Mirvac Projects Pty Ltd

Australian Technology Park Remedial Action Plan

2 Locomotive Street, Eveleigh, NSW

15 June 2016

51142/104280 (Revision 0)

JBS&G Australia Pty Ltd

www.jbsg.com.au

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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
AGST	Aboveground Storage Tank
AST	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
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level
Ha	Hectare
HIL	Health-based Investigation Level
HSL	Health Screening Level
HHRA	Human Health Risk Assessment
JBS&G	JBS&G Australia Pty Ltd
LOR	Limit of Reporting
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
RPD	Relative Percentage Difference
SSDA	State Significant Development Application
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total Recoverable Hydrocarbons
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
VENM	Virgin Excavation Natural Material (as defined in *POEO Act*)
VOC	Volatile Organic Compound

1. Introduction and Objectives

1.1 Introduction

JBS&G Australia Pty Ltd (JBS&G) was engaged by Mirvac Projects Pty Ltd (Mirvac, the client) to prepare a standalone site-wide remedial action plan (RAP) 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 1979*).

The ATP precinct, 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 site, herein referred to as 'the site' is legally identified as Lots 8, 9, 12 in Deposited Plan (DP) 1136859, Lot 4000 in DP 1194309, Part Lot 4007 in DP 1194309 and Part Lot 10 in DP 1136859 (**Figure 3**) and occupies an area of 11.6 ha. The site includes the Locomotive Workshop, public roads/domains (road reserves and pedestrian easements, recreational facilities and the eastern most extent of Lot 10 DP 1136859) and Developable Lots (Lots 8, 9 and 12). Lots 4001 to 4006 including the International Business Centre, National Innovation Centre, Traffic Management Centre (formally the RTA Building), Ambulance Service Building and Biomedical Building footprints) and Lot 501 DP 1033739 (rail easement) fall outside the site boundaries, as shown on **Figure 2**. It is noted Lots 4000 to 4007 were previously identified as Lot 13 in DP1136859.

The ATP precinct, including the site, has been subject of a number of previous investigations which have identified historical land uses comprising locomotive workshops, foundries, railway sidings and goods yards. The ATP precinct, including the 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 and 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 (PAHs), and/or heavy metals as associated with fill materials historically used across the sites or resultant from historical site activities. Localised areas of asbestos impact have identified.

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

Remediation/management is required to address contamination and aesthetic issues identified in JBS&G (2015a[1], 2016a[2] and 2016b[3]) within Developable Lots and the Locomotive Workshop in order to make these site portions suitable for their permissible land uses. The balance of the site (road reserves, pedestrian easements and recreational facilities) has been subject to numerous assessments, from a contamination perspective, with a draft Site Audit Statement (SAS,

[1] *Mirvac Projects Pty Ltd – Australian Technology Park Detailed Site Assessment. 2 Locomotive Street, Eveleigh NSW*. JBS&G Australia Pty Ltd dated 9 December 2015 (JBS&G 2015a)

[2] Mirvac Projects Pty Ltd Human Health Risk Assessment, 2 Locomotive Street, Eveleigh, NSW. JBS&G Australia Pty Ltd dated 15 June 2016 reference 51142/102227 Rev 0 (JBS&G 2016a)

[3] *Mirvac Projects Pty Ltd - Ecological Risk Assessment, 2 Locomotive Street, Eveleigh NSW*. JBS&G Australia Pty Ltd dated 15 June 2016 Ref:51142-102217 Rev 0 (JBS&G 2016b)

Ramboll 2015a[4]) issued September 2015 certifying that public domain areas (road reserves, pedestrian easements and recreational facilities) are suitable for ongoing recreational and commercial/industrial land uses subject to implementation of the environmental management plan (EMP, ES 2015a[5]) prepared for these land parcels.

A SAS has been issued for Lots 10 and 11 in DP 1136859, for which the site is part (pedestrian easement between the Channel 7 building and Lot 12) certifying Lots 10 and 11 in DP 1136859 are suitable for their permissible land uses (commercial) subject to implementation of the EMP (DP[6]) prepared for these land parcels. It is understood Rod Hardwood of Environmental Strategies Pty Ltd prepared the SAS and Douglas Partners Pty Ltd prepared the EMP.

Landscaping and public domain improvements and extension and augmentation of physical infrastructure/utilities is proposed within Lot 4007 (previously Lot 13). Documented procedures, adopted from the EMP (ES 2015a), are required to ensure the ongoing suitability of public domain areas for their specified land uses and compliance with the EMP (ES 2015a and DP) requirements.

This RAP has been prepared with reference to relevant guidelines made or endorsed by the NSW Environment Protection Agency (EPA) inclusive of NEPC (2013[7]) and also the requirement of SEPP 55[8].

1.2 Objective

The objectives of this RAP are to:

- Characterise and document the known extent of environmental impact within the site via presentation of a conceptual site model (CSM);
- Identify the remedial strategy(ies) to be adopted by an assessment of remedial options and development objectives; and
- Document the procedures and standards to be followed in order to remove the risks posed by contaminated soils, to make the site suitable for permissible (commercial and commercial with childcare centres) land uses, while ensuring the protection of human health and the surrounding environment.

[4] *Site Audit Statement/Report – Public Open Space Area, Australian Technology Park, Eveleigh.* Ramboll Environ Pty Ltd dated 4 September 2015, draft document (Ramboll 2015a)

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

[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

[7] National Environment Protection (Assessment of Site Contamination) Measure, Amendment No 1 (2013). National Environment Protection Council (NEPC 2013)

[8] *Managing Land Contamination – Planning Guidelines SEPP 55 Remediation of Land*. Department of Urban Affairs and Planning. Environment Protection Authority 1998 (DUAP 1998)

2. Proposed Development

2.1 Development Framework and Design

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 upgrade to the existing public domain within ATP. Building heights of 4, 7 and 9 storeys are proposed across the three 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. UGDC has actively encouraged new development and employment opportunities 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 (Lots 8 and 9).

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 13.2 hectares, is located within the City of Sydney local government area (LGA).

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 current SSDA works boundary excludes the Locomotive Workshop, however, future development associated with the adaptive re-use of the Locomotive Workshop will be the subject of separate future applications. To avoid the preparation of a separate RAP for the Locomotive Works, and the ensure consistency with regards to the remedial approach across the site/ATP, the Locomotive Workshop has been included in this RAP and the site boundary.

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**. Landscape design plans are also presented in **Appendix A**.

Adaptive reuse and refurbishment of the Locomotive Workshop for commercial purposes is proposed in future development. This will involve modifications to the interior. The concrete slab will be retained.

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

2.2 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.

3. Site Conditions and Land Uses

3.1 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 3.1**.

Table 3.1 Summary Site Details

Lot Numbers (as shown on **Figure 3**)	Lots 8, 9, 12 in DP 1136859 Lot 4000 in DP 1194309 (previously Lot13 DP 1136859) Part Lot 4007 in DP 1194309 (previously Lot13 DP 1136859) Part Lot 10 in DP 1136859
Street Address	Australian Technology Park, 2 Locomotive Street, Eveleigh, NSW, 2015
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 4000 DP 1194309 – ongoing commercial land use Part Lot 4007 DP 1194309 – 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 a roads, sports oval, tennis courts and picnic facilities (recreational land use) Part Lot 10 DP 1136859 – commercial land use (Channel 7)
Proposed Developable Land Uses	Part Lot 10 DP 1136859 and Part Lot 4007 DP 1194309 – ongoing commercial (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 Lot 4000 DP 1194309 -–adaptive reuse for ongoing commercial land uses

3.2 Site Layout

The site comprises an irregular shaped parcel of land accommodating Developable Lots and public domain areas 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 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 site is defined as part of the 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 Workshop and Developable Lots (Lots 8, 9 and 12). Areas excluded from the site include Lots 4001 to 4006 including the International Business Centre, National Innovation Centre, Traffic Management Centre, Ambulance Service Building and Biomedical Building), Lot 501 in DP 1033739 (rail tunnel easement) and land currently tenanted by Seven

Network (Channel Seven – Lots 10 and 11 in DP 1136859) (but includes the public domain easement between Lot 10 in DP1136859 and Lot 12 in DP 1136589).

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 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.

3.3 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.

Lots 4001 to 4006 in DP 1194309 including the 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. Lot 501 DP 1033739 (rail easement) also falls outside the site boundary. As discussed above, the pedestrian easement between Lot 10 in DP1136859 and Lot 12 in DP 1136589 falls within the site boundary.

3.4 Geology and Soils

Reference to the 1:100 000 Geological Series Sheet for Sydney (DMR 1983[9]) indicates that the site is largely underlain by Ashfield Shale of the Wianamatta Group and Quaternary sediments, although limited in extent and skeletal in nature (i.e. within the southern extents of Lots 8 and 9 and Lot 4007).

Ashfield Shale, which are located across the majority of the site typically comprises black to dark grey shales with laminate. A thin horizon of Quaternary sediments, commonly referred to as the Botany Sand Beds (BSB) is present within the southernmost site extent. BSB typically comprise 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[10]) 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, the vertical extent of fill is reported to be 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.

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.

Silty clay soils, with small isolated clayey sand/sand lens 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** Lot 12 is noted to be underlain by fill and in turn clay and shale bedrock.

Groundwater seepage was noted at a number of sampling locations during historical investigation activities. Seepage water levels varied from 0.8 m to 5 m below ground level (bgl) over a period of twenty two years.

[9] Sydney 1:100 000 Geological Series Sheet 9130 (Edition 1). Department of Mineral Resources, 1983 (DMR 1983)
[10] 1:100 000 *Sydney Soil Landscapes Map Sheet 9130 Edition 1*, Department of Land and Water Conservation, Published 1989

3.5 Acid Sulfate Soils

Review of the *Acid Sulfate Soil Risk Map for Botany Bay*[11] 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 consider the potential for ASS/PASS if development activities involve excavation of natural soils beneath the water table.

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

3.6 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 10 m and 20 m 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.

Based on communications with Mirvac, it is understood that site is highly engineered, and alterations to the site's topography are subject to development controls.

3.7 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 becoming surface water run off toward 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.

[11] *Acid Sulfate Soil Risk Map – Botany Bay,* Edition 2, 1997 1:25 000 Ref: 91 30S3. NSW DLWC

3.8 Hydrogeology

Based on local topography, geology and reported depths to groundwater, groundwater flow is anticipated to be to the south, towards Shea's Creek/Alexandra Canal. Shallow groundwater at the site is anticipated to occur perched at the base of the fill/sand materials and at the interface with the much less permeable shale / sandstone following rain fall events. Within the underlying bedrock, groundwater is expected to be confined to zones of relatively higher permeability (i.e. faults, fractures and weathered seams of clay and sandy clay within the bedrock) and therefore limited in extent.

Previous assessments within the site have identified groundwater at depths of approximately 16.8 m AHD within the norther site extent falling to approximately 13.2 m AHD within the southern site extent.

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.

A review of the Botany Groundwater Management Zones map (DNR 2009[12]) indicates that hydrogeologically 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).

3.9 Meteorology

A review of average climatic data for the nearest Bureau of Meteorology monitoring location (Sydney Airport AMO[13]) 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.

[12] 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)

[13] 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.

4. Summary of Site History

The ATP precinct 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 as presented in JBS&G (2015a), the site was used to manufacture components required for steam locomotive assembly and repair. As such, 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 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 6**). 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 (location unknown). Light non-aqueous phase liquid (LNAPL) hydrocarbons and elevated dissolved hydrocarbons have historically been reported at sample location MW3 within Area 2 (**Figure 7D**) and within Lot 10 DP 1136859 (beneath the Channel 7 building, outside the site boundary).

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 (beyond the site) resulting in some localised soil and groundwater contamination. Lots 10 and 11 in DP 1136859 have recently been the subject of a SAS, certifying that Lots 10 and 11 in DP 1136859 are suitable for commercial land use subject to implementation of an EMP. 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 but is understood to occupy the northern most extent of the pedestrian easement portion of Lot 10.

5. Previous Investigations / Contamination Status

The following provides a summary of previous investigations:

5.1 Detailed Site Assessment (JBS&G 2015a)

JBS&G prepared a standalone site-wide detailed site investigation (DSI, JBS&G 2015a) report comprising a review of historical reports prepared for the ATP. The scope of works completed for this assessment comprised:

- A review of available historical information to identify potential areas of environmental concern (AEC);
- Review and collation of available information in relation to site natural and contamination conditions;
- Development of a 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.

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 PAH exceeding adopted NEPC (2013) ecological criteria and, in relatively few locations, adopted health-based criteria. 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 was recommended;
- 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, it was noted potential remains for more widespread asbestos impact within the fill materials in portions of the site;
- Previous investigations have considered the risk of ASS/PASS to be low, however there has reported to be uncertainty in the potential for acid 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 were 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 draft Non-Statutory Section A SAS (Ramboll 2015a) 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 EMP (ES 2015a) 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 (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 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 (ES 2015a) 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, groundwater has been assessed across the broader ATP precinct and no groundwater remediation is considered to be required; and
- Should fill materials be subject to cut and fill activities, and potential remains for the placement of fill from the unsaturated zone within the saturated zone, the potential for detrimentally affecting groundwater conditions, for example by increased contaminant leaching, needs to be considered.

On this basis, it was 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 was 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.

Future works within public domain areas are required to be undertaken in accordance with the EMP prepared for these land parcels (ES 2015a).

5.2 Lot 12 Fill Retention Assessment (JBS&G 2016c[14])

The investigation comprised collection of soil samples from across Lot 12 on a systematic grid basis skewed to areas of historical elevated total and/or toxicity characteristic leaching procedure (TCLP) contaminant concentrations.

The objective of the investigation was to evaluate fill materials within Lot 12 to establish whether fill materials are environmentally suitable for placement below the future Lot 12 building, specifically the placement of fill from the unsaturated zone within the saturated zone and the potential for detrimentally affecting groundwater conditions by increased contaminant leaching. A secondary

[14] *Mirvac Projects Pty Ltd – Australian Technology Park Lot 12 Fill Retention Assessment*. 2 Locomotive Street, Eveleigh, NSW. JBS&G Australia Pty Ltd dated 29 January 2016 (JBS&G 2016c)

objective was to assess whether ASS/PASS conditions/properties were present at depth within Lot 12.

Sampling was conducted at eighteen locations, from which soil samples were collected at regular intervals until natural soils or prior refusal. A total of thirty six primary soil samples were submitted for heavy metals, TRH, PAH and Australian standard leaching procedure (ASLP) heavy metal and PAH analysis. In addition, to replicate the excavation, stockpiling and homogenisation process as a result of earth works (and potential for disaggregation), JBS&G also submitted six 5 kg samples of fill materials for column leach analysis in accordance with ASTM (D4874-95[15]).

The report was prepared as a factual presentation of data which was subsequently interpreted in JBS&G (2016b). Relevant data is provided as **Appendix B**.

Fill materials and natural site soils within Lot 12 were identified as not containing ASS/PASS properties requiring management.

5.3 Locomotive Workshop Soil Vapour Assessment (JBS&G 2016d[16])

The objective of this investigation was to assess the concentration of soil vapour contaminants, specifically volatile organic compounds (VOCs) underlying the Locomotive Workshop. The scope of works completed for this assessment comprised:

- Installation of twenty seven systematic sub-slab soil vapour points on an approximately 30 m grid across the Locomotive Workshop, sample collection, and subsequent laboratory analysis at a National Association of Testing Authority (NATA) certified laboratory for volatile organic compounds (VOC);
- Subsequent to receipt of the certificates of analysis of the initial sampling event , installation of six targeted sub-slab soil vapour locations, sample collection and laboratory analysis at a NATA certified laboratory for VOCs to assist in plume delineation / source identification in areas of elevated VOC concentrations; and
- Preparation of a factual letter report summarising the results of the sampling and analysis.

The report was prepared as a factual presentation of data which was subsequently interpreted in JBS&G (2016a). Relevant data is provided as **Appendix C**.

5.4 Human Health Risk Assessment (JBS&G 2016a)

JBS&G completed a human health risk assessment (HHRA) for the site with respect to permissible land uses. Based on the results of the assessment, the following were noted:

- It was considered that risks to site users associated with direct contact exposures (i.e. incidental ingestion, dermal contact, dust inhalation) to contaminated soils can be managed through the establishment and maintenance of physical barriers, with potentially complete source-pathway-receptor linkages limited to sub-surface maintenance workers and construction workers;
- Risks to sub-surface maintenance workers and construction workers posed by contaminated soils are acceptable for non-asbestos contaminants, however, due to the potential for unexpected finds it is recommended that safe work procedures are implemented during subsurface works in order to reduce exposures via the incidental ingestion, dermal contact and inhalation pathways to the extent practicable in accordance with current guidance and legislation, inclusive of WorkSafe Australia (July 2014) Review of Hazards and Health Effects

[15] ASTM Designation: D4874-95 (Reapproved 2014) – Standard Test Method for Leaching Solid Material in a Column Apparatus (ASTM D4875-95).

[16] *Locomotive Workshop Soil Vapour Assessment*. JBS&G Australia Pty Ltd dated 27 May 2016 (JBS&G 2016d)

of Inorganic Lead, Information Sheet as well as National Health and Medical Research Council (April 2016) Managing Individual Exposure to Lead in Australia – A Guide for Health Practitioners;

- Asbestos contaminated soils are not widespread, however, friable forms have been detected and the presence of asbestos contamination in any particular area cannot be precluded on the basis of the available information. As such, asbestos clearance procedures should be developed and implemented in accordance with current guidance and legislation where ground disturbance is proposed;
- A review of the groundwater data indicates that no risk management measures and/or further assessment are warranted with respect to exposure to contaminants in groundwater. However, considering the proximity of the site with respect to the Botany Sands Aquifer Embargo Area, groundwater use for purposes other than monitoring should be precluded;
- Although contaminant concentrations in soil vapour exceed adopted screening criteria in a number of samples collected beneath the Locomotive Workshop floor, the available indoor air monitoring data indicates that vapour inhalation risks are acceptable to current users of the building. Due to the magnitude of criteria exceedances in sub-surface vapour monitoring samples it is recommended that ongoing indoor air monitoring is conducted. The air monitoring should continue until such time that the sub-slab to indoor air attenuation being observed can be explained by establishing an adequately representative vapour intrusion model based upon site specific data (e.g. establishment of variation in relation to representative sub-slab and indoor air concentrations, foundation thickness, mixing space volume, air exchange rate etc.);
- Although it is considered unlikely that vapour inhalation risks to subsurface workers in the vicinity of the Locomotive Workshop are unacceptable, as a conservative measure it is recommended that ongoing management of the site includes provision to conduct air monitoring using a Photo-Ionisation Detector (PID) during excavations in the vicinity of the Locomotive Workshop and the establishment of a 0.1ppm trigger level (based on sub-chronic risk, to be adjusted for PID lamp) for action (e.g. cease work, active ventilation) in order to appropriately manage risks to human health; and
- Additional investigations are required in relation to Lot 12 to assess vapour intrusion risks associated with the adjacent Locomotive Workshop area. As the proposed development for Lot 12 includes a partially sunken car park, these investigations will also need to consider the potential for contaminated groundwater seepage. The additional investigations should be followed by a site specific risk assessment which considers the proposed development plans and identifies whether risks to future users of Lot 12 are unacceptable. In the event that unacceptable risks are identified, appropriate management measures will need to be developed and implemented in order to reduce risks to acceptable levels.

5.5 Ecological Risk Assessment (JBS&G 2016b)

JBS&G completed an ecological risk assessment (ERA) for the site. Based on the results of the assessment, the following were noted:

- Growing media (imported) are used in accessible areas of the site where potential plantings are proposed to occur;
- A minimum depth of 0.5 m of growing media should be adopted in areas of grasses / shrubs, or depths of 0.1 m in areas already subject to management by the existing Environmental Management Plan;

- A minimum depth of 1.5 m, not exceeding 2 m, is appropriate for areas of the site where larger trees are proposed to be planted;
- Growing media should have levels of constituents consistent with ecological protection criteria for 'urban residential and public open space' as provided to NEPC (2013), and levels of aldrin, dieldrin and polychlorinated biphenyls (PCBs) below laboratory detection limits;
- Fill materials on site are not suitable to be used as growing media, unless demonstrated to be environmentally suitable by additional targeted sampling and analysis;
- A significant extent of the natural soils on the site, generally at depths in proximity to the extent of the fill based soils, are further not suitable to be used as growing media, unless demonstrated otherwise. Where natural soils are proposed to be used on site as growing media they will require to be validated for heavy metals, TRH and PAHs;
- Natural soils on site (underlying fill materials) may be suitable to be used as growing media subject to validation of hydrocarbons meeting NEPC (2013) criteria; and
- There is not considered to be an unacceptable ecological risk, from a protection of groundwater/off site ecological receptor perspective, to the re-use of fill materials within the site subject to the retention of fill materials within clay based soils as present over the majority of the site. The levels of potential leachates, where fill materials are retained in this lithology, have been demonstrated to be negligible.

5.6 Summary of Known Contamination Status

The following sections provide key comments in relation to historical investigations made available and applicable to the site summarised by JBS&G (2015a). Historical sample locations are shown in **Figures 7A** to **7D**. Soil, groundwater and soil vapour exceedances when compared to NEPC (2013) are shown in **Figures 8A, 8B East, 8B West, 8C, 8D, 8E East** and **8E West**. A summary of soil and groundwater analytical data is presented in **Appendix D**. Soil vapour data is presented in **Appendix C**.

The ATP precinct, for which the site is part, has been the subject of over one hundred contamination investigations over a period of 22 years.

A draft Non-Statutory Section A SAS (Ramboll 2015a) was issued in September 2015 certifying that public domain areas within Lot 4007 in DP 1194309 (road reserves, pedestrian easements and recreational facilities) are suitable for ongoing recreational and commercial land uses subject to implementation of the EMP (ES 2015a) prepared for these land parcels.

A Non-Statutory Section A SAS (Environ 2014a[17]) was issued for Lot 8 in DP 1136859 in 2014 certifying that Lot 8 was suitable for commercial land uses. This land parcel is now proposed to accommodate commercial land use, potentially including a childcare facility (or similar) and the SAS (Environ 2014a) is not applicable to the proposed redevelopment.

A Non-Statutory Section B SAS was issued for Lot 9 (Environ 2014b[18]) and Lot 12 (Environ 2014c[19]) in DP 1136859 certifying that the nature and extent of the contamination has been appropriately determined for the purposes of planning future management or redevelopment of the site.

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

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

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

It is understood a Non-Statutory Section A SAS[20] has been issued for Lots 10 and 11 in DP 1136859 certifying that these land parcels are suitable for commercial land uses subject to implementation of the EMP (DP) prepared for these land parcels.

In addition, groundwater beneath the ATP precinct has been identified as not requiring remediation (Environ 2014a/b/c, Ramboll 2015a).

