- Off-site human health receptors of groundwater are unlikely.

4.3.2 Ecological

The following potential receptors were identified by JBS&G:

- Current and future on-site vegetation; and
- Aquatic ecology of the Tamar River.

Auditor's Opinion

The Auditor considers that:

- **The quality and completeness of the investigations completed are sufficient; and**
- **Potential receptors were well defined.**

4.4 Conceptual Site Model

A conceptual site model (CSM) was developed to assess the risks to human health and the environment from contaminants of concern identified on site. The components of the CSM are discussed as follows.

JBS&G (ESA) report included the source/pathway/receptor elements (**Sections 4.1 to 4.3** above). A CSM was provided in a table format (see **Table 6** below) and diagrammatic CSM figure was provided and is reproduced as **Attachment 8**.

Table 6: Conceptual Site Model		
Source	Pathway	Receptor
TCE (and associated CEs) in groundwater from the adjacent ACL site	<p>Migration of groundwater from the adjacent ACL site, which is up-hydraulic gradient of the Site.</p> <p>The Consultant also noted that migration via surface water/flooding into a major drain at the ACL site could explain the pattern of contamination at the Site in combination with the above.</p>	<p><u>Human Receptors:</u></p> <p>Current land use – site workers (i.e. farmers)</p> <p>Proposed future residential use – residents, recreational site users, construction workers and sub-surface maintenance workers.</p> <p>Off-site groundwater beneficial uses – unlikely</p> <p><u>Ecological receptors:</u></p> <p>On site – Flora and fauna</p> <p>Off site – freshwater ecosystems</p>

Auditor's Opinion

The Auditor considers that:

- **The contaminants of concern and receptors were well defined;**
- **The contaminants of concern adequately reflect likely off-site sources, and**
- **The pattern of contamination is likely due to combination of surface water flow in drains at the ACL site as well as traditional groundwater migration.**

5. Basis for Adoption of Assessment Criteria

EPA Tasmania refer to the National Environmental Protection (Assessment of Site Contamination) Measure (ASC NEPM) as the primary reference for assessment levels.

5.1 Groundwater Criteria

The groundwater criteria adopted by JBS&G are detailed in **Table 7** below. Some of the source documents have since been updated so the most recent reference is shown.

Table 7: Groundwater Criteria			
Groundwater Criteria	Source	Criteria selected?	Consultant Justification
Ecological			
Fresh Water Guidelines (FWG)	ANZG (2018)	Y – FWG	Tamar River located 1.5 km west
Human Health			
Recreation/Aesthetics (NHMRC)	NHMRC (2018)	Y	Tamar River located 1.5 km west
Recreation/Aesthetics (WHO)	WHO (2020)	Y	Tamar River located 1.5 km west
Health Screening Levels for low density residential – Vapour intrusion (HSL A VI)	ASC NEPM Schedule B(1)	Y	Proposed residential land use
Primary Industries – Aquaculture	ANZECC (2000)	Y	Tamar River located 1.5 km west

* A revised TCE value of 8 µg/L is to be used based on WHO guidance 'Trichloroethene in drinking-water – Background document for development of WHO Guidelines for drinking-water quality', World Health Organisation 2020.

Auditor's Opinion

The Auditor notes that the criteria adopted by JBS&G were considered suitable given that potable and irrigation use of groundwater is unlikely given the expected low yield of the aquifer.

5.2 Soil Vapour Criteria

The soil vapour criteria adopted by JBS&G are detailed in **Table 8** below. Some of the source documents have since been updated so the most recent reference is shown.

Table 8: Soil Vapour Criteria			
Soil Criteria	Reference	Criteria selected?	Consultant Justification
Human Health			
Interim Health Investigation Levels for VOC compounds (HIL A VI)	ASC NEPM Schedule B(1)	Y	Proposed residential land use
Health Screening Levels for Vapour Intrusion (HSL A)	ASC NEPM Schedule B(1)	Y	Proposed residential land use
US EPA RSLs (residential)	RSLs (2018)	Y	Proposed residential land use

Auditor's Opinion

The Auditor notes that the criteria adopted by JBS&G were considered suitable.

6. Groundwater Monitoring Review

6.1 Summary of Works Completed

Groundwater monitoring first commenced at the ACL site in 2006, during which time one well (MW09) was installed on the Audit site. Monitoring has been undertaken approximately annually between 2006 and 2017. In 2021 JBS&G installed eight new wells across the audit site to assess the nature and extent of the TCE plume onsite. Only the 2021 monitoring results, provided in JBS&Gs ESA report, have been reviewed.

Table 9: Audited Site Assessments	
Author and Event Date	Works Completed
JBS&G, March 2021	Installation of eight groundwater wells (MW19 – MW26) Sampling of 25 groundwater monitoring wells (MW01 – MW03, MW06 – MW26, INJ01) located on site and off site (on the ACL site)

Groundwater monitoring included:

- gauging depth to water;
- measurement of water quality parameters; and
- purging of wells and subsequent sampling of groundwater.

A summary of the sampling locations is shown in **Table 10**. The groundwater monitoring well network is shown in **Attachment 3**.

