

August 2007

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CSIRO Property Services

Grassy Woodland, 37 Graham Road, Highett, Victoria

Environmental Audit Report

CARMS Reference 68549–3, Service Order No. 8003038

May 2020

ENVIRONMENT PROTECTION ACT 1970**Statement of Environmental Audit**

I, John Throssell of GHD Pty Ltd 180 Lonsdale Street, Melbourne, a person appointed by the Environment Protection Authority ('the Authority') under the *Environment Protection Act 1970* ('the Act') as an environmental auditor for the purposes of the Act, having:

1. been requested by Karen Wright of Commonwealth Scientific and Industrial Research Organisation (CSIRO) Business & Infrastructure Services to issue a certificate of environmental audit in relation to the site located at CSIRO Grassy Woodland, 37 Graham Road, Highett VIC 3190, located in the Bayside City Council, comprising the land defined by the Certificate of Title Volume 8032 Folio 504 (part of Lot 1 on TP223183), owned by CSIRO. The site is currently unoccupied.
2. had regard to, amongst other things,
 - a. guidelines issued by the Authority for the purposes of Part IXD of the Act,
 - b. the beneficial uses that may be made of the site, and
 - c. relevant State environment protection policies/industrial waste management policies, namely:
 - (i) State environment protection policy (Prevention and Management of Contamination of Land) 2002
 - (ii) State environment protection policy (Waters) 2018
 - (iii) State environment protection policy (Air Quality Management) 2001
 - (iv) State environment protection policy (Ambient Air Quality) 1999
 - (v) Industrial Waste Management Policy (Waste Acid Sulphate Soils) 1999
 - (vi) Environment Protection (Industrial Waste Resource) Regulations 2009
3. in making a total assessment of the nature and extent of any harm or detriment caused to, or the risk of any possible harm or detriment that may be caused to, any beneficial use made of the site by any industrial processes or activity, waste or substance (including any chemical substance), and
4. completed an environmental audit report in accordance with section 53X of the Act, a copy of which has been sent to the Authority and the relevant planning and responsible authority.

HEREBY STATE that I am of the opinion that the site (as shown on the figure attached to this Statement) is suitable for the beneficial uses associated with:

- *Recreation/Open space*
- *Commercial*
- *Industrial*

subject to the following conditions attached thereto:

- Condition 1 From the date of completion of this audit, the owner of the site must implement and maintain the Environmental Management Plan (22 May 2020) which forms part of this Statement of Environmental Audit and is also attached to this environmental audit report.

The condition of the site is detrimental or potentially detrimental to any (one or more) beneficial uses of the site. Accordingly, I have not issued a Certificate of Environmental Audit for the site in its current condition, the reasons for which are presented in the environmental audit report. The terms and conditions that need to be complied with before a Certificate of Environmental Audit may be issued are set out as follows:

- Removal of all residual ACM impacted fill and aesthetic impacts within designated Tree Protection Zones and beneath the area labelled as Fifth St.

Other related information:

- Asbestos containing materials (ACM) are present within fill in the designated Tree Protection Zones and beneath Fifth St (>1 m depth), and soil in these areas needs ongoing management in accordance with the attached Environmental Management Plan. For the remainder of the site, ACM has been removed as far as practicable, however occasional ACM fragments may be encountered within the soil during excavation works. These ACM fragments do not represent a health risk to occupiers of the site. If encountered, any fragments must be handled and disposed in accordance with the relevant regulations.
- Groundwater at the site contains naturally elevated concentrations of inorganics (chloride, nitrate and total dissolved solids) and metals (copper, zinc). These levels are considered typical of the natural groundwater quality surrounding the site and do not constitute pollution in accordance with clause 15(d) of State Environment Protection Policy (Waters) 2018.
- Groundwater in the southern part of the site has historically reported concentrations of organics (trichloroethene). The concentrations are considered to be associated with an off-site source to the south of the site, and do not preclude any relevant beneficial uses of groundwater.
- In accordance with Section 53ZE of the Act, the occupier of the site must provide a copy of this Statement to any person who proposes to become an occupier of the site.

This Statement forms part of the Environmental Audit Report: GHD Pty Ltd, “*CSIRO, Environmental Audit Report, Grassy Woodland, 37 Graham Road, Highett, Victoria, CARMS Reference 68549-3, Service Order No. 8003038*” (May, 2020). Further details regarding the condition of the site may be found in the Environmental Audit Report.

DATED: 25 May 2020

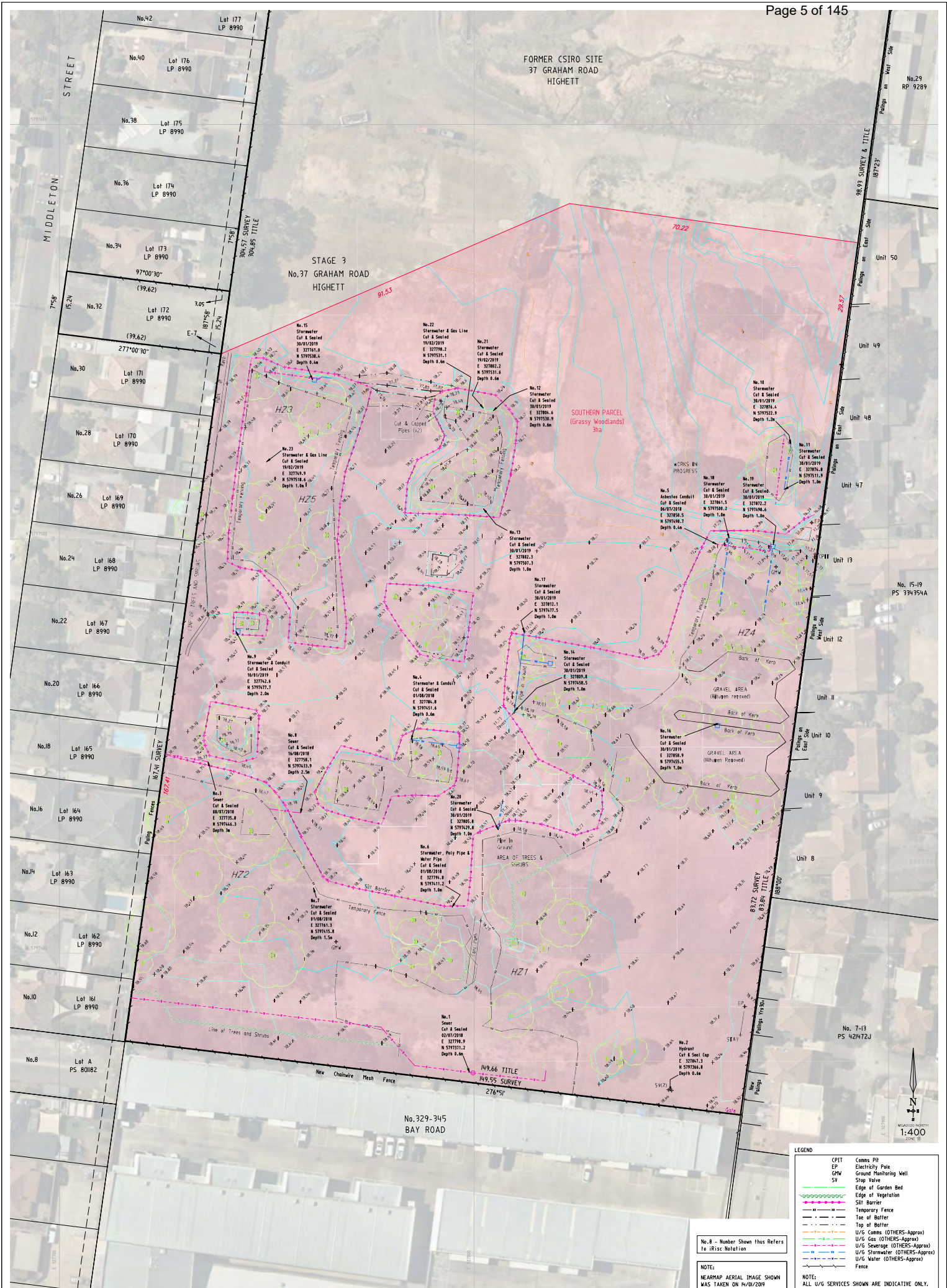
SIGNED:



MR JOHN THROSSELL

ENVIRONMENTAL AUDITOR

(Appointed Pursuant to the Environment Protection Act 1970)





CSIRO Highett - Grassy Woodlands

Environmental Management Plan

674398CH-0007-NP-RPT-0001 | 4

22 May 2020

Commonwealth Scientific and Industrial Research Organisation



CSIRO Highett - Grassy Woodlands

Project No: 674398CH
 Document Title: Environmental Management Plan
 Document No.: 674398CH-0007-NP-RPT-0001
 Revision: 4
 Document Status: Final
 Date: 22 May 2020
 Client Name: Commonwealth Scientific and Industrial Research Organisation
 Client No: -
 Project Manager: Jye Grogan
 Author: Jye Grogan / Monique Farmer / Liam Gooley
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CH2M Hill Australia Pty Ltd (now Jacobs)

Level 7, 177 Pacific Highway
 North Sydney NSW 2060 Australia
 PO Box 632 North Sydney
 NSW 2059 Australia
 T +61 2 9928 2100
 F +61 2 9928 2444
www.jacobs.com

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Document history and status

Revision	Date	Description	Author	Reviewed	Approved
Rev0	24/02/2020	Draft for comment	LG/MF	PB	LG
Rev1	06/04/2020	Revised draft	JG	LG	LG
Rev2	14/04/2020	Final for issue	LG	LG	LG
Rev3	19/05/2020	Revised based on Auditor comments	JG	PB	JG
Rev3.1	20/05/2020	Re-issue, correction of typographical error and update to Appendix B (B.2.1) and Appendix B (B.3)	JG	PB	JG
Rev4	22/05/2020	Revised based on Auditors comments	JG	PB	JG

Key Information

Who should use this EMP – any employee or contractor on-site.

Why was this EMP developed – asbestos contaminated soil remains on parts of the site and requires on-going management.

Why is there asbestos contaminated soil on the site – the site was formally part of a larger CSIRO facility, and as some buildings were constructed between 1950s-1980s they contained bonded asbestos cement sheeting as a building material. Over time, some of the asbestos was mixed with near surface soil.

Where is the asbestos contaminated soil – it's mostly deeper than 10 cm in the areas closest to the trees. However due to activity such as rain or burrowing animals, asbestos can be brought up to the surface. This is why it needs to be managed.

How will the asbestos contaminated soil be managed – it will be managed by:

- Access to the asbestos contaminated soils is restricted through fenced off areas and restricted general access.
- A 10 cm ground cover, such as mulch or topsoil and grass has been laid on the site surface to act as a separation layer and this will be maintained into the future.
- Unrestricted excavation of soils on the site is not allowed. Excavation of soil can only be carried out by specialist personnel trained in asbestos, and requires a work permit to be issued.

Is there a risk to using the site – the site has undergone environmental assessment and remediation works. A statutory environmental audit has been completed by an EPA appointed Environmental Auditor, a process which is rigorous and conservative. The Environmental Auditor has reviewed all the available site information and has concluded that the site is suitable for use as a public open space, as long as residual contamination is managed through the implementation of this EMP. The EMP sets the framework and requirements for managing the asbestos contaminated soil.

What do I need to do – anyone undertaking work or visiting the site needs to be inducted and made aware of the requirements of this EMP. These are detailed within this document.

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Appendices G, H, I and J of this EMP are provided in full within Appendix I of the Audit report

Acronyms and Abbreviations

µg/L	Micrograms per Litre
>	Greater Than
%	Percent
ACM	Asbestos Containing Material
AF	Asbestos Fines
BCC	Bayside City Council
CH2M	CH2M HILL Australia Pty Ltd
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CoPC	Contaminants of potential concern
EIL	Ecological Investigation Level
EMP	Environmental Management Plan
EPA	Environment Protection Authority
ESL	Ecological screening level
FA	Fibrous Asbestos
GME	Groundwater monitoring event
ha	Hectares
HIL	Health Investigation Level
iRisC	Independent Risk Consulting Pty Ltd
Jacobs	Jacobs Group Australia Pty Ltd
LOR	Limit of Reporting
m	Metres
m ²	Square Metres
m ³	Cubic Metres
mAHD	Metres Australian Height Datum
mbgl	Meters Below Ground Level
mg/kg	Milligrams per Kilogram
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
SEPP	State Environmental Protection Policy
TDS	Total dissolved solids

1. Introduction

CH2M HILL Australia Pty Ltd (CH2M), now Jacobs¹, was commissioned by the property division of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) as the environmental consultant overseeing contamination investigation and validating remediation works at the CSIRO-owned facility located at Graham Road, Highett, Victoria (the facility). The location of the facility is shown in Figure 1, and is described as 37 Graham Road, Highett, or Lot 1 of TP223183.

In 2012, for the purposes of investigation and remediation, CSIRO requested that the facility be split into two separate parcels of land ('Highett north' and 'Highett south'). The facility was later split into three separate parcels of land, referred to as 'Highett north', 'Highett south' and 'the Future Grassy Woodlands'. The Future Grassy Woodlands (the site), as shown in Figure 1, is located in the southern portion of the facility and comprises an area of approximately 3 ha.

The proposed future use of the site, following transfer from the purchaser, understood to be Chaolong Developments Pty Ltd or its nominee Sunkin Highett Pty Ltd (the purchaser)², to Bayside City Council, is intended to be Public Conservation and Resource Zone (PCRZ)³, which broadly corresponds to a public open space land use (NEPM, 2013). Further information on the site is provided in Section 2. Whilst the proposed land use with respect to the BCC planning scheme is not confirmed, this EMP has been prepared in consideration of the NEPM (2013) public open space land use.

It is noted that at the time of completing this EMP, CSIRO was the owner of the site, and Chaolong Developments Pty Ltd or its nominee Sunkin Highett Pty Ltd the proposed purchaser⁴; ultimately the land will be transferred to BCC as the future owner. On that basis, and for the purpose of implementation of this plan, Table 1.1, below, identifies the site owner, their key responsibility for management of the site, the period of time over which that responsibility applies, and the relevant section of this EMP that is required to be implemented.

Table 1.1: Site Ownership, Responsibility for Management and EMP Implementation Schedule

Site Owner	Anticipated Site Use	Period of Ownership	Management Responsibility	Implementation Schedule
CSIRO	No Public Access	Until transfer to Sunkin Highett Pty Ltd	- Implement monitoring and maintenance of existing site controls - No public access to site - Access to site by authorised persons only	Appendix A of this EMP
Sunkin Highett Pty Ltd		Until transfer to Bayside City Council		
Bayside City Council	Controlled Access	Upon transfer from Sunkin Highett Pty Ltd	- Preparation of site for on-going public access - Implement monitoring and maintenance of site for on-going public access	Appendix B of this EMP

1.1 Background

Since January 1999, several environmental investigations at the facility were undertaken that identified historic potentially contaminating activities and associated contaminants of potential concern (CoPC). Investigations

¹ On December 15, 2017, CH2M officially became part of Jacobs as a wholly-owned direct subsidiary. At present, CH2M remains a separate legal entity and will continue to operate and conduct business accordingly.

² Chaolong Developments Pty Ltd has nominated Sunkin Highett Pty Ltd as the proposed nominated purchaser. Subject to CSIRO approval (pending) Sunkin Highett Pty Ltd will be eventual purchaser of the land from CSIRO.

³ Bayside City Council, 2018 Highett Structure Plan, September 2018, https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.bays-yoursay/files/3415/3679/2513/Final_Highett_Structure_Plan_September.PDF

⁴ Subject to CSIRO approval of the nomination – see footnote 2.

prior to CH2M involvement are documented and summarised in “CSIRO Highett Facility (South), Victoria: Phase 1 and 2 Site Investigation” report (CH2M, 2012).

CSIRO engaged CH2M in 2009 to undertake an investigation of the entire facility given the concern regarding contamination (CH2M, 2012). Following completion of this investigation, CSIRO engaged John Throssell of GHD Pty Ltd (GHD) as an Environment Protection Authority (EPA) Victoria appointed Environmental Auditor to perform an environmental audit of the facility pursuant to Part IXD of the Environment Protection Act 1970.

Works completed since the 2012 investigation included demolition of buildings and removal of associated demolition debris, removal of surface soils in and around building footprints, and asbestos abatement overseen by iRisC Pty Ltd (iRisC) engaged by PSG Holdings Pty Ltd (PSG) on behalf of CSIRO. Areas occupied by trees earmarked for protection, were designated as tree protection zones (Section 2.2). Tree protection zones were established in consultation and agreement between CSIRO and BCC and were exempted from any remediation activities to ensure longevity of the trees.

The validation of remediation for the Future Grassy Woodlands is documented in the validation report, titled Validation Report: Portion of Southern Area of 37 Graham Road Highett – “Future Grassy Woodland” (Jacobs 2020) (herein referred to as “the Validation Report”). The Validation Report identified residual asbestos containing material (ACM) and fibrous asbestos (FA) within the soils at the site which requires management by an environmental management plan (EMP), which is the purpose of this document.

1.2 Objectives

The objective of this EMP is to identify that there are requirements for on-going use of the site that pertain to the presence of asbestos in surface and subsurface soils. The EMP is arranged to address two land use scenarios (based on the intended transition of site ownership), as follows:

- The current use of the Site (Vacant lot with no public access); and
- The intended long-term use of the Site as a public open space (PCRZ)

This EMP summarises the site contamination status following remediation and validation works undertaken (Jacobs 2020), and identifies requirements as outcomes from the Site Environmental Audit, including:

- measures required to ensure on-going suitability of the site for its intended use (public open space), including establishment of ground cover/landscaping at certain areas;
- site inspection and monitoring frequencies;
- the requirement that processes for on-going management of health and safety are established;

This EMP aims to ensure that health and safety risks associated with the site are appropriately managed. To achieve this, the EMP requires preparation of task-specific Asbestos Management Plan(s) (AMP) and Safe Work Method Statement (SWMS) for site works, to be prepared by an Environmental Consultant / Occupational Hygienist, for the conduct of maintenance works as may be required at the Site that have the potential to disturb surface and subsurface soils. The task-specific AMP and SWMS are to meet the requirements of Victorian Occupational Health and Safety Regulations (2017) and WorkSafe Victoria requirements.

Accordingly, this EMP includes reference to the following:

- WorkSafe Victoria (2018a) Compliance Code : Managing Asbestos in Workplaces
- WorkSafe Victoria (2018b) Compliance Code: Removing Asbestos in Workplaces.
- WorkSafe Victoria (2010) Asbestos-Contaminated Soil.

It is noted that the EMP is limited to the site as shown on Figure 1 and should be reviewed / revised in accordance with the requirements in Section A.11.4 (Appendix A) and B.11.4 (Appendix B)

1.3 Structure of the EMP

The following sections of the EMP apply to all site owners (identified in Table 1.1) during their period of site ownership:

- Section 1, includes background information on the site; objectives of the EMP; structure of the EMP implementation; guidelines used in the creation of the EMP; enforceability for the implementation of the EMP; and limitations of the EMP.
- Section 2, includes site identification information; details regarding areas of ecological significance at the site; identification of site management areas (Tree Protection Zones, General Access Areas (remediated/validated) and General Access Areas (non-remediated)); information regarding previous site remediation; contamination status at the completion of remediation; and roles and responsibilities pertaining to the EMP.
- Section 3, includes references cited in the EMP.

The following section of the EMP applies to CSIRO and Sunken Highett Pty Ltd, during their period of ownership

- Appendix A. Site Use – No Public Access

The following section of the EMP applies to Bayside City Council

- Appendix B. Site Use – Public Open Space (PCRZ)

1.4 Guidelines

The following guidelines, and standards were considered during the development of the EMP:

- National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure, 1999 (NEPC, 1999 (2013 amended)), hereafter referred to as the NEPM.
- State Environment Protection Policy (Prevention and Management of Contamination of Land) (Victorian Government, 2002).
- EPA Victoria, Soil hazard categorisation and management - Industrial Waste Resource Guidelines (IWRG) Publication 621 (EPA Victoria, 2009), hereafter referred to as IWRG 621.
- Western Australian Department of Health (WA DOH), 2009, Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (WA DoH, 2009)⁵.
- enHealth 2012 Guidelines for Assessing Human Health Risks from Environmental Hazards. Australian Government (enHealth, 2012).

1.5 Enforceability

The requirement for implementation of this EMP is an outcome from the process of Environmental Audit, according to the requirements of the Environmental Auditor (Mr John Throssell of GHD).

1.6 Limitations

This EMP is given strictly in accordance with, and subject to, the following limitations:

- The EMP was prepared for CSIRO ("Client") in accordance with the Scope of Work agreed between Jacobs and the Client.
- Jacobs assumes no responsibility for conditions we were not authorised to investigate.
- This report is based, in part, on unverified information supplied to Jacobs from several sources during the project research. Therefore, Jacobs does not guarantee its completeness or accuracy, and assumes no responsibility for errors or omissions related to this externally supplied information.
- An understanding of the Site conditions depends on the integration of many pieces of information; some regional, some site specific, some structure-specific and some experienced-based.
- The advice tendered in this report is based on information obtained from the field investigation locations, test points, sample points and field and laboratory data, and is not warranted in respect to the conditions that may be encountered across the Site at other than these locations. It is emphasised that the actual characteristics of the sub-surface and surface materials may vary between adjacent test points and sample intervals and at locations other than where observations, explorations and investigations have been made. Sub-surface conditions, including groundwater levels and contaminant concentrations can change in a limited space and time.
- The previous investigations reviewed during the preparation of this EMP identified actual surface and subsurface conditions only at those locations where samples were taken and when they were analysed. This data has been interpreted and an opinion rendered regarding the overall environmental conditions.
- This report has not been prepared for the purpose of assessing the suitability of soil and fill on the Site for foundations.

⁵ Noted to be under review by WA DoH. Future revisions of the EMP should consider the currency of this guideline.

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- This report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way. Jacobs accepts no responsibility for any circumstances that arise from the issue of the report which has been modified as outlined above.
 - This report has been prepared for the use of the Client relating to the property as described in the report in accordance with the terms and limitations stated in the agreement. No warranty, expressed or implied, is made.

2. Site Information

An overview of the existing condition of the site, environmental setting and surrounding land uses based on information obtained from the validation report (Jacobs, 2020) and relevant additional information obtained since its completion is provided in Table 2.1.

Table 2.1: Summary of site description

Site Overview
Site History
The site was formerly used by CSIRO as a scientific research and education facility. The facility was occupied by several divisions (including the Materials Science and Engineering; Process Science and Engineering; Land and Water; Ecosystem Science; Science Education and the Central Engineering Facility) until its closure in the 1990s.
Topography, Surface Water and Drainage
The site is gently undulating with an overall slight fall in gradient towards the east. Localised cut and fill works have occurred prior to construction, after demolition of the buildings and from the remediation works. Stormwater is expected to flow from the site towards Port Phillip Bay, which is located approximately 2.5 kilometres to the southwest.
Local Geology and Soils
Prior to remediation, the average and maximum fill thickness across the site observed by CH2M (2012) was ~0.5 m and ~1.8 m respectively and described as comprising sand, silts and gravel mixed with varying quantities of topsoil and anthropogenic materials, including brick, glass, metal fragments, and ACM. Fill within areas subject to remediation was removed during the remediation works. Fill is underlain by Brighton Sand Group Deposits comprising sand, silty sand and sandy clays and silts. The Brighton Sand Group Deposits are underlain by factored siltstone and mudstone of the Newport Formation and Silurian Age bedrock.
Groundwater
The groundwater-bearing zone is within the Brighton Sand Group Deposits. Based on the gauging of groundwater monitoring wells located across the facility, groundwater has been observed to generally lie at approximately 3.5 mbgl and to flow in a west to southwest direction.
Within the framework of the Victorian State Environmental Protection Policy (SEPP) (Waters) (Victorian Government, 2018), groundwater beneath the site is interpreted to correspond to Segment B defined as concentration of total dissolved solids (TDS) within the range 1,200 to 3,100 mg/L; corresponding protected groundwater beneficial uses are discussed in the Validation Report (Jacobs, 2020).

2.1 Site Identification

Table 2-2: Site Identification

Identifier	Detail
Street Address	37 Graham Road, Highett VIC 3190
Lot and Plan Number ⁶	Lot 1 of Plan TP223183
Site Area	Approximately 3 ha (30,000 m ²)
Current Land Owner	CSIRO
Identified Intended Future Land Owner(s)	Sunkin Highett Pty Ltd (purchaser), for later transfer to Bayside City Council ⁷
Zoning ⁸	CA – Commonwealth Land (not in scheme)
Proposed Zoning	Public Conservation and Resource Zone
Local Government Area	Bayside City Council

⁶ Information current at the time of reporting

⁷ Subject to approval by CSIRO of Sunkin Highett Pty Ltd as nominated purchaser, in the absence of which the purchaser is Chaolong Developments Pty Ltd. It is understood that Bayside City Council will be transferred ownership of the Site, by the purchaser, after a period of up to 12 months following its purchase.

⁸ Information obtained from www.planning.vic.gov.au, planning property report for 37 Graham Road, Highett VIC 3190, current at 5 December 2019.

2.2 Areas of Ecological Significance

Portions of the site are occupied by native vegetation which have been identified to be of high conservation significance in a flora and fauna assessment report (Biosis, 2011) commissioned by CSIRO; including areas described as a “significant example of Plains Grassy Woodland” and “the only remaining example of Yellow Box woodland on Melbourne’s sandbelt”. Four individual habitat zones and seven tree protection zones were identified encompassing River Red Gum, Yellow Box and Swamp Paperbark species. Very high and high conservation significance vegetation was identified to comprise over 0.18 ha and 0.25 ha respectively. The report recommended, with respect to protection of trees, that areas twice the diameter of the tree canopy be protected from adverse impacts. In consultation and agreement between CSIRO and BCC, designated tree protection zones were established at the site (Figure 2); excavation of soils within those areas was not permitted in order to ensure the longevity of the tree stands. Accordingly, no soil remediation within those zones could be undertaken.

2.3 Site Areas

The site includes broadly two distinct areas: the Tree Protection Zones; and the General Access Areas, as outlined below and shown on Figure 3.

2.3.1 Tree Protection Zones

It is understood that BCC wishes to preserve areas of identified ecological significance (Section 2.2), and therefore remediation of soils within those Tree Protection Zones could not be undertaken. As a result, general access to areas within the Tree Protection Zones must be restricted, unless a surface cover layer is introduced to those areas. As such, the areas have been delineated by temporary fencing and sediment fencing, as shown on Figure 2.

2.3.2 General Access Areas

The remainder of the site, outside of the Tree Protection Zones, is for general access. Recognising areas where remediation was not undertaken, the General Access Areas comprise of:

- Remediated Areas (areas where soil was removed and/or validated to remain on the site).
- Non-Remediated Areas (areas which have not been remediated for asbestos). There remains some uncertainty as to the presence of ACM within the top 0.1 m of soil across the General Access Areas (non-remediated).
- Fifth Street Remediation Area – which has been remediated to 1.0 m depth by placement of clean material from surface to 1.0 m depth, however soil below 1.0 m depth is contaminated.

2.4 Site Remediation

Site soil remediation works were conducted between 2016 and 2019, as documented in the Validation Report (Jacobs 2020). The remediation broadly comprised the following:

- Tree Protection Zones – no remediation has been undertaken per Section 2.2.
- General Access Areas – Remediated Areas:
 - The excavation and off-site disposal of soil within former building footprints, roadways, former carparks, garden beds and areas, and in the vicinity of underground assets (shown on Figure 2).
 - Removal and off-site disposal of surface and subsurface infrastructure (i.e. conduit). Subsurface infrastructure comprising ACM which was unable to be removed as it was present beneath Tree Protection Zones was cut, sealed, and surveyed (i.e. it remains in place), as shown on Figure 4.

- The area known as Fifth Street was remediated by excavation to 1 m below ground level and off-site disposal of asbestos impacted soil, then installation of a geofabric membrane capping deeper asbestos impacted fill, and backfilling with site-derived clean fill, as shown on Figure 2.
- General Access Areas – Non-Remediated Areas – no remediation/validation for asbestos was undertaken. Asbestos remediation and validation works overseen and undertaken by iRisC targeted former building footprints, roadways, former carparks, garden beds and grassed areas, and areas in the vicinity of underground assets, where asbestos had been indicated. There remains some uncertainty as to the presence of ACM within the top 0.1 m of soil across the General Access Areas (non-remediated).
- Fifth Street Remediation Area (as shown on Figure 3)
 - The 'Fifth Street Remediation Area', as identified on Figure 3, was remediated to one metre below ground level (1 mbgl), a geofabric membrane was installed to the base and walls of the remediated area, providing a barrier layer between asbestos impacted soil. Clean fill material was backfilled into the area.

The Validation Report (Jacobs, 2020) concluded that the remediation/validation works were successfully completed at the Site and that it is considered suitable for Public Open Space land use, comprising a grassy woodland area; provided the management measures detailed in this EMP are implemented, including actions prior to public access.

2.5 Contamination Status

Previous investigations, remediation, and validation activities have shown that concentrations of contaminants of concern are low and below the relevant criteria for a public open space land use, with the exception of:

- Tree Protection Zones:
 - The presence of ACM within the top 10 cm of soil is present and requires ongoing management.
 - The presence and concentration of ACM and AF/FA deeper than 10 cm within the tree protection zones is also suspected and requires ongoing management.
 - Redundant ACM services remain present at depth across the site, and require ongoing management (as identified in Figure 4).
- General Access Areas (remediated/validated):
 - These areas have been remediated and/or validated and assessed as being suitable for a public open space land use.
 - Erosion and migration of asbestos from adjacent Tree Protection Zones may occur during heavy rainfall and/or high wind events. Ongoing management of General Access Areas is required to ensure that the surface soil profile remains free of asbestos.
- General Access Areas (non-remediated):
 - The presence of ACM within the top 10 cm of soil is suspected and requires ongoing management. An assessment of exposure with respect to the above is provided in Appendix F.
- Fifth Street Remediation Area (as shown on Figure 3)
 - This area was remediated to a depth of 1 metre below ground level (mbgl) indicated by a geofabric membrane layer.
 - Asbestos impacted fill material is present below the geofabric membrane layer at depths greater than 1 mbgl.

2.6 Roles and Responsibilities

General responsibilities are outlined below:

- Environmental Auditor:
 - Approval and enforcement of this EMP as a requirement of the outcome of the Environmental Audit of the Site.
- Site Owner (as identified in Table 1.1):
 - Implementation of the relevant appendix (Appendix A or Appendix B) of this EMP as specified in Table 1.1
 - Incorporate this EMP into their management system
 - Provide a full copy of this EMP to employees and contractors, and discuss it as part of the site induction process.
 - Oversee and enforce the implementation of this EMP.
 - Undertake the required ongoing monitoring and inspections - Engage an Environmental Consultant / Occupational Hygienist to advise upon performance of these works to be compliant with Victorian Occupational Health and Safety Regulations (2017) and WorkSafe Victoria Compliance Code Managing Asbestos in Workplaces (2018)).
 - Implement and complete corrective actions, as required.
 - Complete and maintain the required registers and records.
 - Enforce requirements of this EMP by site contractors.
- Contractors:
 - Implement the EMP with oversight of the site owner.
 - Develop a task/job specific Asbestos Management Plan compliant with Victorian Occupational Health and Safety Regulations (2017) and WorkSafe Victoria Compliance Code Managing Asbestos in Workplaces (2018a). other WorkSafe Victoria requirements (2010, 2018a) and Safe Work Method Statement, and ensure that site works are undertaken in compliance with that Asbestos Management Plan.
 - Provide adequate asbestos awareness training of all employees and sub-contractors during site induction.
 - Complete registers and records as required.
 - Complete works in an environmentally responsible manner.
 - Ensure appropriate environmental protection measures are in place and working correctly.
 - Complete incident reports and complaint reports.
 - Ensure employees and sub-contractors comply with the requirements of this EMP and the Asbestos Management Plan.
- Environmental Consultant / Occupational Hygienist:
 - To be engaged: to advise upon performance of ongoing monitoring and inspections (as identified in the relevant appendix, Appendix A or Appendix B), to be compliant with Victorian Occupational Health and Safety Regulations (2017), WorkSafe Victoria Compliance Code Managing Asbestos in Workplaces (2018a), and other WorkSafe Victoria requirements (2010, 2018a); to undertake further environmental assessment if required in the future; and to prepare revision to this EMP if/when required.
 - Sample, analyse, and classify waste materials for off-site disposal to landfill, as required.

- Provide a report of findings and any recommendations to the site owner from the undertaking of ongoing monitoring and inspections.