Subsequent to the aforementioned, the site has been subject to an ERA (JBS&G 2016b) and HHRA (JBS&G 2016a).

5.6.1 Summary of Known Fill/Soil Contamination Status

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. Fill materials within the site 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 have been shown to contain elevated concentrations of heavy metals (principally copper, zinc and to a lesser extent lead), semi to non-volatile TPHs/TRH, PAHs (including concentrations of carcinogenic PAH compounds as benzo(a)pyrene TEQ) and, in parts, asbestos.

Within the Developable Lots (Lot 8, Lot 9 and Lot 12) the reported concentrations of the identified contaminants (where present) in the fill material typically exceed endorsed generic/site-derived ecological criteria and, in relatively few cases, exceed endorsed health-based criteria as adopted in JBS&G (2015a) for proposed permissible land uses (Lots 8 and 9 – commercial with childcare use; Lot 12 – commercial use).

No significant amounts of volatile contaminants were detected in fill materials. Elevated TRH (F2 fraction) and/or naphthalene concentrations in fill materials at isolated locations in Lot 9 at BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 historically exceeded the adopted NEPC (2013) health-based criteria. 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. Based on the results of the ERA/HHRA (JBS&G 2016b and JBS&G 2016a), fill materials at sample locations BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 are considered not to represent a potential vapour risk requiring management.

Asbestos in the form of asbestos fine/ fibrous asbestos (AF/FA) has been identified in isolated areas within Developable Lots (one location within both Lots 8 and 9 and two locations within Lot 12). However, it is noted that while asbestos was identified in isolated samples, extensive observations of “rubble” and other building-material related inclusions were noted on the borehole logs from previous investigations, and the nature of historical investigation methods, indicate that asbestos may be more widespread within the fill materials than currently identified.

There is no discernible pattern to the distribution of contaminants within the fill material and the impact is not confined to any particular portion(s) of site. The sample depths at which elevated concentrations of the nominated contaminants were identified ranged from immediately beneath ground surface until fill termination indicating the presence of contaminants is associated with the fill material itself, rather than discrete point sources.

The majority of constituents 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 downgradient groundwater receptors. Based on the results of the ERA (JBS&G 2016b), reported calculations undertaken to assess potential worst case levels of leachate generated from site fill materials, the reuse of site fill materials, and the potential impact to site groundwater and

[20] A copy of the SAS and EMP has not been provided for review. It is understood Rod Hardwood of Environmental Strategies Pty Ltd prepared the SAS and Douglas Partners Pty Ltd prepared the EMP

hydrogeologically down gradient potential receptors of groundwater, have indicated fill materials do not pose an unacceptable ecological risk. Fill materials from Lot 12 are considered suitable for retention in the proposed borrow pit beneath the future Lot 12 building, as discussed in **Sections 5.5** and **7.4.1**.

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. PAHs and heavy metals). On this basis, it is considered appropriate to apply the associated NSW EPA general immobilisation approvals (EPA 1999[21] and EPA 2009[22]) when consideration is given to evaluating a waste classification(s) for material required to be excavated during the remedial works.

Although the risk has been considered low, previous investigations have been uncertain with respect to potential for ASS/PASS within natural soils underlying the site. With due consideration to the geological and soil characteristics of the site (i.e. sands with minor peat material in parts), in addition to historical information presented in JBS&G (2015a), 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. Notwithstanding the aforementioned, assessment activities as part of JBS&G (2016c) did not identify ASS/PASS properties within Lot 12 fill materials or natural soils requiring ongoing management.

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 draft SAS (Ramboll 2015a) was issued in September 2015 certifying that public domain areas within Lot 4007 (road reserves, pedestrian easements and recreational facilities) are suitable for ongoing recreational and commercial land uses subject to implementation of the EMP (ES 2014a) prepared for this land parcel. As discussed above, a SAS has also been issued for Lot 10 in DP 1136859 certifying Lot 10 in DP 1136859 is suitable for commercial land use subject to implementation of the EMP (DP) prepared for this land parcel.

5.6.2 Summary of Known Groundwater Contamination Impact

As documented in JBS&G (2015a), SAS's prepared for various land parcels within the ATP precinct and ERA (JBS&G 2016D), groundwater has been assessed across the site and no groundwater remediation is considered to be required.

Identified historical groundwater contamination issues underlying the ATP precinct, incorporating but not necessary directly applicable to the site, include:

- Elevated concentrations of heavy metals (principally zinc and copper) in groundwater identified in various parts of site;
- Elevated zinc concentrations at BH508 within Lot 9, which may be related to overlying fill conditions;
- Light non-aqueous phase liquid (LNAPL) historically reported (in the 1990s) within the northern site extent (MW3 – Area 2) and GWP208A within Lot 10; and
- Dissolved phase concentrations of TRH in groundwater related to the presence of LNAPL and in localised areas likely associated with other TRH sources (e.g., UST(s) and/or historical site activities).

[21] *General Approval of the Immobilisation of Contaminants in Waste – 1999/05. Ash, ash-contaminated natural excavated materials or coal-contaminated natural excavated materials*. (EPA 1999).

[22] *General Approval of the Immobilisation of Contaminants in Waste – 2009/07. Metallurgical furnace slag or metallurgical furnace slag contaminated natural excavated materials*. (EPA 2009).

As documented in JBS&G (2015a), no known LNAPL sources have been reported during recent groundwater sampling events and TRH (and other organic COPC) concentrations have generally been below the laboratory limit of reporting (LOR) or only marginally exceeding the laboratory LOR.

As discussed in JBS&G (2016b), unsaturated fill materials from Lot 12 are considered environmentally suitable for placement within the saturated zone beneath the future Lot 12 building (**Sections 5.5 and 7.4.1**).

5.6.3 Summary of Known Soil Vapour Contamination Impact

Sub-slab vapour samples collected from underlying Bays of the Locomotive Workshop have reported TCE concentrations ranging between 0.0655 mg/m^3 to 6.167 mg/m^3. Concentrations of tetrachloroethene (PCE) ranging from 0.1667 mg/m^3 to 3.167 mg/m^3 have also been reported beneath the Locomotive Workshop along with other volatile compounds. However, on the basis that ambient air quality sampling results were reported below the adopted assessment criteria, no current risk from sub-slab vapour conditions has been identified. As discussed in JBS&G (2016a) ongoing ambient air monitoring is required to demonstrate ongoing commercial land use suitability.

Although it is considered unlikely that risks to subsurface workers in the vicinity of the Locomotive Workshop are unacceptable, as a conservative measure it is recommended that ongoing management of the site includes provision to conduct air monitoring using a PID during excavations in the vicinity of the Locomotive Workshop and the establishment of a 0.1 ppm trigger level (based on sub-chronic risk, to be adjusted for PID lamp) for action (e.g. cease work, active ventilation) in order to appropriately manage risks to human health.

It is noted the source of the PCE/TCE concentrations detected beneath the Locomotive Workshop is unclear at the time of this report, noting that two discrete source areas appear to exist (i.e. western portion associated with SV03/SV07 and a larger area in the eastern portion). In addition, the lateral extent of PCE/TCE contamination in soil vapour above adopted criteria is uncertain to the south (i.e. towards Lot 12) in both the western or eastern source areas.

Although soil vapour data is not available for Lot 12, the available evidence suggests that it is highly unlikely that soil or groundwater contamination currently exists within Lot 12 which represents a potentially significant source of PCE/TCE contamination in soil vapour. Historical soil investigations conducted across Lot 12 have included relatively limited analysis for PCE/TCE, however, relatively extensive C_6-C_9 /C_6-C_{10} analysis has been conducted and the available results are not indicative of a significant C_6-C_9 /C_6-C_{10} contamination source in soils. Historical groundwater investigations conducted across Lot 12 have not identified concentrations of PCE/TCE above the laboratory limit of reporting, noting that PCE analysis has been relatively limited. Although PCE analysis has been relatively limited for groundwater, C_6-C_9/C_6-C_{10} analysis has been relatively extensive and the results are not indicative of a significant C_6-C_9/C_6-C_{10} contamination source apart from an isolated result which can be attributable to petroleum hydrocarbon contamination which meets vapour intrusion based screening levels (i.e. MW149: C_6-C_9 less BTEX – 0.15mg/L, toluene - 0.95mg/L).

Based upon the available soil and groundwater data for Lot 12, it appears as though it is unlikely that there is significant source of PCE/TCE within Lot 12. However, the potential for PCE or TCE to pose unacceptable vapour intrusion risks to users of future buildings upon Lot 12 cannot be precluded due to the following:

- The source of the PCE/TCE contamination detected in soil vapour beneath the Locomotive Workshop is unclear, noting that given Lot 12 is located hydraulically downgradient of the Locomotive Workshop and the available groundwater data for Lot 12 indicates a lack of PCE/TCE contamination, a shallow source in soil is suspected;
- The lateral extent of PCE/TCE in soil vapour at concentrations exceeding adopted criteria is unclear between the Locomotive Workshop and Lot 12;

- No soil vapour data is available for Lot 12;
- Due to the equilibrium phase partitioning characteristics of PCE/TCE, the absence of evidence for a significant source of PCE/TCE contamination in soil and groundwater does not provide sufficient evidence that PCE/TCE may not be present in soil vapour at concentrations exceeding adopted criteria; and
- Depending upon the nature of the PCE/TCE source beneath the Locomotive Workshop, there are some future development scenarios for Lot 12 whereby TCE/PCE related risks could be exacerbated (e.g. temporary construction dewatering may draw in TCE/PCE contaminated groundwater).

Additional data will be obtained to address the uncertainty around the TCE/PCE contamination detected in soil vapour beneath the Locomotive Workshop and better define the lateral extent of PCE/TCE in soil vapour at concentrations exceeding adopted screening criteria. The target depth for the soil vapour investigations will consider the likely depth of future building foundations. A risk assessment will subsequently be conducted on the basis of the additional data and specific redevelopment scenarios in order to ensure that risks posed by PCE/TCE in soil vapour are appropriately managed.

Fill material across the balance of the site is not considered to represent a potential soil vapour risk.

5.6.4 Hazardous Building Materials

Lead based paint has been identified within the Locomotive Workshop. Lead based paints are required to be removed from the Locomotive Workshop or documented in the Hazardous Materials Register prepared for the Locomotive Workshop and managed under an EMP.

6. Conceptual Site Model

6.1 Overview

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).

6.2 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 and the ERA have noted that groundwater has been assessed as part of the greater ATP site and that no groundwater remediation is 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 Workshop are considered COPC.

6.3 Potentially Contaminated Media

Potentially contaminated media comprise:

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

Fill Materials

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/TPH, 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 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 D**. 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 NEPC (2013) are shown on **Figures 8A**, **8B-East**, **8B-West**, **8C** and **8D**.

As noted by the ATP 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.

TRH F2 and/or naphthalene concentrations were identified at sample locations BH7, BH8 and BH510 within Lot 9 at concentrations exceeding relevant NEPC (2013) 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. As discussed above, based on the results of the ERA/HHRA (JBS&G 2016b and JBS&G 2016a), fill materials at sample locations BH7/1.5-1.6, BH8/0.6-1.0 and BH10/0.9-1.0 are considered not to represent a potential vapour risk requiring management.

It is noted previous investigations have identified 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.

As discussed in JBS&G (2015a), fill/soil materials are generally characterised by low leachability. Assessment of leachability (JBS&G 2016b) has identified fill materials do not representing a potential migration issue requiring management.

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). On this basis, it is appropriate to apply the associated NSW EPA general immobilisation approvals (EPA 1999 and EPA 2009) when consideration is given to evaluating a waste classification(s) for material required to be excavated during the site development works.

Natural Soils

Analysis of natural soil samples indicated contaminated material is 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. Assessment activities as part of JBS&G (2016c) did not identify ASS/PASS properties within Lot 12 fill or natural soils requiring management.

Soil Vapour

Sub-slab vapours beneath a portion of the Locomotive Workshop have been identified to contain TCE and PCE 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. As such, no current risk from sub-slab vapour within the Locomotive Workshop has been reported.

As discussed in **Section 5.6.3**, additional data will be collected from the Locomotive Workshop and to the south of the Locomotive Workshop to address the uncertainty around the identified TCE/PCE soil vapour impact.

With regards to the balance of the site, as discussed in the HHRA (JBS&G 2016a), fill materials do not represent a potential vapour risk with respect to permissible land uses.

Ongoing ambient air monitoring is required within the Locomotive Workshop.

Groundwater

Groundwater has been found to be characterised with levels of a range of heavy metals above the adopted assessment ANZECC (2000) 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 **Appendix D**, 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 under existing site conditions. However, the potential for affecting groundwater conditions, for example by increased contaminant leaching, will need to be considered in any redevelopment proposal.

As discussed in **Section 5**, the ERA (JBS&G 2015b) concluded that fill material are suitable to remain on site, including the retention of unsaturated fill materials from Lot 12 below the water table in Lot 12 (i.e. within clay soils/shale).

As discussed in **Section 3.8,** 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.

6.4 Potential Exposure Pathways

The ATP precinct, for which the site is part, is currently subject to EMPs (ES 2015a and DP[23]) to control exposures to identified contamination to ensure site suitability. However, potential exposure pathways relevant to the proposed redevelopment is required. The 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.

[23] This report has not been made available for review. Year unknown

Oral and dermal contact of regular site users to current in-sit' 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 construction activities. Whilst temporary dewatering may be required to achieve construction requirements (i.e. the borrow in Lot 12 to retain fill materials), 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 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 fill/sand 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 JBS&G (2015a and 2016a), ambient air results suggest that soil vapour concentrations of TCE/PCE 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 or site development activities result increase exposure (i.e. within Lot 12 with a sunken/at grade car parking). 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; however these are considered not to represent a potential vapour risk requiring management.

6.5 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/vapours 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

- The marine water ecosystem of Alexandra Canal 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.

6.6 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 COPC 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. Remedial Action Plan

7.1 Remedial Goal

The goal for the remediation and/or ongoing management of environmental impact is to:

- Remove unacceptable risks to human populations working on/using the site posed by fill/soil contamination within Developable Lots;
- Maintain requirements in the EMPs (ES 2015a and DP) or appropriate revised management requirements to ensure ongoing suitability of public domain areas for recreational and commercial land uses;
- Prevent exposure of human populations working on/using the site to potentially impacted soils and soil vapour underlying the Locomotive Workshop, and hazardous materials within the Locomotive Workshop that may cause an unacceptable risk; and
- Remove or manage unacceptable ecological risks to flora posed by fill/soil contamination (where applicable).

All remediation works, consistent with the site redevelopment proposed by Mirvac, requires to be undertaken in a manner consistent with principles of ecologically sustainable development (ESD). Of most relevance of remedial works to ESD, where necessary protection of potential and ecological receptors is able to be demonstrated, is best achieving waste minimisation.

7.2 Extent of Remediation

Based on historical investigations as summarized in JBS&G (2015a), the results of JBS&G (2016a and 2016b), and subject to the limitations of those investigations, the following areas require remediation/management:

- Fill materials across the Developable Lots identified as contaminated with heavy metals, TRH/TPH, asbestos and PAHs to varying degrees requiring management;
- Fill materials across the public domain areas identified as contaminated require ongoing management via implementation of the EMPs (ES 2015a and DP);
- Management of identified sub-slab vapour conditions underlying the Locomotive Workshop building; and
- Lead based paint within the Locomotive Workshop requires removal or management and documentation in a Hazardous Materials Register to ensure no unacceptable health risk.

In addition, as discussed in **Section 5.6.3**, additional investigations are proposed to be undertaken to address the uncertainty around the TCE/PCE contamination detected in soil vapour beneath the Locomotive Workshop and better addressing the lateral extent of PCE/TCE in soil vapour at concentrations exceeding adopted screening criteria (including to the south). The target depth for the soil vapour investigations will consider the likely depth of future building foundations, including those of Lot 12 being down gradient of the Locomotive Workshop. A risk assessment will subsequently be conducted on the basis of the additional data and specific redevelopment scenarios in order to ensure that risks posed by PCE/TCE in soil vapour are appropriately managed.

7.3 Assessment of Remedial Options

The *Contaminated Sites Guidelines for the NSW Auditor Scheme* (DEC 2006[24]) lists the following order of preference for soil remediation and management:

[24] *Contaminated Sites – Guidelines for the NSW Site Auditor Scheme (2nd Edition)*. NSW Department of Environment and Conservation 2006 (DEC 2006)

- On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
- Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;
- Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill; and
- Consolidation and isolation of the soil on-site by containment within a properly designed barrier.

In addition, it is also a requirement that remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed. And, where there are large quantities of soil with low levels of contamination, alternative strategies are required to be considered or developed (DEC 2006).

Remedial options of Developable Lots and the Locomotive Workshop have been assessed for the site as detailed in **Table 7.1** following.

Works within pubic domains are required to be undertaken in accordance with documented procedures in ES (2015a) and procedures herein.

Table 7.1 Assessment of Remedial Options

Remedial Option	Applicability	Assessment
1. On-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level.	Metals Metals are unable to be destroyed. However, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified inorganic contaminants of concern (e.g. cement stabilisation).	Metals Not a suitable option Metals are unable to be destroyed, so this is not an option which is able to be considered. Microencapsulation is not considered necessary given the absence of identified groundwater impacts requiring remediation.
	PAHs Polycyclic aromatic hydrocarbons present in site soils are typically restricted to heavier non-volatile constituents. These can be remediated by thermal processes. However this requires substantial investment in plant and equipment and substantial energy use. Similarly for heavy metals, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified organic contaminants of concern (e.g., cement stabilisation).	PAHs Not a suitable option Remediation options are available for PAH contaminated fill contaminants, generally restricted to thermal treatment processes which are energy intensive. These options are not considered consistent with the green star rating objectives for the site. Microencapsulation is not considered necessary given the absence of identified groundwater impacts requiring remediation.
	TRH Hydrocarbon constituents present in site soils are typically restricted to semi to non-volatile constituents. There is a potential that they may be able to be remediated on site by a bioremediation style remediation method. Bioremediation occurs where contaminants are chemically broken-down by the metabolic processes of micro-organisms into less toxic or non-toxic forms. Recent NSW EPA guidance requires bioremediation methods to demonstrate that pollutant emissions are not discharged to the atmosphere. On this basis, the lateral extent of the bioremediation activity requires to be restricted to ensure that air emissions from remediation materials are able to be collected. It is considered that bioremediation as implemented by 'biopiles' may be most appropriate for the particular constituents, site area, excavation volumes and requirement to retain hydrocarbon constituents. Biopiles consist of heaped stockpiles of the soil provided with an internal network of screened piping. Air is extracted from the screened pipe sections, by use of a vacuum pump, or by the use of passive flow devices. Collected air requires treatment / filtration to remove volatile constituents. Fresh air is drawn into the biopiles over the remainder of the stockpile surface.	TRH Not a suitable option Given the low detection limits, semi to non-volatile nature of contaminants and time and space limitations, bioremediation of soil impacted with petroleum hydrocarbons is considered lower feasibility at the site.
	Asbestos There is no known technology to remove asbestos fibres from soils. Asbestos present in non-friable forms can be remediated by screening to	Asbestos Not a viable option There is no treatment method available for asbestos impacts.

Remedial Option	Applicability	Assessment
	remove oversize materials. However the co-occurrence of a range of construction and demolition materials with the asbestos containing material reduces the potential effectiveness of screening processes. In addition, where friable asbestos impacts have been identified, screening of impacted material increases the risk of exposure to site workers and migration of fibres within the works area.	On this basis, on site treatment of impacted fill material is considered not to be a viable option.
2. Off-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level, after which the soil is returned to the site.	Metals Metals are unable to be destroyed. However, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified inorganic contaminants of concern (e.g. cement stabilisation).	Metals/TRH/PAHs Not a suitable option. Energy / resource use associated with the transport and return of materials is not considered consistent with green star objectives for the site.
	PAHs Polycyclic aromatic hydrocarbons present in site soils are typically restricted to heavier non-volatile constituents. These can be remediated by thermal processes. However this requires substantial investment in plant and equipment and substantial energy use. Similarly for heavy metals, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified organic contaminants of concern (e.g., cement stabilisation).	
	TRH Hydrocarbon constituents present in site soils are typically restricted to semi to non-volatile constituents. There is a potential that they may be able to be remediated off site by a bioremediation style remediation method.	
	Asbestos There is no known technology to remove asbestos fibres from soils. Asbestos present in non-friable forms can be remediated by screening to remove oversize materials. However the co-occurrence of a range of construction and demolition materials with the asbestos containing material reduces the potential effectiveness of screening processes. In addition, where friable asbestos impacts have been identified, screening of impacted material increases the risk of exposure to site workers and migration of fibres within the works area.	Asbestos Not a suitable option
3. Excavation and off-site removal of the impacted material.	Fill Materials (TRH, PAHs, heavy metals and asbestos) There are currently suitably licensed waste facilities in the Sydney Metropolitan region capable of accepting the identified contaminants within fill materials. These are generally located a significant distance from the site.	Fill Materials (TRH, PAHs, heavy metals and asbestos) A potentially applicable option but inferior to on-site placement (Option 4). The environmental impact of the transport of materials, waste generation and resource use in sourcing materials to re-instate the site to development levels is considered inconsistent with the green star requirements for the site.

Remedial Option	Applicability	Assessment
		Whilst this method is viable from a technical and practical view point, as a result of resource consumption and waste generation volume considerations, this is not the most preferred remedial option available. However, where materials are identified as not being environmentally suitable under option 4, or surplus to construction requirments then this is the preferred option.
4. On-site in situ management of the soil by capping and cover, and ongoing management.	Fill Materials (TRH, PAHs, heavy metals and asbestos) The fill materials, based on the assessment to date, have been found to be largely free of constituents: • That will pose a potential groundwater risk by the demonstrated absence of significant groundwater impact attributable to the site; and • That will pose a potential inhalation risk as demonstrated by the assessment of landfill gases/vapours. On this basis, the impacted fill materials are suitable for retention on the site in areas where human / ecological exposures can be restricted. Where materials are identified as not being suitable for containment, Option 3 is the preferred remedial strategy.	Fill Materials (TRH, PAHs, heavy metals and asbestos) This is the preferred option for the management of impacted fill materials. The retention of the materials will reduce the waste generation and resource requirements of the remediation of the site, as consistent with the site green star objectives. The site is/will be subject to significant areas of building and pavements which will act as appropriate containment structures. This option is of highest ranking with respect to the green star principles as a result of the low waste volumes and energy use. However, consideration of the practical implications of an ongoing site management plan is required prior to implementation.