6.2 Groundwater Sampling Location and Analysis Review

Monitoring well locations were selected to target the inferred extent of the CE plume and to provide sufficient characterisation of up, down and cross-hydraulic gradient groundwater conditions. Groundwater sample locations are presented in **Attachment 3**. The following table presents a summary of sampling locations.

Table 10: Groundwater Monitoring Well Locations	
Site Location	Sample Locations
Up-gradient (on the ACL site)	MW1, MW2, MW3, MW6, MW7, MW8, MW10-MW18
Down-gradient (on the Audit Site)	MW9, MW19-MW26

A low flow pump was used to purge the groundwater wells, with the exception of MW01 (ACL site) and MW23 (Audit Site). Grab samples were collected from these wells as they were either low yielding or contained insufficient water for low flow sampling.

Samples collected from the monitoring wells were analysed for a broad screen which includes volatile chlorinated hydrocarbons, heavy metals, total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), ammonia, sulphate, major cations/anions, pH and TDS. Four wells located on the ACL site were also analysed for PFAS compounds. Insufficient water was

able to be recovered from MW23 for a broad screen analysis; as such only VOCs (the contaminants of concern) were analysed for this sample.

Auditor's Opinion

The Auditor considers that:

- **Monitoring well locations were selected to target potential contamination sources, and to provide sufficient characterisation of the up, down and cross-gradient groundwater conditions;**
- **Monitoring wells were appropriately screened to determine the presence of light non-aqueous phase liquid (LNAPL); and**
- **The groundwater analysis suite adequately addresses the contaminants of concern.**

6.3 Groundwater Sampling Methodology Review

The following table presents a summary of the groundwater sampling methodologies and the Auditor's comments.

Table 11: Groundwater Monitoring Well Installation and Sampling Methodology Assessment	
Methodology	Auditor's Comments
<p>Data Quality Objectives (DQOs). The seven step DQO approach was provided in the SAQP. Site-specific information (i.e. the site-specific problems and goals, site definition etc.) were incorporated.</p>	<p><i>The provided DQOs are considered appropriate, with site-specific information incorporated for this stage of the investigation.</i></p>
<p>Well Construction. All monitoring wells were installed using solid flight auger followed by air hammer techniques through the weathered dolerite. Construction was with 50 mm Class 18 uPVC casing with a slotted section at the base of the monitoring well (the screen interval varied between 4.5 and 7.5 m). The screen interval was backfilled with a graded sand pack, and bentonite seal constructed above screen/casing interface.</p>	<p><i>The monitoring well installation was considered suitable.</i></p>
<p>Well Survey. All new wells, excluding the previously installed wells, were surveyed.</p>	<p><i>The survey was appropriate.</i></p>
<p>Well Development. All monitoring wells were developed within 24 hours of construction.</p>	<p><i>Well development was appropriate.</i></p>
<p>Well Gauging. All monitoring wells were gauged using an interface probe. Monitoring wells were additionally assessed to determine total depth.</p>	<p><i>The well gauging method was appropriate.</i></p>
<p>Well Purging and Sampling. Groundwater purging and sampling was undertaken using low flow pump and bailer (MW01 and MW23 only).</p>	<p><i>The well purging method was considered reasonable, noting that MW01 and MW23 were unable to be sampled using low flow techniques due to insufficient water/yield.</i></p>
<p>Decontamination – Groundwater. All re-usable sampling equipment was decontaminated between samples.</p>	<p><i>The groundwater handling and decontamination methods were appropriate.</i></p>

Table 11: Groundwater Monitoring Well Installation and Sampling Methodology Assessment

Methodology	Auditor's Comments
<p>Sample Handling and Preservation. Samples were collected directly into laboratory supplied containers with appropriate preservative where required.</p> <p>Sample containers for each well were uniquely labelled, sealed and placed on ice in an esky for transport to the analytical laboratory.</p>	<p><i>The preservation methods were appropriate.</i></p>

6.4QA/QC Methodology

The following table presents a summary of the sample quality assurance/quality control (QA/QC) methodologies and the respective auditor comments.