3. References

- Biosis (2011) Flora and Fauna Assessment: CSIRO Highett, Victoria (Biosis, 2011).
- CH2M (2012) CSIRO Highett Facility (South), Victoria: Phase 1 and 2 Site Investigation (CH2M, 2012).
- enHealth (2012) Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth, 2012).
- iRisC (2020) Grassy Woodland Investigations Asbestos in Soil (South), CSIRO 37 Graham Road Highett Victoria (iRisC, 2020).
- Jacobs (2020) CSIRO Highett Remediation Project (Southern), Validation Report: Portion of Southern Area of 37 Graham Road Highett – “Future Grassy Woodland” (Jacobs, 2020).
- NEPC (2013) National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (NEPM, 2013).
- Victorian Environment Protection Authority (EPA) (2009) Industrial Waste Resource Guidelines (IWRG) 621 Soil Hazard Categorisation and Management (IWRG 621).
- Victorian EPA (2009) IWRG 701 Sampling and Analysis of Waters, Wastewaters, Soils and Wastes (IWRG 701).
- Victorian EPA (2017) IWRG 611 Asbestos Transport and Disposal (IWRG 611).
- Western Australian Department of Health (WA DoH) (2009) Guidelines for the Assessment, Remediation, and Management of Asbestos-Contaminated Sites in Western Australia (WA DoH, 2009).
- WorkSafe Victoria (2010) Asbestos-Contaminated Soil (WorkSafe, 2010).
- WorkSafe Victoria (2018a) Compliance Code: Managing Asbestos in Workplaces (WorkSafe, 2018a).
- WorkSafe Victoria (2018b) Compliance Code: Removing Asbestos in Workplaces (WorkSafe, 2018b).

Appendix A. Anticipated Site Use – No Public Access

Appendix A is for implementation by the site owner corresponding to the period of site ownership as identified in Table A.1 (below):

Table A.1: Responsible Party for Implementation of Part A

Site Owner	Anticipated Site Use	Period of Ownership	Management Responsibility	Implementation Requirement
CSIRO	No Public Access	Until transfer to Sunkin Highett Pty Ltd	- Implement monitoring and maintenance of existing site controls - No public access to site - Access to site by authorised persons only	Appendix A of this EMP
Sunkin Highett Pty Ltd ⁹		Until transfer to Bayside City Council		

A.1 Mitigation Measures

WorkSafe Victoria (2018a) provides guidance on mitigation measures to prevent contamination exposure to site users and workers. These control measures should reflect the following hierarchy of controls:

- Eliminating the risk (for example, removal).
- Isolating the risk (for example by barrier, distance or engineering controls).
- Using administrative controls (for example, safe work practices).
- Using Personal Protective Equipment (PPE).

Exposure to impacted soil at the Site could pose a risk to human health and should be avoided or minimised. If soil at the Site, particularly in the Tree Protection Zones (Section A.4.1), General Access Areas (non-remediated) (Section A.4.2) and Fifth Street Remediation Area (Section A.4.4), requires excavation or disturbance then mitigation measures (Sections A.2 to A.10) must be implemented, in accordance with this EMP, to protect human health.

A copy of WorkSafe (2018a) is provided in Appendix H for reference.

A.2 Anticipated Site Use – No Public Access

No permanent mitigation measures are required to be established during the period of site ownership by CSIRO and subsequently Chaolong Developments Pty Ltd or its nominee Sunkin Highett Pty Ltd, on the understanding that the intent for the Site use is that it only be accessible to authorised persons with no access to the general public.

Management measures (including fencing, work zone management, monitoring and inspection) are required to be implemented during the period of site ownership by CSIRO and subsequently Sunkin Highett Pty Ltd, due to the likely presence of asbestos within Tree Protection Zones (Section A.4.1), the General Access Areas (non-remediated) (Section A.4.2), and possibly the Fifth Street Remediation Area (Section A.4.4) identified in Section 2.3).

Ongoing monitoring and inspection requirements are to be undertaken in accordance with Section A.5 below.

The following sections detail the measures to be implemented over this period of site ownership until such point that the site ownership is transferred to Bayside City Council (BCC).

⁹ Or Chaolong Developments Pty Ltd in the absence of CSIRO approval of Sunkin Highett Pty Ltd as nominated purchaser

A.3 Site Access

Site access is to be restricted to authorised persons only, whom have been inducted to the site and this EMP. Appropriate signage must be established and maintained in a clear readable condition to ensure all persons accessing the site are aware that the site is under management due to the potential presence of asbestos at the site.

A.4 Maintenance of Site Conditions

A.4.1 Tree Protection Zones

- Access is to be restricted at these areas because asbestos is likely to be present at surface and at depth in these areas of the site.
- Temporary fencing is to be installed and maintained to prevent access to Tree Protection Zones from unauthorised persons;
- If access, or maintenance works, are required to be undertaken, the works area is to be treated as an asbestos works zone and appropriate management measures are to be employed (in accordance with Sections A.6 to A.10). Any intrusive works within Tree Protection Zones must be notified to BCC and permission or a work permit sought prior to works. Due to the protection status of these areas, BCC will need to assess likelihood for impact to the health of the trees and necessity for the works.
- It is the responsibility of the site owner (in consultation with their Environmental Consultant / Occupational Hygienist) to ensure access is restricted and the measures meet the requirements of WA DoH (2009).
- Silt fencing is to be installed and maintained at the boundary of Tree Protection Zones to prevent cross-contamination of asbestos from Tree Protection Zones to General Access Areas.
- Inspections are to be undertaken in accordance with Section A.5.

A.4.2 General Access Areas (non-remediated)

- There is the potential for ACM to be present within the top 0.1 m of the soil at General Access Areas (non-remediated).
- If maintenance works are required to be undertaken, these areas are to be treated as an asbestos works zone and appropriate management measures are to be employed (in accordance with Sections A.6 to A.10).
- Inspections are to be undertaken in accordance with Section A.5.

A.4.3 General Access Areas (remediated)

- General Access Areas (remediated) were cleared during remediation of the site and are required to be maintained as 'asbestos free' by the site owner.
- Inspections are to be undertaken in accordance with Section A.5.

A.4.4 Fifth Street Remediation Area

- Surface soils in the 'Fifth Street Remediation Area' as identified on Figure 3 were cleared during remediation of the site and are required to be maintained as 'asbestos free' by the site owner.
- 'Fifth Street Remediation Area' is known to contain asbestos at approximately one metre below ground level (1 mbgl).
- If intrusive works (e.g. soil excavations) are required in this area to a depth of 1 mbgl or greater, the area is to be treated as an asbestos works zone and appropriate management measures are to be employed (in accordance with Sections A.6 to A.10).
- The geofabric membrane marking layer must be replaced if intrusive works damage it or require its removal.

A.5 Site Inspections - Monitoring

- Inspections are to be carried out at a frequency of once per month until the site is transferred to BCC.
- Inspections are to be undertaken by an Environmental Consultant / Occupational Hygienist (refer to roles and responsibilities Section 2.6).
- Inspections should assess for adequacy of controls implemented in Sections A.4.1 to A.4.3, requirements for repairs, and presence of asbestos at surface outside of Tree Protection Zones.
- Any visible asbestos observed during site inspections is to be removed and disposed of by the Environmental Consultant / Occupational Hygienist in accordance with WorkSafe (2018a), and documented in the Routine Site Inspection Form (Appendix E).
- Inspections should yield a report detailing the findings and any corrective actions required. The inspections are to be documented, detailing exactly how it has been completed and noting the ground/surface condition (particularly in the Tree Protection Zones and General Access Areas (non-remediated) – refer to Figure 3). Inspections should be timed to coincide with recent rainfall events such as can reveal ACM. See Appendix E for a suggested inspection checklist.
- Ad-hoc inspections are to be undertaken following rain events of more than 25 mm over a 24-hour period. These inspections will include the whole site, though focus should be placed on areas adjacent to Tree Protection Zones, considering potential for run-off from the Tree Protection Zones.

A.6 General Maintenance

Following implementation of the controls for the use of the site outlined in Section A.4, when general maintenance is undertaken on any part of the site (such as landscaping, excavation by hand or machine, repair of silt fencing), measures should be taken to mitigate potential human exposure or environmental damage.

Prior to undertaking maintenance work the following is required:

- a task-specific Asbestos Management Plan (AMP)
- a task-specific safe work method statement (SWMS)

The task-specific AMP and SWMS is to be prepared by an Environmental Consultant / Occupational Hygienist in accordance with WorkSafe (2018a) to identify potential risks to human health and appropriate controls to be implemented. The site owner must ensure that the task-specific AMP(s) and SWMS(s) are implemented. The controls required will vary depending on the nature of and location of work being undertaken. As a minimum, suitable PPE must be worn during general maintenance activities as outlined in Section A.9 and an exclusion zone established to delineate the work area and prevent unauthorised access.

A.7 Soil Excavation

Where soil disturbance or excavation is undertaken on any part of the site (e.g. installation / repair of underground utilities), measures should be taken to mitigate potential human exposure or environmental damage. Works are to be undertaken in accordance with WorkSafe (2018b) and the task-specific AMP and SWMS prepared for those works by an Environmental Consultant / Occupational Hygienist in accordance with WorkSafe (2018a) (see Appendix I). Due to the requirement for vegetation to be protected within Tree Protection Zones, permission or a work permit must be sought from Bayside City Council prior to any excavation works being carried out in Tree Protection Zones.

If excavations are essential for ongoing maintenance of the Site, this should be coordinated with BCC as appropriate and provision should be made for the appropriate excavation, storage and disposal of this material.

Due to the confirmed asbestos presence at the Site, excavated soil must be treated as potentially contaminated by asbestos; particular attention should be paid to regulations and guidelines regarding asbestos within the workplace, including Asbestos-Contaminated Soil (WorkSafe 2010).

Excavation works must adopt appropriate dust control measures to minimise the risk of exposure through inhalation. Controls are to be documented in the task-specific AMP and SWMS so that workers are aware of their importance. If there is a high risk of dust generation then barriers to divert the wind over the excavation area can be constructed and/or excavations and stockpiled material can be wetted down or sprayed with a binding agent. Barriers may include shade cloth walls of a height one-fifth the length of the work area. The level of controls required will vary depending on the nature of the work being undertaken and the location of the works area on the site.

Other measures that may be adopted to minimise dust include:

- Covering of materials and stockpiles.
- Site equipment is to be fitted with dust suppressors.
- Dampening of exposed areas slightly, during excavation or whenever dust is potentially raised.
- Controlling vehicular access and egress, including that vehicles only leave via the stabilised site access path.
- Minimising the area of the Site that is disturbed at any one time.
- Minimisation of number of 'working' stockpiles.
- When windy conditions result in excessive dust generation, works are to cease until the conditions abate.
- Excavated soil should be returned to the depth and location from which it was excavated, so far as practicable.
- Minimise time period over which excavated soil and excavations are exposed / left open.

Any capping layers previously installed to minimise exposure to contaminated soil at the area of impact should be reinstated to the original condition as soon as practicable after intrusive works have been completed.

During excavation works, inspection for indicators of contamination should be undertaken by an environmental consultant / occupational hygienist. If unexpected contamination is encountered, then work should cease until the risk has been assessed and appropriate control measures are in place.

A.7.1 Requirements for Working with Asbestos Impacted Material

This section applies to Tree Protection Zones, General Access Areas (non-remediated) and Fifth Street Remediated Area (Intrusive works to a depth of 1mbgl or greater)

As ACM, and AF/FA (in one soil sample only), have been reported at the Site, an Environmental Consultant / Occupational Hygienist, experienced in the investigation and management of asbestos in soil should be consulted ahead of any excavation works, and appropriate management measures implemented. Site specific procedures for excavation works are to be specified in the task-specific AMP and SWMS prepared for the works; as a guide those procedures may include:

- The works areas must have a perimeter barrier to restrict access (i.e. exclusion zone).
- An asbestos work area shall be defined and clearly marked.
- Only authorised personnel shall enter the works area.
- All personnel within the asbestos works area shall wear P2 (or higher) class respirators, disposable gloves, and asbestos-rated coveralls whilst completing the works.
- A decontamination area will be marked out within the asbestos works area for the removal and disposal of PPE before workers leave the asbestos works area. All disposable PPE must be disposed of as asbestos waste.
- Static air monitoring at a minimum of three locations will be undertaken during the works.

- At the completion of works, an Environmental Consultant / Occupational Hygienist is to verify and report to the Site owner that the top 10 cm of soil within the excavation footprint after reinstatement of the excavation is visibly free of asbestos, and is suitable for a public open space land use.

A.8 Waste Disposal

If soil at the Site requires offsite disposal, it should be assessed, classified and disposed of in accordance with Victorian Environment Protection Authority (EPA) Industrial Waste Resource Guidelines 621 (IWRG) (2009) and Victorian EPA IWRG 611 (2017). In particular:

- An Environmental Consultant / Occupational Hygienist should be engaged to undertake characterisation sampling. The samples should be analysed by a commercial analytical laboratory using methods endorsed by the National Association of Testing Authorities (NATA).
- Samples should be analysed for contaminants outlined in IWRG 621 at the appropriate rate for the volume of excavated material to be characterised. The Environmental Consultant / Occupational Hygienist should provide the appropriate advice, however, the number of samples should be sufficient to enable calculation of the 95% Upper Confidence Limit (UCL) of the average concentrations.
- The results of the laboratory analyses should be compared to the waste classification limits included in IWRG 621. A waste categorisation letter should be prepared by the Environmental Consultant / Occupational Hygienist and provided to the site owner or appropriate representative.
- The waste classification letter must be provided to the landfill facility, to the facility's satisfaction.
- Copies of all weighbridge and tracking documentation should be provided to the site owner (or appropriate representative) to confirm the material tracking.

A.9 Personal Protective Equipment

Any activity which includes excavation or disturbance of soil at the Site, including routine maintenance work, will require the use of appropriate PPE to prevent potential exposure of site workers to contamination in the soil. PPE requirements are to be specified in the task-specific AMP and SWMS prepared for the works. As a guide, standard PPE requirements identified by WorkSafe Victoria (2018b) include:

- Full length arm and leg coverings.
- Suitable gloves.
- Steel capped boots.
- Disposable boot covers
- Safety glasses.
- Any other activity-specific PPE that may be required.

Table A.2 below provides guidance on the additional level of PPE required to protect workers from potential contaminants during routine work at the Site which have the potential to disturb soil.

Table A.2: PPE Requirements

Activity	Additional Level of PPE Required
Landscaping	Standard + P2 dust mask
Hand excavation	Standard + P2 dust mask
Mechanical excavation	Personnel should have disposable coveralls at all times

Used PPE is to be disposed of in accordance with the decontamination procedures, outlined in Section A.9, below.

A.10 Decontamination Procedures

Further to Section A.7.1, decontamination procedures, including establishment of a decontamination area, are to be specified in the task-specific AMP and SWMS, and implemented in the decontamination area whenever personnel, plant, or equipment leave the exclusion zone. At the completion of the works, soil, water, and PPE stored within the decontamination area is to be disposed of off-site in accordance with Victorian EPA and WorkSafe Victoria (2018b) requirements. As a guide those procedures may include for following.

A.10.1 Personnel

To ensure personnel do not leave the exclusion zone with potentially contaminated clothing, personnel are to:

- Remove outer gloves and store for reuse.
- Remove disposable coveralls, boot covers and dust mask and place in a dedicated bin for asbestos wastes disposal.
- Thoroughly wash hands and face.

A.10.2 Vehicles, Plant, and Equipment

All vehicles, plant, and equipment are to be washed or otherwise cleaned in the decontamination zone to ensure that contaminated soil, water, or dust is removed before leaving site.

A.11 Implementation and Monitoring

This section details responsibilities as the Site owner including, training and awareness, communication and compliance and environmental record keeping.

The requirement for implementation of this EMP is an outcome of the Environmental Audit of the Site; the Environmental Audit Report issued for the Site is a public document, and has been provided to the EPA and the relevant Planning Authority. Implementation and update of this EMP will be the responsibility is the site owner.

A.11.1 Training and Awareness

Workers who will undertake site maintenance and earthwork activities where excavation or disturbance of soil may occur must be inducted and trained in accordance with the requirements of the task-specific AMP and SWMP prepared for those works, prior to undertaking any physical works. All staff and grounds maintenance staff and contractors must have completed asbestos awareness training.

Specific inductions regarding these works should cover the following:

- The type, nature and health risks of the contaminants.
- Location and occurrence of contamination.
- Roles and responsibilities of the stakeholder parties.
- The processes and procedures to be followed to prevent exposure to contaminants.
- The correct use of maintenance and control procedures, protective equipment and work methods to minimise the risk of exposure to contaminants.
- Emergency response and unexpected finds protocols.

The site owner is to keep a record of site inductees provided with the above information Appendix B for Site Induction Register template.

A.11.2 Communication and Complaints

Workers at the Site are to be encouraged to report any concerns regarding contamination to their supervisor. Significant concerns must be communicated to the site owner so that they can be appropriately recorded and managed.

A.11.3 Environmental Records

A record (e.g. an asbestos register) should be kept by the site owner of the nature of the contamination at the Site. This EMP is suitable as an asbestos register. Copies of the EMP and site contamination records should be maintained at the Site; and provided to workers ahead of any excavation works at the Site.

A.11.4 Review and Update

This EMP should be reviewed every five years to confirm its completeness and currency.

At the completion of 12 months of site inspections in accordance with Section A.5, a review of site inspection frequency should be undertaken by an Environmental Consultant / Occupational Hygienist. The review should have regard to the findings of previous site inspections to determine the long-term site inspection frequency required for the ongoing management of the site (should the period of site ownership be extended). Additionally, this EMP should be updated following regulatory changes relevant to site requirements, and following any additional investigations or unexpected finds, to ensure the most current site data are considered in the management protocols.

The EMP may be ceased following advice from a Victorian EPA accredited site auditor that the impacts are below the applicable land use criteria, through the issuing of a Certificate or Statement of Environmental Audit, stating as such.

A.11.5 Record Keeping

The site owner shall keep records of the inductions, inspections, corrective actions (i.e. maintenance) and reports prepared for the site. These records should be evaluated and used for completing reviews of the EMP. The records are required to be maintained until the EMP is no longer required.

A.12 Corrective Action

It is important that initial mitigation measures are followed up with an ongoing management system. The following sections provide guidance on procedures to be followed which will assist in the continued protection of human health and the environment.

A.12.1 Environmental Monitoring, Inspections and Notification

During the routine inspections, any ACM that is identified on the accessible areas should be collected and appropriately disposed in accordance with the WorkSafe Victoria Compliance and Codes of Practice Removing Asbestos in Workplaces (WorkSafe 2018b).

Incidents that may, or are known to, have the ability to increase the potential for exposure onsite (i.e. fire or flooding) are to be reported to the site owner immediately. The EMP may then require modification to reflect any changed exposure rating or maintenance / remediation requirements. Any corrective actions resulting from the identification of incidents or non-conformances should also be documented and communicated to site workers.

A.12.2 Non-Conformances

Each non-conformance (for example, air monitoring results indicating airborne fibres, or a fragment of ACM becoming exposed at the surface) needs to be documented by site owner and site workers are to be notified as

soon as practicable of any non-conformance, and how it can be addressed and avoided in the future. These may include instances where excavation has been undertaken without due consideration of this document.

A.12.3 Corrective Actions

Each corrective action needs to be documented. If the corrective actions impact site workers then these need to be communicated to each site worker and be included in the training. If it is necessary, supplementary training may be required to assist in more fully informing site workers.

A.12.4 Audits

The site owner shall perform audits of the above-mentioned documentation (such as inspection checklists, non-conformance and corrective action reports) to check that this EMP is being followed and that the health of site users is protected from contaminant exposure. Audits should be conducted every six months.

Appendix B. Anticipated Site Use – For Public Access

Appendix B is for implementation by the site owner and period of ownership referred to in Table B.1 (below):

Table B.1: Responsible Party for Implementation of Appendix B

Site Owner	Anticipated Site Use	Period of Ownership	Management Responsibility	Implementation Requirement
Bayside City Council	Controlled Access	Upon transfer from Sunkin Highett Pty Ltd	- Preparation of site for public access - Implement monitoring and maintenance of site for on-going public access	Appendix B of this EMP

B.1 Mitigation Measures

WorkSafe Victoria (2018a) provides guidance on mitigation measures to prevent contamination exposure to site users and workers. These control measures should reflect the following hierarchy of controls:

- Eliminating the risk (for example, removal).
- Isolating the risk (for example by barrier, distance or engineering controls).
- Using administrative controls (for example, safe work practices).
- Using Personal Protective Equipment (PPE).

Exposure to impacted soil at the Site could pose a risk to human health and should be avoided or minimised. If soil at the Site, particularly in the Tree Protection Zones (Section B.4.1), General Access Areas (non-remediated) (Section B.4.2) and Fifth Street Remediation Area (Section B.4.4), requires excavation or disturbance then mitigation measures (Sections B.2 to B.10) must be implemented, in accordance with this EMP, to protect human health.

A copy of WorkSafe (2018a) is provided in Appendix H for reference.

B.2 Anticipated Site Use – For Public Access

This section of the EMP details actions to be undertaken in the understanding that BCC intends the site to be accessible to the general public. Those actions include permeant mitigation measures, and on-going inspection and monitoring requirements, detailed below.

B.2.1 Site Signage

Following implementation of the controls for the use of the site (Section B.2.2), appropriate signage must be established and maintained in a clear readable condition to communicate that excavation (digging holes) should not be undertaken.

B.2.2 Tree Protection Zones

Access is to be restricted at these areas. If access or maintenance works are required to be undertaken, the zones are to be treated as an asbestos works zone and appropriate management measures are to be employed in accordance with a task-specific Asbestos Management Plan (AMP) and Safe Work Method Statement (SWMS) to be prepared for those works by an environmental consultant / occupational hygienist in accordance with WorkSafe (2018a). Further guidance is included in Section B.6 to B.10.

It is the responsibility of the site owner (in consultation with their Environmental Consultant / Occupational Hygienist) to ensure that measures to restrict access are established, and that the measures meet the requirements of WA DoH (2009). Suitable restrictions include:

- Propagation of ground cover (such as grass) and installation of permanent fencing; and/or
- Landscape design which minimises access (i.e. placement of rock or treated timber to delineate the area, and placement of mulch and/or planting of a native garden over current surface soils (that could not be remediated)).

B.2.3 General Access Areas

There is the potential for ACM to be present within the top 0.1 m of the soil at General Access Areas (non-remediated) (Section 2.5) (This does not include the 'Fifth Street Remediation Area' (Figure 3) which has been remediated to 1.0 m depth by placement of clean material from surface to 1.0 m depth, although contaminated soil below 1.0 m depth remains.) Placement of a 0.1 m capping layer of either imported topsoil and turf, or mulch, would on that basis be required to be implemented and maintained to eliminate public access exposure risk at those areas. Ongoing monitoring and implementation of a suitable EMP will still be required to manage deeper residual asbestos.

To reduce the extent of that capping requirement, a WA DOH (2009) compliant assessment and / or remediation of the top 0.1 m, may be undertaken.

In consultation with the Environmental Auditor, the likelihood of encountering gross asbestos contamination at the General Access Areas has been determined to be low. Accordingly, an alternative management approach to capping at non-remediated areas is presented as follows:

- BCC are to implement a monthly inspection regime for the first 12 months of site ownership (in accordance with Sections B.4 and B.5), including removal of incidental asbestos finds from surface soils.

It is intended that alternative approach should negate a requirement for importation of a capping layer for General Access Areas (non-remediated). On-going monitoring requirements are detailed in Section B.5.

B.2.4 Fifth Street Remediation Area

The 'Fifth Street Remediation Area' as identified on Figure 3 was remediated to one metre below ground level (1 mbgl), a geofabric membrane was installed to the base and walls of the remediated area and clean fill material was backfilled into the area.

If intrusive works (e.g. soil excavations) are required in this area to a depth of 1 mbgl or greater, the area is to be treated as an asbestos works zone and appropriate management measures are to be employed (identified in Section B.4.4). The geofabric membrane marking layer must be replaced if intrusive works damage or require its removal.

B.3 Site Access

Following implementation of the controls for the anticipated use of the site, outlined in Section B.2, site access is to be controlled by the accessibility of the General Access Areas. BCC are to install signage at the Site as per Section B.2.1.

Access to Tree Protection Zones is prohibited unless a landscape design which minimises access is incorporated (as discussed in Section B.2.2) or if further investigation and/or remediation is undertaken to confirm the risks of asbestos exposure are low and acceptable.

B.4 Maintenance of Site Conditions

Maintenance of site conditions established for the use of the site as public open space (Section B.2.1 to B.2.4) is required to maintain reduced risk of exposure to asbestos. The following monitoring and maintenance control measures must be undertaken by BCC. On-going inspection and monitoring requirements are detailed in Section B.5.

B.4.1 Tree Protection Zones

- Tree Protection Zones must be maintained to restrict access to surface soils (that could not be remediated) from the general public at all times by maintaining control measures outlined in Section B.2.2.

B.4.2 General Access Areas (non-remediated)

- There is the potential for ACM to be present within the top 0.1 m of the soil at General Access Areas (non-remediated).
- If maintenance works are required to be undertaken, these areas are to be treated as an asbestos works zone and appropriate management measures are to be employed (in accordance with Sections B.6 to B.10).
- Inspections are to be undertaken in accordance with Section B.5.

B.4.3 General Access Areas (remediated)

- General Access Areas (remediated) were cleared during remediation of the site and are required to be maintained as 'asbestos free' by the site owner.
- Inspections are to be undertaken in accordance with Section B.5.

B.4.4 Fifth Street Remediation Area

- Surface soils in the 'Fifth Street Remediation Area' as identified on Figure 3 were cleared during remediation of the site and are required to be maintained as 'asbestos free' by the site owner.
- 'Fifth Street Remediation Area' (Figure 3) is known to contain asbestos at approximately one metre below ground level (1 mbgl).
- If intrusive works (e.g. soil excavations) are required in this area to a depth of 1 mbgl or greater, the area is to be treated as an asbestos works zone and appropriate management measures are to be employed (in accordance with Sections A.6 to A.10).
- The geofabric membrane marking layer must be replaced if intrusive works damage or require its removal.

B.5 Site Inspections - Monitoring

- Inspections are to be carried out at a frequency of once per month during the first year of site ownership.
- After the first year of site ownership, and for the following five years, site inspections should be carried out at a minimum frequency of twice per year, and then on a yearly basis.
- Inspections are to be undertaken by an Environmental Consultant / Occupational Hygienist (refer to roles and responsibilities Section 2.6).
- Inspections should assess for adequacy of controls implemented in Sections B.2 to B.10, requirements for repairs, and presence of asbestos at surface outside of Tree Protection Zones.
- Any asbestos identified during inspections should be collected for offsite disposal (in accordance with Section A.8) by an Environmental Consultant / Occupational Hygienist in accordance with WorkSafe (2018a), and be documented in the Routine Site Inspection Form (Appendix E)..
- Inspections should yield a report detailing the findings and any corrective actions required, to be prepared for BCC. The inspections are to be documented, detailing exactly how it has been completed and noting the ground/surface condition (particularly in the Tree Protection Zones and General Access Areas (non-

remediated) areas – refer to Figure 3). Inspections should be timed to coincide with recent rainfall events such as can reveal ACM. See Appendix E for a suggested inspection checklist.

- Ad-hoc inspections are to be also undertaken following rain events of more than 25 mm over a 24 hour period. These inspections will include the whole site, and noting particularly areas adjacent to Tree Protection Areas, considering potential for run-off from the Tree Protection Areas.
- After the first 12 months of site ownership, site inspections must be undertaken at a minimum frequency of twice per year by BCC (or an Environmental Consultant / Occupational Hygienist) for the next four years, and then annually thereafter.
- Any visible asbestos observed during site inspections is to be removed and disposed of by an Environmental Consultant / Occupational Hygienist disposal (consistent with Section B.8), and documented in the Routine Site Inspection Form (Appendix E).

The inspections are to be documented, detailing exactly how it has been completed and noting the ground/surface condition (particularly in the areas of impact – refer to Figure 3). Inspections should be timed to coincide with recent rainfall events such as can reveal ACM. See Appendix E for a suggested inspection checklist.

Rectification measures, such as maintenance of signage or restoration of mulch/turf capping should be undertaken as soon as practicable.

B.6 General Maintenance

Following implementation of the controls for the use of the site outlined in Section B.4, when general maintenance is undertaken on any part of the site (such as landscaping, hand excavation, repair of silt fencing), measures should be taken to mitigate potential human exposure or environmental damage.

Prior to undertaking maintenance work the following is required:

- a task-specific Asbestos Management Plan (AMP)
- a task-specific safe work method statement (SWMS)

The AMP and SWMS is to be prepared by an Environmental Consultant / Occupational Hygienist in accordance with WorkSafe (2018a) to identify potential risks to human health and appropriate controls to be implemented. The site owner must ensure that the task-specific AMP(s) and SWMS(s) are implemented. The controls required will vary depending on the nature of and location of work being undertaken. As a minimum, suitable PPE must be worn during general maintenance activities as outlined in Section B.9 and an exclusion zone established to delineate the work area and prevent unauthorised access.

B.7 Soil Excavation

Where soil disturbance or excavation is undertaken on any part of the site (e.g. installation / repair of underground utilities), measures should be taken to mitigate potential human exposure or environmental damage. Works are to be undertaken in accordance with WorkSafe (2018b), and the task-specific AMP and SWMS prepared for those works by an environmental consultant / occupational hygienist in accordance with WorkSafe (2018b) (see Appendix H).

If excavations are essential for ongoing maintenance of the Site, this should be coordinated with BCC as appropriate and provision should be made for the appropriate excavation, storage and disposal of this material.

Due to the confirmed asbestos presence at the Site, excavated soil must be treated as potentially contaminated by asbestos; particular attention should be paid to regulations and guidelines regarding asbestos within the workplace, including Asbestos-Contaminated Soil (WorkSafe 2010).

Excavation works must adopt appropriate dust control measures to minimise the risk of exposure through inhalation. Controls are to be documented in the task-specific AMP and SWMS so that workers are aware of their

importance. If there is a high risk of dust generation then barriers to divert the wind over the excavation area can be constructed and/or excavations and stockpiled material can be wetted down or sprayed with a binding agent. Barriers may include shade cloth walls of a height one-fifth the length of the work area. The level of controls required will vary depending on the nature of the work being undertaken and the location of the works area on the site.

Other measures that may be adopted to minimise dust include:

- Covering of materials and stockpiles.
- Site equipment is to be fitted with dust suppressors.
- Dampening of exposed areas slightly, during excavation or whenever dust is potentially raised.
- Controlling vehicular access and egress, including that vehicles only leave via the stabilised site access path.
- Minimising the area of the Site that is disturbed at any one time.
- Minimisation of number of 'working' stockpiles.
- When windy conditions result in excessive dust generation, works are to cease until the conditions abate.
- Excavated soil should be returned to the depth and location from which it was excavated, so far as practicable.
- Minimise time period over which excavated soil and excavations are exposed / left open.

Any capping layers previously installed to minimise exposure to contaminated soil at the area of impact should be reinstated to the original condition as soon as practicable after intrusive works have been completed.

During excavation works, inspection for indicators of contamination should be undertaken by an Environmental Consultant / Occupational Hygienist. If unexpected contamination is encountered, then work should cease until the risk has been assessed and appropriate control measures are in place.

B.7.1 Requirements for Working with Asbestos Impacted Material

This section applies to Tree Protection Zones and Fifth Street Remediated Area (Intrusive works to a depth of 1mbgl or greater)

As ACM and AF/FA (in one soil sample only) have been reported at the Site, an Environmental Consultant / Occupational Hygienist experienced in the investigation and management of asbestos in soil should be consulted ahead of any excavation works, and appropriate management measures implemented. Site specific procedures for excavation works are to be specified in the task-specific AMP and SWMS prepared for the works; as a guide those procedures may include:

- The works areas must have a perimeter barrier to restrict access (i.e. exclusion zone).
- An asbestos work area shall be defined and clearly marked.
- Only authorised personnel shall enter the works area.
- All personnel within the asbestos works area shall wear P2 (or higher) class respirators, disposable gloves, and asbestos-rated coveralls whilst completing the works.
- A decontamination area will be marked out within the asbestos works area for the removal and disposal of PPE before workers leave the asbestos works area. All disposable PPE must be disposed of as asbestos waste.
- Static air monitoring at a minimum of three locations will be undertaken during the works.
- At the completion of works, Environmental Consultant / Occupational Hygienist is to verify and report to the Site owner that the top 10 cm of soil within the excavation footprint after reinstatement of the excavation is visibly free of asbestos, and is suitable for a public open space land use.

B.8 Waste Disposal

If soil at the Site requires offsite disposal, it should be assessed, classified and disposed of in accordance with Victorian Environment Protection Authority (EPA) Industrial Waste Resource Guidelines 621 (IWRG) (2009) and Victorian EPA IWRG 611 (2017). In particular:

- An Environmental Consultant / Occupational Hygienist should be engaged to undertake characterisation sampling. The samples should be analysed by a commercial analytical laboratory using methods endorsed by the National Association of Testing Authorities (NATA).
- Samples should be analysed for contaminants outlined in IWRG 621 at the appropriate rate for the volume of excavated material to be characterised. The Environmental Consultant / Occupational Hygienist should provide the appropriate advice, however, the number of samples should be sufficient to enable calculation of the 95% Upper Confidence Limit (UCL) of the average concentrations.
- The results of the laboratory analyses should be compared to the waste classification limits included in IWRG 621. A waste categorisation letter should be prepared by the Environmental Consultant / Occupational Hygienist and provided to the site owner or appropriate representative.
- The waste classification letter must be provided to the landfill facility, to the facility's satisfaction.
- Copies of all weighbridge and tracking documentation should be provided to the site owner (or appropriate representative) to confirm the material tracking.