7.4 Proposed Remedial Approach

Developable Lots and the Locomotive Workshop

As shown in **Table 7.1**, with consideration to DEC (2006) hierarchy for remediation, the characteristics of soils requiring remediation, the environmental setting of the area and the proposed development, the preferred remediation/management approach is a combination of on-site management (cap/cover creating a physical barrier) and implementation of a long-term environment management plan (LTEMP) and/or off-site disposal where fill/soil is surplus to development requirements.

Where off-site disposal of surplus materials is required, materials with a lower waste classification/potential for off-site re-use should be selected in preference, if environmentally suitable for onsite retention, to impacted materials to minimise waste generated by the works.

As discussed in **Section 5**, the ERA (JBS&G 2015b) concluded that fill material are suitable to remain on site, including the retention of unsaturated fill materials from Lot 12 below the water table in Lot 12 in the proposed borrow pit (i.e. clay soils), as discussed in **Section 7.4.1.**

The proposed cap/cover arrangements, providing physical separation from retained fill are presented in **Section 7.6.2.**

Soils moved between stages/across the broader site will require that a materials tracking system is implemented during works (as described in **Section 7.6.5**).

Public Domain Areas

As discussed above, public domains areas have been the subject of previous investigations, with a draft/final SASs issued certifying that Lots 10 and 4007 are suitable for permissible land uses (commercial, recreational, road reserves and pedestrian easements) subject to implementation of procedures presented in ES (2015a) and the DP EMP. The implemented remedial strategy comprises cap/cover. Current cap/cover arrangements, providing physical separation are summarised in **Section 3.2** and presented in detail in ES (2015a).

Any future works are required to be undertaken in accordance with procedures documented in ES (2015a) and procedures herein. The proposed cap/cover arrangement, providing physical separation from retained fill are presented in **Section 7.6.2.**

Soils moved within the site will require that a materials tracking system is implemented during works (as described in **Section 7.6.5**).

Locomotive Workshop

Elevated sub-slab soil vapour TCE and other VOC constituents concentrations have been reported underlying Bays of the Locomotive Workshop. However, ambient air quality results from within the building collected as part of ongoing EMP requirements were all reported below the adopted assessment criteria to date (JBS&G 2016a). As such, no current risk from sub-slab vapour conditions has been reported.

As discussed in JBS&G (2016a), ongoing ambient air monitoring is required. The current capping arrangements, generally comprising concrete slab floor ranging in thickness from 0.4 m to 0.7 m are required to be maintained.

Air monitoring should continue until such time that the sub-slab to indoor air attenuation being observed can be explained empirically by establishing an adequately representative vapour intrusion model based upon site specific data (e.g. establishment of variation in relation to representative sub-slab and indoor air concentrations, foundation thickness, mixing space volume, air exchange rate etc.).

7.4.1 Additional Development Details

A description of the proposed development application was provided in **Section 2**. A summary of the key development attributes relevant to the preferred remediation/management method, as discussed below, is provided following. Development plans showing the layout of the buildings within Developable Lots and the broader site are shown in **Appendix A**.

Lot 8

Construction of a four storey building within Lot 8 (Community Building) comprising of gym, retail, community, commercial and childcare uses over the majority of the lot. The building will be constructed largely at grade, with minor excavation required for lift wells and services etc. The concrete slab of the building will serve as a physical barrier.

Surface treatments external to the building comprise hardstands (paved areas underlain by a concrete slab or similar). A small landscaped area, constructed garden bed with validated environmentally suitable soils rather than existing site fill is proposed along the northern lot extent.

A schematic diagram is presented on **Figure 9A**. Cross Section Locations are shown on **Figure 9**.

No direct exposures will be present. A marker layer will underlie physical barriers (hardstands/nominated thick of environmentally suitable material), denoting the extent of retained fill.

Lot 9

Construction of a nine storey building within Lot 9 (Building 1) comprising parking, retail, commercial and childcare uses in the southeast portion. The building footprint will occupy the majority of the lot. The building will be constructed largely at grade, with minor excavation required for lift wells and services etc. The concrete slab of the building will serve as a physical barrier.

Surface treatments external to the building comprise hardstands (asphaltic parking and paved areas underlain by a concrete slab or similar). No landscaping (garden beds or similar) is proposed.

A schematic diagram is presented on **Figure 9B**. The cross section locations is shown on **Figure 9**.

No direct exposures will be present. A marker layer will underlie physical barriers (hardstands), denoting the extent of retained fill.

Lot 12

Construction of a seven storey building within Lot 12 (Building 2) comprising of parking, retail and commercial uses. The carpark (two levels in areas) will be partially sunken and constructed at-grade given the tiered site topography (**Section 3.6**) (i.e. level with Central Avenue but sunken below the Locomotive Street road frontage). A portion of materials from the 'upper tier' of the current carpark at Lot 12 will require excavation to achieve design levels. As discussed above and in the ERA (JBS&G 2016b), fill materials from Lot 12 are environmentally suitable for retention in a borrow pit beneath the proposed building.

The concrete slab of the building will serve as a physical barrier to retained fill materials both within the borrow pit and surrounds.

Surface treatments external to the building comprise hardstands (paved areas underlain by a concrete slab or similar). No landscaping (garden beds or similar) is proposed.

A schematic diagram is presented on **Figure 9C** of the proposed capping arrangement. The cross section locations is shown on **Figure 9**.

No direct exposures will be present. A marker layer will underlie physical barriers (hardstands), denoting the extent of retained fill.

With regards to the borrow pit/retention of fill materials beneath the future Lot 12 commercial building, to minimise waste generation and help achieve a green star rating, Mirvac propose to excavate fill materials, natural soils and bedrock to depths ranging to approximately 9 AHD m to 11 m AHD. The proposed excavation location/layout is shown on **Figure 10**. Additional design details are summarised in **Table 7.2** below.

Table 7.2 Summary of Burrow Pit Design Details

Current Lot 12 layout	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 m in height separates the two tiers. A portion of materials from the 'upper tier' of the current carpark at Lot 12 will require excavation to achieve design levels (i.e. sunken car parking when compared to Locomotive Street).
Borrow pit footprint	The borrow pit is proposed to be excavated beneath the future Lot 12 commercial building offset by approximately 26 m from the eastern Lot 12 boundary, 5 m from the southern Lot 12 boundary and approximately 40 m from the south western Lot 12 boundary. The borrow pit abuts the northern and western Lot 12 boundary. A secant pile wall (or similar) is proposed along the northern and western Lot 12 boundaries, retaining fill materials from neighbouring allotments. Potential remains for the secant pile wall (or similar) to be extended along the north eastern Lot 12 boundary, however, these details have yet to be confirmed/finalised. The borrow pit layout is shown on **Figure 10.** The secant pile wall (or similar) will help reduce groundwater migration
Borrow pit area	6 975 m^2
Borrow pit elevation (base)	Mirvac propose to excavate fill materials, natural soils and bedrock to depths ranging to approximately 9 AHD m to 11 m AHD, as shown on **Figure 10**
Borrow pit elevation (top)	The top of the borrow pit (cap) will comprise the future commercial building concrete slab foundation The proposed construction basal level for the proposed multi-storey commercial building range from RL 15.45 m AHD within the northern Lot extent to RL 16.7 m to 16.4 m AHD within the southern Lot extent.
Groundwater levels	Previous assessments within the site have identified groundwater at depths of approximately 16.8 m AHD within the norther site extent falling to approximately 13.2 m AHD within the southern site extent. Recent groundwater level monitoring by JBS&G within Lot 12 recorded groundwater levels within the northern Lot 12 extent ranging between 17 m AHD and 17.5 m AHD. Groundwater levels within the southern Lot 12 extent were recorded to range between 13.5 m AHD and 13.9 RL m AHD. The noticeable difference in groundwater levels is attributed to the two tiers lot topography and encountered lithology/geology, with groundwater perched at the interface with the much less permeable materials
Borrow pit excavation faces	The base of the burrow pit will largely terminate in bedrock within isolated areas of residual clay. The walls will be largely comprise bedrock/residual clay soils with isolated areas of more permeable soils. As discussed above, a secant pile wall (or similar) is proposed along the northern and western Lot 12 boundaries, retaining fill materials from neighbouring allotments. Potential remains for the secant pile wall (or similar) to be extended along the north eastern Lot 12 boundary, however, these details have yet to be confirmed/finalised

Following construction of the borrow pit, a program of groundwater monitoring will be undertaken consistent with those historically undertaken across the site, as documented in JBS&G (2015a). Groundwater monitoring wells will be the subject of groundwater sampling events at three monthly intervals for a period of 12 months. Following completion of the four groundwater monitoring events, a qualitative assessment of groundwater quality/conditions will be completed providing conclusions on the status of groundwater leaving Lot 12 and the site.

Public Domains Areas

Excluding Developable Lots (Lots 8, 9 and 12), the site is occupied/surfaced by either or a combination of the following as documented in the site EMP (ES 2015a):

- 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).

Landscaping and public domain improvements and/or extension and augmentation of physical infrastructure/utilities within Lots 10 and 4007 are proposed. This largely comprises the addition of landscaped areas (constructed garden beds which will be in validated environmentally suitable soils rather than existing site soils) along road reserves and paved extents, installation of services (trenching), bike racks and changes to the road alignment etc. The only major change to the current public domain configuration is the construction of a park/grassed area within the north eastern site extent, as shown in design plans provided in **Appendix A.** A schematic diagram is presented on **Figure 9D**. The cross section locations is shown on **Figure 9**.

Public domain improvements and/or extension and augmentation of physical infrastructure/utilities is to be undertaken in accordance with procedure documented in EMP prepared for these site portions. The key principal in the EMP (ES 2015a) is maintaining appropriate cover/capping to prevent direct contact exposure to normal site users from fill materials.

With respect to newly established landscaped areas, these will be required to be in accordance with the principals of the EMPs and the requirements of the RAP, specifically the requirements for physical separation of impacted fill material based upon the *Guidelines for the Assessment of On-Site Containment of Contaminated Soil*, September 1999, ANZECC (ANZECC 1999)

As discussed in the JBS&G (2016a and 2016b) and herein, materials imported to the site for the establishment of vegetated areas or service backfill will need to be demonstrated to be environmentally suitable.

Locomotive Workshop

The Locomotive Workshop is a large heritage listed masonry and steel former railway building, which has undergone adaptive reuse in recent years for commercial purposes. With the notable exception of Bays 1 and 2 (Blacksmith and heritage room) within the Locomotive Workshop, based on advanced sample locations the concrete slab floor varies in thickness ranging from 0.4 m to 0.7 m and was noted to be in good condition with no observed cracks or fissures.

Within Bays 1 and 2 (Blacksmith and heritage room) ground surface treatments comprised a combination of gravels / crushed concrete (approximately 0.5 m in thickness) and / or asphaltic hardstands.

Future development associated with the adaptive re-use of the Locomotive Workshop will be the subject of separate future applications. It is understood the development will largely involve internal remodelling rather than removal of existing hardstands/demolition of structures.

A concrete slab floor will serve as the physical barrier.

7.5 Regulatory and Planning Requirements

The following planning requirements for the proposed remedial works are presented.

Environment Planning and Assessment Act 1979/SEPP 55

The site is listed as a State Significant Site within Schedule 3 of the Major Projects State Environmental Planning Policy. As such development approval for the project falls under the provisions of Part 4 of the *EP&A Act.*

The specific State Environmental Planning Policy which is relevant to remediation of the site is SEPP 55 (Remediation of Land), which requires that development consent is not granted unless contamination has been considered and, if required, remediated.

JBS&G understand that the project is being assessed under Part 4 of the EP&A Act, with consideration of remediation works, and the consent authority for the remediation works is the Director General of the NSW Department of Planning.

Specifically in relation to the subject site, SEPP 55 also requires that:

- The proposed remediation works are carried out in accordance with the DUAP (1998) and any guidelines in force under the *CLM Act*;
- The proposed remediation works are carried out in accordance with any development consent conditions; and
- Notice of completion is provided to the local council and the consent authority (Department of Planning) within 30 days of completion of the works, with the details required under Regulation 18 of SEPP 55.

Environment Planning and Assessment Regulation 2000 – Schedule 3 Designated Development

The proposed remediation works do not constitute designated development.

Protection of the Environment Operations Act 1997

The proposed remediation/validation activities are not considered required to be licensed under the *Protection of the Environment Operation Act 1997*.

Water Management Act 2000

Should dewatering be required, a dewatering and potentially a re-injection approval will be required from the NSW Department of Primary Industry - Water (DPI-Water) for any dewatering proposed with site remediation works. The approval will require to be obtained prior to the undertaking of any groundwater dewatering and treatment. At this stage, short term dewatering is not anticipated as developments plans do not include subsurface basements.

Protection of the Environment Operations (Waste) Regulation 2014

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works will not require to be licensed. Section 48 of the Reg. requires that wastes are stored in an environmentally safe manner. It is also stipulates that vehicles used to transport waste must be covered when loaded. This regulation also details additional tracking requirements for vehicles carrying Special (Asbestos) waste.

Provision is provided in the Regulation and EPA (2014) guidelines for the NSW EPA to approve the immobilisation of contaminants in waste (if required).

Waste Classification Guidelines (EPA 2014a[25])

All wastes generated and proposed to be disposed off-site shall be assessed, classified and managed in accordance with this guideline. Where wastes require immobilisation prior to off-site disposal (to reduce waste classifications) an immobilisation approval shall be sought in accordance with Part 2 of this guideline. Immobilisations are only anticipated to be required with unexpected finds.

City of Sydney (2004) 'Contaminated Land Development Control Plan'

The Council DCP provides a number of environmental and site management provisions required to be employed during remediation works. While consent conditions from Director General of the NSW

[25] *Waste Classification Guidelines – Part 1: Classifying Waste*. NSW EPA 2014 (EPA 2014a)

Department of Planning as part of the SSDA will supersede these, the Council DCP may be adopted as minimum standards for the environmental management of remediation works and requirements of on-going environmental management plans, subject to consent conditions.

7.6 Remediation Scope of Works

It is envisaged that remedial and validation works will be conducted as a staged process as required for site development. Within each proposed stage (**Appendix A**), remediation works will comprise, where appropriate, the following actions.

7.6.1 Site Establishment

For each stage of remediation works the site boundary will be defined and secured as appropriate to ensure that all safety and environmental controls are implemented, including necessary contractor briefings and inductions for the remediation workforce. A summary of the controls are provided in **Sections 9** and **10**.

7.6.2 Capping and Cover of Onsite Retained Fill/Soil

Developable Lots

The principal of the onsite management approach is to retain materials in situ, provide physical separation between impacted fill/soil materials and receptors (e.g. site users or flora) to prevent direct contact via capping or cover by buildings and pavement, and implementation of a LTEMP to maintain the capping/cover. Since no significant volatile contamination has been identified, control of vapours intrusion is not required. Within Developable Lots, physical separation will largely be provided by the concrete floor/foundation of the proposed buildings and pavement.

Requirements for physical separation of impacted fill material are based upon ANZECC (1999). With consideration to the primary COPC in impacted fill materials, containment by physical covering in conjunction with appropriate control measures is considered appropriate.

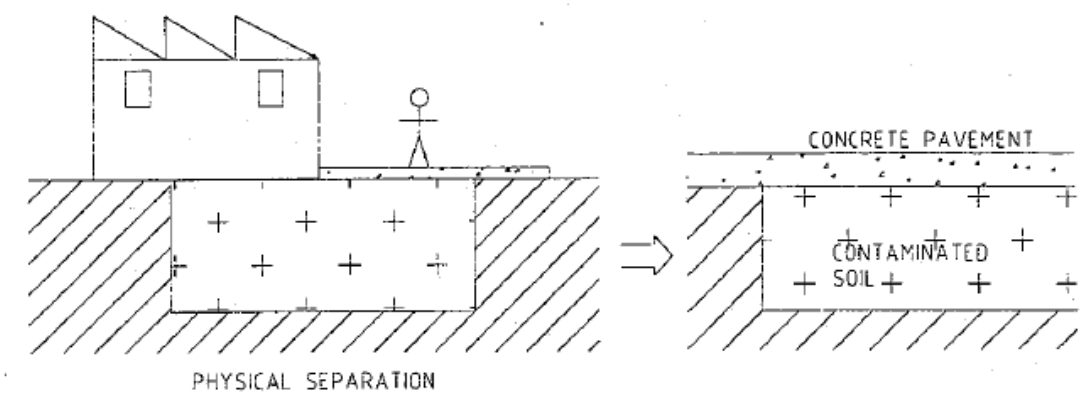
Based on fill/soil physical properties, analytical results (**Appendix D**) and the findings of JBS&G (2016a and 2016b), contaminates generally fall within Groups 1, 2 and 10, as listed in Table 1 (ANZECC, 1999). For these contaminant groups, inhalation of vapours is not a primary exposure. Therefore, implementation of a 'cap and contain' strategy as indicated in ANZECC (1999), in conjunction with appropriate control measures, is appropriate with respect to management of the health risk.

Furthermore, based on fill/soil physical properties, analytical results (**Appendix B** and **D**) and the findings of JBS&G (2016b), water exclusion and isolation using bottom lining as listed in Table 2 (ANZECC, 1999) is not considered necessary.

The minimum typical requirements for physical separation include:

- Permanent concrete floor slab or asphalt surfaced pavement. The pavement outside of the building footprint shall be underlain by a marker layer; or
- A thickness of soil that is unlikely to be penetrated by future users of the site. A minimum soil cover thickness of 0.5m is nominated as underlain by a layer of 'marker layer' in areas of exposed site soil (i.e. landscaped beds).

As shown schematically below:



Source: ANZECC (1999)

Given the specific development plans as understood at the time of preparation of the RAP, the following capping and cover procedures within Developable Lots are to be implemented:

- Cover of fill materials by buildings – installation of a marker layer overlying potentially contaminated material to denote the extent of retained fill. The concrete floor slab shall act as a physical barrier. Buildings will cover the majority of the Developable Lot areas;
- Cover of fill materials by permanent paved areas beyond building footprints – installation of a marker layer overlying potentially contaminated material followed by sub-grade material validated as environmentally suitable materials for human exposure (where required) and then the permanent pavement (i.e. concrete, asphalt, pavers, etc.);
- Capping of fill materials in landscaped areas – installation of the marker layer at a minimum depth of 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), or a minimum of 1.5 m below final finished site levels in areas of tree planting, with environmentally suitable materials placed above to the final levels; and
- Within underground services trenches – in the event underground services trenches are to be installed, the service infrastructure will require to be installed above a marker layer within suitable materials for potential human and/or ecological exposure.

The marker layer, where required, shall consist of a light coloured knitted HDPE or similar with a density of greater than 248 grams per square metre (or equivalent). The specific details of the marker layer will require to be included in the site validation report and LTEMP documents in addition to plans showing the extent of capped area within the site.

As per the requirements of the HHRA and ERA, material above the marker layer extending to the final finished ground level will be required to be environmentally suitable material for human and/or ecological exposure (as appropriate). These capping materials shall generally comprise growing media, but may potentially comprise material originating from within the site validated as suitable for reuse in accordance the requirements outlined in **Sections 8.1.7** and **8**; imported virgin excavated natural material (VENM) or material certified in accordance with an exemption issued by the NSW EPA. Where materials are proposed for beneficial reuse under a NSW EPA exemption (i.e. imported to the site), fill material will need to be further assessed for land use suitability. Sampling densities and analysis for COPC will be dependent on the volume, material type, source and subject to Site Auditor endorsement and acceptance along with meeting the facilities EPL.

<u>Public Domain Area and the Locomotive Workshop</u>

Given the specific development plans as understood at the time of preparation of the RAP, the following capping and cover procedures within public domain areas and the Locomotive Workshop are to be implemented:

- Existing cover and capping arrangements as documented in ES (2015a) and the DP EMP are required to be maintained or reinstated following improvements and/or extension and augmentation of physical infrastructure/utilities within Lots 10 and 4007. No marker layer is required to be installed given the broader area is not underlain by a marker layer. Where new services are to be installed, to reduce the risk to future maintenance workers, backfill shall comprise validated environmentally suitable materials, as per the requirements of the HHRA (JBS&G 2016a) and ERA (JBS&G 2016b). In addition, material used to backfill services is required to be environmentally suitable material for human and/or ecological exposure (as appropriate) and meet the requirements of WorkSafe Australia and National Health and Medical Research Council guidance/legislation in relation to occupation hygiene exposure.
- New landscaped areas – where new landscaped areas are proposed a minimum depth of 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), or a minimum of 1.5 m below final finished site levels in areas of tree planting. As per the requirements of the HHRA (JBS&G 2016a) and ERA (JBS&G 2016b), material used to backfill is required to be environmentally suitable material for human and/or ecological exposure (as appropriate).

Works within Lot 4007 are required to be undertaken in accordance with procedures documented in ES (2015a) or a subsequent revised EMP approved by the Site Auditor and additional requirements outlined in this RAP.

Works within Lot 10 are required to be undertaken in accordance with procedures documented in DP EMP or a subsequent revised EMP approved by the Site Auditor and the additional requirements outlined in this RAP.

Given the heritage status of the Locomotive Workshop, and with consideration of the requirements of ANZECC (1999), a concrete slab is considered suitable as a cover. No marker layer is required.

Where materials are proposed for beneficial reuse under a NSW EPA exemption (i.e. imported to the site), fill material will need to be further assessed for land use suitability. Sampling densities and analysis for COPC will be dependent on the volume, material type, source and subject to Site Auditor endorsement and acceptance along with meeting the facilities EPL.

7.6.3 Off-Site Removal of Impacted Materials

Where contaminated fill/soil is not suitable for onsite management or is surplus to construction requirements, materials are proposed to be remediated by off-site removal and disposal. Materials shall be classified in accordance with EPA (2014) *Waste Classification Guidelines* or an appropriate exemption as created under the *Protection of the Environment Operations (Waste) Regulation 2014*.

Given the identification of ash and slag inclusions in fill material samples with elevated total PAH and metal concentrations, the ash and slag inclusions are concluded to be a significant source of these contaminants. On this basis, it is appropriate to apply the associated NSW EPA general immobilisation approvals (EPA 1999 and EPA 2009) when consideration is given to evaluating a waste classification(s) for material required to be excavated during the remedial works.

Material will require to be removed to a facility lawfully able to receive it.

7.6.4 Asbestos Management

As discussed in the HHRA (JBS&G 2016), asbestos contaminated is not widespread, however, friable forms have been detected and the presence of asbestos contamination in any particular area cannot be precluded on the basis of the available information. As such, asbestos clearance procedures should be developed and implemented where ground disturbance is proposed.

Asbestos contaminated soil necessitating management for potential asbestos exposure is defined in *How to Manage and Control Asbestos in the Workplace Code of Practice*, December 2011, Safe Work

Australia/ NSW WorkCover (SWA 2011/NSW WorkCover 2011). Environmental, health and safety management requirements for the handling of these materials will be based on the requirements provided for asbestos-related works in SWA 2011/NSW WorkCover 2011. This will include preparation of an asbestos register and associated asbestos removal control/management plan as outlined in SWA 2011/NSW WorkCover 2011.