Table 12: Groundwater QA/QC Assessment

Methodology	Auditor's Comments
<p>Field QC Sampling & Analysis. Collection included: Blind duplicates (intra laboratory) were collected at a rate of at least 1/20 samples for the assessment. Split duplicates (inter laboratory) were collected at a rate of at least 1/20 samples for the assessment. Rinsate and/or trip blanks and/or trip spikes were collected.</p>	<p><i>The field QC sampling methodology was considered acceptable for the JBS&G works.</i></p>
<p>Field QC Results & Data Acceptability. Detailed assessment of QA/QC was conducted by JBS&G. Relative percent difference (RPDs) were generally less than the laboratory limit of reporting (LOR) or returned RPDs within the acceptable criteria of 0 – 50%, except in some isolated occurrences, which can be attributed to matrix heterogeneity and where low concentrations can produce misrepresentative RPDs.</p> <p>Rinsate Blank Samples. Concentrations were less than the laboratory LOR.</p> <p>Trip Blank Samples. Concentrations were less than the laboratory LOR.</p> <p>Spike Blank Samples. Concentrations were between 70 and 130 % recovery.</p>	<p><i>The Auditor agrees that the RPDs are generally satisfactory and that field QC and laboratory results are reliable and acceptable.</i></p>
<p>Chain of Custody (CoC). The CoC documentation was complete and appropriate.</p>	<p><i>The CoCs were appropriate and copies were provided.</i></p>
<p>NATA Registration. The laboratories were NATA accredited for all methods.</p>	<p><i>Certificates provided, NATA stamps confirmed.</i></p>
<p>Holding Times. Samples were extracted and analysed within recommended holding times.</p>	<p><i>Holding times were appropriate.</i></p>
<p>Limit of Reporting (LOR). The LORs appropriate and generally consistent, with the exception of some PAHs which exceeded the assessment criteria. However PAHs were below the PQL in all samples analysed.</p>	<p><i>LORs were deemed appropriate.</i></p>
<p>Laboratory QC Sampling. Samples included duplicates, surrogate spikes, matrix spikes and laboratory control samples.</p>	<p><i>Laboratory QC sampling is considered appropriate.</i></p>
<p>Laboratory QC Results. The results were within each of the laboratories' acceptable range. Some minor non-conformances were noted across the assessment phases and attributed to matrix heterogeneity or high concentrations of analytes in individual samples.</p>	<p><i>The Laboratory QC data is considered acceptable. The isolated non-conformances are not considered to be indicative of significant data quality issues.</i></p>

Auditor's Opinion

Overall, the Auditor considers that the assessment scope adequately addresses contaminant delineation (areas and analytes) and that the methodologies and quality management implemented by JBS&G were appropriate for this specific site and generally compliant with DWER guidelines.

It is noted that total delineation has not been achieved to the north and south west but considered that groundwater TCE impacts have been adequately covered to assess the risks.

7. Soil Vapour Monitoring Review

7.1 Summary of Works Completed

Soil vapour sampling was undertaken as part of the JBS&G ESA works:

Table 13: Audited Site Assessments	
Author and Event Date	Works Completed
JBS&G, March 2021	Installation of 22 soil vapour bores (SVP60 – SVP81). The soil vapour bores were installed to the depth of refusal on dolerite (ranged between 0.8 and 1.2 mbgl). All soil vapour bores were sampled using a laboratory supplied Summa canister, and analysed for VOCs (including CEs) and TRH.

The soil vapour bore network is shown in **Attachment 4**.

Auditor's Opinion

The Auditor considers that:

- **Monitoring bore locations were selected to provide sufficient characterisation of soil vapour conditions across the Site; and**
- **The vapour analysis suite adequately addresses the contaminants of concern.**

7.2 Sampling Methodology Review

Table 14 summarises the review of the soil and vapour sampling methodologies, with the respective Auditor's comments.

Table 14: Soil Vapour Sampling Methodology Review	
Methodology	Auditor's Comments
Data Quality Objectives (DQOs). The seven step DQO approach was provided in the SAQP. Site-specific information (i.e. the site-specific problems and goals, site definition etc.) were incorporated.	<i>The provided DQOs are considered appropriate, with site-specific information incorporated for this stage of the investigation.</i>
Referenced Guidance. Works were based on <i>Assessment of Site Contamination National Environmental Protection Measure (ASC NEPM, NEPC 1999, amended 2013)</i> and <i>CRC Care Technical Report No. 13 – Field Assessment of Gas (2009)</i> .	<i>The use of these guidance documents for these works is considered appropriate.</i>
Vapour Bore Construction. Proposed construction details are provided in the SAQP and the ESA. Construction logs provided in ESA.	<i>Construction of vapour bores is considered appropriate.</i>
Post Installation Equilibrations. Soil vapour bores were sampled approximately 5 days after installation.	<i>All vapour bores were suitably equilibrated (>8 hours) prior to sampling.</i>
Methodology Vapour Ports (TO15). Detailed in the SAQP and ESA, including purging, integrity testing and sampling has been provided.	<i>Testing and sampling methodologies are considered appropriate and in conformance with CRC CARE (2013) vapour guidance requirements.</i>

Table 14: Soil Vapour Sampling Methodology Review	
Methodology	Auditor's Comments
Equipment Calibration. The Photo-ionisation Detector(PID) and Landfill Gas Meter was calibrated prior to undertaking the field work. The calibration certificates are provided in the appendices of the ESA.	The calibration methodology considered adequate and certificates were provided.
Sampling Frequency: One on-site soil vapour event has been completed in March 2021 which included 22 on-site primary vapour samples.	Consistent with Box 5.9 of CRC Care Technical Report 23 (CRC Care, 2013), additional rounds of soil vapour sampling and analysis are not warranted given that the Margin of Safety (MOS) values calculated are greater than 10 for the primary CoPCs (Refer Section 11.2).

Auditor's Evaluation – Section 7 Site Investigation Review

Overall, the Auditor considers that sufficient investigations have been undertaken to adequately assess soil vapour concentrations and associated risks.

In addition, the methodologies and QA/QC selected were appropriate for this specific site and are generally compliant with CRC Care and ASC NEPM Guidelines.

7.3 QA/QC Methodologies

Table 15 presents a summary of the sample quality assurance/quality control (QA/QC) methodologies and the respective Auditor's comments.

