

Preliminary Site Investigation

Box Hill Institute, Spring Street, Box Hill, Victoria

V161141GReport02.1

Prepared for
Box Hill Institute

March 2017





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Preliminary Site Investigation

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Eurofins-mgt Laboratory (Primary):

Report No. 532061

Report No. 533268

ALS Laboratory (Secondary):

Report No. EM1700852

Data Quality Validation Report

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Checksite Historical Report

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Checksite Geology and Groundwater Report

Appendix J 3 Pages
Fieldwork Record Sheets
PID Calibration Certificate
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List of Abbreviations and Units

Chemical Names

BaP	Benzo(a)pyrene
BTEX	Benzene, Toluene, Ethylbenzene & Xylenes (subset of MAH)
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
MAH	Monocyclic Aromatic Hydrocarbons
OCP	OrganoChlorine Pesticides
OPP	OrganoPhosphate Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	PolyChlorinated Biphenyls
PHC	Petroleum Hydrocarbons
SVOC	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons (= TPH)
VOC	Volatile Organic Compounds
VHC	Volatile Halogenated Compounds

Technical Terms

AASS	Actual Acid Sulfate Soil
ABC	Ambient Background Concentration
ACL	Added Contaminant Limit
ACM	Asbestos Containing Material
AGL	Above Ground Level
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AS	Australian Standard
ASS	Acid Sulfate Soil
AST	Above-ground Storage Tank
BDL	Below Detection Limit
BGL	Below Ground Level
CEC	Cation Exchange Capacity
COC	Chain of Custody
CoEA	Certificate of Environmental Audit
CoPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
DELWP	Department of Environment, Land, Water and Planning
DQI	Data Quality Indicator
DQO	Data Quality Objective

DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
ESL	Ecological Screening Level
HIL	Health Investigation Level
HSL	Health Screening Level
LOR	Limit of Reporting
MGA	Map Grid of Australia
MSDS	Material Safety Data Sheet
N/A	Not Applicable
NATA	National Association of Testing Authorities
NDD	Non-Destructive Digging
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
PID	Photo-ionisation detector (measures in ppm)
PSI	Preliminary Site Investigation
QA	Quality Assurance
QC	Quality Control
RPD	Relative Percentage Difference
SAQP	Sampling and Analysis Quality Plan
SEPP	State Environment Protection Policy
SoEA	Statement of Environmental Audit
UST	Underground Storage Tank

Units

ha	Hectares
mbgl	Metres Below Ground Level
mBGS	Metres Below Ground Surface
mbTOC	Metres below Top of Casing
mg/kg	Milligram per Kilogram (approximately equivalent to ppm)
mg/L	Milligram per Litre
ppb	Part per Billion
ppm	Parts per Million
µg/kg	Microgram per Kilogram (approximately equivalent to ppb)
µg/L	Microgram per Litre
µS/cm	Micro Siemens per Centimetre (Electrical Conductivity - Water)

Preliminary Site Investigation

Box Hill Institute, Spring Street, Box Hill, Victoria

1 Introduction

1.1 Background

Cardno Victoria Pty Ltd (“Cardno”) was engaged by Box Hill Institute (“the Client”), to conduct a Preliminary Site Investigation (PSI) in the area of proposed development at Box Hill Institute, Spring Street, Box Hill, Victoria. The location and features of the site are shown on Figures 1 and 2, presented in Appendix A.

The PSI was carried out in accordance with the scope and limitations presented in Cardno’s proposal of 11 July 2016 (Our Ref: VS161141GProposal01.2). The assessment commenced following approval of the proposed works by the Client on 13 October 2016. It is noted that, at the request of the Client, fieldwork was delayed until January 2017 due to access restrictions during the teaching term.

The Client proposes to develop four parcels of land at 18 Spring Street and the rear of 853 Whitehorse Road, Box Hill, as part of the Campus Modernisation Program. This PSI is required to assess the contamination status of the land prior to development.

1.2 Purpose & Objectives

The purpose of this assessment is to provide the Client with preliminary advice on the contamination status of the site and the consequent implications for the suitability of the site for its intended use.

The objectives of the assessment are:

- > To identify the potential for past or current uses and activities at the site and in the immediate vicinity to have caused contamination of the land and groundwater at the site.
- > To make a preliminary assessment of any detriment to the proposed use of the site, potentially caused by the identified contamination.
- > An indication of whether contamination is likely to affect the future use or development of the site.
- > Provide recommendations for any further work considered necessary to assess or make the site suitable for the proposed use.

1.3 Standard of Assessment and Limitations

This investigation has been undertaken in general accordance with the current “industry standards” for a site investigation for the purpose, objectives and scope identified in this report. These standards are set out in:

- > National Environment Protection Council (NEPC) (1999) *National Environment Protection (Assessment of Site Contamination) Measure*, as amended (registered on 15 May 2013). This is referred to from here on as “the NEPM” or “NEPM (2013)”.
- > Standards Australia (2005) *AS4482.1- 2005: Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*.

The agreed scope of this investigation has been limited for the current purposes of the Client. The investigation may not identify contamination occurring in all areas of the site, or occurring after sampling

was conducted. Subsurface conditions may vary considerably away from the sample locations where information has been obtained.

This site investigation report is not any of the following:

- > An Environmental Audit Report as defined under the Environment Protection Act 1970.
- > A detailed site investigation (DSI) report sufficient for an Environmental Auditor to be able to conclude a statutory environmental audit.
- > A geotechnical report, and the bore logs or test pit logs may not be sufficient as the basis for geotechnical advice.
- > A detailed hydrogeological assessment in conformance with EPA Victoria Publication 668 Hydrogeological Assessment (Groundwater Quality) Guidelines (EPA 2006).
- > An assessment of groundwater contaminants potentially arising from other sites or sources nearby.

An overview of site environmental assessments is included in Appendix K.

1.4 Scope of Assessment

Cardno carried out the following tasks in order to satisfy the purpose and objectives of this assessment.

Defined the Site, Features & Surrounds:

- > Obtained the property title description from a Land-data Property Report.
- > Defined the site boundaries based on title information and established a site base plan.
- > Identified the site features including main buildings, services and other infrastructure.
- > Defined the topography, surface water drainage of the site and its proximity to the nearest surface water body and any associated potentially sensitive aquatic ecosystems.
- > Identified the location of nearby sensitive environments and receptors such as residential, child-care and primary schools, wetlands or streams.
- > Identified the zoning of the site under the local Planning Scheme.

Hydrogeology & Groundwater Resource Use

- > Reviewed the regional and local hydrogeology to identify likely site soil types, aquifers, likely groundwater occurrence, expected flow direction, quality and resource value.
- > Ascertained the actual utilisation of groundwater at and in the vicinity of the site through a search of the Victorian Water Measure Information System Database at Department of Environment, Land, Water and Planning (DELWP) website.

Review of Public Records on Site History

- > Publicly available documents relevant to the site (to the extent readily available):
 - Historical chain of land titles
 - Historical and current maps of the area
- > Selected historical aerial photos available from the DELWP archive (and obtained copies).
- > Public registers such as provided below to identified any sites (this and nearby sites):
 - Priority (Contaminated) Site Register
 - Statements and Certificates of Environmental Audit (Contaminated Land) SoEA/CoEA.
 - Energy Safe Australia register to identify any cathodic protection systems on the site potentially associated with underground fuel storage tanks (USTs).