From a land use suitability, the potential for asbestos will be managed via means of cap/cover through the establishment and maintenance of physical barriers.

7.6.5 Materials Tracking

Movement of materials will be required at the site and shall be moved as per a material tracking plan as documented following. The tracking system is designed to track the quantity and quality of materials from their arrival on site or their derivation point, through temporary storage to placement.

The system comprises the following elements;

- Definition of Roles and Responsibilities;
- Material quality information;
- Material movement tracking;
- Material emplacement;
- Documentation required;
- Dealing with non-conformance; and
- Dealing with expected and unexpected finds

7.6.5.1 Roles and Responsibility

The Principal Contractor will be responsible for the following:

- Implementation and overall management of onsite procedures and protocols defined in the RAP document.
- Responsible for ensuring all subcontractors and consultants employed in reuse material classification generation, movement and placement are adequately briefed in the requirements of the RAP.
- Will take ultimate responsibility for the movement and placement of materials intended for reuse.
- Will ensure clear lines of communication are maintained between all relevant responsible parties.
- Will be responsible for liaison with suppliers in sourcing of materials from offsite, whether imported VENM or material under a NSW EPA exemption.
- Responsible for ensuring the RAP is operated effectively in conjunction with other relevant documents and in line with the overarching Health, Safety and Environmental Plan, Asbestos Management Plan to be developed for the site works.

JBS&G will be responsible for the following:

- Undertaking sampling and characterisation works of materials, as required, for potential beneficial reuse, as per the requirements of the RAP.
- Responsible for identification of the AF/FA impacted materials.

- Liaise with the Principal Contractor with regards to the importation of materials which does not meet the definition of VENM to ensure materials meet the project requirements and to prevent unsuitable materials being inadvertently brought onto the site, such that the site cannot be validated as suitable for proposed permissible uses.
- Undertake inspections when material importation works are being undertaken to confirm materials sampled are consistent with those being imported.
- Review materials tracking documents submitted by the Principal Contractor and investigate/resolve any discrepancies.
- Cross check inspection findings with materials tracking sheets.
- Provide directives (decisions) relating to a proposed and/or placed fill materials suitability.

7.6.5.2 Material Tracking

The movement of classified materials within the site will be controlled by an appropriately managed Materials Tracking System, as discussed below.

In order to minimize double handling on the site, improve cost effectiveness and reduce environmental impacts, every effort should be made to facilitate the movement of excavated or imported material directly to the area of placement.

It is, however, recognized that this objective may not always be practical and hence the following range of potential material movements is anticipated:

- Stockpile to Placement;
- Import to Emplacement;
- Import to Stockpile;
- Stockpile to Stockpile; and
- Offsite disposal.

7.6.5.3 Materials Characterisation Form

All material movements within the site will be controlled using Materials Classification Forms (MCF) and Material Tracking Sheets (MTS).

Each MCF outlines procedures for confirming material quality, quantity and summarising existing analytical data. The MCF will be completed by the Principal Contractor and/or the Civil Works Contractor and will include the following:

- A unique MCF document name/number;
- A summary of VENM/ENM reports prepared JBS&G;
- Materials description; and
- Material reuse suitability summary.

Each MCF will be completed and signed off by the Principal Contractor/Civil Works Contractor based on material characterisation reports prepared by JBS&G. Once completed, the MCF will be incorporation into the Principal Contractors materials tracking system prior to placement within the Developable Site.

An example of the MCF is presented in **Appendix E**.

7.6.5.4 Materials Tracking Sheet

The MTS is a two part document which requires information to be collected at the material source location and at one of the three potential destination sites. An example of the MTS is presented in **Appendix F**.

All MTSs will be uniquely referenced and stored as a record of material movements.

This first part (Part A) of the document will record the following data:

i. Time and date;

ii. Truck registration or plant identification;

iii. Load quantity; and

iv. MCF reference name/number. The MCF will provide details on items such as a source location reference, visual/olfactory observations, materials classification/reuse zone suitability summary.

The document will also be used for materials required for onsite placement or temporary stored prior to placement and will be completed at the point of unloading. The sheet will record the following details:

- Items i, ii, iii, as above;
- Visual and olfactory observations; and
- Zone of emplacement.

The final portion of the sheet (Part B) will be completed for materials which cannot be used within the site and are scheduled for off-site disposal in accordance with EPA (2014).

Items I, ii, iii and iv above will be recorded initially. The name of the haulage company responsible for transferring the material to the tip site and the details of the receiving site must also be recorded. Prior to leaving the site, the material should have undergone a waste classification in accordance with EPA (2014) and confirmation of this should be acknowledged on the sheet.

Finally, a note should be made of the consignment note number or receipt identification obtained.

The MTS will be reviewed and signed off as completed by the Principal Contractor and or Civil Works Contractor.

7.6.5.5 Material Placement

Zones (grid references) of material placement will be accurately surveyed. This will allow the interrogation of the data set to ensure reuse material loads have been correctly deposited and a record kept of cumulative loads deposited in any particular zone.

8. Validation Plan

8.1 Overview

Validation data is required to be collected to verify the effectiveness of the remedial works and document the final site conditions as being suitable for the proposed future use(s).

The following sections establish the Data Quality Objectives (DQOs) to be adopted during validation of the site remediation works.

8.1.1 Data Quality Objectives

8.1.1.1 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 involves 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 site assessment activities have identified the presence of impacted fill material which will require remediation/management for the site to be considered suitable for the proposed uses. The proposed remediation strategy for the site includes cap/cover or off-site disposal, and implementation/revision of a LTEMP.

Works undertaken within public domains are require to be undertaken in accordance with procedures documented in ES (2015a)/DP EMP and requirements of this RAP.

During the proposed remediation activities, sufficient validation documentation of the site activities is required to demonstrate that the identified environmental and health based risks to future use(s) of the site have been adequately managed to render the site suitable for the proposed land use.

8.1.2 Identify the Decision

The following decisions are required to be addressed during validation:

<u>Developable Lots</u>

- Have cover/capping layers been installed appropriately and in accordance with the RAP requirements?
- Are accessible soils environmentally suitable?
- Are imported soils (where required) environmentally suitable for their proposed use?
- Have the site remediation activities been undertaken in compliance with the regulatory requirements?
- Is the site (Developable Lots) suitable for the proposed use?

<u>Public Domain Areas and the Locomotive Workshop</u>

- With regards to newly establish landscaped areas, have cover/capping layers been installed appropriately and in accordance with the RAP requirements?
- Are accessible soils environmentally suitable?
- Are imported soils (where required) environmentally suitable for their proposed use?

- Have sub-slab vapour assessment activities underlying the Locomotive Workshop been undertaken in accordance with the requirements of ES (2015a) and the HHRA (JBS&G 2016a)?
- Have works within public domains been undertaken in accordance with ES (2015a)/DP EMP?
- Have the site remediation activities been undertaken in compliance with the regulatory requirements?
- Is the site (Public Domain Areas and the Locomotive Workshop) suitable for the proposed use?

8.1.3 Identify Inputs to the Decision?

Inputs to the decisions are:

- Detailed development plans to be provided by Mirvac appropriate to identify;
  - Building design details;
  - Areas of accessible soils; and
  - Areas of plantings.

  Design plans and landscape plans are provided in **Appendix A**.
- Analytical data collected as part of the ongoing ambient air monitoring/EMP requirements;
- Field observations in relation to inspection of stockpiled materials, excavations bases and walls for odours, sheen, discolouration and other indicators of potential contamination;
- Waste classification and/or material characterisation data obtained during assessment of fill material;
- Disposal dockets and relevant documents in relation to appropriate disposal of materials;
- Survey data as to the extent and thickness of capping materials and extent environmentally impacted materials; and
- Data quality indicators as assessed by quality assurance/quality control (QA/QC).

8.1.4 Define the Study Boundaries

The study boundaries of the site are as follows:

- The lateral extent of the works relevant to this RAP as presented in **Figure 2** and **Table 3.1;**
- The vertical extent of the works is defined as the depths required to implement appropriate capping, as schematically shown in **Figures 9A** to **9D**.

Validation works will be completed with development timelines to be informed by Mirvac.

It is noted that the validation works may be undertaken in stages as a result of construction sequencing, landscaping activities, etc. Where this occurs, then the validation will be similarly undertaken in stages, and the validation survey shall clearly define the extent of staged validation completed at the time of each validation assessment.

8.1.5 Develop a Decision Rule

Decision rules are provided following for each of the environmental issues anticipated on the site.

Developable Lots

Have marking and capping layers been installed appropriately and in accordance with RAP requirements?

The marker and capping layers must be installed across the extent of the remedial area, as graphically shown in **Figures 9A** to **9C.** The marker layer must be installed to the RAP requirements, as well as the manufacturer's installation requirements. The vertical and lateral extents of the marker layer should be surveyed (**Section 8.1.7**), along with consistent and comprehensive photographic evidence.

Where soil based material is to be used as a capping layer, placed above the marker layer and readily accessible to human users, this material is required to be validated as meeting the health and ecological validation requirements for the site in addition to aesthetic requirements.

All imported materials to be used as the capping layer must be environmentally suitable, as defined below. As per the requirements of the ERA (2016b), growing media should have levels of constituents consistent with ecological protection criteria for 'urban residential and public open space' as provided to NEPC (2013), and levels of aldrin, dieldrin and PCBs below laboratory detection limits.

Capping arrangements are discussed in **Section 7.4.2**.

Are imported soils environmentally suitable for their proposed use?

Material used for capping above the marker layer shall be validated:

- Growing media: Material to be used as growing media in landscaped areas of the site, whether sourced from on-site or imported from off-site will require to meet the health based assessment criteria suitable for the appropriate land use in **Section 8** in addition to:
    - Aesthetics requirements;
    - Growing media should have levels of constituents consistent with ecological protection criteria for 'urban residential and public open space' as provided to NEPC (2013), and levels of aldrin, dieldrin and PCBs below laboratory detection limits; and
    - Growing media capping in such areas shall comprise installation of the marker layer at a minimum depth of 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), or a minimum of 1.5 m but not more than 2 m below final finished site levels in areas of tree planting.
- VENM: VENM shall be as defined under the Protection of the Environment Operations (POEO) Act 1997.
- Site Materials: Where site fill/soil based material is to be used as capping placed above the marker layer and readily accessible by human users, this material is required to be validated as meeting the health/ecological validation requirements for the site in addition to aesthetic validation requirements. Material sourced from within the site proposed to be reused as cover/capping will be required to meet land use exposure criteria presented in Section 8 as appropriate for the relevant end land use.

Where a valid data set can be generated as based on a consideration of the location of soils on the site and the potential exposure scenarios, the following statistical criteria will apply:

- The 95 % UCL avg concentrations shall be below the soil criteria;

- The standard deviation of the generated data set shall be below 50 % of the soil criteria; and
- The maximum concentration shall be below 250 % of the soil criteria.

Existing data for chemical constituents (not asbestos) shall be included in analytical data sets created for the soils.

Waste Classification or Exemptions

Excess soils requiring off-site disposal are required to be classified in accordance with EPA (2014). Soils may also be classified as 'excavated natural material' as per sampling and analysis undertaken in accordance with the excavated natural material exemption 2012 (ENM exemption) or as other exempt material as via successful implementation of an alternative applicable exemption. Existing data for chemical constituents (not asbestos) shall be included in analytical data sets created for the soils.

Are there any outstanding regulatory compliance issues associated with site remediation activities?

A qualitative assessment of the completed works in relation to EPA, DWE, WorkCover, Department of Planning, etc. approvals will be undertaken during and following the completion of remediation activities.

Locomotive Workshop and Public Domain Areas

Have marking and capping layers been installed appropriately and in accordance with RAP requirements?

As the broader area is not underlain by a marker layer, application of a marker layer to denote the extent of rained fill is not proposed in areas of public domain improvements and extension and augmentation of physical infrastructure.

As discussed in **Section 7.6.2** (capping arrangements), existing cover/capping arrangements as documented in ES (2015a) and the DP EMP are required to be maintained or reinstated following improvements and/or extension and augmentation of physical infrastructure/utilities within Lots 10 and 4007. Based on the results of the HHRA (JBS&G 2016a), fill materials are considered suitable to backfill services provided ongoing management under an EMP.

New landscaped areas. Where new landscaped areas are proposed a minimum depth of 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), or a minimum of 1.5 m below final finished site levels in areas of tree planting. As per the requirements of the ERA (JBS&G 2016b), material used to backfill is required to be environmentally suitable material for human and/or ecological exposure (as appropriate). The vertical and lateral extents of the capping profile are required to be surveyed (**Section 8.1.7**), along with consistent and comprehensive photographic evidence.

Are imported soils environmentally suitable for their proposed use?

Material used for capping above shall be validated:

- Growing media: Material to be used as growing media in landscaped areas of the site, whether sourced from on-site or imported from off-site will require to meet the health based assessment criteria suitable for the appropriate land use in **Section 8.5** in addition to:
    - Aesthetics requirements;
    - Growing media should have levels of constituents consistent with ecological protection criteria for 'urban residential and public open space' as provided to NEPC (2013), and levels of aldrin, dieldrin and PCBs below laboratory detection limits; and
    - Growing media capping in such areas shall comprise a minimum depth of 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), or a

minimum of 1.5 m but not more than 2 m below final finished site levels in areas of tree planting.

- VENM: VENM shall be as defined under the Protection of the Environment Operations (POEO) Act 1997.
- Site Materials: Where site fill/soil based material is to be used as capping placed above the marker layer and readily accessible by human users, this material is required to be validated as meeting the health/ecological validation requirements for the site in addition to aesthetic validation requirements. Material sourced from within the site proposed to be reused as cover/capping will be required to meet land use exposure criteria presented in **Section 8.5** as appropriate for the relevant end land use. All materials are required to be compliant with current WH&S guidance and legislation.

Where a valid data set can be generated as based on a consideration of the location of soils on the site and the potential exposure scenarios, the following statistical criteria will apply:

- The 95 % UCL avg concentrations shall be below the soil criteria;
- The standard deviation of the generated data set shall be below 50 % of the soil criteria; and
- The maximum concentration shall be below 250 % of the soil criteria.

Existing data for chemical constituents (not asbestos) shall be included in analytical data sets created for the soils.

Waste Classification or Exemptions

Excess soils requiring off-site disposal are required to be classified in accordance with EPA (2014). Soils may also be classified as 'excavated natural material' as per sampling and analysis undertaken in accordance with the excavated natural material exemption 2012 (ENM exemption) or as other exempt material as via successful implementation of an alternative applicable exemption. Existing data for chemical constituents (not asbestos) shall be included in analytical data sets created for the

Ambient Air Monitoring

As per the requirements of the HHRA (JBS&G 2016a) and EMP (ES 2015a), air monitoring should continue until such time that the sub-slab to indoor air attenuation being observed can be explained empirically by establishing an adequately representative vapour intrusion model based upon site specific data (e.g. establishment of variation in relation to representative sub-slab and indoor air concentrations, foundation thickness, mixing space volume, air exchange rate etc.).

Are there any outstanding regulatory compliance issues associated with site remediation activities?

A qualitative assessment of the completed works in relation to EPA, DWE, WorkCover, Department of Planning, etc. approvals will be undertaken during and following the completion of remediation activities.

8.1.6 Specific Limits of Decision Error

This step is to define, in statistical terms, the decision-makers acceptable error rates based on the consequences of making an incorrect decision. Two types of decision error are defined in AS4482.1-2005 'Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds':

(a) Deciding that the site is acceptable when it actually is not; and

(b) Deciding that the site is unacceptable when it is.

AS4482.1-2005 nominates setting limits of 5% probability of (a) type errors and 20% probability of (b) type errors. These limits are in general accordance with suggested limits as outlined in US EPA

(July 1994) 'Using the Data Quality Objectives Process in Risk Assessment'. While the methodology for determining whether the number of samples collected is sufficient to satisfy these limit is appropriate for site investigation it is generally not appropriate for site validation or remediation works. Where impact is present in the materials on the site that requires remediation then application of the limits is not relevant and therefore a qualitative assessment shall be undertaken of potential decision errors associated with the data.

8.1.7 Optimise the Design for Obtaining Data

The validation sampling design is summarised for each specific type of validation works as follows.

8.1.7.1 Sub-slab Vapour – Locomotive Workshop

As discussed above, elevated sub-slab soil vapour TCE concentrations have been reported underlying 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. As per the requirements of the HHRA (JBS&G 2016a) and EMP (ES 2015a), ongoing monitoring is required.

The air monitoring should continue until such time that the sub-slab to indoor air attenuation being observed can be explained empirically by establishing an adequately representative vapour intrusion model based upon site specific data (e.g. establishment of variation in relation to representative sub-slab and indoor air concentrations, foundation thickness, mixing space volume, air exchange rate etc.).

Should monitoring identify a potential human health risk, then procedures in the Contingency Plan (**Section 9.3**) should be applied.

The current capping arrangements are required to be maintained.

8.1.7.2 Installation of the Physical Barrier (cap/cover)

Installation of cover/capping in Developable Lots shall be defined by survey as completed by a registered surveyor and/or building as-built drawings sufficient to identify:

- The lateral extent and upper depth height of known environmentally impacted materials (i.e. residual fill materials underlying the cover) within each remediation area/stage;
- The lateral extent and type of cover (e.g. building or permanent pavement) within the remediation area/stage; and
- Confirmation, by photos or otherwise, of the installation of the 'marker layer' underlying the cover (as required).

In preparing the final survey, it is noted that alternate contractors may undertake site preparation and services installation activities during proposed development works. To this effect, validation of the cover installation may be undertaken in stages.

Capping requirements (i.e. thickness etc.) are detailed in **Section 7.6.2**.

<u>Growing Media</u>

Site sourced fill or soil material to be used as growing media within Developable Lots shall be sampled at a rate of at least one sample per 70 m^3 with a minimum of three samples per source/end location. Where small material quantities are being assessed (i.e. < 400 m^3), consideration of whether the data set is sufficiently robust with respect to the assessed material will be required to be documented in the validation report. Alternatively, the rate of sample analysis may require to be increased to provide sufficient data.

Site sourced fill samples shall be analysed for TRH, PAHs, heavy metals, (including As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), asbestos and soil

pH in combination with consideration of the source location and material inspection. In addition, assessment of the potential presence of aesthetic issues, including staining, discolouration and/or odorous soil conditions will be completed.

Site sourced natural soils shall be analysed for TRH and PAHs. In addition, assessment of the potential presence of aesthetic issues, including staining, discolouration and/or odorous soil conditions will be completed.

Imported material to be used as growing media/capping material shall be assessed on a batch basis, with a minimum of ten samples collected for each specific supplier's product. Samples shall be analysed for TRH, PAHs, heavy metals, (including As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), OCPs, PCBs, asbestos and soil pH. The materials shall be further inspected for any aesthetic indicators of contamination.

VENM

VENM shall be as defined under the *Protection of the Environment Operations (POEO) Act 1997* and characterised by at least five samples per source site and 1 per 1,000 m^3 being collected if more than 10,000 m^3. Visual inspection is required.

Site Materials

Site sourced materials shall be characterised as per Growing Media (above).

8.2 Soil Sampling Methodology

The soil sampling method shall be determined by the Field Scientist as consistent with the observations of the site sub-surface and appropriate to generate representative samples. The soil sampling method shall be consistent with the data quality indicators in **Section 8.4**.

Where sample locations are placed by boreholes, undisturbed samples, as collected by push tube or SPT sampler, are preferred where able to be effectively implemented. Otherwise samples may be recovered from solid flight augers or via test pitting. Re-usable equipment shall require to be decontaminated between sampling locations.

8.2.1 Soil Sample Containers

During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination shall be noted on field reporting sheets/field logs.

Collected soil samples shall be immediately transferred to sample containers of appropriate composition (glass jars) fitted with Teflon sealed lids. 500 mL samples shall be additionally collected and placed in new zip lock bags where asbestos analysis is required. Sample labels shall record sample identification number and date and time of sampling. Sample containers shall be transferred to a chilled ice box for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form shall be completed and forwarded with the samples to the testing laboratory, containing the following information:

- Sample identification;
- Signature of sampler;
- Date of collection;
- Type of sample;
- Number and type of container;
- Inclusive dates of possession; and
- Signature of receiver.

8.2.2 PID Screening

Soil samples will be screened during field works using a photo-ionisation detector (PID) to assess the potential presence of VOCs including petroleum hydrocarbons. Samples obtained for PID screening will be placed in a sealed plastic bag for approximately 5 minutes to equilibrate, prior to a PID being attached to the bag. Readings will then monitored for a period of approximately 30 seconds or until values stabilise and the stabilise/highest reading will be recorded on the field sample forms. The PID will be calibrated prior to the commencement of field works and then check readings will be completed on a daily basis during the field program using suitable calibration gas. If required, the PID will be re-calibrated during the field program in accordance with manufacturer's instructions.

8.3 Laboratory Analysis

NATA accredited laboratories shall be used for all analysis of samples. Appropriate methods and limits of reporting (LORs) are required for comparison to relevant criteria.

Laboratory methods and LOR as summarised in **Table 8.1** are proposed to be adopted for analysis of soil samples collected during remediation/validation activities.

Table 8.1: Soil Laboratory Analysis Methods (all units in mg/kg unless stated)

Analyte	Limit of Reporting	Laboratory Method
METALS		
Arsenic	4.0	ICP-AES (USEPA 200.7)
Cadmium	1.0	ICP-AES (USEPA 200.7)
Chromium (total)	1.0	ICP-AES (USEPA 200.7)
Chromium (VI)	1.0	Alkali leach colorimetric (APHA3500-Cr/USEAP3060A)
Copper	1.0	ICP-AES (USEPA 200.7)
Lead	1.0	ICP-AES (USEPA 200.7)
Nickel	1.0	ICP-AES (USEPA 200.7)
Zinc	1.0	ICP-AES (USEPA 200.7)
Mercury (inorganic)	0.1	ICP-AES (USEPA 200.7)
TRH		
C6 – C9 Fraction	25	Purge Trap-GCMS (USEPA8260)
C10 – C36 Fraction	250	Purge Trap-GCFID (USEPA8000)
BTEX		
Benzene	1.0	Purge Trap-GCMS (USEPA8260)
Toluene	1.0	Purge Trap-GCMS (USEPA8260)
Ethylbenzene	1.0	Purge Trap-GCMS (USEPA8260)
Total Xylenes	3.0	Purge Trap-GCMS (USEPA8260)
PAH		
Benzo(a)pyrene	0.05	GCMS (USEPA8270)
Total PAHs	1.55	GCMS (USEPA8270)
PCBs		
PCBs (total)	0.9	GCECD (USEPA8140,8080)
OCP/OPP		
Aldrin + Dieldrin	0.2	GCECD (USEPA8140,8080)
Chlordane	0.1	GCECD (USEPA8140,8080)
DDT + DDD + DDE	0.3	GCECD (USEPA8140,8080)
Heptachlor	0.1	GCECD (USEPA8140,8080)
PHENOLS		
Total Phenols	5	Distillation-Colorimetric (APHA 5530)
VOC		
PCE	1.0	Purge Trap-GCMS (USEPA8260)
TCE	1.0	Purge Trap-GCMS (USEPA8260)
Cis 1,2 DCE	1.0	Purge Trap-GCMS (USEPA8260)
Trans 1,2 DCE	1.0	Purge Trap-GCMS (USEPA8260)
VC	1.0	Purge Trap-GCMS (USEPA8260)
OTHER		
Asbestos	Presence/ 0.1 g/kg	PLM / Dispersion Staining as per AS4964:2004
Soil pH	0.1	5:1 leach

8.4 Quality Assurance/Quality Control

The pre-determined Data Quality Indicators (DQIs) established for the project are discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parameters), and are shown in **Table 8.2**.