B.9 Personal Protective Equipment

Any activity which includes excavation or disturbance of soil at the Site, including routine maintenance work, will require the use of appropriate PPE to prevent potential exposure of site workers to contamination in the soil. PPE requirements are to be specified in the task-specific AMP and SWMS prepared for the works. As a guide, standard PPE in accordance with work safety requirements, i.e. WorkSafe Victoria (2018b) include:

- Full length arm and leg coverings.
- Suitable gloves.
- Steel capped boots.
- Disposable boot covers.
- Safety glasses.
- Any other activity-specific PPE that may be required.

Table B.2 below provides guidance on the additional level of PPE required for routine work at the Site with the potential to disturb soil in order to protect workers from potential contaminants.

Table B.2: PPE Requirements

Activity	Additional Level of PPE Required
Landscaping	Standard + P2 dust mask
Hand excavation	Standard + P2 dust mask
Mechanical excavation	Personnel should have disposable coveralls at all times

Used PPE is to be disposed of in accordance with the decontamination procedures, outlined in Section B.10, below.

B.10 Decontamination Procedures

Further to Section B.7.1, decontamination procedures, including establishment of a decontamination area, are to be specified in the task-specific AMP and SWMS, and implemented in the decontamination area whenever

personnel, plant, or equipment leave the exclusion zone. At the completion of the works, soil, water, and PPE stored within the decontamination area is to be disposed of off-site in accordance with Victorian EPA and WorkSafe Victoria (2018b) requirements. As a guide those procedures may include the following (Section B.10.1 and B.10.2):

B.10.1 Personnel

To ensure personnel do not leave the exclusion zone with potentially contaminated clothing, personnel are to:

- Remove outer gloves and store for reuse.
- Remove disposable coveralls, boot covers and dust mask and place in a dedicated bin for asbestos wastes disposal.
- Thoroughly wash hands and face.

B.10.2 Vehicles, Plant, and Equipment

All vehicles, plant, and equipment are to be washed or otherwise cleaned in the decontamination area to ensure that contaminated soil, water, or dust is removed before leaving site.

B.11 Implementation and Monitoring

Initial implementation of this EMP will be the responsibility of the site purchaser, understood to be Sunkin Highett Pty Ltd until which point the site is transferred to BCC.

Upon transfer of ownership to BCC, BCC, will be responsible for the implementation of this EMP and updates, as required. Information in this EMP should be communicated by BCC to employees and contractors working on the Site.

This section details BCC's responsibilities as the Site owner (once ownership is transferred to BCC), in respect to training and awareness, communication and compliance and environmental record keeping.

The requirement for implementation of this EMP is an outcome of the Environmental Audit of the Site; the Environmental Audit Report issued for the Site is a public document, and has been provided to the EPA and the relevant Planning Authority. Implementation and update of this EMP will be the responsibility of the site owner.

B.11.1 Training and Awareness

Workers who will undertake site maintenance and earthwork activities where excavation or disturbance of soil may occur must be inducted and trained in accordance with the requirements of the task-specific AMP and SWMP prepared for those works, prior to any physical works. BCC is responsible for this training; all BCC staff and grounds maintenance staff must have completed asbestos awareness training.

Specific inductions regarding these works should cover the following:

- The type, nature and health risks of the contaminants.
- Location and occurrence of contamination.
- Roles and responsibilities of the stakeholder parties.
- The processes and procedures to be followed to prevent exposure to contaminants.
- The correct use of maintenance and control procedures, protective equipment and work methods to minimise the risk of exposure to contaminants.
- Emergency response and unexpected finds protocols.

BCC is to keep a record of site inductees provided with the above information Appendix B for Site Induction Register template.

B.11.2 Communication and Complaints

Workers at the Site are to be encouraged to report any concerns regarding contamination to their supervisor and BCC such that they can be appropriately recorded and managed.

B.11.3 Environmental Records

A record (e.g. an asbestos register) should be kept by BCC of the nature of the contamination at the Site. This EMP is suitable as a basis for an asbestos register; copies of the EMP and site contamination records should be maintained for access at the Site as required; and provided to workers ahead of any excavation works at the Site. In addition, copies of site inspections (Section B.5) should also be retained by Council to ensure an up to date record of ACM observations and removal is maintained.

B.11.4 Review and Update

This EMP should be reviewed by an Environmental Consultant / Occupational Hygienist every five years to confirm its completeness and currency; that review should include review of Council's records of site inspection (Section B.14).

At the completion of 12 months of site inspections in accordance with Section B.5, a review of site inspection frequency should be undertaken by an Environmental Consultant / Occupational Hygienist. The review should have regard to the findings of previous site inspections to determine the long-term site inspection frequency required for the ongoing management of the site.

Additionally, this EMP should be updated following regulatory changes relevant to site requirements, and following any additional investigations or unexpected finds, to ensure the most current site data are considered in the management protocols.

Implementation of the EMP may be ceased only following agreement by a Victorian EPA appointed auditor.

B.11.5 Record Keeping

The BCC shall keep records of the inductions, inspections, corrective actions (i.e. maintenance) and reports prepared for the site. These records should be evaluated and used for completing reviews of the EMP. The records are required to be maintained until the EMP is no longer required.

B.12 Corrective Action

It is important that initial mitigation measures are followed up with an ongoing management system. The following sections provide guidance on procedures to be followed which will assist in the continued protection of human health and the environment.

B.12.1 Environmental Monitoring, Inspections and Notification

During the routine inspections, any ACM that is identified on the accessible areas should be collected and appropriately disposed in accordance with the WorkSafe Victoria Compliance and Codes of Practice Removing Asbestos in Workplaces (WorkSafe 2018b).

Incidents that may, or are known to, have the ability to increase the potential for exposure onsite (i.e. fire or flooding) are to be reported to BCC immediately. The EMP may then require modification to reflect any changed exposure rating or maintenance / remediation requirements. Any corrective actions resulting from the identification of incidents or non-conformances should also be documented and communicated to site workers.

B.12.2 Non-Conformances

Each non-conformance (for example, air monitoring results indicating airborne fibres, or a fragment of ACM becoming exposed at the surface) needs to be documented by BCC and site workers are to be notified as soon as practicable of any non-conformance, and how it can be addressed and avoided in the future. These may include instances where excavation has been undertaken without due consideration of this document.

B.12.3 Corrective Actions

Each corrective action needs to be documented. If the corrective actions impact site workers then these need to be communicated to each site worker and be included in the training. If it is necessary, supplementary training may be required to assist in more fully informing site workers.

B.12.4 Audits

BCC shall perform audits of the above-mentioned documentation (such as inspection checklists, non-conformance and corrective action reports) to check that this EMP is being followed and that the health of site users is protected from contaminant exposure.

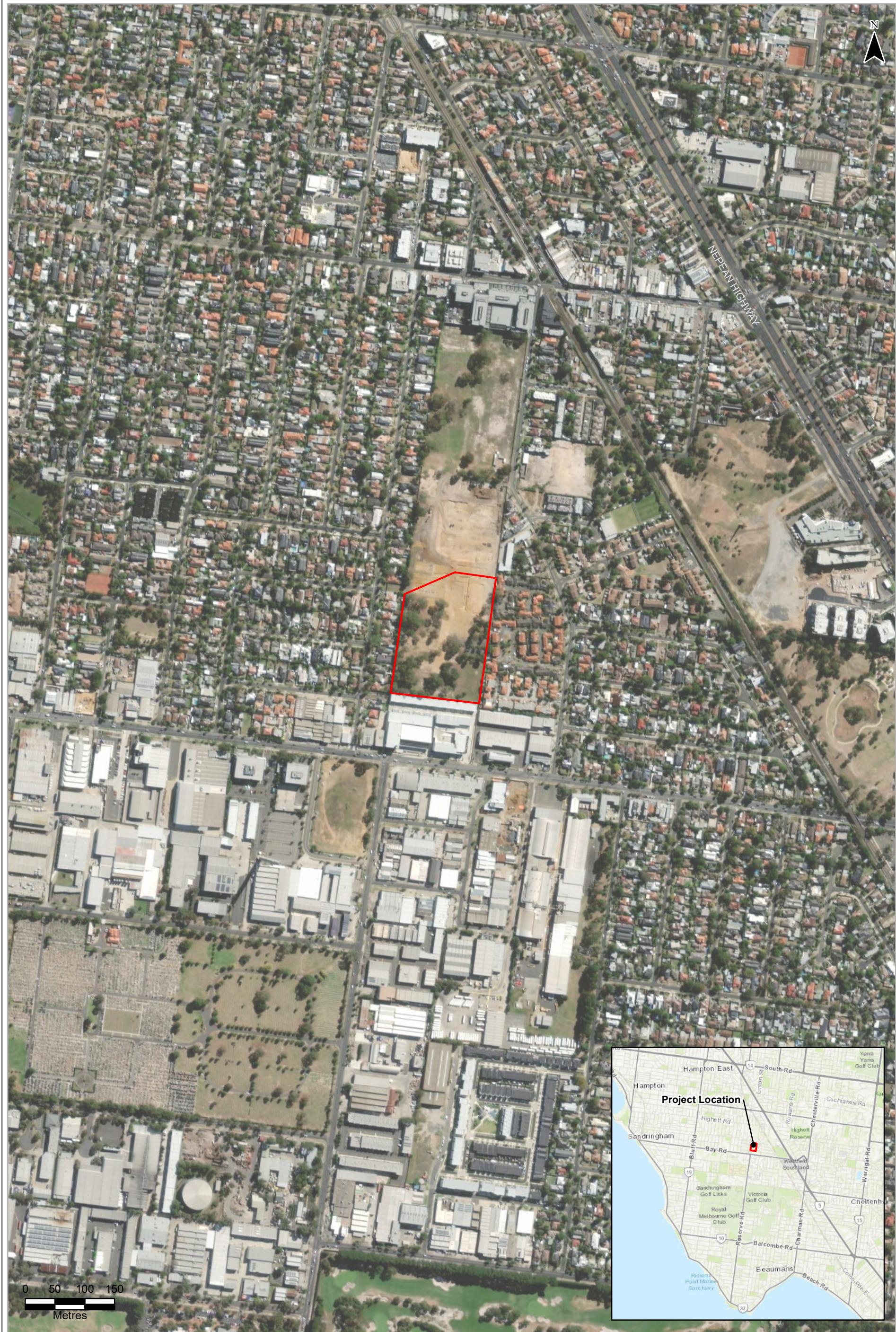
Appendix C. Figures

Figure 1: Site Location

Figure 2: Remediated/Validated Footprints

Figure 3: Site Areas

Figure 4: Location of In-Situ Asbestos Remaining On-Site



JACOBS
Jacobs Australia Pty Ltd
Level 11, 452 Flinders St
Melbourne, Vic, 3000

 Site Boundary

Project No:
Last Modified: March 2020
Coordinate System: MGA Zone 55 (GDA 2020)
Notes:
1. Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar
Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and
the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO,
USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance
Survey, Esri Japan, METI, Esri China (Hong Kong), (c)

FIGURE 1
Site Location

Environmental Management Plan
Grassy Woodland, Highett, Victoria



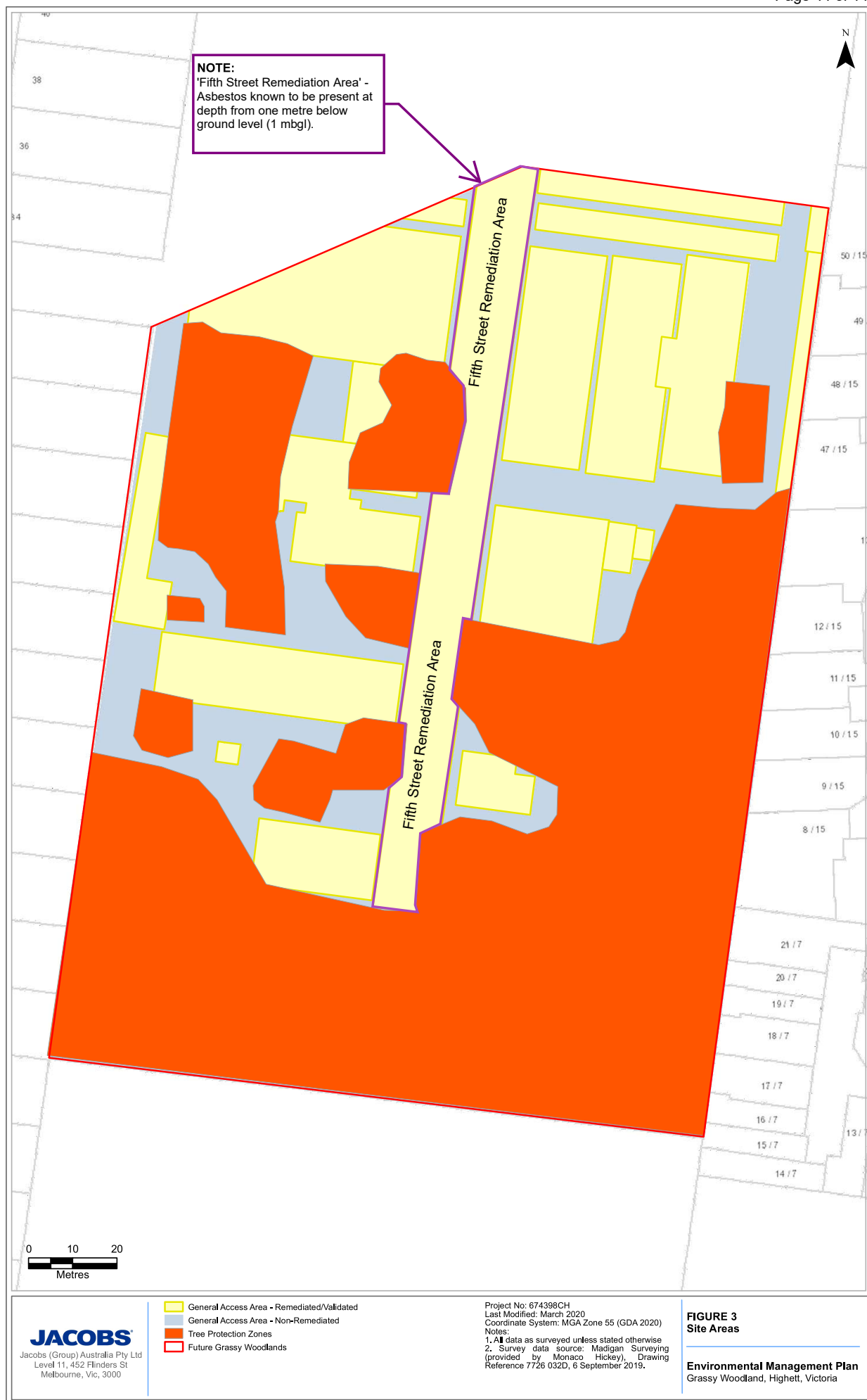
JACOBS
Jacobs (Group) Australia Pty Ltd
Level 11, 452 Flinders St
Melbourne, Vic, 3000

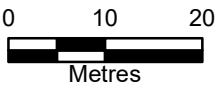
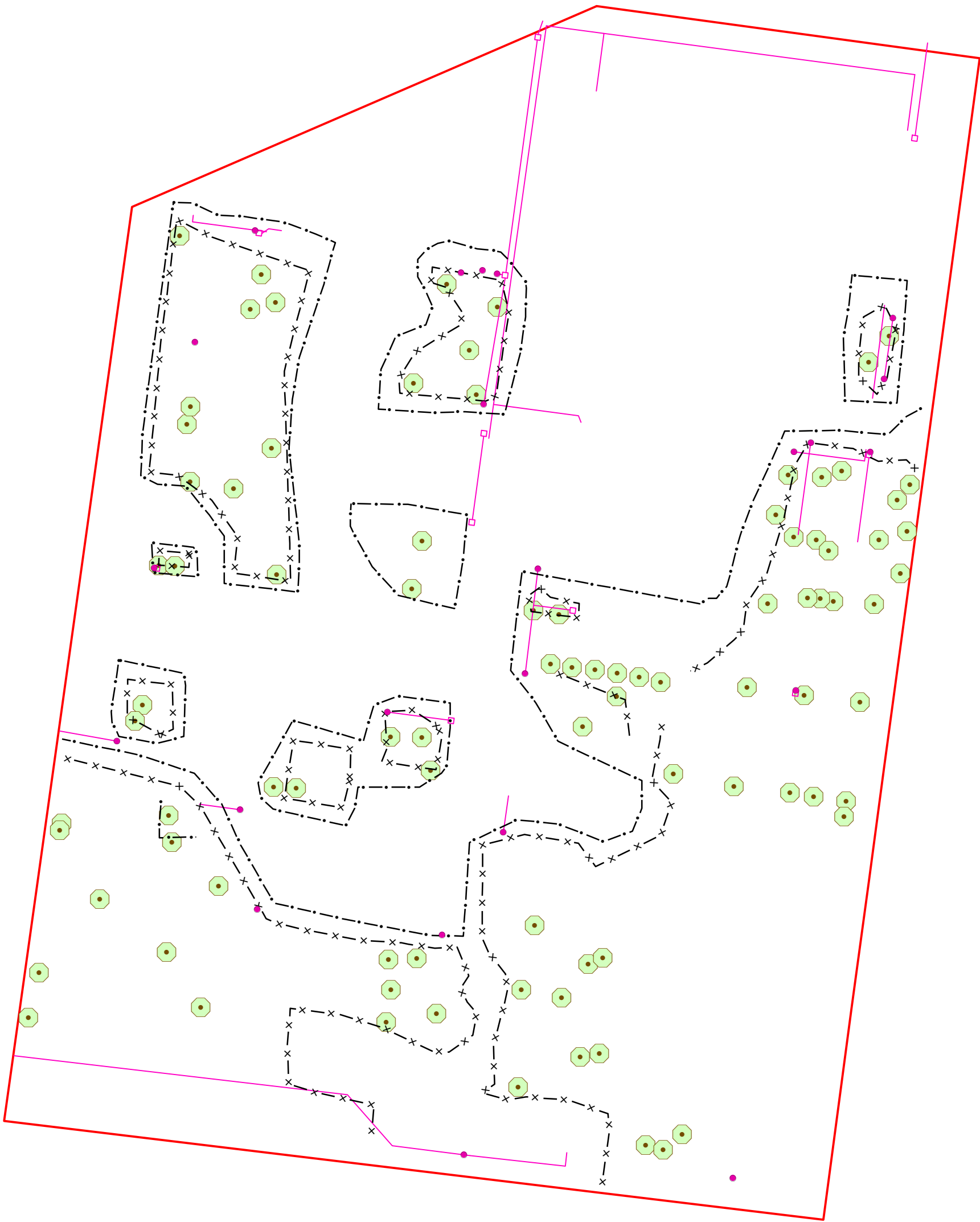
- Silt Barrier
- Tree Protection Fencing
- Concrete Curbs and Slabs
- Tree
- Former Building Footprint
- Non-building Footprint
- Former Grassy Mound
- Site Boundary

Project No: 674398CH
Last Modified: March 2020
Coordinate System: MGA Zone 55 (GDA 2020)
Notes:
1. All data as surveyed unless stated otherwise
2. Survey data source: Madigan Surveying
(provided by Monaco Hickey), Drawing
Reference 7726 032D, 6 September 2019.

FIGURE 2
Remediated/Validated Footprints

Environmental Management Plan
Grassy Woodland, Highett, Victoria





JACOBS

Jacobs (Group) Australia Pty Ltd
Level 11, 452 Flinders St
Melbourne, Vic, 3000

- Cut and Seal Point
- Silt Barrier
- x — Tree Protection Fencing
- Underground Services
- Tree
- Site Boundary

Project No: 674398CH
Last Modified: March 2020
Coordinate System: MGA Zone 55 (GDA 2020)
Notes:
1. All data as surveyed unless stated otherwise
2. Survey data source: Madigan Surveying
(provided by Monaco Hickey), Drawing
Reference 7726 032D, 6 September 2019.

FIGURE 4
Location of In-Situ Asbestos
Remaining On-Site

Environmental Management Plan
Grassy Woodland, Highett, Victoria

Signing the site induction register confirms that the inductee has read the EMP, and understands the site risks and requirements of the EMP.

Appendix D. Site Induction Register

Appendix E. Routine Site Inspection Form

Part A: Site details	
Site Location	Highett Grassy Woodland, Graham Road, Highett, VIC 3190
Weather conditions:	
Date of Inspection:	
Inspection conducted by:	
Signature:	

Part B: Complete prior to site inspection		
Item	Description	Yes / No
1	Have you read this Environmental Management Plan, prepared by Jacobs?	
2	Are you aware of the site contamination status and areas where remediation measures have been implemented?	
3	Do you understand the objective of the site inspection?	
4	Do you have a copy of the site plan to mark out any potential areas of concern identified during your inspection?	
5	Do you have a camera to take photos of observations made during your inspection?	

Part C: Complete during the site inspection			
Item	Description	Yes / No	Comments / Action
1	Is signage present and in good condition?		
2	Is vegetation and mulch cover located within publicly accessible locations healthy and adequate?		
3	Are there any indications of illegal dumping activities?		
4	Are surface areas free of waste / potential asbestos containing materials (PACM)?		

Part C: Complete during the site inspection			
Item	Description	Yes / No	Comments / Action
5	Are there any visible signs of ground disturbance within areas of known Asbestos contamination?		
6	Are there any bare patches / ground disturbance in areas where mulch has been formerly applied?		
7	Has any PACM been observed during the site inspection?		
8	Any complaints from members of the public?		
9	Take photographs to help identify if significant changes have occurred since the previous site inspection.		

Part D: Complete after the site inspection			
Item	Description	Yes / No	Comments / Action
1	Are there any corrective actions required? (Provide detailed information and proposed timelines)		
2	Is the Environmental Management Plan adequate or does it require updating?		

Part D: Complete after the site inspection

Item	Description	Yes / No	Comments / Action

Part E: Close Out Process

Item	Description	Comments / Action
1	Corrective action completed:	
2	Close out inspection: Name Signature Date	
3	Site owner (or appropriate representative): Name Signature Date	

Appendix F. General Information Regarding Asbestos

F.1 Asbestos

By way of background, “asbestos” is a generic name given to the fibrous variety of six naturally occurring minerals that have been used in commercial products. The three asbestos minerals commonly used in Australia were amosite, crocidolite and chrysotile. Asbestos is made up of fibre bundles and these bundles, in turn, are composed of thin fibres that can be easily separated from one another. The bundles have splaying ends and are very flexible.

Historically asbestos was used in many products because of its high tensile strength, relative resistance to acid and temperature, varying textures and degrees of flexibility. Asbestos was used in construction and manufacturing from the mid-1940s to the mid-1980s, because it is incombustible, durable, versatile and resistant to chemicals. Chrysotile (white) asbestos was the most prevalent making up 90% of asbestos used in Australia (enHealth, 2013).

In the late 20th century, there was growing evidence that high concentrations of airborne asbestos fibres could cause serious health problems, including scarred lungs, asbestosis and cancer. This was most commonly associated with working directly with asbestos fibres in the occupational environment, such as mining asbestos minerals or manufacturing asbestos containing products. Since then asbestos has been the focus of extensive scientific and medical scrutiny. Australia banned the use or import of blue (crocidolite) and brown (amosite) asbestos / asbestos products in the mid-1980s (enHealth, 2013). From 31 December 2003 a total ban on manufacture, use, reuse, import, transport, storage and sale of all forms of asbestos came into force (enHealth, 2013).

F.2 Asbestos Exposure Pathways

The ‘exposure pathway’ is the course a chemical takes from the source to the receptor, and as such includes the source, an exposure point and exposure route, and typically a transport/exposure medium (e.g. air or water). Routes of asbestos exposure are listed by enHealth (2013) as ingestion, inhalation and dermal absorption. Completed pathways, i.e. where there is a source of contaminant, an exposure pathway and a human receptor indicate a potential for a risk to human health and/or the environment for that substance to occur. Exposure pathways for asbestos exposure are listed by enHealth (2013) as ingestion, inhalation and dermal absorption.

For any qualitative risk assessment, the following information is presented:

- General contaminant information including toxicity.
- Pathways and exposure routes specific to the Site.
- Mitigation measures that can be initiated to manage any potential risk.

Chapter 3 of enHealth (2012) provides guidance on conducting qualitative exposure assessments for sites contaminated with asbestos. Consideration has to be given to the type, nature and condition of the asbestos; as well as exposed surface area, accessibility, location and use of the Site; and potential for migration of contamination.

The identified contaminant of concern at the Site is asbestos; in this case occurring predominantly bound in manufactured building materials (i.e. ACM).

Schedule B1 page 29 of NEPM (2013) states that “asbestos only poses a risk to human health when fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage.”

Asbestos and asbestos materials are described formally using three terms:

- Bonded asbestos-containing-material or 'bonded ACM' (ACM) – material containing asbestos that is not friable asbestos, including material containing asbestos fibres reinforced with a bonding compound.
- Fibrous asbestos (FA) – asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure.
- Asbestos fines (AF) – free fibres, small fibre bundles and also small fragments of bonded ACM which is degraded such that fibres could release (NEPC 2013b).

FA and AF containing materials have the potential to generate, or be associated with, free asbestos fibres; FA and AF must therefore be carefully managed to prevent release of fibres to the air (NEPM, 2013).

In this case, the asbestos identified occurs predominantly bound within manufactured building materials (ACM). Due to the confirmed presence of asbestos at the site, there is the potential for generation of AF and FA due to activities such as excavation or trafficking across the site.

A summary of the residual asbestos known and potentially present at the Site is presented in Section 2.5.

F.3 This EMP

The site has undergone environmental assessment and remediation works, and statutory environmental audit has been completed by an EPA appointed Environmental Auditor. The Site will be utilised ultimately as public open space, comprising a mix of recreational and conservation spaces; key receptors for potential exposure to the identified asbestos contamination include recreational users, and site workers undertaking maintenance activities (i.e. landscaping or installation of utilities). The Environmental Auditor has reviewed all the available site information, including this EMP, and has concluded that the site is suitable for use as a public open space, as long as residual contamination is managed through the implementation of this EMP.

This EMP sets the framework and requirements for managing the asbestos contaminated soil.

Executive summary

Table 1 Summary of Audit Information

Summary information required	
Auditor	Mr John Simon Throssell
Auditor account number	75645
Auditor appointment end date	7 February 2021
Audit type	s53X
Date EPA notified of audit	07/10/2010 for the entire CSIRO Highett Site. 04/04/2012 for the audit of Highett South (the southern part of CSIRO Highett Site, which included the Grassy Woodland area). 14/10/2019 for an adjusted area of Highett South. The initial area notified in 2012 has now been split into two audit sites: (1) Highett South and (2) Grassy Woodland (this report).
Audit service order number	80003038 (CARMS 68549-3)
Name of person requesting audit	Karen Wright ¹
Relationship of person requesting audit to site	Project Manager, Capital Works – CSIRO Business & Infrastructure Services
Name of premises owner	CSIRO
Date of auditor engagement	6 June 2010
Completion date of the audit	25 May 2020
Reason for audit	Redevelopment of Commonwealth land to a more sensitive land use (voluntary)
Audit Categorisation	Risk
Environmental segments	Air, Land, Groundwater, Surface Water
If an audit was required by an EPA notice, licence or other, please provide EPA reference number	
Current land use zoning	Commonwealth Land Not Controlled by Planning Scheme (CA)
EPA region	Southern Metro
Municipality	Bayside City Council
Dominant – Lot on plan	Certificate of Title Volume 8032 Folio 504 (part of Lot 1 TP223183H)
Additional – Lot on plan	
Site/premises name	Grassy Woodland (part of CSIRO Highett Site)

¹ Initial Audit request was made by Ross Stevens (CSIRO Property Resource Manager) in 2010

Summary information required		
Building / complex sub-unit No.		
Street/Lot – Lower No.	37	
Street/Lot – Upper No.		
Street Name	Graham	
Street type (road, court, etc.)	Road	
Street suffix (North, South etc.)		
Suburb	Highett	
Postcode	3190	
GIS Coordinate of Site centroid	GDA94 – Longitude / Latitude in decimal degrees	
Longitude / Northing (GDA94)	145.04001259803772	
Latitude / Easting (GDA94)	-37.95407066956861	
Site area (m ²)	30,000	
Members and categories of support team utilised	Eric Friebe (human health risk assessment)	
Further works or requirements	On-going management of soils on the site in accordance with the site specific Environmental Management Plan.	
Nature and extent of continuing risk	Bonded asbestos containing material (ACM) such as below ground services and fragments of ACM in fill remain within areas of the site designated as Tree Protection Zones. Access and management of these areas is prescribed in the Environmental Management Plan which forms part of the Statement of Environmental Audit.	
Outcome of the audit	Statement of Environmental Audit	
Has EPA determined CUTEP at the site?	No	
Has the Auditor determined CUTEP at this site	No	
Has a GQRUZ been identified at the site / beyond the site by EPA	No	
Does NAPL remain at the site	No	
Please indicate which of the protected beneficial of groundwater are precluded due to pollution	Protected Use	Precluded?
	Water dependent ecosystems and species	Not relevant
	Potable mineral water supply	Not relevant
	Agriculture and irrigation (irrigation)	No
	Agriculture and irrigation (stock watering)	No

Summary information required		
	Water-based recreation (primary contact recreation)	No
	Industrial and commercial water use	No
	Buildings and structures	No
	Traditional Owner cultural values	Not relevant
	Cultural and spiritual values	Not relevant
	Geothermal properties	Not relevant

*NB – Leave cell blank if not applicable

Table 2 Physical Site Information

Summary information required	
Historical land use	CSIRO testing and research of coatings, fluid dynamics and hydraulic research, test dynamometer testing, agricultural engineering, mechanical engineering research, as mechanical workshops, office administration and in the storage, handling and use of a wide range of chemicals and inert materials.
Current land use	Vacant
Proposed future land use	Not confirmed but understood to include public open space and other public amenities (including for community, conservation or heritage purposes).
Surrounding land use - north	The central part of the CSIRO Highett Site (Highett South), beyond which is the northern part of the CSIRO Highett Site (Highett North) and the Highett Shopping Centre (formerly Department of Defence land).
Surrounding land use - south	The commercial properties that front onto Bay Road.
Surrounding land use - east	Residential and Commercial (including Clear Edge Filtration (Australia) who provided industrial filtration products and the R E Ross Industrial Centre, now vacant). Progressive redevelopment to residential. A rail easement (Frankston line) is present behind these properties
Surrounding land use - west	Single dwelling Residential
Proposed land use zoning	Public open space
Nearest surface water receptor - name	Melbourne Water flood retarding basin
Nearest surface water receptor - direction	West-southwest
Likely point of groundwater discharge	Port Phillip Bay (approximately 4 km south-west of the site)
Site aquifer formation	Brighton Group
Groundwater flow direction	West-southwest
Groundwater TDS range	1,720 mg/L to 6,250 mg/L in 2019
Groundwater segment	B
Are multiple aquifers impacted by the pollution at the site?	No

Summary information required	
Perched groundwater depth – upper	n/a
Perched groundwater depth - lower	n/a
Regional groundwater depth – upper	9 mbgl
Regional groundwater depth - lower	10.6 mbgl
Number of bores within 2 km	326
Closest extractive use (distance in m)	200 m (WRK974423, registered for domestic and stock use)
Zone of groundwater plume influence (m from site boundary)	N/A
Year groundwater was last monitored	July 2019
Have you attached electronic copies of current groundwater analytical results presented as a summary table?	Yes (submission via EPA Interaction portal)

This Executive Summary presents a brief summary of information described in the audit report.

The Executive Summary should be read in conjunction with the full audit report titled “*Environmental audit report, Grassy Woodland, 37 Graham Road, Highett, Victoria, CARMS Reference 68549–3, Service Order No. 800303*” and interpreted in the context of the more detailed information presented in the body of the audit report, the purpose and scope of the audit, and the disclaimers/limitations discussed in Section 1.6 of the audit report.