Site Inspection & Surrounds

- > Checked that the “fenced site” conforms to that shown on title plans.
- > Confirmed the site features and identify any visible evidence of fuel storage tanks (above or below ground) and other infrastructure with potential to cause contamination of soil and/or groundwater.
- > Checked soil types where possible, and evidence of site cutting and filling or subsidence or placement of solid wastes.
- > Assessed the surrounding area (to a radius of about 200 m and to the extent possible) for potential sources of contamination of soil or groundwater at the site.

Interviews

- > Conducted interviews with landowners familiar with the site history for anecdotal information relevant to the assessment (to the extent possible).

Non-Intrusive Site Investigations

- > Surveyed the site using an underground service locator.

Intrusive Site Investigation Sampling & Testing

- > Implemented a comprehensive Sampling and Analysis Quality Plan (SAQP) including laboratory analysis of field quality control (QC) samples.
- > Performed intrusive investigation of soil conditions at the site by drilling and sampling at selected locations and applying methods set out in the following sections of this report. These works included the investigation of soil and fill
- > Tested selected soil samples for a broad range of analytes using a National Association of Testing Authorities (NATA) accredited laboratory.

Reporting

- > Prepared this report to provide findings and recommendations relevant to the objectives of the assessment.

2 Site Description & Setting

2.1 Site Definition and Description

Table 2-1 summarises the key details defining the site. The location of the site is shown in Figure 1, Appendix A.

Table 2-1: Site Identification Details

Site Address	Box Hill Institute, Spring Street, Box Hill, Victoria
Site Area	Approximately 6,100 m ²
Title Details	Part of Lot 1 on TP172856; Lot 6 on PS434842; Lot 1 on TP117804; Lot 1 on TP239909; Lot 1 on TP408312
Municipality	City of Whitehorse
Current Site Owner	Box Hill Institute
Planning Zones	Public Use Zone 2 – Education (PUZ2) Residential Growth Zone 3 (RGZ3)
Planning Overlay	Parking Overlay – Precinct 1 Schedule (PO1)

2.2 Proposed Development

The Client proposes to redevelop the site for mixed use development.

The proposed development in the northern part of the site will include a 29 storey building with three levels of basement car parking. The first three or four storeys (from the ground floor up) are proposed as teaching facilities for the nursing school, and the upper storeys will consist of residential apartments.

The development in the southern part of the site will include a car parking area consisting of a single level deck car park with a conventional asphalt paved car park located below.

The areas surrounding the above proposed infrastructure will consist of car parks and access roads consisting of conventional asphalt pavements.

The site will continue to be used as a campus for educational purposes with limited exposure to soil in unpaved areas or during sub-surface maintenance works.

2.3 Site Use & Infrastructure

The site is currently used as a car park and there is no infrastructure in this area. There is a small recreation area in the south-east part of the site which has a barbecue, metal benches and a number of concrete seats, as shown in Plate 6, Appendix D.

2.4 Surrounding Land Uses

The surrounding land uses, nearby potential sources of contamination and sensitive receptors are outlined in Table 2-2.

Table 2-2: Surrounding Land Uses

Direction	Land Use or Activity
North	<ul style="list-style-type: none"> ▪ Flats, then hospitals (Box Hill and Epworth) further to the north, including parking in parts of the buildings ▪ Residential houses to north-east ▪ Salvation Army building and carpark to the north-east
West	<ul style="list-style-type: none"> ▪ New multi-storey block of flats (currently unoccupied) ▪ Residential housing ▪ Wellington Road, then more residential housing ▪ Anaconda sports and camping shop (former Spotlight building appears partly vacant) ▪ BP Service Station on north-west corner of Wellington and Whitehorse Roads intersection
East	<ul style="list-style-type: none"> ▪ Box Hill Institute buildings (Nelson Campus) ▪ Then Nelson Road ▪ Then commercial buildings, including, from south to north, Department of Human Services & Health, Confucius Library, automotive repair, panel beater, Box Hill RSL.
South	<ul style="list-style-type: none"> ▪ Box Hill Institute buildings (Nelson Campus) ▪ KFC ▪ Then Whitehorse Road ▪ Then commercial buildings, including multi-storey building currently under construction

2.5 Topography and Drainage

The site is located in an area that is relatively flat with no significant topographical features. There is a fall of approximately 2 m from south-east to north-west across the site, with the land sloping down towards Bushy Creek to the north of the site. The land also slopes gently down from the south-west part of the site to the west towards Wellington Road.

2.6 Geology and Hydrogeology

The geology and hydrogeology of the site have been interpreted from a desktop study of the following reference, noting that no environmental groundwater assessment was conducted at this site:

- > Ringwood 1:63,360 map sheet, Geological Survey of Victoria (1981)

The principal aquifer at the site is the Silurian Bedrock Aquifer (Anderson Creek Formation) which occurs as a fractured rock water table aquifer, comprising sandstones with interbedded siltstones and shales. The aquifer is understood to provide low bore yields which are rarely sufficient for a domestic supply.

Groundwater was expected to occur at a depth of between 10 m and 20 m below ground level (mbgl) where it forms the water table in the Anderson Creek Formation. Groundwater piezometers installed at the site as part of Cardno's geotechnical investigation recorded water levels ranging from 13 m to 14 m below ground level. The groundwater bores were not surveyed and therefore groundwater flow direction could not be determined.

Based on local and regional topography, groundwater is expected to flow in a south-westerly direction towards Back Creek and Gardiners Creek, and in the direction of Port Phillip Bay.

2.7 Groundwater Quality & Beneficial Uses

The Victorian Groundwater Beneficial Uses Map Series (1995) shows the groundwater in this area to have a salinity in the range of 3,501 to 13,000 mg/L TDS¹, and is therefore classified as Segment C according to the State Environmental Protection Policy (SEPP) *Groundwaters of Victoria (1997)*. The DELWP (2016) database reports a salinity range of 3,500 to 7,000 mg/L TDS, confirming that the groundwater is expected to be Segment C.

The following beneficial uses of groundwater are protected under Segment C of the Groundwater SEPP:

- > Maintenance of ecosystems
- > Stock watering
- > Industrial water use
- > Primary contact recreation
- > Buildings and structures.

2.8 Groundwater Resources & Usage

It is relevant to any assessment of groundwater condition to know if the groundwater at or in the vicinity of the site is used by owners of groundwater bores. All bores in Victoria should be registered with the relevant rural water authority in compliance with the *Water Act 1989*.

A search of relevant databases was completed by CheckSite (2016), with the results included CheckSite Geology & Groundwater report, included in Appendix I. The CheckSite report includes a table which presents groundwater bores within 1 km of the subject site. The table includes the bore ID, bore depth, bore distance from the site, and bore uses (where available). The report also includes a groundwater bore location plan.

The search identified 19 bores within 1 km of the site, including the following bore types:

- > Observation (13)
- > Domestic and stock (1)
- > Not known (5)

It is noted that three groundwater bores are located hydraulically down-gradient of the site. These include two investigation bores, likely installed to monitor groundwater at the service station at this location. The other is of unknown use, though apparently also at the service station site and thus possibly for observation. There are no potential private bore users, such as stock or domestic use, downgradient of the site that would be impacted by any contamination from the subject site. Further, no potential sources of groundwater contamination were identified at the subject site.

It is noted that, in the experience of Cardno, groundwater may also be used by persons with unregistered bores not appearing on the database.

¹ Assumes a conversion of electrical conductivity (EC) and total dissolved solids (TDS) as follows:
EC x 0.65 μ S/cm = TDS mg/L

3 Site History & Potential for Contamination

3.1 Search of Public Records

The following Environment Protection Authority (EPA) registers and public records were searched for information on potential sources of contamination from nearby sites.

