Mirvac Projects Pty Ltd

Australian Technology Park Detailed Site Assessment

2 Locomotive Street, Eveleigh NSW

9 December 2015

51142/101779 (Rev C)

JBS&G

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Abbreviations

Term	Definition
ACM	Asbestos Containing Material
AEC	Area of Environmental Concern
AF/FA	Asbestos Fines / Fibrous Asbestos
AHD	Australian Height Datum
ASLP	Australian Standard Leaching. Procedure
ASS	Acid Sulphate Soils
AST	Aboveground Storage Tank
ATP	Australian Technology Park
bgl	Below Ground Level
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CBA	Commonwealth Bank of Australia
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DA	Development Application
DQI	Data Quality Indicator
DQO	Data Quality Objectives
DP	Deposited Plan
DPI Water	NSW Department of Primary Industry - Water
EMP	Environmental Management Plan
EPA	NSW Environment Protection Authority
ESL	Ecological Screening Level
Ha	Hectare
HIL	Health-based Investigation Level
HSL	Health Screening Level
JBS&G	JBS&G Australia Pty Ltd
LOR	Limit of Reporting
Mirvac	Mirvac Projects Pty Ltd
OCP	Organochlorine Pesticides
OPP	Organophosphorus Pesticides
NEPC	National Environment Protection Council
OEH	NSW office of Environment and Heritage
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan

Term	Definition
RPD	Relative Percentage Difference
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total Recoverable Hydrocarbons
TPH	Total Petroleum Hydrocarbons
SSDA	State Significant Development Application
UGDC	UrbanGrowth NSW Development Corporation
UST	Underground Storage Tank
VENM	Virgin Excavation Natural Material (as defined in *POEO Act*)
VOC	Volatile Organic Compound

Executive Summary

Introduction and Objectives

JBS&G Australia Pty Ltd (JBS&G) was engaged by Mirvac Projects Pty Ltd (Mirvac, the client) to prepare standalone site-wide detailed site investigation (DSI) report for a portion of the Australian Technology Park (ATP). The Mirvac developable site, herein referred to as the 'site', forms a portion of ATP and is legally identified as Lots 8, 9, 12 in Deposited Plan (DP) 1136859, Part Lot 13 in DP 1136859, Part Lot 10 in DP 1136859 and Lot 505 in DP 1033739 and occupies an area of 11.6 ha.

This report supports a State Significant Development Application (SSDA) to be submitted to the Department of Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Mirvac is seeking to secure approval for the redevelopment of three Developable Lots (Lots 8, 9 and 12) within the site for business/commercial premises along with public domain works. Building heights of 4, 7 and 9 storeys are proposed across the development site. In addition, a concept proposal for the continued commercial use and adaptive reuse of the heritage listed Locomotive Workshop also forms part of this project.

ATP has been continuously developed since its establishment in 1996, but has been underutilised as a technology and business precinct for quite some time. UrbanGrowth NSW Development Corporation (UGDC) has actively encouraged new development and employment opportunities at the site for the past fifteen years, and Mirvac intends to continue upon this and deliver upon the precinct's full potential.

Scope of Work

The scope of works completed for this assessment comprised:

- A review of available historical information to identify potential areas of environmental concern;
- Review and collation of available information in relation to site natural and contamination conditions;
- Development of a conceptual site model (CSM); and
- Comparison of available data with relevant endorsed criteria to assess, from a contamination perspective, the suitability of the site/individual land parcels for the permissible land uses.

Conclusions and Recommendations

The following summarises the contamination status at the site:

Numerous historical site investigations have assessed the contamination conditions at the site over the last 22 years, with the total number of investigation locations exceeding those recommended by endorsed guidelines;

Fill materials are present underlying the site and variously comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, slag, sedimentary clast and construction rubble;

Fill materials within Developable Lots were reported to contain concentrations of heavy metals, total petroleum hydrocarbons (TPHs)/total recoverable hydrocarbons (TRH) and polycyclic aromatic hydrocarbons (PAH) exceeding adopted ecological criteria and in relatively few locations, adopted health-based criteria, and no significant amounts of volatile contaminants were detected in fill materials;

However, there was no discernible pattern to the distribution of contaminants within the fill material and the impact was not confined to any particular portion(s) of the site. Furthermore, the vertical extent of potential contamination in fill material is considered to be consistent with the depth of fill material;

- Elevated volatile contaminants of potential concern (COPC) concentrations in fill materials at isolated locations within Lot 9 at BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 within were reported to historically exceed the adopted health-based criteria. Further assessment of current fill conditions at these locations with respect to the proposed future land uses is required;
- Asbestos was identified in isolated samples (BH12/0.1-0.2 within Lot 8, BH10/2.0-2.1 within Lot 9, BH2/3.0-3.0 and BH4/0.35-0.4 within Lot 12). Given the occurrence of anthropogenic inclusions and historical investigation methods used, potential remains for more widespread asbestos impact within the fill materials in portions of the site, and development of a suitable unexpected finds protocol should be considered; ;
- Previous investigations have considered the risk of ASS/PASS to be low, however there has reported to be uncertainty in the potential for acid sulfate soils (ASS)/potential acid sulfate soils (PASS) within natural soils at depth. Further consideration of the potential for ASS/PASS and management measures is required if development activities involve significant excavation of natural soils beneath the water table;
- Fill materials within public domain areas have been identified to contain elevated concentrations of heavy metals, PAHs and TPH/TRH, generally consistent with that reported for Developable Lots that will require management. Non-Statutory Section A Site Audit Statement (SAS) has been issued for public domain areas within the ATP certifying that public domains are suitable for the proposed ongoing recreation and/or commercial/ industrial land uses subject to implementation of the environmental management plan (EMP) prepared for these land parcels;
- A SAS has been issued for Lot 10 certifying that Lot 10 is suitable for commercial land use subject to implementation of the EMP prepared for this land parcel;
- On the basis of potential variability in fill quality and identification of anthropogenic inclusions within the fill soil profile, aesthetic issues require management;
- Elevated sub-slab soil vapour trichloroethlene (TCE) concentrations have been reported underlying Bays 5 and 6 of the Locomotive Workshop. However, ambient air quality results from within the building collected as part of ongoing EMP requirements were all below the adopted assessment criteria. As such, no current risk from sub-slab vapour conditions has been reported, however, additional assessment of sub-slab vapour conditions underlying the Locomotive Workshop may be warranted to support ongoing management if the exposure scenario changes under the adaptive reuse or change to the EMP is necessary;
- Lead paint dust has been identified within the Locomotive Workshop requiring ongoing management;
- As documented in SAS's prepared of the ATP precinct and discussed in **Section 5**, groundwater has been assessed across the broader ATP precinct and no groundwater remediation is considered to be required; and
- The potential for detrimentally affecting groundwater conditions, for example by increased contaminant leaching, needs to be considered in the redevelopment. This includes, but is not limited to, fill materials at BH508 (Lot 9) and within the top 1.5 m of fill materials within the central and central-northern portions of Lot 12 that have been identified as potentially

containing leachable zinc and lead concentrations, respectively, which may require management with respect to future development of the Lots.

On this basis, it is considered that the site can be made suitable for the proposed land use provided that a suitable remediation plan/management strategy is appropriately implemented as part of site redevelopment to address identified contamination issues at the site.

It is recommended that a management strategy and/or Remedial Action Plan (RAP) be developed and implemented in accordance with the relevant regulatory requirements to manage the identified contamination issues at the site so as to render the Developable Lots and areas of adaptive reuse suitable for their permissible uses.

1. Introduction and Background

1.1 Introduction

JBS&G Australia Pty Ltd (JBS&G) was engaged by Mirvac Projects Pty Ltd (Mirvac, the client) to prepare standalone site-wide detailed site investigation (DSI) report for a portion of the Australian Technology Park (ATP). This report supports a State Significant Development Application (SSDA) to be submitted to the Department of Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The ATP, for which the site is part, comprises a 13.2 hectare (ha) parcel of land and is occupied by a number of modern high rise buildings, heritage industrial buildings, private roads and public domains, as shown in **Figures 1** and **2**. The Mirvac developable site, herein referred to as the 'site', is legally identified as Lots 8, 9, 12 in Deposited Plan (DP) 1136859, Part Lot 13 in DP 1136859, Part Lot 10 in DP 1136859 and Lot 505 in DP 1033739 (**Figure 3**) and occupies an area of 11.6 ha. The site includes the Locomotive Workshop, public roads/domains (roads and pedestrian easements, recreational facilities and the eastern most extent of Lot 10 DP 1136859) and Developable Lots (Lots 8, 9 and 12). The footprints of existing ATP site structures (including the International Business Centre, National Innovation Centre, Traffic Management Centre (formally the RTA Building), Ambulance Service Building and Biomedical Building footprints) within Lot 13 DP 113659 fall outside the site boundaries and are not part of the site, as shown on **Figure 2**.

The ATP, including the site, has been subject to a number of previous investigations which have identified historical land uses comprising locomotive workshops, foundries, railway sidings and goods yards. The ATP, including and site, was used to manufacture components required for steam locomotive assembly and repair. Site activities were reported to have comprised brass, iron and steel founding, heavy engineering machining, blacksmith works, refuelling, cleaning, degreasing, including the use of solvents and paints.

Soil impact has been identified as associated with hot-spots of semi- and non-volatile petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAH), and/or heavy metals, associated with fill materials historically used across the site or resultant from historical site activities. Localised areas of asbestos impact have been reported.

It is understood Mirvac has been announced by UrbanGrowth NSW Development Corporation (UGDC) as the successful party in securing ownership and redevelopment rights for the site for ongoing use as a campus style precinct catering for science and technology bases occupants. In addition, it is further understood Mirvac propose to develop Developable Lots 8, 9 12 in DP 1136859 for commercial land use, with Lots 8 and 9 to potentially including a childcare facilities (or similar). Adaptive reuse of Locomotive Workshop is proposed for ongoing commercial land use excluding childcare facilities.

This DSI report documents the current environmental status of the site and assesses the suitability of Developable Lots and areas of adaptive reuse (Locomotive Workshop) for their proposed uses, or if such conclusion cannot be made, demonstrates that they can be made suitable for the proposed uses through management and/or remediation. This document is intended to also assist Mirvac with their understanding of the site contamination status and preparation of a SSDA submission. This document relies on available documents as presented in **Section 5**.

The investigation was developed in accordance with guidelines made or approved by the NSW Environment Protection Authority (EPA) and relevant Australian Standards.

1.2 Objectives

The objective of the standalone site-wide DSI report were to:

- Collate and review available data to provide a single stand-alone characterisation document summarising site contamination conditions in relation to the permissible site land uses and identify associated ongoing environmental management requirements; and
- Provide sufficient data to support the preparation of a site-wide remedial action plan (RAP) so as to optimise the manner in which potential issues that may negatively impact upon future development and/or infrastructure services upgrades are addressed from a contamination management perspective.

1.3 Scope of Works

The scope of works completed for this assessment comprised:

- A review of available historical site use and background information to identify potential areas of environmental and chemical concern;
- Review and collation of available regional and site specific information in relation to geology, hydrogeology, etc. including previous environmental and geotechnical site investigation data to confirm site conditions and the presence of potential areas of environmental concern (AEC);
- Development of a site-wide conceptual site model (CSM) based on the available information specific to the site; and
- Comparison of available site investigation data with relevant health/ecological based site assessment criteria sourced from NSW EPA endorsed guidelines to assess, from a contamination perspective, the suitability of the site/individual land parcels for the permissible land uses.

1.4 Site Development and Frame Work

Introduction

This report supports a SSDA to be submitted to the Department of Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Mirvac is seeking to secure approval for the urban regeneration of the Australian Technology Park (ATP), including the redevelopment of three car parking lots within ATP for the purposes of commercial, retail and community purposes, along with an extensive upgrade to the existing public domain within ATP. Building heights of 4, 7 and 9 storeys are proposed across the 3 development lots.

ATP has been continuously developed since its establishment in 1996, but has been underutilised as a technology and business precinct for quite some time. UrbanGrowth NSW Development Corporation (UGDC) has actively encouraged new development and employment opportunities at the Park for the past 15 years, and Mirvac intends to continue upon this and deliver upon the precinct's full potential, with the development of circa 107,400 m^2 for employment uses, which will facilitate the employment homes of an extra 10,000 staff everyday within ATP by development completion.

Background

Mirvac has been announced by UGDC as the successful party in securing ownership and redevelopment rights for the ATP precinct (the site), following an Expression of Interest (EOI) and an Invitation to Tender (ITT) process which commenced in 2014. Mirvac has also secured the Commonwealth Bank of Australia (CBA) as an anchor tenant for the development and intends to

immediately commence the urban regeneration of this precinct through the lodgement of this SSDA. CBA's commitment to the precinct is in the form of one of the largest commercial leasing pre-commitments in Australian history, occupying circa 95,000 square metres of commercial, retail, community and childcare NLA, which will house circa 10,000 technology focused staff by 2019 and 2020. Mirvac's redevelopment goes well beyond the development on the 3 development lots, as it includes the regeneration of the public domain within ATP, the addition of retail to activate the precinct and also the provision of community facilities such as a community centre, a gym and 2 x 90 child childcare facilities.

Site Description

The ATP precinct is strategically located approximately 5 km south of the Sydney central business district (CBD), 8 km north of Sydney airport and within 200 m of Redfern Railway Station. The ATP precinct, with an overall area of some 13.6 hectares, is located within the City of Sydney local government area (LGA), as shown in **Figure 1**.

Three key lots remain undeveloped within the ATP precinct and are presently used for at-grade worker and special event car parking. These sites are:

- Lot 8 in DP 1136859 – site area circa 1,937 m^2;
- Lot 9 in DP 1136859 – site area circa 8,299 m^2; and
- Lot 12 in DP 1136859 – site area circa 11,850 m^2.

The ATP site layout is shown in **Figure 2**.

In addition, the site contains the Locomotive Workshops which is a large heritage listed masonry and steel former railway building, which has undergone adaptive reuse in recent years for commercial purposes. The SSDA works boundary excludes the Locomotive Workshop. Future development associated with the adaptive re-use of the Locomotive Workshop will be the subject of separate future applications.

Overview of Proposed Development

The development application seeks approval for the following components of the development:

- Site preparation works, including demolition and clearance of the existing car parking areas/ancillary facilities and excavation;
- Construction and use of a 9 storey building within Lot 9 (Building 1), comprising of parking, retail, commercial and childcare uses;
- Construction and use of a 7 storey building within Lot 12 (Building 2) comprising of parking, retail and commercial uses;
- Construction and use of a 4 storey community building within Lot 8 (Community Building) comprising of gym, retail, community, commercial and childcare uses;
- Extensive landscaping and public domain improvements throughout the precinct for the benefit of the local community; and
- Extension and augmentation of physical infrastructure/utilities as required.

A more detailed and comprehensive description of the proposal is contained in the Environmental Impact Statement (EIS) prepared by JBA. Design Plans for Lots 8, 9 and 12 are provided in **Appendix A**.

Adaptive reuse and refurbishment of the Locomotive Workshop for commercial purposes is proposed in future development.

It is understood works are to be undertaken in a staged manner.

Planning Framework

State Environmental Planning Policy (SEPP) Major Development 2005 is the principal environmental planning instrument applying to the site. Schedule 3, Part 5 of the Major Development SEPP sets out the zoning, land use and development controls that apply to development on the site.

As the development has a capital investment value of more than $10 million it is identified as State Significant Development under the State Environmental Planning Policy (State and Regional Development) 2011, with the Minister for Planning the consent authority for the project.

2. Site Condition & Surrounding Environment

2.1 Site Identification

This site is a part of the ATP campus style precinct catering for science and technology based occupants, in a historical setting, comprising heritage renewal as well as modern state of the art facilities. The site is located approximately 5 km south of the Sydney CBD, 8 km north of Sydney airport and within 200 m of Redfern Railway Station. The site, with an overall area of some 11.6 hectares, is located within the City of Sydney LGA.

The site is bound to the north by a railway easement, east by Garden and Cornwallis Streets, south by Henderson Road and to west by Alexander Street and a childcare facility.

The location of the site is shown in **Figure 1**, current layout is shown in **Figure 2**. Site details are summarised in **Table 2.1**.

Table 2.1 Summary Site Details

Lot Numbers (as shown on **Figure 3**)	Lots 8, 9, 12 in DP 1136859 Part Lot 13 in DP 1136859 Lot 505 in DP 1033739 Part Lot 10 in DP 1136859
Street Address	Australian Technology Park, 2 Locomotive Street, Eveleigh, NSW
ATP Site Area	Approximately 13.2 ha
Site Area	Approximately 11.6 ha, as shown in **Figure 3**
Local Government Authority	City of Sydney
Geographic Coordinates (MGA 56)	Please refer to **Figure 3**
Zoning	SEPP Major Development 2005 under the City of Sydney Local Environment Plan 2012
Previous Land Uses	Locomotive workshops, foundries, railway sidings and goods yards
Current Land Uses	Lot 8 DP 1136859 – vacant land / car park Lot 9 DP 1136859 – vacant land / car park Lot 12 DP 1136859 – vacant land / car park Lot 13 DP 1136859 and Lot 505 DP 1033739 – campus style precinct comprising heritage renewal as well as modern state of the art facilities for science and technology based occupants (commercial land use). In addition areas of public open space comprising roads, a sports oval, tennis courts and picnic facilities (recreational land use) Lot 10 DP 1136859 – commercial land use
Proposed Developable Land Uses	Part Lot 10 DP 1136859, Part Lot 13 DP 1136859 and Lot 505 DP 1033739 – ongoing commercial/industrial (road and pedestrian easements) and recreational land uses Lot 8 DP 1136859 – commercial potentially including a child care centre Lot 9 DP 1136859 – commercial potentially including a child care centre Lot 12 DP 1136859 – commercial Locomotive Workshop (part Lot 13 DP 1136859) –adaptive reuse for commercial land use

2.2 Site Layout

The site is defined as part ATP precinct, comprising the public domain areas of the ATP precinct (roads, pedestrian easements and recreations facilities) including the pedestrian easement between Lots 10 and 12, the Locomotive Work Shop and Developable Lots (Lots 8, 9 and 12). Areas excluded from the site include the footprints of existing structures within Lot 13 (International Business Centre, National Innovation Centre, Traffic Management Centre, Ambulance Service Building and Biomedical Building) and land currently tenanted by Seven Network (Channel Seven – Lots 10 and 11

in DP 1136859) (but including the public domain easement between Lot 10 DP 1136859 and Lot 12 DP 1136859).

Excluding Developable Lots (Lots 8, 9 and 12), the site is occupied/surfaced by either or a combination of the following:

- Road Reserves - primarily surfaced with bituminous concrete, concrete pavements or ceramic pavers with landscaped areas (garden beds with mulch/topsoil ground cover),
- Pedestrian Easements - primarily surfaced with bituminous concrete, concrete pavements or ceramic pavers with landscaped areas (garden beds with mulch/top soil ground cover), and
- Areas of Open Public Space – public accessible parks comprising primarily areas surfaced with grass cover (Vice Chancellors Oval and lawn areas), tennis courts, barbeque picnic area and areas surfaced with bituminous concrete, concrete and/or ceramic pavements with landscaped areas (garden beds with mulch/top soil ground cover).

Developable Lots (Lots 8, 9 and 12) are largely level, surfaced with bituminous concrete pavements with minor areas of exposed soils (garden beds). Lot 12 is noted to comprise two tiers, an upper level flush with the Locomotive Street road frontage, and a low level flush with the Central Avenue road frontage. An earthen/concrete embankment retaining wall of approximately 3-4 m in height separates the two tiers.

Developable Lots are currently used as overflow car parking facilities and proposed to be developed to accommodate commercial land use, with Lots 8 and 9 potentially including childcare facilities or similar.

The Vice Chancellors Oval and recreational areas located within the southern site extent are surfaced with grass cover and also act as a flood detention basin.

The Eastern Suburbs/Illawarra Train Line Tunnel runs below ground parallel to Henderson Road along the southern site boundary.

2.3 Surrounding Land Uses

The surrounding land uses have been identified as comprising:

- North – The site is bound to the north by a railway easement and in turn mixed land use comprising heritage (Carriage Works) renewal (commercial land use - art centre, restaurant/bar and markets), residential allotments and the University of Sydney campus facilities;
- East – The site is bound to the east by Cornwalls and Garden Street, across which are mixed land uses comprising residential and commercial allotments. Several residential and commercial allotments bound the site to the south east (corner of Henderson Road and Garden Street);
- South – The site is bound to the south by Henderson Road, across which are mixed land uses comprising residential and commercial allotments. A child care facility (Alexandria Childcare Centre) bounds the site to the south west. The Eastern Suburbs/Illawarra Train Line Tunnel runs parallel to Henderson Road along the southern site boundary (**Figure 1**); and
- West – The site is bound to the north west by a railway easement and associated infrastructure (RailCorp Depot), Lots 10 and 11 in DP 1136859 comprising commercial land uses (Channel 7 Building) and a child care centre (Alexandria Childcare Centre) to the south west.

Several existing buildings within Lot 13 in DP 1136859 (International Business Centre, National Innovation Centre, Traffic Management Centre, Ambulance Service Building and Biomedical Building)

and Lots 10 and 11 in DP 1136859 (Seven Network Building) line the site periphery, falling outside the subject site.

2.4 Geology and Soils

Review of the Sydney Geological Map (Sheet 9130, 1983[1]) has identified that the site is underlain by Middle Triassic aged Ashfield Shale (regionally) and in turn Hawkesbury Sandstone of the Wianamatta Group, and Quaternary sediments.

Ashfield Shale are characterised by shale and laminate with weathered clays. Quaternary sediments, commonly referred to as the Botany Sand Beds (BSB) in this region, is comprised of unconsolidated to semi-consolidated permeable sands. The sands are medium to fine grained quartz marine sands with minor shell fragments and podzols. The sand is interspersed with lenses of layers of peat, peaty sand, silt and clay, which become more common in the lower part of the sequence. The BSBs can be up to 30 m to 60 m thick and are underlain typically with Hawkesbury Sandstone.

Based upon the Sydney 1:100,000 Soil Landscape series (DLWC 1989[2]) the Site is located within the Blacktown soil landscape group. The landscape is generally characterised by gently undulating rises on Wianamatta shales, local relief to 30 m and slopes usually <5%, broad rounded crests and ridges with gently inclined slopes, cleared eucalypt woodland and tall, open forest (dry sclerophyll forest).

Soils are characteristically shallow to moderately deep (<100 cm) hard setting mottled texture contrast soils, red and brown podzolic soils and crests grading to yellow podzolic soils on lower slopes and in drainage lines.

Limitations of the Blacktown group include moderately reactive, highly plastic subsoil, low soil fertility and poor soil drainage.

Previous investigations, as discussed in **Section 5**, identified fill materials across the entire site with minor exceptions, ranging from a skeletal fill soil profile to 7.6 m in depth (**Figure 4**). In general fill vertical extent is greatest within the northern site extent, adjacent the Locomotive Workshop. Fill materials are considered result from a combination of site activity (waste products) and importation of fill materials to establish site levels. Historical logs depicting the encountered lithology are provided in **Appendix B**.

Fill materials were noted to comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, slag, metal, ceramic, brick, sedimentary clast and construction rubble.

Natural Aeolian sands and/or silty clay soils, and in turn shale/sandstone bedrock were encountered underlying fill materials. Detailed schematic cross section of the identified subsurface conditions are provided as **Figure 5** and **Figures 5A** to **5D.**

2.5 Acid Sulfate Soils

Review of the *Acid Sulfate Soil Risk Map for Botany Bay*[3] indicates that the subject site is located within an area of '*no known occurrence of Acid Sulfate Soils*'. Acid sulfate soils (ASS) are not known or expected to occur in areas having this classification.

Notwithstanding the aforementioned, previous investigations have reported potential for ASS/potential acid sulfate soils (PASS) within natural soils at depth.

With due consideration to the geological and soil characteristics of the site (i.e. peat material), in addition to historical information, management of development activities should assess for the potential for ASS/PASS if development activities involve excavation of natural soils beneath the water table.