- Precision - measures the reproducibility of measurements under a given set of conditions. The precision of the data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD)[26] of duplicate samples.

[26] $RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$

Where C0 is the analyte concentration of the original sample. Cd is the analyte concentration of the duplicate sample

- Accuracy - measures the bias in a measurement system. The accuracy of the laboratory data that is generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.
- Representativeness –expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.
- Comparability - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- Completeness – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.

Table 8.2: Summary of Quality Assurance / Quality Control Program

Data Quality Objective	Frequency	Data Quality Indicator
Precision		
Blind duplicates	1 / 20 samples	<50% RPD[1]
Split duplicates	1 / 20 samples	<50% RPD[1]
Trip blank	1 / media / day	<LOR
Rinsate blank	1 / media / day	<LOR
Trip spike	1 / media / day	70-130%
Accuracy		
Surrogate spikes	All organic samples	70-130%[2]
Matrix spikes	1 per lab batch or 20 samples	70-130%[2]
Laboratory control samples	1 per lab batch or 20 samples	70-130%[2]
Representativeness		
Sampling appropriate for media and analytes		-
Laboratory blanks	1 per lab batch	<LOR
Samples extracted and analysed within holding times.	-	Soils: 7 days for VOCs/pH, 14 days for all other analytes.
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All samples
Standard analytical methods used for all analyses	All Samples	All samples
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples
Limits of reporting appropriate and consistent	All Samples	All samples
Completeness		
Soil description and COCs completed and appropriate	All Samples	- All samples
Appropriate documentation	All Samples	- All samples
Satisfactory frequency and result for QC samples	All QA/QC samples	-
Data from critical samples is considered valid	-	Critical samples valid

[1]If the RPD between duplicates is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

[2]Lower recoveries may be recorded for some semi-volatile organic analyses particularly including phenols.

8.5 Validation Criteria

8.5.1 Soil Criteria

Based on the proposed development/adaptive reuse details, in accordance with the decision process for assessment of urban redevelopment sites (DEC 2006), and with consideration of JBS&G (2016a and 2016b), concentrations of contaminants in media shall be compared against adopted criteria as presented in **Tables 8.3** and **8.4**, sourced from the following:

Lots 8 and 9

Lots 8 and 9 are proposed to be developed to accommodate commercial land uses potentially including childcare facilities (or similar). As such, land use criteria for a childcare centre has been adopted.

- Criteria established in the HHRA (JBS&G 2016a);
- Health based Investigation Levels (HILs) for residential with access to soils land use NEPC (2013) - HIL-A;
- Health Screening Levels (HSLs) for petroleum hydrocarbons considering potential for vapour intrusion, coarse grained soil for low-high density residential (HSL A & B) land use at 0.0-1.0 m depth (NEPC 2013);
- As a conservative measure, generic and site specific ecological investigation levels (EILs) were derived through the added contaminant limits;
- Management Limits for TRH, coarse grained soils for residential land use – NEPC (2013);
- Ecological Screening Levels (ESLs) for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for residential land use (NEPC 2013); and
- Where there are no NSW EPA endorsed thresholds the laboratory LOR has been adopted as an initial screening value for the purposes of this assessment.

Recreation Land Uses (Oval and Public Open Spaces)

The following criteria is to be adopted for areas of recreational land use.

- Criteria established in the HHRA (JBS&G 2016a);
- HILs for recreational land use NEPC (2013) - HIL-C;
- HSLs for petroleum hydrocarbons considering potential for vapour intrusion, coarse grained soil for recreational (HSL-C) land use at 0.0-1.0 m depth (NEPC 2013);
- As a conservative measure, generic and site specific EILs were derived through the added contaminant limits;
- Management Limits for TRH, coarse grained soils for recreational land use – NEPC (2013);
- ESLs for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for recreational land use (NEPC 2013); and
- Where there are no NSW EPA endorsed thresholds the laboratory LOR has been adopted as an initial screening value for the purposes of this assessment.

Lot 12, Locomotive Work Shop and Pedestrian/Road Easements (Lots 4000 and 4007)

Lot 12, Lot 4007 and the Locomotive Workshop (Lot 4000) are proposed commercial uses excluding childcare facilities.

- Criteria established in the HHRA (JBS&G 2016a);
- HILs for commercial land use NEPC (2013) - HIL-D;
- HSLs for petroleum hydrocarbons considering potential for vapour intrusion, coarse grained soil for commercial (HSLD) land use at 0.0-1.0 m depth (NEPC 2013);
- As a conservative measure, generic and site specific EILs were derived through the added contaminant limits;
- Management Limits for TRH, coarse grained soils for commercial land use – NEPC (2013);
- ESLs for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for commercial land use (NEPC 2013); and
- Where there are no NSW EPA endorsed thresholds the laboratory limit of reporting (LOR) has been adopted as an initial screening value for the purposes of this assessment.

Table 8.3 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	600	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	300	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 (surface soils)	-	No visible asbestos			-	-
Asbestos (top 0.5 m)	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]			-	-
Asbestos (below 0.5 m)	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 8.4 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

In addition, as per the requirements of the ERA (JBS&G 2016b), growing media should have levels of constituents consistent with ecological protection criteria for 'urban residential and public open space' as provided to NEPC (2013), and levels of aldrin, dieldrin and polychlorinated biphenyls (PCBs) below laboratory detection limits;

8.5.1.1 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 will be 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 will 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).

8.5.1.2 Material Characterisation for Off-site Disposal

Materials shall be classified in accordance with EPA (2014) Waste Classification Guidelines or an appropriate exemption as created under the Protection of the Environment Operations (Waste) Regulation 2014.

In addition, consideration was also be 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.

8.5.2 Vapour Screening Criteria

Concentrations in vapour samples will initially be compared against published levels as presented in **Tables 8.3** and **8.4** 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 8.5: 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 8.6: Vapour Sample Analytical Schedule (mg/m³) – HSL 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.

8.5.3 Water

Groundwater at the site has been comprehensively assessed and a HHRA (JBS&G 2016a) and ERA (JBS&G 2016b) have been completed that conclude there is no risk to future site users or the environment from groundwater (currently or in the future). As a result, no additional groundwater assessment or validation of groundwater is proposed.

Notwithstanding the aforementioned, the following is proposed:

- As discussed in **Section 7.4.1**, following construction of the borrow pit, a program of groundwater monitoring will be undertaken consistent with those historically reported, as documented in JBS&G (2015a). Existing or replacement groundwater monitoring wells will be the subject of groundwater sampling events at three monthly intervals for a period of 12 months. Following completion of the four groundwater monitoring events, a qualitative assessment of groundwater quality/conditions will be completed providing conclusions on the status of groundwater leaving Lot 12 and the site.

- As discussed in **Section 5.6.3**, additional investigations are proposed to be undertaken to address the uncertainty around the TCE/PCE contamination detected in soil vapour beneath the Locomotive Workshop and better addressing the lateral extent of PCE/TCE in soil vapour at concentrations exceeding adopted screening criteria (including to the south). The target depth for the soil vapour investigations will consider the likely depth of future building foundations, including those of Lot 12 being down gradient of the Locomotive Workshop. A risk assessment will subsequently be conducted on the basis of the additional data and specific redevelopment scenarios in order to ensure that risks posed by PCE/TCE in soil vapour are appropriately managed.

8.6 Reporting

8.6.1 Validation Report

A validation report(s) shall be prepared at the completion of the remediation works. This report shall:

- Update relevant portions of the site description and CSM as prepared in this RAP relevant to the validation assessment footprint;
- Present all sampling field notes and laboratory data including calibration certificates for field monitoring equipment, environmental monitoring etc.;
- Undertake an assessment of QA/QC of analytical data generated by the works and identify data that is reliable for use in characterising the applicable portion of the site;
- Sort data into data sets as required by the decision rules;
- Assess whether sufficient data has been obtained to meet required limits on decision error;
- Undertake assessment to the decision rules and identify any environmental data which causes decision rules to be failed;
- Provide a summary of waste disposal activities and volumes of waste removed from the relevant portions of the site;
- Identify the requirements for the EMP (where appropriate) including inclusion of a survey clearly identifying the extent of the retained impacted material and associated capping; and
- Provide a comment on the suitability of the site portion for the proposed use and requirements for any ongoing monitoring/management (where applicable).

It is noted that remedial works are proposed to be staged. As such, staged remedial validation reporting and Site Auditor signoff will be required.

8.6.2 Long-Term Environmental Management Plan

In addition to the requirements of the validation report, long term management is required where residual contamination (e.g. capped impacted fill material) is retained on-site.

To this end a LTEMP will be prepared to detail the ongoing management and monitoring requirements for applicable portions of the site. The LTEMP will incorporate the requirements of the current EMPs (ES 2015a/DP) as relevant to the redeveloped site. The precise nature and extent of the management requirements will not be known until remediation/management works are conducted and the validation data obtained. The LTEMP will be prepared for the relevant portions of the site following the completion of the validation activities. There is a potential that several LTEMPs may be prepared as relevant to works stages.

The provisions in the LTEMP must be feasible (i.e., able to be implemented) and able to be legally enforceable (i.e., a mechanism exists, such as development consent conditions, to give the plan a basis in law).

The LTEMP will broadly comprise ongoing measures to:

- Maintaining accessible soils in the upper 0.5 m of the soil profile on the site;
- Maintaining permanent physical barriers; and
- Prevent any potential beneficial use of groundwater.

The LTEMP(s) are required to document the following elements:

- A statement of the objectives of the LTEMP – i.e., to ensure continued suitability of the site following remediation.
- Identification of residual environmental contamination issues at the site that require ongoing management/monitoring to meet the LTEMP objectives, including the type of contamination and location within the site (including a survey plan prepared by a registered surveyor).
- Documentation of environmental management measures which have been implemented to address the identified environmental issues at the site. This will mainly revolve around control and maintenance of physical separation layers.
- Description of management controls to limit the exposure of site users to known areas of contamination to acceptable levels.
- Description of responsibilities for implementing various elements of the provisions contained in the LTEMP.
- Timeframes for implementing the various control/monitoring, etc. elements outlined in the LTEMP.
- Environmental monitoring and reporting requirements (if required) for the future management of environmental impact underlying the site including:
    - Appropriate monitoring locations and depth within and down-gradient of any residual contamination;
    - Relevant assessment criteria to be used in evaluating monitoring results;
    - Frequency of monitoring and reporting;
    - Process for reviewing monitoring data and how decisions will be made regarding the ongoing management strategy;
    - The length of time for which monitoring is expected to continue;
- The regulatory authorities involved and the management inputs required from each;
- The integration of environmental management and monitoring measures for soil and groundwater;
- Health and safety requirements for particular activities;
- A program of review and audits;
- The relevant consent authority is satisfied that the inclusion of a development consent condition relating to the implementation of the LTEMP is acceptable; and
- Corrective action procedures to be implemented where LTEMP assessment criteria are breached.

9. Contingency Plan

A review of the proposed contamination-related aspects of the works associated with development the site has been undertaken and has identified a number of potential risks, outlined in the following sections that required the development of contingencies to ensure that the objectives of this RAP are met.

The Contingency Plan is required to be part of the remedial environmental plan (REMP), as described in **Section 10.1**, below, and part of the work health and safety plan (WHSP), as described in **Section 10.2**.

9.1 Unexpected Finds

The possibility exists for hazards that have not been identified to date to be present within fill materials or underlying pavements/building on the site. The nature of hazards which may be present and which may be discovered at the site are generally detectable through visual or olfactory means, for example:

- The presence of significant aggregates of friable asbestos materials (visible) as opposed to minor occurrences of fragments or fibre bundles in soil;
- Excessive quantities of Construction/Demolition Waste (visible);
- Hydrocarbon impacted materials (visible/odorous);
- Drums, waste pits, former pipework or underground storage tanks (USTs) (visible);
- Oily Ash and/or oily slag contaminated soils/fill materials (visible/odorous);
- Tarry like impacted soil/fill material (visible/odorous).

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances (or any other unexpected potentially hazardous substance) be identified, the procedure summarised in **Figure 9.1** is to be followed.

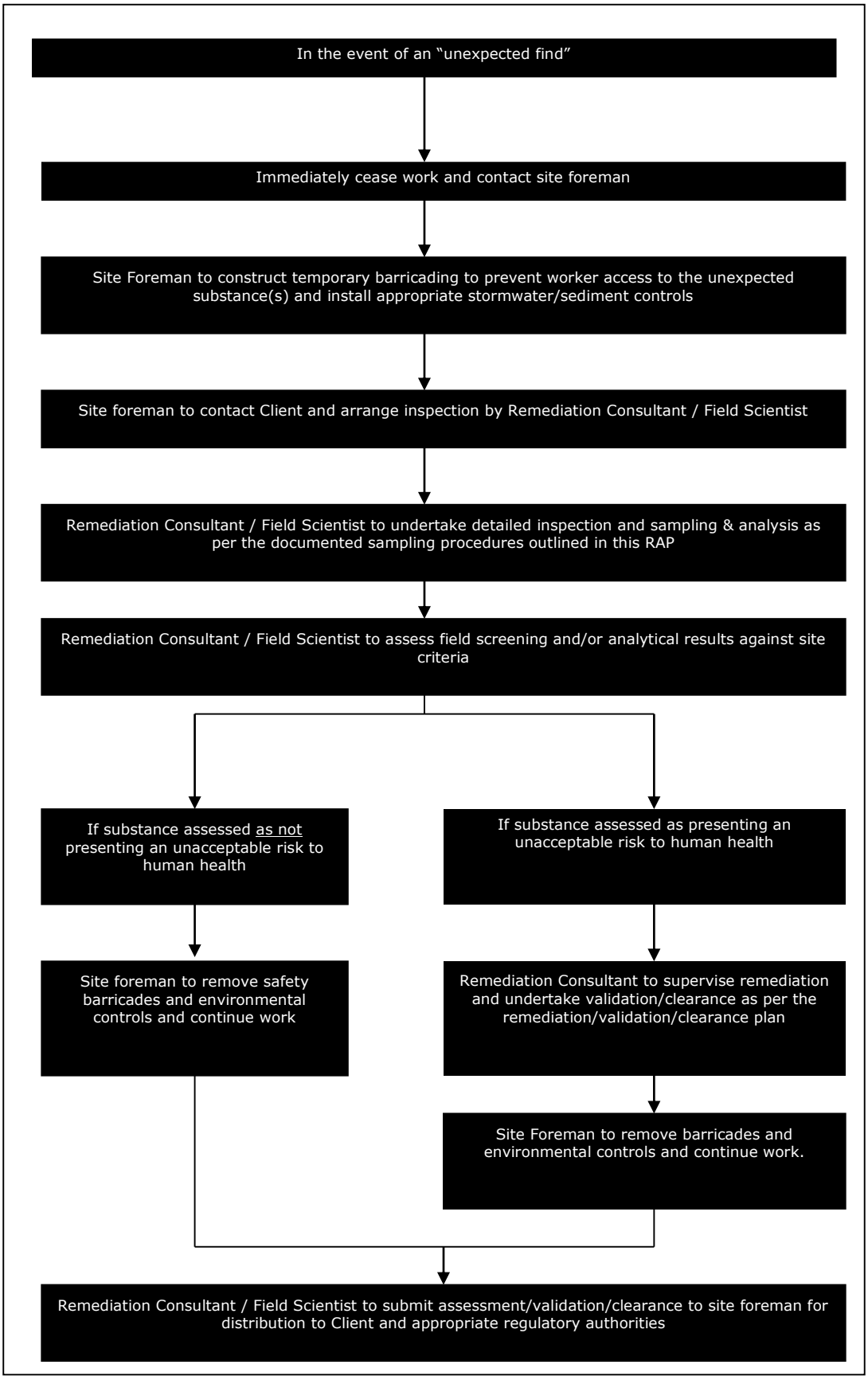
An enlarged version of the unexpected finds protocol, suitable for use on site, should be posted in the Site Office and referred to during the Site Specific Induction by the Remediation Contractor.

The sampling strategy for each “unexpected find” shall be designed by a suitably qualified environmental consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, is it at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance/materials shall meet the minimum requirements outlined in EPA (1995) in addition to those outlined in **Section 7**.

Following removal of hardstands across the site, an inspection of the site’s surface for the presence of visible ACM in accordance with NEPC (2013) or other visual or olfactory indicators of contamination should be undertaken.

Figure 9.1 - Unexpected Finds Protocol



9.2 Change in Development Plans

In the event that the approved development plans are changed from those available at the time of preparation of this RAP, particularly where significant amendment of the extent of permanent paving at the site, consideration of the suitability of the proposed remedial strategy will be required.

9.3 Vapour beneath the Locomotive Workshop

Should soil vapour concentrations beneath the Locomotive Workshop be identified as representing a health risk to site occupants/users, then in-situ chemical stabilisation/remediation may be required.

9.4 Identification of Underground Storage Tank

There is the potential that an underground storage tank(s) may be encountered during demolition of the pavements or subsequent earthworks. In the event of such an occurrence, the Unexpected Finds Protocol as discussed in **Section 9.1** comprising inspection, testing and appropriate action as advised by the Field Scientist (**Section 9.1**).

9.5 Identification of Oily or Tarry Materials

In the event that oily/tarry materials are encountered, the provisions outlined in the unexpected finds protocol will be implemented, comprising inspection, testing and appropriate action as advised by the Field Scientist (**Section 9.1**).

Any suspected oily/tarry materials must be segregated from other excavated materials and placed in a designated area with appropriate odour and sediment controls until such time as appropriate assessment is completed and a methodology is confirmed for their appropriate management. In the event that the oily/tarry materials do not meet the Site Acceptance Criteria, then they shall be stored in a secure area for later treatment or classified and removed from the site for treatment and/or disposal at an appropriately licensed facility.

9.6 Material Storage Breach

In the event that any materials storage containment controls are breached and stockpiled materials classified as asbestos contaminated soil or otherwise have escaped (or have the potential to escape), then the management controls shall be rectified and investigations undertaken to review the adequacy of the controls and any improvements implemented. The REMP (**Section 10**) shall include a documented process for identifying and responding to such incidents.

9.7 Emissions Complaints

Due to the nature of the activities and type of contaminants identified at the site, there is a potential for complaints to be received from members of the public and/or occupants of surrounding properties relating to environmental emissions including:

- Noise and vibration arising from excavation, piling and other works;
- Dust emissions arising from excavation, material handling and placement; and
- Visibly impacted water quality in surface water discharge from the site.

Monitoring of all environmental emissions shall be undertaken during the works as detailed in the REMP (discussed in **Section 10**) and appropriate actions taken to further control emissions following receipt of a complaint. The REMP shall contain provision for contingency actions where excessive emissions occur, however it is anticipated that one or more of the following actions will be considered:

- Increased application of odour screening/masking chemicals on odorous materials;
- Disturbance of soils during meteorologically favourable periods only; and/or
- Covering of impacted soils.

10. Other Remediation Documents

10.1 Environmental Management

10.1.1 Preparation of a Remediation Environmental Management Plan

Prior to commencement of remediation works, a REMP shall be prepared by the Remediation Contractor, which documents the environmental monitoring and management measures required to be implemented during the remediation and construction related activities associated with the construction of the site.

The REMP shall address each of the nominated items in **Section 10.1.2** and shall include the Contingency Plan, referred to in **Section 9**, above. Additional environmental management requirements may be required as part of works to support the SSDA or subsequent development consent conditions.

10.1.2 Required Elements/Procedures

An assessment of the proposed activities and the associated elements required to be incorporated into the REMP is provided in **Table 10.1**. The REMP is required to address each of the required elements and procedures in full detail and to include detailed monitoring processes and procedures, corrective actions and reporting requirements.

Table 10.1 Required Elements of the REMP

Element	Specific Minimum Requirements to be included in REMP
1. Dust and Airborne Hazard Control	Dust and asbestos air monitoring. Provisions for dust control based on monitoring results.
2. Flora and Fauna	As appropriate.
3. Heritage/Archaeological	In accordance with relevant heritage/archaeological studies.
4. Visual Impacts	Visual monitoring at site boundary Specific colour requirements for various controls/measures, including PPE (e.g., navy coveralls)
5. Emergency Response	As appropriate. Procedures required for spill incident response including material storage breach.
6. Noise Control	Hours of operation, consistent with the consent conditions. Boundary monitoring at commencement of work site activities with potential for environmental noise emissions. Potential noise monitoring at nearest receptors. Procedures for control and management of noise emissions, as appropriate (e.g., restricted hours).
7. Traffic	Controls on vehicle movements on public roads. Controls on transport of tar impacted materials.
8. Protection of Adjoining Structures	As appropriate.
9. Odour Control	Management of all potential odour generating activities (i.e., excavation of petroleum hydrocarbon contaminated soils) with appropriate odour controls incorporating safeguards and monitoring. Daily monitoring of odour levels at site boundary during handling of malodorous materials. Procedures for addressing elevated odour monitoring results, including, but not limited to: reduction in earthworks activities within odorous material areas during adverse meteorological conditions; application of odour masking solutions at the odour source or between identified source(s) and receptor(s); review of biopile operation and covering identified potential odour sources by hydromulching or with less odorous materials.
10. Handling of Contaminated Soil and Groundwater	Soil and water management (stockpiling, site access, excavation pump out, reinstatement).
11. Soil Storage/Placement Areas	Soil and water management (stockpiling, site access, excavation pump out, reinstatement). Bunding.