Table 3-1: EPA Register Search

EPA Register/ Website	Date of Search	Register Information	Search Outcome On-site	Nearby Sites	Comments
Priority (Contaminated) Sites Register	27/10/16	Sites where a Clean-Up Notice (CUN) or Pollution Abatement Notice (PAN) has been issued	Not listed	Former landfill at 14 Federation Street, Box Hill	Former landfill is listed as requiring ongoing management
Environmental Audits Completed	6/12/16	Environmental audits completed within 1 km of site	Not listed	Four sites listed: <ul style="list-style-type: none"> 27-28 Oxford Street, Box Hill (600 m to the south); CoEA issued on 4/10/93 4 Hotham Street, 779-791 Whitehorse Road, Mont Albert (1.6 km to the west); SoEA issued on 15/05/03 Former Box Hill Landfill, Federation Street, Box Hill (900 m to the south); SoEA issued on 18/10/04 519-521 Station Street, Box Hill (700 m to the south-east); SoEA issued on 21/01/16 	Audit reports were not reviewed as this additional work was beyond the current scope of work but may be required at a later stage of the assessment
Groundwater Quality Restricted Use Zone (GQRUZ)	6/12/16	Identifies an area where the use or extraction of groundwater is restricted due to the presence of contamination	Not listed	None listed	-
Notified (Ongoing) Environmental Audits	6/12/16	Current (on- going) environmental audits within 1 km of site	Not listed	None listed	-

Copies of the results of the above searches are presented in Appendix H.

Table 3-2: Other Public Records Search

Public Records	Date of Search	Register Information	Comments
Aerial Photographs: DELWP	22/10/16	Historical activities on site and nearby. Aerial photos dating back to 1931 were reviewed.	Selected photographs are presented in Appendix F. Key events relevant to the site are summarised in Table 3-3.
Certificates of Title	1/02/17	Key events relative to the site	Current and historical Certificates of Title are presented in Appendix G. Key events relevant to the site are summarised in Table 3-3.
Historical maps <ul style="list-style-type: none"> Parish Plan - Nunawading Planning Schemes for 1954, 1959, 1968 Melbourne Metropolitan Board of Works (MMBW) 	26/10/16	Historical infrastructure or land use	<p>Parish Plan:</p> <ul style="list-style-type: none"> Shows the site to be part of Allotment 4 <p>Historical Planning Scheme:</p> <ul style="list-style-type: none"> 1954: Site is shown as part public open space, part commercial / industrial 1959: Site is shown as mostly light industrial. 1968: Site is shown as mostly light industrial, residential in north. <p>MMBW Plan:</p> <ul style="list-style-type: none"> Site is shown on 1928 figure as Plan No. 3082 <p>The above plans are included in Appendix F.</p>
Fuel infrastructure: Energy Safe Victoria	25/10/16	Register for cathodic protection of fuel storage systems (including underground storage tanks)	No record of cathodic protection system installed on-site. The Energy Safe letter is included in Appendix H.
Acid Sulphate Soils: DELWP Coastal Acid Sulphate Soil (CASS) map (CheckSite, 2016)	22/10/16	Potential for CASS to be present	The map shows that the site is not located in an area of potential acid sulfate soils (Appendix I).

3.2 Summary of Relevant Historical Activities

Historical land uses and activities occurring at the site are summarised in Table 3 3. Activities with the potential to cause contamination are in bold text and are generally older than two years prior to the time of site assessment activities. Historic aerial photographs are included in Appendix F and certificates of title are included in Appendix G.

Table 3-3: Land Use History & Activities

Date	Information Source	Interpretation
November 1931	Aerial Photograph	Black & White, Scale: 1:2,500: The site appears to consist of mostly vacant land in a largely residential area. At least one house is present in the north of the site. A large building is apparent in south-east corner of site, extending further to the south. Few trees are present on the site.
March 1954	Aerial Photograph	Black & White, Scale of original: 1:20,000: Two houses are present in the northern part of the site and one in the central western part. The southern portion of the site is occupied by large buildings , probably Box Hill TAFE. Still vacant areas in the central part of the site. Surrounding area is largely residential.
February 1970	Aerial Photograph	Black & White, Scale of original: 1:30,000: Still two houses in north of site and large buildings with gabled roofing in south of site. Houses in the west of the site have been removed and there

Date	Information Source	Interpretation
		is now a larger vacant area in the central part of the site. There are increased commercial activities/buildings to the south-east of the site, including parking areas to the south of Whitehorse Road and the east of Nelson Road.
March 1972	Aerial Photograph	Black & White, Scale of original: 1:7,200: The site is largely unchanged. There has been off-site clearing of houses and land to construct car parking lots, including to the south-west of the site and to the east of the site.
December 1987	Aerial Photograph	Black & White, Scale of original: 1:10,000: The large, central part of the site now has a bitumen car park . Otherwise, it is unchanged, with two houses still present in the north, and large buildings in the south. The area is becoming increasingly commercial/industrial , with houses to the east of the site and to the south of Whitehorse Road replaced by office buildings . Whitehorse Road has been widened to include two lanes of traffic on each side.
September 1991	Aerial Photograph	Colour, Scale of original: 1:15,000: The site and its surrounds appear to be largely unchanged.
23 May 1994	Historic Certificate of Title	Haddon Storey in his capacity as minister for the time being, administering the Tertiary Education Act 1993, is the sole proprietor of the site at Lot 1 on Title Plan 117804T.
21 September 1995	Historic Certificate of Title	The Salvation Army (Victoria) Property Trust of 5 Hamilton Street, Mont Albert, 3127, is the sole proprietor of the site at Lot 1 on Title Plan 239909W.
9 June 1999	Historic Certificate of Title	The Salvation Army (Victoria) Property Trust of 5 Hamilton Street, Mont Albert, 3127, is the sole proprietor of the site at Lot 1 on Title Plan 408312U.
December 2005	Aerial Photograph	Colour, Scale: 1:2,500: The buildings in the south of the site have been demolished. In this southern area, the land is now either vacant or used for car parking . There has been further significant development adjacent to the site. The car park to the south-west has been replaced by a large building and there are new buildings to the east of the site.
December 2010	Aerial Photograph	Colour, Scale: 1:2,500: The majority of the site is now used as a car park . The northern-most house has been demolished and that area is vacant. Only one house remains in the northern part of the site. Surrounding buildings and land use is largely unchanged, apart from the demolition of large buildings to the south-east of the Whitehorse Road and Nelson Road intersection, and their replacement by a large car park.
14 January 2004	Current Certificate of Title	Box Hill Institute of Technical and Further Education of 465 Elgar Road, Box Hill, is the sole proprietor of the sites at Lot 1 on Title Plan 408312U, Lot 1 on Title Plan 239909W and Lot 1 on Title Plan 117804T.
7 October 2014	Current Certificate of Title	Box Hill Institute of Technical and Further Education of 465 Elgar Road, Box Hill, is the sole proprietor of the site at Lot 6 on Plan of Subdivision 434842D.
October 2016	Aerial Photography (NearMap)	The site is now vacant, with all buildings having been removed. The site is now used as a car park , mostly with asphalt cover. The south-west car park appears to be sealed with concrete and the northern car park appears to have crushed rock cover (possibly bluestone). Surrounding buildings and land use are largely unchanged. There is multi-storey development to the south of the site, immediately south of Whitehorse Road.

3.3 Previous Site Contamination Assessments

Cardno understands that there are no previous environmental site assessments or related documentation available for the site.