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1 1:100 000 *Sydney Geological Map Sheet 9130 Edition 1*, Department of Mineral Resources, Published 1983
2 1:100 000 *Sydney Soil Landscapes Map Sheet 9130 Edition 1*, Department of Land and Water Conservation, Published 1989
3 *Acid Sulfate Soil Risk Map – Botany Bay,* Edition 2, 1997 1:25 000 Ref: 91 30S3. NSW DLWC

The nearest occurrence of identified ASS comprises the sediments of the Alexandra Canal, located approximately 1.4 km to the south the site.

2.6 Topography

A review of the *1:25,000 Botany Bay Topographic M*ap (9130-3-S) indicates that the site lies at an elevation of between approximately 10m and 20m above Australian Height Datum (AHD). The site is reported to slope gently to the south west.

Based on communications with the client, it is understood that site is highly engineered, and alterations to the site's topography are subject to development controls, with the Vice Chancellors and recreational areas used as a stormwater detention basin.

The site is situated within an area of gently undulating rises associated with dune formations. In the vicinity of the site, regional ground levels fall gently toward the south generally toward Shea's Creek, located approximately 600 m to the south east of the site and Alexandra Canal located approximately 1.4 km to the south of the site.

2.7 Hydrology

The nearest surface water receptor is the Alexandra Canal, located approximately 1.4 km to the south of the site. Alexandra Canal flows into the Cooks River, located approximately 4.5 km to the south west of the site which discharges into Botany Bay approximately 6 km to the south west of the site.

Existing pavements occupy greater than approximately 85% of the site and as such, rainfall within the site is anticipated to generally be controlled by the current storm water system, draining toward the Henderson Road site boundary and then into the regional storm water system. It is understood that regional storm water flow occurs via below ground infrastructure to the Alexandra Canal.

In unsealed sections of the site, a portion of rainfall is expected to infiltrate the relatively permeable sandy fill soils, with the remainder of rainfall expected to become surface run off towards the site boundary and then the regional storm water system.

As discussed above, based on communications with the client, it is understood that site is highly engineered, and alterations to the site's topography and in turn hydrology are subject to development controls, with the Vice Chancellors Oval and recreational areas fronting Henderson Road used as a stormwater detention basin.

2.8 Hydrogeology

As discussed in **Section 2.4**, the site lies on the edge of the Botany Sand Beds aquifer. Two main groundwater systems are anticipated to operate in the vicinity of the site and more broadly across the Botany Sand Beds:

- A deeper, confined groundwater system resident in the fractures/porous Hawkesbury Sandstone which form the basement of the Botany Basin aquifer; and
- A shallow unconfined to semi-confined aquifer system resident within the unconsolidated sediments of the Botany Sand Beds.

At a regional level, groundwater flow within the shallow aquifer system is through primary porosity, where water flows between the grains of sediments. The inflows, outflows and storage of the Botany Sand Beds define the water balance. Recharge is predominantly through rainfall infiltration although some water is also imported into the basin from Sydney Water's reticulated mains supply.

Consistent with the historical extensive use of groundwater in the Botany Sands aquifer, a significant number of registered groundwater wells (predominantly downgradient of the site) have previously been identified in proximity of the site. A review of the Botany Groundwater Management Zones

map (DNR 2009[4]) indicates that the site is partially located within, and downgradient areas are located within, Zone 2 of the Botany Sands Aquifer Embargo Area. The DNR indicate that the Embargo Area "*incorporates localities with known or suspected contamination from past industrial activity*". Residents of properties situated within this zone are advised that groundwater use is now banned, especially for drinking water, watering gardens, washing windows and cars, bathing or to fill swimming pools. Industrial users are required to test the bore water at least annually and provide the results to the NSW Department of Primary Industry - Water (DPI) and the Office of Environment and Heritage (NSW OEH).

Previous assessment (see **Section 5**) within the site has identified groundwater at depths of 16.8 m AHD within the norther site extent falling to 13.2 m AHD within the southern site extent.

Previous assessments (see **Section 5**) inferred that shallow groundwater within the fill material and unconsolidated alluvial sediments flows in a southerly direction. As discussed above, previous assessment have identified the potential for the Eastern Suburbs/Illawarra Train Line Tunnel along Henderson Road to influence groundwater flow direction.

Regional groundwater movement in the deeper confined sandstone/shale bedrock underlying the site is expected to flow in a south westerly direction consistent with the topography to Botany Bay and the Shea's Creek/Alexandra Canal system.

2.9 Meteorology

A review of average climatic data for the nearest Bureau of Meteorology monitoring location (Sydney Airport AMO[5]) indicates the site is located within the following meteorological setting:

- Average minimum temperatures vary from 7.2 in July to 19.0 in February;
- Average maximum temperatures vary from 17.0 in July to 26.5 in January;
- The average annual rainfall is approximately 1083 mm with rainfall greater than 1 mm occurring on an average of 96 days per year; and
- Monthly rainfall varies from 60 mm in September to 121 mm in June with the wettest periods occurring on average in February, March and June.

[4] Botany Groundwater Management Zones map, www.water.nsw.gov.au/water-management/water-quality/groundwater/botany-sand-beds-aquifer/Botany-Sands-Aquifer/default.aspx NSW Department of Natural Resources (DNR 2009)

[5] http://www.bom.gov.au/climate/averages/tables/cw_066037.shtml Commonwealth of Australia, 2013 Bureau of Meteorology, Product IDCJCM0028 prepared at 20 October 2015 and accessed by JBS& on 20 October 2015.

3. Site History

The following summarises the ATP site history presented in previous reports described in **Section 5**. The ATP site was occupied by a large complex of rail workshops and yards throughout the late nineteenth and most of the twenty century. The northern portion of the ATP precinct, adjacent the railway lines was occupied by the Eveleigh Locomotive Workshops, while the southern ATP extent was occupied by the Alexandria Goods Yards.

Based on review of historical investigations (**Section 5**), the ATP site was used to manufacture components required for steam locomotive assembly and repair. As such, ATP site activities were reported to have comprised brass, iron and steel founding, heavy engineering machining, blacksmith works, refuelling, cleaning, degreasing, including the use of solvents and paints.

As part of its development, the ATP site was extensively filled and built up with a range of hard fill material including sand, clay, railway ballast, construction and demolition and other waste materials (see **Figure 4** for inferred fill depth). Fill materials were reported resultant from site derived waste and materials importation.

The primary potentially contaminating activities at the ATP site was considered to be its previous use as part of the Eveleigh Railway Workshops. Workshops included a paint shop, potash shed, wheel press, welder shop, copper shop, Oliver shop, tin smiths and pattern shop among others. The Locomotive Workshop was partitioned to accommodate a blacksmiths, fitter shop, machine shop, fabrication shop etc. Other significant buildings included the Engine Shop, foundry and Alexandria Goods Shed (**Figure 6**).

The potash shed was reported to have been used to wash dirt and grease from the locomotive wheels and axles and to remove rust and scale through acid bath drenching.

The central site extent housed a significant building being 240 m long and 40 m wide by 10 m high, located across Lot 12 and Central Avenue and extending into Lots 10 and 11 beyond the site boundary. Furnaces, smelting apparatus and furnace pits were reported, with the building surfaced with a dirt floor. The building in this area was reported to have comprised three sections for casting, one each for iron, brass and steel.

Lots 8 and 9 in DP 1136859 and recreation areas within the southern site extent formed part of the former Alexandria Goods Shed which was demolished in the 1980s. The shed is understood to have been used for the storage and re-distribution of coke, coal, wood, grain and livestock via railway.

Archaeological reports presented in previous reports indicated that an underground storage tank (UST) may have been located between the Locomotive Workshop and the large erecting shop (**Figure 2**). The contents of the potential UST were unknown. In addition, it was reported solvent like substances were stored in a UST(s), along with a waste oil separator in the north eastern site extent. No records of UST(s) and the waste oil waste oil separator removal and validation were made available or discussed in historical reports.

Major fuel storage and dispensing was largely associated with infrastructure on the perimeter of the site north of Lots 10 and 11 in DP 1136859 () resulting in some localised soil and groundwater contamination. Lots 10 and 11 in DP 1136859 have recently been the subject of a Site Audit Statement (SAS), certifying the lots are suitable for commercial land use subject to implementation of an EMP (DP[6]). Lot 10 is understood to have a multi-level basement, with the basement likely terminating in natural soils. It is further understood that the basement does not extend to the south eastern most extent of Lot 10.

[6] It is noted that a copy of the Lot 10 and 11 SAS and associated Douglas Partners Pty Ltd EMP was not made available for review

Although the aforementioned historical information does not contain details specific to each site portion or Lot uses, and detailed locations of former petroleum or chemical infrastructure, the limited specific history has been compensated for by the density of investigation locations (**Section 5** and shown on **Figure 7A** to **7D**).

4. Assessment Criteria

4.1 Regulatory Guidelines

The assessment has been undertaken with consideration to aspects of the following guidelines, as relevant:

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

Contaminated Sites: Sampling Design Guidelines. NSW Environment Protection Authority 1995 (EPA 1995).

Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites. NSW Office of Environment and Heritage 2011 (OEH 2011).

Contaminated Sites: Guidelines for the NSW Site Auditor Scheme 2nd Edition. NSW Department of Environment and Conservation 2006 (DEC 2006).

Waste Classification Guidelines Part 1: Classifying Waste. NSW EPA November 2014 (EPA 2014).

Contaminated Sites: Guidelines on Duty to Report Contamination under the Contaminated Land Management Act 1997 (as amended 2015). NSW EPA 2015 (EPA 2015).

Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination. NSW Department of Environment and Conservation 2007 (DEC 2007)

National water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000. Australian and New Zealand Environment and Conservation Council. Agriculture and Resource Management Council of Australia and New Zealand (ANZECC 2000).

Guidelines for Managing Risks in Recreational Water. Australian Government, National Health and Medical Research Council 2008 (NHMRC 2008).

4.2 Soil Criteria

4.2.1 Site Assessment Rationale

The site is proposed to be used for ongoing commercial land use as a campus style precinct catering for science and technology based occupants with areas of recreational land use.

Lots 8 and 9 are proposed to be developed to accommodate commercial land uses potentially including childcare facilities (or similar).

Lot 12 and the Locomotive Work Shop are proposed for ongoing commercial land use.

Part Lot 10, comprising public domain areas is proposed for ongoing commercial land use.

Part Lot 13 and Lot 505 DP 1033739, comprising public domain areas, is proposed for ongoing commercial/industrial (roads and pedestrian easements) and recreational (sport facilities and open space) land uses.

Based on the proposed development/adaptive reuse details and ongoing recreational/commercial land uses, and in accordance with the decision process for assessment of urban redevelopment sites (DEC 2006), concentrations of contaminants in the soil have been compared against published ecological/health based investigation levels as presented in **Tables 4.1** and **4.2**, sourced from the following:

Lots 8 and 9

- Health-based Investigation Levels (HIL) for Commercial Land Use potentially including a Childcare Centre (HIL-A) – NEPC (2013);
- Health Screening Levels (HSLs) for vapour intrusion, coarse grained soil for Commercial Land Use potentially including a Childcare Centre (HSL-A) at various depths – NEPC (2013);
- Management limits for hydrocarbons for Urban Residential, Parkland and Public Open Space uses, coarse grained soil – NEPC (2013);
- Generic and Derived Investigation Levels (EILs) for Urban Residential and Public Open Space uses - NEPC (2013); and
- Ecological Screening Levels (ESLs) for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for Urban Residential and Public Open Space land use - NEPC (2013).

Where there are no NSW EPA endorsed thresholds (*i.e*. individual VOC compounds), the laboratory limit of detection has been adopted as an initial screening value for the purposes of this assessment.

Public Domain (Oval, recreational areas and Public Open Spaces)

- Health-based Investigation Levels (HIL) for Recreational Land Use (HIL-C) - NEPC (2013);
- Health Screening Levels (HSLs) for vapour intrusion, coarse grained soil for Recreational Land Use (HSL-C) at various depths - NEPC (2013);
- Management limits for hydrocarbons, Urban Residential, Parkland and Public Open Space uses, coarse grained soil – NEPC (2013);
- Generic and Derived Ecological Investigation Levels (EILs) for Urban Residential and Public Open Space uses - NEPC (2013); and
- Ecological Screening Levels (ESLs) for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for Urban Residential and Public Open Space land use - NEPC (2013).

Where there are no NSW EPA endorsed thresholds (i.e. individual VOC compounds), the laboratory limit of detection has been adopted as an initial screening value for the purposes of this assessment.

Lot 12, Locomotive Work Shop and Pedestrian/Road Easements

- Health-based Investigation Levels (HIL) for Commercial Land Use (HIL-D) – NEPC (2013);
- Health Screening Levels (HSLs) for vapour intrusion, coarse grained soil for Commercial Land (HSL-D) at various depths – NEPC (2013);
- Management limits for hydrocarbons, Commercial, coarse grained soil – NEPC (2013);
- Generic and Derived Ecological Investigation Levels (EILs) for Commercial/Industrial uses - NEPC (2013); and
- Ecological Screening Levels (ESLs) for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for Commercial/Industrial land use - NEPC (2013).

Table 4.1 Health Based Soil Investigation Criteria and Hydrocarbon Management Limits (all units in mg/kg)

	Laboratory Method	Health Investigation/ Screening Levels			Management Limits[5]	
		HIL-A	HIL-C	HIL-D	Urban Residential, Parkland and Public Open Space	Commercial/Industrial
METALS						
Arsenic	ICP-AES (USEPA 200.7)	100	300	3 000	-	-
Cadmium	ICP-AES (USEPA 200.7)	20	90	900	-	-
Chromium	ICP-AES (USEPA 200.7)	100[1]	300[1]	3 600[1]	-	-
Chromium (VI)	Alkali leach colorimetric (APHA3500-Cr/USEAP3060A)	100	300	3 600	-	-
Copper	ICP-AES (USEPA 200.7)	6 000	17 000	240 000	-	-
Nickel	ICP-AES (USEPA 200.7)	400	1 200	6 000	-	-
Lead	ICP-AES (USEPA 200.7)	300	1 200	1 500	-	-
Zinc	ICP-AES (USEPA 200.7)	7 400	30 000	400 000	-	-
Mercury (inorganic)	Cold Vapour ASS (USEPA 7471A)	40[2]	80[2]	730[2]	-	-
PAHs						
Carcinogenic PAHs (as B(a)P TEQ)[3]	GCMS (USEPA8270)	3	3	40	-	
Total PAHs[4]	GCMS (USEPA8270)	300	400	4 000	-	-
BTEX						
Benzene	Purge Trap-GCMS (USEPA8260)	0.5[6]	NL[6]	3[6]	-	-
Toluene	Purge Trap-GCMS (USEPA8260)	160[6]	NL[6]	NL[6]	-	-
Ethylbenzene	Purge Trap-GCMS (USEPA8260)	55[6]	NL[6]	NL[6]	-	-
Total Xylenes	Purge Trap-GCMS (USEPA8260)	40[6]	NL[6]	230[6]	-	-
Naphthalene	Purge Trap-GCMS (USEPA8260)	3	NL	NL	-	-
TRH						
F1 C_6-C_{10}	TPH Purge Trap-GCMS (USEPA8260)	45[6,7]	NL[6,7]	260[6,7]	700[5]	700[5]
F2 >C_{10}-C_{16}	TPH Purge Trap-GCMS (USEPA8260)	110[6]	NL[6,7]	NL[6,7]	1 000[5]	1 000[5]
F3 >C_{16}-C_{34}	Purge Trap-GCFID (USEPA8000)	-	-	-	2 500	3 500
F4 >C_{34}-C_{40}	Purge Trap-GCFID (USEPA8000)	-	-	-	10 000	10 000
OCPs						
DDT + DDD + DDE	GCECD (USEPA8140,8080)	240	400	3 600	-	-
Aldrin + Dieldrin	GCECD (USEPA8140,8080)	6	10	45	-	-
Chlordane	GCECD (USEPA8140,8080)	50	70	530	-	-
Endosulfan	GCECD (USEPA8140,8080)	270	340	2 000	-	-
Endrin	GCECD (USEPA8140,8080)	10	20	100	-	-
Heptachlor	GCECD (USEPA8140,8080)	6	10	50	-	-

	Laboratory Method	Health Investigation/ Screening Levels			Management Limits[5]	
		HIL-A	HIL-C	HIL-D	Urban Residential, Parkland and Public Open Space	Commercial/Industrial
HCB	GCECD (USEPA8140,8080)	10	10	80	-	-
Methoxychlor	GCECD (USEPA8140,8080)	300	400	2 500	-	-
HERBICIDES/PESTICIDES						
2,4,5-T	GCECD (USEPA8140,8080)	600	800	5 000		
2,4-D	GCECD (USEPA8140,8080)	900	1 300	9 000		
MCPA	GCECD (USEPA8140,8080)	600	800	5 000		
MCPB	GCECD (USEPA8140,8080)	600	800	5 000		
Mecoprop	GCECD (USEPA8140,8080)	600	800	5 000		
Picloram	GCECD (USEPA8140,8080)	4 500	5 700	35 000		
Atrazine	GCECD (USEPA8140,8080)	320	400	2 500		
Chlorpyrifos	GCECD (USEPA8140,8080)	160	250	2 000		
Bifenthrin	GCECD (USEPA8140,8080)	600	730	4 500		
PCBs						
Total PCBs	GCECD (USEPA8140,8080)	1	1	7	-	-
PHENOLS						
Phenol	GCECD (USEPA8140,8080)	3 000	40 000	240 000		
VOCs						
PCE	Purge Trap-GCMS (USEPA8260)	1[8]	1[8]	1[8]		
TCE	Purge Trap-GCMS (USEPA8260)	1[8]	1[8]	1[8]		
Cis 1,2 DCE	Purge Trap-GCMS (USEPA8260)	1[8]	1[8]	1[8]		
Trans 1,2 DCE	Purge Trap-GCMS (USEPA8260)	1[8]	1[8]	1[8]		
VC	Purge Trap-GCMS (USEPA8260)	1[8]	1[8]	1[8]		
OTHER						
Asbestos	PLM / Dispersion Staining	No asbestos capable of being detected via the investigation, which comprises both visual identification and sample analysis by a NATA accredited laboratory [4]				

Notes:

1. Guideline values presented are for Chromium (VI) in absence of total Chromium values. Where total Chromium results are elevated, samples will be analysed for Chromium (VI).
2. Guideline values are for inorganic mercury. Where elevated mercury concentrations are encountered and/or site information suggests the potential presence of elemental mercury and/or methyl mercury, consideration of applicability would be needed.
3. Carcinogenic PAHs calculated as per Benzo(a)pyrene Toxicity Equivalent Factor requirements presented in NEPC (2013)
4. Total PAHs calculated as per requirements presented in NEPC (2013).
5. Management Limits are based on coarse grained soil, with F1 and F2 concentrations inclusive of naphthalene and BTEX compounds.
6. Soil Health Screening Levels for Vapour Intrusion: Sand Soils. Values presented are those for 0 to <1 m bgl as the most conservative level. Reference should be made to results tables for further detail of levels at greater depths. NL: Non-limiting.

7. Values for F1 C6-C9 are obtained by subtracting BTEX (Sum) from laboratory result for C6-C9 TRH.
8. No EPA endorsed criteria, The LOR is proposed as a screening level in the absence of endorsed site specific criteria.

Table 4.2 Ecological Screening Levels and Soil Quality Guideline Values (all units in mg/kg)

	Laboratory Method	ESLs Urban Residential and public open space	SQGs (Aged)[3] Urban Residential and public open space	ESLs Commercial/Industrial	SQGs (Aged)[3] Commercial/industrial
METALS					
Arsenic	ICP-AES (USEPA 200.7)	-	100	-	160
Cadmium	ICP-AES (USEPA 200.7)	-	-	-	-
Chromium	ICP-AES (USEPA 200.7)	-	250	-	420
Chromium (VI)	Alkali leach colorimetric (APHA3500-Cr/USEAP3060A)	-	-	-	-
Copper	ICP-AES (USEPA 200.7)	-	210	-	300
Nickel	ICP-AES (USEPA 200.7)	-	270	-	460
Lead	ICP-AES (USEPA 200.7)	-	1 100	-	1 800
Zinc	ICP-AES (USEPA 200.7)	-	590	-	920
Mercury (inorganic)	Cold Vapour ASS (USEPA 7471A)	-	-	-	-
PAHs					
Benzo(a)pyrene	GCMS (USEPA8270)	0.7	-	1.4	
Naphthalene	GCMS (USEPA8270)	-	170	-	370
BTEX					
Benzene	Purge Trap-GCMS (USEPA8260)	50	-	75	-
Toluene	Purge Trap-GCMS (USEPA8260)	85	-	135	-
Ethylbenzene	Purge Trap-GCMS (USEPA8260)	70	-	165	-
Total Xylenes	Purge Trap-GCMS (USEPA8260)	105	-	180	-
TRH					
F1 C_6-C_{10}	TPH Purge Trap-GCMS (USEPA8260)	180[1]	-	215	
F2 >C_{10}-C_{16}	TPH Purge Trap-GCMS (USEPA8260)	120[2]	-	170	
F3 >C_{16}-C_{34}	Purge Trap-GCFID (USEPA8000)	300	-	1 700	
F4 >C_{34}-C_{40}	Purge Trap-GCFID (USEPA8000)	2 800	-	3 300	
OCPs					
DDT	GCECD (USEPA8140,8080)	-	180		640

Notes:

1. Values for F1 C6-C9 are obtained by subtracting BTEX (Sum) from laboratory result for C6-C9 TRH.
2. Values for F2 >C10-C16 are obtained by subtracting naphthalene from laboratory result for >C10-C16 TRH.
3. Based on a pH of 6.5, >2.5 % clay and a CEC of 20

4.2.2 Application of Soil Assessment Criteria

For soils to be considered as meeting the health/ecological based assessment criteria (i.e., not posing an unacceptable risk), the following criteria were adopted:

Either:

all contaminant concentrations were less than the adopted site assessment criteria,

Or:

The upper 95% confidence limit on the average concentration for each analyte (calculated for samples collected from consistent soil horizons, stratigraphy or material types) was below the adopted criterion;

No single analyte concentration exceeded 250% of the adopted criterion; and

The standard deviation of the results was less than 50% of the criterion.

In addition to the numerical criteria, the following visual observations also supplemented the assessment process:

No visible asbestos containing material in addition to laboratory analysis results; and

Consideration was given to odorous or discoloured soils (caused by contamination).

4.2.3 Material Characterisation for Off-site Disposal

Preliminary assessment of material that may require off-site disposal during proposed construction works was completed by others (see **Section 5**) in accordance with the total soil contaminant concentration (SCC) and where relevant, the toxicity characteristic leaching procedure (TCLP) criteria presented in the NSW EPA (2014) *Waste Classification Guidelines*.

In addition, consideration was given to general immobilisation of contaminants in waste approvals issued in accordance with the provisions in Clause 28 of the *Protection of the Environment Operations (Waste) Regulation 1996*, including:

- General Approval of Immobilisation of Contaminants in Waste No. 2009/07 Metallurgical furnace slag or metallurgical furnace slag contaminated natural excavated materials; and
- General Approval of Immobilisation of Contaminants in Waste No. 1999/05 Ash, ash contaminated natural materials or coal-contaminated natural excavated materials.

4.3 Groundwater Criteria

DEC (2007) '*Guidelines for the Assessment and Management of Groundwater Contamination*' instructs that groundwater investigation levels (GILs) be based on a consideration of groundwater's environmental values. Environmental values are defined in ARMCANZ (2000) as "...particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health which require protection from the effects of pollution, waste discharges and deposit".

NEPC (2013) presents six environmental values which are required to be considered in the assessment of contaminated groundwater including:

- Aquatic ecosystems;
- Aquaculture and human consumers of food;
- Agricultural water;
- Recreation and aesthetics;

- Drinking water; and
- Industrial water.