Table 15: QA/QC Review	
Methodology	Auditor's Comments
<p>QC Sampling and Analysis</p> <p>Field QA/QC for vapour sampling included: Two intra-laboratory duplicates (Dup01 and Dup02) of SVP63 and SVP77 respectively.</p> <p>Two inter-laboratory duplicates (Split01 and Spilt02) of SVP73 and SVP79 respectively.</p> <p>The inter-laboratory duplicates were only analysed for a limited suite (chlorinated alkenes) compared to the complete TO-15. This is considered acceptable because the Contaminants of Concern (COC) are chlorinated alkenes.</p> <p>Canister pressures and isopropanol concentrations were included as part of the leak test assessment.</p>	The type and rate of QC sampling was generally considered acceptable and largely compliant with guidelines.
<p>Field QC Results and Data Acceptability:</p> <p>Soil and Vapour: The relative percent difference (RPD) values for soil vapour duplicates are provided in the ESA.</p> <p>Concentrations of some solvents and MAHs were above the recommended 30% RPD. JBS&G considered that the elevated RPDs were attributed to the relatively low concentrations reported.</p>	The primary sample should be adopted unless the calculated RPD is exceeded and then the highest concentration should be adopted. Because these duplicate concentrations were not above adopted guidelines, this was not considered to be significant.
<p>Chain of Custody (CoC). CoC documentation was provided with sample numbers, description, sample date and they were signed by the persons accepting custody of the samples.</p>	The CoCs were appropriate and copies were provided.

Table 15: QA/QC Review	
Methodology	Auditor's Comments
NATA Registration. The primary (Eurofins) and QC laboratories (EnviroLab) used by the Consultant are National Association of Testing Authorities (NATA) accredited.	Certificates were provided, NATA stamps confirmed.
Holding Times. Laboratory certificates with holding times were not provided in the ESA.	As indicated in laboratory certificates, holding times were appropriate.
Laboratory QC Sampling Methodology. Matrix spikes, surrogate recoveries, laboratory control samples (LCS), blanks and internal duplicates were completed.	Laboratory QC sampling methodologies are considered appropriate.
<p>Laboratory LORs and QC Results. The standard LORs were below the adopted Tier 1 screening levels, as required by the Data Quality Indicators (DQI's), with the exception of 1,1,2-trichloroethane, hexachlorobutadiene and 1,2-dibromomethane.</p> <p>JBS&G consider that this is unlikely to affect the outcomes of the assessment as these chemicals are not expected to be present at the elevated concentrations at the Site. It is noted that the LORs were raised as a result of the presence of high concentrations of other chemicals in the sample.</p> <p>No laboratory QC outliers were reported; all spike recoveries and duplicate RPDs within acceptable range.</p>	<p>The phenomena whereby high concentrations requires the laboratory to dilute samples, which then elevates the LORs, is well known.</p> <p>Laboratory QC data is otherwise considered acceptable.</p>
Consultant QC Conclusions. JBS&G concluded that the data obtained was considered representative of site conditions and suitable for use.	Based on above, the Auditor confirms that the laboratory results are reliable and acceptable.

Auditor's Evaluation – Section 7 Site Investigation Review

Overall, the Auditor considers that the sampling scope has adequately addressed the DQOs and provided adequate contaminant delineation (areas and analytes).

In addition, the methodologies and QA/QC selected were appropriate for this specific site and are generally compliant with CRC Care and ASC NEPM Guidelines.

8. Tier 1 Risk Assessment

8.1 Groundwater Analytical Results

The following table summarises the groundwater analytical results from 2006 to 2021 monitoring for the Audit site. A figure showing TCE concentrations across the site is provided as **Attachment 6**.

Table 16: On-site Groundwater Results Exceeding Tier 1 Criteria				
Sample ID Exceeding Tier 1 Criteria	Criteria(mg/L)	2006 – 2017 results exceeding Tier 1 criteria (mg/L)	March 2021 results exceeding Tier 1 criteria (mg/L)	Outcome
MW9	WHO (0.008) potable ¹	TCE (maximum of 0.21)	TCE (0.33)	See Section 12
	WHO (0.08) recreation	TCE (maximum of 0.21)	TCE (0.33)	
	FWG (0.33) FWG (0.008)	TCE (maximum of 0.21) Not previously analysed	TCE (0.33) Zinc (0.009)	
MW19	WHO (0.008) potable	Not installed until 2021	TCE (0.12)	See Section 12
	WHO (0.08) recreation	Not installed until 2021	TCE (0.12)	
	FWG (0.008)	Not installed until 2021	Zinc (0.014)	
MW20	WHO (0.008) potable	Not installed until 2021	TCE (0.11)	See Section 12
	WHO (0.08) recreation	Not installed until 2021	TCE (0.11)	
	FWG (0.0014) FWG (0.008)	Not installed until 2021	Copper (0.003) Zinc (0.039)	
MW21	WHO (0.008) potable	Not installed until 2021	TCE (0.013)	See Section 12
	WHO (0.08) recreation	Not installed until 2021	None	
	FWG (0.0014) FWG (0.008)	Not installed until 2021	Copper (0.002) Zinc (0.021)	
MW22	WHO (0.008) potable	Not installed until 2021	TCE (0.12)	See Section 12
	FWG (0.0014)	Not installed until 2021	Copper (0.002)	
MW23	WHO (0.008) potable	Not installed until 2021	None	NA
MW24	WHO (0.008) potable	Not installed until 2021	None	See Section 12
	FWG (0.001)	Not installed until 2021	Chromium III+VI (0.002)	
	FWG (0.0014)		Copper (0.003)	
	FWG (0.011)		Nickle (0.022)	
FWG (0.008)	Zinc (0.035)			