3.4 Non-intrusive Site Investigations

3.4.1 Site Inspection & Observations

A detailed site inspection was carried out by an experienced Cardno environmental scientist on 27 January 2017. The following observations were recorded:

1. The majority of the site includes car parking areas and asphalt roads that link the parking areas. There are no buildings on the site.
2. The northern car park has a gravel surface, the southern car park has a concrete surface, and all other car parks have asphalt surfaces.
3. The narrow east-west part of the site which extends to Wellington Road includes a concrete path and a garden bed to the south.
4. The south-eastern part of the site is a recreational area with a barbecue, concrete seats and metal benches. The surface of this area is sealed by concrete paving stones.
5. There are many large trees, mainly eucalypts, mostly in garden beds between the parking lots. There are also trees and shrubs in the garden bed along the afore-mentioned concrete path.
6. Surface soils were not observed, as most of the site is sealed by asphalt or concrete, or covered by bluestone gravel. Wood chip cover is present in the garden beds.
7. The site is mostly level and surface water run-off is to gutters and drains at the site.
8. The site was generally tidy and clean.

3.5 Summary of Potential contamination

The assessment has identified several potential sources of contamination (and related Contaminants of Potential Concern – COPC) which are summarised in Table 3-4. The locations of these areas of interest are referred to as Environmental Assessment Areas (EAAs) and are identified in Figure 3, Appendix A.

Table 3-4: Site Activities and Potential Contaminants of Concern

Environmental Assessment Area	Site Activity / Potential Source	Contaminants of Potential Concern	Comments
On-Site Sources			
EAA1	Imported fill	Petroleum hydrocarbons, BTEX (benzene, toluene, ethyl benzene, xylenes), polyaromatic hydrocarbons, metals, asbestos and pesticides	Contaminated fill may have been used beneath infrastructure at the site, including car park and former buildings. Potential exists for the fill to impact the natural soils and groundwater at the site.
Off-Site Sources			
EAA2	Panel beater and automotive repair premises to east of site	Petroleum hydrocarbons, BTEX, solvents	Potential groundwater plume as a result of spillage or leakage of contaminants at these sites. The premises are considered to be hydraulically up-gradient to cross-gradient of the site and therefore the potential plume may extend beneath the site and create a soil vapour hazard.

Environmental Assessment Area	Site Activity / Potential Source	Contaminants of Potential Concern	Comments
EAA3	Service station to south-west of site, on corner of Whitehorse and Wellington Roads	Petroleum hydrocarbons, BTEX	Potential hydrocarbon plume in groundwater extending beneath the site and presenting a soil vapour hazard at the site. However, this is unlikely as the service station is considered to be hydraulically cross-gradient (and possibly down-gradient) of the site.
EAA4	Imported fill	Petroleum hydrocarbons, BTEX (benzene, toluene, ethyl benzene, xylenes), polyaromatic hydrocarbons, metals and pesticides	Contaminated fill may have been used beneath infrastructure in the vicinity of the site, including former and current buildings and roads near the site. Potential exists for the fill to impact the groundwater beneath the site.

4 Site Investigations

4.1 Sampling and Analysis Quality Plan

4.1.1 Data Quality Objectives and Indicators

The data quality objectives that will be adopted by Cardno for the PSI are detailed in Table 4-1. A comprehensive assessment of the data quality indicators relating to both field and laboratory procedures will be undertaken and detailed in the PSI report, including aspects detailed in Table 4-2.

Table 4-1: Data Quality Objectives

Data Quality Objective Step	Description
1. State the Problem	The Client is looking to develop the site as part of a campus modernisation program. Does soil contamination at the site present a constraint to the development potential of the site?
2. Identify the Decision	Does the site history indicate any potential for contamination sources to be present at the site? Is there potential for soil contamination to be present at the site which may impact the proposed development? Is remediation required to make the site suitable for residential development use? Are additional management measures required during site development?
3. Identify the Inputs into the Decision	Available historical and public searches relevant to the site will be reviewed to identify potential contamination sources. A soil assessment will be undertaken to investigate potential contamination.
4. Study Boundaries	The site boundary is presented in Figures 1 to 4, Appendix A.
5. Develop a Decision Rule	A data quality review of the soil sample data will be completed to assess the validity of reported analytical results.
6. Specify Limits on Decision Error	In assessing the reliability of the soil analytical data: <ul style="list-style-type: none"> ▪ Standard laboratory acceptance limits for internal laboratory quality control testing will be reported in NATA laboratory certificates. ▪ Relative percentage difference (RPD) for quality control (QC) field duplicate data will be assessed against the acceptance limits specified in AS4482.1.
7. Optimise the Design for Obtaining the Data	Additional soil and possible groundwater investigation may be required if contamination is identified during the intrusive investigations works, or if additional contaminant sources are identified during the site history review.