Current and projected contaminant concentrations in groundwater are required to be compared to the GILs at the points of existing and realistic future use for each relevant environmental value.

DEC (2007) instructs that all environmental values of groundwater be identified to allow development of appropriate GILs. NSW Government (2006) '*Environmental Objectives for Water Quality and River Flow*' are nominated as an appropriate source of environmental values. DEC (2007) further recommends that groundwater with a level of total dissolved solids below 2000 mg/L be considered suitable for potential use as drinking water.

Groundwater investigation criteria are adopted with reference to EPA's endorsed environmental values for the Cooks River catchment in addition to the inclusion of drinking water as an environmental value based on the requirements outlined in DEC (2007) and the potential for human contact to groundwater down-gradient of the site. As such, application of the adopted groundwater criteria shall be as follows:

- Drinking Water and Recreational Criteria – shall be applied to groundwater as human contact with groundwater may occur via mixing of groundwater and the surface waters of the Alexandra Canal/Cooks River system and subsequent Botany Bay foreshore area. As described in **Section 2.8**, the site is underlain by the Botany Sand Beds aquifer and on the edge of Zone 2 of the Botany Sands Aquifer Embargo Area. As such, domestic use of groundwater is prohibited, including for drinking purposes, and consideration of drinking water criteria is for screening purposes only.
- Ecological Criteria – shall similarly be applied to groundwater as a result of potential exposure down-gradient of the site.

Given that the ultimate receiving water body, comprising Botany Bay, is a tidal marine environment, threshold values for marine environments have been adopted for this assessment. It has been assumed that the receiving waters are slightly to moderately disturbed ecosystems based on their location within the metropolitan area.

Recreational criteria as provided in **Table 4.3**, and are based on guidance in NHMRC (2008) which indicates concentrations of substances at 10 times drinking water guideline provides a screening approach for assessing whether further consideration of risks to recreational waters is warranted.

Table 4.3 Groundwater Assessment Criteria (units in µg/L unless noted)

	Laboratory Method	Drinking Water Criteria[1]	Marine Aquatic Ecosystem Criteria[2]	Recreational Criteria – primary and secondary contact[3]
METALS				
Arsenic	ICP-AES (USEPA 200.8, 6020A)	10	2.3	100
Cadmium	ICP-AES (USEPA 200.8, 6020A)	2	0.7[4]	20
Chromium	ICP-AES (USEPA 200.8, 6020A)	50	4.4	500
Copper	ICP-AES (USEPA 200.8, 6020A)	2 000	1.3	20 000
Lead	ICP-AES (USEPA 200.8, 6020A)	10	4.4	100
Mercury	ICP-AES (USEPA 200.8, 6020A)	1	0.1[4]	10
Nickel	ICP-AES (USEPA 200.8, 6020A)	20	7	200
Zinc	ICP-AES (USEPA 200.8, 6020A)	3000	15	30 000
BTEX				
Benzene	P&T GC/MS (USEPA 8020A)	1	500	10
Toluene	P&T GC/MS (USEPA 8020A)	800	180[5]	8 000
Ethylbenzene	P&T GC/MS (USEPA 8020A)	300	5[5]	3 000
o-Xylene	P&T GC/MS (USEPA 8020A)	600[8]	350[5]	6000
m-Xylene	P&T GC/MS (USEPA 8020A)		75[5]	
p-Xylene	P&T GC/MS (USEPA 8020A)		200[5]	
TRH				
C_6 – C_9 Fraction	P&T GC/MS (USEPA 8020A)	-	10[9]	-
C_{10} – C_{36} Fraction	GC/FID (USEPA 8000)	-	250[9]	No odour or sheen
PAHs				
Naphthalene	GCMS (USEPA8270)	-	50[4,10]	-
Anthracene	GCMS (USEPA8270)	-	0.1[4,5,6,7]	-
Phenanthrene	GCMS (USEPA8270)	-	0.6[4,5,6]	-
Fluoranthene	GCMS (USEPA8270)	-	1[4,5,6]	-
Benzo(a)pyrene	GCMS (USEPA8270)	0.1[7]	0.1[4,5,6]	0.1
VOCs				
PCE	P&T GC/MS (USEPA 8020B)	50	70	500
TCE	P&T GC/MS (USEPA 8020B)	-	330[6]	-

	Laboratory Method	Drinking Water Criteria[1]	Marine Aquatic Ecosystem Criteria[2]	Recreational Criteria – primary and secondary contact[3]
Cis 1,2 DCE	P&T GC/MS (USEPA 8020B)	-	1[9]	-
Trans 1,2 DCE	P&T GC/MS (USEPA 8020B)	-	1[9]	-
VC	P&T GC/MS (USEPA 8020B)	10[9]	100[6]	10
Styrene	P&T GC/MS (USEPA 8020B)	30	-	300
OTHER				
Ammonia (at pH 6)	Colorimetric (EPA 350.1)	100	5 960[12]	1 000
NOx (based on Nitrate as N)	Colorimetric (EPA 353.2)	10 000	7 200[13]	100 000

Notes

1 Australian Drinking Water Guidelines (NHMRC/NRMMC 2011)
2 95% Protection Trigger Values for Marine Water (ANZECC/ARMCANZ 2000)
3 Guidelines for Managing Risks in Recreational Waters – 10 times Drinking Water Values as a screening level (NHMRC 2008)
4 99% Protection Level used, as recommended by ANZECC/ARMCANZ 2000
5 Low Reliability Trigger Value (ANZECC/ARMCANZ 2000)
6 Indicative Interim Working Level (ANZECC/ARMCANZ 2000)
7 Laboratory limit of reporting is greater than the available criterion, hence the laboratory LOR is adopted as the screening level.
8 Total Xylenes
9 Laboratory LOR is adopted as the criterion as a screening level in the absence of EPA endorsed assessment value.
10 Moderate Reliability Trigger value in marine waters.
11 In absence of NSW EPA endorsed values, USEPA RSLs for Tap Water adopted as screening level for assessment purposes.
12 Ammonia value for pH 7.2 as presented in ANZECC (2000) adopted based on average pH reported by the laboratory for groundwater samples.
13 Nitrate value based on 95% trigger value in freshwater, NIWA Correspondence 30/09/2002: *Nitrate Guideline Values in ANZECC 2000*.

In addition to the criteria established above, consideration has also been given to the Health Screening Levels for Vapour Intrusion presented in NEPC (2013) as presented in **Tables 4.4** and **4.5** below. The adopted criteria are based upon a sand matrix and a HSL-A and HSL-D land uses to result in assessment values with respect to site conditions and future land uses.

Table 4.4 Groundwater HSLs for Vapour Intrusion (µg/L) HSL-A

Analytes	HSL-A (µg/L)			
Sand	**2 m to <4 m bgl**	**4 m to <8 m bgl**	**>8 m bgl**	**Solubility Limit**
Benzene	800	800	900	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Total Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
F1 C_6 - C_{10} Fraction	1 000	1 000	1 000	9 000
F2 C_{10} - C_{16} Fraction	1 000	1 000	1 000	3 000

Table 4.5 Groundwater HSLs for Vapour Intrusion (µg/L) HSL-D

Analytes	HSL-D (µg/L)			
Sand	**2 m to <4 m bgl**	**4 m to <8 m bgl**	**>8 m bgl**	**Solubility Limit**
Benzene	5 000	5 000	5 000	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3 900
Total Xylenes	230	NL	NL	21 000
Naphthalene	NL	NL	NL	170
F1 C_6 - C_{10} Fraction	6 000	6 000	7 000	9 000
F2 C_{10} - C_{16} Fraction	NL	NL	NL	3 000

4.4 Vapour Screening Criteria

Historically, sub-slab vapour has been collected from beneath existing site structures. Concentrations in vapour samples will initially be compared against published levels as presented in **Tables 4.6** and **4.7** where relevant, as sourced from the following:

- Health based Screening Levels (HSLs) for vapour intrusion – Residential and Commercial Land Use – NEPC (2013); and
- Interim Health based Investigation Levels (HILs) for soil vapour – Residential and Commercial Land Use – NEPC (2013).

Table 4.6. Vapour Sample Analytical Schedule (mg/m³) – HSL A / HIL A

Analytes	NEPC (2013) HSL-A / HIL-A			
Sand	**0 m to <1 m bgl**	**1 m to <2 m bgl**	**2 m to <4 m bgl**	**4 m to <8 m bgl**
Benzene	1	3	6	10
Toluene	1 300	3 800	7 300	15 000
Ethylbenzene	330	1 100	2 200	4 300
Total Xylenes	220	750	1 500	3 000
Naphthalene	0.8	3	6	10
F1 C_6-C_{10}	180	640	1 300	2 600
F2 >C_{10}-C_{16}	130	560	1 200	4 800
PCE	2	2	2	2
TCE	0.02	0.02	0.02	0.02
Cis 1,2 DCE	0.08[1]	0.08[1]	0.08[1]	0.08[1]
1,1,1 TCA	60	60	60	60
VC	0.03	0.03	0.03	0.03

Notes: 1. Any assessment of cis-1,2-DCE is considered to be sufficiently protective of potential exposures to the trans-1,2-DCE isomer consistent with NEPC (2013) recommendations noting the contrasting toxicity of each. In the event trans-1,2-DCE is reported at notable concentrations in either sub-slab or ambient vapour, consideration will be required in the HHRA process.

Table 4.7. Vapour Sample Analytical Schedule (mg/m³) – HIL D / HIL D

Analytes	NEPC (2013) HSL-D			
Sand	**0 m to <1 m bgl**	**1 m to <2 m bgl**	**2 m to <4 m bgl**	**8 m + bgl**
Benzene	4	10	30	65
Toluene	4 800	16 000	39 000	84 000
Ethylbenzene	1 300	4 600	11 000	25 000
Total Xylenes	840	3 200	8 000	18 000
Naphthalene	3	15	35	75
F1 C_6-C_{10}	680	2 800	7 000	15 000
F2 >C_{10}-C_{16}	500	2 400	NL	NL
PCE	8	8	8	8
TCE	0.08	0.08	0.08	0.08
Cis 1,2 DCE	0.3[1]	0.3[1]	0.3[1]	0.3[1]
1,1,1 TCA	230	230	230	230
VC	0.1	0.1	0.1	0.1

Notes: 1. Any assessment of cis-1,2-DCE is considered to be sufficiently protective of potential exposures to the trans-1,2-DCE isomer consistent with NEPC (2013) recommendations noting the contrasting toxicity of each. In the event trans-1,2-DCE is reported at notable concentrations in either sub-slab or ambient vapour, consideration will be required in the HHRA process.

5. Previous Investigations

A range of assessment reports, prepared by others, have been made available for review by JBS&G. The following sections provide a summary of the information and site characterisation data presented within key available assessment reports. These reports include both historical and information relating to investigations conducted at that time.

Comments in relation to contaminants of potential concern (COPC) are provided in the following text in relation to assessment criteria adopted by the author at the time of report preparation. This comprises the range of health investigation levels presented in NEPC (1999[7]) and EPA (1994[8]) for investigation results generally up to an including the end of 2012; ANZECC (2000[9]) for groundwater thresholds and NEPC (2013[10]) for results from 2012 onward (where TRH and benzo(a)pyrene TEQ values were presented in reports.

Exceedances of assessment criteria presented in **Section 4** are shown in accompanying summary results tables (**Appendix C**) and **Figures 8A-8E**.

This is considered appropriate to identify contaminants requiring further consideration in relation to proposed development of the site.

5.1 Lot 8 DP 1136859 - Previous Investigations

The following summarises reports made available to JBS&G of previous investigations at Lot 8 in DP 1136859. Historical sample locations are shown on **Figure 7A**. Soil exceedances are shown on **Figures 8A**. A summary of historical soil analytical data is presented in **Table A** (**Appendix C**). Historical TCLP data is presented in **Table F** (**Appendix C**).

5.1.1 Contamination Assessment (DP 2005a[11])

DP (2005a) undertook a Phase 2 Contamination Assessment which comprised a review of historical information and field works including the advancement of five additional soil sample locations to supplement six historical soil sample locations. In addition, six groundwater monitoring wells were installed across the site, one within Lot 8 (soil bore converted to a groundwater monitoring well).

Sample locations identified fill materials to variable depths ranging from 0.4 m bgl to 1.7 m bgl. A number of locations reported refusal on anthropogenic materials (ballast) or bedrock. Fill materials were reported to generally comprise gravelly sandy, silty sands with inclusions of railway ballast and sedimentary clast. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and in turn silty clay soils and shale/sandstone bedrock were encountered underlying fill materials. Standing groundwater was reported at depths ranging between 2.6 m bgl (13.41 m AHD) and 2.8 m bgl (13.21 m AHD) within Lot 8, within Aeolian sands.

DP (2005a) reported analytical results from eleven sample locations (five as part of the current assessment and six from historical sample locations), exceeding the EPA (1995[12]) minimum sample density of seven sample location for an area of approximately 1 937 m^2.

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7 *National Environment Protection (Assessment of Site Contamination) Measure, 1999.* National Environment Protection Council, 1999 (NEPC 1999)

8 *Contaminated Sites: Guidelines for Assessing Service Station Sites*. NSW EPA December 1994 *(EPA 1994)*

9 *Australian and New Zealand Guidelines for Fresh and Marine Waste Quality, Volume 1.* Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand, October 2000 (ANZECC 2000)

10 *National Environment Protection (Assessment of Site Contamination) Measure, 1999 Amendment No. 1* National Environment Protection Council *2013 (NEPC 2013)*

11 *Report on Contamination Assessment. Development Parcel C2 Australian Technology Park, Eveleigh. Douglas Partners Pty Ltd dated July 2005 reference 43078A-1 (DP 2005a)*

12 *Contaminated Sites Sampling Design Guidelines*. NSW EPA 1995 (EPA 1995)

Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylenes (BTEX), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), phenols, asbestos and volatile organic compounds (VOCs) soil analytical results were within the adopted commercial/industrial NEPC (1999) assessment criteria. With the exception of lead and copper, all heavy metal concentrations were below the adopted commercial/industrial assessment criteria. Sample BH18/0.5-1.0 returned elevated lead and copper concentrations of 2 139 mg/kg and 5 210 mg/kg, respectively. Sample BH18/0.5-1.0 returned a lead concentration of 2 270 mg/kg.

Polycyclic aromatic hydrocarbons (PAHs) concentrations were within the adopted commercial/industrial assessment criteria with the exception of sample BH97/0.0-0.2 with a total PAHs and benzo(a)pyrene concentrations of 221 mg/kg and 18.8 mg/kg, respectively. DP (2005a) reported the occurrence of the PAH exceedance may be attributed to overlying of bituminous material (asphalt pavement).

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for mixed commercial/industrial and childcare facility (or similar) land use (e.g. HIL-A, HSL-A) identified the following:

Health

- Lead at sample locations BH18/0.5-1 (2 139 mg/kg) and BH18/1.0-1.5 (2 270 mg/kg) exceeded the adopted lead health based criterion of 300 mg/kg.

Ecological

- Sample locations BH18/0.5-1, BH18/1.0-1.5, BH18/1.5-2.0, BH327/0.8-1.0 and BH327/0.8-1.0 exceeded the adopted copper ecological criterion of 210 mg/kg, with concentrations of 5 210 mg/kg, 3 660 mg/kg, 280 mg/kg and 220 mg/kg, respectively;
- Lead at sample locations BH18/0.5-1 (2 139 mg/kg) and BH18/1.0-1.5 (2 270 mg/kg) exceeded the adopted lead ecological based criterion of 1 100 mg/kg.
- Sample locations BH18/0.5-1 and BH18/1.0-1.5 exceeded the adopted zinc ecological criterion of 590 mg/kg, with concentrations of 1 353 mg/kg and 1 343 mg/kg, respectively; and
- Benzo(a)pyrene exceeded the adopted ecological criteria of 0.7 mg/kg at sample locations BH324/1.0-1.1 (0.7 mg/kg), BH327/0.8-1.0 (1 mg/kg), BH68/0.6-0.7 (0.9 mg/kg) and BH97/0.0-0.2 (18.8 mg/kg).

Arsenic, cadmium, chromium, mercury, BTEX, phenols, PAHs, PCBs, OCPs and OPPs contaminant concentrations in groundwater were all reported below the adopted ANZECC (2000) groundwater assessment criteria. Elevated lead (10 µg/L), nickel (27 µg/L), copper (2 µg/L) and zinc (31 µg/L - 350 µg/L) concentrations were reported across the site. Lead and nickel considered potentially resultant of fill conditions within Lot 8 whilst copper and zinc were reported to be representative of groundwater conditions of urban environments.

A TRH C_{10}-C_{36} concentration of 52 000 µg/L was reported at sample location MW318 (**Figure 7C**) western end of Locomotive Street, beyond the site boundary. TRH C_{10}-C_{36} contaminant concentrations ranging between 100 µg/L to 400 µg/L were reported within the balance of groundwater sample locations across the site (**Table E**, **Appendix C**).

DP (2005a) reported TPH/TRH was detected in fourteen of the eighteen groundwater samples historically analysed from across the ATP precinct and broader area, of these the following exceeded the Dutch IV criterion of 0.6 mg/L:

- Sample MW42 (within the rail easement) with a total TPH contaminant threshold concentration of 90 970 µg/L in 1993[13];
- Sample MW4 (Area 2) with a total TPH contaminant threshold concentration of 73 600 µg/L in 1994[12];
- Sample MW5 (Area 3) reported with a total TPH contaminant threshold concentration of 65 900 µg/L in 1994. It is noted tabulated data for MW5 has TPH concentrations below the laboratory LOR whilst MW6 has a total TPH concentration of 66 000 µg/L in 1994;
- Sample MW01 (off-site) with a TRH contaminant threshold concentration of 681 µg/L in 2001; and
- Light non-aqueous phase liquid (LNAPL) at sample location MW3 (Area 2) in 1994.

DP (2005a) reported that the identified TPH/TRH impacts were likely originating from the following sources:

- The former State Railway Authority Fuelling Station to the north west of the site; and
- Potentially originating from the former Engine Shop east of the Locomotive Workshop Building (current office building, **Figure 2**).

A detailed assessment/review of historical groundwater conditions is provided in **Section 5.4** below.

5.1.2 Supplementary Contamination Assessment (DP 2008a[14])

DP (2008a) undertook a Supplementary Contamination Assessment and waste classification evaluation which comprised a review of historical information and field works including the advancement of six additional soil sample locations to supplement the eleven historical sample locations and ASS assessment. In addition, three groundwater monitoring wells were installed within Lot 8 to assess groundwater conditions migrating onto and off Lot 8.

Sample locations identified fill materials similar to DP (2005a) with fill depths ranging between 1.1 m bgl and 1.8 m bgl. Fill inclusions of slag, peat, ash and building rubble were reported. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and in turn clay and shale/sandstone bedrock were encountered underlying fill materials. Standing groundwater was reported at depths of 2.0 m bgl (13.75 m AHD) to 2.24 m bgl (13.51 m AHD) within Lot 8, within Aeolian sands.

Selected samples were submitted for a range of COC including heavy metals, total petroleum hydrocarbons (TPH), PAHs, BTEX, phenols, PCBs, OCPs, VOCs and asbestos. In summary, the findings of soil contaminant concentrations were similar to DP (2005a). All heavy metal and PAH contaminant concentrations were below the adopted NEPC (1999) commercial/industrial assessment criteria. No discussion was provided with respect to ecologic exceedances.

[13] It is noted there are inconsistencies in reported contaminant threshold concentrations within reports. Data presented in Table C has been largely derived from ES (2014f). Contaminant threshold concentrations are largely in the same order of magnitude. More recent analytical data has not identified TRH and heavy metal concentrations reported in historical reports.

[14] *Report on Supplementary Contamination Assessment and Waste Classification. C3 Development Parcel Australian Technology Park, Eveleigh*. Douglas Partners Pty Ltd dated May 2008 reference 45231 Rev 1 (DP 2008a)

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for mixed commercial/industrial and childcare facility (or similar) land use (e.g. HIL-A, HSL-A) identified the following:

Health

- Carcinogenic PAHs as benzo(a)pyrene TEQ at sample location BH404/0.5-1.0 with a contaminant concentration of 5.353 mg/kg.

Ecological

- Benzo(a)pyrene exceeded the adopted ecological criteria of 0.7 mg/kg at sample locations BH401/0.5-0.6 (0.9 mg/kg) and BH404/0.5-1.0 (3.7 mg/kg).

Analysis of groundwater samples collected from groundwater monitoring wells within Lot 8 identified elevated zinc concentrations of 180 µg/L at sample locations BH402/MW402 and BH403/GW403 indicating Lot 8 is not negatively contributing to elevated zinc concentrations, with concentrations migrating onto and off the Lot consistent. All other COPC (heavy metals, TPH, BTEX, PCBs, OCPs and VOCs) were reported below the adopted ANZECC (2000) assessment criteria.

A detailed assessment/review of historical groundwater conditions is provided in **Section 5.4** below.

Field screening and laboratory analysis concluded natural soils did not contain ASS/potential acid sulphate soil (PASS) properties, however, it was reported natural soils were acidic.

The Lot's soils were generally classified as 'inert waste' under the then relevant waste classification guidelines.

5.1.3 Site Audit Statement/Report (Environ 2008a[15])

A Non-Statutory Section A Site Audit Statement (SAS) was issued for the Lot 8 (previously Part Lot 500 DP 1033739) in 2008 certifying that Lot 8 was suitable for commercial/industrial land use.

The Site Auditor commented soil had been adequately characterised for waste disposal but noted additional ASS/PASS assessment may be required prior to determining waste classification status.

The Site Auditor also noted, no contamination was reported which may lead to groundwater contamination and there are low concentrations of some contaminants in groundwater, however, any future abstraction would require investigation of the groundwater resource and approval from the NSW Department of Natural Resources (now the NSW Department of Primary Industry – Water).

5.1.4 Limited Environmental Site Assessment (ES 2014a[16])

ES (2014a) undertook a Limited Environmental Site Assessment that comprised a review of historical information and fieldworks including the advancement of two additional sample locations. The objective of the assessment was to expand on previous assessments documenting the environmental status of Lot 8 and provide the Site Auditor with additional soil assessment information to determine if there is a need to modify the Non-Statutory SAS issued for Lot 8.

Sample locations identified fill materials similar to previous investigations with fill depths ranging between 2.7 m bgl and 4.0 m bgl. Fill inclusions of brick, sedimentary clasts and building rubble were reported. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and in turn residual silty clay soils were encountered underlying fill materials. A thin peat layer was reported generally below overlying Aeolian sands and above residual silty clay

[15] *Site Audit Statement/Report – C3 Development Australian Technology Park Eveleigh.* Environ Australia Pty Ltd dated May 2008 (Environ 2008a)

[16] *Limited Environmental Site Assessment. Lot 8 Australian Technology Park Eveleigh.* Environmental Strategies Pty Ltd dated August 2014 reference 14061RP01_v01 (ES 2014a)

soils. Standing groundwater was reported at depths of 2.7 m bgl to 3.24 m bgl (top of casing) within Aeolian sands, consistent with previous investigations.

Representative soil samples were submitted for a range of COPC including TRH, PAHs, BTEX, OCPs, PCBs and asbestos. All reported contaminant concentrations were below current adopted assessment criteria (**Section 4**) for mixed commercial/industrial and childcare facility (or similar) land use (e.g. HIL-A, HSL-A) with the exception of the following:

Health and Ecological

- Sample BH13/1.0-1.1 with a benzo(a)pyrene of 1.4 mg/kg above the ecological criteria of 0.7 mg/kg; and
- Sample BH12/0.1-0.2 which returned positive identification for chrysotile and amosite asbestos. ES (2014a) reported the asbestos detection in shallow fill has not been laterally delineated, and therefore may be present at other locations of Lot 8. Historical sample analysis of asbestos was noted to be largely confined to sub-surface soils and not within surface soils where if encountered are likely to be present.

In summary the findings of soil contaminant concentrations were similar to previous investigations and that reported in Environ (2008a).