¹ Included for reference purposes only as not considered a realistic beneficial use

Table 16: On-site Groundwater Results Exceeding Tier 1 Criteria				
Sample ID Exceeding Tier 1 Criteria	Criteria(mg/L)	2006 – 2017 results exceeding Tier 1 criteria (mg/L)	March 2021 results exceeding Tier 1 criteria (mg/L)	Outcome
MW25	WHO (0.008) potable	Not installed until 2021	None	See Section 12
	FWG (0.001)	Not installed until 2021	Chromium III+VI (0.002)	
	FWG (0.0014)		Copper (0.005)	
	FWG (0.011)		Nickle (0.022)	
MW26	FWG (0.008)	Zinc (0.084)		
MW26	WHO (0.008) potable	Not installed until 2021	None	

Anthropogenic compounds; toluene, cis-1,2-DCE, 1,1-DCE, TRH F1 and PFAS compounds (PFOA, PFOS, PFHxS) were detected in the on-site wells (MW9, MW19 - MW26 in March 2021) though the concentrations were below criteria.

Auditor's Opinion

The Auditor considers that:

- **Groundwater results indicate some minor metals impacts above FWG near the drain and elevated TCE concentrations across the Site; and**
- **The groundwater results are representative of the migration of the TCE plume from the ACL site to the Audit Site.**

8.2 Soil Vapour Analytical Results

The following table summarises the soil vapour analytical results from the 2021 monitoring for the Audit Site. A figure showing TCE concentrations across the Site is provided as **Attachment 7**.

Table 17: Soil Vapour Results Exceeding Tier 1 Criteria			
Sample ID Exceeding Tier 1 Criteria	Criteria ($\mu\text{g}/\text{m}^3$)	March 2021 results exceeding Tier 1 criteria ($\mu\text{g}/\text{m}^3$)	Outcome
SVP60	NEPM Interim HIL A	None	NA
SVP61	NEPM Interim HIL A	None	NA
SVP62	NEPM Interim HIL A	None	NA
SVP63	NEPM Interim HIL A	None	NA
SVP64	NEPM Interim HIL A	None	NA
SVP64	NEPM Interim HIL A	None	NA
SVP65	NEPM Interim HIL A	None	NA

Table 17: Soil Vapour Results Exceeding Tier 1 Criteria			
Sample ID Exceeding Tier 1 Criteria	Criteria ($\mu\text{g}/\text{m}^3$)	March 2021 results exceeding Tier 1 criteria ($\mu\text{g}/\text{m}^3$)	Outcome
SVP66	NEPM Interim HIL A	None	NA
SVP67	NEPM Interim HIL A	None	NA
SVP68	NEPM Interim HIL A (20)	TCE (37)	See Section 12
SVP69	NEPM Interim HIL A	None	NA
SVP70	NEPM Interim HIL A	None	NA
SVP71	NEPM Interim HIL A (20)	TCE (310)	See Section 12
SVP72	NEPM Interim HIL A	None	NA
SVP73	NEPM Interim HIL A	None	NA
SVP74	NEPM Interim HIL A	None	NA
SVP75	NEPM Interim HIL A	None	NA
SVP76	NEPM Interim HIL A	None	NA
SVP77	NEPM Interim HIL A	None	NA
SVP78	NEPM Interim HIL A	None	NA
SVP79	NEPM Interim HIL A	None	NA
SVP80	NEPM Interim HIL A	None	NA
SVP81	US EPA RSL (residential) non-carcinogenic (630)	1,2,4-trimethylbenzene (920)	See Section 12

Anthropogenic compounds; TRH, BTEX, solvents (1-methyl-4 ethylbenzene, heptane, hexane, acetone), 1,3,5-trimethylbenzene, 2,2,4-trimethylbenzene, cyclohexane and chloroform were detected in some of the on-site soil vapour bores though the concentrations were below criteria.

Auditor's Opinion

The Auditor considers that:

- **The presence of TCE in soil vapour correlates with the presence of TCE in groundwater beneath the Site. Soil vapour concentrations are highest where the depth to groundwater is lower near the drain (i.e. depth to groundwater at SVP68/71 was estimated to be approximately 3.6 m based on the topography and depth to water at the closest groundwater well, MW22); and**
- **The soil vapour results are representative of the attenuation of vapours from TCE impacted groundwater which has migrated from the ACL onto the Audit Site.**

9. Pattern of Groundwater and Soil Vapour Impacts

The auditor considers that the presence of elevated TCE concentration in groundwater and soil vapour are associated with contaminated groundwater which has migrated from the ACL site.