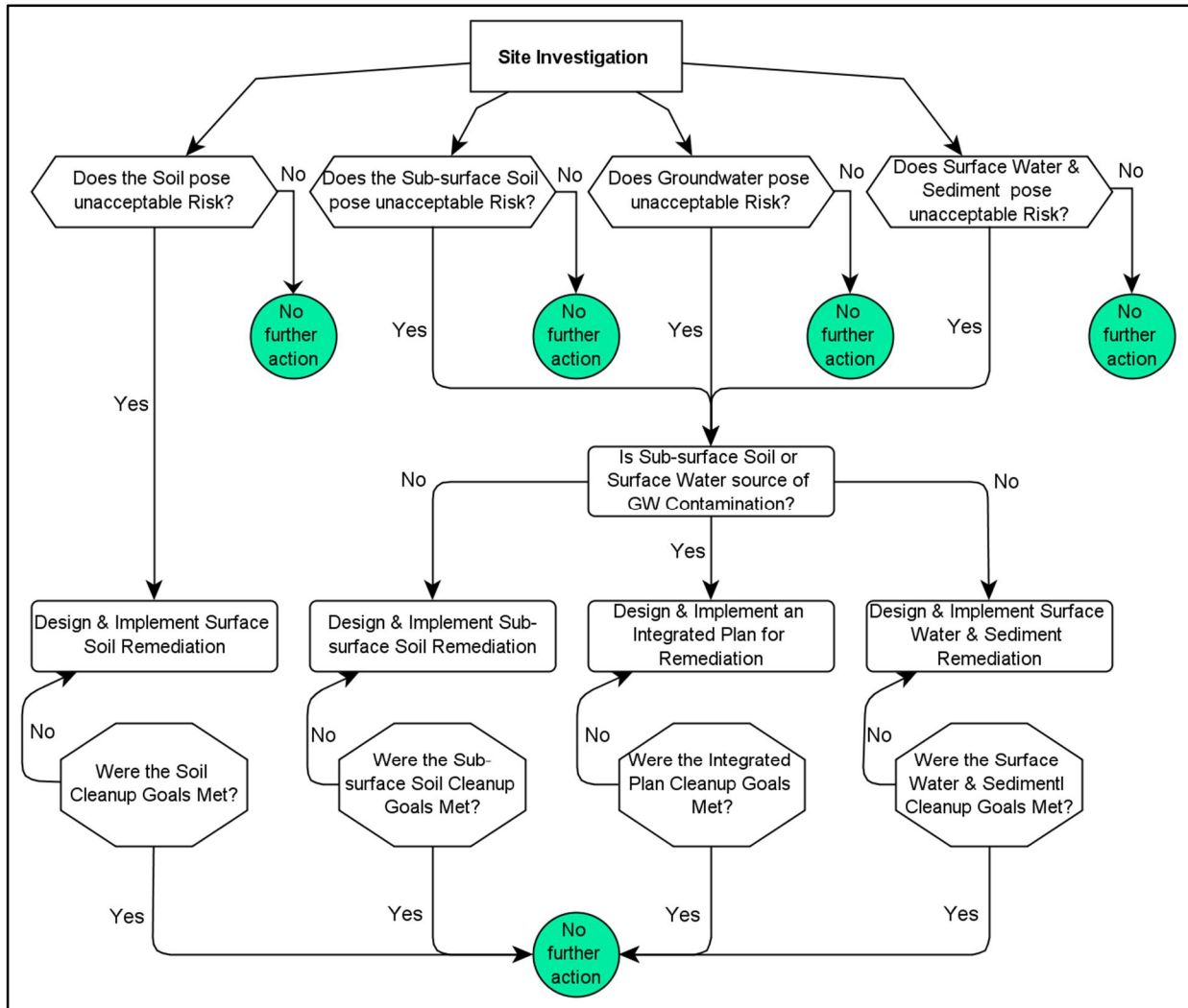


Figure 4-1: DQO Process for Multiple Decisions required for Site Investigation²

An assessment of the Data Quality Indicators (DQIs) relating to both field and laboratory procedures will be undertaken with appropriate documentation provided for each environmental element or media assessed. The DQIs adopted for the SAQP are summarised in Table 4-2.

Table 4-2: Data Quality Indicators

Data Quality Indicator	Detail
QA Documentation	Provision of appropriate work plans, SAQP and DQO defined for the site and all QA/QC aspects documented.
Bias	A measure of the potential distortion in an analysis which can result in errors in one direction (e.g. one laboratory consistently higher results or consistent poor spiked matrix recovery). Bias will be assessed with reference to the analysis of spiked matrix samples (NEPC 1999b).
Representativeness	A qualitative measure of the confidence that data is representative of each medium present on the site. Use of appropriate and documented sampling methods, sampling handling, preservation and transport and holding times.
Precision:	A quantitative measure of data variability or reproducibility, measured by the calculation of %RPD values for duplicate samples (i.e. measure of agreement).

² Process flow chart adapted from the *Guidance for the Data Quality Objectives Process* (US EPA, 2000).

Data Quality Indicator	Detail
	<p>Precision in DQIs is considered an important assessment in an environmental study (EPA, 2002). It can be measured as follows:</p> <ul style="list-style-type: none"> Percentage of the mean of the measurement such as Relative Percent Difference (i.e. %RPD). The %RPD will be calculated for the field and secondary duplicate (i.e. inter and intra-laboratory analysis); and Use of similar analytical method and instrument (e.g. for inter-laboratory assessment). <p>The %RPD will be considered as acceptable if the values are less than 30% (NEPC, 2013). Should there be a result that is greater than 30% difference, then a “review should be conducted of the cause (e.g. instrument calibration, appropriateness of method used)” (NEPC, 2013).</p> <p>For the purpose of this SAQP field and secondary duplicates should be collected at a rate of 1 in 20 samples (NEPC, 2013).</p>
Accuracy	<p>A quantitative measure of the closeness of data to a ‘true value’, measured by the analysis of spike, blank and laboratory control samples (LCS). The LCS consists of a standard reference material or a matrix of known concentration.</p> <p>For the purpose of assessing accuracy it is required that at least one LCS for each process batch³ be analysed (NEPC, 2013).</p>
Comparability	<p>A qualitative measure of the confidence that data may be considered to be equivalent for each sampling and analytical event. By use of standard procedures, comparable methods, qualified personnel and review of sample integrity.</p>
Completeness	<p>A measure of the amount of usable data (expressed as a percentage - %) from a data collection activity, based on completeness of test program, overall QA/QC completeness and validity of dataset.</p>

4.2 Sample Strategy & Methodology

The soil sampling fieldwork was conducted on 27 January 2017.

The scope and method of the work is summarised in Table 4-3. Locations were chosen to provide even coverage of the site (grid locations). Target areas associated with potential sources of contamination were not identified at the site. Sample locations are summarised in Table 4-4 and shown in Figure 4, Appendix A.

The sample locations were located on-site using permanent site features, as identified on 2016 aerial photography.

Table 4-3: Soil Investigation Activity Summary

Activity	Details
Dates of Field Activity	27 January 2017 (soil bores SB01 to SB15)
Service Location	Services were identified using Dial Before You Dig plans and an underground service locator prior to any sub-surface works being undertaken.
Concrete Cutting	Bores SB11 and SB15 were concrete cut prior to drilling. The concrete thickness for both bores was approximately 300 mm.
Drilling Method	Bores were drilled using the direct push method. A hand-auger was used for SB14 because the drill rig could not access this location.
Bores Drilled and Depths	With the exception of bore SB05, all soil bores were drilled to depths ranging from 0.8 to 1.1 m. Bore SB05 terminated at 0.1 m due to refusal on what was believed to be concrete. Two bores were attempted in the vicinity of SB05.

³ The NEPM Schedule B3 – *Guideline on Laboratory Analysis of Potentially Contaminated Soil* defines a laboratory process batch to consist of up to “20 samples that are similar in term of matrix and test procedure, and are processed as one unit for the QC purposes” (NEPC, 2013).

Activity	Details
	Bore SB14 terminated at 0.8 m due to collapse of the hole in gravel fill. All other bores met with refusal on weathered siltstone bedrock.
Soil Logging	Records of soils encountered, samples collected and related observations are presented in bore logs in Appendix C.
Soil Sampling	Soil samples were generally collected at 0.1 m, 0.5 m, 1.0 m. Variations in sample depth may have occurred at obvious changes in soil lithology. If indications of potential contamination were observed, such as fill material, buried rubbish, odorous soils and soil staining, then soil sampling would continue to natural or non-impacted soils to assess the nature and extent of potential contamination. Soil samples were stored in glass jars provided by the laboratory. All samples were labelled with an indelible marker pen on water resistant labels attached to the sample jars.
Decontamination Procedure	Reusable soil sampling equipment was rinsed with Decon 90 and deionised water prior to the collection of each sample.
Soil Screening	Soil samples were field screened using a calibrated PID, noting any odours or visual signs of contamination. PID readings are shown in the bore logs, presented in Appendix C. PID calibration records are provided in Appendix J.
Sample Preservation and Transport	Samples were stored on ice, in an esky while on-site and in transit to the laboratory under Chain of Custody documentation.
Borehole Abandonment	Bores were backfilled with soil cuttings produced during drilling. Concrete cored areas and asphalt surfaces were reinstated as necessary.

Table 4-4: Sample Locations

Location	Location Name	Depth of Investigation (m)	Rationale
Grid Locations			
Grid across site	SB01 to SB15	Mostly 1.0	To assess for impacts resulting from site activities, including the placement of fill beneath the car park area.

The fieldwork was undertaken by an experienced environmental scientist in accordance with the agreed scope of work and using methods set out in the Cardno Quality Management System which conforms to the industry standard of practice.

The records and observations made during the field work are presented in bore logs and fieldwork records presented in the Appendices.

4.2.1 Laboratory Analysis – Soil

All near-surface samples were selected for laboratory testing. The analysis program was based on general screening for potential contamination, visual and olfactory observations, and the site history review. The selected samples were tested for a broad range of inorganic and organic parameters.

Selected samples were individually tested for a range of inorganic and organic parameters. The laboratory program employed for the testing of individual samples is summarised in Table 4-5.