5.1.5 Site Audit Statement/Report (Environ 2014a[17])

A Non-Statutory Section A SAS was issued for the Lot 8 in 2014 certifying that Lot 8 was suitable for commercial land uses.

The Site Auditor commented a number of investigations have been conducted and have encountered mixed fill ranging from approximately 1.1 m to 4.0 m in depth. Fill materials was described as asphalt underlain by a mix of gravelly sand, silty sand, clay and sandstone with inclusion of ash, slag, railway ballast, blue metal and peaty material. The fill was noted to contain low concentrations of contaminants such as metals and PAHs. Asbestos was detected by laboratory analysis at one sample location.

The Site Auditor noted, if the Lot is redeveloped to remove current surfacing, it would need to be verified that there is no visible asbestos in any exposed surfaces soils. If soil is removed from site in redevelopment, it would need to be classified and disposed in accordance with applicable guidelines and regulations at the time. Preliminary waste classification under guidelines of the time indicated that the fill was likely classified as general solid waste, but was required to be verified.

The Site Auditor commented groundwater had been assessed across the broader ATP precinct. No groundwater remediation was considered to be required. The Site Auditor stated the potential for affecting groundwater conditions, for example by increased contaminant leaching potential, would need to be considered in any redevelopment proposal. Any future groundwater abstraction would require investigation of the groundwater resource and approval from the NSW Department of Natural Resource (now the NSW Department of Primary Industry – Water).

5.2 Lot 9 DP 1136859 – Previous Investigations

The following summarises reports made available to JBS&G of previous investigations at Lot 9 in DP 1136859. Historical sample locations are shown on **Figure 7A**. Soil exceedances are shown on **Figures 8A**. A summary of historical soil analytical data is presented in **Table A** (**Appendix C**). Historical TCLP data is included in **Table F** (**Appendix C**).

[17] *Site Audit Statement/Report – Lot 8 Australian Technology Park Eveleigh.* Environ Australia Pty Ltd dated December 2014 (Environ 2014a)

5.2.1 Environmental Status Report (ES 2014b[18])

ES (2014b) prepared an Environmental Status Report based on previous investigations. ES (2014b) reported that five historical investigations have been completed for Lot 9 between 1993 and 2014 comprising forty nine sample locations, exceeding the EPA (1995) minimum sample density of twenty sample location for an area of approximately 8 229 m^2.

Analytical analysis was reported from 42 of the 49 sample locations.

Eight groundwater monitoring wells were reported to have historically been advanced within Lot 9, with seven of the wells serviceable in 2014. JBS&G identified sixteen wells have historically been advanced within Lot 9. A detailed assessment/review of historical groundwater conditions is provided in **Section 5.4** below.

The lots surface was largely paved with bituminous pavements. Sample locations identified fill materials to variable depths ranging from 0.03 m bgl to 4.0 m bgl. A number of locations reported refusal on anthropogenic materials and/or ballast/firm fill. Fill materials were reported to generally comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, slag, sedimentary clast and construction rubble. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and in turn residual silty clay soil were encountered underlying fill materials. A thin peat layer was reported at approximately 6.5 m bgl and 7.5 m bgl, generally below overlying Aeolian sands and above residual silty clay soils.

A total of 127 (JBS&G identified 124) soil samples were reported to have been submitted for a range of COPC including heavy metals, TRH/TPH, PAHs, OCPs, PCBs, VOCs and asbestos.

Twenty two soil samples were reported to have exceeded the adopted assessment criteria (combination of NEPC 1999 and NEPC 2013). Twenty of the samples exceeding the adopted assessment criteria were collected from fill materials, with the balance (two samples) collected from natural soils.

In total, 18 of the 42 sample locations submitted for analysis reported contaminant concentrations above the adopted commercial/industrial assessment criteria. Exceedances were generally reported in gravelly sands or coarse grained material.

Samples which exceeded the adopted assessment criteria reported the following maximum concentrations of COPC:

- TRH C_{10}-C_{16} with a maximum concentration of 1 000 mg/kg;
- TRH C_{16}-C_{34} with a maximum concentration of 13 000 mg/kg;
- TPH C_6-C_{36} with a maximum concentration of 2 455 mg/kg;
- TPH C_{10}-C_{36} with a maximum concentration of 15 250 mg/kg;
- F2 TRH >C_{10}-C_{16} with a maximum concentration of 1 000 mg/kg;
- Benzo(a)pyrene with a maximum concentration of 160 mg/kg;
- Carcinogenic PAHs with a maximum concentration of 220 mg/kg; and
- Asbestos was detected at one sample location.

Numerous heavy metals exceeded the adopted ecological criteria.

[18] Environmental Status Report – Lot 9 Australian Technology Park Locomotive Street, Eveleigh. Environmental Strategies Pty Ltd dated September 2014 (ES 2014b)

A number of the heavy metal and PAH exceedances were attributed to the presence of slag or ash within the fill soil profile. TCLP data indicated that samples with elevated heavy metal and PAH concentrations showed low (relative to reported groundwater concentrations) leachate concentrations, with the exception of slightly elevated lead concentrations in some samples.

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for mixed commercial/industrial and childcare facility (or similar) land use (e.g. HIL-A, HSL-A) identified the following:

Health

- Chromium exceeded the adopted health criterion of 100 mg/kg at sample location BH24/1.5-2.0 with a concentration of 103 mg/kg;
- Lead exceeded to adopted health criterion of 300 mg/kg and at sample locations BH1/1.5-2.0 (429 mg/kg), BH15/1.5-1.6 (310 mg/kg), BH24/1.5-2.0 (954 mg/kg), BH26/1.5-2.0 (471 mg/kg), BH502/1.4-1.5 (550 mg/kg), BH502/1.9-2.0 (300 mg/kg), BH506/1.9-2.0 (390 mg/kg) and BH81/0.8-1.0 (1 180 mg/kg);
- TRH >C_{10}-C_{16} exceeded the adopted management limit criterion of 1 000 mg/kg at sample location BH7/1.5-1.6 with a concentration of 1 000 mg/kg;
- TRH >C_{16}-C_{34} exceeded the adopted management limit criterion of 2 500 mg/kg at sample location BH7/1.5-1.6 with a concentration of 13 000 mg/kg;
- TRH F2 exceeded the adopted HSL 0 m - 1 m criterion of 110 mg/kg at sample location BH8/0.06-0.1 with a concentration of 140 mg/kg
- TRH F2 exceeded the adopted HSL 1 m - 2 m criterion of 240 mg/kg at sample location BH7/1.5-1.6 with a concentration of 1 000 mg/kg;
- Carcinogenic PAHs as benzo(a)pyrene TEQ exceeded the adopted heath criterion of 3 mg/kg at sample locations BH10/2.0-2.1 (6 mg/kg), BH10/3.0-3.1 (4 mg/kg), BH14/2.5-2.6 (3 mg/kg), BH502/1.4-1.5 (10.3 mg/kg), BH505/0.5-0.6 (11.05 mg/kg), BH507/0.9-1.0 (41.16 mg/kg), BH507/1.8-2.0 (6.353 mg/kg), BH508/1.4-1.5 (3.379 mg/kg), BH510/0.9-1.0 (23.23 mg/kg), BH511/0.9-1.0 (0.9-1.0 mg/kg), BH7/1.5-1.6 (220 mg/kg), BH7/2.0-2.1 (11 mg/kg), BH8/0.06-0.1 (37 mg/kg), BH8/1.0-1.1 (36 mg/kg), BH80/3.0/3.45 (12.5 mg/kg) and BH9/1.0-1.1 (9 mg/kg);
- Naphthalene exceeded the 0 m – 1 m HSL criterion of 3 mg/kg at sample location BH10/0.9-1.0 (12 mg/kg), and
- Total PAHs exceeded the adopted health criterion at sample locations BH507/0.9-1.0 (367.5 mg/kg), BH7/1.5-1.6 (2 400 mg/kg), BH8/0.06-0.1 (310 mg/kg) and BH8/1.0-1.1.

Ecological

- Copper exceeded the adopted ecological criterion of 210 mg/kg at sample locations BH502/1.4-1.5 (220 mg/kg), BH507/0.9-1.0 (220 mg/kg) and BH81/0.8-1.0 (223 mg/kg);
- Zinc exceeded the adopted ecological criterion of 590 mg/kg at sample locations BH1/1.5-2.0 (614 mg/kg), BH502/1.4-1.5 (1 200 mg/kg), BH502/1.9-2.0 (620 mg/kg) and BH81/0.8-1.0 (2 040 mg/kg);
- TRH C_{15}-C_{28} exceeded the adopted ESL criterion of 300 mg/kg at sample locationsBH1/0.5-1.0 (352.5 mg/kg), BH23/0.5-1.0 (335.1 mg/kg), BH26/1.5-2.0 (552 mg/kg), BH505/0.5-0.6 (350 mg/kg), BH507/0.9-1.0 (1 600 mg/kg) and BH510/0.9-1.0 (1 100 mg/kg),

- TRH C_{29}-C_{36} exceeded the adopted ESL criterion of 300 mg/kg at sample locations BH26/1.5-2.0 (831 mg/kg), BH507/0.9-1.0 (780 mg/kg), BH510/0.9-1.0 (610 mg/kg) and BH511/0.9-1.0 (670 mg/kg),
- TRH >C_{10}-C_{16} exceeded the adopted ecological criterion of 120 mg/kg at sample locations BH7/1.5-1.6 (1 000 mg/kg), BH8/0.06-0.1 (140 mg/kg) and BH8/1.0-1.1 (180 mg/kg);
- TRH >C_{16}-C_{34} exceeded the adopted ESL criterion of 300 mg/kg at sample locations BH10/2.0-2.1 (950 mg/kg), BH15/1.5-1.6 (330 mg/kg), BH7/2.0-2.1 (350 mg/kg), BH7/1.5-1.6 (13 000 mg/kg), BH8/0.06-0.1 (2 000 mg/kg), BH8/1.0-1.1 (2 400 mg/kg) and BH9/1.0-1.1 (460 mg/kg); and
- Benzo(a)pyrene exceeded the adopted ecological criterion of 0.7 mg/kg at sample locations BH10/2.0-2.1 (3.9 mg/kg), BH10/3.0-3.1 (2.5 mg/kg), BH14/2.5-2.6 (2.2 mg/kg), BH14/4.0-4.1 (0.77 mg/kg), BH14/1.5-1.6 (1.2 mg/kg), BH15/1.5-1.6 (1 mg/kg), BH23/0.5-1.0 (1.1 mg/kg), BH502/1.4-1.5 (6.9 mg/kg), BH502/1.9-2.0 (1 mg/kg), BH505/0.5-0.6 (7.4 mg/kg), BH506/1.9-2.0 (1.9 mg/kg), BH507/0.9-1.0 (28 mg/kg), BH507/1.8-2.0 (4.3 mg/kg), BH508/1.4-1.5 (2.3 mg/kg), BH509/3.4-3.5 (0.7 mg/kg), BH510/0.9-1.0 (17 mg/kg), BH511/0.9-1.0 (20 mg/kg), BH512/1.4-1.5 (0.7 mg/kg), BH68/0.6-0.7 (0.9 mg/kg), BH7/1.5-1.6 (160 mg/kg), BH7/2.0-2.1 (7.7 mg/kg), BH7/3.0-3.1 (1.2 mg/kg), BH7/0.0-0.5 (1.6 mg/kg), BH71/0.8-1.0 (1.8 mg/kg), BH74/0.9-1.0 (1.3 mg/kg), BH8/0.06-0.1 (27 mg/kg), BH8/1.0-1.1 (26 mg/kg), BH80/3.0-3.45 (8.1 mg/kg), BH81/0.8-1.0 (1.1 mg/kg), BH89/1.8-2.0 (2.4 mg/kg), BH9/1.0-1.1 (6 mg/kg), BH90/1.8-2.0 (1.7 mg/kg) and BH99/0.8-1.0 (0.7 mg/kg).

5.2.2 Site Audit Statement/Report (Environ 2014b[19])

A Non-Statutory Section B SAS was issued for the Lot 9 in 2014 certifying that the nature and extent of the contamination has been appropriately determined.

The Site Auditor commented that laboratory analyses of fill samples identified elevated concentrations of metals, TRH/TPH and PAHs. Concentrations exceeded the adopted human health criteria in only a small number of samples of fill materials. No significant amounts of volatile contaminants were detected and no clear distribution of contaminants within fill was identified.

The Site Auditor noted groundwater had been assessed across the broader ATP precinct. No groundwater remediation was considered to be required. The Site Auditor stated the potential for affecting groundwater conditions, for example by increased contaminant leaching potential, would need to be considered in any redevelopment proposal. Any future groundwater abstraction would require investigation of the groundwater resource and approval from the NSW Department of Natural Resource (now the NSW Department of Primary Industry – Water).

Site Auditor stated, due to the investigation methods, asbestos and anthropogenic material is likely to be present at a greater density than indicated by the field observations and analytical results. An unexpected finds protocol is recommended during redevelopment of the Lot.

The Site Auditor reported, the nature and extent of contamination has been appropriately determined for the purpose of planning future management or redevelopment.

5.3 Lot 12 DP 1136859 – Previous Investigations

The following summarises reports made available to JBS&G of previous investigations at Lot 12 in DP 1136859. Historical sample locations are shown in **Figure 7B**. Soil exceedances are shown on **Figure 8C – East** and **Figure 8C – West**. A summary of historical soil analytical data is presented in **Table B** (**Appendix C**). Historical TCLP data is included in **Table F** (**Appendix C**).

[19] *Site Audit Report – Lot 9 Australian Technology Park Eveleigh.* Environ Australia Pty Ltd dated December 2014 (Environ 2014b)

5.3.1 Preliminary OH&S Soil Sampling (GETEX 2013a[20])

GETEX (2013a) undertook a limited soil sampling program for occupation health and safety (OH&S) purposes. The scope of works comprised the collection of soil samples from six sample locations from depths of 0.1 m bgl to 0.6 m bgl within Lot 12.

Soil samples were analysed for heavy metals, PAHs, TPH, BTEX, phenols, OCPs, PCBs and asbestos. In summary, GETEX (2013a) found that reported soil contaminant concentrations were similar to those reported in previous investigations across the broader ATP site. An elevated benzo(a)pyrene concentration of 2.4 mg/kg was reported.

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for commercial/industrial land use (e.g. HIL-D, HSL-D) identified the following:

- Copper exceeded the adopted ecological criterion of 300 mg/kg at sample locations BH17/0.4-0.5 (300 mg/kg), BHS13/0.5-0.6 (13 000 mg/kg) and BH19/0.4-0.45 (3 200 mg/kg);
- Lead at sample location BHS13/0.5-0.6 (13 000 mg/kg) exceeding the ecological (1 800 mg/kg) and health (1 500 mg/kg) assessment criteria; and
- Benzo(a)pyrene exceeded the ecological criterion of 1.4 mg/kg at sample location BH15/0.3-0.35 with a concentration of 2.4 mg/kg.

5.3.2 Environmental Status Report (ES 2014c[21])

ES (2014c) prepared an Environmental Status Report based on previous investigations. ES (2014c) reported eight historical investigations have been completed for Lot 12 between 1993 and 2014 comprising ninety five sample locations, exceeding the EPA (1995) minimum sample density of twenty five sample location for an area of approximately 11 850 m^2.

Five groundwater monitoring wells were reported to have historically been advanced within Lot 12. Based on a review of historical reports, JBS&G have identified twelve historical groundwater monitoring wells. A detailed assessment/review of historical groundwater conditions is provided in **Section 5.4** below.

Lot 12 was reported to be largely surfaced with bituminous pavements with minor areas of landscaping (garden beds). Sample locations identified fill materials to variable depths ranging from 0.5 m bgl to 6.0 m bgl. A number of locations reported refusal on anthropogenic materials and/or ballast/firm fill. Fill materials were reported to generally comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, slag, metal, charcoal, concrete, ceramic, brick, sedimentary clast and construction rubble. Several historical sample from 1993 reported chemical/organic odours and chemical staining. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and in turn residual silty clay soil and shale bedrock were encountered underlying fill materials within the western, south western Lot extent. Residual silty clay soils and shale bedrock were encountered across the balance of the Lot underlying fill materials. Consistent with the broader site, a thin peat layer (black silty clay soils) was reported at several locations generally below overlying Aeolian sands (where encountered) and above residual silty clay soils.

Three hundred and thirty four (only two hundred and twenty nine presented in ES 2014c) soil samples were reported to have been submitted for a range of COPC including heavy metals, TRH/TPH, PAHs, OCPs, PCBs, VOCs and asbestos.

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[20] *Garden Beds Preliminary Soil Contamination Sample Locations – Garden Beds Locomotive Street Australian Technology Park Sydney.* Getex Pty Ltd dated 18 April 2013 (GETEX 2013a)

[21] Environmental Status Report – Lot 12 Australian Technology Park Locomotive Street, Eveleigh. Environmental Strategies Pty Ltd dated August 2014 (ES 2014c)

Thirty three soil samples collected from twenty nine sample locations were reported to have exceeded the adopted assessment criteria at the time of report preparation (combination of NEPC 1999 and NEPC 2013).

Samples which exceeded the adopted assessment criteria at the time of report preparation reported the following maximum concentrations of COC:

- TPH C_{16}-C_{34} with a maximum concentration of 4 800 mg/kg;
- TPH C_{10}-C_{36} with a maximum concentration of 5 325 mg/kg;
- Lead with a maximum concentration of 12 000 mg/kg;
- F2 TRH >C10-C16 with a maximum concentration of 1 467 mg/kg;
- Benzo(a)pyrene with a maximum concentration of 36 mg/kg;
- Carcinogenic PAHs with a maximum concentration of 51.46 mg/kg; and
- Asbestos was detected at two sample locations.

A number of the heavy metal and PAH exceedances were attributed to the presence of slag or ash within the fill soil profile.

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for commercial/industrial land use (e.g. HIL-D, HSL-D) identified the following:

Health

- Lead exceeded the adopted heath criterion of 1 500 mg/kg at sample locations BH52/0.0-0.1 (3 440 mg/kg), BH52/0.5-1.0 (2 880 mg/kg), BH53/1.5-2.0 (1 590 mg/kg), BH56/0.8-0.9 (2 890 mg/kg), BH604/0.1-0.2 (5 000 mg/kg), BH605A/0.9-1.0 (12 000 mg/kg), BH620A/0.4-0.5 (1 500 mg/kg), BHB1/0.0-0.3 (2 100 mg/kg), BHB2/0.0-0.6 (4 300 mg/kg), BHD5/0.5-1.1 (1 500 mg/kg), BHF6/0.1-0.4 (1 900 mg/kg), BHS13/0.5-0.6 (3 000 mg/kg) and TP53C/1.8-1.9 (1 830 mg/kg);
- TRH >C_{16}-C_{14} exceeded the adopted management limit criterion of 3 500 mg/kg at sample locations BH4/0.35-0.4 (4 800 mg/kg),
- TRH >C_{15}-C_{28} exceeded the adopted management limit criterion of 3 500 mg/kg at sample locations BH620A/0.4-0.5 (3 800 mg/kg), and
- Carcinogenic PAHs as benzo(a)pyrene TEQ exceeded the adopted heath criterion of 40 mg/kg at sample location BH625/0.9-1.0 (51.46 mg/kg).

Ecological

- Copper exceeded to adopted ecological criterion of 300 mg/kg at fifty nine sample locations within ninety four samples ranging from 300 mg/kg to 10 000 mg/kg;
- Lead exceeded the adopted ecological criterion of 1 800 mg/kg at sample locations BH52/0.0-0.1 (3 440 mg/kg), BH52/0.5-1.0 (2 880 mg/kg), BH56/0.8-0.9 (2 890 mg/kg), BH604/0.1-0.2 (5 000 mg/kg), BH605A/0.9-1.0 (12 000 mg/kg), BHB1/0.0-0.3 (2 100 mg/kg), BHB2/0.0-0.6 (4 300 mg/kg), BHF6/0.1-0.4 (1 900 mg/kg), BHS13/0.5-0.6 (3 000 mg/kg) and TP53C/1.8-1.9 (1 830 mg/kg);
- Nickel exceeded the adopted ecological criterion of 460 mg/kg at sample location BH4/0.35-0.4 with a concentration of 1 200 mg/kg;
- Zinc exceeded the adopted ecological criterion of 920 mg/kg at sample locations BH143/1.0-1.1 (1 100 mg/kg), BH147B/1.0-1.1 (2 400 mg/kg), BH2/0.5-0.6 (1 000 mg/kg), BH52/1.5-2.0 (4 550 mg/kg), BH53/1.5-2.0 1 (560mg/kg), BH605A/0.9-1.0 (1 600 mg/kg),

BHB4/0.0-0.2 (4 409 mg/kg), BHC1/0.0-0.2 (3 300 mg/kg), BHC5/1.1-1.5 (1 600 mg/kg), BHD5/0.1-0.4 (1 300 mg/kg), BHD5/0.5-1.1 (1 100 mg/kg) and BHE6/0.5-1.0 (2 200 mg/kg);

- TRH >C_{10}-C_{16} exceeded the adopted ESL criterion of 170 mg/kg at sample locations BH5/3.0-3.1 (400 mg/kg);
- TRH >C_{10}-C_{14} exceeded the adopted ESL criterion of 170 mg/kg at sample location BH620A/0.4-0.5 (590 mg/kg);
- TRH >C_{16}-C_{14} exceeded the adopted ESL criterion of 1 700 mg/kg at sample locations BH4/0.35-0.4 (4 800 mg/kg);
- TRH F2 exceeded the adopted ESL criterion of 170 mg/kg at sample locations BH5/3.0-3.1 (400 mg/kg), BH50/0.0-0.4 (200.8 mg/kg), BH51/2.8-3.0 (1 100 mg/kg), BH52/0.0-0.1 (1 467 mg/kg), BH52/0.5-1.0 (839.1 mg/kg), BH53/0.0-0.1 (477.1 mg/kg) and BH61/0.6-0.8 (314 mg/kg);
- TRH >C_{15}-C_{28} exceeded the adopted ESL criterion of 1 700 mg/kg at sample locations BH620A/0.4-0.5 (3 000 mg/kg) and BH25/0.9-1.0 (1 800 mg/kg); and
- Benzo(a)pyrene exceeded the adopted ecological criterion of 1.4 mg/kg at sample locations BH15/0.3-0.5 (2.4 mg/kg), BH4/0.35-0.4 (1.5 mg/kg), BH4A/1.0-1.1 (5.8 mg/kg), BH51/2.8-3.0 (15.5 mg/kg), BH52/0.0-0.1 (5.5 mg/kg), BH59/1.0-1.45 (2 mg/kg), BH604/0.1-0.2 (5.5 mg/kg), BH611/0.9-1.0 (1.5 mg/kg), BH613/2.9-3.0 (1.5 mg/kg), BH615A/0.1-0.2 (1.4 mg/kg), BH615A/0.9-1.0 (1.6 mg/kg), BH619/0.4-0.5 (13 mg/kg), BH623/0.9-1.0 (2.1 mg/kg), BH624/0.9-1.0 (10 mg/kg), BH625/0.9-1.0 (35 mg/kg), BH626/0.9-1.0 (1.8 mg/kg) and BHS13/0.5-0.6 (3.1 mg/kg).

TCLP analyses identified that a portion of lead is potentially leachable under the TCLP conditions from fill material within the top 1.5 m of fill within the central and central northern Lot extent (**Figures 8B-East** and **8B-West**) which require consideration for management and waste classification, if relevant, with respect to future development of the site. It is noted that downgradient groundwater monitoring wells have not reported elevated lead concentrations.

5.3.3 Site Audit Statement/Report (Environ 2014c[22])

A Non-Statutory Section B SAS was issued for the Lot 12 in 2014 certifying that the nature and extent of the contamination has been appropriately determined.

It was reported that Lot 12 has been the subject of several previous investigations. Fill materials comprising sand, silt and clay with inclusions of concrete and crushed sandstone were reported. Ash, slag and charcoal were reported in approximately half the sample locations. Asbestos was not visually identified, however, was detected in several samples submitted for laboratory analysis.