Element	Specific Minimum Requirements to be included in REMP
	Heavy vehicle/personnel decontamination. Interim storage requirements for materials requiring later treatment. Site drainage requirements, incorporating clean/dirty areas and modifications to existing surface water and drainage controls beneath retained pavements. Monitoring as required.
12. Sediment Control	Bunding. Collection/treatment/handling impacted sediments.
13. Operation of Site Office	As appropriate.
14. Decontamination of Heavy Equipment	As appropriate.
15. Environmental Monitoring	Monitoring of dusts, noise, odour and fibres. Monitoring as required for vibration and water releases. Inspection checklists and field forms. Monitoring within the Locomotive Workshop is required as per the requirements of the EMP and HHRA.
16. Environmental Criteria	Soil and water criteria as sourced from RAP.
17. Material Classification	As detailed in this RAP. Materials tracking, including QA/QC inspection and sampling.
18. Community Relations Plan	Specific communication protocols, incorporating nomination of specific contact persons & details and requirements for communications/response register.
19. Incident Reporting	As appropriate, including standard form/checklist.
20. Security and Signage	Secure site perimeter. Site boundary signage.
21. EMP Review	As appropriate.
22. Training	As appropriate.
23. Contact Details	Company/personnel details, including names/phone numbers for: - Principal Contractor - Site Auditor - Remediation Consultant - Remediation Contractor - OH&S Compliance - Environmental Compliance
24. Stockpiling	All materials stockpiled onsite will be managed by the Remedial Contractor. Unique numbers will be provided for each stockpile, the source of the stockpile, its estimated volume, material characterisation and its location onsite (via GPS) will also be recorded consistent with the Material Tracking Plan provided as **Section 7.6**. The following procedures will be implemented by the Remedial Contractor: • No stockpiles of soil or other materials shall be placed on footpaths or nature strips unless prior Council approval has been obtained; • All stockpiles of soil or other materials shall be placed away from drainage lines gutters or stormwater pits or inlets; • All stockpiles of soil or other materials likely to generate dust or odours shall be covered; • All stockpiles of chemically contaminated soil shall be stored in a secure area and be covered if remaining more than 24 hours; and • All stockpiles of asbestos contaminated soils shall be kept damp and covered to minimise potential fibre release, and if left for more than 24 hours, be stored in a secure area.

10.1.3 Certification

Prior to commencement of remediation works, the Remediation Contractor is required to have the REMP endorsed as acceptable by the Environmental Consultant and Site Auditor appointed to validate the works.

A copy of the REMP and the endorsement to the satisfaction of Environmental Consultant and Site Auditor are required to be provided by the Principal Contractor/Remedial Contractor prior to commencement of remediation works.

10.1.4 Hours of Site Operation/Duration of Works

Remediation works shall be completed in accordance with the permissible hours of work and noise as nominated in of the Development Consent.

The appointed remediation contractor will be required to include a proposed schedule of remediation works within the REMP submitted for endorsement as discussed above.

10.2 Health and Safety

10.2.1 Work Health and Safety Management Plan

A Work Health & Safety Management Plan (WHSP) shall be prepared by the Remediation Contractor prior to commencement of remediation works. The Plan shall contain procedures and requirements that are to be implemented as a minimum during the works, in addition to the Contingency Plan, referred to in **Section 9**.

The objectives of the WHSP are:

- To apply standard procedures that minimises risks resulting from the works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards, mandatory safety practices and procedures;
- Monitoring of potential hazards and implementation of corrective measures; and
- Provision for contingencies that may arise while operations are being conducted at the site.

10.2.2 Additional Site-Specific Elements/Procedures

In addition to the normal construction-related matters, the WHSP shall address the following site-specific specific hazards associated with the works relating to the management of contaminated soil and groundwater:

- Under/aboveground services, specifically former petroleum infrastructure (if encountered);
- Use of plant and machinery within confined spaces (i.e. tank pit excavations);
- Contact to asbestos contaminated soils, including AF/FA impacted soils (friable asbestos);
- Contact with contaminated soil (heavy metals, TRH and PAHs), groundwater and vapours, including requirements for specific Personal Protective Equipment (PPE); and
- Heat/cold stress.

10.2.3 Asbestos

During the remedial works, perimeter asbestos in air monitoring will be conducted at each applicable remedial works area boundary when soil with AF/FA are being disturbed. Air monitoring will be conducted on a daily basis at relevant locations whilst disturbance of asbestos contaminated areas takes place.

Air monitoring will be conducted during any ground disturbance activities within impacted soil at the site to verify that implementation of appropriate control measures have been successful at managing the risk of air borne fibre generation. Air monitoring will be undertaken in accordance with the requirements of the National Occupational Health and Safety Commission (NOHSC) Asbestos Code of Practice and Guidance Notes, in particular the *Guidance note for the estimation of airborne asbestos dust* [NOHSC 3002:2005].

10.2.4 Additional Consideration of Chemical Contaminants

In addition to general assessment of the potential for exposure to chemical contaminants the WHSP should also include specific consideration of additional contaminants such as lead and polycyclic aromatic hydrocarbons distributed throughout fill materials.

As a precautionary measure, the WHSP should include the requirement for the plan to be revised in the event of an unexpected find of contaminated material during remediation and/or construction.

When working with contaminated materials in general, care needs to be taken to ensure that the contamination is not introduced to the worker via ingestion, inhalation or absorption. The WHSP must detail the PPE and decontamination requirements to be followed to control the risks posed by potential exposure to chemical contaminants at the site.

11. Conclusions and Recommendations

11.1 Conclusions

Overall, it is considered that the proposed actions outlined in this RAP conform to the requirements of the *Contaminated Sites Guidelines for the NSW Site Auditor Scheme (2nd Edition)* (DEC 2006) because they are: technically feasible; environmentally justifiable; and consistent with relevant laws policies and guidelines endorsed by NSW EPA.

Subject to the successful implementation of the measures described in this RAP and the recommendations below, it is concluded that the site can be made suitable for the intended uses and that the risks posed by contamination can be managed in such a way as to be adequately protective of human health and the environment.

11.2 Recommendations

It is recommended that the processes outlined in this RAP be implemented and that the following documentation be developed and implemented to ensure the risks and impacts during remediation works are controlled in an appropriate manner:

- A REMP, to document the monitoring and management measures required to control the environmental impacts of the works and ensure the validation protocols are being addressed; and
- A WHSP to document the procedures to be followed to manage the risks posed to the health of the remediation workforce.

The REMP and WHSP will require to be cognisant of the potential occurrence and storage / handling of asbestos contaminated soils.

Upon completion of the works, or within various specific areas, validation report(s) are required to be submitted by the Remediation Consultant to the Site Auditor for certification that the site, or relevant portion(s) are suitable for the proposed uses. Implementation of the EMP (ES 2015a), and a long-term Environment Management Plan (LTEMP) prepared by the Remediation Consultant for Site Auditor for approval, is required.

12. 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.

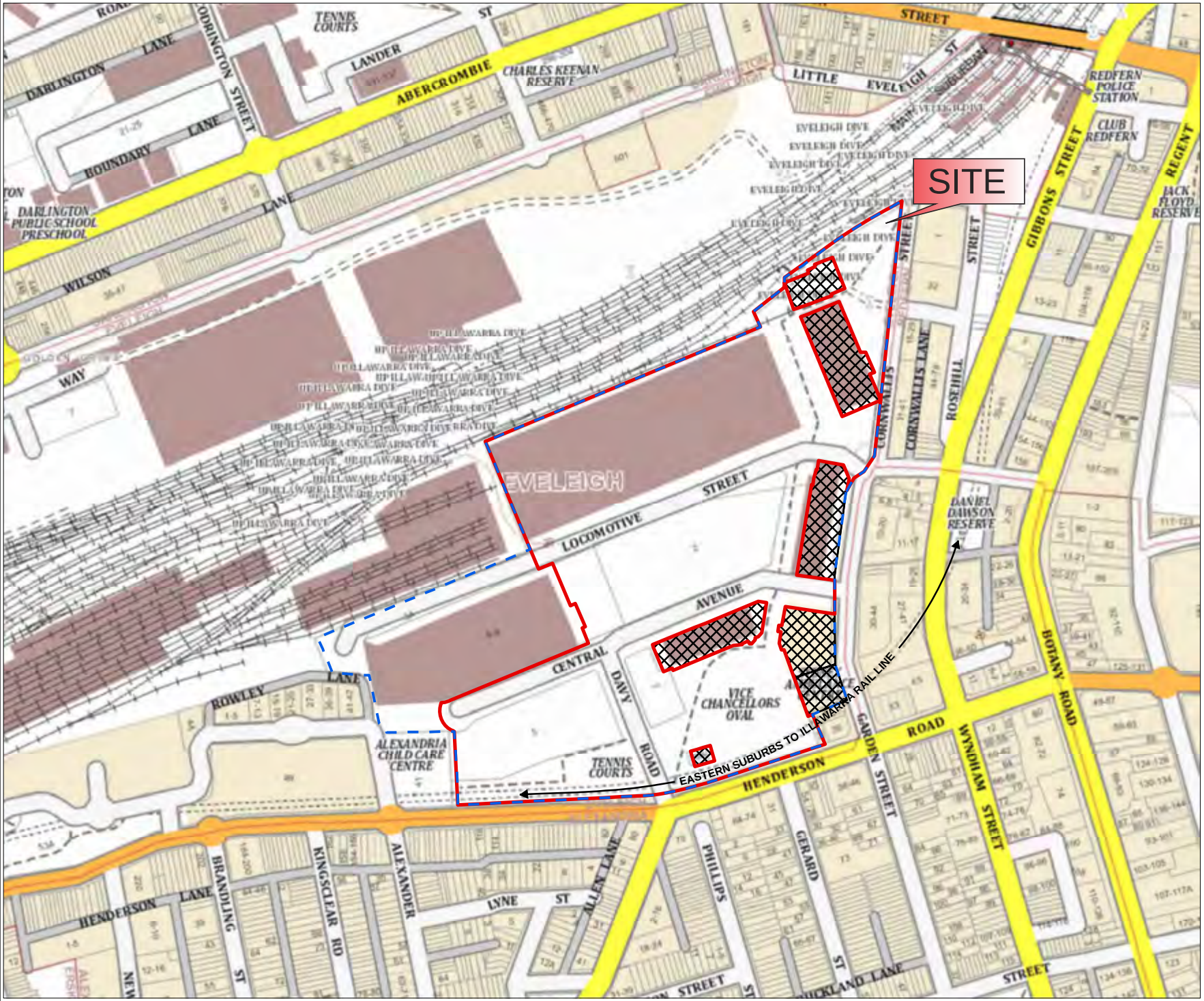
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the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

Figures



Legend:

- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries Excluded from "The Site"

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:4,500

0 50 100
metres

Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SITE LOCATION

FIGURE 1:

File Name: 51142_01
Reference: https://maps.six.nsw.gov.au/

Legend:

- Approximate Boundary - ATP
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"
- UST (Inferred Historical Location)

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:3,500

0 40 80
metres

Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SITE LAYOUT

FIGURE 2:

File Name: 51142_02
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au

ID	Easting	Northing
1	333246.146	6247884.562
2	333244.717	6247874.719
3	333249.004	6247868.846
4	333269.800	6247811.219
5	333273.907	6247812.619
6	333284.633	6247786.774
7	333132.920	6247742.202
8	332964.732	6247733.630
9	332961.638	6247797.811
10	332950.268	6247822.948
11	333078.318	6247874.821
12	333047.076	6247944.192
13	333035.035	6247939.195
14	332988.564	6248050.651
15	333228.276	6248150.135
16	333222.423	6248163.545
17	333249.014	6248184.579
18	333249.411	6248193.311
19	333351.804	6248259.986
20	333327.992	6248038.132
21	333318.864	6248024.242
22	333309.736	6248018.685
23	333303.883	6248008.013
24	333305.757	6248018.320
25	333300.730	6248030.093
26	333279.166	6248033.798
27	333277.976	6248026.257
28	333272.816	6248012.763
29	333259.852	6247933.917
30	333293.088	6247929.437
31	333293.229	6247899.961
32	333250.115	6247906.787
33	333247.099	6247890.118

Legend:

- Approximate Boundary - ATP Site
- Cadastral Boundaries
- Approximate Boundary - The Site

Lot and DP Boundaries

- Lot 8 DP1136859
- Lot 9 DP1136859
- Lot 10 DP1136859
- Lot 12 DP1136859
- Lot 4007 DP1194309
- Lot 4000 DP1194309
- Cadastral Boundaries Excluded from "The Site"
- Site Coordinate Location

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:2,500

0 40 80
metres

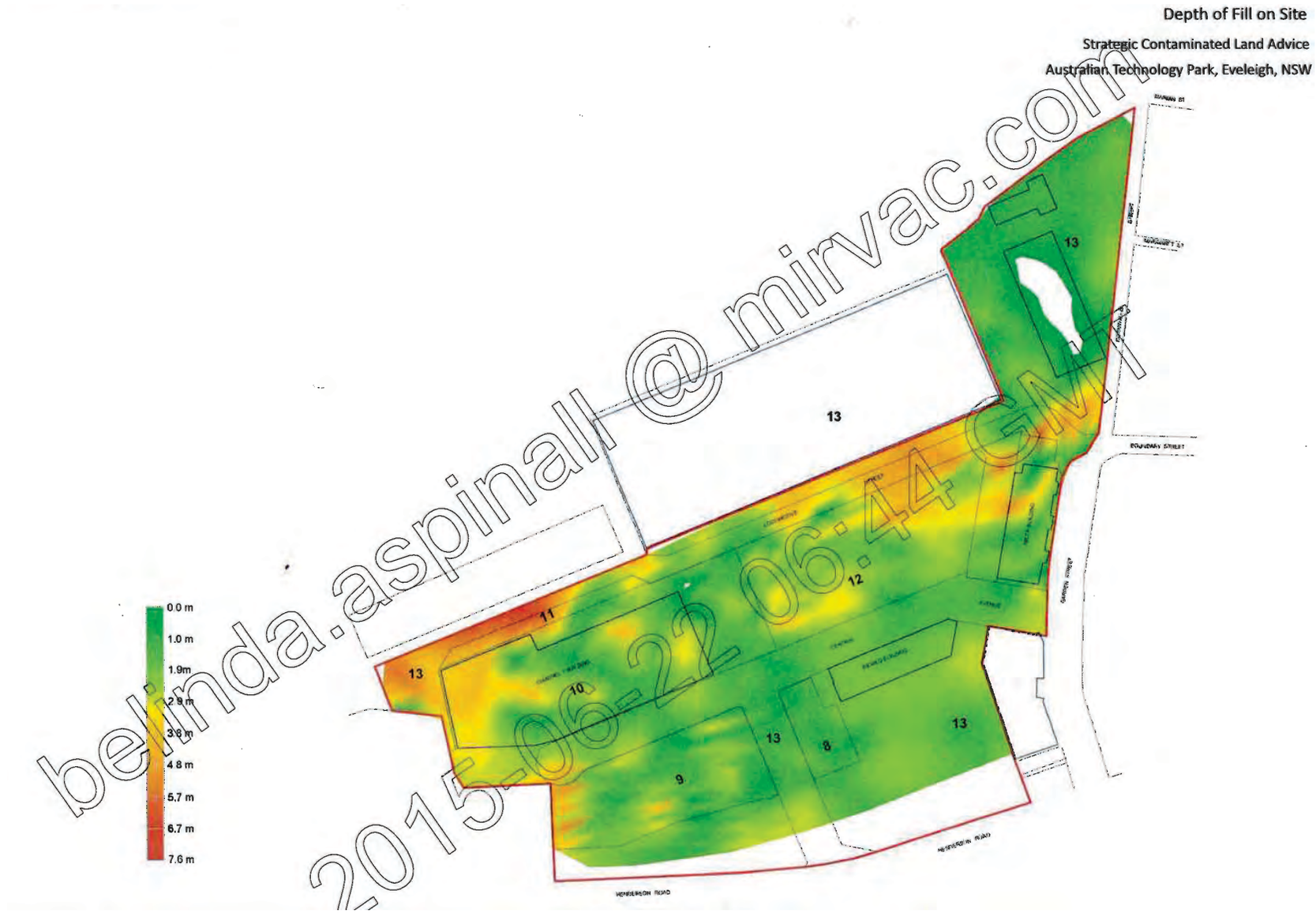
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

CADASTRE - LOT AND DP LOCATION

FIGURE 3:

File Name: 51142_03
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

JBS&G

Client: Mirvac

Version: R02 Rev B	Date: 23-Nov-2015
Drawn By: RF	Checked By: NC

Scale: Approximate

0 50 100
metres

Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

DEPTH OF FILL

FIGURE 4:

File Name: 51142_04
Reference: Adopted from Environmental Strategies, 2013, Strategic Contaminated Land Advice - Figure 5A

Legend:

- Approximate Boundary - ATP Site
- Approximate Boundary - "The Site"
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2015
Drawn By: RF	Checked By: NC

Scale: 1:3,500

0 40 80
metres

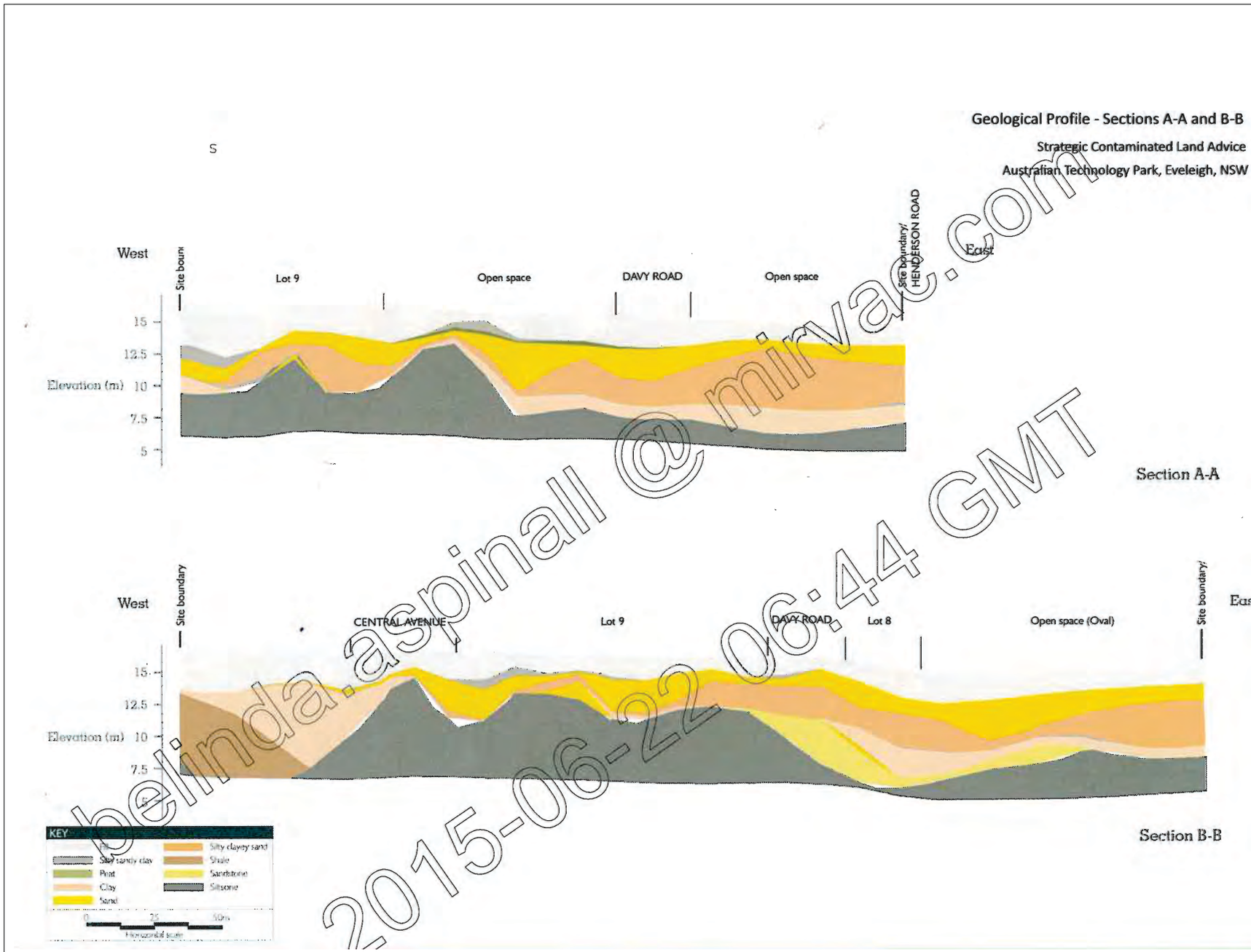
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

CROSS SECTION LOCATIONS

FIGURE 5:

File Name: 51142_03
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 16-Jun-2016
Drawn By: RF	Checked By: NC

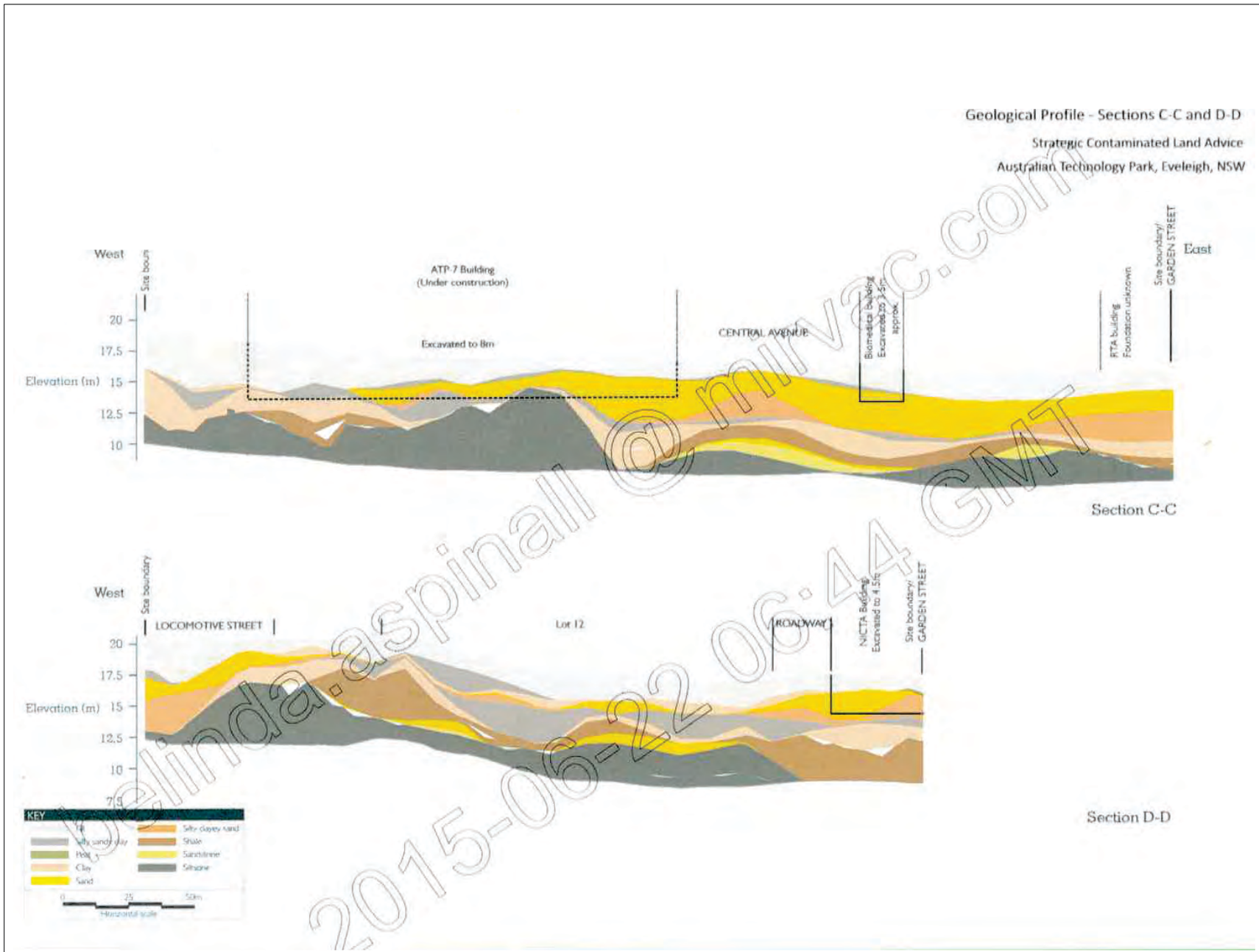
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SECTIONS A-A and B-B