Table 4-5: Laboratory Testing Program

Location	Samples	Analysis
Grid locations	SB01/0.1, SB02/0.2, SB03/0.1, SB06/0.1 to SB10/0.1, SB11/0.3, SB13/0.1, SB14/0.1, SB15/0.3	TPH, BTEX, PAH, metals (8)
	SB04/0.1 and SB12/0.1	NEPM 2013 Screen, CEC, pH

Location	Samples	Analysis
Grid locations	SB02/0.5	TPH, BTEX, metals (8)
	SB07/0.5	PAH

Analytical Screen Definitions

NEPM 2013 Screen: PAH (as BaP TEQ)/ Total PAHs/ Phenols/ OCP/ OPP/ PCBs/ Acid Herbicides/ Atrazine/ Bifenthrin/ Toxaphene / CN Free / Metals (As, Be, B, Cd, Co, Cr, Cu, Pb, Hg, Mn, Ni, Se, Zn)/ Cr6+

Metals (8): As, Cd, Cr (total), Cu, Pb, Hg, Ni, Zn

Note: A sample could not be collected at SB05, as the attempted bores terminated at shallow depth due to refusal.

The primary laboratory was Eurofins-mgt in Oakleigh, Melbourne, and the secondary laboratory (quality control) was ALS in Springvale, Melbourne. Both laboratories are NATA-accredited for the parameters tested.

Copies of the NATA stamped laboratory reports and the Cardno Chain of Custody and sample receipt records are included in Appendix E. Tabulated laboratory results are presented in Appendix B. The quality control/ quality assurance (QA/QC) of the soil sampling program is discussed in Section 4.3.

4.3 Quality Control / Quality Assurance

A critical aspect of a PSI is the demonstration of the quality of the data used as the basis for the assessment. This is achieved through a Data Validation process which includes a review of the following aspects of the data collection process:

- > Project Quality Objectives and Plans
- > Data Representativeness
- > Data Precision & Accuracy
- > Laboratory Performance
- > Data Comparability
- > Data Set Completeness.

A detailed review of these aspects has been undertaken, the results of which are presented in Appendix E. The data validation process has concluded that there are no significant systematic errors in the data collection process for soil sampling and analysis. Therefore, the data set used as the basis for the soil assessment is considered valid and complete.

5 Contamination Assessment Criteria

The following sections summarise the sources of assessment criteria adopted for this project. The relevant assessment criteria are included in the tabulated analytical data presented in Appendix B.

5.1 Soil Assessment Criteria

5.1.1 On-site Retention

The *SEPP Prevention and Management of Contamination of Land* (2002) and its variation (gazetted 26 September 2013) designate protected beneficial uses according to a site's land use. The proposed development of the site, as described in Section 2.2, is for the campus redevelopment at Box Hill Institute. The land uses associated with this development would be:

- > Sensitive Use (High Density)
- > Recreation/Open Space
- > Commercial

To determine whether contaminated soil may pose a hazard to human health or the environment, the levels of contaminants reported in the soil are generally assessed against recognised standards and guidelines.

In December 1999, the National Environment Protection Council (NEPC) formulated the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) in relation to investigation levels for soil and groundwater in the assessment of site contamination (NEPC 1999a). In April 2013, the amendment to NEPM was officially approved (registered on 15 May 2013) with various changes including new ecological and health investigation and screening levels included (NEPC 1999b). This is referred to from now on as "the NEPM". It includes human health and ecological investigation levels (HIL and EIL) for a range of metals, inorganic compounds and organic compounds. Screening levels (HSL and ESL) have been provided for petroleum hydrocarbons. Both the investigation levels and screening levels are applied in the same manner in that they are the upper concentrations of a contaminant above which further investigation is required.

Therefore the beneficial uses and NEPM (NEPC 2013) assessment criteria commensurate with the site land use(s) are:

- > **NEPM Ecological Investigation/Screening Levels (EIL/ESL):** to assess potential risks to terrestrial ecosystem based on the following generic land use settings:
 - **Areas of ecological significance** where the primary intention is conserving and protecting the natural environment, including national parks, state parks, wilderness areas and designated conservation areas
 - **Urban residential and public open space**
 - **Commercial and industrial**
- > **NEPM Health Investigation/Screening Levels (HIL-B, HSL-B):** Residential with minimal opportunities for soil access and home-grown produce is not grown and consumed. This category includes dwellings with fully and permanently paved yard space such as high-rise buildings and flats.
- > **NEPM Health Investigation/Screening Levels (HIL-C, HSL-C):** Parks, recreational open space and playing fields, including secondary schools and footpaths. This category excludes urban bushland and reserves which should be assessed under a site-specific assessment where appropriate.
- > **NEPM Health Investigation/Screening Levels (HIL-D, HSL-D):** Commercial/Industrial. This category includes premises such as shops and offices as well as factories and industrial sites.

- > **NEPM Management Limits for TRH fractions (Residential, parkland and public open space):** Management limits where high concentrations of low toxicity hydrocarbons may be unacceptable due to the potential for formation of LNAPL, fire and explosive hazard and effects on buried infrastructure by hydrocarbons.
- > **NEPM Management Limits for TRH fractions (Commercial/industrial):** Management limits to assess the potential for formation of LNAPL, fire and explosive hazard and effects on buried infrastructure by hydrocarbons.

The initial screening levels for determining the “contamination status of land” are generally the most conservative of these investigation/screening levels applicable for site based on specific soil and site characteristics.

The beneficial use of land referred to as “aesthetics” may be precluded where land is considered offensive to the senses – e.g. through the presence of offensive odour or unusually coloured staining. It is therefore not possible to quantify circumstances where this protected beneficial use is precluded (it is a subjective assessment about how the average person might respond) and as such criteria for the assessment land aesthetics cannot be adopted.

While pH, sulphate, redox potential and salinity may have detrimental impacts upon buildings and structures, assessment of such risk falls outside the scope for this assessment, i.e. SEPP *Prevention and Management of Contamination of Land* and its variation does not refer to guidelines. Assessment criteria adopted for buildings and structures are available from Table 6.4.2 of Australian Standard AS2159-2009 (Standard Australia 2009) based on soil pH and sulphate concentrations.

“Investigation levels” or “screening levels” presented in the NEPM are not intended to be interpreted as “maximum permissible levels”, “clean up levels” or “safe levels”, rather, they are levels at which further investigation or assessment should be undertaken to provide assurance that unacceptable contamination does not occur to an extent that could cause harm or detriment for users of the land. Subsequent assessment on a site-specific basis often results in higher levels being acceptable. However, since the “investigation levels” or “screening level” are generally set at conservatively low levels, they are often taken to be the acceptable levels.

6 Discussion of Soil Results

6.1 Field Observations

Soil conditions observed during the soil sampling program are summarised in Table 6-1. It is noted that a soil sample could not be collected at bore SB05, as the bores attempted in this location terminated at refusal at shallow depth. It is unclear what caused the refusal, but it was possibly concrete. Detailed soil descriptions are provided in the bore logs in Appendix C.

Table 6-1: Typical Soil Profile

Sub-Surface Horizon	Typical Depth Range	Description
FILL: Sandy SILT to Silty GRAVEL	Surface to ~0.40 m; +0.8 m in one location	Typically light brown-grey, slightly moist, firm to dense, low plasticity; no odour or staining. Occurs from the surface in the northern car park and below the asphalt or concrete in most other areas.
Silty CLAY	~0.40 m to 0.9-1.1 (depth of refusal)	Mottled brown-orange-red, slightly moist, hard, high plasticity. This clay interval is probably weathered siltstone.
SILTSTONE	~0.8 m to depth of refusal (0.9 to 1.1 m)	Highly weathered, mottled orange-brown to white, firm to hard, slightly moist. At eight locations (SB01 to SB03, SB07, SB08, SB10, SB11 and SB15) bedrock siltstone was encountered at depths of approximately 0.8 m. At five other locations, the bores met refusal at similar depths on 'suspected' siltstone bedrock.