The Site Auditor commented laboratory analyses of fill samples identified elevated concentrations of heavy metals, particularly lead and copper, and PAHs. Concentrations exceeded the adopted human health criteria in only a small number of samples of fill materials. No significant amounts of volatile contaminants were detected and no clear distribution of contaminants within fill was identified.

It was noted, groundwater has been assessed as part of the greater ATP site. No groundwater remediation was considered to be required. It was stated that the potential for affecting groundwater conditions, for example by increased contaminant leaching would need to be considered in any redevelopment proposal. Any future groundwater abstraction would require

[22] *Site Audit Statement/Report – Lot 12 Australian Technology Park Eveleigh.* Environ Australia Pty Ltd dated December 2014 (Environ 2014c)

investigation of the groundwater resource and approval from the NSW Department of Natural Resource (now the NSW Department of Primary Industry – Water).

The Site Auditor commented, due to the investigation methods, asbestos and anthropogenic material is likely to be present at a greater density than indicated by the field observations and analytical results. An unexpected finds protocol was recommended to be implemented during redevelopment of the Lot.

The Site Auditor reported the nature and extent of contamination has been appropriately determined for the purpose of planning future management or redevelopment.

5.4 Site Wide Assessments – Previous Investigations

The following summarises reports made available to JBS&G of previous investigations of public domain areas (roads, pedestrian easements and recreational facilities), the Locomotive Workshop and ATP-wide assessments involving Developable Lot and/or groundwater characterisation activities.

Historical soil and soil vapour sample locations are shown in **Figure 7C**. Groundwater monitoring well locations are shown on **Figure 7D**. Soil exceedance are shown on **Figures 8C** and **8D**. Groundwater exceedances are shown in **Figures 8E East** and **8E West**.

A summary of historical soil analytical data is presented in **Tables C** and **D** (**Appendix C**). A summary of groundwater analytical data is presented in **Table E** (**Appendix C**).

5.4.1 Phase 2 Limited Soil Investigation (ES 2010a[23])

ES (2010a) undertook a limited soil investigation of the water tower located within the north eastern site extent (**Figure 6**). The limited soil investigation was required to assess the soil beneath the support structure of the water tower, from a contamination perspective, given the historical use of the area as a former locomotive workshop/yard.

The scope of works comprised advancement of four boreholes to depth of approximately 4 m bgl and collection of fill and natural soil samples. Sample locations identified fill ranging in depth from 3.34 m bgl to 3.4 m bgl. Fill materials were reported to generally comprise gravelly sandy, silty sands with inclusions of railway ballast and sedimentary clast. Historical logs are provided in **Appendix B**.

Natural Aeolian sands were encountered underlying fill materials. Standing groundwater and/or groundwater seepage was not reported.

TPH, BTEX, OCPs, OPPs, heavy metal and asbestos soil analytical results were within the adopted commercial/industrial NEPC (1999) assessment criteria.

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for commercial/industrial land use (e.g. HIL-D, HSL-D) identified the following:

Benzo(a)pyrene at sample locations BHN/0.1-0.2 and BHGN/3.3-3.4 with concentrations of 3 mg/kg, above the ESL criterion of 1.4 mg/kg.

5.4.2 Revised Strategic Contaminated Land Advice (ES 2010b[24])

ES (2010b) undertook a review of historical information and the contamination status of the ATP site documenting residual risks from existing buildings and infrastructure, as well an assessment of developable Lots.

Fill materials were reported to occur across the entire ATP site with minor exceptions, ranging from a skeletal fill soil profile to 7.6 m in depth. In general, fill conditions were greatest along Locomotive

[23] *Phase 2 Limited Soil Investigation – Australian Technology Park Water Tower, Locomotive Street, Eveleigh, NSW.* Environmental Strategies dated 2 September 2010 (ES 2010a)

[24] *Revised Strategic Contaminated Land Advice, Australian Technology Park. Environmental Strategies dated 15 September 2010 (ES 2010b)*

Street site extent. Fill materials were considered resultant from a combination of site activity and importation of fill materials to establish site levels. Available historical logs are provided in **Appendix B**.

Fill materials were reported to comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, slag, sedimentary clast and construction rubble.

Fill materials were shown to be contaminated with heavy metals, TPHs/TRHs and PAHs (including benzo(a)pyrene) and, in parts, asbestos (Developable Lots). There was no discernible pattern to the distribution of contaminants within the fill material and the impact was not confined to any particular portion(s) of the site. It was noted that, while asbestos was identified in isolated samples, given the occurrence of anthropogenic inclusions, potential remained for more widespread asbestos impact within the fill materials in portions of the site.

The sample depths at which elevated concentrations of the nominated contaminants were identified range from immediately beneath hardstands/establish site vegetation, to fill termination indicating contamination is associated with the fill material itself, rather than discrete point sources.

The reported concentrations of the identified contaminants (where present) in the fill materially typically exceed ecological investigation levels and in some cases, exceed the health based threshold concentrations for commercial land uses. It is noted ES (2010b) did not present a complete tabulated data set against ecological and health assessment criteria, rather just plotted existing analytical data with modelled confidence levels for determination of available contamination data across the site, and also to identify contamination levels for various media graphically.

ES (2010b) reported analysis of natural soil samples indicated contaminated material was generally limited to the fill material overlying the natural soils. Several samples reported elevated TRH/TPH, PAHs and heavy metals within the top 0.2 m of the nature soil profile, potentially resultant from sample collection methods (boreholes).

Seventy boreholes were reported to have been converted to groundwater monitoring bores. ES (2010b) reported, groundwater depths of 3.5 m bgl to 8.5 m bgl within the northern site extent, to between 1.5 m bgl and 3.5 m bgl within the central and southern site extent. Groundwater was reported to flow generally to the south-southwest.

Groundwater analytical data reported elevated concentrations of lead, nickel, copper, chromium and cadmium in a number of areas across the site. Elevated hydrocarbons (PAHs and ethylbenzene) were reported in proximity to the north western corner of the Locomotive Workshop and elevated levels of TPH (C_{10}-C_{36}) in a number of wells across the site.

With respect to individual land parcels, the following was reported/identified:

Lots 8, 9 and 12

At the time of reporting, ES (2010b) stated Lots 8, 9 and 12 were subject to a Site Audit. The Site Audit for Lot 8 was reviewed, however, Site Audits for Lots 9 and 12 were incomplete. A detailed assessment of Lots 8, 9 and 12 is provided in **Sections 3.1**, **3.2** and **3.3**, respectively. The location of each lot is shown on **Figures 2** and **3**.

Locomotive Workshop

No historical assessments were reported to have been undertaken within this portion of the site.

Roadways

It was reported that contaminated fill has been or was proposed to be placed beneath road reserves and potential remains for exposure to contaminants of concern during site development/upgrade activities.

It was further noted the sampling density with the road reserves was not acquiescent with EPA (1995) sampling design guidelines. In particular, Central Avenue south of Lot 12 and the Biomedical Building was reported to have been poorly characterised.

Open Spaces

Public open space areas to the south and south east of the site, adjacent to Henderson Road were reported to have been poorly assessed. Confidence levels for assessing contamination in public open spaces was reported to have been approximately in the order of 50%. Further assessment was recommended to characterise site conditions within this portion of the site.

Groundwater

Elevated heavy metals concentrations were identified in groundwater. Concentrations were considered generally representative of urban environment and not requiring management. All other organic contaminants were reported generally within ANZECC (2000) thresholds with some fluctuation and exceedances. Several wells reported TRH/TPH concentrations.

Historically (early 1990s) Light Non Aqueous Phase Liquid (LNAPL) and high levels of TPH were reported within MW3 within Area 2.

Summary Findings

In summary ES (2010b) identified the following areas with respect to the site which represented lower confidence in contamination characterisation:

- Eastern portion of Central Avenue (no data);
- The central eastern portion of Lot 12 (limited soil and groundwater data);
- Locomotive Building (soil vapour potential)
- The Vice Chancellors Oval (limited soil and groundwater data); and
- Henderson Road frontage (limited soil and groundwater data).

ES (2010b) also discussed opportunities and constraints associated with Developable Lots, however, this largely pertained to excavation and off-site disposal and provided a preliminary cost estimates.

5.4.3 Report on Groundwater Quality (DP 2010a[25])

DP (2010a) undertook a groundwater data gap assessment to address limitations identified in ES (2010a). The scope of works comprised installation of seven of the recommended fourteen groundwater monitoring wells. Sample locations within the southern site extent, in proximity to Henderson Road, were not able to be advanced due to the presence of the Eastern Suburbs/Illawarra Train Line Tunnel.

Sample locations identified fill materials similar to that across the broader site comprising coarse grained sands, crushed sandstone, silty sands with inclusions of bricks, coal waste, slag, asphalt and building demo waste. Fill was encountered to a depth of 2 m bgl. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and in turn clay and shale/sandstone bedrock were encountered underlying fill materials. Standing groundwater was reported at depths of 0.95 m bgl to 8.15 m bgl, with groundwater shallowest within the southern site extent.

[25] *Report on Groundwater Quality Assessment. Australian Technology Park – 2 Locomotive Street, Eveleigh*. Douglas Partners Pty Ltd dated May 2010 (DP 2010a)

The seven newly installed and two existing wells were sampled, with collected samples submitted for a range of organic and inorganic contaminants including heavy metals, PAHs, TRH, BTEX, VOCs, OCPs and PCBs.

In summary, the findings of groundwater contaminant concentrations were similar to previous investigations. With the exception of zinc at sample location MW508 (Lot 9) with a concentration of 1 600 µg/L, all heavy metal concentrations were below the adopted ANZECC (2000) assessment criteria or considered representative of urban background levels. Sample location MW104 (Lot 12) reported a TRH C_{10}-C_{36} contaminant concentrations of 470 µg/L, below the adopted assessment criterion of 600 µg/L.

DP (2010a) reported groundwater was not significantly contaminated or required remediation and was typical of urban environments.

5.4.4 Additional Analysis of Zinc in Groundwater (DP 2010b[26])

This report presents the results of zinc analysis on a groundwater sample collected from groundwater monitoring well MW508 (Lot 9). The well was originally sampled in May 2010 (DP 2010a) which reported an elevated zinc concentration of 1 600 µg/L. Sampling and analysis of the well in June 2010 reported a zinc contaminant concentration of 16 µg/L. DP (2010b) reported the elevated concentration reported by DP (2010a) was considered an anomaly.

5.4.5 Ambient Air Quality Assessment (DP 2010c[27])

This report presents the results of ambient air quality conducted within the footprint of existing ATP site structures.

Historically, few soil and/or groundwater analytical data has been collected from beneath existing ATP site structures, including the Locomotive Workshop. To establish whether vapour generation by potentially contaminated soils has resulted in potential an unacceptable health risk, an ambient air quality assessment was undertaken within the ground floor/basement levels of the following buildings:

- Locomotive Workshop (within the site);
- The Engine Room (now NIC building);
- IBC Building; and
- RTA Building

Samples were collected over a 24 hour period, using calibrated summa canisters in accordance with *ASTM D 5466 – Method for Determination of Volatile Organic Chemicals in Atmospheres*.

Ten summa canisters were placed across the ground floor within the breathing zone of an adult within the Locomotive Workshop. Four samples were collected from the RTA Building and two from both the NIC and IBC Buildings.

Samples were submitted for USEPA T015 analysis. All contaminant concentrations were below the adopted assessment criteria. It is noted low concentrations of toluene were reported in all samples. Several samples also returned slightly elevated concentrations of trimethylbenzene below the adopted assessment criterion.

Slightly elevated concentrations of mono-aromatic compounds were attributed to the former use in, or during manufacturing of plastics, cleaning products, inks, particleboard and office furniture and

[26] *Additional Analysis for Zinc from Groundwater Monitoring Well DP508 (GW508) Australian Technology Park, Eveleigh.* Douglas Partners Pty Ltd dated 21 June 2010 (DP 2010b)

[27] *Ambient Air Quality Assessment – The Locomotive, IBC, NIC and RTA Buildings, Australian Technology Park*. Douglas Partners Pty Ltd dated 18 May 2010 (DP 2010c)

the use of solvents. Slightly elevated concentrations of trimethylbenzene were attributed to former use of dyes, perfumes and resins and fuels.

DP (2010c) concluded, that there were no significant adverse impacts to air quality within existing ATP site structures.

5.4.6 Preliminary OH&S Soil Sampling (GETEX 2011a[28])

GETEX (2011a) undertook a limited soil sampling program for occupation health and safety (OH&S) purposes. The scope of works comprised the collection of soil samples from five surface locations.

Soil samples were submitted for heavy metals, PAHs, TPH, BTEX, phenols, OCPs, PCBs and asbestos. In summary, reproted soil contaminant concentrations were similar to those reported for previous site investigations. An elevated benzo(a)pyrene concentration of 1.1 mg/kg was reported at sample location BHLoc 4 (Area 1).

Comparison of soil analytical data with current adopted assessment criteria (**Section 4**) for commercial/industrial land use (e.g. HIL-D, HSL-D) identified reported contaminant concentrations were below the adopted site assessment criteria.

5.4.7 Report on Round Two Groundwater Quality Assessment (DP 2011a[29])

This report details the methodology and results of a second round of groundwater assessment of nine existing groundwater monitoring wells across the site.

Groundwater across the site was reported to contain elevated levels of copper, nickel and zinc which were generally considered representative of background urban environments and similar to previous investigations. Zinc at sample location MW508 (Lot 9) was considered not to be representative of urban environments with a concentration of 640 µg/L and requiring further assessment.

Several groundwater samples identified low TRH contaminant concentrations below the adopted assessment criterion of 600 µg/L. Subsequent silica gel clean up on representative samples reported either no TRH or reduced TRH contaminant concentrations. With the exception of dieldrin in sample MW107 (Area 4) with a contaminant concentration of 0.01 µg/L, all other organic contaminant concentrations were below the laboratory limit of reporting (LOR) and the adopted ANZECC (2000) assessment criteria. The dieldrin concentration in sample MW107 was reported below the adopted site assessment criterion.

DP (2011a) reported that, with the exception of zinc at sample location MW508 (Lot 9), groundwater was not significantly contaminated and does not require remediation or additional investigations. Further assessment of zinc concentrations at sample location MW508 was recommended.

5.4.8 Groundwater Quality Assessment (DP 2012a[30])

This report details the methodology and results of a third round of groundwater assessment of nine existing groundwater monitoring wells across the site.

Groundwater across the site was reported to contain elevated levels of heavy metals similar to previous investigations and generally considered representative of background urban environments. Zinc at sample location MW508 (Lot 9) was considered not to be representative of urban environments with a concentration of 410 µg/L.

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[28] *Preliminary OH&S Soil Sampling – Old Gardeners Shed/Compound Area Australian Technology Park Sydney.* Getex Pty Ltd dated 20 December 2011 (GETEX 2011a)

[29] *Round 2 Groundwater Quality Assessment – Australian Technology Park 2 Locomotive Street Eveleigh.* Douglas Partners Pty Ltd dated January 2011 (DP 2011a)

[30] *Groundwater Quality Assessment Australian Technology Park 2 Locomotive Street Eveleigh.* Douglas Partners Pty Ltd dated January 2012 (DP 2012a)

Several groundwater samples identified low TRH contaminant concentrations below the adopted assessment criterion of 600 µg/L. All other organic contaminant concentrations were below the laboratory LOR and the adopted ANZECC (2000) assessment criteria.

DP (2011a) reported with the exception of zinc at sample location MW508, groundwater was not significantly contaminated and does not require remediation or additional investigations. Further assessment of zinc concentrations at sample location MW508 was recommended.

5.4.9 Strategic Contaminated Land Advice (ES 2013a[31])

This report updated ES (2010b) with environmental data collected since 2010. The historical review comprises records from one hundred and six reports with ninety two of the assessments were reported in ES (2010b).

The site's lithology, hydrogeology and general contamination status was similar to that reported by ES (2010b). Since the original data set analysis, the following data gap locations had undergone further investigation with respect to the site:

- The Vice Chancellors Oval (limited groundwater characterisation); and
- Lot 12 central-eastern area assessment works (soil and groundwater).

Based on the review of historical and additional data sources, ES (2013a) reported the following limitations in data requiring further assessment:

- The Vice Chancellors Oval (groundwater data is limited);
- Henderson Road frontage (no soil or groundwater data); and
- Eastern Portion of Central Avenue (no soil or groundwater data).

5.4.10 Environmental Management Plan (ES 2013b[32])

This report updated existing environmental management plans (EMPs) prepared for the ATP. The objectives of the report were to document:

- A description of the nature and location of contamination on site;
- Procedures for residual contamination management across the ATP;
- Responsibilities for the EMP implementation; and
- An implementation schedule for each action in the EMP.

ES (2013b) reported fill materials underlying the ATP are impacted to varying degrees with heavy metals, TRH/TPH and PAHs. Groundwater was also reported to be potentially impacted to varying degrees by TPH/TRH, PAHs, BTEX and VOCs. JBS&G note that no reference to historical identification of asbestos was made.

To control risks associated with identified COPC, the EMP required the following procedures to be implemented to ensure the ongoing land use suitability of the ATP:

- Maintenance of existing capping arrangements comprising:
  - Grass and/or mulch;
  - Pavers with underlying sand bedding layers;

[31] *Strategic Contaminated Land Advice 2012 Australian Technology Parks Sydney Limited.* Environmental Strategies Pty Ltd dated February 2013 (ES 2013a)

[32] *Environmental Management Plan 2013 Revision.* Environmental Strategies Pty Ltd dated January 2013 reference 12067 EMP (ES 2013b)

- Concrete and bituminous pavements;
- Floor boards; and
- Crushed concrete and ballast gravels (Locomotive Workshop Bays 1 and 2).

These capping layers are required to be maintained in good condition. It was reported it was the responsibility the land owner or land owners representative to maintain public domain areas and Developable Lots. Existing ATP building are the responsibility of the strata management/building manager who reports to the land owner or land owners representative.

A capping integrity inspection by a qualified person (environmental consultant) is required annually to document capping arrangements/conditions and provided advise with respect to ongoing risk/exposure management;

- Routine groundwater monitoring at six monthly intervals, comprising groundwater gauging and analysis of samples from all accessible groundwater monitoring wells for heavy metals, BTEX, TRH, PAHs and VOCs. A record is required to be kept of any developments works that will involve any long term or temporary extraction of groundwater;
- Given the lack of analytical data from beneath the Locomotive Workshop, ambient air monitoring is required to be conducted at varying times of the year to assess the effects of weather and seasonal variations (minimum annually) and potential risk (if any) to human health.

  It was reported that recent ambient air monitoring identifies VOC concentrations greater than those historically reported; and
- Lead dust monitoring of Bays 1 and 2 within the Locomotive Workshop.

The EMP documents the personal protective equipment requirements and procedures to be implemented during intrusive works, and reporting and monitoring requirements.

5.4.11 Groundwater Monitoring Report (ES 2014d[33])

ES (2014d) undertook an assessment of groundwater conditions across the site as part of the bi-monthly EMP requirements. The objective of the assessment was to quantify the concentrations of COPC in groundwater, establish trends and determine risks to appropriate receptors.

The scope of works included the review of historical reports and the gauging, sampling and analysis of fourteen groundwater monitoring wells. Collected groundwater samples were submitted for TRH, BTEX, heavy metals, PAHs, VOCs, OCP, organophosphate pesticides (OPPs) and PCBs.

Based on the results of the current investigation, the following was reported:

- LNAPL was not detected in any of the groundwater monitoring wells during the sampling event;
- Groundwater samples contained slightly elevated heavy metal concentrations considered representative of urban environments;
- One groundwater monitoring well (MW619) located within Lot 12 returned concentrations of TRH and PAH slightly above the laboratory LOR, but below the adopted assessment criteria. ES (2014d) reported the TRH/PAH concentrations at sample location MW619 did not represent a potential human health risk with respect to vapour;

[33] *Groundwater Monitoring Report – Australian Technology Park*. Environmental Strategies Pty Ltd dated February 2014 (ES 2014d)

- Concentrations of BTEX, VOCs, OCPs and OPPs were below the laboratory LOR.

ES (2014d) reviewed historical groundwater data and reported that:

- Arsenic concentrations have fluctuated, however, have been generally been below the adopted assessment criterion;
- Cadmium concentrations have generally remained below the adopted assessment criterion with some minor exceedances;
- Copper concentrations have fluctuated since 2012 with a number of sampling events showing concentrations above the adopted assessment criterion. The highest concentration was detected at sample location MWAH1 (Area 1 with a concentration of 67 µg/L) in 2013. Current copper concentrations were reported to range between <1 µg/L to 10 µg/L;
- Mercury concentrations increased in the most recent sampling event. Previous results have indicated that mercury concentrations have consistently been below the LOR, however, two sample locations, MW402 (Lot 8) and MW503 (Lot 9) had concentrations of 0.05 µg/L, below the adopted assessment criterion;
- Nickel concentrations have generally remained below the adopted assessment criterion of 7 µg/L for all sampling locations with the exception of the up-gradient well GWAH1 (Area 1). Nickels concentrations at this location have been declining from its peak in 2013 of 80 µg/L to now (time of reporting) 11 µg/L;
- Lead concentrations have generally remained on or marginally above the LOR (1 µg/L). The highest concentration of lead has been 19 µg/L. The most recent concentration was below the adopted assessment criterion;
- TRH/TPH (C_{10}-C_{14}, >C_{16}-C_{34}, and C_{29}-C_{36}) concentrations have generally been below the LOR with the exception of sample MW619 (Lot 12). This location reported concentrations of 120 µg/L, 460 µg/L and 110 µg/L, respectively;
- TRH/TPH (C_{15}-C_{28}, >C_{16}-C_{34}, C_{10}-C_{36}) concentrations have generally been below the LOR with the exception of MW619 (Lot 12) which reported concentrations decreasing from C_{15}-C_{28} 500 µg/L in 2013 to 180 µg/L, C_{10}-C_{36} 730 µg/L in 2013 to 180 µg/L in the most recent sampling event;
- TRH F2 concentrations have generally been below the LOR with the exception of MW619 (Lot 12) which had concentrations decreasing from 230 µg/L in 2013 to below the LOR in the most recent sampling event;
- Naphthalene concentrations have generally been below the LOR with the exception of MW619 (Lot 12) which concentrations decreasing from 2 µg/L in 2013 to below the LOR in the most recent sampling event;
- Chloroform concentrations have generally been below the LOR with the exception of MW619 (Lot 12) which reported concentrations decreasing from 2 µg/L in 2013 to below the LOR in the most recent sampling event;
- Acenapthene concentrations have generally been below the LOR with the exception of MW619 (Lot 12) which reported concentrations decreasing from 4 µg/L in 2013 to2 µg/L in the most recent sampling event; and
- From 2013, with the exception of the above, PAHs, VOCs, BTEX, OCPs, OPPs and PCBs have all been reported below the laboratory LOR

Groundwater levels were reported to have been generally stable since early 2013.

LNAPL was reported historically (1994) at sample location MW4 (Area 2). The following TPH concentrations were reported at MW4 in 1994:

- TPH C_6-C_9 - 200 mg/kg;
- TPH C_{10}-C_{14} - 92 00 mg/kg;
- TPH C_{15}-C_{28} - 64 000 mg/kg;
- TPH C_{28}-C_{36} – 4 600 mg/kg; and
- TPH C_{10}-C_{36} – 79 000 mg/kg.

However, TPH concentrations were reported to be less than the LOR at MW5 (located downgradient of MW4).

Elevated TPH/TRH concentrations were also reported at locations to the southwest of the Locomotive Workshop in proximity to an inferred former UST (**Figure 2**) at sample location MW319 and the western extent of Locomotive Street (MW318), south of the former refuelling station. This location is off-site.

As discussed above, more recent analytical data has reported TRH concentrations generally below the laboratory LOR.

5.4.12 Environmental Status Report Public Open Space (ES 2014e[34])

ES (2014e) prepared an 'Environmental Status Report' based on previous investigations within areas of public domains (i.e. roadways, pedestrian easements and recreational facilities) within the ATP precinct.