FIGURE 5a:

File Name: 51142_05a
Reference: Adopted from Environmental Strategies, 2013, Strategic Contaminated Land Advice - Figure 7A



Legend:

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: .15-Jun-2016
Drawn By: RF	Checked By: NC

Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SECTIONS C-C to D-D

FIGURE 5b:

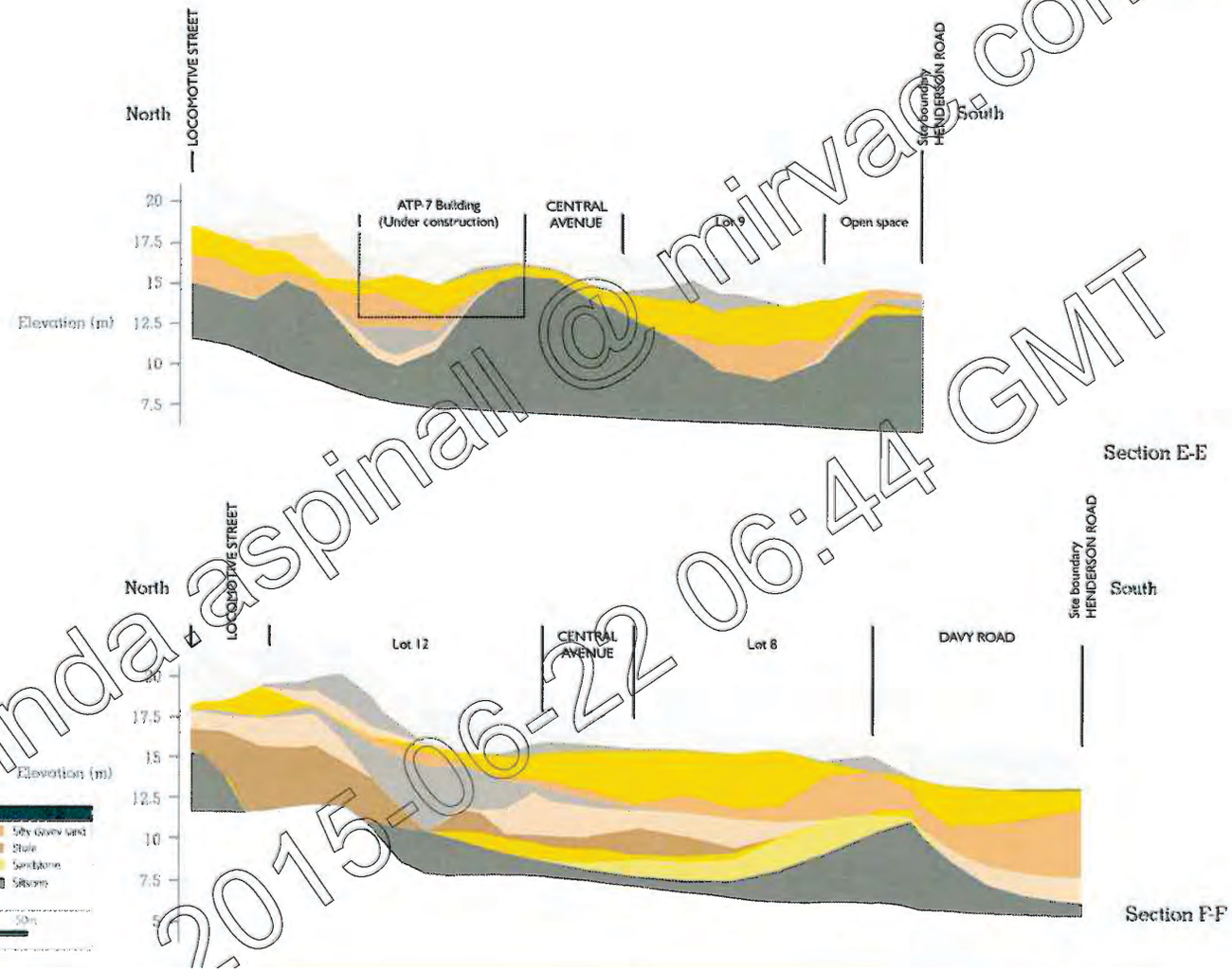
File Name: 51142_05b
Reference: Adopted from Environmental Strategies, 2013, Strategic Contaminated Land Advice - Figure 7B

5

Geological Profile - Sections E-E and F-F

Strategic Contaminated Land Advice

Australian Technology Park, Eveleigh, NSW



Legend:

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SECTIONS E-E and F-F

FIGURE 5c:

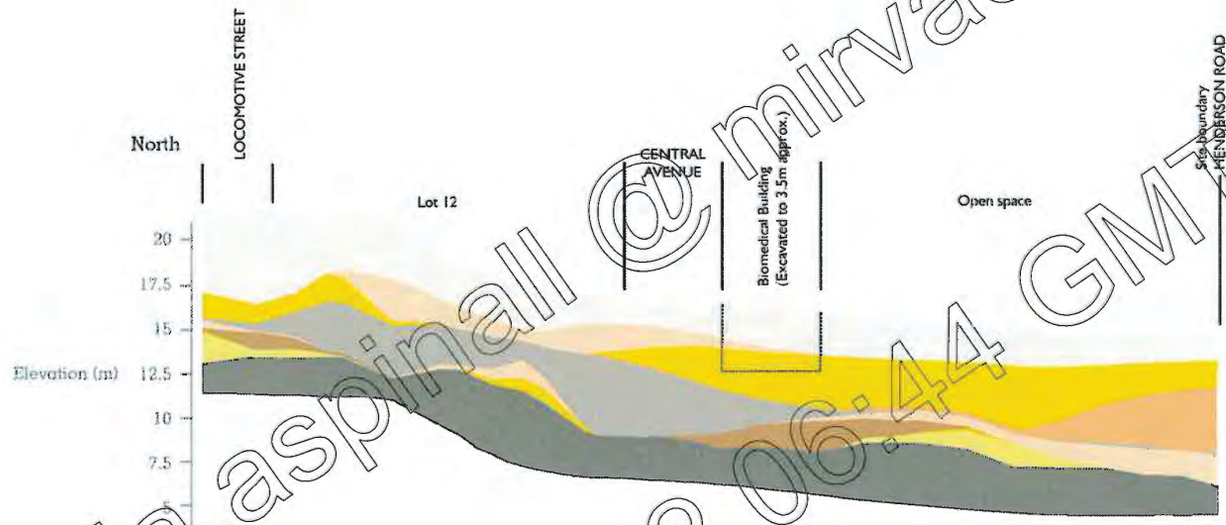
File Name: 51142_05c
Reference: Adopted from Environmental Strategies, 2013, Strategic Contaminated Land Advice - Figure 7C

S

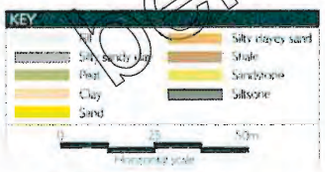
Geological Profile - Section G-G

Strategic Contaminated Land Advice

Australian Technology Park, Eveleigh, NSW



Section G-G



Legend:

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

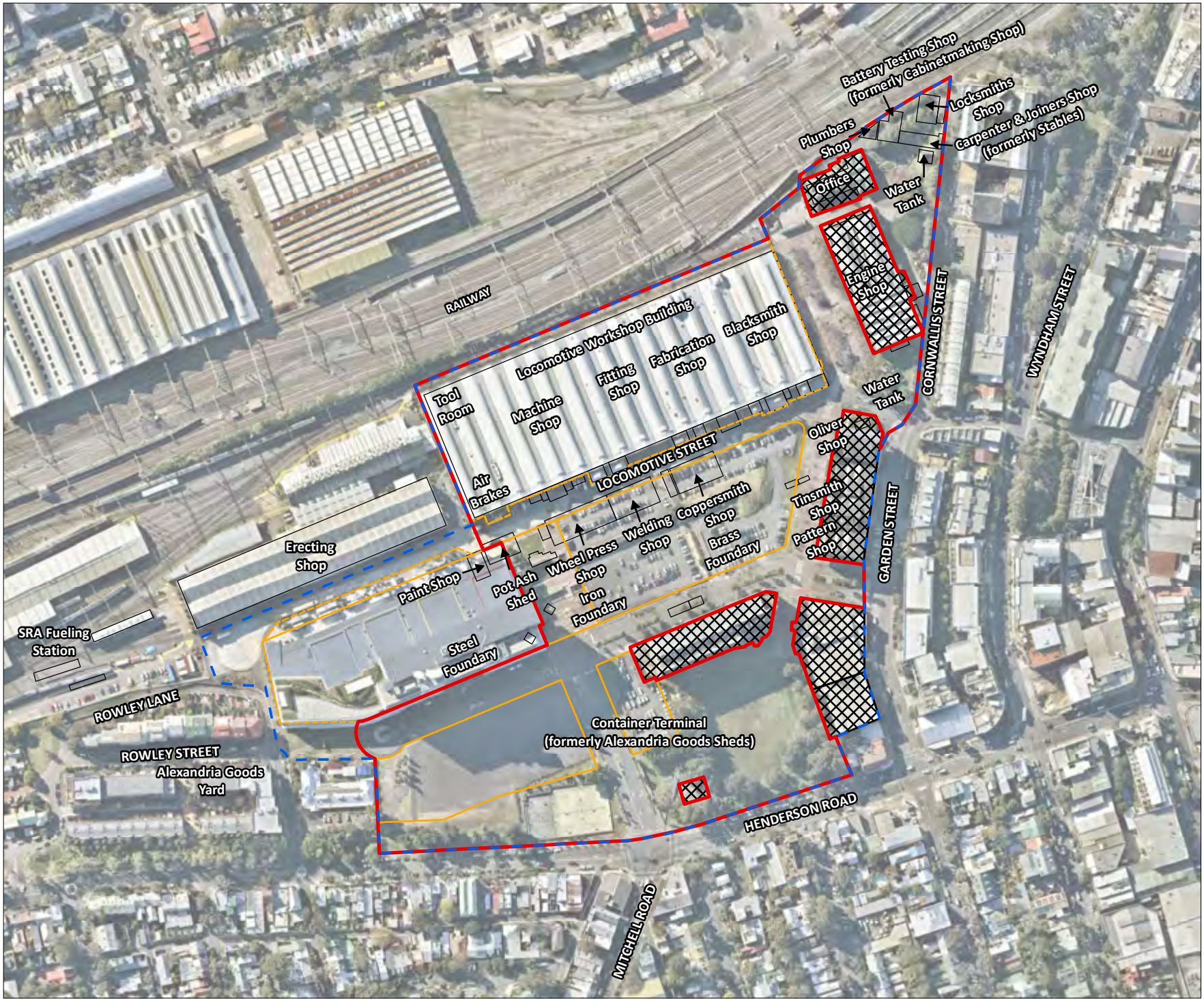
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SECTIONS G-G

FIGURE 5d:

File Name: 51142_05d
Reference: Adopted from Environmental Strategies, 2013, Strategic Contaminated Land Advice - Figure 7D



Legend:

- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"
- Historic Site Layout

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:3,500

0 40 80
metres

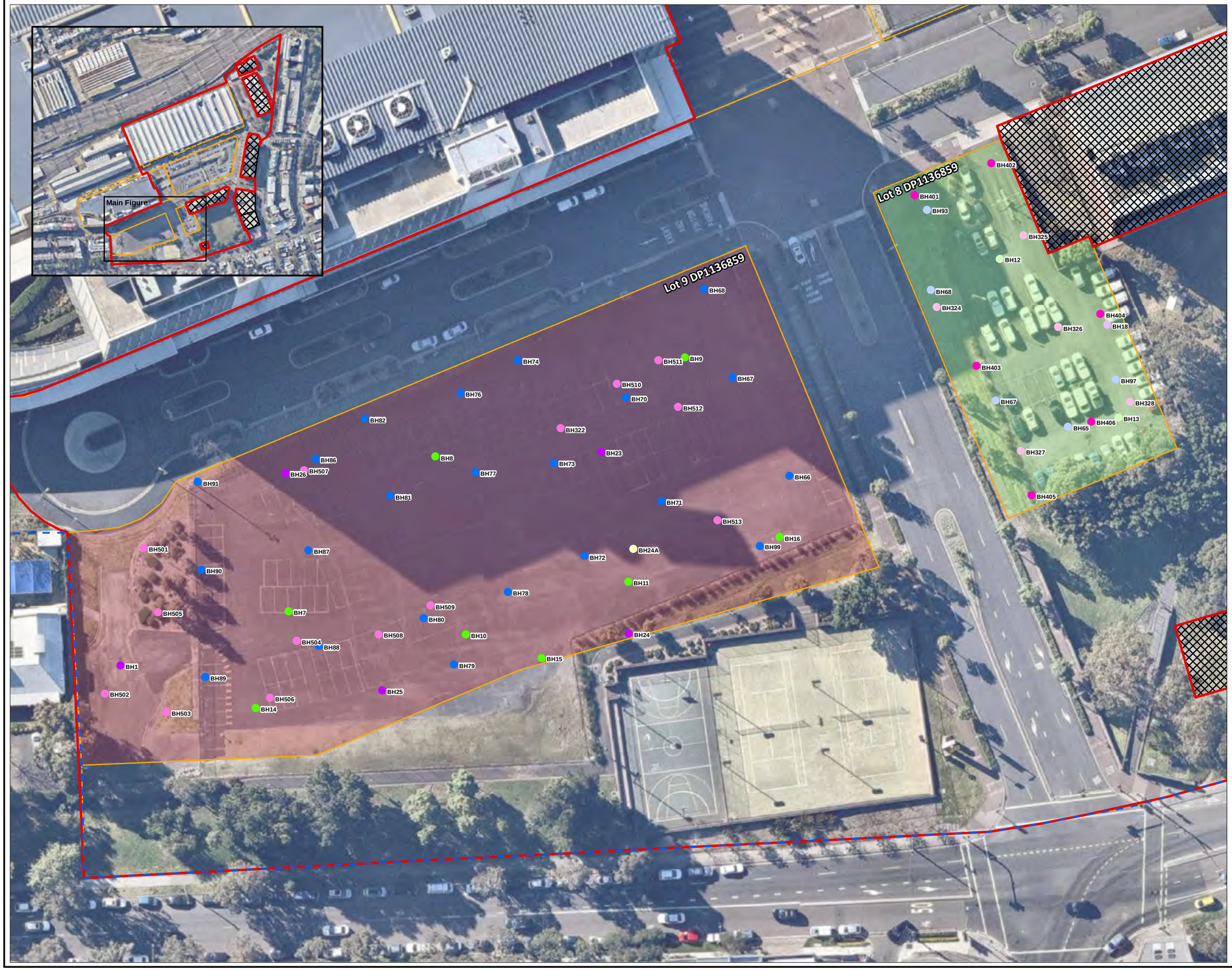
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

HISTORICAL SITE LAYOUT

FIGURE 6:

File Name: 51142_06
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

Historical Soil Sample Locations

- CMPS&F 1994 (ES 2014b) - Lot 9
- DP 2005a - Lot 8
- DP 2008 (ES 2014b) - Lot 9
- DP 2008a - Lot 8
- ES 2014a - Lot 8
- ES 2014b - Lot 9
- HLA 2001 (DP 2005a) - Lot 8
- HLA 2001 (ES 2014b) - Lot 9
- HLA 2001 (ES 2014e) - Lot 8
- JET 1993 (DP 2005a) - Lot 8
- JET 1993 (ES 2014b) - Lot 9
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Lot & DP

- Lot 8 DP1136859
- Lot 9 DP1136859

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:650

0 14
metres

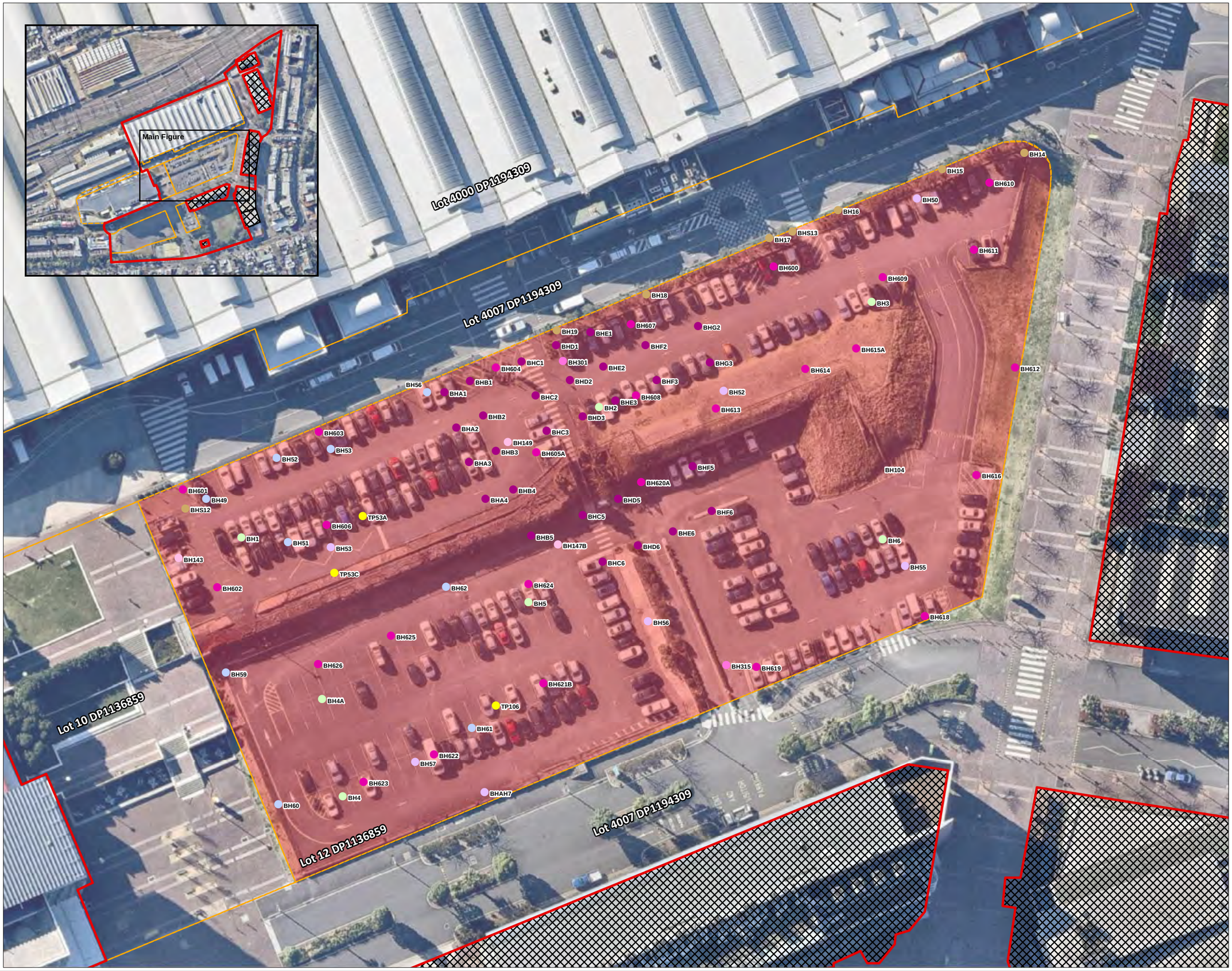
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC SOIL SAMPLE LOCATIONS LOT 8 AND 9

FIGURE 7A:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07a.mxd
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

Historical Soil Sample Locations

- CMP&F 1993 (ES 2014e) - Lot 12
- CMPS&F 1994 (ES 2014c) - Lot 12
- DP 2003 (ES 2014c) - Lot 12
- DP 2005a - Lot 12
- DP 2008 (ES 2014c) - Lot 12
- DP 2009 (ES 2014c) - Lot 12
- ES 2014 (ES 2014c) - Lot 12
- GETEX 2013 (ES 2014c) - Lot 12
- HLA 2001 (ES 2014c) - Lot 12
- JET 1993 (ES 2014c) - Lot 12
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Lot & DP