6.2 PID Screening Results

Soil samples were screened for the presence of volatile organic compounds (VOCs) using a photo-ionisation detector (PID) in the headspace of bagged samples. The results of PID screening are included in the soil bore logs in Appendix C and summarised as follows:

- > The PID headspace readings are generally low and do not indicate significant or widespread contamination by VOCs (that are normally detected by PID).

6.3 Soil Laboratory Results

6.3.1 Discussion of Site Specific Soil Assessment Criteria

NEPM (NEPC 2013) allows for calculation of EIL based on site-specific physico-chemical parameters measured at the site as shown in Table 6-2 below. More information about the derivation of the copper, nickel and zinc EIL criteria is tabulated in Table B-1, Appendix B. These concentrations relate to urban residential and public open space.

Table 6-2: Summary Table of Physico-chemical Parameters

Analytes	pH	CEC	Fresh/Aged	ABC mg/kg	ACL mg/kg	EIL mg/kg
Cu	9.1	24	Aged	10	210	220
Ni			Aged	5	305	310
Zn			Aged	40	800	840

Notes:

CEC: Cation Exchange Capacity

ABC: Ambient Background Concentration

ACL: Added Contaminant Level

EIL: Ecological Investigation Level

6.3.2 Soil Results

The results of laboratory analysis have been compared against adopted assessment criteria and presented in Table B-1 in Appendix B. An interpretation of these data are summarised as follows:

- > A single sample, SB07/0.1, analysed for benzo(a)pyrene TEQ (upper bound) reported a concentration of 4.6 mg/kg which slightly exceeds the adopted assessment criterion of 4.0 mg/kg for Residential B Health Investigation Level.
- > A single sample, SB13/0.1, analysed for benzo(a)pyrene TEQ (upper bound) reported a concentration of 3.2 mg/kg which slightly exceeds the adopted assessment criterion of 3.5 mg/kg for Residential C Health Investigation Level.
- > All other samples that were analysed reported concentrations either below the limits of reporting (LORs) or otherwise detectable concentrations were below all adopted assessment criteria.

Table 6-3 presents a summary of the results that exceeded the investigation criteria. The laboratory reports from primary and secondary laboratories are provided in Appendix E.

Table 6-3: Summary of Soil Results Exceeding Criteria

Analyte	Adopted Criteria (mg/kg)	Sample ID	Reported Concentration (mg/kg)
Carcinogenic PAHs, as B(a)P TEQ ¹	4.0 ² , 3.0 ³	SB07/0.1	4.6
		SB13/0.1	3.5

Notes:

1. B(a)P TEQ = Benzo(a)pyrene toxic equivalent quotient (calculated from 8 PAH species)
2. Carcinogenic PAHs, as B(a)P TEQ – NEPM 2013 HIL Residential B
3. Carcinogenic PAHs, as B(a)P TEQ – NEPM 2013 HIL Recreational C

6.4 Protection of Beneficial Uses of Land

The results have also been interpreted with reference to SEPP *Prevention and Management of Contamination of Land* (2002) and variation (gazetted 26 September 2013). The following discusses the results of this assessment in relation to the beneficial uses of the site protected by this policy.

Table 6-4 discusses potential risks posed to the protected beneficial uses of land based on the results of soil analysis and in consideration of the findings of the PSI (desktop and site history research) and DSI findings.

Table 6-4: Risk to Protected Beneficial Uses

Protected Beneficial Use	Risk Potential
Maintenance of modified ecosystems	All samples analysed reported contaminant concentrations below the adopted environmental assessment criteria. Therefore, the near-surface soils are not considered likely to cause harm to modified ecosystems.
Human health	One near-surface soil sample, SB07/0.1, reported a concentration slightly exceeding the NEPM HIL-B criterion for carcinogenic PAHs (as B(a)P TEQ) adopted for high density residential use (in this case the location of proposed multi-storey residential apartments). A deeper sample, SB07/0.5, was collected at this location to test whether the B(a)P has leached into the underlying natural soil (clayey silt). The sample reported the concentrations of all PAH analytes to be below LOR, indicating that the elevated PAHs are limited to near-surface fill, and possibly sourced from the car park asphalt. PAH concentrations were compared with those expected in road asphalt and were found to be similar for the PAH analytes (Ifenna & Osuji, 2013). One near-surface soil sample, SB13/0.1, reported a concentration slightly exceeding the NEPM HIL-C criterion for carcinogenic PAHs (as B(a)P TEQ)

Protected Beneficial Use	Risk Potential
	<p>adopted for recreational use (in this case in the location of an above-ground car parking lot). It was decided that the analysis of a deeper sample was not required for the following reasons:</p> <ul style="list-style-type: none"> • The PAH exceedance is very slight (measured concentration of 3.2 mg/kg against a criterion of 3.0 mg/kg). • The fill, as described in the SB13 bore log, is reported as silty gravel and does not include any wastes, staining or odours. • The sample analysed is near-surface and the PAH may be sourced from the asphalt car park surface. The fill extends to only 0.3 m, with the underlying clayey silt interpreted to be natural soil, most likely to be weathered siltstone. • The proposed development of a car park at this location indicates that recreational users of the site will not be impacted.
Buildings and structures	<p>While full assessment of potential risks to buildings and structures falls outside the scope for this assessment, field observations combined with the results of pH analysis suggest a low likelihood of corrosion risk due to contamination. Table 6.4.2(C) of Australian Standard AS2159-2009 <i>Piling - Design and Installation</i> shows the severity of soil pH and sulphate concentrations on concrete.</p> <p>Soil pH was tested in near-surface soils at three locations and reported values ranging from 8.3 to 9.9 units. Based on the limited pH results and relative to Table 6.4.2(c) of the AS2159 guideline, soil at the site is considered to be “non-aggressive” to concrete structures.</p>
Aesthetics	<p>Field observations made during the site inspection and sampling program did not identify soil or materials that might be considered offensive to the senses. As such, it is considered unlikely that soil quality at the site would pose a risk to the aesthetics of land.</p>
Production of food, flora and fibre	<p>Two of the samples reported concentrations exceeding the adopted assessment criteria for carcinogenic PAHs (as B(a)P TEQ). Therefore, it is considered possible that the near-surface soils may cause harm to plant species at some locations at the site. However, the proposed development at these locations does not include the planting of flora and therefore this beneficial use will not be relevant.</p>

7 Conceptual Site Model

As per the requirements of NEPC 2013, a preliminary Conceptual Site Model (CSM) of contamination has been prepared. A brief interpretation is presented below:

- > **Potential Contamination and Source:** The Contaminants of Potential Concern identified as part of the desktop site history review and site investigation were metals, PAHs and hydrocarbons in potential imported fill beneath the site surface.
- > **Potential Exposure Pathways:** Dermal contact/ingestion of soils impacted by metals, PAHs and petroleum hydrocarbons (either as a result of direct contact in-situ or from wind erosion/atmospheric dispersion of dust); inhalation of petroleum hydrocarbon vapours; and uptake by plant roots.
- > **Potential Receptors:** On-site and off-site occupants, commercial workers, maintenance workers and ecosystems.
- > **Completion of Pathway:** Carcinogenic PAHs in near-surface soils were reported in concentrations slightly exceeding the adopted assessment criteria. The source of the contamination is considered to be near-surface fill beneath the asphalt surface of the car park. As such, the pathway is considered complete.