In accordance with NEPC (2013), for the purpose of assessment, the assessment areas were broken into areas based on current land use. These areas were assessed against commercial/industrial land use (HIL-D) or public open space/recreational land use (HIL-C), and ecological criteria dependent on the location of the sample and the current land use at that location.

ES (2014e) reported eight historical investigations had been completed between 1993 and 2014 comprising one hundred and four known sample locations, exceeding the EPA (1995) minimum sample density of fifty five sample location for an area of approximately 50 000 m^2. Two hundred and eighty five samples were reported to have been submitted for analysis. It is noted the current assessment site excludes the western extents of Locomotive Street and Central Avenue, which were included in the ES (2014c) assessment.

Eighty two groundwater monitoring wells were reported to have historically been advanced across the ATP precinct and broader area. A detailed assessment/review of historical groundwater conditions is discussed in **Section 5.4.14**.

The Lot's surface was reported to be largely paved with the following:

- Road Reserves - primarily surfaced with bituminous concrete, concrete pavements or ceramic pavers with landscaped areas (garden beds),
- Pedestrian Easements - primarily surfaced with bituminous concrete, concrete pavements or ceramic pavers with landscaped areas (garden beds), and
- Areas of Open Public Space – public accessible parks comprising primarily areas surfaced with grass vegetation (Vice Chancellors Oval and fields), tennis courts, barbeque picnic area and areas surfaced with bituminous concrete, concrete and/or ceramic pavements with landscaped areas (garden beds).

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Sample locations identified fill materials to variable depths ranging from 0.5 m bgl to 7.6 m bgl. A number of locations reported refusal on anthropogenic materials and/or ballast/firm fill. Fill materials were reported to generally comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, slag, sedimentary clast and construction rubble. Historical logs are provided in **Appendix B**.

Natural Aeolian sands and/or residual silty clay soil were encountered underlying fill materials. A thin peat layer was reported at various locations across the site, generally below overlying Aeolian sands and above residual silty clay soils.

Soil samples were reported to have been submitted for a range of COPC including, but not limited to, heavy metals, TRH/TPH, PAHs, OCPs, PCBs, VOCs and asbestos.

Forty six soil samples (forty fill and six natural soil samples) were reported to have exceeded the adopted assessment criteria (combination of NEPC 1999 and NEPC 2013). Exceedances were generally reported in gravelly sands or coarse grained material.

Samples which exceeded the adopted assessment criteria reported the following maximum concentrations of COC:

- TPH C_6-C_9 with a maximum concentration of 1 506 mg/kg;
- TPH C_{10}-C_{14} with a maximum concentration of 3 289 mg/kg;
- TPH C_{29}-C_{36} with a maximum concentration of 5 000 mg/kg;
- TPH C_6-C_{36} with a maximum concentration of 23 000 mg/kg;
- TRH >C_{10}-C_{16} with a maximum concentration of 9 303 mg/kg;
- F2 TRH with a maximum concentration of 17 972 mg/kg;
- Benzo(a)pyrene with a maximum concentration of 18.8 mg/kg;
- Carcinogenic PAHs with a maximum concentration of 24.645 mg/kg;
- Lead with a maximum concentration of 6 500 mg/kg;
- Chromium with a maximum concentration of 250 mg/kg;
- Copper with a maximum concentration of 5 2010 mg/kg;
- Nickel with a maximum concentration of 140 mg/kg; and
- Zinc with a maximum concentration of 4 200 mg/kg.

All reported soil contaminant concentrations at locations within the site were below current adopted assessment criteria (**Section 4**) for commercial/industrial (e.g. HIL-D, HSL-D) and recreational land use (e.g. HIL-C) (depending on location) with the exception of the following:

Recreational (oval and sporting facilities)

Area 5 - Health

- Lead exceeded the adopted health criterion of 600 mg/kg at sample locations BH15/0.0-0.1 (876 mg/kg), BH18/0.5-1.0 (2 139 mg/kg) and BH18B/2.0 (1 240 mg/kg); and
- Carcinogenic PAHs as benzo(a)pyrene TEQ exceeded the adopted heath criterion of 3 mg/kg at sample locations BH12/0.5-1.0 (6.844 mg/kg) and BH97/0.2 (24.65 mg/kg).

Area 5 – Ecological

- Copper exceeded the adopted ecological criterion of 210 mg/kg at sample locations BH18/0.5-1.0 (5 210 mg/kg), BH18/1.5-2.0 (280 mg/kg), BH18B/1.5 (210 mg/kg) and BH18B/2.0 (4 650 mg/kg);
- Lead exceeded the adopted ecological criterion of 1 100 mg/kg at sample locations, BH18/0.5-1.0 (2 139 mg/kg) and BH18B/2.0 (1 240 mg/kg);
- Zinc exceeded the adopted ecological criterion of 590 mg/kg at sample locations, BH12/0.5-1.0 (739 mg/kg), BH18/0.5-1.0 (1 353 mg/kg), and BH18B/2.0 (1 150 mg/kg);
- TRH C_{15}-C_{28} exceeded the adopted ESL criterion of 300 mg/kg at sample location BH12/0.5-1.0 (536.1 mg/kg);
- TRH C_{15}-C_{36} exceeded the adopted ESL criterion of 300 mg/kg at sample location BH12/0.5-1.0 (726.8 mg/kg);
- TRH F2 exceeded the adopted ESL criterion of 120 mg/kg at sample locations BH12/0.5-1.0 (542.6 mg/kg) andBH13/0.5-1.0 (181.9 mg/kg); and
- Benzo(a)pyrene exceeded the adopted ecological criterion of 0.7 mg/kg at sample locations BH12/0.5-1.0 (4.1 mg/kg) and BH97/0.2 (18.8 mg/kg).

Area 7 - Health

- Lead exceeded the adopted health criterion of 600 mg/kg at sample locations BH24/1.5-2.0 (954 mg/kg) and BH24B/1.5 (5 500 mg/kg).

Area 7 – Ecological

- Copper exceeded the adopted ecological criterion of 210 mg/kg at sample location BH24B/1.5 with a concentration of 1 450 mg/kg;
- Lead exceeded the adopted ecological assessment criteria of 1 100 mg/kg at sample location BH24B/1.5 with a concentration of 5 500 mg/kg; and
- Zinc exceeded the adopted ecological criterion of 590 mg/kg at sample locations BH24B/1.5 (890 mg/kg) and BH24B/1.5 (4 200 mg/kg).

Commercial/Industrial (road reserves and pedestrian easements)

Area 1 - Health

- Lead exceeded the adopted heath criterion of 1 500 mg/kg at sample locations BH64/0.0-0.1 (2 100 mg/kg), BH65/0.5-1.0 (1 850 mg/kg), BHAH9/0.3-0.5 (1 620 mg/kg),
- TRH C_{10}-C_{14} exceeded the adopted management limit criterion of 1 000 mg/kg at sample locations BH48/4.5-5.0 (3 289 mg/kg) and BH60/6.0-6.5 (2 910 mg/kg),
- TRH C_{15}-C_{28} exceeded the adopted management limit criterion of 3 500 mg/kg at sample locations BH48/4.5-5.0 (9 681 mg/kg) and BH60/6.0-6.5 (6 393 mg/kg), and
- TRH C_{15}-C_{36} exceeded the adopted management limit criterion of 3 500 mg/kg at sample locations BH48/4.5-5.0 (10 330 mg/kg) and BH60/6.0-6.5 (6 491 mg/kg),

Area 1 – Ecological

- Copper exceeded the adopted ecological criterion of 300 mg/kg at sample locations BH61/0.5-1.0 (416 mg/kg), BH64/0.0-0.1 (1 160 mg/kg), BH69/0.5-1.0 (8 650 mg/kg), BHAH1/0.0-0.1 (325 mg/kg), BHAH11 (443 mg/kg), BHAH11 (398 mg/kg), BHAH5/0.0-0.1 (687 mg/kg), BHAH6/0.0-0.1 (522 mg/kg), BHAH9/0.0-0.1 (311 mg/kg), BHAH9/0.3-0.5 (492 mg/kg), TP64C/0.5-0.6 (2 260 mg/kg) and TP64D/0.6-0.7 (840 mg/kg);

- Lead exceeded the adopted ecologic criterion of 1 800 mg/kg at sample locations BH64/0.0-0.1 (2 100 mg/kg) and BH65/0.5-1.0 (1 850 mg/kg);
- Zinc exceeded the adopted ecological criterion of 920 mg/kg at sample locations BH69/0.5-1.0 (921 mg/kg), BHAH11/0.0-0.1 (3 340 mg/kg), BHAH5/0.0-.1 (1 010 mg/kg), BHAH8/0.0-0.1 (1 130 mg/kg) and BHAH9/0.3-0.5 (931 mg/kg),
- TRH C_{10}-C_{14} exceeded the adopted ESL criterion of 170 mg/kg at sample locations BH48/4.5-5.0 (3 289 mg/kg), BH60/6.0-6.5 (2 910 mg/kg), BHAH11/0.0-0.1 (206.6 mg/kg), BHAH5/0.0-0.1 (546.7 mg/kg), BHAH6/0.0-0.1 (976.6 mg/kg), BHAH8/0.0-0.1 (423.4 mg/kg) and BHAH9/0.0-0.1 (323.4 mg/kg),
- TRH C_{15}-C_{28} exceeded the adopted ESL criterion of 1 700 mg/kg at sample locations BH48/4.5-5.0 (9 681 mg/kg) and BH60/6.0-6.5 (6 393 mg/kg),
- TRH C_{15}-C_{36} exceeded the adopted ESL limit of 1 700 mg/kg at sample locations BH48/4.5-5.0 (10 330 mg/kg), BH60/6.0-6.5 (6 491 mg/kg), BH65/0.5-1.0 (1 754 mg/kg) and BH69/0.5-1.0 (2 127 mg/kg); and
- TRH F2 exceeded the adopted ESL of 170 mg/kg at sample locations BH48/0.0-0.1 (512 mg/kg), BH48/4.5-5.0 (12 970 mg/kg), BH49/0.5-1.0 (827.1 mg/kg), BH60/0.0-0.1 (233.6 mg/kg), BH60/6.0-6.5 (9 303 mg/kg), BH60/9.0-9.5 (276.9 mg/kg), BH63/0.0-0.1 (638.6 mg/kg), BH63/0.5-1.0 (751.1 mg/kg), BH64/0.0-0.1 (1 276 mg/kg), BH65/0.5-1.0 (1 344 mg/kg), BH65/1.5-2.0 (267.1 mg/kg), BH69/0.5-1.0 (1 525 mg/kg), BH69/1.5-2.0 (178.6 mg/kg), BHAH10/0.0-0.1 (314.4 mg/kg), BHAH11/0.0-0.1 (413.2 mg/kg), BHAH2/0.0-0.1 (434.2 mg/kg), BHAH5/0.0-0.1 (1 293 mg/kg), BHAH6/0.0-0.1 (1 954 mg/kg), BHAh8/0.0-0.1 (666.8 mg/kg), BHAH9/0.0-0.1 (648.8 mg/kg), BHAH9/0.3-0.5 (314.6 mg/kg) and TP96/0.5-0.6 (940 mg/kg).

Area 2 - Health

- Lead exceeded the adopted health criterion of 1 500 mg/kg at sample locations BH47/0.5-1.0 (2 130 mg/kg) and TP99/1.8-1.9 (6 500 mg/kg);
- TRH C_6-C_9 exceeded the management limit criterion of 700 mg/kg at sample location BH47/0.5-1.0 with a concentration of 1 506 mg/kg;
- TRH C_{10}-C_{14} exceeded the adopted management limit criterion of 1 000 mg/kg at sample location TP99/1.8-1.9 (1 980 mg/kg);
- TRH C_{15}-C_{28} exceeded the adopted management limit criterion of 3 500 mg/kg at sample locations BH46/0.0-0.1 (3 706 mg/kg) and TP99/1.8-1.9 (16 000 mg/kg);
- TRH C_{15}-C_{36} exceeded the adopted management limit criterion of 3 500 mg/kg at sample location TP99/1.8-1.9 (5 000 mg/kg); and
- TRH C_{15}-C_{36} exceeded the adopted management limit criterion of 3 500 mg/kg at sample locations BH46/0.0-0.1 (5 079 mg/kg) and TP99/1.8-1.9 (21 000 mg/kg).

Area 2 – Ecological

- Copper exceeded the adopted ecological criterion of 300 mg/kg at sample locations BH46/0.0-0.1 (1 020 mg/kg), BH47/0.5-1.0 (734 mg/kg), BHS4/0.1-0.2 (300 mg/kg), BHS7/0.1-0.2 (530 mg/kg), TP99/0.2-0.3 (1 250 mg/kg) and TP99 1.8-1.9 (6 600 mg/kg);
- Lead exceeded the adopted ecologic criterion of 1 800 mg/kg at sample locations BH47/0.5-1.0 (2 130 mg/kg) and TP99/1.8-1.9 (6 500 mg/kg);
- Zinc exceeded the adopted ecological criterion of 920 mg/kg at sample location TP99/1.8-1.9 with a concentration of 2 950 mg/kg;

- TRH C_6-C_9 exceeded the adopted ESL criterion of 215 mg/kg at sample location BH47/0.5-1.0 with a concentration of 1 506 mg/kg;
- TRH C_{10}-C_{14} exceeded the adopted ESL criterion of 170 mg/kg at sample locations BH45/0.0-0.1 (231.2 mg/kg), BH46/0.0-0.1 (249.6 mg/kg) and TP99/1.8-1.9 (1 980 mg/kg);
- TRH C_{15}-C_{28} exceeded the adopted ESL limit criterion of 1 700 mg/kg at sample locations BH46/0.0-0.1 (3 706 mg/kg) and TP99/1.8-1.9 (16 000 mg/kg);
- TRH C_{29}-C_{36} exceeded the adopted ESL limit criterion of 1 700 mg/kg at sample location TP99/1.8-1.9 (5 000 mg/kg);
- TRH C_{15}-C_{36} exceeded the adopted ESL limit criterion of 1 700 mg/kg at sample locations BH45/0.0-0.1 (1 881 mg/kg), BH46/0.0-0.1 (5 079 mg/kg) and TP99/1.8-1.9 (21 000 mg/kg);
- TRH F2 exceeded the adopted ESL criterion of 170 mg/kg at sample locations BH45/0.0-0.1 (1 744 mg/kg), BH46/0.0-0.1 (3 950 mg/kg), BH47/0.5-1.0 (782.5 mg/kg) and TP99/1.8-1.9 (17 970 mg/kg); and
- Benzo(a)pyrene exceeded the adopted ecological criterion of 1.4 mg/kg at sample locations BH45/0.0-0.1 (4.3 mg/kg), BH46/0.0-0.1 (8.6 mg/kg), TP99/0.2-0.3 (2.8 mg/kg) and TP99/1.8-1.9 (4.6 mg/kg).

Area 3 - Ecological

- Copper exceeded the adopted ecological criterion of 300 mg/kg at sample locations BH51/0.0-0.1 (659 mg/kg) and BH51/0.5-1.0 (470 mg/kg); and
- Zinc exceeded the adopted ecological criterion of 920 mg/kg at sample locations BH51/0.0-0.1 (1 500 mg/kg), BH51/0.5-1.0 (1 100 mg/kg) and TP115/0.9-1.0 (2 260 mg/kg).

Area 6 - Ecological

Benzo(a)pyrene at sample locations BH70/0.5 (1.6 mg/kg) and BH71/0.8-1.0 (1.8 mg/kg).

ES (2014e) stated while elevated concentrations of heavy metals, TRH and PAHs have been reported, provided current site capping arrangements are maintained in good condition, the potential for exposure was negligible.

ES (2014e) stated that provisions of the site EMP should be enforced to ensure the ongoing site suitability.

5.4.13 Interim Advice Letter No. 1 (Environ 2014d)

Environ (2014d) provided interim advice with respect to groundwater conditions within Lots 8, 9 and 12. The Site Auditor commented that groundwater monitoring has not identified any current significant groundwater contamination on Lots 8, 9 or 12. As no ongoing source of contamination is known, no further groundwater data is required to assess suitability of Lots 8, 9 and 12 for commercial/industrial land use.

The Site Auditor noted that concentrations of some metals (copper, nickel and zinc) were above the ecological criteria for marine waters. The concentrations were reported to be generally not significantly elevated, with the exception of zinc at sample location MW508 in Lot 9.

5.4.14 Site Wide Groundwater Monitoring (ES 2014f[35])

ES (2014f) were engaged to complete a review of historical results and additional characterisation activities to identify current groundwater contamination issues associated with historical site uses and known contaminated fill material on site.

The objectives of the assessment were to:

- Collate data from previous groundwater monitoring events (GME);
- Identify current groundwater impact; and
- Identify any potential off-site migration.

ES (2014f) reported numerous historical groundwater investigations had been completed between 1993 and 2014, with a total of 82 groundwater monitoring well locations across the ATP precinct and broader area, some locations with multiple sampling rounds. The final data set included 152 individual groundwater samples from 64 monitoring locations.

ES (2014f) reported the following historical groundwater physiochemical parameters:

- Historical groundwater temperatures have ranged between 16.2 and 23.2 degrees;
- Historical groundwater pH has ranged between 4.75 and 6.42, being slightly acidic to neutral;
- Historical dissolved oxygen (DO) records ranged between 0.00 parts per million (ppm) to 32.5 ppm;
- Historical oxidation reduction potential (ORP) ranged between 5 mV and 500 mV indicating oxidising conditions; and
- Historical conductivity measurements ranged between 90 micro Siemens/centimetre (µS/cm) and 968 µS/cm indicating groundwater is fresh in nature.

The following is a synopsis of historical groundwater characterisation activities presented in ES (2014f):

<u>1993</u>

Ten groundwater monitoring wells were installed in 1993, nine of which were sampled. Groundwater analytical results reported the following:

- Arsenic, cadmium, lead and mercury were below the LOR. Copper of 200 µg/L was reported at sample location (MW42) and zinc with concentrations of 10 µg/L to 30 µg/L at six locations; and
- TRH was detected at all sample locations. The dominant fraction was C_{15}-C_{28}. The highest TRH concentration was measured in MW42 (off site) at 60 970 µg/L. This location is noted to be within the railway easement to the west of the site.

<u>1994</u>

Five groundwater monitoring wells were installed in 1994. Groundwater monitoring well MW3 (Area 2) reported LNAPL. Down gradient wells did not identify LNAPL. Groundwater analytical results reported the following:

[35] *Site Wide Groundwater Monitoring Report, Australian Technology Park*. Environmental Strategies Pty Ltd dated July 2014 (ES 2014f)

- Arsenic and copper were reported below the LOR. Lead was detected at MW4 (Area 2) at a concentration of 10 µg/L. Zinc was detected at MW2 (Lot 10) at 10 µg/L and MW5 (Area 3) at 10 µg/L; and
- TPH impact was reported in MW3 (Area 2) in the form of LNAPL and down gradient well MW4 (Area 2) reported TPH C6-C36 concentration of 79 000 µg/L.

1994 - 2001

ES (2014f) reported a number of wells were installed between 1994 and 2001, the reports were not reviewed. It is noted that subsequent investigations presented analytical data within this timeframe, with the results presented in **Table E** (**Appendix C**).

Groundwater analytical results identified elevated heavy metals, PAHs (urban background levels) and TPH concentrations, generally below the adopted assessment criteria at the time.

2001

Four groundwater monitoring wells were installed in 2001. The four newly advanced wells and one existing well were sampled. ES (2014f) reported no COPC concentrations exceeded the adopted criteria, however, groundwater monitoring wells reported TRH ranging from 408 µg/L to 681 µg/L. It was reported that the TPH impact was considered localised.

2005 - 2008

ES (2014f) reported a number of groundwater monitoring wells were installed between 2005 and 2008, largely associated with the development of Lots 10 and 11 in DP 1136859 (Channel 7 Building). Analytical results are presented in **Table E** (**Appendix C**).

LNAPL was identified at one location (MWP208A) within Lot 11 in DP 1136859. Five wells (MWP208A-A to MWP208A-E) were installed around the identified LNAPL, one well returned a TRH concentration above the LOR. The source of the LNAPL was not identified.

TRH was also reported in several groundwater monitoring wells on site with the highest concentrations present in MW318 (DP318) and MW602 (DP602) located off-site at the western extent of Locomotive Street. The elevated TRH concentrations were considered resultant from up gradient sources (refuelling station), with contaminated groundwater migrating onto the site.

An off-site UST was reported in close proximity of the south western corner of the Locomotive Workshop. ES (2014f) reported that it was not known if the UST had been removed or otherwise.

ES (2014f) reported two reports on groundwater quality beneath the former refuelling station were made available but excluded from the assessment given it relates to 'offsite groundwater conditions".

2010

Seven newly installed and two existing wells were samples in May 2010. With the exception of zinc at sample location MW508 (Lot 9) all heavy metal concentrations were below the adopted ANZECC (2000) assessment criteria or considered representative of urban background levels. Sample location MW104 (Lot 12) reported a TRH C_{10}-C_{36} contaminant concentrations of 470 µg/L, below the adopted assessment criterion of 600 µg/L.

2011

A groundwater assessment of nine existing groundwater monitoring wells was undertaken in 2011 from locations across the site, including those within the north eastern site extent which historically identified LNAPL.

Groundwater across the site was found to contain elevated levels of copper, nickel and zinc which were generally considered representative of background urban environments and similar to previous

investigations. Zinc at sample location MW508 (Lot 9) was considered not to be representative of urban environments with a concentration of 640 µg/L and requiring further assessment.

Several groundwater samples identified low TRH contaminant concentrations below the adopted assessment criterion of 600 µg/L. Subsequent silica gel clean up on representative samples reported either no TRH or reduced TRH contaminant concentrations. With the exception of dieldrin in sample MW107 (Area 4) with a contaminant concentration of 0.01 µg/L, all other organic contaminant concentrations were below the laboratory LOR and the adopted ANZECC (2000) assessment criteria. The dieldrin concentration in sample MW107 was reported below the adopted site assessment criterion.

It was reported with the exception of zinc at sample location MW508 (Lot 9), groundwater was not significantly contaminated and does not require remediation or additional investigations. Further assessment of zinc concentrations at sample location MW508 was recommended.

2012

Groundwater across the site was found to contain elevated levels of heavy metals similar to previous investigations and generally considered representative of background urban environments. Zinc at sample location MW508 (Lot 9) was considered not to be representative of urban environments with a concentration of 410 µg/L and requiring further assessment.

Several samples identified low TRH contaminant concentrations below the adopted assessment criterion of 600 µg/L. All other organic contaminant concentrations were below the laboratory LOR and the adopted ANZECC (2000) assessment criteria.

It was reported, with the exception of zinc at sample location MW508, groundwater was not significantly contaminated and does not require remediation or additional investigations. Further assessment of zinc concentrations at sample location MW508 was recommended.

A second round of groundwater characterisation activities were undertaken in late 2012. The results identified elevated heavy metals (zinc, cadmium, nickel and copper). All other COPC were below the laboratory LOR. It was reported, heavy metal concentrations had generally decreased across the site with the exception of sample location MW508 which reported an increase in zinc.

Sample location MW619 (Lot 12) reported a TRH C10-C36 concentrations of 560 µg/L and an oily sheen observed.

2013

Several new/replacement wells were installed across the site.

Groundwater characterisation activities in early 2013 reported slightly elevated heavy metal (zinc, nickel and copper) concentrations, generally representative of urban environments.

No LANPL was recorded and concentrations of TRH were below the adopted criteria with the exception of the following:

- MW619 (Lot 12) with a TRH C_{10}-C_{14} concentration of 110 µg/L, TRH C_{15}-C_{28} concentration of 360 µg/L and a total TRH concentration of 520 µg/L.

All organic concentrations were below the laboratory LOR with the exception of acenaphthene at sample location MW619 (Lot 12) with a concentration of 4 µg/L.