- Lot 12 DP1136859

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:650

0 14
metres

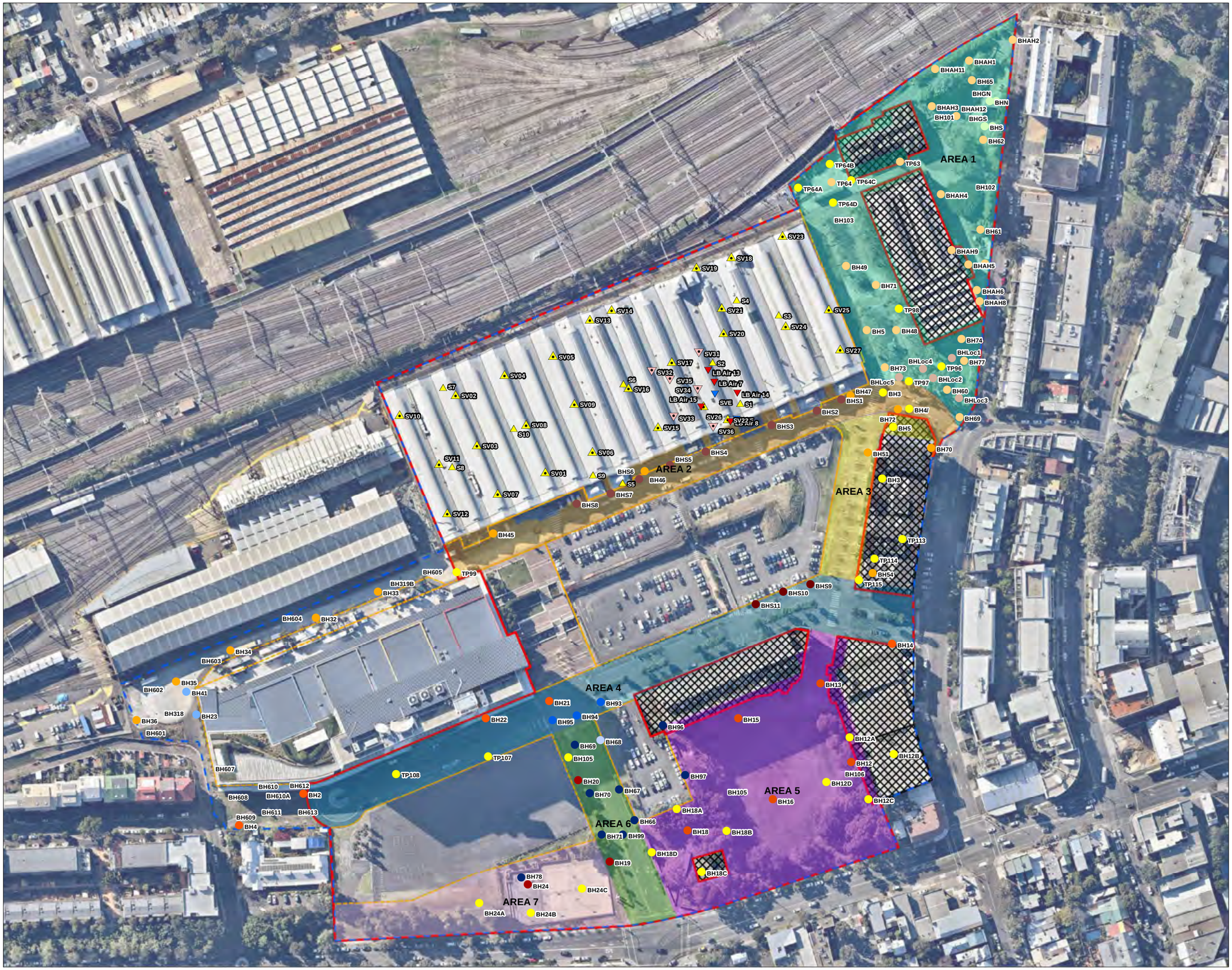
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

HISTORIC SOIL SAMPLE LOCATIONS LOT 12

FIGURE 7B:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07b.mxd
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

Historical Ambient Air and Soil Vapour Locations

- Ambient Air DP 2010c
- Ambient Air ES 2015a
- Soil Vapour ES 2015a
- Soil Vapour Location - JBS&G May 20 2016
- Soil Vapour Location - JBS&G May 5-6 2016

Historical Soil Sample Locations

- CMPS&F 1993 (ES 2014e) - Lot 13 Area 1
- ES 2010 (ES2014e) - Lot 13 Area 1
- GETEX 2011-2013 (ES 2014e) - Lot 13 Area 1
- GETEX 2011-2013 (ES 2014e) - Lot 13 Area 2
- GETEX 2011-2013 (ES 2014e) - Lot 13 Area 4
- HLA 2001 (DP 2005a) - Lot 13 Area 6
- HLA 2001 (ES 2014e) - Lot 13 Area 2
- HLA 2001 (ES 2014e) - Lot 13 Area 4
- HLA 2001 (ES 2014e) - Lot 13 Area 5
- HLA 2001 (ES 2014e) - Lot 13 Area 6
- HLA 2001 (ES 2014e) - Lot 13 Area 7
- JET 1993 (ES 2014e) - Lot 13 Area 1
- JET 1993 (ES 2014e) - Lot 13 Area 2
- JET 1993 (ES 2014e) - Lot 13 Area 4
- JET 1993 (ES 2014e) - Lot 13 Area 5
- JET 1993 (ES 2014e) - Lot 13 Area 6
- JET 1993 (ES 2014e) - Lot 13 Area 7
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Development Area - Lot 4007

- AREA 1
- AREA 2
- AREA 3
- AREA 4
- AREA 5
- AREA 6
- AREA 7

JBS&G

Job No: 51142

Client: Mirvac

Version: R02 Rev 0 | Date: 15-Jun-2016

Drawn By: RF | Checked By: NC

Scale 1:2,000

0 40
metres

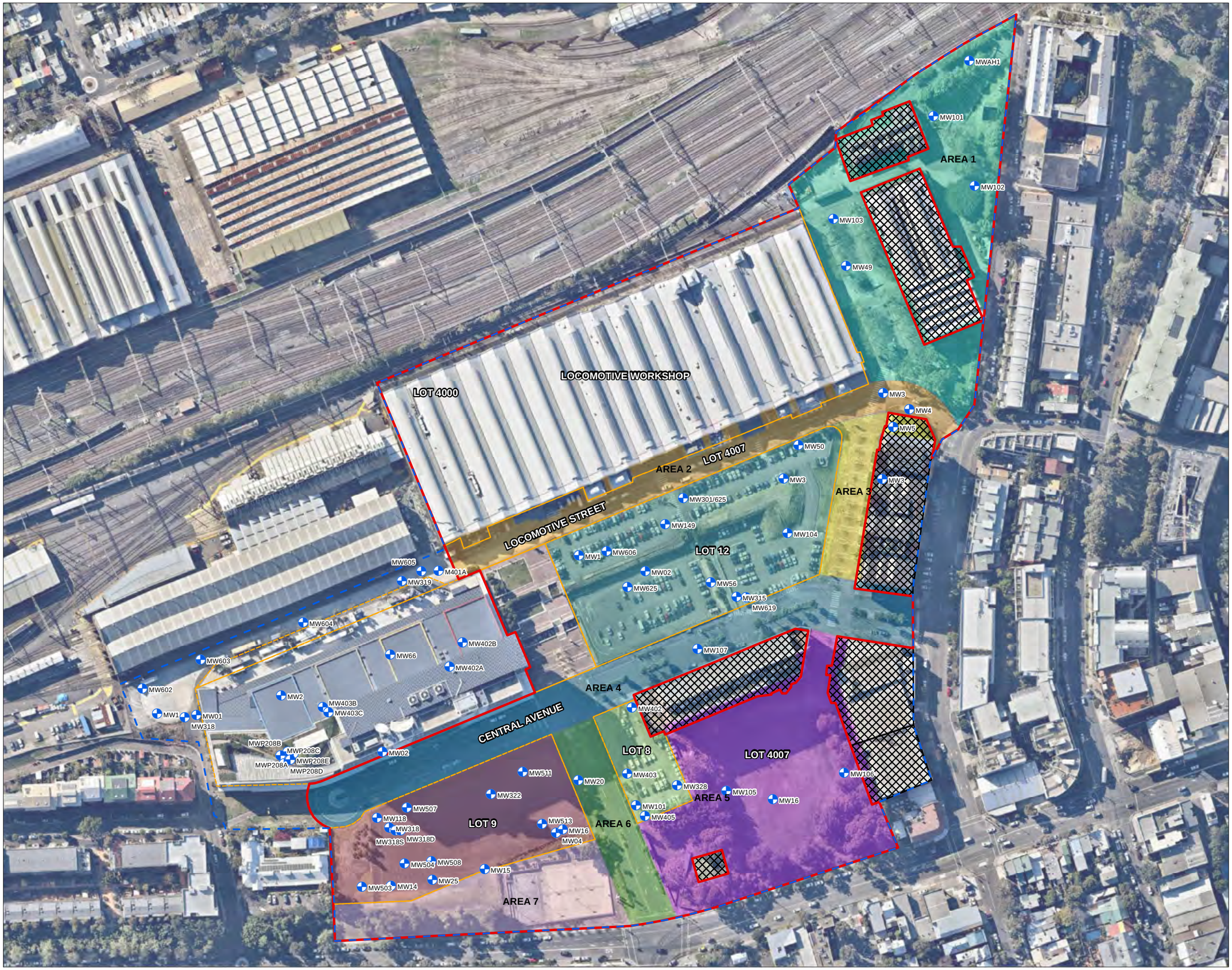
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC SOIL/SOIL VAPOUR SAMPLE LOCATIONS LOTS 4000 AND 4007

FIGURE 7C:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07c.mxd
Reference:



Legend:

- Historical Groundwater Monitoring Location
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Development Area - Lot 4007

- AREA 1
- AREA 2
- AREA 3
- AREA 4
- AREA 5
- AREA 6
- AREA 7

Lot & DP

- Lot 12 DP1136859
- Lot 8 DP1136859
- Lot 9 DP1136859

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC
Scale 1:2,000	

0 40
metres

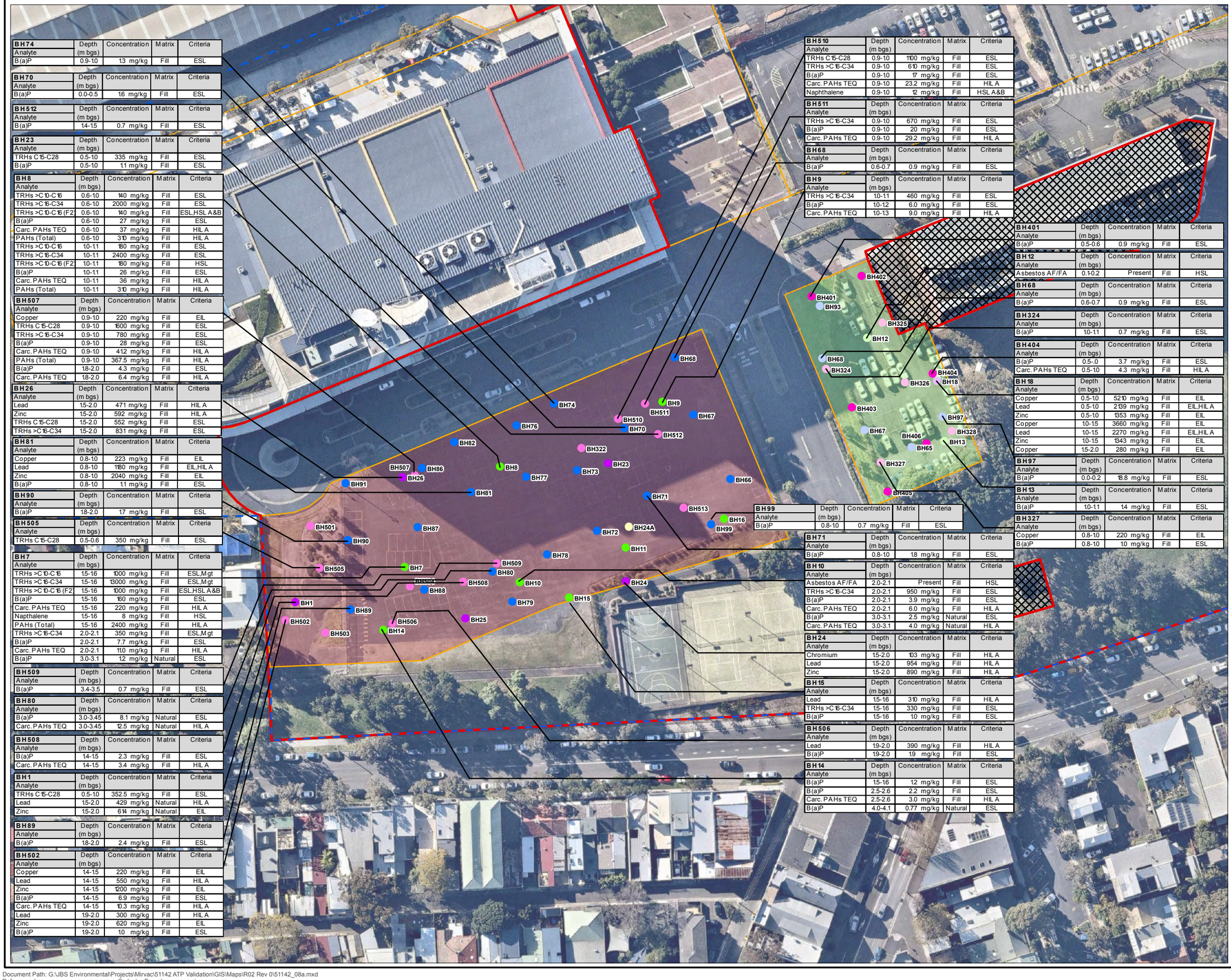
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC GROUNDWATER MONITORING WELL LOCATIONS

FIGURE 7D:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07d.mxd
Reference:



BH74	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.9-10	13 mg/kg	Fill	ESL

BH70	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.0-0.5	16 mg/kg	Fill	ESL

BH512	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	14-15	0.7 mg/kg	Fill	ESL

BH23	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs C15-C28	0.5-10	335 mg/kg	Fill	ESL
B(a)P	0.5-10	1.1 mg/kg	Fill	ESL

BH8	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs >C10-C16	0.6-10	140 mg/kg	Fill	ESL
TRHs >C16-C34	0.6-10	2000 mg/kg	Fill	ESL
TRHs >C10-C16 (F2	0.6-10	140 mg/kg	Fill	ESL,HSL A&B
B(a)P	0.6-10	27 mg/kg	Fill	ESL
Carc. PAHs TEQ	0.6-10	37 mg/kg	Fill	HIL A
PAHs (Total)	0.6-10	310 mg/kg	Fill	HIL A
TRHs >C10-C16	10-11	180 mg/kg	Fill	ESL
TRHs >C16-C34	10-11	2400 mg/kg	Fill	ESL
TRHs >C10-C16 (F2	10-11	180 mg/kg	Fill	HSL
B(a)P	10-11	26 mg/kg	Fill	ESL
Carc. PAHs TEQ	10-11	36 mg/kg	Fill	HIL A
PAHs (Total)	10-11	310 mg/kg	Fill	HIL A

BH507	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Copper	0.9-10	220 mg/kg	Fill	EIL
TRHs C15-C28	0.9-10	1600 mg/kg	Fill	ESL
TRHs >C16-C34	0.9-10	780 mg/kg	Fill	ESL
B(a)P	0.9-10	28 mg/kg	Fill	ESL
Carc. PAHs TEQ	0.9-10	412 mg/kg	Fill	HIL A
PAHs (Total)	0.9-10	367.5 mg/kg	Fill	HIL A
B(a)P	18-2.0	4.3 mg/kg	Fill	ESL
Carc. PAHs TEQ	18-2.0	6.4 mg/kg	Fill	HIL A

BH26	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Lead	1.5-2.0	471 mg/kg	Fill	HIL A
Zinc	1.5-2.0	592 mg/kg	Fill	HIL A
TRHs C15-C28	1.5-2.0	552 mg/kg	Fill	ESL
TRHs >C16-C34	1.5-2.0	831 mg/kg	Fill	ESL

BH81	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Copper	0.8-10	223 mg/kg	Fill	EIL
Lead	0.8-10	1180 mg/kg	Fill	EIL,HIL A
Zinc	0.8-10	2040 mg/kg	Fill	EIL
B(a)P	0.8-10	1.1 mg/kg	Fill	ESL

BH90	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	1.8-2.0	1.7 mg/kg	Fill	ESL

BH505	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs C15-C28	0.5-0.6	350 mg/kg	Fill	ESL

BH7	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs >C10-C16	1.5-1.6	1000 mg/kg	Fill	ESL,M,gt
TRHs >C16-C34	1.5-1.6	13000 mg/kg	Fill	ESL,M,gt
TRHs >C10-C16 (F2	1.5-1.6	1000 mg/kg	Fill	ESL,HSL A&B
B(a)P	1.5-1.6	160 mg/kg	Fill	ESL
Carc. PAHs TEQ	1.5-1.6	220 mg/kg	Fill	HIL A
Napthalene	1.5-1.6	8 mg/kg	Fill	HSL
PAHs (Total)	1.5-1.6	2400 mg/kg	Fill	HIL A
TRHs >C16-C34	2.0-2.1	350 mg/kg	Fill	ESL,M,gt
B(a)P	2.0-2.1	7.7 mg/kg	Fill	ESL
Carc. PAHs TEQ	2.0-2.1	110 mg/kg	Fill	HIL A
B(a)P	3.0-3.1	12 mg/kg	Natural	ESL

BH509	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	3.4-3.5	0.7 mg/kg	Fill	ESL

BH80	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	3.0-3.45	8.1 mg/kg	Natural	ESL
Carc. PAHs TEQ	3.0-3.45	12.5 mg/kg	Natural	HIL A

BH508	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	1.4-1.5	2.3 mg/kg	Fill	ESL
Carc. PAHs TEQ	1.4-1.5	3.4 mg/kg	Fill	HIL A

BH1	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs C15-C28	0.5-1.0	352.5 mg/kg	Fill	ESL
Lead	1.5-2.0	429 mg/kg	Natural	HIL A
Zinc	1.5-2.0	614 mg/kg	Natural	EIL

BH89	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	1.8-2.0	2.4 mg/kg	Fill	ESL

BH502	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Copper	1.4-1.5	220 mg/kg	Fill	EIL
Lead	1.4-1.5	550 mg/kg	Fill	HIL A
Zinc	1.4-1.5	1200 mg/kg	Fill	EIL
B(a)P	1.4-1.5	6.9 mg/kg	Fill	ESL
Carc. PAHs TEQ	1.4-1.5	10.3 mg/kg	Fill	HIL A
Lead	1.9-2.0	300 mg/kg	Fill	HIL A
Zinc	1.9-2.0	620 mg/kg	Fill	EIL
B(a)P	1.9-2.0	1.0 mg/kg	Fill	ESL

BH510	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs C15-C28	0.9-1.0	1100 mg/kg	Fill	ESL
TRHs >C16-C34	0.9-1.0	610 mg/kg	Fill	ESL
B(a)P	0.9-1.0	17 mg/kg	Fill	ESL
Carc. PAHs TEQ	0.9-1.0	23.2 mg/kg	Fill	HIL A
Naphthalene	0.9-1.0	12 mg/kg	Fill	HSL A&B

BH511	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs >C16-C34	0.9-1.0	670 mg/kg	Fill	ESL
B(a)P	0.9-1.0	20 mg/kg	Fill	ESL
Carc. PAHs TEQ	0.9-1.0	29.2 mg/kg	Fill	HIL A

BH68	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.6-0.7	0.9 mg/kg	Fill	ESL

BH9	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
TRHs >C16-C34	10-11	460 mg/kg	Fill	ESL
B(a)P	10-12	6.0 mg/kg	Fill	ESL
Carc. PAHs TEQ	10-13	9.0 mg/kg	Fill	HIL A

BH99	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.8-1.0	0.7 mg/kg	Fill	ESL

BH71	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.8-1.0	1.8 mg/kg	Fill	ESL

BH10	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Asbestos AF/FA	2.0-2.1	Present	Fill	HSL
TRHs >C16-C34	2.0-2.1	950 mg/kg	Fill	ESL
B(a)P	2.0-2.1	3.9 mg/kg	Fill	ESL
Carc. PAHs TEQ	2.0-2.1	6.0 mg/kg	Fill	HIL A
B(a)P	3.0-3.1	2.5 mg/kg	Natural	ESL
Carc. PAHs TEQ	3.0-3.1	4.0 mg/kg	Natural	HIL A

BH24	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Chromium	1.5-2.0	103 mg/kg	Fill	HIL A
Lead	1.5-2.0	954 mg/kg	Fill	HIL A
Zinc	1.5-2.0	890 mg/kg	Fill	HIL A

BH15	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Lead	1.5-1.6	310 mg/kg	Fill	HIL A
TRHs >C16-C34	1.5-1.6	330 mg/kg	Fill	ESL
B(a)P	1.5-1.6	1.0 mg/kg	Fill	ESL

BH506	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Lead	1.9-2.0	390 mg/kg	Fill	HIL A
B(a)P	1.9-2.0	1.9 mg/kg	Fill	ESL

BH14	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	1.5-1.6	1.2 mg/kg	Fill	ESL
B(a)P	2.5-2.6	2.2 mg/kg	Fill	ESL
Carc. PAHs TEQ	2.5-2.6	3.0 mg/kg	Fill	HIL A
B(a)P	4.0-4.1	0.77 mg/kg	Natural	ESL

BH401	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.5-0.6	0.9 mg/kg	Fill	ESL

BH12	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Asbestos AF/FA	0.1-0.2	Present	Fill	HSL

BH68	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.6-0.7	0.9 mg/kg	Fill	ESL

BH324	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	10-11	0.7 mg/kg	Fill	ESL

BH404	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.5-.0	3.7 mg/kg	Fill	ESL
Carc. PAHs TEQ	0.5-1.0	4.3 mg/kg	Fill	HIL A

BH18	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Copper	0.5-1.0	5210 mg/kg	Fill	EIL
Lead	0.5-1.0	2139 mg/kg	Fill	EIL,HIL A
Zinc	0.5-1.0	1353 mg/kg	Fill	EIL
Copper	10-15	3660 mg/kg	Fill	EIL
Lead	10-15	2270 mg/kg	Fill	EIL,HIL A
Zinc	10-15	1343 mg/kg	Fill	EIL
Copper	1.5-2.0	280 mg/kg	Fill	EIL

BH97	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	0.0-0.2	18.8 mg/kg	Fill	ESL

BH13	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
B(a)P	10-11	14 mg/kg	Fill	ESL

BH327	Depth	Concentration	Matrix	Criteria
Analyte	(m bgs)			
Copper	0.8-1.0	220 mg/kg	Fill	EIL
B(a)P	0.8-1.0	1.0 mg/kg	Fill	ESL

Legend:

Historical Soil Sample Locations

- CMPS&F 1994 (ES 2014b) - Lot 9
- DP 2005a - Lot 8
- DP 2008 (ES 2014b) - Lot 9
- DP 2008a - Lot 8
- ES 2014a - Lot 8
- ES 2014b - Lot 9
- HLA 2001 (DP 2005a) - Lot 8
- HLA 2001 (ES 2014b) - Lot 9
- HLA 2001 (ES 2014e) - Lot 8
- JET 1993 (DP 2005a) - Lot 8
- JET 1993 (ES 2014b) - Lot 9
- Approximate Boundary - ATP
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Lot & DP

- Lot 8 DP1136859
- Lot 9 DP1136859

JBS&G

Job No: 51142

Client: Mirvac

Version: R02 Rev 0 | Date: 15-Jun-2016

Drawn By: RF | Checked By: NC

Scale 1:1,000

0 20
metres

Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC EXCEEDANCES IN SOIL AND REMEDIAL EXTENT - LOT 8 AND 9

FIGURE 8A:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_08a.mxd
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au