The source of the contamination is thought to primarily be Plant 4 on the ACL site (Refer **Attachment 4**) and traditional contaminant migration will normally show a consistent distribution of the contaminant reducing with distance from the source. However, the ad-hoc nature of the TCE concentrations (Refer **Attachment 6**) cannot be wholly explained by this and the extent of the TCE impacts plume (> 450 – 500m) is hard to reconcile given the expected overall low permeability of the aquifer.

It is therefore considered likely that as well as entering the aquifer at Plant 4 on the ACL site, it is likely that at some time there has been a surface water flooding event that resulted in diffuse spreading of TCE along the main drain on the ACL site (refer **Attachment 9**) which later has migrated vertically to the groundwater some distance from the original source. It is noted that the shallow soil profile has been logged to contain gravel which could aid in the spread of the subsurface water prior to reaching the true groundwater level which is generally around 19m depth away from the incised drainage features.

The limited elevated TCE soil vapour concentrations are located above the highest groundwater concentrations and shallowest depth to groundwater which is consistent with classic vapour migration via Henry's Law and thus is well understood.

10. Community Consultation Review

No off-site activities were undertaken, other than on the ACL site which were notified prior to commencing works. At this stage no off-site impacts have been identified. Therefore, no community consultation activities were required at that time.

Auditor's Opinion

The Auditor considers that the extent of community consultation was acceptable.

11. Additional Risk Assessment Review

As per EPA Tasmania guidelines, if Tier 1 assessment levels are exceeded, then further investigation (Tier 2 simple risk assessment) is required to determine whether the identified substances of concern pose a risk in the existing or proposed site setting, and to determine the scale and urgency of further action if appropriate.

Based on the Tier 1 risk assessment detailed in **Sections 7, 8 and 9**, further human health risk assessment was completed for impacts identified, as detailed below.

JBS&G provided a CSM in Section 7 of the ESA, showing the potential for a source, pathway and receptor linkage to be present, associated with elevated concentrations of TCE in soil vapour onsite above tier 1 criteria for future residents, construction workers and subsurface maintenance workers.

The risk assessment was limited to assessment of onsite contamination and risks. Potential linkages associated with off-site receptors should be assessed as part of further assessment of the ACL site, which is considered to be the source of contamination.

11.1 Qualitative Human Health Risk Assessment – Groundwater Impacts

Concentrations of TCE exceed WHO guidelines for potable and recreational use. Neither of these receptors are considered to be present on site:

- Recreation – the closest down-hydraulic gradient surface water receptor is considered to be the Tamar River (1.5 km west of the Site); and
- Extraction of groundwater (potable, irrigation, recreation or industrial) – considered unlikely due to the low yield of the unconfined aquifer, absence of current operational bores within 2 km of the Site and presence of a municipal water supply system.

Therefore, the potential for a source, pathway and receptor linkage to be present on site (other than via the inhalation pathway) is considered to be unlikely. In the event that extraction of groundwater for a beneficial use is proposed, then the groundwater would need to be tested for suitability.

Auditor's Opinion

It is the Auditor's opinion that risk associated with groundwater conditions has been satisfactorily assessed and Site groundwater conditions do not pose an unacceptable risk to human health.

11.2 Quantitative Human Health Risk Assessment – Soil Vapour Impacts

Concentrations of TCE exceed ASC NEPM Interim HIL A at two locations, and concentrations of 1,2,4-trimethylbenzene exceeded US EPA RSLs at one location. A risk assessment was undertaken by JBS&G to assess the vapour intrusion risk to human health for a more sensitive residential land use. The results are presented below:

Table 9.11: Summary of ILCR Calculations (Carcinogenic Endpoints)

Exposure Scenario	TCE	Acceptable ILCR
Residential dwelling (slab on grade, no basement)	1.1×10^{-7}	1×10^{-5}
Subsurface maintenance trench / excavation to 1 mbgl	2.3×10^{-8}	1×10^{-5}

Table 9.12: Summary of HI Calculations (Non-carcinogenic Endpoints)

Chemical	TCE	1,2,4-TMB	Total HI	Acceptable HI
Residential dwelling (slab on grade, no basement)	3.0×10^{-2}	1.5×10^{-3}	3.1×10^{-2}	1.0
Subsurface maintenance trench / excavation to 1 mbgl	7.4×10^{-3}	2.9×10^{-6}	7.4×10^{-3}	1.0

JBS&G found that there were no unacceptable risks identified for current site users (farmers) or potential future site users (residents in slab on grade dwellings, construction workers and subsurface maintenance/ construction workers in subsurface maintenance trenches to a depth of 1 mbgl) on the basis of the data collected in the ESA. It is noted that the margin of safety in the risk levels is quite significant being between 90 and 322 for residential use and 135 and 435 for maintenance workers.

Habitable basements were not included in the analysis as the depths where vapour was sampled was not deep enough to assess the risk. However, it is noted that the presence of shallow and competent bedrock renders this an unlikely future scenario and given the levels of vapour found, the risk for this use is unlikely to be significant.

Noting that HHRA are based on current levels of TCE vapour it a Plume Stability Assessment (PSA) is required to predict the likely potential future concentrations at the source and Vermeer Avenue site. This will allow the future risks to be assessed. Given the factor of safety determined from the current HHRA it is considered unlikely that future risks will be significant but the PSA will should quantify this and provide a TCE trigger level to assess future concentrations against.