Abbreviations

ABC	Ambient Background Concentration
ACL	Added Contaminant Limit
ACM	Asbestos Containing Material
AF	Asbestos Fines
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASLP	Australian Standard Leachate Procedure
AST	Above ground Storage Tank
BMRD	Building Materials and Research Division
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CH2M	CH2M Hill Australia Pty Ltd (now part of Jacobs Engineering Group Inc.)
cis-1,2-DCE	cis-1,2-dichloroethene
CoEA	Certificate of Environmental Audit
CoPC	Contaminants of Potential Concern
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCE	Dichloroethene
DO	Dissolved Oxygen
DoD	Department of Defence
DNAPL	Dense Non-aqueous Phase Liquid
EIL	Environmental Investigation Level
EPA	Environment Protection Authority
EP Act	<i>Environment Protection Act 1970</i>
EQI	Environmental Quality Indicator
ESL	Ecological Screening Level
FA	Fibrous Asbestos
GMRRW	Guidelines for Managing Risks in Recreational Water
GPR	Ground Penetrating Radar
HHRA	Human Health Risk Assessment
HI	Hazard Index
HIL	Health Investigation Level
HSL	Health Screening Level

HVOL	Halogenated Volatiles
iRisC	Independent Risk Consulting Pty Ltd
LOR	Limit of Reporting
m	Metre
MAH	Monocyclic aromatic hydrocarbons
mg/kg	milligrams per kilogram
n/a	Not applicable
NAPL	Non-aqueous Phase Liquid
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PID	Photo-ionisation Detector
QA	Quality Assurance
QC	Quality Control
RBCA	Risk Based Corrective Actions
RfC	Reference Concentration
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
SEPP	State Environment Protection Policy
SoEA	Statement of Environmental Audit
SVOC	Semi Volatile Organic Compound
TCE	Trichloroethene
TDS	Total Dissolved Solids
TIT	Triple Interceptor Trap
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons (represents extracted biological and petroleum hydrocarbons (TPH) and is the normal laboratory analysis method)
USEPA	United States Environmental Protection Agency

UST	Underground Storage Tank
UCL	Upper Confidence Limit
UPSS	Underground Petroleum Storage Systems
VC	Vinyl Chloride
VCH	Volatile Chlorinated Hydrocarbon
VOC	Volatile Organic Compound
µg/L	micrograms per litre
µS/cm	micro Siemens per Centimetre

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Appendices

Appendix A – Certificate of Title and Survey Plan

Appendix B – Assessment Guidelines

Appendix C – Site Photographs

Appendix D – Tables

Appendix E – Assessor's Figures

Appendix F – Registered Groundwater Bore Information and Groundwater Resource Report

Appendix G – CH2M Hill 2010 ESA Report

Appendix H – Jacobs 2020 Validation Report

Appendix I – Jacobs 2020 Environmental Management Plan

Appendix J – Biosis 2011 Flora and Fauna Assessment Report

Appendix K – Other Key Reports Reviewed by the Auditor

Appendix L – Statistical Analysis of Analytical Dataset Representing Final Site Conditions

1. Introduction

1.1 Background

This Environmental Audit Report sets out the results of an Environmental Audit conducted in accordance with Part IXD of the *Environment Protection Act* 1970. The report was completed in accordance with the guidelines issued by the Environment Protection Authority (EPA) for environmental audits of contaminated sites.

The purpose of initiating the audit was to assess the suitability of the site for redevelopment to a more sensitive land use. Table 3 below presents the details on the appointment of the auditor and details to describe the site. The auditor originally notified the EPA of the request to issue a Certificate of Environmental Audit for the whole of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Highett Site in October 2010 while he was employed by Parsons Brinckerhoff. In April 2012 the auditor informed the EPA of the intention to audit the CSIRO Highett Site in two parts (northern and southern sections).

Subsequently in February 2019, the southern part of the site was further divided into two smaller audit sites. In total, there are three audit areas covering the entire CSIRO Highett Site (also known as 'CSIRO Site'):

- 'Highett North' (northern section), EPA reference 80003038 (CARMS 68549-1)
- 'Highett South' (middle section), EPA reference 80003038 (CARMS 68549-2)
- 'Grassy Woodland' (southern section containing remnant significant vegetation), EPA reference 80003038 (CARMS 68549-3).

Figure 1 of shows the location of 'Grassy Woodland' within the context of the larger CSIRO Site. This audit report is for the Grassy Woodland portion of the site (also known as 'audit site' or 'the site') only.

Table 3 Details on the appointment of the auditor and site background

Name of Auditor	John Throssell
Term of appointment of Auditor	8 August 2014 to 7 February 2021
Date Certificate requested	7 October 2010
Owners of the site	CSIRO
Person requesting a Certificate	Karen Wright ² – Project Manager, Capital Works – CSIRO Business & Infrastructure Services
Municipality	Bayside City Council
Title Information	Certificate of Title Volume 8032 Folio 504 (part of Lot 1 TP223183H)
Zoning	Commonwealth Land not controlled by Planning Scheme (CA)
Address of the Site	37 Graham Road, Highett
Current Occupier	Site is currently vacant
Site Area	30,000 m ²

² Initial Audit request was made by Ross Stevens (CSIRO Property Resource Manager)

Site Assessor	Jacobs (formerly CH2M Hill Australia Pty Ltd) Independent Risk Consulting (iRisC)
EPA Reference Number	80003038 (CARMS 68549-3)
Audit Completion Date	25 May 2020

1.2 Input to this report by auditor's support team

Mr Eric Friebe a member of the auditor's expert support team was involved with this audit. The GHD staff and support team members that assisted with this audit are provided in Table 4.

Table 4 Auditor's team assisting with audit

Name	Qualification/Role/ Experience area	Contribution to audit
Kirsty Dalton	Auditor's assistant/ Project manager	Assisted with review of the assessor's reports and inspected the site.
Effie Nikolis	Auditor's assistant / Project manager	Assisted with the review of assessor's reports, inspected the site and assisted with the preparation of the final environmental audit report and inspected the site.
Eric Friebe	Technical director – Health risk assessment (member of auditor's expert support team)	Reviewed and commented on human health risk assessment prepared by the assessor.

1.3 Issue of Certificates and Statements of Environmental Audit

The Environmental Audit system provides a mechanism of assuring planning and responsible authorities, prospective purchasers and others that potentially contaminated land is suitable for particular uses. If the contamination status of the site does not preclude any beneficial uses, then a Certificate of Environmental Audit will be issued. If the auditor is of the opinion that contamination may render a site unsuitable for some beneficial uses, the auditor must issue a Statement of Environmental Audit to that effect.

The Statement will outline the specific uses that will not be compromised by the contamination present at the site, and any conditions or restrictions on activities at the site that may need to be observed.

1.4 Assessment team

The following environmental consultants or contractors were involved in the project undertaking various environmental assessment and reporting roles as listed in table below.

Table 5 Assessment Team

Company	Role	Description
Jacobs (formerly CH2M Hill Australia, CH2M)	Environmental consultant ('the assessor')	Conducted environmental monitoring and prepared reports and documentations for the audit site (and wider CSIRO Highett Site)
Independent Risk Consulting (iRisC)	Asbestos and hazardous material consultants	Conducted asbestos survey, removal and validation works during the demolition of on-site buildings and infrastructure. iRisC also conducted asbestos testing and identification.

Company	Role	Description
Pacific Services Group Holdings Pty Ltd	Project manager working on behalf of CSIRO	Engaged by CSIRO to project manage and coordinate the remediation and earthworks at the audit site.
Monaco Hickey; PSG Holdings	Demolition contractor, project manager	Conducted earthworks and demolition works at the audit site.
City Circle	Demolition	Demolition contractors engaged by iRisC to assist with the project management of asbestos removal works from the site.
SLH Industries (SLH)	Asbestos removalist	Licensed asbestos removalists engaged by iRisC to remove friable and bonded asbestos from site infrastructure.
Australian Technical Services Pty Ltd (ATS)	Asbestos removalist	Licensed asbestos removalists engaged by iRisC to remove friable and bonded asbestos from site infrastructure.
Eurofins mgt (formerly Labmark)	Laboratory	Engaged by CH2M and iRisC to conduct laboratory analysis.
ALS (formerly Ecowise Environmental)	Laboratory	Engaged by CH2M to conduct laboratory analysis.
EnviroProtect (Vic) Pty Ltd	Laboratory	Engaged by iRisC to conduct laboratory analysis asbestos testing and identification.

1.5 Documents reviewed

The following documents have been reviewed for the purposes of this audit. Reports produced in the period from 1999 to 2004 were read by the auditor but were not the subject of independent and critical review. All subsequent key reports were critically reviewed (refer to Table D3, D4 and D5 Appendix D).

Table 6 Documents reviewed

Author	Date	Document Title	Provided in Appendix of this audit report
A.H Doull	January 1999	Environmental Inspection Report, CSIRO Highett Site, Division of Building Construction and Engineering	No
PPK Environment & Infrastructure	1 August 2000	Draft CSIRO, Environmental Site Assessment, Phase 1 History Review	No
Kilpatrick and Associates Pty Ltd	25 March 2004	Underground Storage Tank Soil Validation Assessment and Stockpiled Soil Classification at CSIRO Highett Victoria	No
Kilpatrick and Associates Pty Ltd	19 April 2004	Underground Storage Tank Soil Validation Assessment and Stockpiled Soil Classification at CSIRO Highett Victoria	No
JFTA Petrochemical Services	April 2004	Removal of Underground Storage Tanks Completion Report	No

Author	Date	Document Title	Provided in Appendix of this audit report
CH2M Hill Australia Pty Ltd	August 2009	Sampling Analysis and Quality Plan for Phase 2 Site Investigation. FINAL Ref:390608.01.05 Rev.C	No (already provided as Appendix H of CH2M 2010 ESA report in Appendix G)
CH2M Hill Australia Pty Ltd	February 2010	Phase 1 and Phase 2 Site investigation. FINAL Ref.390608.01, Rev.B	Yes (Appendix G)
Biosis Research	April 2011	Flora and fauna assessment: CSIRO Highett, Victoria	Yes (Appendix J)
CH2M Hill Australia Pty Ltd	April 2011	Sampling Analysis and Quality Plan for Further Assessment for Environmental Audit. FINAL. Ref 418773Rev1	No (contained in CH2MH 2012 Phase 1 & 2 report which is contained in Appendix F of Jacobs 2020 Validation report)
CH2M Hill Australia Pty Ltd	5 July 2011	CSIRO Highett Further Assessment. Technical Update. Tech. Memo No. 1	Yes (Appendix K)
CH2M Hill Australia Pty Ltd	26 July 2011	CSIRO Highett - Further Assessment. Technical Update. Tech Memo No. 2	Yes (Appendix K)
CH2M Hill Australia Pty Ltd	25 October 2011	CSIRO Highett - Further Assessment of Volatile Chlorinated Hydrocarbons. Tech Memo No. 3.	Yes (Appendix K)
CH2M Hill Australia Pty Ltd	December 2011	Sampling Analysis and Quality Plan for Additional Assessment undertaken in 2012	Yes (Appendix K)
CH2M Hill Australia Pty Ltd	25 January 2012	CSIRO Highett - Further Assessment of Volatile Chlorinated Hydrocarbons in Groundwater. Tech Memo No. 5	Yes (Appendix K)
CH2M Hill Australia Pty Ltd	18 June 2012	CSIRO Highett Facility (North), Victoria: Phase 1 and 2 Site Investigation, Rev 0, Draft report [#]	No
CH2M Hill Australia Pty Ltd	19 June 2012	CSIRO Highett Facility (South), Victoria: Phase 1 and 2 Site Investigation, Rev 0, Draft report	No (already provided as Appendix F of Jacobs 2020 Validation Report)

Author	Date	Document Title	Provided in Appendix of this audit report
CH2M Hill Australia Pty Ltd	8 June 2016	CSIRO Highett Daily Validation / Inspection Diary	No
CH2M Hill Australia Pty Ltd	19 July 2016	CSIRO Highett Daily Validation / Inspection Diary	No
CH2M Hill Australia Pty Ltd	25 July 2016	CSIRO Highett – Additional Passive Soil Vapour Investigation, Southern Boundary	No (already provided as Appendix G of Jacobs 2020 Validation Report)
iRisC	11 December 2017	Asbestos Management Plan (South)	No (already provided as Appendix M of Jacobs 2020 Validation Report)
iRisC	11 December 2017	Asbestos in Soil Handling and Management Plan (South)	No (already provided as Appendix M of Jacobs 2020 Validation Report)
Jacobs	3 April 2020	CSIRO Highett Remediation Project (Southern) Validation Report Southern Area of 37 Graham Road Highett – Future Residential Zone, Victoria: Validation Report Rev 5	Yes (Appendix H)
Jacobs	22 May 2020	CSIRO Highett – Grassy Woodlands Environmental Management Plan, 674398CH-0007-NP-RPT-0001 2	Yes (Appendix I)
Note: # This report was prepared for the former Highett North area, prior to the relocation of the southern audit boundary in February 2019.			

1.6 Information About Your Audit Report

This statutory environmental audit report titled 'Environmental Audit Report, Grassy Woodland, 37 Graham Road, Highett, Victoria, CARMS Reference 68549–3, Service Order No. 800303' ("Report") has been prepared in accordance with Part IXD of the Environment Protection Act 1970. The Report represents the Auditor's opinion of the condition of the site in relation to the presence and impact of contamination at the site and its suitability for all relevant beneficial uses stated in the Certificate of Environmental Audit at the date the Certificate of Environmental Audit is signed. This Report:

- *Has been prepared by John Simon Throssell of GHD Pty Ltd ("GHD") and his team as indicated in the appropriate sections of this Report for CSIRO;*
- *May be used and relied on by CSIRO;*
- *May be used by and provided to EPA for the purpose of meeting statutory obligations in accordance with the relevant sections of the Environment Protection Act 1970;*
- *May be provided to other third parties but such third parties' use of or reliance on the Report is at their sole risk because of, and subject to, the uncertainties associated with this audit as noted in the following paragraphs and in this Report; and*
- *May only be used for the purpose as stated in Sections 1.1 and 1.3 of the Report (and must not be used for any other purpose).*

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

The services undertaken by the Auditor and his team in connection with preparing this Report were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards in accordance with Part IXD of the Environment Protection Act 1970.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by the Auditor when undertaking the audit and preparing the Report. The assumptions are specified throughout this Report.

In undertaking the audit and preparing this Report, the Auditor is required to make judgments regarding the completeness, reliability and accuracy of the information, and the potential for contamination to impact human health and the environment. The Auditor makes these judgments based on the information available, the potential impact of contaminants based on the current scientific understanding of the significance and behavior of contaminants, the specific characteristics of the contaminants matrices and current regulatory policy and legislation. The nature of contaminated site investigations is such that there is always some uncertainty in these matters; as new information can arise, the science underlying these matters can change, and regulatory policy and legislation can change. The Auditor and his team have formed their opinion on the basis of the information available and their understanding of the current science and regulatory policy and legislation, applying processes and considerations in accordance with professional practice. It is possible that new information, a changed scientific understanding or changed regulatory policy and requirements will become available in the future that may lead to a different interpretation. The Auditor and GHD expressly disclaim responsibility for changes that arise because of any such new information, changed science or changed regulatory policy or legislation.

The Auditor and GHD have prepared this Report on the basis of information provided by CSIRO, assessment consultants and others who provided information to GHD (including Government authorities). The Auditor and GHD have verified the information received to the extent practicable and within the scope specified in the Environmental Auditor (contaminated land): Guidelines for Issue of Certificates and Statements of Environmental Audit (EPA Victoria, December 2015). There is some information which it has not been practicable to verify or check, and the Auditor and GHD are not responsible for this information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, this unverified information.

The Auditor and GHD are not responsible for the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

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

2. Assessment guidelines

Environmental protection in Victoria is legislated under the *Environment Protection Act 1970* (EP Act). Sub-ordinate legislation within the EP Act includes State Environment Protection Policies (SEPPs) that prescribe beneficial uses and objectives that are to be met to protect the various segments of the environment.

As a significant body of the assessment work completed at the site was conducted prior to 2018 and there have been delays in reporting, this audit has been significantly progressed after the transition period to the new SEPP Waters 2018 (19 January 2019) has ended. Therefore, the audit considered both the SEPP Groundwater of Victoria and SEPP Waters of Victoria as well as the new SEPP (Waters), effective in October 2018. The auditor is of the opinion that reliance on the previous SEPPs does not pose an unacceptable risk. This was communicated to EPA in February 2019.

The policies considered for the audit included:

- State Environment Protection Policy (Prevention and Management of Contamination of Land) 2002 and its variation (effective 26 September 2013)
- SEPP (Groundwaters of Victoria) 1997 and its variation (effective 21 March 2002)
- SEPP (Waters of Victoria) 1988 and its variations; including Schedule F6 Waters of Port Phillip Bay (1997)
- SEPP (Waters) Gazette No. S493, 19 October 2018
- SEPP (Air Quality Management) 2001

The SEPPs nominate the investigation levels required to protect beneficial uses.

The auditor considers that the beneficial uses considered and assessment guidelines adopted by the Assessor were consistent with the objectives of the SEPPs for soil, soil vapour and groundwater.

The guidelines and criteria for assessing soil, soil vapour and groundwater adopted by the auditor are discussed in Appendix B.

3. Site definition

3.1 Site physical definition and description

The description and definition of the site are as follows:

Table 7 Site definition and description

Aspect	Comments
Site Locality	The audit site (Grassy Woodland) is located in the southern portion of 37 Graham Road Highett, approximately 20 km south-east of Melbourne CBD. The site is shown on Figure 1. The assessor also provided site locality plans as Figure 1 or 2 in its report.
GIS Coordinate of Site centroid	GDA94 – Longitude / Latitude in decimal degrees
- Longitude / Northing (GDA94) - Latitude / Easting (GDA94)	145.0400126 -37.95407067
Area	The audit site is 30,000 m ² in area and comprises of an approximately rectangular allotment.
Surrounding Land Use	North: The central part of the CSIRO Highett Site (Highett South), beyond which is the northern part of the CSIRO Highett Site (Highett North) and the Highett Shopping Centre (formerly Department of Defence land). East: Residential and Commercial (including Clear Edge Filtration (Australia) who provided industrial filtration products and the R E Ross Industrial Centre, now vacant). Progressive redevelopment to residential. A rail easement (Frankston line) is present behind these properties. South: The commercial properties that front onto Bay Road. West: Residential
Topography	The assessor has described the topography of the Grassy Woodland site as gently undulating with an overall slight fall towards the east. Some localised cut and fill had occurred on the site following demolition of buildings and the completion of soil remediation works.
Surface water	There is no natural surface water body located on-site. A former creek line or stream entered the eastern side of the CSIRO site, to the north of the Grassy Woodland, travelled north and discharged off-site at the north-west corner of the Highett North site (refer to Figure 2 at the end of this report). In the 1950s, this stream was culverted and became a subsurface drain (CH2M 2010). There are easements placed over this stormwater drain in Highett North (refer to Appendix A of CH2M 2012a). The nearest natural surface water is Port Phillip Bay located some four kilometres to the south-west of the site. There are some ornamental water features in public parks, and water storages associated with local golf links, however these are not directly fed by groundwater. The nearest artificial surface water body is a Melbourne Water flood retarding basin at Avoca Street located approximately 650 m to the west of the site.

Aspect	Comments
Vegetation	A flora and fauna assessment was conducted for the entire CSIRO site in April 2011 (Biosis Research 2011) and is provided in Appendix J. This assessment identified flora and fauna of ecological significance, including four habitat zones containing Gippsland and River Red-gum trees and grasses and shrubs of ecological significance. The flora and fauna assessment report described the Grassy Woodland audit area as a significant example of Plains Grassy Woodland (Biosis 2011). The vegetation at the CSIRO site at the commencement of the audit comprised a mixture of native and introduced trees, grasses and shrubs, in areas where the land was not occupied by buildings and pavements. At the completion of assessment and remedial works, including building demolition, designated tree protection zones within areas of temporary fencing were established on the site, as shown on Figure 5 of Jacobs Validation report (Jacobs 2020a).

The information provided in Section 1 and this section satisfactorily defines the site for the purposes of the audit.

3.2 Site physical status at audit commencement

The Grassy Woodland site was formerly the southern portion of a CSIRO research and education facility, researching building materials and performance, fire science, energy technologies, industrial processes, mining and urban infrastructure. A range of facilities and infrastructure were present on the site including:

- Scientific laboratories (including for fluid hydraulic research, coatings, fluid dynamics)
- Engineering workshops with below ground interceptor and drainage pits
- Offices
- Substation
- Cooling tower
- Storage for redundant equipment, chemicals and materials
- Underground storage tanks (USTs) – a total of five located on the Grassy Woodland audit area

The buildings at the site were used for a wide range of uses including for the testing and research of coatings, fluid dynamics and hydraulic research, test dynamometer testing, agricultural engineering, mechanical engineering research, as mechanical workshops, office administration and in the storage, handling and use of a wide range of chemicals and inert materials. The site also contained amenities and below ground drainage pits. A summary of the site features including buildings, site drainage, storage and waste disposal areas is provided in Table 8 below. Figure 2 at the end of this report show the former site layout.

Table 8 Description of key site features at commencement of audit

Feature	Location	Area (m ²)	Comments
Site Buildings- General	Entire Highett Site	29,676	The property contained approximately 55 main buildings that were constructed between the early 1940s to the mid 1990s. The buildings varied considerably in age and construction materials. Buildings created prior to the early 1970s were generally of timber or brick veneer. Newer buildings were constructed of brick or concrete. Several buildings on the property contained hazardous building materials, in particular asbestos cement sheeting and sprayed linings (i.e. Limpet, pipe insulation) and some polychlorinated biphenyls (present in light fittings). Buildings which produced liquid waste were connected to grease traps, solvent and oil interceptor traps, neutralising pits prior to waste being discharged to sewer.
Building 43: Deep sewer pit and storage garage	north west part of Grassy Woodland site	45	There is little available information regarding Building 43. It is understood that Building 43 was a storage garage and was approximately 15 m from the access point to a 3.5 m deep sewer pit.
Building 44: Fluid hydraulic research	north west corner, immediately west of Building 213	192	Limited information was available for Building 44. It is understood that Building 44 was used for fluid hydraulic research and was located adjacent to Building 206 (used to store fuel). The hazardous materials register on the site indicated that Building 44 did not contain asbestos materials. Following the demolition of Building 44, iRisC did not observe asbestos in soils within the footprint and in the vicinity of Building 44.
Building 101: Admin / Lab and CSIRO Science Education Centre	North-eastern corner of the Grassy Woodland audit site	930	Only the southern half of the building is located on the Grassy Woodland audit site. Building 101 comprised a two-storey brick building with a basement and was constructed around 1954. It was the main admin and laboratory building and was historically used for a range of uses including as a bacteriology lab, photo-processing lab and dark room, cold room and sterilising room. Liquid waste from Building 101 was connected to a grease / interceptor trap and neutralizing pit, prior to discharge to sewer. A gas driven boiler was located in the basement of the building. The asbestos register on the site indicated that this building contained non-friable asbestos materials (including vinyl tiles, millboard and electrical switch panels). These materials were removed by iRisC prior to demolition.

Feature	Location	Area (m ²)	Comments
Building 102: Process Bay / Laboratory	North-east corner of Grassy Woodland audit site.	884	Building 102 comprised of a two storey brick veneer building constructed in approximately 1954. This building was used for a range of uses including a process bay and laboratory. A substation was historically present along the western boundary of Building 102. A boiler was also noted to be present in Building 102 by iRisC. The asbestos register on the site indicated that this building contained non-friable asbestos materials (including bonded ACM, pipe work seals, gasket seals and Zelemite electrical switch panels).iRisC also reports that friable asbestos (around the boiler and pipework lagging) were present in Building 102. These materials were removed by iRisC prior to demolition.
Building 103: Coatings Laboratory and former workshop	Central part of the Grassy Woodland audit site	772	Building 103 comprised of a two storey brick veneer building constructed in approximately 1963. This building was used for a range of uses including as a coatings laboratory and as a mechanical workshop. Building 103 was equipped with below ground oil and water separator and settlement pits to intercept potential leaks from machinery prior to discharge to sewer. The asbestos register on the site indicated that this building contained friable asbestos materials in the form of a textile in a window glazing joint. iRisC also reports that friable asbestos (pipework lagging) was present in Building 103. These materials were removed by iRisC prior to demolition.
Building 104: Laboratory and Library Wing	North-east corner of Grassy Woodland audit site.	1361	Building 104 comprised of a two storey brick veneer building constructed in approximately 1969. This building was used for a range of uses including as a laboratory and a library. The asbestos register on the site indicated that this building contained non-friable asbestos materials (including bonded ACM, vinyl tiles, mastic in expansion joints, gasket seals and Zelemite electrical switch panels). iRisC also reports that friable asbestos (pipework lagging) was present in Building 104. These materials were removed by iRisC prior to demolition.
Building 105: Store and former workshop	Central part of the Grassy Woodland audit site	148	Building 105 comprised of a single storey aluminium building constructed in approximately 1950. This building was used as a store and former workshop. Building 105 was equipped with below ground oil and water separator and settlement pits to intercept potential leaks from machinery prior to discharge to sewer. The asbestos register on the site indicated that this building contained non-friable asbestos materials (including bonded ACM and Zelemite electrical switch panels).These materials were removed by iRisC prior to demolition.

Feature	Location	Area (m ²)	Comments
Building 106: Chemicals Store	Western portion of Grassy Woodland audit site	55	Building 106 comprised of a single storey brick building constructed in approximately 1965. This building was used as a chemicals store. CH2MH noted in 2012 that strong acids and alkalis as well as solvents were stored in Building 106. It also noted that chemicals were stored safely and no signs of spills or surface staining was observed during its inspections of the site (CH2MH 2012b). The asbestos register on the site indicated that this building contained non-friable asbestos materials (including bonded ACM and Millboard). These materials were removed by iRisC prior to demolition.
Building 107: Garden Tool Shed	Central portion of the Grassy Woodland audit site.	23	Building 107 comprised of a small corrugated iron shed used to store tools. The hazardous materials register on the site indicated that Building 107 did not contain asbestos materials.
Building 108: Cooling tower	Central portion of the Grassy Woodland audit site.	93	Building 108 comprised of a single storey brick building constructed in approximately 1973. This building was historically used as a cooling tower. An above ground storage tank was located immediately to the north of this building. The hazardous materials register on the site indicated that Building 108 did not contain asbestos materials.
Building 109: Cold Room	Central portion of the Grassy Woodland audit site.	38	Building 109 comprised of a single storey steel building constructed in approximately 1977. This building was historically used as a cold room. This building was not listed in the asbestos register for the site, however its is considered unlikely that it contained asbestos materials given its use as a cold room. This building was adjacent to Building 108.
Building 201: Engineering Workshops and Paint shop	North-west corner of Grassy Woodland audit site.	2,360	With the exception of the northwest corner of Building 201 which is located in the Highett South site, Building 201 is located on the Grassy Woodland audit site. Building 201 comprised a two-storey brick veneer building constructed circa 1957. This building was used for a range of uses including mechanical engineering research, engineering workshops and a paint shop. Building 201 was equipped with below ground oil and water separator and settlement pits to intercept potential leaks from machinery prior to discharge to sewer. The asbestos register on the site indicated that this building contained non-friable asbestos materials (including bonded ACM, vinyl tiles and electrical switch panels). These materials were removed by iRisC prior to demolition.
Building 206: Fuel store	South central part of Grassy Woodland audit site.	14	Building 206 comprised a single storey corrugated iron structure, built circa 1958. This building was used to store fuel. Building 206 was located in the vicinity of Building 44 (used for fluid hydraulic research) and Building 213 (used for engine test dynamometer testing) in the southern part of the audit site. The asbestos register on the site indicated that this building did not contain asbestos.

Feature	Location	Area (m ²)	Comments
Building 207: Fluid Dynamics Lab	South western part of the Grassy Woodland audit site.	1670	Building 207 comprised a two storey brick and concrete building, built circa 1969. This building was used as a laboratory to test fluid dynamics and contained a basement level and several small internal workshops and dry labs within the building. The asbestos register on the site indicated that this building contained both friable asbestos (i.e sprayed ceiling fire linings (Limpet)) and non-friable asbestos materials (asbestos cement sheeting, vinyl floor tiles, mastic duct seals and electrical switch panels (Zelemite)). These materials were removed by iRisC prior to demolition.
Building 208: Agricultural Engineering Laboratory	Southern part of the Grassy Woodland audit site.	796	Building 208 comprised a two storey brick and concrete building, built circa 1977. This building was used for agricultural engineering purposes. The asbestos register on the site indicated that this building contained both friable asbestos (i.e sprayed ceiling fire linings (Limpet)) and non-friable asbestos materials (asbestos cement sheeting, Millboard, vinyl floor tiles and mastic duct seals). These materials were removed by iRisC prior to demolition.
Building 213: Engineering Test Dynamometer Laboratory	Southern part of the Grassy Woodland audit site.	111	Building 213 comprised of a one storey brick veneer building constructed circa 1979. This building was used as an engineering test dynamometer laboratory. CH2MH reported that a washing bay pit and cooling tower were located along the south extent of Building 213, close to the southern boundary of the Grassy Woodland. This building was located adjacent to three USTs containing solvents (hydrocarbons) on the Grassy Woodland audit site. The asbestos register on the site indicated that this building contained non-friable asbestos materials (in vinyl tiles and mastic duct seals). These materials were removed by iRisC prior to demolition.
Building 214: Plant Room	Western boundary of Grassy Woodland audit site	37	Building 214 comprised of a one storey brick building constructed circa 1978. This building was used as a plant room. The asbestos register on the site indicated that this building contained non-friable asbestos materials (bonded asbestos cement sheeting). These materials were removed by iRisC prior to demolition.
Building 215: Research Support	Central portion of Grassy Woodland audit area	1180	Building 215 comprised a two storey brick and concrete building, built circa 1980. This building was used for the purposes of research support. The asbestos register on the site indicated that this building contained non-friable asbestos materials (in gaskets and as bonded asbestos cement sheeting). These materials were removed by iRisC prior to demolition.

Feature	Location	Area (m ²)	Comments
Drainage pits and sumps	Various	Various	A large number of below ground grease traps, neutralising pits, oil and water separators and settlement pits exist across the wider CSIRO Highett Site. All wet chemistry buildings / laboratories were equipped with neutralizing tanks and were connected to drainage pits, which discharged liquid waste to sewer under a Trade Waste Agreement (TWA) with South East Water³. A description of these pits and sumps is provided within the relevant building descriptions. A surface stormwater drain, thought to be the alignment of a former creek, is located off-site and runs south to north along the centre of Highett North audit site.
Underground storage tanks	On-site (five) Off-site (one)	unknown	Six underground storage tanks were identified as being present on the wider CSIRO Highett Site during the previous investigations at the property. Five of these were located on the Grassy Woodland audit site. JFTA Petrochemical Services (JFTA) was engaged by CSIRO in early 2004 to remove these USTs and associated pipelines from the site. Tank destruction certificates are included in the JFTA report (JFTA 2004), which is contained in Appendix K of this report. Tank removal works were documented by Kilpatricks and Associates (Kilpatricks) in 2004. Kilpatricks also retrieved soil validation samples from the tankpit excavations, with all tank pit validation samples reporting results below adopted soil criteria and no discernible hydrocarbon staining or odour. Tanks UST 1 to UST 3 were located immediately north of Building 213. These were noted to historically contain 'solvents', were constructed of Category 4 steel and had a capacity of 2,500L each. Although the contents of each tank were not defined, it is considered most likely that these contained thinners (i.e. toluene / benzene), methylated spirits or kerosene (Kilpatrick 2004a). During tank decommissioning by JFTA in 2004, the condition of the tanks was not recorded. UST4 was located between buildings 102 and 104 and was noted to historically contain heating oil (Kilpatrick 2004a). UST 4 was constructed of Category 4 steel and had a capacity of 4,500L. During tank decommissioning by JFTA in 2004, the tank was noted to be in good condition. UST 5 was located between buildings 101 and 102 and was noted to historically contain diesel. UST 5 was constructed of Category 4 steel and had a capacity of 13,600L. During tank decommissioning by JFTA in 2004, the tank was noted to be in poor condition with surface corrosion, surface pitting and a visible hole at the base of the tank (Kilpatricks 2004b). It is noted that groundwater monitoring well MW09 was installed in the immediate vicinity of UST 5 and did not detect any hydrocarbon contamination, with all analytical results reported below laboratory reporting limits.

³ As described in CH2MH 2010, the TWA with South East Water was Trade Waste Number: 576 and expired in 2014.

Feature	Location	Area (m ²)	Comments
Above ground storage tanks	Northern boundary of Building 108.	unknown	A total of two AST were identified on the entire CSIRO Highett site of which, one of which was located on the Grassy Woodland audit site (immediately north of Building 108).
Electrical substations	Various	n/a	One substation was identified on-site in Highett South and it was located along the western boundary of Building 102 (refer to Figure 2 at the end of this report). In addition, there are two other substations on the wider CSIRO Highett site (one in Highett North and one in Highett South audit areas). There is also an external substation located off-site (just beyond the north-east corner of Highett North site).
Storage Areas	Various	n/a	The site contained numerous unoccupied buildings used for the storage of miscellaneous equipment and material (mostly inert). A large variety of chemicals were stored on the site including acids, alcohols, solvents, paints and food additives. Chemicals were stored in sealed containers on wooden pallets or concrete floors. Fuel storage areas were identified in workshops across the site. Spill management kits were located in many buildings where fuel was stored.

3.3 Site physical status at audit completion

At the completion of the audit, the Grassy Woodland audit site was vacant with all buildings, pavements and structures removed from the site, apart from a kerbed gravel car parking area (refer to site photographs presented in Appendix C). Any basement structures had also been removed.

The flora and fauna assessment report (Biosis 2011) identified four distinct areas of 'high' conservation value comprising of large or medium to small sized River Red-gum native trees on the wider CSIRO site, many of which were located on the Grassy Woodland audit site. The Biosis report is contained in Appendix K. The intent was to retain all the native trees, however in early 2019 significant quantities of bonded asbestos containing materials (ACM) were identified in the fill across the CSIRO site. The decision was made to remove the majority of ACM impacted fill, resulting in the removal of some of the native trees across the CSIRO site. However, all native trees were able to be retained on the Grassy Woodland audit site, inside designated Tree Protection Zones with residual ACM impacted fill and underground services containing ACM remaining (as shown on Figure 5 at the end of this report). Remediation works were undertaken to remove some of the asbestos impacted fill at Grassy Woodland (outside the Tree Protection Zones) and this is described in Section 6 of this report.