A second round of groundwater of groundwater sampling was reported to have been undertaken in 2013. Groundwater analytical results were reported to be similar to that reported earlier in 2013.

2014

The results of groundwater investigations identified heavy metal (zinc, nickel, and copper) above the adopted assessment criteria in several monitoring wells. All other COPC were reported at concentrations below the laboratory LOR or the adopted assessment criteria.

Summary

Comparison of recent (i.e. post-2014) groundwater analytical data with adopted assessment criteria presented in **Section 4** has not identified the potential for vapours with respect to permissible land uses. The results of groundwater investigations identified heavy metal (zinc, nickel, and copper) above the adopted assessment criteria in several monitoring wells, however, contaminant concentrations are considered representative of urban environment and not requiring remediation.

5.4.15 Sub Slab Vapour and Ambient Air Sampling (ES 2015a[36])

ES (2015a) were engaged to undertake a limited assessment of ambient air and sub-slab vapour within the Locomotive Workshop. The objective of the investigation was to determine if there was an immediate risk posed from trichloroethlene (TCE) concentrations historically reported in sub-slab vapour samples.

It was reported that indoor air monitoring has been completed annually at the ATP precinct since 2012. The monitoring has been undertaken as a precautionary measure, due to the historically reported presence of contaminated fill material and groundwater on site in addition to the absence of subsurface characterisation beneath ATP precinct building footprints.

ES (2015a) reported historical indoor air sampling identified instances where COPC in the site's subsurface were reportedly detected within indoor air samples.

The scope of works comprised:

- Ambient air sampling of five publically accessible locations around two TCE detected areas (SVE and SVF) within Bays 5 and 6 of the Locomotive Workshop. The sampling and analysis was reported to have been undertaken over a long weekend when air conditioning units were switched off; and
- Sub-slab vapour sampling was completed from the two locations within Bays 5 and 6 that reported elevated TCE concentrations concurrently with the ambient air sampling.

Detections of the following analytes were reported above the LOR:

- Cyclohexane at sample location LB Air 13 with a concentration of 2.1 µg/m^3;
- Dichloromethane at sample locations LB Air 7 and LB Air 13 with concentrations of 2.1 µg/m^3 and 2.8 µg/m^3,respectively;
- Hexane at sample locations LB Air 8 and LB Air 13 with concentrations of 2.1 µg/m^3 and 3.5 µg/m^3,respectively;
- Isopropyl Alcohol at sample locations LB Air 7 (11.5 µg/m^3), LB Air (8.4 µg/m^3), LB Air 13 (13.3 µg/m^3), LB Air 14 (24.6 µg/m^3) and LB Air 15 (9.8 µg/m^3);
- Toluene at sample locations LB Air 7 (4.5 µg/m^3), LB Air 8 (4.5 µg/m^3), LB Air 13 (7.2 µg/m^3), LB Air 14 (2.2 µg/m^3) and LB Air 15 (2.6 µg/m^3);
- Ethanol at sample locations LB Air 7 (7.9 µg/m^3), LB Air 8 (14.3 µg/m^3), LB Air 13 (7.5 µg/m^3), LB Air 14 (7.0 µg/m^3) and LB Air 15 (6.2 µg/m^3);

[36] *Sub-Slab Vapour and Ambient Air Sampling. Locomotive Building, Australian Technology Park*. Environmental Strategies Pty Ltd dated May 2015 (ES 2015a)

- Tert-Amyl Ether at sample location LB Air 14 with a concentration of 5.4 µg/m^3; and
- Acetone at sample locations LB Air 7 (5.2 µg/m^3), LB Air 8 (11.6 µg/m^3), LB Air 13 (10.9 µg/m^3), LB Air 14 (4.0 µg/m^3) and LB Air 15 (8.5 µg/m^3).

All ambient air concentrations were below the adopted assessment criteria.

Sub-slab vapour locations SVE and SVF reported concentrations below the laboratory LOR with the exception of:

- TCE at SVE (0.11 mg/m^3) and SVF (0.0655 µg/m^3). TCE at SVE exceeded at adopted criterion of 0.08 mg/m^3; and
- Propene at SVE (0.112 mg/m^3).

Sample locations are shown on **Figure 7C**.

ES (2015a) reported historically concentrations of TCE in soil vapour samples have decreased between December 2014 (SVE – 0.235 mg/m^3 and SVF – 0.307 mg/m^3) and April 2015 (SVE – 0.117 mg/m^3 and SVF – 0.0655 mg/m^3).

ES (2015a) concluded:

- Ambient air quality results indicates that no exceedances were reported within the Locomotive Workshop;
- All historical ambient air TCE concentrations were reported to be below the LOR within the Locomotive Workshop since sampling first occurred in October 2012;
- TCE concentrations in sub-slab vapour at sample locations SVE exceeded the assessment criteria. SVE and SVF exceeded the assessment criteria in December 2014**;**
- The reported TCE concentrations in sub-slab vapour samples, requires further delineation to confirm the extent of impact and sources of contamination;
- There appears to be no direct correlation between the ambient air and sub-slab vapour results with the publically accessible areas;
- Based on the ambient air results, it appears that the TCE concentrations are not posing a direct risk to site users within the publically accessible areas in the immediate vicinity of SVE and SVF; and
- There is a moderate to high risk to the environment as the TCE plume has not been delineated.

ES (2015a) did not qualify or quantify the risk in relation to their conclusion "*There is a moderate to high risk to the environment as the TCE plume has not been delineated*".

ES (2015a) recommended:

- The EMP for the ATP be updated to include the TCE detection within the Locomotive Workshop;
- Delineation and mapping of the horizontal extent of the TCE sub-slab vapour plume;
- Limited groundwater investigation in Bays 5 and 6; and
- Preparation of a human health and ecological risk assessment (HHERA).

5.4.16 Groundwater Monitoring Report (ES 2015b)

ES (2015b) undertook an assessment of groundwater conditions across the site as part of the bi-monthly EMP requirements. The objective of the assessment was to quantify the concentrations of COPC in groundwater, establish trends and determine risks to appropriate receptors.

Key finds of ES (2015b) were:

- ES (2015b) reported LNAPL was not encountered within groundwater monitoring wells across the site;
- Groundwater samples were collected from twenty sample locations and submitted for heavy metal, TRH, BTEX, PAHS and VOCs;
- All COPC concentrations were reported below the adopted assessment criteria with the exception of the following:
    - Arsenic at sample location MW508 (Lot 9) with a concentration of 10 µg/L;
    - Copper in a number of wells ranging from 2 µg/L to 4 µg/L;
    - Zinc in a number of wells ranging from 16 µg/L to 92 µg/L. Sample location MW508 (Lot 9) returned a zinc concentration of 650 µg/L.

In summary, ES (2015b) concluded heavy metals in groundwater were considered generally consistent with previous recent sampling events, and considered representative of background conditions in an urban environment.

The zinc concentration reported at MW508 (Lot 9) was considered to be associated with localised impacted fill materials. ES (2015b) noted groundwater monitoring wells downgradient of this location contained zinc concentrations an order of magnitude below the MW508 concentrations, indicating that impacted zinc is not migrating off-site.

ES (2015b) recommended that all wells be surveyed to established groundwater flow direction.

5.4.17 Site Audit Statement/Report (Ramboll 2015a[37])

A draft Non-Statutory Section A SAS was issued for public domains within the ATP precinct comprising road reserves (Locomotive Street, Central Avenue and Davy Road), pedestrian easements, garden beds and open space areas (Vice Chancellors Oval, tennis courts and basketball courts) has been issued certifying that public domains are suitable for the proposed land uses subject to implementation of the updated EMP[38].

The Site Auditor commented that a number of investigations have been conducted and have identified fill materials comprising sand, silt and clay with gravels, crushed sandstone and concrete. Ash, slag and charcoal were identified in approximately half the sample locations. Asbestos has not been identified in fill material in the site, however, was identified in similar fill elsewhere on the site. Due to the sampling methodology (boreholes), asbestos and anthropogenic material is likely to be present at a greater density then indicated by the field observations.

It was reported laboratory analysis of fill samples identified elevated concentrations of metals, TRH/TPH and PAHs. Concentrations exceeded the adopted human health criteria in only a small proportion of the samples. No significant amounts of volatile contaminants (i.e. benzene) were detected. No clear distribution of contaminants within the fill has been identified.

The Auditor noted the site assessment area was surfaced with hardstand and established gardens and lawn. An EMP had been prepared to manage contaminated fill materials by maintaining the surface separation layer. The EMP should be applied to minor landscaped areas where mulch and topsoil is thin or not present.

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[37] *Site Audit Statement/Report – Public Open Space Area, Australian Technology Park, Eveleigh.* Ramboll Environ Pty Ltd dated September 2015, draft document (Ramboll 2015a)

[38] *Environmental Management Plan, Australian Technology Park, Eveleigh NSW*. Environmental Strategies Pty Ltd dated August 2015 Revision 0 (ES 2015c)

The Auditor noted groundwater has been assessed on the greater ATP precinct and that no groundwater remediation is considered to be required. Any future groundwater abstraction would require investigation of the groundwater resource and approval from the relevant authority at the time.

5.4.18 Lot 10 DP 1136859

As discussed above, a SAS has been issued for Lots 10 and 11 in DP 1136859 certifying Lots 10 and 11 are suitable for their permissible land use (commercial) subject to implementation of the EMP prepared for these land parcels. A copy of the SAS and EMP was not made available for review. It is understood the Rod Hardwood of Environmental Strategies Pty Ltd prepared the SAS and Douglas Partners Pty Ltd prepared the EMP.It is further understood that, with the exception of the south eastern Lot 10 extent, a basement carpark underlies Lot 10. Any future upgrades to the public domain area between the building footprint within Lot 10 and Lot 12 will be restricted by the basement extent.

5.5 Data Evaluation

An evaluation of data usability for all currently available reports has identified that for the most part, previous data collection activities have been completed and documented in a manner suitable to support the development of a CSM of site contamination potential.

Non-Statutory Section SAS's (Environ 2014a/b/c, Rambol, 2015) prepared for the site have established that that the nature and extent of the contamination, excluding within the Locomotive Workshop footprint, has been appropriately characterised.

Whilst it is acknowledged that there are minor inconsistencies/non-conformances with standard data quality indicators as presented in current relevant EPA made or endorsed guidelines, and several transcription errors within historical reports have been identified, the presented data is considered suitable for use in the development of a remedial action plan.

6. Conceptual Site Model

NEPC (2013) identifies a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments.

NEPC (2013) identified the essential elements of a CSM as including:

- Known and potential sources of contamination and contaminants of concern including the mechanism(s) of contamination;
- Potentially affected media (soil, sediment, groundwater, vapours etc.);
- Human and ecological receptors;
- Potential and complete exposure pathways; and
- Any potential preferential pathways for vapour migration (if potential for vapours identified).

6.1 Constituents of Concern

As identified in **Section 5**, the following COPC have been identified within fill materials underlying the site:

- PAH compounds, including as benzo(a)pyrene TEQ;
- TRH/TPH;
- Individual heavy metals, in particular lead, nickel and zinc; and
- Isolated areas of asbestos impact, occurring as free asbestos fibres in fill material (fibrous asbestos).

Site Audit Reports have noted that groundwater has been assessed as part of the greater ATP site and that no groundwater remediation was considered to be required. However, groundwater COPCs are considered related to those identified for fill materials and typical of urban environments, including heavy metals, TRH/TPH and PAHs.

Volatile organic compounds in sub-slab vapour underlying a portion of the Locomotive Building are considered COPC.

6.2 Potentially Contaminated Media

Potentially contaminated media comprise:

- Fill materials;
- Underlying natural soils;
- Subsurface vapour underlying the Locomotive Building; and
- Groundwater

<u>Fill Materials</u>

The fill materials have been identified across the site and found to be heterogeneous (though broadly consistent across the site) comprising generally of gravelly sandy, silty sands, clayey sands, clay, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, sedimentary clast, construction rubble, boiler ash and metallurgical slag gravel inclusions.

Available site characterisation data has identified that samples of fill material have, in some instances, concentrations of carcinogenic PAH compounds (including benzo(a)pyrene TEQ), TRH,

heavy metal (principally copper, nickel and lead) and asbestos (friable) in exceedance of ecological-based assessment criteria, and at relatively few locations, adopted health-based criteria (**Section 4**) as relevant to the proposed future permissible land uses. As noted by the Site Auditor, concentrations exceeded the adopted human health criteria in only a small number of samples of fill materials and no significant amounts of volatile contaminants were detected.

A summary of existing analytical data is provided in **Appendix C**. Depth of fill and cross sections of site's lithology are depicted in **Figure 4** and **Figure 5** and **Figures 5A** to **5D**, respectively to assist with the interpretation of site conditions. Soil sample exceedance with respect to land used criteria presented in **Section 4** are shown on **Figures 8A**, **8B-East**, **8B-West**, **8C** and **8D**.

As noted by the Site Auditor, no clear distribution of contaminants within fill has been identified. The sample depths at which elevated concentrations of the nominated contaminants were identified range from immediately beneath hardstands/establish site vegetation, until fill termination indicating contamination is associated with the fill material itself, rather than discrete point sources. However, there are indications that COPC concentrations are reported to be higher at near-surface sample locations compared to at the base of fill (e.g. at Lot 12), which indicate a contribution from former site activities.

TRH F2 and/or naphthalene concentrations identified at sample locations BH7, BH8 and BH510 within Lot 9 at concentrations exceeding relevant assessment criteria (e.g. HSL-A) for vapour intrusion. However, TRH F2 and/or naphthalene concentrations at locations adjacent to BH7/BH8/BH510 at Lot 9 were reported less than the adopted assessment criteria, suggesting these areas are isolated and small relative to the Lot area.

It is noted previous investigations have identified isolated asbestos impact within Developable Lots; however, given the sampling methodology (boreholes) and the occurrence of anthropogenic materials within the fill soil profile, potential remains for more widespread asbestos impact. The extent of asbestos in fill materials at these locations has not been delineated.

Assessment of leachability (as determined by TCLP analyses in **Table F** of **Appendix C**) of fill samples for waste classification and material management purposes suggests fill/soil materials are generally characterised by low leachability with the exception of elevated TCLP leachable zinc concentrations at BH508 (Lot 9) and elevated TCLP leachable lead concentrations in some samples collected from within the top 1.5 m of fill within central and central-northern Lot 12 (**Figures 8B-East** and **8B-West**) which requires consideration with respect to management of these materials in future development of the site. It is noted that ash and slag inclusions in fill material have been identified at a significant portion of locations, and the ash and slag inclusions are inferred to be a significant source of COPCs (e.g. heavy metals and PAHs).

Natural Soils

Analysis of natural soil samples indicated contaminated material was generally limited to the fill material overlying the natural soils. Several soil samples reported elevated TRH/TPH, PAH and heavy metals within the inferred top 0.2 m of the nature soil profile. Potential remains for the historical sampling methodology to have resulted in minor cross-contamination of samples of underlying natural profile.

Although the risk of ASS/PASS has been considered low, previous investigations have reported uncertainty in the potential for ASS/PASS within natural soils.

Soil Vapour

Sub-slab vapours beneath a portion of the Locomotive Workshop have been identified to contain TCE concentrations exceeding commercial/industrial land used criteria. However, ambient air sampling has reported ambient air TCE and other volatile COPC concentrations within the Locomotive Workshop to be less than adopted assessment criteria. While it has been reported there

is no current risk associated with TCE in sub-slab vapour to site users subject to implementation of the EMP, the nature and extent of volatile COPCs underlying the Locomotive Workshop is not clearly defined.

Groundwater

Groundwater has been found to be characterised with levels of a range of heavy metals above the adopted assessment criteria. Historically, elevated groundwater TPH/TRH concentrations have been identified in areas of proximity to historical petroleum storage and handling areas, though the highest concentrations were reported to be at off-site locations at the western end of Locomotive Street or reported in the 1990s (i.e. unlikely to be representative of current conditions). As shown in **Table E** (**Appendix C**), current TPH/TRH concentrations are several orders of magnitude below those reported in 1993/1994, suggesting removal of TPH source and/or attenuation has occurred. LNAPL has not been identified in the most recent monitoring rounds.

Site Audit Reports have noted that no groundwater remediation was considered to be required. However, the potential for affecting groundwater conditions, for example by increased contaminant leaching, will need to be considered in any redevelopment proposal. It is noted that there is an embargo prohibiting domestic use, and controlling industrial use, of groundwater downgradient of the site. Any future groundwater abstraction would require investigation of the groundwater resource and approval from the NSW Department of Natural Resource (now the NSW Department of Primary Industry – Water). In the event that groundwater is encountered during redevelopment works that will require dewatering, excavation dewater will require appropriate management.

6.3 Potential Exposure Pathways

The ATP site is currently subject to EMPs to control exposures to contamination as described in **Section 5.4.10** and **5.4.17**. However, the following describes exposure pathways considered to be potentially complete for the site include:

- Potential dermal and oral contact to impacted soils as present at shallow depths and/or accessible by future service excavations; and/or
- Potential oral and dermal contact to shallow groundwater as accessible by potential future service excavations; and/or
- Inhalation of COPC vapours migrating upwards from current in-situ impacted soils; and/or

Potential contaminant uptake by vegetation proposed to be established in the vegetated areas of the site, potentially including large tree plantings.

Oral and dermal contact of regular site users to current '*in-situ*' soils on the site is anticipated will be/is restricted over the majority of the site by existing site cover arrangements (buildings, pavements and hardstands, mulch, grass cover and/or topsoil physical barrier), future buildings and hardstands. Notwithstanding the aforementioned, should site cover arrangements be augmented to accommodate site development upgrades, there is the potential for site users to have dermal, inhalation and/or oral contact to impacted surface soils.

There is limited potential exposure to groundwater at the site. Excavation workers in deep excavations/trenches may potentially be exposed to infiltrating seepage water during building basement excavation/construction activities. Whilst temporary dewatering may be required to achieve construction requirements, it is not anticipated that any ongoing groundwater extraction will occur within the site in the future following completion of construction works. The site is underlain by Botany Sand Beds Aquifer and on the edge of the Botany Aquifer Groundwater Management Zone 2, as such groundwater removal at and downgradient of the site for domestic purposes is prohibited and restricted for industrial purposes.

The potential for contamination migration via surface water movement and infiltration of water and subsequent migration through the soil profile is considered generally to be low given the extent of impermeable pavements at the site. However, the potential for infiltration of surface water via leakage from poorly maintained sub-surface stormwater infrastructure is noted.

Given the relatively permeable nature of the underlying sandy soils, migration of contamination via groundwater movement is considered to be a potential migration pathway. However, groundwater assessment have been undertaken since the 1990s, and no significant groundwater contamination is currently identified that would require groundwater remediation. The potential for affecting groundwater conditions, for example by increased contaminant leaching, would need to be considered in any redevelopment.

As discussed in **Section 5**, ambient air results suggest that soil vapour concentrations of TCE within the Locomotive Workshop are not posing a direct risk to site users, however, inhalation of vapours migrating upwards from current *in-situ* impacted soils and/or groundwater represent a potential exposure pathway should building hardstand be removed or altered. In addition, potential remains for inhalation of vapours migrating upwards from current *in-situ* impacted soils at sample locations BH7, BH8 and BH510 within Lot 9.

6.4 Receptors

Potential receptors of environmental impact present within the site which will require to be addressed with the site include:

- Future users of the non-paved areas of the site who may potentially be exposed to COPC through direct contact with impacted soils and/or inhalation of dusts/fibres associated with impacted soils; and/or
- Excavation/construction/maintenance workers conducting activities at or in the vicinity of the site, who may potentially be exposed to COPC through direct contact with impacted soils/groundwater present within excavations and/or inhalation of dusts/fibres/vapours associated with impacted soils; and/or
- Future site workers and users of the site who may potentially be exposed to COPC through inhalation of vapours via migration and/or direct contact with contaminated soil beneath the Locomotive Workshop; and/or
- Recreational users and marine water ecosystem of Alexandra Canal and downstream receiving environments located hydro-geologically downgradient of the site. Groundwater has not been found to pose a potentially significant risk to off-site receptors; and/or
- Flora species to be established on the landscaped/vegetated areas of the site including potential large tree plantings.

Where volatile organic compound impact is identified, potential inhalation exposure to vapours will also require to be considered.

6.5 Preferential Pathways

For the purpose of this assessment, preferential pathways have been identified as natural and/or man-made pathways that result in the preferential migration of COC as either liquids or gases.

Man-made preferential pathways are present throughout the site, generally associated with extensive fill materials, and at near surface depths over the remainder of the site. Fill materials are anticipated to have a high permeability.

Sub-surface services are also present, or will be present as part of site redevelopment, throughout the site. Preferential pathways can be created by the generally higher permeability backfill used to re-instate these trenches.

Preferential pathways are also important in the assessment of potential off-site sources of COPC. Preferential pathways are potentially present in the adjoining road network, as associated with service easements.

7. Data Quality

7.1 Data Quality Objectives

In accordance with the requirements of NEPM (2013) and DECC (2006), data quality objectives (DQOs) developed for the site contamination assessment are documented in the following sections.

7.1.1 State the Problem

Mirvac has been announced by UGDC as the successful party in securing ownership and redevelopment rights for the site for ongoing use as a campus style precinct catering for science and technology bases occupants. This will involve upgrades to existing infrastructure (road and pedestrian easements), landscaped areas (garden beds and tree planting areas) and recreational facilities (tennis and basketball courts, and the Vice Chancellors Oval).

In addition, Mirvac propose to develop Developable Lots 8, 9 and 12 in DP 1136859 for commercial land use, with Lots 8 and 9 to potentially including childcare facilities (or similar). Adaptive reuse of Locomotive Workshop is proposed for ongoing commercial land use excluding childcare facilities.

Previous investigations (**Section 5**) completed for the site have identified fill materials to be contaminated with heavy metals (principally copper, lead and nickel), TPHs/TRHs, PAHs (including carcinogenic PAH compounds as benzo(a)pyrene TEQ), and, in parts, asbestos. With the exception of asbestos impacted soils, there was no discernible pattern to the distribution of contaminants within the fill material and the impact was not confined to any particular portion(s) of the site. The reported concentrations of the identified contaminants (where present) in the fill material typically exceed ecological assessment criteria and in some cases, exceed the adopted health-based assessment criteria relevant to respective land uses.

It is noted extensive inclusion of building and demolition rubble have been reported within the fill soil profile, and the potential remains for more widespread asbestos impact.

Given the proposed redevelopment, an assessment of the suitability of the site for the proposed uses is required to support a SSDA to be submitted to the Department of Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Information on potential site contamination conditions presented in earlier sections of this report resulted in the conceptual site contamination information presented in **Section 6** of this report, which together form a CSM.

7.1.2 Identify the Decision

Based on the decision making process for assessing urban redevelopment site detailed in DEC (2006), the following decisions must be made:

- Are there any unacceptable risks from soil or soil vapour to likely future on site receptors?
- Are there any issues relating to the local area background soil concentrations that exceed appropriate soil criteria?
- Are there any impacts of chemical mixtures?
- Are there any aesthetic issues?
- Are there any unacceptable risks to likely future on-site or down-gradient receptors from groundwater?
- Is the site suitable for the proposed land use? / Is a site management strategy required?

7.1.3 Identify Inputs to the Decision

Inputs identified to provide sufficient data to make the decisions nominated above include:

- Historical site information including physical observations of encountered lithology and anthropogenic inclusion, as discussed in **Section 5** and presented in **Appendix B**;
- Historical site laboratory chemical analysis results, as discussed in **Section 5** and presented in **Appendix C** (summary of soil and groundwater analytical results); and
- Proposed land use details (**Section 1.4**).

7.1.4 Define the Study Boundaries

The site is bound to the north by a railway easement, east by Garden and Cornwallis Streets, south by Henderson Road and to west by Alexander Street and a childcare facility. The lateral study boundaries for the site is shown schematically in **Figure 2**.

The site legally identified as Lots 8, 9 and 12 in DP 1136859, Part Lot 13 in DP 1136859, Part Lot 10 in DP 1136859 and Lot 505 in DP 1136859, occupies approximately 11.6 ha of the Australian Technology Park and is located at 2 Locomotive Street, Eveleigh, NSW.