Note that the following works are recommended to support these findings:

- One additional round of soil vapour and groundwater assessment at the Vermeer Avenue Site.
- An assessment of plume stability is undertaken including the derivation of TCE trigger levels, and
- No extraction of groundwater for any beneficial use, without adequate testing to confirm its suitability

The Auditor requested his expert, [REDACTED] from EP Risk to review the human health risk assessment with consideration of Appendix E of the NSW EPA Contaminated Land Management Guidelines for the NSW Site Audit Scheme (2017). A copy [REDACTED] review is provided in **Appendix C**.

Auditor's Opinion

It is the Auditor's opinion that human health risk associated with soil vapour conditions has been satisfactorily assessed with current site conditions posing no risk to human health.

11.3 Qualitative Ecological Risk Assessment – Groundwater Impacts

Concentrations of metals (chromium III+VI, copper, nickel and zinc) exceed ANZG guidelines for freshwater ecosystems. No freshwater receptors are considered to be present on site:

- Freshwater ecosystems – the closest down-hydraulic gradient surface water receptor is considered to be the Tamar River (1.5 km west of the Site).

Therefore, the potential for a source, pathway and receptor linkage to be present on site is considered to be unlikely. In the unlikely event that extraction of groundwater for a beneficial use is proposed, then it would need to be tested for suitability.

Auditor's Opinion

It is the Auditor's opinion that ecological risk associated with groundwater conditions has been satisfactorily assessed with current site conditions posing no risk to ecological receptors.

12. Parcel-Specific Information

The following table presents parcel-specific information with regard to key compliance details as defined under Section 3.3.2 of DWER's Contaminated Sites Guideline *Requirements for Mandatory Auditors Reports* (DER 2016a).

Table 18: Parcel-Specific Information	
Information	Auditor's Comment
	Audit Site 40 Vermeer Avenue, Newnham Tasmania
Contamination status and whether the contamination poses or potentially poses a risk of harm to public health, the environment or any environmental value.	<i>The Auditor considers that the Site does not pose a risk of harm to human health or the environment, subject to the following assumptions and recommendations as outlined in Section 11..</i>
Assessment as to whether the condition of the Site is impacting surrounding land and/or land uses.	<i>Scope of works was limited to assessing on-site contamination and risks.</i>
Assessment as to whether any further investigation is required, recommended or necessary.	<i>Further assessment is required, as outlined in Section 11.2.</i>
Assessment as to whether any remediation or risk mitigation/management measures are required at the Site.	<i>The plume stability assessment will determine if remediation and/or risk mitigation/management measures are required at the source site (ACL). Note this is considered to be unlikely based on the available results.</i>
Suitability or appropriateness of a management plan.	<i>None required.</i>
Evaluation of the suitability of the Site (parcel-specific where relevant) for the proposed land uses.	<i>The Site is suitable for current (farming) and future low density residential use based on current soil vapour and groundwater levels.</i>

13. Auditor's Conclusions and Recommendations

13.1 Conclusions

In 2021 an ESA was conducted which included groundwater and soil vapour investigations at the Site to assess the risk to current (agricultural) and future site users (residential), from chlorinated ethenes migrating via groundwater from the adjacent source site (ACL) site. The works included the installation of nine groundwater wells and thirteen soil vapour probes and were conducted as the results of an EPA Tasmania Investigation Notice on the Site (IN 10534/1 dated 7 January 2021).

Based on the results of the ESA, the auditor does not consider that there is any beneficial use of groundwater on site due to the expected low yield of the aquifer. For benchmarking purposes however, concentrations of the main contaminant of concern i.e. TCE were compared to human health criteria for potable and recreational use.

In summary:

- Elevated concentrations of TCE in groundwater and soil vapour are present on site as a result of the migration of the TCE groundwater plume from the adjacent ACL site. Due to the low risk posed by these concentrations the site is not identified as a 'contaminated site' as per the Environmental Management and Pollution Control Act 1994;
- Groundwater concentrations of TCE exceeding human health criteria for potable and recreational use were identified, although withdrawal of groundwater is unlikely given the expected low yield, no abstraction is recommended without prior testing of the water to confirm suitability; and
- Current soil vapour concentrations of TCE and 1,2,4-trimethylbenzene were found **not to present** a risk to current (agricultural) and potential site users (any residential land use) with a high margin of safety. Less sensitive uses such as commercial or industrial are also permitted. It is noted that habitable basement use has not been considered however the presence of shallow and competent bedrock renders this an unlikely future scenario, and given the levels of vapour found, the risk for this use is unlikely to be significant.