At the completion of remediation works, significant re-contouring of the site surface had occurred to level the site in the north eastern corner of the Grassy Woodland. The majority of the central and southern portions of the Grassy Woodland which contain the designated Tree Protection Zones have not changed significantly since the commencement of the audit. At the completion of the audit, the surface of the site comprises primarily bare earth or grassed areas with established native trees within designated Tree Protection Zones. The site is secured with a perimeter fence and locked access gate.

Aside from the previously described drainage easement that runs through the Northern and Southern audit areas, and a stormwater drain that runs along the western boundary of the site, all other active services were removed during demolition and validation works. Some services which were constructed from bonded asbestos (such as old water pipes) and located within the Tree Protection Zones, were capped and left insitu (to avoid damaging root systems of native trees). These asbestos pipes are shown on Figure 5 of Jacobs Validation Report (Jacobs 2020a) and will need ongoing management into the future (see Section 8.2 and 10). Photographs showing the final condition of the site are presented in Appendix C.

3.4 Proposed site development

Following the sale of the site by the Commonwealth, the site will be developed as public open space. Although the nature of the development has not been confirmed, it is understood that this will also include use of the site for community, conservation or heritage purposes⁴.

⁴ Although this use has not been defined, CSIRO has indicated that Bayside City Council intends to fence the Grassy Woodland audit area for use as a conservation area with restricted public access to the site.

3.5 History of use

3.5.1 On-site historical use

The site history review undertaken by the CH2M (2010) included information provided by:

- CSIRO
- Anecdotal interviews with CSIRO personnel
- Certificate of title search
- Aerial photograph search
- Royal Historical Site of Victoria
- the State Library of Victoria
- Dial-Before-You-Dig asset owners
- Bayside City Council
- WorkCover
- EPA
- Previous investigations of the site and surrounds

A summary of the site history review undertaken by CH2M in 2010 (CH2M 2010) and 2012 (CH2M 2012b draft report dated 19/06/2012) and Jacobs (Jacobs 2020a) provided the following general information for the wider CSIRO Highett site and the Grassy Woodland:

- Graham Rd was first sealed in 1937, and Building 1, located on Highett North was constructed for the Department of Defence (DoD) around 1942. The DoD used the building as an engine reconditioning and testing facility until around 1945. The majority of Buildings across the CSIRO site were completed between 1945 and 1969, with site development generally extend from the north to the south. Many of these older buildings contained bonded ACM. Over the course of time, some of these buildings were demolished and newer buildings erected in their place.
- The Building Materials and Research Division (BMRD) of CSIRO later occupied other areas of the CSIRO site and primarily undertook research of concrete, gypsum and clays. The Forest and Forest Products groups also later conducted research into chemical development and testing of wood preservatives and termite treatments.
- Other divisions of CSIRO including the Division of Energy Technology, the Division of Building construction and Engineering and Food Science Australia also occupied the CSIRO site. These divisions undertook research into alternative motor fuels, solar technology, food flavours, dairy research and milk powder products.
- Several pits were observed to be present on site. These included grease pits and oil / water separators (associated with former workshop buildings 101, 103, 105, 201 and 207) as well as sediment traps and neutralising pits (associated with laboratory buildings 101, 102, 103, 104, 207, 208 and 213). All pits were observed to be in good condition by CH2MH in 2012 (CH2MH 2012b).
- Six USTs were present on the CSIRO site; one UST on Highett North and five on the Grassy Woodland (audit sites. CH2M undertook a search of the WorkCover database, which did not show records pertaining to the storage of dangerous goods on the CSIRO site.

- All liquid waste from laboratory buildings on site was neutralized prior to being discharged to sewer via a trade waste agreement with Southern Rural Water (Trade Waste No. 576, Reference Number 14).
- There are no known clean up notices, council overlays, sections 173 agreements under the *Planning and Environment Act 1987*, nor is the site listed on the EPA's contaminated sites register.
- CH2M noted that spill management was being practiced and spill kits were observed in areas where chemicals were being stored (including buildings 102, 102, 103, 104, 201, 207, 208 and 213). All waste oils, such as hydraulic oil, machine oil and cutting oil, were stored at a facility immediately north of Building 201 on the Highett South audit area prior to off-site disposal by a licensed waste contractor (CH2M 2012b).
- A spill of copper sulphate compound is understood to have occurred in the garden bed along the northern side of Building 207, causing local vegetation stress in the immediate area of the spill (2012b). It is understood that this occurred in the mid 1990s. As discussed in Section 6 of this report, this area was remediated by iRisC in 2019. No other odours or major spills of chemicals were noted to have occurred on the Grassy Woodland audit site (CH2MH 2012b).

The auditor considered that the site history investigation was adequate for the purpose of identifying potential contamination at the site.

3.5.2 Historical use of adjoining land

Prior to the establishment of the northern portion of the CSIRO site by the DoD and subsequently CSIRO in the 1930s and 1940s, the CSIRO site and surrounds were predominantly occupied by semi rural properties used for grazing and market gardens. A summary of historical off-site land use is presented in Table 9 below.

Table 9 Historical use of adjoining land

Direction	Year	Comments
North	Pre 1930s	Semi-rural properties and market gardens
		The land to the north-west of the Highett North site originally housed a woollen mill. The same buildings were subsequently occupied by the Taxation Commission as an archival facility.
	Post 1930s	Department of Defence occupied Highett North in the 1930s and 1940s. The Department of Defence operated an Aeronautical Research Facility. CSIRO occupied Building 1 on Highett North in 1945. Buildings on Highett South were completed between early 1950s and 1970, with a wide range of uses including for the laboratory testing of materials (including timber, concrete, adhesives), as mechanical workshops, office administration and in the storage, handling and use of a wide range of chemicals and inert materials.
South	Pre-1930's	Prior to 1930s the area to the south of Grassy Woodland comprised predominantly of semi rural properties. Later the area was developed for industrial / commercial use along Bay Road.

Direction	Year	Comments
East	Pre 1940s	Semi-rural properties and market gardens
		Land to the east of the site was originally developed for light industrial purposes. In particular, the properties were occupied by a variety of commercial and light industrial uses including a consulting engineer, an accountancy firm, a furniture manufacturer and a manufacturing agent. The Highett Gasworks located at 1136 Nepean Highway is located approximately 500 m east of the site and operated between 1939 and 1972).
	1953-1990s	Highett Primary School was established in 1953 and closed in 1990s when the land was redeveloped for residential purposes.
West		Residential development in Highett began in the 1940s and was the primary land use to the west of the site by the 1950s. Residential land use continues to today.

The potential contaminants of concern identified from the site history description are summarised in Table 10.

Table 10 Potential contaminants of concern

Site Activity / Source	Location	Potential Contaminants of Concern
On site		
Buildings containing asbestos	Various	Bonded ACM Friable asbestos (in the form of asbestos textiles, spray on insulation (Limpet) and pipe lagging)
Workshop activities including paint shop, engineering workshops and machine testing	Buildings 103, 105, 201 and 207	Solvents, TPH, BTEX, semi volatile organic compounds (SVOC) and lead
Photographic processing	Building 101	Metals, in particular silver Nitrated compounds
Laboratories including for fluid dynamics and hydraulic research	Buildings 101, 102, 104, 106, 207 and 213	pH, VOC and SVOC, phenolics (including creosols) and solvents
Cooling tower	Building 213	Scale and corrosion inhibitors (such as phosphoric or sulphuric acid and bicarbonates to neutralize acidity) Biocides (such as bromine)
General weed control		Metals, organochlorine pesticides (OCP) and organophosphorous pesticides (OPP)
Electrical substation	Western boundary of Building 102	Polychlorinated biphenyl (PCB), large chain hydrocarbons. However, it is reported that PCB oils were not stored on-site.
Chemical storage areas	Building 106 and 201.	TPH (Building 201) pH, metals, strong acids and alkalis (building 106).

Site Activity / Source	Location	Potential Contaminants of Concern
Off site		
Highett North	Building 1 Engine testing, including a foundry and factory which constructed tanks and reconditioned aeronautical engines prior to 1945.	Metals (mercury, boron, copper, chromium, arsenic), total petroleum hydrocarbon (TPH), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbon (PAH), polychlorinated biphenyl (PCB), formaldehyde, phenols and halogenated volatile organic compounds (VOC).
Highett North	Incineration of waste materials (outside Building 19 and 21)	Metals, PAH, dioxins and furans
Highett North	UST (storage of fuels and solvents)	BTEX, TPH, lead
Highett South	Timber treatment activities (Building 32, 302 and 303)	Metals (arsenic, copper and chrome), TPH, creosols and phenols
Highett South	Workshop activities including paint shop (Buildings 41 and 201)	Solvents, TPH, BTEX, semi volatile organic compounds (SVOC) and lead
Former foundry	North of the Highett North site (approximately 600m north of Grassy Woodland)	TPH, PAH, metals, VOC's, solvents, formaldehyde, phenols. Limited information is available about this feature. This area north of Highett North was reported to be an aeronautical research facility of the Department of Defence.
Industrial property at 329 Bay Street	Along the southern boundary of Grassy Woodland	Trichloroethene (TCE) and breakdown compounds
Former gasworks	Approximately 800 m north east of the site	TPH, PAH, metals, cyanide. The former stream which traversed the Highett North also drained the former gasworks located to the east. Based on anecdotal evidence, black coal dust was sometimes observed in this former stream.
Manufacturer of specialised filters for industrial applications. Historically this property was also used for the manufacture and processing of textiles (circa 1969-2009).	Approximately 320 m north east of the site and Graham Road (36-40 Graham Road, Highett)	VOC (including cis-1,2-dichloroethene, dichloromethane, trichloroethene, tetrachloroethene and vinyl chloride), TPH, metals Appendix B of Jacob's Validation Report (2020 presents the available information for this neighbouring manufacturing site.
Sources: Draft CSIRO, Environmental Site Assessment, Phase 1: Site History Review (PPK, 1999) Phase 1 and 2 Site Investigation Report (CH2M 2010 and CH2M 2012b)		

3.6 Audits undertaken on nearby sites

CH2M (2010) identified five properties within 500m radius of the Highett Site that were the subject of statutory environmental audits. An environmental audit is also currently underway at the neighbouring manufacturing site located at 36-40 Graham Road. The Auditor also undertook a further review of audits undertaken on nearby properties in late 2019. Relevant details of the completed audited sites are listed in Table 11 below

Table 11 Audits undertaken on nearby sites

Location	Approximate distance from subject site	EPA CARMS No.	Comments
32-34 Graham Road	140, northeast	75232-1	Certificate of Environmental Audit (CoEA) issued in June 2018. Former light manufacturing facility that is proposed to be redeveloped into high-density residential apartment with single level basement carpark. Groundwater concentrations (TDS, sodium, pH, copper, nickel, vanadium, zinc) above the adopted criteria were identified and these were considered by the auditor to be naturally occurring and not to constitute pollution.
36-40 Graham Road	320 m northeast	75573-1	Statement of Environmental Audit (SoEA) issued in February 2020, which required the implementation of an asbestos management plan and site specific groundwater quality management plan (GQMP). This property was a former textile manufacturing and metal fabricating facility, and more recently manufactured filtration products. The property is proposed for mixed use commercial and residential land use, comprising of a one level basement with commercial use on the ground floor and a multi-storey residential apartment complex including an aged care facility above it. Groundwater concentrations of metals (copper, nickel, zinc) and sodium, chloride and sulphate were identified above the adopted criteria and these were considered by the Auditor to be naturally occurring and do not constitute pollution. Concentrations of beryllium, cobalt, lead, nitrite and 1,4 dichlorobenzene above criteria were noted to be reflective of regional ambient groundwater conditions and not to be site sourced. However concentrations of nitrate, total nitrogen and vinyl chloride reported above criteria were considered to be site sourced pollution. A clean up to the extent practicable (CUTEP) determination was made by the Auditor and the site was declared a groundwater quality restricted use zone (GQRUZ).
Corner Graham Rd and Highett Road	Adjoining northern site boundary	44791-1	Certificate of Environmental Audit (CoEA) issued in 2001. Former DoD land used for aeronautical component testing. Groundwater testing did not identify any substantial impact.
Stage 1, 7-13 Graham Road	Adjoining the south eastern boundary of Highett South	36024-1	Statement of Environmental Audit (SoEA) issued in 1999. Former light industrial site that has been redeveloped for residential use. No groundwater investigation undertaken.

Location	Approximate distance from subject site	EPA CARMS No.	Comments
Stage 2, 7-13 Graham Road	Adjoining the south eastern boundary of Highett South	36024-2	Statement of Environmental Audit (SoEA) issued in 1999. Former light industrial site that has been redeveloped for residential use. No groundwater investigation undertaken.
284 Highett Road	Adjoining northern site boundary	60341-1	CoEA issued in 2007. Industrial use 1941 to 1961, subsequently commercial use. Some elevated metals in groundwater
1112 Nepean Highway	400 m east	21041-1	SoEA issued in 1993, for continued commercial industrial use. Former service station and mechanics workshop on corner with Highett Road. Groundwater assessment was not undertaken. This property is now a rental car agency.
1136 Nepean Highway	500 m east	37308-1	Two SoEA were issued 2011 for the former Highett gasworks. Groundwater impacts (metals, cyanide, ammonia and sulfate) below the site extend to the west below the railway reserve and. There are ongoing site management requirements. Western margin of site determined not to be suitable for any use.

Since 2010, there has been additional audits completed, and they are mainly located along Nepean Highway to the east of the wider CSIRO site.

3.7 Review of EPA Notices, Register, Licences and / or Trade Waste Agreements

There has been no EPA licence or notice issued for the audit site. The site is not subject to any overlays related to contaminated land and is not on the EPA Priority Sites Register.

There was a trade waste agreement (Trade Waste No. 576, Reference No. 14) between CSIRO and South East Water Limited for the site. This trade waste agreement was valid from 15 September 2004 to 15 September 2014. A copy of this trade waste agreement was provided as Appendix F of Phase 1 and 2 Site Investigation Report (CH2M 2012b) provided in Appendix G of this report.

3.8 Site soils and hydrogeology

The soil and groundwater borelogs recorded at the site are contained within Appendix K of the assessor's report (CH2M 2012b), which is contained within Appendix G.

3.8.1 Geology

The 1:63 360 Ringwood Geological Map (Geological Survey of Victoria) indicates that the site is located on the Tertiary aged Brighton Group sediments (CH2M 2010). The bore logs provided by the assessor were consistent with this description. Groundwater is present within the Brighton Group sediments (Brighton Group Aquifer).

3.8.2 Soils

The assessor indicated that the soils on-site generally consisted of:

- Fill material to approximately 1.8m depth covered the site and comprised reworked natural material containing some inert waste such as brick, concrete, glass, bonded ACM and metal fragments (Jacobs 2020a). Fill in some localised areas extended to a maximum depth of 3.7m and this was associated with underground infrastructures including basements and utility services (i.e. Building 43 sewer pit). The majority of fill containing bonded ACM or anthropogenic materials on the site was subsequently removed and residual soils were validated, however asbestos impacted fill remains at the site within designated Tree Protection Zones (refer Section 6 of this report).
- The natural soil profile comprised silty sands and sandy silts grading into alluvial gravels iron stone in a sandy matrix, with mottled sandy clay at depth. The soil profile was interpreted by Jacobs to be typical of soils derived from the Brighton Group sands. Underlying the Brighton Group sediments are fractured siltstones and mudstones of the Newport Formation and Silurian age bedrock (Jacobs 2020a).

Jacobs did not report any odorous or stained soils during its investigation of the site in 2019 and 2020 (Jacobs 2020a), however a spill of copper sulphate in the vicinity of Building 207 (resulting in surface stained soil) was noted by CH2MH in 2010 (CH2MH 2012b). This soil was later excavated and removed from the site as Category C waste containing asbestos (refer Section 6 of this report).

3.8.3 Groundwater flow system

The Brighton Sands at the site generally comprise an unconfined aquifer. Groundwater below Grassy Woodland was encountered at approximately 9 m depth (approximately 28.5 mAHD). Overall, groundwater flow across the site was interpreted to be in a west and south-westerly direction towards Port Phillip Bay (refer to Figure 3 at the end of this report), consistent with regional groundwater flow. The groundwater hydraulic gradient at the site was estimated by the assessor to be 0.01 for the Highett South site (CH2M 2012b), but more recent results from the 2019 groundwater monitoring event (GME) by Jacobs indicated a shallower hydraulic gradient of 0.004 (Jacobs 2020a).

There has been no hydraulic aquifer testing conducted at the site.

3.8.4 Groundwater database and groundwater quality

Groundwater is used quite extensively in the Melbourne Bayside area as a relatively low salinity supply and is accessible from the unconfined aquifer of the Brighton Group sediments. Historically groundwater was used for stock and domestic supply, but with the availability of reticulated scheme water, groundwater use is now largely for irrigation of domestic gardens and public parks. A review of the State Groundwater Database by the CH2M in 2010 identified 155 bores within 2 km radius of the site, including a number of investigation bores.

A review of the DELWP's Water Measurement Information System (WMIS) database by the auditor conducted on 14 February 2020 identified 326 registered groundwater bores within the same radius from the site's centroid (refer to Appendix F). Of the 326 bores identified:

- 61 bores were not in use
- 8 bores were decommissioned
- 257 bores registered to be in use:
 - 199 bores for groundwater investigation and/or observation
 - 7 bores for domestic use or domestic/miscellaneous use
 - 21 bores were for both domestic and stock use
 - 1 bore for domestic and stock and groundwater investigation
 - 1 bore for stock/miscellaneous use
 - 15 bores registered for irrigation use
 - 2 bores registered for industrial use
 - 11 recorded as miscellaneous and/or unknown use

The nearest bore registered for domestic and stock use is WRK974423 located at 23 Middleton Street, approximately 200 m west of the site. This bore is screened from 3 to 9 mbgl and appears to be installed in the same hydrogeological setting to that on site.

Groundwater salinity between 1001 mg/L and 3,500 mg/L is indicated in DELWP's Groundwater Resource Report and the depth to water table within the Brighton Group Sediments is <5 mbgl (refer to Appendix F). The site is located within the Moorabbin Groundwater Management Area of the East Port Phillip Bay Groundwater Catchment.

The regional salinity range discussed above is generally consistent with the salinity measured in the August 2009, June 2011 and July 2019 groundwater monitoring event (refer to Section 5.4.3 below).

4. Conceptual Site Model

Jacobs prepared a Conceptual Site Model (CSM) for the site in its 2020 Validation Report (Jacobs 2020a). Key aspects of the CSM are presented in Section 6 and Table 6-1 of the Validation Report and are summarised below.

4.1 Site characteristics

Site characteristics are detailed in Section 2 of the Validation report (Jacobs 2020a) and includes a discussion of the historical infrastructure and use of the site and surrounding areas, an understanding of the geology and hydrogeology of the site and regional area, and a discussion of site topography and surface water drainage.

4.2 Potential sources of contamination and chemicals of concern

On-site and off-site known or potential contamination sources are listed in Table 6-1 of the Validation report. These include historical use of former buildings, historical chemical storage areas and drainage pits across the site, underground fuel storage tanks (UST's) and associated bowers, hazardous building materials and asbestos impacted fill and potentially impacted groundwater migrating onto the site from off-site properties.

Jacobs listed the corresponding chemicals of concern for potential sources of contamination at the site. These are detailed in Table 6-1 of the validation report and included a wide range of chemicals including hydrocarbons, heavy metals, pesticides, solvents, acids and asbestos. These were reflective of the historical use of the site.

4.3 Potential exposure pathways

Contaminant exposure pathways considered by Jacobs are detailed in Table 6-1 and included direct contact exposure settings, inhalation of volatile compounds, inhalation of friable asbestos and discharge of site groundwater at point of discharge.

4.4 Ecological and human health receptors

Ecological receptors considered by Jacobs included site flora and fauna and the groundwater receiving environment (assumed to be Port Phillip Bay). Human health receptors considered by Jacobs included future residential users, construction workers and maintenance workers.

4.5 Summary of Conceptual Site Model

The assessor conducted sufficient site characterisation to develop a robust and defensible conceptual site model that demonstrated:

- Understanding of the site's geomorphological and environmental setting
- Understanding of the geological, hydrogeological and hydrogeochemical conditions of the subsurface soils and groundwater systems that could be impacted by contaminants of concern
- Understanding of the location, nature and extent of the primary and secondary contaminant sources present on the site
- Understanding of the fate and transport of the contaminants of concern in the environment of the site and nearby surrounds

- Understanding of the likely human and environmental receptors that may be present on the site under the future developments that are permissible on the site
- Understanding of the nature of the exposure mechanisms of receptors to the contaminants of concern.

At the completion of the audit, the site had been remediated and all primary sources of contamination (with the exception of asbestos impacted fill in some areas), had been removed and the majority of residual soils validated. No known soil vapour or groundwater contamination remains on the site. Asbestos impacted fill remains within the designated Tree Protection Zones and this soil will require on-going management to mitigate risks to future site users, through the implementation of a site specific Environmental Management Plan (EMP) developed for the Grassy Woodland audit site (see Section 10 of this report).

As long as the remaining asbestos impacted fill within the Tree Protection Zones is managed in accordance with the EMP, the final condition of the site does not pose a risk to current and future human and ecological receptors both on-site and off-site.

5. Site investigation activities

5.1 Chronology of key site activities relevant to the environmental audit

A chronology of key site activities relevant to the environmental audit is presented in Table 12 below. The auditor's inspections listed in the table were conducted for both Grassy Woodland and other two audit areas of CSIRO Highett Site (Highett North, Highett South).

Table 12 Key site activities

Date	Site Activity
January 1999	An environmental inspection of the site was completed by A.H Doull.
August 2000	PPK Environment & Infrastructure completed a Draft Phase 1 History Review for the site
7 October 2010	EPA notified by the Auditor that he has been engaged to conduct a s53X audit of the entire CSIRO Highett Site.
March to April 2004	Underground storage tanks were removed by Kilpatrick & Associates and JFTA Petrochemical Services
2009 to 2010	The assessor conducted site investigations at the CSIRO Highett Site which included soil, groundwater and drain water sampling.
October 2010	Engagement of John Throssell as Environmental Auditor to conduct a 53X audit of the entire CSIRO Highett Site. Regular monthly site meetings were subsequently held between CSIRO, Auditor, iRisC and Monaco Hickey to discuss progress of assessment and remedial works on the wider CSIRO site.
9 December 2010	The auditor inspected the site with the assessor and client. On-site buildings and past activities were discussed as well as the assessor's proposed site investigation and reporting timeline.
12 January 2011	Former auditor's assistant conducted a site visit.
27 May 2011	The auditor inspected the site with the assessor and discussed the proposed sampling locations.
16 August 2011	Meeting held between auditor, assessor and CSIRO to discuss soil and groundwater results and future works.
20 February 2012	Meeting held between auditor, assessor and CSIRO.
4 April 2012	The auditor notified EPA that the s53X audit of the CSIRO Highett Site is to be conducted in two stages (north and south sections).
2013	Demolition of buildings and infrastructure commenced in Highett North and validation of ACM within building footprints and other areas.
12 February 2014	Auditor inspected the site with representatives of CSIRO and Monaco Hickey. Majority of the buildings have not been demolished.
12 May 2016	Auditor inspected the progress of demolition works in Area 1, 2 and 3 with personnel from CH2M, Greencap and Monaco Hickey.
19 July 2016	Auditor inspected the demolition and asbestos removal works with personnel from CH2M, iRisC and Monaco Hickey. Building 10, 11, 12, 13, 14, 15, 26, 27 29 and 30 had been removed. Accumulation of ACM debris in stormwater sumps observed and significant use of creosote on floor slab and below floor boards was observed at selected buildings in Highett North.
29 August 2016	Meeting held between auditor, assessor and CSIRO to discuss progress of demolition and validation works.

Date	Site Activity
27 September 2016	Auditor inspected the site to assess demolition progress with personnel from iRisC and CH2M.
December 2017 to September 2018	Removal of asbestos within buildings and infrastructure across the Highett South site.
December 2017 to January 2019	Progressive demolition of buildings and building slabs across the Highett South and Grassy Woodland audit sites (following progressive removal of asbestos).
23 January 2018	Auditor inspected the southern portion of the CSIRO Highett Site, which included Grassy Woodland.
circa February 2018	Demolition of buildings and infrastructure and ACM remediation and validation works ceased in Highett North.
24 April 2018	Auditor inspected the southern portion of the CSIRO Highett Site, which included Grassy Woodland, with personnel from iRisC to observe the demolition and ACM validation progress.
6 July 2018	Auditor inspected the southern portion of the CSIRO Highett Site with iRisC representatives. This included the Grassy Woodland.
22 August 2018	Auditor inspected the northern, southern and grassy woodland portions of the CSIRO Highett Site with remediation contractor and iRisC.
18 October 2018	Auditor and his assistant inspected the site to observe ACM validation works conducted at Highett South, include Fiffth Street and ACM trenching work.
22 January 2019	Auditor inspected the southern portion of the CSIRO Highett Site, which included Grassy Woodland.
6 February 2019	Auditor inspected progress of demolition and soil validation works with representatives of CSIRO, iRisC, Monaco Hickey, Jacobs and Pacific Services Group Holdings Pty Ltd. Power poles on eastern margin of the southern part of the Highett Site are to remain. ACM excavation and abatement works continue on north site of Building 031. Larger screen being used to expedite ACM screening process. On-going challenges regarding sourcing of suitable fill material to replace exported contaminated fill.
January to March 2019	On-site remediation trials for asbestos impacted fill conducted by iRisC on the Highett South site. This comprised of (1) soil sieving using an excavator with a 30mm bucket and (2) soil sifting using a SCS 205S triple deck sifting machine and Portafill 5000CT 14 Tonne screen. This is further discussed in Section 5 of this report.
19 March 2019	Auditor inspected the southern portion of the CSIRO Highett Site, which included Grassy Woodland, with remediation contractor and iRisC and discussed the change in asbestos remediation strategy to deal with asbestos fines.
10 May 2019	Auditor and his assistant attended a site meeting and inspected the northern and southern portions of the site with representatives of CSIRO, iRisC, Jacobs, PSG Holdings and Monaco Hickey.
14 May 2019	Auditor conducted site inspection of Highett North.
June 2018 to February 2020	Progressive remediation and excavation of asbestos impacted fill at Highett South and Grassy Woodland. This comprised of the excavation, classification and off-site disposal of asbestos impacted fill and subsequent validation of residual soils by iRisC. Remedial works were undertaken by City Circle / SLH ⁵ and Monaco Hickey under supervision of iRisC. Some near surface soils containing bonded ACM were sieved, validated and abated soil later re-used on site. Refer Section 6.3.2

⁵ A-Class licensed asbestos removal contractor as issued under the Victorian Occupational Health and Safety Regulations 2017 by the Victorian WorkSafe Authority (Licence No.H15/00688).

Date	Site Activity
August 2019 – February 2020	Asbestos remediation works were undertaken at Highett North, with all fill removed and underlying soils validated. This was undertaken by City Circle / SLH and Monaco Hickey under supervision from iRisC.
Jul 2018 to Feb 2020	Asbestos remediation works were undertaken in areas of the Grassy Woodland outside of the designated Tree Protection Zones. Remedial works were undertaken by City Circle / SLH (licensed asbestos removalists) with supervision from iRisC.
9 October 2019	Auditor and his assistant attended a site meeting and inspected the entire CSIRO site, including the northern, southern and the Grassy Woodland portions of the site, with representatives of CSIRO, iRisC, Jacobs, PSG Holdings and Monaco Hickey. Asbestos remediation works on the Highett South site and Grassy Woodland were complete, while asbestos remediation works on Highett North were continuing.
28 February 2020	Meeting with CSIRO in Clayton head office to discuss final site condition of Grassy Woodland audit site and discuss on-going management of residual asbestos contaminated soil through the implementation of an EMP.
28 February 2020	Auditor and his assistant conducted the final inspection of Highett North, Highett South and Grassy Woodland audit areas. Remediation works had been completed across the site with contractors dismantling temporary buildings and fixtures in preparation to leave the site. The Auditor and his assistant dug approximately 8 shallow test holes across the Grassy Woodland audit area using a shovel, to assess for the visual presence of bonded ACM in remaining fill. ACM was only observed within near surface soil in the Tree Protection Zones. This is further discussed in Section 6.4.3 and 8 of this report.
25 May 2020	Completion date of the audit for Grassy Woodland.

5.2 Field investigation summary

5.2.1 On-site investigation

Summary of historical site investigation works are presented in Table 13 and Table 14 below. It should be noted that the environmental investigations prior to 2012 were undertaken for the entire CSIRO Highett Site, while those after 2012 focused on individual audit areas.

Table 13 Summary of site investigations (1999 to 2004)

Date	Assessor	Scope of work
January 1999	A H Doull	Compiled high-level environmental history of the land, infrastructure, building and activities at the CSIRO Highett Site and recommended management actions
August 2000	PPK Environment & Infrastructure	Phase 1 site history review for the CSIRO Highett Site including site visit, review public literature/references, interview staff.
March 2004	Kilpatrick & Associates	Removed four USTs from two excavations and validated the spoil material for off-site disposal purposes. (Same work as reported in JFTA 2004 report below).
April 2004	Kilpatrick & Associates	Removed two USTs from two excavations and validated the spoil material for off-site disposal. (Same work as reported in JFTA 2004 report below)
April 2004	JFTA Petrochemical Services	Removed six USTs from four excavations from CSIRO Highett Site. None of the USTs were within the audit site. Of the six UST's, one was within the Highett North and five were within Grassy Woodland audit areas. Excavations were backfilled with excavated soil and imported rock. No soil was removed off-site.

Table 14 Summary of site investigations (2009 to current)

SAQP or Work Plan	Assessment Report	Scope of work
Sampling, Analysis and Quality Plan for Phase 2 Site Investigation (CH2M Hill 2009)	Phase 1 and Phase 2 Site investigation. FINAL Ref.390608.01.Rev.B (CH2M Hill 2010)	• This report covers the entire CSIRO Highett Site and it was prepared to assess the contamination status of the site and whether the potential contamination posed an adverse risk to human health and the environment. • Conducted site history review. • Underground service location clearance at locations of proposed soil and groundwater sampling. • Undertaken Ground Penetrating Radar (GPR) to identify any potential USTs in an open area bounded by Building 1, 23 and 37. • Soil sampling at 114 locations. This comprised of 69 grid sampling locations and 45 targeted locations. • Sampling of drain water at three locations in the main subsurface drain in the audit site • Installation and monitoring of ten groundwater monitoring bores in August 2009. Six of these are located within the Highett North audit site (MW1, MW2, MW4, MW7, MW8 and MW10), one is located with the Highett South audit site (MW5) and three are located in the Grassy Woodland audit site (MW3, MW6, MW9).

SAQP or Work Plan	Assessment Report	Scope of work
Sampling Analysis and Quality Plan for Further Assessment for Environmental Audit (CH2M 2011a)	CSIRO Highett Further Assessment – Technical Update, Technical Memorandum No. 1 (CH2M Hill 2011b)	- This technical memorandum reports on work undertaken to further delineate land contamination reported in the Phase 1 and Phase 2 Site Investigation (CH2M 2010). - Drilling of 38 soil bores at the entire CSIRO Highett Site at the following locations: - One soil bore (T45) in the vicinity of the exit point of historical subsurface drain in the north-western corner of the Highett North site. 13 soil bores targeting pits, sumps and interceptors - Eight soil bores in the vicinity of Building 23. 16 soil bores around perimeter of buildings containing asbestos building materials.
–	CSIRO Highett Further Assessment – Technical Update, Technical Memorandum No. 2 (CH2M 2011c)	- This technical memorandum reports on work undertaken to further delineate groundwater contamination reported in the Phase 1 and Phase 2 Site Investigation (CH2M 2010). - This work covered the northern portion of the CSIRO Highest Site (i.e. Highett North only). - Three groundwater monitoring bores (MW11, MW12 and MW13) were installed on 8 and 9 June 2011. - Gauging of all bores on the CSIRO Highett Site, and sampling of six existing bores (MW1, MW2, MW4, MW7, MW8 and MW10) and three newly installed bores on 29 and 30 June 2011.
CSIRO Highett - Further Assessment of Volatile Chlorinated Hydrocarbons, Technical Memorandum No. 3 (CH2M 2011d)	–	- This technical memorandum presents a work plan to evaluate groundwater VCH impacts in relation to risk to human health of future occupiers of the site. - This work covered the northern portion of the CSIRO Highest Site (i.e. Highett North only). - A Groundwater Monitoring Event (GME) is proposed where existing bores are to be gauged and six bores (MW2, MW8, MW10, MW11, MW12 and MW13) are to be sampled. - A targeted human health risk assessment to evaluate indoor vapour risk was conducted after the GME.
Sampling, Analysis and Quality Plan for Additional Assessment, Draft Document (CH2M 2011f)	CSIRO Highett – Further Assessment of Volatile Chlorinated Hydrocarbons in Groundwater, Technical Memorandum No. 5 (CH2M 2012b)	- This technical memorandum documents the third GME targeting VCH impacts conducted in December 2011. - This work covered the northern portion of the CSIRO Highest Site (i.e. Highett North only). - All existing bores were gauged and six bores (MW2, MW8, MW10, MW11, MW12 and MW13) were sampled for TDS, VCH and natural attenuation parameters in December 2011.