8 Summary of Conclusions and Recommendations

8.1 Summary of Contamination Potential

The site history review has identified several potential sources of contamination which are described in detail in Section 3.5 of this report (including Table 3-4). Their locations are shown in Figure 3, Appendix A. These include the following:

- > Contaminated fill may have been used beneath the sealed car park surface at the site. Potential exists for the fill to impact the natural soils and groundwater at the site. (EAA1)
- > Panel beater and automotive repair premises to the east of the site are a potential source of groundwater contamination as a result of possible spillage or leakage of fuels or chemicals used at these premises (EAA2). A potential groundwater plume may extend beneath the subject site and present a soil vapour hazard.
- > The service station to the south-west of the site represents a potential source of petroleum hydrocarbons in groundwater should there have been leakage or spillage of fuels at this location (EAA3). A groundwater plume may extend beneath the subject site and present a soil vapour hazard.
- > Imported fill may be present beneath buildings and other infrastructure around the site, and is a possible source of contamination of the groundwater beneath the site, should contaminants leach into the groundwater (EAA4).

8.2 Soil Contamination Assessment

Cardno did not identify any visual or odorous indications of contamination during the soil sampling program. At most soil sample locations the fill comprises sandy silt and silty gravel, with no obvious contamination. At two locations (SB12 and SB13), bluestone gravels were noted in the fill.

The results of the limited soil sampling and testing indicate that:

- > Fill is present in all areas tested, typically occurring to depths of 0.4 m to 0.5 m below ground level and terminating on bedrock siltstone. The fill was reported to be sandy silt to silty gravel with no visible or odorous evidence of contamination.
- > Soil vapour screening using a photo-ionisation detector (PID) did not record any elevated concentrations that may indicate contamination by potential petroleum hydrocarbons or other volatile organics.
- > Two samples (SB13/0.1 and SB15/0.3) reported heavy mineral TRH concentrations above the limit of reporting (LOR). However, the concentrations are not significantly high and do not exceed any adopted assessment criteria.
- > At one test location (SB07), the near-surface soil sample reported a concentration of carcinogenic PAHs slightly exceeding the adopted health investigation level (HIL-B) criterion for high density residential land use.
- > At one test location (SB13), the near-surface soil sample reported a concentration of carcinogenic PAHs slightly exceeding the adopted health investigation level (HIL-C) criterion for recreational land use.

8.3 Significance of Results

In the context of the proposed development of the site for a nurse training facility, high density residential apartments and car parking, the carcinogenic PAH contamination identified in fill is considered to be a low potential risk at the site. It is considered likely that the contamination in the near-surface fill may be a result of PAH analytes leaching from the overlying asphalt surface, rather than being sourced from imported fill containing contaminants such as ash.

The PAH contaminated soil is unlikely to represent a risk to the health of future site occupants and workers, including site construction and maintenance, and is considered no greater risk than the existing asphalt car park surface, which is likely to contain significantly higher concentrations of PAH.

The low concentrations heavy mineral TRH reported at two locations at the site are not considered to represent contamination that warrants any further testing or follow-up. The PID results do not indicate that the TRH extends to deeper levels of the fill or natural soil, and it is considered possible that the TRH is sourced from seepage of small amounts of fuels or oils from vehicles, given the use of the site as a car park, including at bores SB13 and SB15.

Given the proposed site development and the limited extent of soil sampling at the site, the presence of pockets of contamination occurring elsewhere at the site cannot be discounted. Therefore, if soils are proposed to be removed from the site during development, the bulk soils will need to be assessed and classified prior to off-site disposal.

Given the distance of the service station from the site and its hydraulically cross-gradient location (to the south-west of the site), the risk of a petroleum hydrocarbon plume in groundwater beneath the site is considered to be low. The panel beaters and automotive repairs businesses are hydraulically up-gradient to cross-gradient from the site, and therefore there is potential for contaminants from these sites to impact groundwater beneath the subject site, if they leaked or were spilt in significant quantities. During the soil sampling program, Cardno did not record elevated PID readings that may indicate soil vapours from a groundwater plume. However, the presence of hydrocarbon vapours elsewhere at the site cannot be discounted. It is noted that groundwater beneath the site is relatively deep. Piezometers installed at three locations at the site, as part of Cardno's geotechnical investigation, recorded water levels ranging from 13 m to 14 m below ground level. No hydrocarbon odours were reported in the piezometers or during drilling of the bores.

8.4 Recommendations

Cardno recommends that:

- > Based on the information presented in this report, the soils at the site did not report contamination that would preclude the proposed development.
- > Sufficient information is presented in this assessment to conclude that an environmental audit, as described in Potentially Contaminated Land General Practice Note (DSE, 2005), is not required at the site.
- > Should soils be removed from the site at the time of construction works during the proposed development, the soils will need to be sampled, laboratory tested and categorised for disposal to an off-site facility.

9 References

Legislation and Guidelines

1. *Environment Protection Act*, 1970 (Act No.8056/1970), Victoria.
2. Government of Victoria (1997) *State Environment Protection Policy (Groundwaters of Victoria)*, Victorian Government Gazette, S160, 17 December 1997.
3. Government of Victoria (2002) *State Environmental Protection Policy (Prevention and Management of Contamination of Land)*, Victorian Government Gazette, S95, 4 June 2002.
4. Government Victoria (2013) *Variation to the State Environmental Protection Policy (Prevention and Management of Contamination of Land)*, Victorian Government Gazette, G39, 26 September 2013.
5. *Water Act*, 1989 (Act No. 80/1989), Victoria.

General References

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Specific References

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Appendix A

4 Pages

Figures

Figure 1: Site Locality Plan

Figure 2: Site Layout Plan

Figure 3: Environmental Assessment Areas

Figure 4: Bore Location Plan

Appendix B

5 Pages

Tables of Test Results

Table B-1: Soil Analytical Results

Table B-2: RPD Results

Table B-3: Rinsate and Trip Blank Results

Appendix C

16 Pages

Bore Construction Details

Soil Bores SB01 to SB15

Cardno UCS

Appendix D

4 Pages

Site Photographs

Plate 1: Northern car park – looking north-west

Plate 2: Central / northern car park, showing proposed bore SB05 – looking west

Plate 3: Central car park – looking south-west

Plate 4: Central / southern car park – looking north

Plate 5: South-west car park – looking south-west

Plate 6: Recreation area, showing proposed bore SB14 – looking south-east

Plate 7: Walk-way in south-west part of site – looking east

Plate 8: Drill rig at bore SB02 in north car park – looking north-west

Appendix E

68 Pages

Laboratory Reports & Chain of Custody Records

Eurofins-mgt Laboratory (Primary):

Report No. 532061

Report No. 533268

ALS Laboratory (Secondary):

Report No. EM1700852

Data Quality Validation Report

Appendix F

19 Pages

Checksite Historical Report

Appendix G

128 Pages

Checksite Site Report

Property and Planning Reports

Appendix H

17 Pages

Checksite Environmental Report

Appendix I

11 Pages

Checksite Geology and Groundwater Report

Appendix J

3 Pages

Fieldwork Record Sheets

PID Calibration Certificate

Quality Control Register

Appendix K

3 Pages

Information about Environmental Reports