13.2 Summary of Suitability and Restrictions

Table 19: Auditor Conclusions and Recommendations for 40 Vermeer Avenue, Newnham Tasmania					
Current Nature and Extent of Contamination					
Land Parcel	Soil	Groundwater	Soil Vapour	Surface Water	Sediments
40 Vermeer Avenue, Newnham Tasmania (volume/folio: 106901/1)	Not applicable (NA)	Copper, chromium, nickel, zinc > FWG TCE > potable and recreation WHO	None	NA	NA
Suitability for use					
40 Vermeer Avenue, Newnham Tasmania	The Site is considered suitable for any land use including low density residential as defined in the risk assessment.				
Restrictions on Use {for C-RR, R-RU, C-RU}					

40 Vermeer Avenue, Newnham Tasmania	Groundwater should not be abstracted for any purpose other than environmental monitoring.
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13.3 Auditor Recommendations

The Auditor recommends that:

- One additional round of soil vapour and groundwater assessment at the Vermeer Avenue Site.
- An assessment of plume stability is undertaken including the derivation of TCE trigger levels, and
- No extraction of groundwater for any beneficial use is undertaken, without adequate testing to confirm suitability

14. Compliance with Investigation Notice

The EPA Tasmania Investigation Notice on the Site (IN 10534/1 dated 7 January 2021) and covering letter required that the ESA address a number of issues and these are summarised in the following table along with our reference of where this can be found in the audit report.

Table 20: Auditors Opinion on Compliance with the Investigation Notice	
IN 10534/1 Requirements	Auditor's Comment
An Environmental Site Assessment (ESA) must be completed	Refer to Appendix D
The ESA must determine, with respect to the area of land, whether chlorinated ethenes originating in, on or under the pollutant source land have resulted or will result in any portion of the area of land being a contaminated site.	Refer to Section 13.1
The scope of the ESA must include whether an actual adverse effect on the health or safety of human beings that is not negligible and/or an actual adverse effect on the environment which is not negligible is occurring or is likely to occur taking into account:	
<ul style="list-style-type: none"> Current and intended land use(s) including residential use. The ESA must include but not be limited to vapour risk posed by chlorinated ethenes in groundwater and direct contact with groundwater; and 	Refer to Section 11
<ul style="list-style-type: none"> Environmental values of groundwater and the use of groundwater (taking into consideration suitability for current and realistic future uses). 	Refer to Section 11
The ESA must include a conceptual site model.	Refer to Section 4 and Attachment 8
The CSM must include consideration of how variations in the following, may impact potential receptors:	
<ul style="list-style-type: none"> Chlorinated ethene concentrations in groundwater. 	Refer to Section 8
<ul style="list-style-type: none"> Geology, including thickness of the clay layer above the groundwater 	Refer to Section 4.2
<ul style="list-style-type: none"> Depth to groundwater 	Refer to Section 4.2
<ul style="list-style-type: none"> Where the CSM identifies a source-pathway-receptor linkage, an assessment of the level of risk to human health and the environment. To address this requirement direct measurements of vapour concentrations will be necessary 	Refer to Section 4.2 and 11
A statement as to whether an unacceptable risk to a receptor has been identified in the CSM	Refer to Section 13.1
A statement as to whether any portion of the area of land is a contaminated site	Refer to Section 13.1
An assessment of the adequacy of the management measures in place to manage any risks identified to human health and the environment	Refer to Section 11 noting that no management measures are required aside from limiting extraction of groundwater.
Where the existing management measures are assessed to be adequate to manage such risk(s) to an acceptable level, the reasons for this assessment must be stated.	Not applicable as no existing management measures are in place

The ESA and audit report are considered to address the requirements of the Investigation Notice IN10534/1.

15. Bibliography

The following documents have either been referred to in this report or the document is noted as being relevant for obtaining further information.

ANZECC (2000) Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Australian and New Zealand Guidelines for Marine and Freshwater.

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AS4482.2 (2005) Australian Standard AS4482.2, Guide to the Sampling and Investigation of Potentially Contaminated Soils: Part 2 Volatile Substances.

AS/NZS 4360 (2004) Australian and New Zealand Standard for Risk Management.

AS/NZS 5667.1 (1998) Australian/New Zealand Standard AS/NZS 5667.1, Water Quality –Sampling, Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples.

AS/NZS 5667.11 (1998) Australian/New Zealand Standard (AS/NZS 5667.11), Water Quality –Sampling, Part 11: Guidance on Sampling of Groundwaters.

ASC NEPM (1999) National Environmental Protection (Assessment of Site Contamination) Measure (as amended 2013). National Environmental Protection Council (NEPC)

CIRIA (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings, Report C665. London.

CRC CARE (2013) 'Petroleum hydrocarbon vapour intrusion assessment: Australian guidance', CRC for Contamination Assessment and Remediation of the Environment, CRC CARE Technical Report no. 23,

NHMRC, NRMMMC (2011) Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

NOHSC (National Occupational Health and Safety Commission) (1995) Adopted National Exposure Standards for Atmospheric WHO (2021) Petroleum Products in Drinking Water, World Health Organisation

16. Limitations of the Report

The conclusions presented in this report are relevant to the condition of the Site and the state of legislation currently enacted as at the date of this report. They depend on the accuracy and truthfulness of the environmental reports provided.

I have used a degree of skill and care required as an Auditor under the DWER Contaminated Sites Guidelines *The Western Australian Contaminated Sites Auditor Scheme* (DER 2016b). Conclusions are based on representative samples of locations at the Site, the intensity of those samples being in accordance with the usual levels of testing carried out for this type of investigation. Due to the inherent variability in natural soils I cannot warrant that the whole overall condition of the Site is identical or substantially similar to the representative samples.