SAQP or Work Plan	Assessment Report	Scope of work
–	CSIRO Highett Facility (North), Victoria: Phase 1 and 2 Site Investigation, Draft report (CH2M 2012a)	- This report compiles the environmental works and results pertaining to Highett North audit site only undertaken in 2009 to 2012. - Completed a human health indoor vapour risk appraisal for VCH in groundwater (refer to Section 14 and Appendix U of the assessor's report).
	CSIRO Highett Facility (South), Victoria: Phase 1 and 2 Site Investigation, Draft report (CH2M 2012b)	- This report compiles the environmental works and results pertaining to Highett South and Grassy Woodland audit sites only undertaken between 2010 and 2012. - This report includes a summary of site history.
-	CSIRO Highett – Additional Passive Soil Vapour Investigation, Southern Boundary (CH2M 2016)	- This technical memorandum documents the results of passive soil vapour sampling undertaken by CH2M in the vicinity of Buildings 206 and 213, located Grassy Woodland audit site. This involved the installation and sampling of 26 passive soil vapour samplers in the vicinity of buildings 206 and 213. - The letter also documents the review of off-site groundwater data retrieved from the site immediately to the south of the Grassy Woodland audit site (located at 329 Bay Street). - CH2M concluded that TCE is not a contaminant of concern at the CSIRO site and that the TCE impacts in groundwater beneath 329 Bay Street were not sourced from the CSIRO site. This is further discussed in Section 5.4.4 of this report.
–	CSIRO Highett Remediation Project (Southern) - Validation Report – Future Grassy Woodland (Jacobs 2020a)	- This report covers the most southern section the CSIRO Highett Site (i.e. the Grassy Woodland audit site) only. - The conclusions and findings from Phase 1 and 2 Site Investigation report (CH2M 2010) were summarised. - This report was prepared to summarise the further asbestos assessment works undertaken by iRisC, as well as asbestos removal and validation works, soil validation works completed by iRisC and to assess the status of the remaining soil and groundwater at the audit site. - In early 2019, it became apparent that the fill across the Grassy Woodland site was contaminated with significant quantities of bonded asbestos. ACM impacted fill beneath the demolished buildings, internal roadways and parking areas was subsequently removed and residual natural soils validated by iRisC. Although Jacobs was not directly involved in these remedial works, Jacobs reviewed the works undertaken by iRisC and documented these in its Validation report (Jacobs 2020a). The remedial works undertaken on the audit site are discussed in Section 6 of the audit report. - A final GME was undertaken across the wider CSIRO site in July 2019 (which includes Highett North and Grassy Woodlands audit sites). Some of the wells had been damaged and only one groundwater well (MW5) was able to be sampled on

SAQP or Work Plan	Assessment Report	Scope of work
		the Highett South site. Results of the GME are discussed in the report. • In total 18 buildings have been demolished on the audit site. ACM impacted fill beneath these buildings was removed and asbestos validation sampling conducted. A review of iRisC's Soil Clearance Letters, Soil Classification Letters and Waste Dockets was undertaken by Jacobs. • Areas which contained vegetation of ecological significance (Biosis 2011) were designated as Tree Protection Zones and were fenced off. The Tree Protection zones were not remediated and asbestos impacted fill remains in these areas, which will need to be managed into the future through the implementation of a site specific Environmental Management Plan (EMP). • Asbestos impacted fill is also present at depths of >1 m beneath the central roadway running through the centre of Grassy Woodland, known as Fifth Street. This area was capped with 1 m thick layer of site won natural soils. The remediation area along Fifth Street is shown in the Assessors figures in the Validation report and also resented in Appendix E of this report.
-	CSIRO Highett - Grassy Woodlands, Environmental Management Plan (Jacobs 2020b)	• The EMP summarises the contamination remaining on the site, identifies risks and risk mitigation measures and sets out the framework to manage contamination into the future. • The EMP outlines key roles and responsibilities and requirements for record keeping, monitoring and corrective actions. The EMP contains a summary page at the front of the document which communicates key aspects of the EMP to the reader.

5.2.2 Off-site investigation

With the exception of soil and groundwater investigations undertaken on the northern portion of the CSIRO Highett Site (i.e. 'Highett North') and the central portion of the CSIRO Highett Site (i.e. 'Highett South'), no other off-site investigations were undertaken by the assessor.

As part of its review of potential off-site sources for groundwater impacts, the assessor considered some groundwater information collected from published audit reports for the following neighbouring properties:

- Site located at 36-40 Graham Road, northeast of Grassy Woodland audit site. This neighbouring site was previously a manufacturing facility with steel fabrication and textile manufacture and could potentially be a source of groundwater contamination.
- Site located at 329 Bay Street, immediately south of the Grassy Woodland audit area. This information is in Appendix G of the Validation Report (provided in Appendix H of this report; Jacobs 2020a). This neighbouring site was previously an industrial facility (including a Telstra operations centre, a service station and a chemical manufacturing business, CH2M 2012b) and is considered likely to be the source of TCE groundwater contamination observed at this property.

For natural background levels of the Brighton Group Aquifer, concentrations from ‘background’ groundwater monitoring bores, Bore ID 9120001 and 9130009 located adjacent to Nepean Highway, from a nearby audit site (Former Highett Gasworks; CARMS number 37308-1 and 37308-2) located approximately 500 m north east of the Grassy Woodland audit site was reviewed by the auditor. These two bores are located up-hydraulic gradient from the Former Highett Gasworks site and are considered to represent background groundwater conditions.

Table 15 provides a summary of the off-site groundwater concentrations measured at three sites north east of the Grassy Woodland audit area. The data shows that the concentrations of metals and major ions measured at the neighbouring site at 36-40 Graham Road are higher than those measured further east (up-gradient) at Nepean Highway. The groundwater conditions measured at the adjacent sites (which migrates westerly towards Grassy Woodland) are considered representative of regional impacts.

Table 15 Summary of off-site groundwater concentrations

Concentration (mg/L)	Bores located at 36-40 Graham Road, Highett (Refer to Section 4.2.2 of Appendix H of Jacobs Validation Report 2020a)	Bores located at 32-34 Graham Road, Highett (Data source: Table 23 and Appendix F of Prensa 2018)	Background bores (Bore ID 912001 and 913009) located up-hydraulic gradient of the former Highett Gasworks, 1136-1168 Nepean Highway, Highett (Parsons Brinckerhoff 2011)
Sulfate as SO ₄ :		n/a	
Range	18 to 719		1.4 to 200
Mean	312		50.6
Median	157		15
Chloride:			
Range	23 to 2000	23 to 86	4 to 250
Mean	604	–	75.7
Median	470	–	58.5
Sodium:			
Range	120 to 890	130 to 350	35 to 270
Mean	437	–	89.4
Median	420	–	45
Copper:			
Range	0.001 to 0.053	0.001 to 0.008	<0.001 to 0.025
Mean	0.014	–	0.003
Median	0.011	–	0
Lead:			
Range	<0.001 to 0.026	<0.001 to 0.009	<0.001 to 0.003
Mean	0.003	–	0.0003
Median	0.002	–	0
Nickel:			
Range	0.04 to 0.31	0.004 to 0.082	<0.005 to 0.23
Mean	0.11	–	0.043
Median	0.094	–	0.012

Concentration (mg/L)	Bores located at 36-40 Graham Road, Highett (Refer to Section 4.2.2 of Appendix H of Jacobs Validation Report 2020a)	Bores located at 32-34 Graham Road, Highett (Data source: Table 23 and Appendix F of Prensa 2018)	Background bores (Bore ID 912001 and 913009) located up-hydraulic gradient of the former Highett Gasworks, 1136-1168 Nepean Highway, Highett (Parsons Brinckerhoff 2011)
Zinc:			
Range	0.008 to 0.52	0.008 to 0.095	0.013 to 0.18
Mean	0.079	–	0.066
Median	0.061	–	0.04
Notes:			
Concentrations below detection (<LOR) is treated as zero to calculate the mean and median.			

Furthermore, vinyl chloride (up to 0.027 mg/L) was reported above the adopted criterion in off-site bores located at 36-40 Graham Road in May 2017 to April 2018. However, these were interpreted by the environmental consultant to be erroneous and may be “*due to poor quality well installation materials*”. However, it is noted that the majority of wells were installed at the same time (either in 2017 or replacement wells in 2018) and vinyl chloride concentrations were also reported above the laboratory limits of reporting (LOR) in some of the remaining groundwater wells at 36-40 Graham Road (i.e. 0.15 µg/L in MW5 and 0.27 µg/L MW8 in May 2018). This indicates that the reported vinyl chloride results are likely to be reflective of the condition of groundwater rather than installation materials in MW5 or MW8. This confirms the presence of vinyl chloride and other VOCs (such as cis-1,2-dichloroethene, dichloromethane, trichloroethene, tetrachloroethene) in the groundwater up-hydraulic gradient (north east) of the audit site. A groundwater quality restricted use zone (GQRUZ) was implemented at 36- 40 Graham Road and the environmental audit completed indicated that vinyl chloride was sourced from this property.

5.3 Assessor's site assessment information

The scope of the environmental assessments undertaken by the assessor are summarised in Section 5.2.1 and copies of the assessor's reports are provided in Appendix G and Appendix H of this report.

The key reports relevant to the final condition of the audit site are:

- CSIRO Highett Facility (South), Victoria: Phase 1 and 2 Site Investigation (CH2M 2012b)
- CSIRO Highett Remediation Project (Southern): Validation Report – Grassy Woodland Rev 0 (Jacobs 2020a)

A copy of the EMP titled *CSIRO Highett - Grassy Woodlands, Environmental Management Plan*, (Jacobs 2020b) is also provided in Appendix I of this report. The EMP is discussed in more detail in Section 10.

The relevant environmental sampling information presented in the key assessor's reports is listed in Table 16 below.

Table 16 Assessor's site assessment information

Assessment Details	Phase 1 and 2 Site Investigation report (CH2M 2012b)	Validation Report (Jacobs 2020a)
Site history	Section 3	A brief summary of site use is presented in Section 2. A conceptual site model (CSM) is discussed in Section 6, which lists the historical use of each building with the Grassy Woodland Audit site.
Details of sampling and analysis	Section 9	Sections 5.2 (soil), 5.3 (groundwater), 9.3 (asbestos abatement and soil validation) and 9.5 (soil classification for off-site disposal). More specific details relevant to soil sampling are contained within tables in Section 10. Additional details of sampling and analysis are also contained in the individual iRisC validation letters (contained as Appendix R of Validation report) and iRsC waste categorisation letters (included as Appendix P of Validation Report).
QAQC discussion	Section 9.8 and 13, and Appendix T	Section 11 of Validation report. Further details are also presented in individual iRisC waste categorisation letters for off-site disposal in Appendix P of validation report.
Field observations	Section 10.1.1 (soil and groundwater) Section 10.2.1 (soil), Section 10.2.2 (groundwater), Section 10.3.1 (groundwater), and Appendix L	Section 5, Appendix D (Jacobs 2019 GME), Appendix R (iRisC's soil validation letters Appendix I (5th Street Remediation and Validation Approach).
Borelogs	Appendix K	Appendix F (CH2M soil and groundwater borelogs).
Field measurements	Appendix K (soil PID readings) and Appendix L (groundwater sampling)	Appendix D (Jacobs 2019 GME) Appendix R (individual iRisC validation letters) Appendix P (individual iRsC waste categorisation letters).
Site plans	Figure 1 to 5	Figure 1 to 11 in Appendix A Figures of areas sampled as part of validation of asbestos remediation are shown in individual iRisC's soil clearance reports in Appendix R and P of report..
Table of analytical results	Appendix O (2009 and 2010 soil results) Appendix P (2011 soil results) Appendix Q (2009 to 2012 groundwater results) Appendix R (Stage 3 soil results)	Appendix B (Table B.1, Table B3, Table B4 for soil) (Table B2-1 and Table B.2-2 for groundwater)

5.4 Field sampling and laboratory testing program

The field sampling and laboratory testing program was designed by the CH2M/Jacobs to characterise the natural soils and any fill material remaining on-site. The testing was undertaken by the following laboratories:

- Primary laboratory: Ecowise Environmental (now part of ALS)
- Secondary (split sample) laboratory: Labmark (now part of Eurofins | mgt).

It is noted that for further soil assessment conducted in 2011, ALS Brisbane was also used as a secondary laboratory. This is not considered to be ideal as the secondary laboratory is still of the same parent company.

For the work conducted by iRisC and reported in the Validation Report (Jacobs 2020a), the following laboratories were used:

- Primary Laboratory (for chemical analyses): Eurofins | Mgt
- Secondary Laboratory (for chemical analyses): ALS Environmental
- Asbestos testing and identification in soil samples: Enviro Protect (iRisC internal laboratory)

These laboratories are NATA accredited for the chemical and asbestos testing undertaken.

The sampling and testing program undertaken by the assessor is summarised below.

5.4.1 Soil Assessment by Jacobs

Soil bores were advanced to natural soil or refusal. Samples were collected from varying depths in the soil core, and selected samples were submitted for laboratory analysis based on field observations. Soil samples retrieved during soil sampling were collected by the following methods:

- Hand auger, where site conditions required
- Push-tube drill rig

Prior to 2019, a total of 22 grid soil sampling locations (G47 to G68) and 13 target soil sampling locations (T6-T8, T9-T12, T20, T21, T24 and T19-T21) were advanced in Grassy Woodland. Sampling locations are shown on Figure 3 in the Validation report (also provided in Appendix E). Soil samples were retrieved and analysed for a broad range of potential contaminants including one or more of metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Mo, Pb, Se, Sn and Zn), hexavalent chromium, phenol, PAH, TPH or TRH, BTEX, SVOC, VOC, OCP, cyanide, sulfate, pH, CEC, clay content, and asbestos; or the EPA waste classification suite.

Samples from the soil investigation were retrieved and analysed from a range of depths, from near surface to a maximum of 1.5 mbgl, comprising both fill and natural soil.

Refer to Section 9 of CH2M (2012b) report for further details regarding sample analysis for soil investigation in 2010 and 2011. The location of the soil sampling (soil bores) from 2009 to 2011 is presented in Figure 3 in Appendix A of Jacobs Validation Report (Jacobs 2020a).

A full summary of results of the laboratory testing program undertaken by the assessor, is provided in Table D1 of Appendix D and Appendix B of the Validation Report (which is presented in Appendix H of this report). Logs for the soil bores are presented in Appendix U of the Validation Report (Jacobs 2020a).

5.4.2 Further Soil Assessment by iRisC

As the building demolition works progressed across the site, it became apparent that significant quantities of bonded asbestos were present within fill beneath many building footprints and surrounding areas. This resulted in further investigation of soils for asbestos by iRisC in 2018 and led to subsequent remediation of ACM impacted fill across the Grassy Woodland audit area in 2019 (refer to Section 6 of this report). iRisC further soil assessment locations are shown on Figure 6 of Jacobs Validation report (2020a).

Further assessment of soils for the presence of asbestos was undertaken by iRisC within the Grassy Woodland and comprised the following:

- Excavation of 12 small test trenches (TT1-TT5, TT9-TT13, TT19-TT20) in late 2018, excavated through fill to a depth of up to 0.7m and into underlying natural soil. The purpose of these test trenches was to inform the presence / absence of visible asbestos in material underlying internal site roads and car parks prior to their decommissioning. Significant bonded ACM Was encountered in near surface will at locations TT2-TT4.
- Excavation of a long trench (TT36), along the entire length of Fifth Street in 2018. This trench was excavated to a depth of 2 m along the former road running through the centre of the Grassy Woodland. Significant amounts of bonded ACM were encountered within fill in this area, which was partly remediated and capped with clean fill (refer to Section 6). An additional 10 auger holes (AB01-AB10⁶) were advanced along Fifth Street roadway in October 2018, ranging in depth fro 0.5 m to 2 m and for the purposes of in-situ soil classification.
- Advancement of 25 mechanical auger holes (BH01-BH25) in September 2018 beneath internal roadways and car parks in the Grassy Woodland audit area. These boreholes ranged in depth between 0.3 and 0.7m and were advanced for the purposes of in-situ classification and off-site disposal of material.
- A supplementary investigation of asbestos in soil was undertaken by iRisC in August 2019 in designated Tree Protection Zones that had not previously been assessed. This covered an area of approximately 15,171 m² and resulted in the advancement of 50 grid spaced boreholes and six trenches. The boreholes were advanced in areas of high ecological value (Biosis 2011) using a 300 mm auger to minimise damage to vegetation, and ranged in depth between 0.5m and 0.7m. The six test trenches were excavated in areas that were not ecologically significant and ranged in depth between 0.5m and 0.6m (CPT1-CPT6). The objective of this assessment was to understand the distribution of bonded ACM within fill in these areas. Asbestos was observed in 27 of the 56 locations and bonded ACM retrieved during this assessed was submitted to the laboratory for testing.
- A quantitative asbestos assessment was undertaken by iRisC in September 2019. This involved the re-drilling of previously advanced boreholes in August 2019, in order to minimise damage to ecologically significant vegetation. As no additional bonded ACM was found, iRisC undertook a quantitative assessment of ACM in soil using the quantities of ACM submitted to the laboratory in August 2019. The % w/w ACM in soil was calculated by iRisC to range between 0.000017% to 0.00027%, which is well bellow the adopted NEPM criteria for bonded asbestos (0.01% w/w for residential and 0.02% w/w for recreational open space land use). The results of the quantitative assessment are described in more detail in Section 10.2.3.2 of Jacobs Validation report (Jacobs 2020a).

⁶ These boreholes were labelled by iRisC as BH01 to BH10, however to avoid confusion and duplication in numbering of locations, these were re-named by Jacobs as AB01–AB10 (Jacobs 2020a)

- 14 soil samples were retrieved from these locations and submitted to the laboratory for asbestos fibre analysis. Of the 14 samples submitted, asbestos fibres were only detected in one sample (GA7). This was attributed to the presence of anthropogenic fill at this location, which varied in nature to that elsewhere on the audit site and was not representative of fill across the remaining Grassy Woodland. Jacobs concluded that the detection of asbestos fibres in soil at location GA7 was not significant as this soil was subsequently removed from the site and this fill was not representative of fill across the remaining audit site. In reaching its conclusion, Jacobs considered multiple lines of evidence including that no other soil sample analysed reported asbestos fibres across the site and that perimeter air monitoring results did not detect asbestos fibres. The results of the quantitative assessment are described in more detail in Section 10.2.3.2 of Jacobs Validation report (Jacobs 2020a).
- Following the completion of remedial works, iRisC did not undertake a thorough assessment of the top 10 cm of soil beneath the building footprints and in remediated areas across the Grassy Woodland. The possibility remains that bonded ACM is present within the top 10cm of soil, however the risk is considered low and any potential ACM would be at concentrations (% w/w) below adopted criteria for bonded asbestos in soil in a recreational open space landuse setting.

The results of the further assessment by iRisC confirms that although bonded ACM was present within fill in some areas, results were reported at concentrations below adopted criteria for ACM in soil. Jacobs also concluded that other potential contaminants of concern (such as metals) were present in fill, but these were reported below the adopted health based criteria for recreational open space landuse. Although fill was subsequently removed as part of remedial works in some areas of the Grassy Woodland, residual fill containing bonded asbestos remains on the site and will require management into the future. The final condition of the site is discussed in Section 8.

5.4.3 Groundwater

Five groundwater wells were installed within the Grassy Woodland audit area. These were MW3, MW5, MW9, MW14 and MW15. MW09 was only sampled once in 2009 after which it was damaged. Adjacent groundwater monitoring bores include MW02 (within Highett North audit area) and MW05 (within Highett South audit area). Table 17 lists the on-site bores and the two adjacent bores, their total depth, screen interval and when they have been sampled. The bores were all purged and sampled using low-flow micropurge technique.

Table 17 Summary of groundwater monitoring bores' construction and sampling information

Bore ID	Total bore depth (m)	Screen interval (mbgl)	July 2019 SWL (mbgl)	Groundwater monitoring event (GME)					
				August 2009	June 2011	Dec 2011	April 2012	April 2016	July 2019
MW03	13.6	9.5-13.5	9.95	Yes	No	No	No	No	Yes
MW06	13	10-13	10.54	Yes	No	No	Yes	No	Yes
MW09	12.8	6.8-12.8	-	Yes	No	No	No	No	No
MW14	12	9-12	-	No	No	No	Yes [#]	No	No
MW15	12	9-12	10.62	No	No	No	Yes	No	Yes

Bore ID	Total bore depth (m)	Screen interval (mbgl)	July 2019 SWL (mbgl)	Groundwater monitoring event (GME)					
				August 2009	June 2011	Dec 2011	April 2012	April 2016	July 2019
MW05 (off-site on Highett South)	11.8	5.8-11.8	9.30	Yes	No	No	No	No	Yes
MW02 (off-site on Highett North)	7	3-7	4.46	Yes	Yes	Yes	No	Yes ^{##}	Yes
Notes: # MW14 was only sampled in 2012 and was analysed for selected analytes including chlorinated hydrocarbons, petroleum hydrocarbon and solvents with all results reported below laboratory reporting limits. # # MW02 was analysed for VOC only in April 2016.									

Based on the June 2009 monitoring event when the majority of bores across the wider CSIRO Highett site were sampled, the field parameters of the groundwater were:

- Slightly acidic to neutral (pH 5.89 to 7.25).
- Salinity ranging from approximately 510 mg/L to 3,620 mg/L (based on electric conductivity of 0.80 mS/cm to 5.65 mS/cm); excluding data from MW10 which is considered to be impacted by a leaking stormwater drain.
- Dissolved oxygen 1.38 to 5.07 ppm
- Redox +79.1 to +155.8 mV
- Temperature 14.2 to 17.4 °Celsius

Measured salinity across the CSIRO property (which includes the Grassy Woodland audit site) has been consistent across the GMEs. Wells MW01, MW02 and MW13 on the CSIRO North site have reported the lowest TDS values (560mg/L to 2010mg/L), while wells to the south (MW3 and MW6) have consistently reported the highest TDS values (3,800mg/L to 6,250mg/L). MW14 was only sampled once in 2012 and TDS was measured at 7,500 mg/L. Measured groundwater standing water levels at the site have also been consistent, ranging in depth on the CSIRO North site between 3.65 mbgl to 4.19 mbgl, reaching a depth of around 10 mbgl to the south (Jacobs 2020a).

For the GMEs conducted in 2009 and 2019 (which included a more comprehensive site wide assessment of groundwater), the groundwater samples were generally analysed for the following compounds:

- Metals (arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, silver, tin and zinc)
- Ammonia as N, nitrate, nitrite, sulfate and sulfide
- Major cations and ions
- Total cyanide
- Total Petroleum Hydrocarbon (TPH) C₆-C₃₆ and Polycyclic Aromatic Hydrocarbon (PAH)
- Volatile Organic Compounds (VOC) and Semi Volatile Organic Compounds (SVOC)

- Organochlorine Pesticide (OCP)
- Polychlorinated Biphenyl (PCB)
- Bore MW2 was analysed for VOC only in 2016
- MW14 was only analysed for VOC, solvents, TPH/BTEX in 2012.

The assessor's groundwater analytical results (Appendix B of Validation Report, 2020) are also provided as Table D2 of Appendix D in this audit report. Further discussion of groundwater analytical results is presented in Section 9.

5.4.4 Soil Vapour

CH2M (now Jacobs) undertook a passive soil vapour (PSV) assessment in the southern part of Grassy Woodland in 2016. This involved the installation of 26 passive soil vapour samplers within shallow soil on the Grassy Woodland audit site and was in response to TCE being identified in groundwater on the adjacent property at 329 Bay Road. The objective of the PSV assessment was to identify any potential shallow sources of chlorinated hydrocarbons on the audit site, which may have resulted from historical use. The PSV assessment targeted the areas in the vicinity of former buildings 206 (fuel store) and 213 (engine dynamometer testing and adjacent to 3 UST's).

The PSV results reported low concentrations of PCE and xylenes, with no detection of TCE. CH2M concluded that the low concentrations of PCE were not sufficient to indicate gross PCE contamination in these areas which may have resulted in PCE contamination of groundwater. Furthermore PCE has not been detected in soils or groundwater beneath the Grassy Woodland. This implies that the TCE impacts reported in groundwater on adjacent property at 329 Bay Road did not originate from historical activities on the audit site. The PSV assessment is presented in Appendix G of Jacobs Validation report (Jacobs 2020a).

5.5 Adequacy of the assessor's investigation program - soils

The site area is approximately 3 hectares. For this area, the Australian Standard (AS 4482.1) indicates that to detect hot spots of contamination of 32.4 m (refer Table E1 AS 4482.1) diameter with a confidence of 95%, 40 sample points arranged in a grid over the site are required. Testing was conducted at only 22 grid locations across the Grassy Woodland audit site which is lower than the number suggested in AS 4482.1. However, this is not considered to be significant as the detail provided in the site history (over time and area) did not indicate a high potential for significant contamination in the fill across the site (with the exception of bonded asbestos). Laboratory analytical results also did not indicate the fill as being a source of contamination, with the majority of soil analytical results reported either below NEPM criteria for recreational open space land use (soils remaining on site) or below the upper limit for Category C waste (soil classification undertaken by iRisC in 2018 / 2019 for the purposes of off-site disposal). The potential for contamination on the site is more related to specific sources (such as buildings or pits present), which were assessed by targeted sampling locations (CH2M and later Jacobs), with analytical results indicating low risk. Considering the results of the targeted soil sampling program and soil classification for off-site disposal undertaken at the site, the number of soil samples collected at the site is considered appropriate for the purposes of the audit.

Additional investigation of soils for the presence of asbestos was undertaken by iRisC in 2018 and 2019, with subsequent remediation of ACM impacted fill across a large portion of the Grassy Woodland audit area in late 2019 and early 2020. This is discussed in more detail in Section 6 of this report.

5.6 Adequacy of the assessor's investigation program – groundwater

Based on available relevant guidelines and current industry practise, the auditor considers the assessor's groundwater investigation to be adequate. Five groundwater monitoring bores are present on the Grassy Woodland audit site, with a further 9 monitoring bores on Highett North and one on Highett South. Although some of the groundwater wells on the Grassy Woodland site were only sampled once, the wells across the wider CSIRO property have been sampled over several GMEs and provide an overall picture of groundwater in the immediate vicinity of the audit site. Wells were sampled using an appropriate sampling technique (i.e. low-flow micropurge) and have been analysed for an appropriate suite of contaminants commensurate with the historical use of the site. As detailed in Table 17 the bores on the Grassy Woodland audit site have been installed with 4 to 6 m screen and the water table is observed within the screen interval.

5.7 Adequacy of the assessor's investigation program – soil vapour

Based on available relevant guidelines and current industry practise, the auditor considers the assessor's passive soil vapour assessment to be adequate. The assessment took into account data from soil and groundwater assessments undertaken on the audit site, groundwater data from adjacent site at 329 Bay Road, historical activities undertaken at the site and focused on areas where the risk of contamination was likely to be high (i.e. building 206 and 213).

6. Site Remediation Activities

As demolition progressed on the site, it became apparent that significant quantities of bonded ACM were present within near surface fill on the site. The key driver for soil remediation across the site was the presence of bonded ACM in fill. The remediation approach adopted by iRisC and the timeline of remedial works are discussed in the sections below.

6.1 Chronology of Remediation Activities

Prior to the commencement of demolition, iRisC supervised the removal of known asbestos products within buildings and infrastructure across the site. Following the completion of demolition works, remediation and validation of asbestos impacted soils was undertaken by iRisC. The chronology of demolition and remediation activities undertaken is detailed in Section 7, Section 8 and Section 9 of Jacobs report and is outlined below:

- **Dec 2017 to Aug 2018** - iRisC supervised the removal of asbestos within buildings and other infrastructure (i.e. services and underground pits) by licensed asbestos removalists City Circle / SLH / ATS. Removal of friable asbestos was undertaken within asbestos enclosures under full negative pressure and clearance letters were supplied by prior to iRisC for each building demolition commencing (Jacobs 2020a).
- **Dec 2017 to Aug 2018** – Following the progressive removal of asbestos within buildings; the buildings, building slabs and other infrastructure across the site were demolished and removed from site by Monaco Hickey. Soil/fill below building slabs was progressively remediated and validated for the presence of asbestos.
- **Jan to Mar 2019** - On-site remediation trials for asbestos impacted soil conducted by iRisC on the adjacent Highett South audit site. This included mechanically sieving soils using a backhoe and 30mm bucket as well as mechanically silting soils using a SCS 205S Tripple Deck sifting machine and Portafill 5000CT 14 Tonne screen. This is further discussed in Sections 6.3.2 and 6.3.3 below.
- **May 2018 to Jan 2020** – Classification and off-site disposal of asbestos impacted fill and validation of residual soils by iRisC. Remediation was undertaken in a staged approach, with iRisC issuing clearance letters for each completed remediation area. Clearance letters are presented in Appendix L of Jacobs Validation report (Jacobs 2020a). Remediation was not undertaken within Tree Protection Zones.

6.2 Remediation goals

The remediation goal was to render the site suitable for recreational open space land use by mitigating potential risks from bonded asbestos within fill. This was achieved by remediating ACM impacted soils outside the Tree Protection Zones and validating residual soils against the following criteria:

- % bonded asbestos in soil to be below the HIL-C criterion of 0.02% w/w
- friable asbestos in soil to be below the HIL-C criterion of 0.001% w/w and
- Top 10cm of soils across the site to be visually free of bonded asbestos.

The Auditor notes that a stand-alone remedial action plan (RAP) was not developed for the site, but rather remediation was undertaken as the project progressed in accordance with iRisC's asbestos work plans (provided in Appendix M of Jacobs Validation report (Jacobs 2020a)) and in consultation with the Auditor as works progressed. This is considered appropriate.

Areas of high ecological significance (i.e. designated Tree Protection Zones) were not remediated, as this would have adversely impacted the vegetation in these areas. Bonded asbestos and redundant services containing ACM remain within fill in these areas and this will require ongoing management (refer Section 10).

6.3 Soil Remediation Approach and Methodology

The remediation strategy is discussed in Section 9 of the Jacobs Validation report (Jacobs 2020a). Remediation was undertaken by Monaco Hickey, City Circle and SHL under the supervision of iRisC.

iRisC developed two work plans which set out the regulatory framework and defined the objectives, remedial goals, approach and procedures to be adopted during remedial works. These are presented in Appendix M of Jacobs validation report. iRisC undertook the remedial work in accordance with its work plans below:

- *Asbestos Management Plan (South)*, dated 11 December 2017 and
- *Asbestos in Soil Handling and Management Plan (South)*, dated 11 December 2017.

Selection of remediation areas outside of designated Tree Protection Zones was initially undertaken by iRisC based on visual observation of bonded ACM in fill during the infrastructure decommissioning and demolition program. As discussed in Section 5.4.2, iRisC undertook additional trench excavation across the site in 2018 to better understand the distribution of ACM in fill beneath roadways and carparks and confirm areas which required remediation. iRisC broadly separated remediation areas into 'building footprints' (areas beneath and in the immediate vicinity of former buildings) and 'non building footprints' (areas not occupied by former buildings, including garden areas and roadways). Upon completion of remedial works, iRisC undertook soil validation sampling to assess for the presence of asbestos fibres in soil and confirm the suitability of residual soils to remain on the site. Based on a weight of evidence approach, some areas were assessed by iRisC as not containing asbestos and these were deemed not to require remediation (these are shown as the blue shaded areas in Figure 10 of Jacobs Validation report (Jacobs 2020a)).

Initially, the remediation strategy was to remove visible ACM from the surface and mechanically sift or screen the soils to remove the bonded ACM and re-use the abated soils on site. However as discussed Sections 6.3.2 and 6.3.3 remediation and re-use of soils on the site was not considered practical or effective. As a result, all mechanically sifted soils were disposed off-site.

Given that the remediation trials on Highett South were unsuccessful, the adopted remediation strategy was to excavate asbestos impacted soils, classify in accordance with EPA guidelines and dispose to landfill as waste containing asbestos. By project completion in early 2020, all ACM impacted fill outside of designated Tree Protection Zones had been removed from the site. The three areas where abated soils were retained on-site are shown in Figure 4b of Jacobs report (Jacobs 2020a). ACM impacted fill remains within designated Tree Protection Zones.

Further assessment for the presence of asbestos in fill by iRisC in 2018 intercepted significant quantities of bonded ACM within fill at depths of up to 2 m beneath the Fifth St central roadway in the Grassy Woodland. The remediation strategy for Fifth St was to excavate the top 1m of asbestos impacted fill, classify and dispose off-site and cap the underlying soils with 1m of site won natural soils from the Highett South audit area. This 1 m thick capping layer provides a physical separation to the underlying asbestos impacted fill and like the residual soils within the designated Tree Protection Zones will require on-going management. The extent of residual ACM impacted fill within Fifth St is shown on Figure 6 and Figure 8 of Jacobs Validation report. Remediation of Fifth St is discussed in Sections 9.3.4 and 10.1.2 of Jacobs Validation report (Jacobs 2020a).

Throughout the asbestos remedial works, the following management measures were implemented by iRisC and SHL to manage potential risks:

- Undertaking asbestos fibre air monitoring at the boundary of the site and in the vicinity of remedial work areas.
- Dampening of stockpiles and excavation areas using misted water to minimise generation of dust and airborne asbestos fibres.
- Using plastic sheeting to segregate ACM impacted stockpiles and underlying ground to prevent cross contamination and covering temporary stockpiles with plastic to minimise generation of dust.
- Wrapping ACM conduits in HDPE plastic, sealing ends with tape and placing in bins prior to disposal.
- Lining EPA licensed transport trucks with plastic prior to placement of ACM impacted soils and transport to landfill.
- Wash-down of heavy vehicles entering or leaving the site in a designated wheel wash area.