The footprints of existing site structures (International Business Centre, National Innovation Centre, Traffic Management Centre (formally the RTA Building), Ambulance Service Building and Biomedical Building footprints) within Lot 13 DP 113659 fall outside the site boundaries, as shown on **Figure 2**.

The maximum vertical extent of the investigation was 9.0 m bgl.

The temporal boundaries of this investigation are from 1993 to 2014, being a period of twenty two years.

7.1.5 Develop a Decision Rule

A summary of the decision rules for the assessment are presented in **Table 6.1.**

Table 6.1 Summary of Decision Rules

Decision Required to be Made	Decision Rule
1. Are there any unacceptable risks to on site future receptors from soils or soil vapour?	Soil/bedrock/vapour analytical data was compared against EPA endorsed criteria as presented in NEPC (2013). For the characterisation sample sets, statistical analysis of the data was undertaken in accordance with relevant guidance documents, as appropriate, to facilitate the decisions. The following statistical criteria was adopted with respect to soil/bedrock: Either: the reported concentrations were all below the site criteria; Or: the average site concentration for each analyte was below the adopted site criterion; no single analyte concentration exceeded 250% of the adopted site criterion; and the standard deviation of the results was less than 50% of the site criterion. And: the 95% upper confidence limit (UCL) of the average concentration for each analyte was below the adopted site criterion. If the statistical criteria stated above were satisfied, the answer to the decision was No. If the statistical criteria were not satisfied, the answer to the decision was Yes.
2. Are there any issues relating to the local area background soil concentrations that exceed appropriate soil criteria?	If the 95% UCL of surface soils exceeds published background concentrations (NEPC 2013), the answer to the decision is Yes. Otherwise, the answer to the decision is No.
3. Are there any chemical mixtures?	Are there more than one group of contaminants present which increase the risk of harm? If there is, the answer to the decision is Yes. Otherwise, the answer to the decision is No.

Decision Required to be Made	Decision Rule
4. Are there any aesthetics issues in fill soils at the site?	If there were any ACM fragments on the ground surface, extraneous fill conditions, or any unacceptable odours or soil discolouration, the answer to the decision is Yes. Otherwise, the answer to the decision is No.
5. Are there any unacceptable risks to likely future on-site or down gradient receptors from groundwater?	Historical site data was compared against the criteria adopted for this assessment as presented in **Section 4**. Have contaminant concentrations been identified at concentrations above the assessment criteria? If yes, further assessment of risk to the identified human or ecological receptors is required to be undertaken as per guidance provided in ANZECC (2000) and NEPC (2013). If the assessment indicated any unacceptable risks then the answer to the decision is Yes. Otherwise the answer to the decision is No.
6. Is a site management strategy required?	Is the answer to any of the above decisions Yes? If yes, a site management strategy is required to address unacceptable contamination concerns at the site so as to make the site suitable for permissible site uses. If no, a site management strategy is not required and the site is considered suitable, from a contamination view point for the proposed use and the site is considered suitable for the proposed permissible land uses.

7.1.6 Specify Limits of Decision Error

As discussed in **Section 5.5**, an evaluation of data usability for all currently available reports has identified that for the most part, previous data collection activities have been completed and documented in a manner considered suitable to support the development of a CSM of site contamination potential. In addition, SAS issued for Developable Lots and public domains have reported that the nature and extent of the contamination has been appropriately determined.

Whilst it is acknowledge that there are some inconsistencies/non-conformances with standard data quality indicators as presented in relevant EPA made or endorsed guidelines, and uncertainties with respect to historical materials movement and potential beneficial reuse subsequent to earlier historical investigations, the presented data is considered suitable for use so long as these uncertainties are considered in the development of future detailed site investigation activities to confirm site contamination characteristics and development of a remedial action plan.

7.1.7 Optimise the Design for Obtaining Data

As discussed in **Section 5**, sampling densities for respective land parcels have exceeded the minimum sampling densities presented in EPA (1995). In addition, SAS issued for Developable Lots and public domains have reported that the nature and extent of the contamination has been appropriately determined.

Based upon the objectives of the investigation and review of historical investigations, the density of the investigations undertaken across the site are considered appropriate to characterise site conditions.

7.2 Investigation Methodologies

Soil samples were collected during the site investigation works using a combination of mechanically (drill rig) and manually (hand auger) advanced boreholes and to a minimal extent collected from excavated spoil (test pits).

It is noted that boreholes are not acquiescent with NEPC (2013) sampling methodology for the assessment of asbestos. Extensive inclusion of construction rubble were encountered within the fill

soil profile. Potential has been identified for more widespread asbestos impact than currently identified.

Soil samples were generally collected directly from the auger or from push tube sleeves/excavated spoil wearing fresh disposable nitrile gloves. Potential disturbance of the soil sample was reportedly minimised where possible during sample collection and placement with laboratory supplied sample containers to reduce the potential for release of volatile organic contaminants.

Visual inspection of excavated material was undertaken at each location for the presence of discolouration, asbestos containing material (ACM) or other indications of potentially contaminated materials. Where identified, the observations were recorded on field logs included as **Appendix B**.

Groundwater investigation methods have involved installation, development and monitoring of groundwater wells. Many historical monitoring locations have only been reported to have been sampled once or few times. Exact details of well construction and installation methodology are not available for all historical monitoring locations, however, available logs are provided in **Appendix B**. The reported methodology of recent groundwater monitoring (e.g. ES 2014f) appears appropriate.

Soil vapour and ambient air sampling methods were described in ES (2015b).

Samples destined for laboratory analysis were transferred to laboratory supplied sample jars and bottles. The sample containers were then for the most part placed in a pre-cooled insulated box for sample preservation prior to and during shipment to the testing laboratory.

The samples were generally transported under chain-of-custody protocols with relevant guidelines at the time of assessment.

8. Results

A summary of available reports documenting historical site investigations is provided in **Section 5**. The following sections summarise the key findings.

A SAS has been issued for public domain areas (everything other than Developable Lots) certifying the public domains are suitable for the ongoing recreational and commercial/industrial land uses subject to implementation of the site EMP (ES 2015c). SAS's have been issued for Developable Lots 8 (Environ 2014a), 9 (Environ 2014b) and 12 (Environ 2014c) stating that the nature and extent of contamination has been appropriately defined.

In addition, a SAS has been issued for Lots 10 and 11 DP 1136859 certifying that Lots 10 and 11 are suitable for commercial land use subject to implementation of the site EMP (DP)

8.1 Fill/Soil

As discussed in **Sections 5** and **6**, shown in figures and analytical summary tables (**Appendix C**), fill materials were reported to occur across the entire site with minor exceptions, ranging from a skeletal fill soil profile to 7.6 m in depth. In general, vertical extent of fill is reported to be greatest along Locomotive Street. Fill materials were considered result from a combination of site activity and importation of fill materials to establish site levels. Fill materials were noted to comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, slag, sedimentary clast and construction rubble.

Fill materials were shown to contain elevated heavy metals (mainly lead, nickel and zinc), TPHs/TRHs, PAHs (including carcinogenic benzo(a)pyrene as TEQ) and, in parts, asbestos. The reported concentrations of the identified contaminants (where present) in the fill material typically exceed ecological-based assessment criteria and, at relatively few locations, exceed the health-based assessment criteria for the respective land uses.

There was no discernible pattern to the distribution of contaminants within the fill material and the impact was not confined to any particular portion(s) of the site. It was noted that, while asbestos was only identified in isolated samples, given the occurrence of anthropogenic inclusions, potential remains for more widespread asbestos impact within the fill materials in portions of the site.

The sample depths at which elevated concentrations of the nominated contaminants were identified range from immediately beneath hardstands/establish site vegetation, to fill termination indicating contamination is associated with the fill material itself, rather than discrete point sources. As such, for management purposes, the potential vertical extent of contamination in fill is considered to be consistent with the depth of fill material, rather than measured sampling depths in the previous investigations.

No significant amounts of volatile contaminants were detected in fill materials. Elevated volatile COPC concentrations in fill samples collected from locations BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 within Lot 9 exceeded the adopted assessment criteria, indicating further consideration of potential vapour intrusion respect to the proposed future land uses is required. However, it is noted that volatile COPC concentrations reported in fill samples from locations adjacent to BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 within Lot 9 were low and acceptable, and no significant amounts of volatile contaminants were detected more broadly in fill materials across the lot or site.

The majority of constituents (with the possible exception of lead and zinc within isolated areas discussed below) reported in fill have low potential for leaching and groundwater contamination has not been identified as an issue of concern with respect to human health and/or sensitive groundwater receptors down-gradient of the site by the previous assessments. Fill materials at sample location BH508 has been identified as potentially containing leachable zinc concentrations requiring further consideration (**Figure 8A**). In addition, lead TCLP analysis identified potential

leachable lead properties within the top 1.5 m of fill within the central and central northern lot extent (**Figures 8B-East** and **8B-West**) if exposure scenarios are changed.

Natural soil samples indicated contaminated material was generally limited to the fill material overlying the natural soils. Several samples of natural soils reported elevated TRH/TPH, PAHs and heavy metals within the top 0.2 m of the nature soil profile, potentially resultant from sample collection methods. Although the risk of ASS/PASS has been considered low, previous investigations have reported uncertainty in the potential for ASS/PASS within natural soils.

8.2 Groundwater

Groundwater has been assessed across the broader ATP precinct. Whilst historically groundwater monitoring results have reported elevated concentrations of TRH and heavy metals (mainly copper, zinc and nickel), and identified the presence of LNAPL, recent (e.i. post-2014) groundwater analytical results have reported contaminant concentrations below the laboratory LOR or within background levels typical of in Sydney urban environments. Comparison of recent groundwater analytical with those presented in NEPC (2013) has not identified the potential for vapour intrusion issues associated with groundwater with respect to permissible land uses.

As reported in SAS's prepared for the ATP precinct, no groundwater remediation is considered to be required. However, the potential for affecting groundwater conditions, for example by increased contaminant leaching, will need to be considered in any redevelopment proposal, and any future groundwater abstraction will require investigation of the groundwater resource and approval from relevant authority at the time.

8.3 Soil Vapour

Soil vapour TCE concentrations have been reported at concentrations exceeding assessment criteria presented in NEPC (2013) for commercial/industrial land use within the Locomotive Workshop. However, TCE (and other COPC) concentrations in ambient air samples collected as part of ongoing monitoring are less than adopted assessment criteria.

8.4 Other

Lead paint has been identified within the Locomotive Workshop requiring remediation/ management.

9. Discussion

9.1 Are there any Unacceptable Risks to On-Site Future Receptors from Soil/Vapour?

Developable Lots

As discussed in **Sections 5**, **6** and **8** and shown in characterisation summary tables (**Appendix C**), fill materials within Developable Lots have been shown to contain elevated concentrations of heavy metals, TRH/TPH, PAHs including carcinogenic benzo(a)pyrene TEQ equivalent concentrations and asbestos to varying degrees. Concentrations exceeded the adopted human health criteria in only a small number of samples of fill materials and no significant amounts of volatile contaminants were detected.

There is no discernible pattern to the distribution of contaminants remaining within fill materials and impact is generally not confined to any particular portion(s) of the lots. As such, for management purposes it is considered that all fill material may be potentially contaminated with heavy metals, TRH/TPH and PAHs and will potentially require management/ remediation.

Asbestos was only identified in few samples at isolated locations within Developable lots. However, given the occurrence of anthropogenic inclusions, potential remains for more widespread asbestos impact within the fill materials in portions of the site. .

While no significant amounts of volatile contaminants were detected in fill materials across the site, fill materials at the following sample locations reported contaminant concentrations above the adopted vapour intrusion HSL assessment criteria:

- Lot 9 BH7/1.5-1.6 with a TRH F2 concentration of 1 000 mg/kg, above the adopted assessment criterion of 240 mg/kg;
- Lot 9 BH8/0.6-1.0 with a TRH F2 concentration of 140 mg/kg, above the adopted assessment criteria of 110 mg/kg; and
- Lot 9 BH510/0.9-1.0 with a naphthalene concentration of 12 mg/kg, above the adopted HSL assessment criterion of 3 mg/kg.

Further assessment is required to determine if current fill conditions at these sample locations require management/remediation under future development scenarios for permissible land use.

Lot 13 – Public Domains

Fill conditions within areas of public domains have been identified to contain contaminant conditions similar to those within Developable Lots. A Non-Statutory Section A SAS has been issued for public domain areas within the ATP certifying that public domains are suitable for the proposed ongoing recreation and commercial/industrial land uses subject to implementation of the EMP (ES 2015c).

As discussed above, a SAS has also been issued for Lots 10 and 11 DP 1136859 certifying commercial land use suitability subject to implementation of the EMP prepared for these land parcels.

Locomotive Workshop

No historical soil analytical data was identified or made available. Elevated sub-slab soil vapour TCE concentrations ranging between 0.0655 mg/m^3 to 0.307 mg/m^3 have been reported underlying Bays 5 and 6 of the Locomotive Workshop. However, ambient air quality sampling results from within the building were all below the adopted assessment criteria. As such, no current unacceptable risk from sub-slab vapour conditions has been reported; however, additional assessment of the nature and extent of TCE in the subsurface underlying the Locomotive Workshop may be warranted to support ongoing management under the EMP.

Lead paint dust has been identified within the Locomotive Workshop requiring management under the EMP.

9.2 Background Soil Concentrations

In-situ natural soils were analysed as part of historical investigations. Reported contaminant concentrations present within natural soils were generally all within background levels when the results were compared to the background levels for urban areas published in NEPC (2013). On this basis, there are considered to not be any issues associated with background soil concentrations that require further consideration.

Previous investigations have considered the risk of ASS/PASS to be low, however there has reported to be uncertainty in the potential for ASS/PASS within natural soils at depth. With due consideration to the geological and soil characteristics of the site (i.e. sands with minor peat material), in addition to historical information, further consideration of the potential for ASS/PASS and management measures is required if development activities involve significant excavation of natural soils beneath the water table.

9.3 Aesthetic Issues Including Odours

With the exception of extraneous anthropogenic inclusion in areas, there were no odours/vapours/staining or other issues in soils identified during the current investigation that may pose an unacceptable aesthetic issue at the site.

As discussed in **Section 5**, a slight discolouration/odour to soils was observed in Developable Lots at depth in samples collected in 1993, however, this is considered to not represent an aesthetic issue requiring management given the depth at which the material was encountered and future development activities.

LNAPL and associated petroleum hydrocarbon impacts have historically been identified in groundwater, however, recent groundwater characterisation activities have not reported the occurrence of LNAPL and associated petroleum hydrocarbon impacts. As such, groundwater is not considered to pose an unacceptable aesthetic issue at the site requiring management.

As noted above, there is potential for asbestos to be more widespread in fill material than currently identified.

On the basis of potential variability in fill quality and identification of anthropogenic inclusions within the fill soil profile, aesthetics issue require management or inclusion of an unexpected finds protocol.

9.4 Chemical Mixtures

While a range of chemical mixtures are present at the site they are not considered to pose a significant contamination issue that will not be addressed by management/remediation requirements as required based on individual contaminant concentrations

9.5 Are There Any Unacceptable Risks to Future On-Site or Down-Gradient Receptors from Groundwater

As documented in SAS's prepared of the ATP precinct and discussed in **Section 5**, groundwater has been assessed across the broader ATP precinct and no groundwater remediation is considered to be required.

Assessment of the ATP precinct groundwater conditions included the historical installation of 82 groundwater monitoring wells and subsequent laboratory analysis of approximately 152 individual groundwater samples over a 22 year period. Samples were analysed for a range of COPC including, but not limited to, heavy metals, PAHs, OCPs, OPPs, PCBs, TRH, BTEX and VOCs.

Historically, groundwater has been identified with elevated concentrations of heavy metals and TRH/TPH concentrations. LNAPL was historically reported (in the 1990s) within the northern site extent (MW3 – Area 2) and within Lot 10. More recently, groundwater heavy metal and TRH concentrations have generally reported contaminant concentrations within the background range anticipated for built-up urban areas associated with inner Sydney. Reported concentrations of organic COPCs (e.g. BTEX, OCPs, OPPs, PAHs, PCBs and VOCs) in groundwater samples recently collected were generally less than the laboratory reporting limits.

The potential for affecting groundwater conditions, for example by increased contaminant leaching, needs to be considered in the redevelopment. This includes, but is not limited to, fill materials at BH508 (Lot 9) and within the top 1.5 m of fill materials within the central and central-northern portions of Lot 12 that have been identified as potentially containing leachable zinc and lead concentrations, respectively, which may require management with respect to future development of the Lots.

9.6 Site Management/Suitability

Based on the results of the investigations and subject to the limitations presented in **Section 11**, it is considered that a RAP is required to document management/remediation of identified contamination issues associated with:

- Fill materials within Developable Lots impacted by heavy metals, petroleum hydrocarbons and PAHs requiring management. It is noted that concentrations typically exceeded adopted ecological criteria but only exceeded adopted human health criteria in a small number of samples of fill materials, and no significant amounts of volatile contaminants were detected;
- The potential for affecting groundwater conditions, for example by increased contaminant leaching, needs to be considered in the redevelopment. This includes, but is not limited to, fill materials at BH508 (Lot 9) and within the top 1.5 m of fill materials within the central and central-northern portions of Lot 12 that have been identified as potentially containing leachable zinc and lead concentrations, respectively, which may require management if the exposure scenario is changed with respect to future development of the Lots;
- Fill materials at isolated locations within Lot 9 at BH7/1.5-1.6, BH8/0.6-1.0 and BH510/0.9- 1.0 historically contained concentrations of naphthalene or TRH (F2 fraction) indicative of potential vapour intrusion issues and require further assessment to establish if materials in these areas require management;
- Asbestos has been identified at sample locations BH12/0.1-0.2 (Lot 8), BH10/2.0-2.1 (Lot 9) and BH2/3.0-3.0 (Lot 12) and BH4/0.35-0.4 (Lot 12). However, asbestos may be more widespread in fill materials than currently identified. As such, either further characterisation of fill materials for asbestos or implementation of appropriate management measures for fill materials is required, and implementation of a suitable unexpected finds protocol;
- Concentrations of TCE in sub-slab vapour underlying the Locomotive Workshop exceeding the adopted human health criterion have been identified; however, ambient air monitoring results within the overlying building are within acceptable criterion. Further assessment of sub-slab conditions underlying the Workshop building is required to support ongoing management if the exposure scenario changes under the adaptive reuse or change to the EMP is necessary;
- Lead paint has been identified within Locomotive Workshop that requires ongoing management;
- Previous investigations have reported there is uncertainty in the potential for ASS/PASS within natural soils at depth. The potential for ASS/PASS should be assessed as part of

development activities if significant excavation of natural soils beneath the water table occurs;

- A SAS was issued for Lots 10 and 11 DP 1136859 within the ATP precinct certifying that these land parcels are suitable for commercial land use subject to implementation of the EMP (DP) prepared for these land parcels; and
- Fill conditions within areas of public domains have been identified to contain contaminant conditions similar to those within Developable Lots. A Non-Statutory Section A SAS has been issued for public domain areas within the ATP certifying that public domains are suitable for the proposed ongoing recreation and commercial/industrial land uses subject to implementation of the EMP (ES 2015c).

In summary, impacts were identified in fill/soil within Developable Lots and Public Domain areas, and soil vapour underlying the Locomotive Workshop, that will require management. A Non-Statutory Section A SAS issued for public domain areas within the ATP states they are suitable for ongoing recreational and commercial/industrial land uses subject to implementation of the EMP (ES 2015c). In addition, a SAS has been issued for Lot 10 certifying that Lot 10 is suitable for commercial land use subject to implementation of the EMP (DP) prepared for these lots.

Successful implementation of an appropriate RAP and implementation of an appropriate EMPs would result in the site being considered suitable for the proposed land use.

10. Conclusions and Recommendations

10.1 Conclusions

Based on the findings of this investigation and subject to the limitations in **Section 11**, the following conclusions are made with respect to the contamination status at the site:

- Numerous historical site investigations have assessed the contamination conditions at the site over the last 22 years, with the total number of investigation locations exceeding those recommended by endorsed guidelines;
- Fill materials are present underlying the site and variously comprise gravelly sandy, silty sands, clayey sands, peat with inclusions of railway ballast, glass, ash, metal, ceramic, brick, slag, sedimentary clast and construction rubble;
- Fill materials within Developable Lots were reported to contain concentrations of heavy metals, TPH/TRH and PAH exceeding adopted ecological criteria and in relatively few locations, adopted health-based criteria, and no significant amounts of volatile contaminants were detected in fill materials;
- However, there was no discernible pattern to the distribution of contaminants within the fill material and the impact was not confined to any particular portion(s) of the site. Furthermore, the vertical extent of potential contamination in fill material is considered to be consistent with the depth of fill material;
- Elevated volatile COPC concentrations in fill materials at isolated locations within Lot 9 at BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 were reported to historically exceed the adopted health-based criteria. Further assessment of current fill conditions at these locations with respect to the proposed future land uses is required;
- Asbestos was identified in isolated samples (BH12/0.1-0.2 within Lot 8, BH10/2.0-2.1 within Lot 9, BH2/3.0-3.0 and BH4/0.35-0.4 within Lot 12). Given the occurrence of anthropogenic inclusions and historical investigation methods used, potential remains for more widespread asbestos impact within the fill materials in portions of the site. Further characterisation of fill materials for asbestos or implementation of appropriate management measures for fill materials is required and implementation of a suitable unexpected finds protocol;
- Previous investigations have considered the risk of ASS/PASS to be low, however there has reported to be uncertainty in the potential for ASS/PASS within natural soils at depth. Further consideration of the potential for ASS/PASS and management measures is required if development activities involve significant excavation of natural soils beneath the water table;
- Fill materials within public domain areas have been identified to contain elevated concentrations of heavy metals, PAHs and TPH/TRH, generally consistent with that reported for Developable Lots that will require management. A Non-Statutory Section A SAS has been issued for public domain areas within the ATP certifying that public domains are suitable for the proposed ongoing recreation and commercial/ industrial land uses subject to implementation of the EMP (ES 2015c);
- A SAS has been issued for Lot 10 certifying that Lot 10 is suitable for commercial land use subject to implementation of the EMP (DP) prepared for this land parcel;
- On the basis of potential variability in fill quality and identification of anthropogenic inclusions within the fill soil profile, aesthetic issues require management;

- Elevated sub-slab soil vapour TCE concentrations have been reported underlying Bays 5 and 6 of the Locomotive Workshop. However, ambient air quality results from within the building collected as part of ongoing EMP requirements were all below the adopted assessment criterion. As such, no current risk from sub-slab vapour conditions has been reported; however, additional assessment of sub-slab vapour conditions underlying the Locomotive Workshop may be warranted to support ongoing management if the exposure scenario changes under the adaptive reuse or change to the EMP is necessary;
- Lead paint dust has been identified within the Locomotive Workshop requiring ongoing management;
- As documented in SAS's prepared of the ATP precinct and discussed in **Section 5**, groundwater has been assessed across the broader ATP precinct and no groundwater remediation is considered to be required; and
- The potential to effect groundwater conditions, for example, by increased contaminant leaching, needs to be considered in the redevelopment. This includes, but is not limited to, fill materials at BH508 (Lot 9) and within the top 1.5 m of fill materials within the central and central-northern portions of Lot 12 that have been identified as potentially containing leachable zinc and lead concentrations, respectively, which may require management if the exposure scenarios change with respect to future development of the Lots.

On this basis, it is considered that the site can be made suitable for the proposed land use provided that a suitable remediation plan/management strategy is appropriately implemented as part of site redevelopment to address identified contamination issues at the site.

10.2 Recommendations

It is recommended that a management strategy and/or RAP be developed and implemented in accordance with the relevant regulatory requirements to manage the identified contamination issues at the site so as to render the Developable Lots and areas of adaptive reuse suitable for their permissible uses.

11. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

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

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

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.