A summary of different aspects of remediation undertaken at the site are described below.

6.3.1 ACM Surface Emu Pick

Removal of visible ACM on the surface was undertaken regularly by iRisC and SHL throughout the duration of the project, including after heavy rain events. Bonded ACM was collected, sealed in plastic bags, placed in plastic lined bins and transported to landfill as asbestos waste. This is described in Section 9.3.4 of Jacobs validation report (Jacobs 2020a).

6.3.2 Bucket Sieving of ACM Impacted Fill Using 30mm sieve

A pilot trial of sieving ACM impacted fill using an excavator with a 30 mm bucket sieve was undertaken on Highett South audit site in early 2019 and this is described in Section 9.3.3 of Jacobs validation report (Jacobs 2020a). Sieving was repeated three times, sieved soils were then inspected by SLH and iRisC and a validation sample was retrieved for laboratory analysis of asbestos fibres. Soils abated using the 30 mm bucket sieving method were deemed as acceptable for re-use on site by iRisC, however this method was time and labour intensive and was not considered practical for adoption as the site wide remediation strategy. A small volume of abated soils were re-used as backfill on the site and these are shown on Figure 4b of Jacobs validation report (Jacobs 2020a) and included the backfilling of trenches TT2-TT4, Eastern Nature Strip and the Grassy Mound adjacent to Building 44.

6.3.3 Mechanical Sifting of ACM Impacted Fill

A pilot trial of mechanically sifting ACM impacted fill using an SCS 205S Deck sifting machine and Portafill 5000CT 14 Tonne screen was also undertaken on Highett South in early 2019. The results of the trial are described in Section 9.3.3 of Jacobs report (Jacobs 2020a). Following the mechanical sifting of soils, a soil validation sample was retrieved by iRisC for laboratory analysis of asbestos fibres. Analytical results reported asbestos fibres in the sieved soil and this remediation trial was abandoned, as detailed in iRisC's letter of 13 March 2019 in Appendix O of Jacobs report (Jacobs 2020a).

All soil which was mechanically sifted was subsequently loaded onto plastic lined trucks and transported to a licenced landfill as waste. No sifted soil was re-used on the site.

6.3.4 Excavation and Off-site Disposal of Asbestos Contaminated Soil

Following the unsuccessful remediation trial results on site, the adopted remediation strategy was to excavated and remove all ACM impacted soil across the site, which were not beneath Fifth St or within designated Tree Protection Zones. Areas identified by iRisC as requiring remediation were excavated, soils temporarily stockpiled and classified in accordance with EPA guidelines and disposed to landfill as either Fill Material / Category C / Category B waste with asbestos. Details of remediation areas, soil classification and volumes disposed to landfill are detailed in Section 9.3.4 and Table 9-1 of Jacobs validation report (Jacobs 2020a). Individual waste classification letters were issued by iRisC for material excavated from each remediation area, and these are contained in Appendix P of Jacobs report (Jacobs 2020a).

Some areas of the site were assessed by iRisC as not containing bonded ACM in fill and therefore deemed not to require remediation. These are discussed in Section 10.2 and shown as blue shaded areas on Figure 10 of Jacobs Validation report (Jacobs 2020a). However, final surface re-contouring of the site resulted in the majority of these soils being removed. As detailed in Section 10.2.5 of Jacobs report, these were excavated and disposed to landfill as either Fill Material with asbestos or Category C waste with asbestos (Jacobs 2020a).

In total, iRisC reported that 10,315 m³ of soils were excavated and disposed off-site as detailed in Table 9-2 of Jacobs Validation report. Jacobs review of waste transport certificates and landfill receipts are detailed in Table 9-3 of its report and indicate that 40 m³ were disposed as Category B with asbestos, 8,010 m³ as Category C with asbestos and 1,030m³ as Fill Material with asbestos. In addition to this, 1,243 m³ of asbestos waste (i.e. bonded ACM pipes etc.) was removed from the site.

The Jacobs validation report (Jacobs 2020a) contains discrepancies in the volume of soil remediated and disposed off-site. For example Table 9-2 of Jacobs report states that 10,315 m³ was excavated and disposed off-site, while Table 9-3 states that this total volume was 9,080 m³ (as recorded by the landfill records). The Auditor sought clarification from Jacobs and iRisC, who advised that discrepancies in volumes were not able to be further clarified due to multiple parties involved on the project and inconsistent record keeping on site over a period of time. The Auditor has reviewed site records, material tracking details and landfill documentation and is satisfied that despite the discrepancies in the Jacobs report, material was appropriately disposed of in accordance with EPA requirements.

6.4 Remediation and Validation of Soils

Remediation undertaken by iRisC for both Building and Non-Building Footprints are discussed in Section 10 of Jacobs report. An outline of remediation and validation works undertaken on site is presented below.

It is noted that although soil validation samples were retrieved in a gridded pattern from the footprints of former buildings, garden areas and roadways where bonded asbestos was observed, not all validation samples are depicted in the figures contained in Appendix A of the Jacobs Validation report (Jacobs 2020a). The Auditor notes however that individual validation letter reports prepared by iRisC are contained in Appendix R of the Validation report and these show the location of all soil validation samples retrieved by iRisC during the remediation and validation works.

6.4.1 Remediation of Building Footprints

Remediation of Building Footprints is discussed in Section 10.1.1 of Jacobs report. Table 10-1 to Table 10-18 detail the demolition, waste categorisation and validation sampling for building footprints (Buildings 43, 43 sewer pit, 44, 101, 102, 103, 104, 105, 106, 108, 109, 201, 206, 207, 208, 213, 214 and 215). These remediation areas and relevant validation samples are depicted in individual iRisC reports contained in Appendix R of the Validation report (Jacobs 2020a). The Auditor notes that only validation samples for Building 101 and 201 are shown on Figure 6 in Appendix A of Jacobs report.

Following the excavation of ACM impacted fill in each remediation area, the footprint of each former building was inspected by iRisC to visually confirm the complete removal of ACM. This was followed by the collection of soil validation samples on a gridded pattern and submission to the laboratory for asbestos fibre analysis. Excavation was undertaken until all soil validation samples reported no asbestos fibres in residual soil.

6.4.2 Remediation of Non-Building Footprints

Remediation on Non-Building Footprints are discussed in Section 10.1.2 of Jacobs report. Table 10-19 to Table 10-25 detail the demolition/removal, waste categorisation and soil validation sampling for Non-Building Footprints including the Forth and Fifth Street roadways, Grassy Mound adjacent to Building 44, Intermediate Zone 1 (between Buildings 102 and 104), Intermediate Zone 2 (between Buildings 41 and 201), Intermediate Zone 3 (south of Building 11), Building 201 Recreational Area and Eastern Nature Strip 1. These areas are shown on Figure 4a and 5 in Appendix A of the Validation report (Jacobs 2020a). Relevant validation samples are depicted in individual iRisC reports contained in Appendix R of the Validation report (Jacobs 2020a).

Following the excavation of ACM impacted fill in each remediation area, each remediation area was inspected by iRisC to visually confirm the removal of ACM. iRisC then retrieved soil validation samples on a gridded pattern and submitted to the laboratory for asbestos fibre analysis. Remediation was ceased when all soil validation samples reported no asbestos fibres were present in residual soils.

6.4.3 Non Remediated Areas

As previously discussed in Section 5.4.2 iRisC undertook additional assessment works in 2018 and 2019 to further understand the distribution of bonded asbestos in fill across the Grassy Woodland. Based on this information, some areas of the site were confirmed not to contain ACM in fill and were deemed by iRisC not to require remediation. These are discussed in Section 10.2 of Jacobs report and include some former roads, carparks and garden areas. These areas are shaded blue in Figure 10 in Appendix A of Jacobs report.. Although assessment locations within these areas reported results below adopted criteria, surface soils within these areas were removed as part of site resurfacing and re-contouring. As detailed in Section 10.2.5 of Jacobs report, these soils were disposed off-site to landfill as either Fill Material with asbestos or Category C soil with asbestos. The Auditor considers this appropriate.

6.4.4 Validation of Remediated Areas

Validation of remediated areas is described in Section 7 and Section 10 of Jacobs Validation report (Jacobs 2020a). Remediation areas were validated by iRisC in a gridded pattern with soils excavated in stages and inspected to visually confirm the absence of bonded asbestos. A soil validation sample was subsequently retrieved from each grid and submitted to the laboratory for analysis of asbestos fibres in soil. Initial validation samples retrieved from some remediated areas (i.e. footprint of Buildings 102, 103, 105, 215 and Intermediate Zone 1), reported asbestos fibres in soil. This was followed by further excavation of soil in 0.1m increments and retrieval of additional soil validation samples by iRisC at these locations. Soils were excavated until all visible ACM impacted fill was removed and analytical results confirmed that no asbestos fibres remained in the soil. On this basis iRisC concluded that residual soils in remediated areas were suitable to remain on the site.

Section 9.3.4 and Table 9-1 of Jacobs report discusses validation sampling undertaken by iRisC, with individual validation letter reports contained in Appendix R of the Validation report (Jacobs 2020a). These remediation areas and relevant validation samples are depicted in individual iRisC reports contained in Appendix R of the Validation report (Jacobs 2020a). The Auditor notes that only validation samples for Building 101 and 201 are shown on Figure 6 in Appendix A of Jacobs report.

6.4.5 Field sampling and laboratory testing program

The field sampling and laboratory testing program was designed by iRisC both for the purposes of waste classification and off-site disposal and for validating residual soils in the footprint of remedial excavations. Soil samples were collected by iRisC primarily using disposable nitrile gloves and submitted for analysis at the following laboratories:

- Primary Laboratory (for chemical analyses): Eurofins | Mgt
- Secondary Laboratory (for chemical analyses): ALS Environmental
- Asbestos testing and identification in soil samples: Enviro Protect (iRisC internal laboratory)

These laboratories are NATA accredited for the chemical and asbestos testing undertaken.

Excavated ACM impacted fill was sampled for a broad range of analytes and subsequently classified by iRisC for off-site disposal in accordance with EPA requirements, which is appropriate. The Auditor notes that limited QA/QC sampling was undertaken during remedial works with only four duplicate sample retrieved and no intra-lab duplicate samples collected by iRisC. However as all the fill has been removed from the site, this is not considered significant. Jacobs reviewed the iRisC waste classification letters and summarised key aspects of its review in Table 9-2 of its report (Jacobs 2020a). Jacobs noted some of discrepancies, but these were not considered significant. These included soil classification in some instances not meeting minimum sampling density and QA/QC sample requirements of relevant guidelines (i.e. IWRG702) and the 95% UCL not being calculated for all stockpiled soil. The Auditor has reviewed site records and concurs with Jacobs that these are not significant.

Validation sampling was generally undertaken on a 5m x 5m grid pattern, with samples retrieved from each grid and submitted for asbestos fibre analysis, with all results being reported below the laboratory reporting limit of 0.1 g/kg. Analytical reports for validation samples are contained in individual iRisC validation letters in Appendix R of Jacobs report (Jacobs 2020a).

The Auditor has reviewed the field sampling and laboratory program for remedial works undertaken by iRisC and considers it to be appropriate.

6.4.6 Consistency of remedial works with regulations

The remedial program was generally consistent with the intent of the land SEPP, guidance in the NEPM ASC and EPA waste management policies and guidelines. A methodical approach was adopted in remediating and validation of ACM impacted fill with 100 mm scrapes and retrieval of soil validation samples. Photographs of site remedial works are presented in Appendix C.

As indicated in Table 12, the Auditor conducted regular site visits to observe the remedial works undertaken at the site and is satisfied with the implementation of the remedial works.

6.5 ACM impacted fill remaining on the site

Following the completion of remediation works on the Grassy Woodland, residual ACM impacted fill is known to remain in the following areas:

1. Within fill in designated Tree Protection Zones and
2. Within fill at depths greater than 1m within the Fifth St roadway

Fill in these areas contains asbestos and will need to be managed to mitigate potential risks to future site users. This will be achieved through the implementation of a site specific EMP developed for the site (refer to Section 10).

6.6 Adequacy of Assessor's remediation program

The key driver for soil remediation on the site was the presence of bonded ACM in fill. Remediation work was undertaken by iRisC in a staged approach and resulted in the removal of ACM impacted fill from a large portion of the site and the subsequent validation of residual soils. Residual ACM impacted fill within the Tree Protection Zones and Fifth St will require on-going management in accordance with the site specific EMP.

Some areas of the site did not contain asbestos impacted fill and these were deemed by iRisC not to require remediation (shown as blue shaded areas on Figure 10 of Jacobs Validation report, Jacobs 2020a). The majority of fill in these areas was removed from the site as part of final site resurfacing and contouring works. A small quantity of abated fill was remediated and determined by iRisC to be suitable for re-used on the Grassy Woodland.

Inconsistencies relating to the tracking of material and volume of soil disposed off-site were noted in the Jacobs report. However, these were due to poor record keeping on site and are not considered significant.

In consideration of the above, the Auditor considers that the remediation program undertaken by iRisC was appropriate.

7. Quality review of site assessment / remediation works and auditor verification

7.1 QA/QC review

The auditor has undertaken a review of the Quality Assurance and Quality Control (QA/QC) documentation presented by the assessor, and reviewed their procedures to verify the integrity of the data presented. A QA/QC review was undertaken for the following key reports:

- CSIRO Highett Facility (South), Victoria: Phase 1 and 2 Site Investigation (CH2M 2012b)
- CSIRO Highett Remediation Project (Southern): Validation Report – Grassy Woodland Rev 0 (Jacobs 2020a)

The findings of the auditor's QA/QC review on the groundwater, soil and asbestos assessment are provided in Table D3, D4 and D5 respectively in Appendix D.

7.2 Auditor verification activities

As listed in Table 12 above, the auditor (and/or his representatives) have visited the site on multiple occasions over the audit period. Other site verification activities included the following:

- Site photographs provided in Appendix C
- Inspection of soil borings, remediation activities and groundwater sampling activities
- Interviews with the client, assessor, occupational hygienist and remediation contractor on-site
- Visual inspection of site surface for the presence of ACM (none identified) in February 2020

7.2.1 Auditor verification sampling

Based on the robustness and defensibility of the data generated by the assessor the auditor did not consider that there was a need for any further verification sampling by the audit team.

However, during the final inspection of the site on 28 February 2020, the Auditor and his assistant dug approximately eight shallow test holes across the Grassy Woodland audit area. This was done using a shovel to assess for the visual presence of bonded ACM in remaining fill across the site. Four test holes were excavated in the 'non-remediated' areas, shaded blue in Figure 10 of Jacobs Validation report (Jacobs 202a). These were areas where iRisC visually assessed the fill in 2018 as not containing ACM and deemed it suitable to remain on the site. The remaining four test holes were dug within the fenced off Tree Protection Zones. The depth of the test holes was approximately 0.4m and penetrated the full depth of fill. The excavated soil was closely inspected by the Auditor and ACM was only observed within fill in the designated Tree Protection Zones. The test holes were subsequently backfilled with the excavated material.

7.2.2 Auditor's final site inspection

The Auditor conducted a final inspection of the site on 28 February 2020 with a representative from Monaco Hickey. Photographs from the final inspection of the site are presented in Appendix C of this report. The following observations were made:

- The site was vacant with no buildings or above ground infrastructure remaining on the site. A secure perimeter fence was observed around the wider CSIRO site.
- Ecologically significant vegetation comprising of large Gippsland and River Red-gum trees, as well as some native grasses and shrubs were observed in the southern part of Grassy Woodland. Silt traps were erected around the trees, which were fenced within designated Tree Protection Zones.
- The surface of the site varied, with designated Tree Protection Zones being raised in comparison with surrounding land where fill had been progressively removed. Surface water ponding was not observed on the site.
- The site surface in the northern and central parts of the Grassy Woodland where fill had been remediated comprised mainly of bare earth, with some areas being sparsely vegetated with weeds. In contrast, the southern and parts of the eastern and western sections of Grassy Woodland comprised of established trees, undergrowth and grassed areas in the designated Tree Protection Zones. These were slightly elevated (100 mm to 200 mm) above the surrounding ground, and bonded ACM was observed in fill around the base of the protected trees.
- Capped services comprising of both ACM, metal and PVC pipes were observed to protrude from within the remaining fill in designated Tree Protection Zones. These services are shown on Figure 6 of Jacobs Validation report (Jacobs 2020a) and will require ongoing management.
- Large concrete pavers were observed in some of the fenced off Tree Protection Zones. No wastes or odorous or stained soils were observed on the surface of the site.

7.3 Conclusions on QA/QC

The auditor has undertaken a review of the of the Quality Assurance and Quality Control (QAQC) documentation for the field assessment conducted. The auditor's detail review of the key site assessment reports are presented in Table D3, D4 and D5 provided in Appendix D of this report. Key points are summarised as follows:

- Overall the frequency and analytical suite of QC samples (field duplicate/split and rinsate/trip blanks) retrieved by CH2M and Jacobs was sufficient.
- The RPDs were generally acceptable, with the exception of a limited number of results that were above the recommended range for calculated RPDs for soil and groundwater results. The elevated RPDs were mainly reported for soil samples retrieved in fill, which is known to have a variable composition and contain anthropogenic materials.
- Sample holding times were generally acceptable.
- Trip blank and rinsate blank sample results were generally reported to be below the laboratory limits of reporting (LOR).
- Calibration certificates were provided in the assessment reports and they indicate that the field equipment were adequately calibrated.
- Internal laboratory QAQC results were generally acceptable. Minor outliers were discussed by the assessor.

- Chains of custody (COC) were provided and were generally completed appropriately. However, it was noted that selected COCs for secondary laboratory for groundwater sampling were not completely fully with signatures and names of sampler omitted and COCs for ACM sample analysis are not provided.
- As the 2012 Phase 1 and 2 Site Investigation report (CH2M 2012b) is a summary report of past investigations conducted for the southern portion of the site, it is noted that a number of QA/QC documentation were missing from this report (e.g. soil and groundwater laboratory reports; results for groundwater blind duplicates; names and results of rinsate blank and trip blank samples).
- Asbestos building soil clearance reports for on-site buildings in Grassy Woodland were presented with supporting NATA sample analysis reports or certificate of analysis.
- There was a general lack of QA/QC sampling undertaken by iRisC during its additional soil assessment and soil validation works in 2018 / 2019 – this includes provision of calibration certificates (not used). It is noted that most of iRisC's work related to assessment, remediation and validation of asbestos in soils, and the majority of these soils were classified for off-site disposal and removed from the site. As such these deficiencies are of low significance to the outcomes of the investigation.

Based on current industry practice and relevant guidelines and standards, the auditor is satisfied that the overall quality of test results is adequate and therefore the results reported are representative of site conditions and can be relied upon.

8. Final site condition - soil

As discussed in Section 6, remediation of ACM impacted fill was undertaken at the site by iRisC, resulting in a large portion of the fill being removed from the site. Known ACM impacted fill remains in the following areas on the site:

- **Tree Protection zones** - due to their ecological significance these areas were not remediated. The Tree Protection Zones are shown on Figure 10 of Jacobs Validation report (Jacobs 2020a) and is also provided as Figure 5 in this report. Capped asbestos services and ACM impacted fill remains in these areas.
- **Fifth St** - Asbestos impacted fill is present at depths of >1m beneath the central roadway running through Grassy Woodland, known as Fifth Street. The top 1m of ACM impacted fill along Fifth St was remediated and then capped with 1m thick layer of site won natural soils. The remediated area along Fifth Street is shown in Figure 8 of Validation report (Jacobs 2020a). This figure is also included as Figure 4 in this report.

The above areas containing residual ACM impacted fill will need to be managed into the future through the implementation of the site specific EMP (refer Section 10).

All other remaining fill was assessed by iRisC as not containing ACM and suitable to remain on the site. A discussion of the final condition of the site is presented below.

8.1 Aesthetics

The soil remaining at the site was not observed to contain unpleasant odours or staining.

Fill within the Tree Protection Zones and beneath Fifth Street (at >1m depth) contains significant quantities of bonded ACM, as well as other anthropogenic materials such as brick, plastic and concrete fragments. This is considered aesthetically unsuitable material for an open space recreational landuse setting, and will require on-going management.

Minor quantities of fill outside of the designated Tree Protection Zones and Fifth St remain on the site and these areas were assessed by iRisC as not containing ACM. The residual fill in these areas may contain occasional solid inert waste such as wood and brick and concrete fragments. As these are typically found in urban environments, these are not considered to be of significance.

8.2 Asbestos

All asbestos within buildings and site infrastructure was removed by iRisC during the demolition phase. Although a large portion of ACM impacted fill was removed from the site during the remedial phase, fill containing significant quantities of ACM remains within designated Tree Protection Zones and beneath Fifth St (at depths >1m). The presence of ACM impacted fill on the site presents an unacceptable risk to future site users and requires management in accordance with the EMP.

Fill in areas outside of the Tree Protection Zones and Fifth St was either remediated by iRisC or deemed as not containing asbestos and suitable to remain. These areas do not require ongoing management through the EMP. Although there is no known asbestos in these areas, it is plausible that occasional fragments of ACM might be encountered during future site works and it is anticipated that standard site management practices for construction works would address this.

8.3 Final Site Contamination Status

Tabulated soil analytical results reflecting the final site condition are presented as Table_B.4 in Appendix B of Jacobs Validation Report (Jacobs 2020a). This data is also presented as Table D1 in Appendix D of this Audit report.

All soil validation samples retrieved by iRisC during soil remedial works were submitted for laboratory analysis of asbestos fibres. The validation results which represent the final condition of soils remaining at the site reported results for asbestos fibres below the laboratory detection limit.

Although the majority of results were reported below the laboratory reporting limits (LOR), some exceedances (technical exceedances) were highlighted in Table D1 for analytes where the LOR was greater than the adopted ecological based criteria. These included some PAHs, ethylbenzene, total cyanide, 1,1-dichloroethane, trichloroethene (TCE), tetrachloroethene (PCE) and vinyl chloride. As the site history did not identify these analytes as key contaminants of concern, and as these were not reported in the groundwater samples retrieved beneath the site, the Auditor does not consider the exceedances of the ecological criteria to be significant or present a risk to ecosystems or future site users. One groundwater well (MW06) reported TCE above laboratory LOR (but below WHO drinking water guideline value), however this is considered to have migrated from the adjacent property to the south and is not a result of historical activities on the Grassy Woodland (refer Section 9).

Concentrations for some analytes was reported above adopted ecological criteria and this is discussed in more detail below.

8.3.1 Nickel

Nickel concentrations in soil across the site were reported between <0.5mg/kg and 127 mg/kg. Of the 51 samples analysed, only one sample reported a concentration (127 mg/kg) exceeding the site specific EIL criterion of 90 mg/kg. All other nickel results were reported either below the laboratory LOR (<0.5mg/kg) or below the EIL, with the average and median nickel concentrations calculated at 9.4 mg/kg and 5mg/kg respectively. In order to evaluate the significance of the residual nickel concentrations at the site, a statistical analysis was undertaken using USEPA software package ProUCL. The raw data and results of the analysis are presented in Appendix L and are summarised following:

- The 95% UCL of the mean for nickel was calculated at 20.6mg/kg and this is below both the EIL and HIL criteria
- The standard deviation of the dataset was also less than 50% of both the EIL and HIL criteria
- No individual nickel concentration exceeds 250% of the adopted criteria

These results indicate that the residual nickel concentrations in soil do not pose an unacceptable risk to ecological and human health receptors in a recreational open space landuse setting. In addition, analytical testing undertaken by CH2M in 2010 (CH2M 2012b) and iRisC in 2018 (Jacobs 2020a), reported low leachability results for metals, PAH and other analytes. This indicates a low risk of these analyte concentrations in soil leaching to groundwater.

8.3.2 pH

pH concentrations in soil varied across the site, ranging from 5.1 pH units (G56_1.0 in natural soil) to 10.5 pH units (T34_1.0 in fill). Most of the reported pH concentrations fell between 6-8 pH units, with the average and median of the dataset calculated at 6.8 at 6.6 pH units respectively.

The maximum value of pH at 10.5 is outside the pH range for typical Australian soils of 6 to 8 and this indicates that soils in some areas of the site are alkaline. However as only two soil samples reported a pH above 8, this is not considered to adversely impact the ability of site soils to sustain flora and fauna.

Only sampling location G56 reported a pH value less than 5.5 units, and this would classify the soil as moderate (sand) or mild (clay) for concrete piles in accordance with Table 6.4.2 (C) of Australian Standard AS2159-2009 for Piling – Design and Installation. Similarly, a pH as low as 5.1 would classify the soil as mild (sand) or non-aggressive (clay) for steel piles in accordance with Table 6.5.2 C of AS2159-2009. Overall this indicates that the soil across the site would not be corrosive to foundations or structures.

8.3.3 PAHs

Benzo(a)pyrene (BaP)

Benzo(a)pyrene (BaP) concentrations in soil exceeded the NEPM ESL criterion of 0.7mg/kg at the following 3 sampling locations:

- T21_0.2 in fill reporting a concentration of 1mg/kg
- G48_0.3 in fill reporting a concentration of 1.1 mg/kg and
- G48_0.5 in natural soil reporting a concentration of 1.6 mg/kg

The EIL criterion of 0.7 mg/kg for BaP is specified in the NEPM ASC, which was last revised in 2013. This criterion was adopted in the NEPM and was based on the ecological criterion published by the *Canadian Council for the Ministers of the Environment* (CCME) at that time. However, the CCME ecological criterion for BaP has since been revised to 20 mg/kg based on more recent ecological data. Therefore the residual BaP concentrations noted above (ranging from 1 mg/kg to 1.6mg/kg) are not significant and are not considered to present an ecological risk at the site. In addition, the calculated risk for carcinogenic PAHs did not exceed the BaP toxicity equivalent quotient (BaP TEQ) human health criterion of 3mg/kg in a recreational open space landuse setting.

In addition, analytical testing undertaken by CH2M in 2010 (CH2M 2012b) and iRisC in 2018 (Jacobs 2020a) reported low leachability results for PAH and other hydrocarbons. This indicates a low risk of these analytes concentrations in soil leaching to groundwater.

Other PAHs

Analytical concentrations of Benz(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Phenanthrene in reported in soil marginally exceeded the CCME soil ecological criteria for residential and open parkland use. The majority of analytical results for these compounds was reported below laboratory limits, with only a handful of results reporting detectable results and marginally above the respective CCME criterion for each compound.

In order to evaluate the significance of the residual Benz(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Phenanthrene concentrations at the site, a statistical analysis was undertaken using USEPA software package ProUCL. The raw data and results of the analysis are presented in Appendix L and are summarised following.

- The 95% UCL of the mean for Benz(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Phenanthrene was calculated at concentrations is below the CCME criteria
- The standard deviation of the dataset was also less than 50% of CCME criteria
- No individual concentration for these compounds exceeds 250% of the adopted CCME criteria

In addition, the calculated risk for carcinogenic PAHs did not exceed the BaP TEQ human health criterion of 3 mg/kg in a recreational open space landuse setting. These results indicate that the residual PAH in soil do not pose an unacceptable risk to ecological and human health receptors in a recreational open space landuse setting.

In consideration of the above and with the exception of asbestos impacted fill in some areas, , no other residual chemical contamination is known to be present on the site which poses an ecological or human health risk.

At the completion of remedial works on the site, asbestos remains within fill in designated Tree Protection Zones and at >1m depths beneath Fifth Street. As long as the asbestos impacted fill is managed through the implementation of the site specific EPM, this does not pose a risk to future site users.

8.4 Site Contamination and protected land beneficial uses

8.4.1 Maintenance of modified / highly modified ecosystems

The beneficial uses associated with land include the maintenance of ecosystems. As the site is a former industrial site and is proposed for development for recreational open space in an urban setting, the protected beneficial use of maintenance of ecosystems applies to both modified and highly modified ecosystems. At the time of issue of this audit report, no residual contamination at concentrations which exceed adopted ecological criteria is known to be present on the site and therefore, the beneficial use of maintenance of ecosystems is not considered to be precluded.

8.4.2 Human health

The beneficial uses associated with land include the protection of human health. At the time of issue of this audit report, no reported chemical concentrations exceeding adopted human health were known to be present on site. However, fill containing significant quantities of bonded ACM remains within designated Tree Protection Zones and beneath Fift St (at depths >1 m). The presence of ACM impacted fill in these areas presents an unacceptable risk to future site users and is considered to adversely impact the protected beneficial use of human health. Fill within designated Tree Protection Zones and beneath Fift St will require on-going management in accordance with the site specific EMP.

Fill in areas outside of the Tree Protection Zones and Fifth St was either remediated by iRisC or deemed as not containing asbestos and suitable to remain. These areas do not require ongoing management through the EMP.

8.4.3 Buildings and structures

The beneficial uses associated with land include the protection of the integrity and durability of buildings and structures. The measured pH of residual soil at the site ranged between 5.1 and 10.5 pH units, which is outside the pH range for typical Australian soils. However, most soils reported a pH value between 6 to 8. The measured pH and field observations by the assessor do not indicate that acidic or corrosive conditions with the potential to adversely impact buildings and subsurface structures exist at the site. Therefore this beneficial use is not considered to be precluded by the condition of soils remaining at the site.

8.4.4 Aesthetics

The beneficial uses associated with land include the protection of the visual and olfactory properties of soil and therefore not be offensive to the senses of human beings.

The soil remaining at the site was not observed to contain unpleasant odours or staining. However, fill within the Tree Protection Zones and beneath Fifth Street (at >1 m depth) contains significant quantities of bonded ACM, as well as other anthropogenic materials such as brick, plastic and concrete fragments. This material is considered aesthetically unacceptable for a recreational open space landuse setting and will required on-going management in accordance with the site specific EMP developed for the site. Fill elsewhere on the site may contain occasional solid inert waste such as wood and brick and concrete fragments. However, as these are typically found in urban environments, these are not considered to be of significance.

8.4.5 Production of food, flora and fibre

The beneficial uses associated with land include the protection of the production and quality of food, flora and fibre that may be grown on the land (such as meat, dairy, fruits, vegetables and grains). The Auditor notes that agricultural production of food on the site is considered unlikely, given its proposed development for use as recreational open space.

As the soil analytical results at the site were generally reported below adopted ecological and human health criteria, this beneficial use is not considered to be precluded by the condition of residual soils at the site.

8.5 Off-site soil contamination

There is no reason to believe that any activities undertaken on the site have resulted in contamination of the surrounding sites. Boundary airborne asbestos fibre monitoring performed by iRisC during the soil remediation works reported results below laboratory reporting limits. In addition, soil excavated from the site was classified in accordance with EPA guidelines and disposed off-site at a licenced landfill facility.

9. Final site condition –groundwater

9.1 Groundwater beneficial uses based on Salinity

The assessor reported that the reported TDS concentrations of groundwater at the site ranges from 918mg/L in MW15 (2012) to 7,500mg/L in MW14 (in 2012). MW15 reported the lowest TDS concentrations across the site with a value of 918 mg/L in 2012 and at 1,720mg/L in 2019. Remaining wells across the site consistently reported a much higher TDS of between 5,500 mg/L (MW06), 6,250 mg/L (MW03) and 7,500 mg/L (MW14 in 2012). MW05 located to the north within the adjacent Highett South audit area reported a TDS value of 2,860 mg/L in the 2019 GME. The low TDS values measured in MW15 are not considered to reflect the salinity of regional groundwater, as up-hydraulic groundwater wells MW2 and MW3 consistently reported a TDS value > 2,000mg/L.

Jacobs considered average values of TDS for each well across multiple GME's. Based on the average salinity values measured, Segment B was adopted in accordance with SEPP *Waters*, to represent the groundwater at the site (refer to Section 3.3 and Table 3-6 of the Validation Report, Jacobs 2020a). This is consistent with the regional groundwater reported in DELWP's groundwater resource report (provided in Appendix F) which documented a salinity range of 1,001 to 3,500 mg/L. The Auditor concurs with Jacobs interpretation.

Based on the salinity of the groundwater, the beneficial uses protected for Segment B under the SEPP *Waters* are:

- Water dependent ecosystems and species
- Potable mineral water supply
- Agriculture and irrigation (irrigation)
- Agriculture and irrigation (stock watering)
- Industrial and commercial
- Water-based recreation (primary contact recreation)
- Traditional Owner cultural values
- Cultural and spiritual values
- Buildings and structures
- Geothermal properties

The new beneficial uses introduced in the SEPP *Waters* (i.e. Traditional Owner cultural values; Cultural and spiritual values; and geothermal properties) are not considered to be relevant on the site or in the near vicinity of the site.

No groundwater remediation has been undertaken at the site.

9.2 Groundwater Contamination Status

No groundwater remediation has been conducted on the site, as no significant impact warranting remediation has been recorded in the regional aquifer beneath the site.

Analytical results for groundwater monitoring events undertaken at the site are summarised in Table B2-1 of Jacobs Validation Report (Jacobs 2020a) and presented as Table D2 in Appendix D of this audit report. The condition of groundwater is discussed in the following sections.

9.3 Groundwater contamination and pollution potential

Is the groundwater likely to be polluted?

It is plausible that groundwater may have been impacted by the former use of the Grassy Woodland audit site for a wide range of activities including for the testing and research of coatings, fluid dynamics and hydraulic research, test dynamometer testing, agricultural engineering, mechanical engineering research, as mechanical workshops and for storage, handling and use of a wide range of chemicals and inert materials.

Furthermore, there is potential for off-site sources of groundwater pollution. These include a manufacturing steel fabrication facility (36-40 Graham Road) and other light industrial sites to the north east of the site; and a former industrial facility located at 329 Bay Street, immediately south of the audit area (CH2M 2012b). TCE contamination in groundwater was reported immediately to the south of the audit site, at 329 Bay Street. However these TCE impacts have been attributed to historical activities carried out on this adjacent property and do not originate from activities carried out on the Grassy Woodland (CH2M 2016).

Fill with elevated metal concentrations in the top 0.5 m of the site has also been identified. However, the leachability testing has indicated that the potential for the metals to leach to groundwater is low and therefore the fill is not considered to be a source of groundwater pollution. In addition, a large portion of fill across the site was remediated and disposed off-site due to the presence of asbestos.

Is the groundwater polluted?

Groundwater analytical results from the sampling events conducted in 2009, 2011, 2012, 2016 and 2019, identified inorganic heavy metal concentrations above the respective adopted ecological criteria. However, these are likely to reflect regional ambient impacts and do not constitute pollution from the site.

TCE was also detected in groundwater well MW06 in 2009 and 2012 at concentrations ranging from 5 µg/L to 8.25 µg/L, marginally above the laboratory LOR of 5 mg/L but below the criterion of 20 µg/L for drinking water (WHO 2005). However in the 2019 GME TCE was reported below laboratory LOR in all wells across the site. As discussed in Section 5.4.4, TCE impacts in MW06 are attributed to historical activities carried out the adjacent property to the south located at 329 Bay St, and are not sourced from the Grassy Woodland audit area. The vapour assessment undertaken on the Grassy Woodland by CH2M in 2016 did not detect TCE in soil vapour, which implies that the TCE detected in MW06 in 2009 and 2012 had migrated onto the site from the adjacent property to the south (CH2M 2016). The TCE concentrations in MW06 do not pose a risk to current or future site users.

No NAPL has been identified at the site.

9.4 Groundwater pollution and protected beneficial use assessment

9.4.1 Water dependant ecosystems and species

The nearest artificial surface water body is a Melbourne Water flood retarding basin in Avoca Street, located approximately 650 m down-hydraulic gradient west of the site. However, given that groundwater beneath the site is located at approximately 10 m depth, it is considered unlikely that groundwater originating from the audit site would intercept water in the Melbourne Water retarding basin which is expected to be a groundwater recharge feature.

The beneficial use of water dependent ecosystems and species applies at the point of groundwater discharge, which is Port Phillip Bay. However, given that the bay is located approximately 4 km south-west of the site, it is not a plausible receptor for groundwater impacts from the Highett site.

Summary tables of groundwater analytical results are presented in Appendix B of Jacobs Validation Report (Jacobs 2020a). Table B.2-2 summarises all reported groundwater results which exceeded adopted criteria. Samples retrieved during the 2019 GME were filtered in the field, while samples retrieved prior to 2019 were not filtered. In its summary analytical results tables, Jacobs has presented both filtered and total metal concentrations. Total metal concentrations were presented for comparison to historical results where filtering was not undertaken in the field.

In the most recent 2019 GME undertaken by Jacobs (Jacobs 2020a), metals concentrations (copper and zinc in filtered samples) measured in the groundwater beneath the site exceeded the adopted ecological criteria. Elevated arsenic, lead, mercury and nickel concentrations have been historically reported in some of the groundwater samples which were not filtered in the field, and the reported metal concentrations are likely attributed to the sediment load in the samples. Exceedances of analytical concentrations for groundwater beneath or immediately adjacent to the Grassy Woodland audit site are summarised in Table B.2-2 of Appendix B of Jacobs Validation report.

The copper and zinc concentrations detected in groundwater at the site are likely to reflect regional ambient impacts, as similar concentrations for these analytes were measured in:

- Majority of the bores located on the adjacent audit areas of Highett North and Highett South
- Off-site bores located at 36-40 Graham Road, immediately northeast of Highett south which reported consistent concentrations as those measured at Highett South

Therefore, the beneficial use 'water dependent ecosystems and species' is considered not to be precluded by groundwater impacts at the site.

9.4.2 Mineral water supply

The natural quality of the groundwater at the site is not effervescent and is not within an area identified as a mineral spring. Therefore in accordance with SEPP Waters and EPA guidelines, this beneficial use is not relevant and is not a protected beneficial use of groundwater at the site.

9.4.3 Water based recreation

The ANZECC 2000 guidelines state that "Recreational water should contain no chemicals that can irritate the skin of the human body. To protect swimmers from harmful effects through ingestion, the guidelines from tables 5.2.3 and 5.2.4 should be applied for other toxicants. Special care must be taken to check for substances that can enter the body by absorption through the skin. Higher concentrations of toxicants may be tolerated occasionally if it is assumed that no person will ingest more than a maximum of 100 mL water during a normal swimming session (NHMRC 1990) compared with 2 L/d for potable water."

Therefore, primary contact recreation criteria can be taken as 10 times the drinking water criteria, where contaminants are not volatile, and therefore do not represent an inhalation risk, and the dermal contact risk is assumed to be minimal.

With the exception of metals, nitrate and chloride, all groundwater results were reported below the adopted criteria for drinking water exposure. As metals, nitrate and chloride are not volatile and do not irritate the skin, drinking water criteria can be multiplied by a factor of 10 to allow for some ingestion during recreational use. With the exception of arsenic in one well (MW06 in 2019), all other groundwater results were reported below the adopted criteria for recreation water use. The marginal exceedance of arsenic in one well is localised and is not considered to be significant. On this basis, this beneficial use is not precluded.

While unlikely, it is possible that groundwater may be used to fill swimming pools in the vicinity of the site, therefore primary contact recreation is considered to be a relevant beneficial use. It is noted that the nearest bore registered for domestic and stock use is WRK974423 located at 23 Middleton Street, approximately 200 m north west of the site. This bore is screened from 3 to 9 mbgl and appears to be installed in the same hydrogeological setting to that on site.

9.4.4 Buildings and Structures

For the protection of this beneficial use, water quality should not be corrosive to buildings and structures. The measured redox, sulphate and chloride concentrations in groundwater were low and within the non-aggressive exposure classification for steel and concrete piles. However, wells MW06 and MW03 reported pH values below 5.5 pH units, and this would classify groundwater as having a mild exposure classification for concrete and steel piles (as detailed in Tables 6.4.2 and 6.5.2 in AS2159, 2009). Elevated groundwater acidity is typical of regional groundwater conditions, and not a function of site based impacts. As such, this beneficial use is not precluded by past site activities, although groundwater acidity should be taken into consideration in the design of building materials for any future development of the site.

Given the depth of groundwater at approximately 10m and the proposed use of the site for recreational open space, it is considered unlikely that buildings and structures would come into contact with groundwater.

9.4.5 Agriculture and irrigation (stock watering)

Use of groundwater agricultural activities includes for stock watering. Assessment criteria for stock watering are outlined in Table B.2-2 of Appendix B of Jacobs Validation Report (Jacobs 2020a). All groundwater analytical results were reported below the adopted criteria.

Given the ready access to a mains water supply, the urban setting of the land and the proposed development of the site for recreational open space land use, it is considered unlikely that groundwater beneath or in the vicinity of the site would be used to water stock. It is noted however that several groundwater bores within a 2km radius of the site are registered for the purpose of 'domestic and stock', however there is no evidence that groundwater in the area is used for stock watering.

As all results were reported below the adopted criteria for stock watering, this beneficial use is not considered to be precluded by the condition of groundwater beneath the site.

9.4.6 Agriculture and irrigation (irrigation)

Use of groundwater for agricultural activities includes for commercial irrigation, irrigation of domestic gardens, parks and golf courses. Assessment criteria were adopted for both short term and long term irrigation, as outlined in Table B.2-2 of Appendix B of Jacobs Validation Report (Jacobs 2020a). Groundwater analytical results for the 2019 GME were reported below the adopted criteria, however elevated arsenic, total chromium (in MW15 in 2019) and nickel (in MW03 in 2009) concentrations have been historically reported in some of the samples not filtered in the field, and this is likely attributed to the sediment load in the samples. Similarly, historical analytical results for wells on adjacent audit areas of Highett North and Highett South have previously reported concentrations for nickel above the long term irrigation trigger levels. Similar nickel concentrations in groundwater have also been reported on properties within the vicinity of the site, indicating that nickel impacts reflect ambient groundwater.

Given the ready access to a mains water supply, the urban setting of the land and the proposed development of the site for recreational open space land use, it is considered unlikely that groundwater beneath the site would be used for commercial irrigation. It is noted however that several domestic and irrigation groundwater bores are registered within a 2km radius of the site and therefore use of groundwater for irrigation (i.e. domestic gardens, parks) exists off-site and is a relevant beneficial use. As all results were reported below the adopted criteria for irrigation in the 2019 GME, this beneficial use is not considered to be precluded by the condition of groundwater beneath the site.

9.4.7 Industrial and commercial

Use of groundwater for commercial or industrial use, would need to meet water quality requirements specific to the industrial use considered. Given the wide range of potential industrial uses, there are no specific industrial / commercial water quality screening criteria and therefore, a site specific risk assessment would be required to confirm the suitability of water for this beneficial use. As a general note, the groundwater would need to be free of any non-aqueous phase liquids (such as separate phase hydrocarbons or chlorinated solvents) and be free of naturally occurring chemicals or contaminants so treatment would not be required.

Given the ready access to a mains water supply, the urban setting of the land and the proposed development of the site for recreational open space land use, it is considered unlikely that groundwater beneath the site would be used for industrial or commercial use. It is noted however that two bores within 2km of the site are registered for industrial use.

9.4.8 Traditional Owner cultural values

Water quality that protects the cultural values of Traditional Owners, ensures that these practices can continue. Traditional Owners cultural values may include traditional aquaculture, fishing, harvesting, cultivation of fresh and marine foods, fish, grasses and medicines (SEPP Waters). Based on the present condition and depth of groundwater beneath the site, and noting that a surface water body is not present on the site, this beneficial use is not considered to be precluded.

9.4.9 Cultural and spiritual values

Water quality that protects the cultural and spiritual needs of a community, ensures that spiritual and ceremonial practices can continue. These can include baptisms, water based festivals and cultural celebrations (SEPP Waters). Based on the present condition and depth of groundwater beneath the site, and noting that a surface water body is not present on the site, this beneficial use is not considered to be precluded.

9.4.10 Geothermal properties

As the groundwater temperature is not within the range of 30 to 70 degrees Celsius defined in SEPP Waters, this beneficial use is not relevant and is not a protected beneficial use of groundwater at the site.

9.5 Summary of pollution, existing and likely future use

Table 18 summarises the relevance of protected groundwater beneficial uses at the site.

Table 18 Summary of beneficial uses, pollution and likelihood of being realised

Protected Segment B Beneficial Uses	Beneficial use precluded by pollution?	Pollutants	Likelihood of being realised		Comment
			On-site	Off-site	
Water dependent ecosystems and species	No	None	Unlikely	Existing	The groundwater is likely to discharge to Port Phillip Bay, located approximately 4km to the south west of the site. Some metal concentrations in groundwater beneath the site exceeded the adopted ecological criteria, However, these are considered to reflect ambient groundwater conditions and are expected to attenuate in the aquifer between the audit site and the bay.
Potable mineral water supply	No	None	No	No	The natural quality of the groundwater at the site is not effervescent and is not within an area identified as a mineral spring. Therefore this beneficial use is not relevant at the site.
Agriculture and irrigation (irrigation)	No	None	Unlikely	Likely	There are several registered bores for this purpose in the vicinity of the site, and therefore use of groundwater for irrigation (i.e. domestic gardens, parks) is likely off-site. This beneficial use is not precluded on the basis of the present condition of groundwater at the site.
Agriculture and irrigation (stock watering)	No	None	Unlikely	Likely	There are registered bores for this purpose in the vicinity of the site. This beneficial use is not precluded on the basis of the present condition of groundwater at the site.

Protected Segment B Beneficial Uses	Beneficial use precluded by pollution?	Pollutants	Likelihood of being realised		Comment
			On-site	Off-site	
Industrial and commercial	No	None	Unlikely	Likely	Given the wide range of potential industrial uses, there are no specific industrial / commercial water quality screening criteria and therefore, a site specific risk assessment would be required to confirm the suitability of water for this beneficial use. There are registered bores for this purpose in the vicinity of the site. This beneficial use is not likely to be precluded on the basis of the present condition of groundwater at the site.
Water-based recreation (primary contact recreation)	No	None	Unlikely	Unlikely	This beneficial use is not precluded on the basis of the present condition of groundwater at the site. While unlikely, it is possible that groundwater may be used to fill or top up swimming pools in the vicinity of the site.
Traditional Owner cultural values	No	None	Unlikely	Unlikely	This beneficial use is not precluded on the basis of the present condition of and depth to groundwater at the site.
Cultural and spiritual values	No	None	Unlikely	Unlikely	This beneficial use is not precluded on the basis of the present condition of and depth to groundwater at the site.
Buildings and structures	No	None	Likely	Likely	This beneficial use is not precluded on the basis of the present condition of and depth to groundwater at the site. However, naturally elevated groundwater acidity should be taken into consideration in the design of building materials for any future development of the site.
Geothermal properties	No	None	Unlikely	Unlikely	The temperature of the groundwater (<30° C) and the depth of the water table at the site do not indicate that the groundwater has natural thermal capacity.

9.6 Off-site migration of groundwater contamination

Contaminants of potential concern in groundwater were below the adopted assessment criteria for the beneficial uses described in Table 18. Therefore, off-site migration of groundwater is not resulting in contamination off-site.

10. Environmental Management Plan

The site specific EMP is presented in Appendix I of this report. The EMP outlines the objectives of the EMP, key roles and responsibilities, it summarises assessment and remediation works undertaken and describes the residual asbestos contamination remaining on the Grassy Woodland audit site. The EMP sets out the framework to manage residual environmental risks at the site. A review of the EMP indicates that it has been prepared in accordance with relevant guidelines⁷.

The summary page at the front of the EMP outlines key information about the EMP, including a summary of residual contamination issues and an overall assessment of risk at the site. The objectives of the EMP are outlined in Section 1.2 of the document, while the legal mechanism through which the EMP will be enforced and implemented is discussed in Section 1.5. Contractors working on the site must be provided with a copy of the EMP by the site owner and sign a site induction form (provided as Appendix D of EMP) declaring that the EMP has been understood.

Section 2 of the EMP provides the historical context of the site and outlines the areas of ecological significance present on the site. Section 2.5 of the document outlines remaining contamination and sets out the various areas on the site where potential risks to future site users need to be managed. Section 2.6 details key roles and responsibilities associated with the EMP. Responsibility for the implementation and maintenance of the EMP has been assigned to the owner of the site, with specific implementation requirements outlined in Appendix A and Appendix B. Currently CSIRO is the owner of the site, however it is understood that the site will be sold to a developer (understood to be Chaolong Developments Pty Ltd) or its nominee (understood to be Sunkin Highett Pty Ltd) who will under existing commercial arrangements provide the site to Bayside City Council in the near future. It is anticipated that Bayside City Council will be the site owner in the long term.

The EMP states that the anticipated use of the site while it is under the ownership of CSIRO and Chaolong Developments Pty Ltd (or its nominee Sunkin Highett Pty Ltd), will result in no public access to the site, with Appendix A of the EMP outlining management requirements during this period. Mitigation measures and specific requirements for the different areas which contain residual contamination, (i.e. designated Tree Protection Zones, Fifth Street, General Access Areas (non remediated)) are detailed in Appendix A.

Once the ownership of the site is transferred to Bayside City Council, it is anticipated that use of the site may result in controlled public access to the site (as public open space), with Appendix B outlining management requirements for this period. Mitigation measures and specific requirements for the different areas which contain residual contamination, (i.e. designated Tree Protection Zones, Fifth Street, General Access Areas (non remediated)) are detailed in Appendix B, with the additional requirement of requiring a permit to be obtained from Bayside City Council prior to commencement of any intrusive works on the site.

As bonded ACM is present within fill beneath Fifth Street and in the designated Tree Protection Zones, access to soils in these areas will be restricted through the need to obtain permission (a permit) from Bayside City Council to undertake intrusive works, landscape designs which minimise access to the soil profile (such as placement of rocks or timber as part of the landscape design), installation of fencing and controlled public access.

⁷ The EMP prepared by Jacobs is in general accordance with Australian Government Department of Environment guidelines for preparation of EMPs, *Environmental Management Plan Guidelines, Commonwealth of Australia 2014*.

Section A.5 of Appendix A specifies the frequency of site inspections, with monthly inspections until ownership of the site is transferred to Bayside City Council. Section A.6 sets out control measures to be implemented during general maintenance activities (including the development of task specific asbestos management plan (AMP) and task specific safe work method statements (SWMS) and use of protective personal equipment (PPE). Section A.7 sets out additional mitigation measures for site work involving excavation of soil (such as the installation or repair of utilities in areas known to contain ACM). These measures include use of appropriate personnel experienced or licenced to work with asbestos, implementing dust suppression measures, demarcating and minimising the size of and access to work zones, use of appropriate PPE, and the requirement to develop an AMP and task specific SWMS.

Section A.8 sets out the requirements for waste disposal, while Section A.10 details required decontamination procedures. Section A.11 outlines the requirements for implementation and monitoring of the EMP and includes requirements for training and awareness, communication and handling of complaints, specifies environmental records required to be kept and when to update and review the EMP. Section A.11.4 states that cessation of the EMP may only be undertaken upon advice of an Environmental Auditor or the issue of a Certificate of Environmental Audit for the site. Section A.12 of Appendix A discusses procedures for implementing corrective actions, including a notification of non-conformances, documentation of corrective actions and internal audits of the EMP. This includes corrective actions resulting from environmental monitoring, monthly and adhoc inspections of the site, reported non-conformances and internal audits undertaken by the site owner to satisfy itself that the EMP is being implemented. Site inspection forms (to be completed as part of scheduled and adhoc inspections) are provided in Appendix E of the EMP. Figures relevant to the EMP are provided in Appendix C, while Appendix D contains a site induction form. Useful asbestos guidelines are provided in Appendix G (enHealth 2013 – Asbestos: a guide for householders and the general public), Appendix H (Worksafe Victoria, Compliance Code: Managing asbestos in workplaces 2018) and Appendix I (Worksafe Victoria, Compliance Code: Removing asbestos in workplaces 2018).

Similar details are outlined in Appendix B following transfer of ownership of the site to Bayside City Council, for the intended use of the site which may include restricted public access (as open space). Some additional details regarding on-going site inspections are outlined in Section B.5. These include monthly site inspections for the first 12 months, biannual inspections after this for the next four years and then on an annual basis. Provision is also made for ad-hoc inspections after heavy rain events, with all visible ACM retrieved and removed by an Environmental Consultant or Occupational Hygienist appropriately trained in dealing with asbestos.

In view of the above, it is considered that the EMP contains relevant key information and adequately sets out the framework for the management of residual asbestos contamination at the site.

The Auditor considers that the implementation of the EMP will be a condition of the Statement of Environmental Audit, and will form part of the Statement of Environmental Audit.

11. Auditor's assessment of risks at the site

11.1 Potential impacts on beneficial uses of land

The final condition of soil at the site is discussed in detail in Section 8. Table 19 summarises the potential impacts of residual contamination at the site on the beneficial uses of land.

Table 19 Evaluation of risk of contamination to beneficial uses of land

Beneficial Use	Land use ⁽¹⁾	Contaminant Concentrations above criteria	Beneficial use precluded by pollution?
Maintenance of modified / highly modified ecosystems	- All residential uses with garden accessible soil - Recreation/ open space - Commercial / Industrial	None	No
Human Health	Residential – single dwelling and medium density	Bonded ACM (within fill in Tree Protection Zones and beneath Fifth St)	Yes
	Childcare centre		Yes
	High density residential		Yes
	Recreation / open space		No, provided that the site is managed in accordance with site specific EMP
	Commercial / industrial		No, provided that the site is managed in accordance with site specific EMP
Buildings and structures	All land beneficial uses	None	No
Aesthetics	Residential – single dwelling and medium density	Bonded ACM (within fill in Tree Protection Zones and beneath Fifth St)	Yes
	Childcare centre		Yes
	High density residential		Yes
	Recreation / open space		No, provided that the site is managed in accordance with site specific EMP.
Production of food flora and fibre	All residential uses with garden accessible soil	None	No

Table Notes: (1) Residential land use descriptions in accordance with EPA Publication 759.3, Appendix 4.

11.2 Potential impacts on relevant beneficial uses of groundwater

The final condition of groundwater at the site is discussed in Section 9. Table 20 summarises the relevance of the protected beneficial uses for Segment B groundwater and the potential impacts of residual contamination on those beneficial uses.

Table 20 Evaluation of risk of contamination to relevant beneficial uses of groundwater

Segment B Beneficial Use	Contaminant above criterion	Is the beneficial use precluded by pollution?
Water dependent ecosystems and species	Copper(a), zinc(a)	Not relevant on- or off-site.
Potable mineral water supply	None. Groundwater is not effervescent.	Not relevant on- or off-site.
Agriculture and irrigation (irrigation)	None	No
Agriculture and irrigation (stock watering)	None	No
Industrial and commercial	None	No. A site specific risk assessment would be required to confirm the suitability of water for this beneficial use.
Water-based recreation (primary contact recreation)	None	No.
Traditional Owner cultural values	None	Not relevant on- or off-site.
Cultural and spiritual values	None	Not relevant on- or off-site.
Buildings and structures	None	No. However naturally elevated regional groundwater acidity should be taken into consideration in the design of building materials for any future development of the site.
Geothermal properties	None	Not relevant on- or off-site.

Table Notes: (a) considered to be reflective of ambient concentrations in regional groundwater.

11.1 Potential impacts on beneficial uses of surface water

Surface water was not sampled during this audit. However it is considered that beneficial uses of surface water would not be precluded by the environmental condition of the site in view of:

- Negligible risk to the beneficial uses of groundwater, including water dependant ecosystems and species at the point of discharge
- The absence of surface water bodies within the boundary of the site

11.2 Potential impacts on beneficial uses of air

Ambient air was not sampled during this audit. However it is considered that beneficial uses of air would not be precluded by the environmental condition of the site in view of:

- Results of the soil and groundwater investigations undertaken at the site, which indicate that volatile contaminant concentrations are very low and do not pose a risk to the beneficial uses of land (and may in turn present a risk to the beneficial uses of air).
- Results of the passive soil vapour assessment undertaken on the Grassy Woodland audit area, which indicate a negligible soil vapour risk.

11.3 Risk of off-site exposure

Based on analytical data, there is no reason to believe that any activities undertaken on the site have resulted in contamination of the surrounding sites; nor that off-site migration of groundwater from the site is resulting in contamination off-site.

12. Audit conclusions

Following completion of the environmental audit at CSIRO 'Grassy Woodland' located in the southern portion of 37 Graham Road, Highett VIC 3190, the following conclusions are drawn:

- The assessor conducted sufficient site characterisation to develop a robust and defensible conceptual site model.
- All buildings and the majority of infrastructure in the audit site have been demolished and removed from the site. Capped services comprising of both ACM, metal and PVC pipes remain within fill in the designated Tree Protection Zones and these will require ongoing management through the implementation of the site specific EMP.
- Soil remediation has been largely driven by the presence of bonded ACM in the fill, including soil below and in the vicinity of former buildings. A large portion of the ACM impacted fill across the site was excavated and disposed off-site, however fill known to contain bonded ACM remains within designated Tree Protection Zones and beneath Fifth St (at depths >1 m).
- The presence of fill containing bonded ACM within Tree Protection Zones and beneath Fifth St could present a risk to human health for a residential land use setting (single dwelling, medium to high density landuse, child care centre), should this soil be exposed. Therefore this precludes use of the site for residential purposes. However, provided that the ACM impacted fill within these areas is managed in accordance with site specific EMP, the residual soil on the audit site does not pose an unacceptable risk to the proposed recreational open space land use.
- Groundwater investigation has identified metals impacts associated with regional impacts (from hydraulically up-gradient sources located off-site to the east and south of the site). Based on the assessment undertaken, the groundwater at the site does not pose a risk to human health in a recreational open space landuse setting.
- The QA/QC activities undertaken by the assessor(s) indicated minor non-compliance and overall, it is considered to provide confidence that the testing results of the soils and groundwater are representative of the conditions at the site.

The environmental auditor is therefore of the opinion that the site is suitable for recreational / open space, commercial and industrial land use. The condition of soils on the site precludes the use of the site for residential land use.

As all beneficial uses of land and groundwater are not be protected, a Certificate of Environmental Audit cannot be issued for the site. Therefore in accordance with the Environment Protection Act 1970, and the appropriate policies and guidelines issued by the EPA, a Statement of Environmental Audit with conditions has been issued and forms part of this report.

These conclusions present a summary of the auditor's review, to briefly present the basis for conclusions regarding the suitability of the site for the proposed use. The conclusions should be read in the context of the more detailed review and opinions presented in the preceding sections of this environmental audit report titled "Environmental audit report, Grassy Woodland, 37 Graham Road, Highett, Victoria, CARMS Reference 68549-3, Service Order No. 800303", and the purpose and limitations of the report discussion in Section 1.

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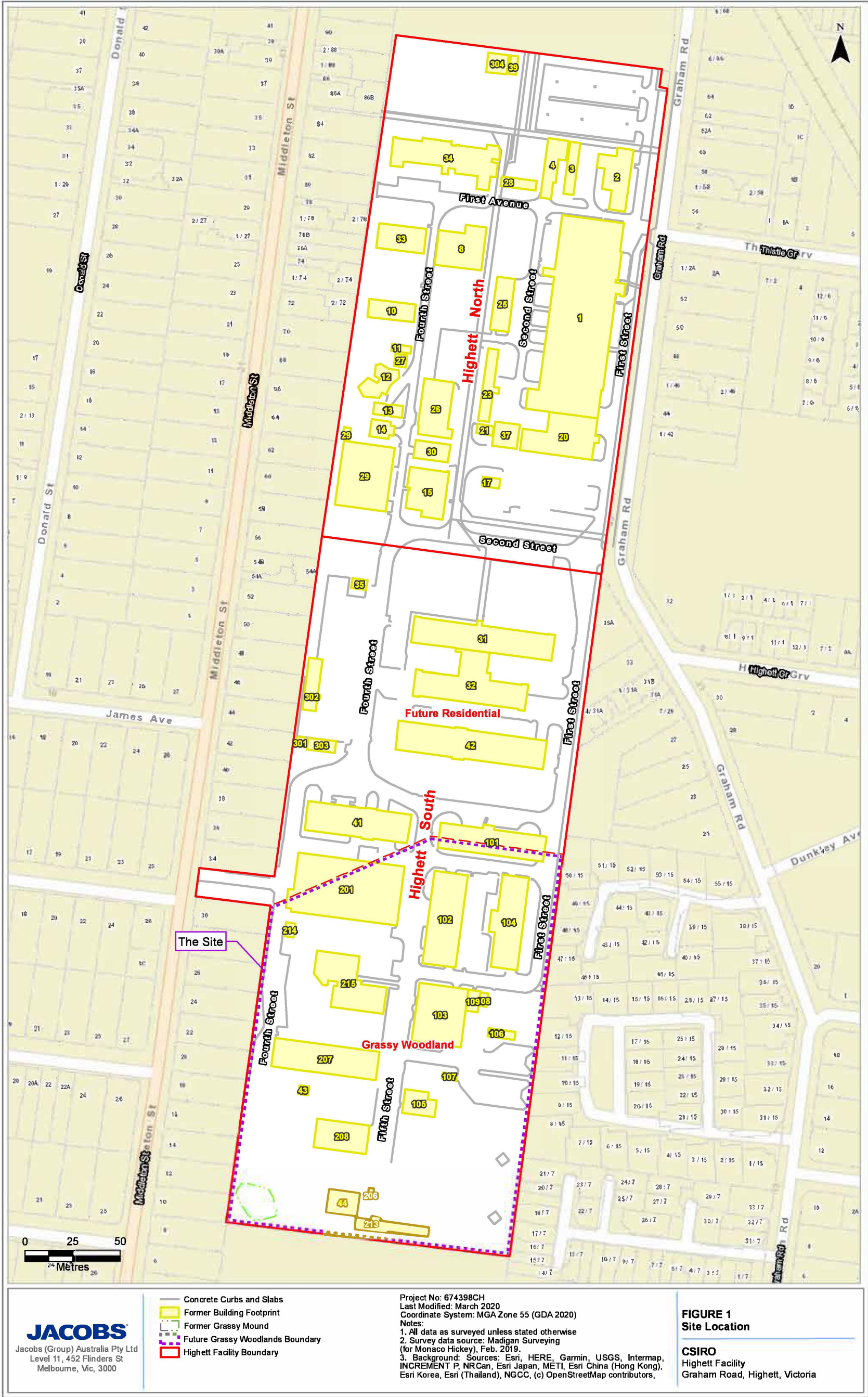
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Figures



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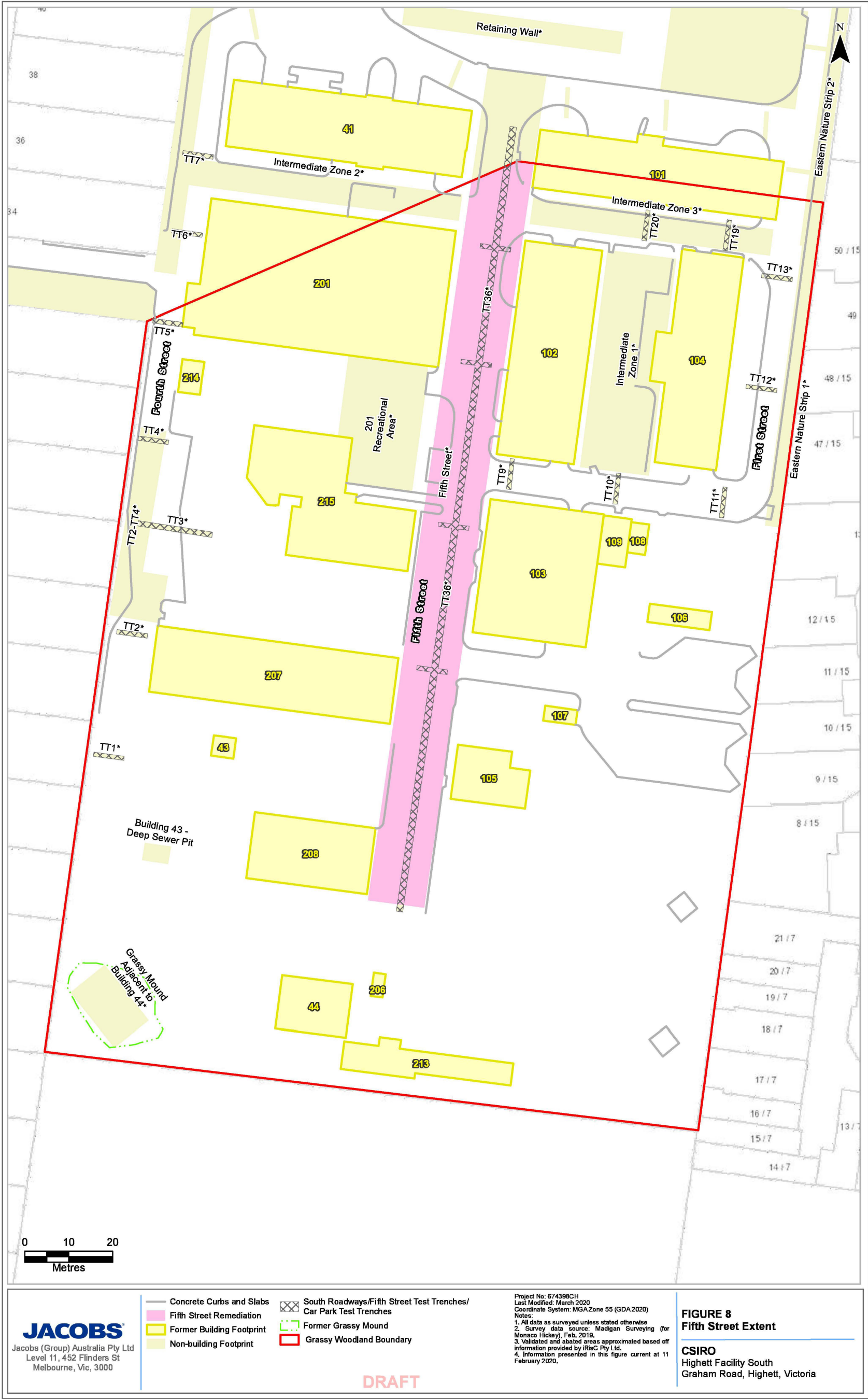
Boundary of CSIRO Highett Grassy Woodlands Audit Site

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Figure 1







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Fifth Street Extent

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Figure 4



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Level 9 180 Lonsdale Street
Melbourne VIC 3000

T: 61 3 8687 8000 F: 61 3 8732 7046 E: melmail@ghd.com

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