ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

DESIGNINC SYDNEY PTY LTD

ON

PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT

FOR

NEW ULTIMO PYRMONT PUBLIC SCHOOL

AT

189 JONES STREET, ULTIMO

24 OCTOBER 2017 **REF: E30361KHrpt-rev2**

Postal Address: PO Box 976, North Ryde BC NSW 1670
Tel: 02 9888 5000 • Fax: 9888 5004
EIS is a division of Jeffery and Katauskas Pty Ltd • ABN 17 003 550 801

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Report prepared by:

Todd Hore
Associate Environmental Engineer

Report reviewed by:

Adrian Kingswell
Principal Environmental Scientist

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EXECUTIVE SUMMARY

Designinc Sydney Pty Ltd ('the client') commissioned Environmental Investigation Services (EIS) to undertake a Preliminary Environmental Site Assessment (ESA) for the new Ultimo Pyrmont Public School at 189 Jones Street, Ultimo.

The ESA included a review of a previous investigation report, walkover site inspection and soil sampling from 8 boreholes across the site.

The site has been owned by the Minister for Education and Training since 1989. Between 1921 and 1989, the land was Crown Land. From 1914 to 1921, the Railway Commissioner for NSW owned the land. Between 1867 and 1914, the land was privately owned. The historical information indicated that the development of the present school features, including the majority of the building construction and slope formation occurred in the 1960s. Placement of the imported topsoil in the upper terrace (eastern playing field) area probably occurred around the mid-1980s. Construction for the administration block was underway in 2002, and the building and current carpark at the western end of the school (lower terrace) were completed prior to 2004. The softfall surface on the upper terrace was placed at some time after 2005.

At the time of the inspection the site was occupied by Ultimo Public School, including various school buildings and playground areas.

The main source of potential contaminant at the site was considered to be the fill material.

Fill material was encountered beneath the pavement in all boreholes and extended to depths of approximately 1.5m to 8.1m. The fill was typically more shallow (approximately 2m) in the west section of the site.

Fill material including the sandy clay in BH3 logged as 'possibly fill' was classified as General Solid Waste (non-putrescible) (GSW). Natural clayey sand and silty sand soil in BH1 and BH2 and sandstone bedrock across the site was classified as Virgin excavated natural material (VENM).

The lead results in the BH6 (1.5-1.95m) and BH6 (3-3.45m) were 310mg/kg and 400mg/kg, respectively, and exceeded the HIL-A criterion.

The B(a)P TEQ result of 13mg/kg in the BH6 (0.5-0.95m) sample exceeded the HIL-A criterion. The remaining PAHs results were below the HIL-A criteria.

The lead results in selected fill samples from BH5, BH6 and BH7, the nickel result in the BH2 (0.4-0.5m) sample and the zinc result in the BH6 (3-3.45m) sample exceeded the EIL-UR&POS criteria. It should be noted that for the majority of these exceedances, the pH, CEC and clay content were not analysed.

The TRH F3 result of 590mg/kg in the BH6 (0.5-0.95m) sample exceeded the ESL-URPOS criterion.

The source of the PAHs and lead including lead in the fill samples is considered to be associated with the ash and slag inclusions encountered in the fill matrix. The natural soil samples analysed below the fill profile were not impacted by the contaminants. The TRH F3 encountered in the fill in BH6 is considered likely to be associated with elevated PAHs rather than a fuel or other hydrocarbon source.

The assessment has identified the following data gaps:
- Areas beneath the existing buildings have not been included in the assessment; and
- The horizontal extent of the contamination has not been adequately assessed.

The decision statements identified for this investigation are outlined below with appropriate responses:
- Do any of the samples contain contaminant concentrations above the SAC?
    - Yes, lead and PAHs were identified above the HILs. These results may present a risk to the site as discussed in Section 10. The risk posed by the fill material at the site will require further assessment.
- Was asbestos identified in any of the samples?

- No.
- Is further investigation required?
  - Yes, further investigation is considered necessary to better assess the nature and extent of the contamination.
- Is the site suitable for the proposed use?
  - In its current configuration with pavement across much of the site, the risk posed by the contamination to site receptors is very low. However is order to make the site suitable for the proposed new development, the recommendations listed below should be implemented.

Based on the scope of works undertaken, EIS are of the opinion that the CoPC identified at the site may pose a risk to the receptors.

EIS consider that the site can be made suitable for the proposed development provided that the following recommendations are implemented to address the data gaps and to better characterise the risks:

1. Undertake a Stage 2 ESA to address the data gaps**;**
2. Prepare a Remediation Action Plan (RAP) to outline remedial measures for the site;
3. In the event active remediation is preferred at the site, prepare a Validation Assessment (VA) report on completion of remediation;
4. In the event management is preferred over active remediation, prepare an Environmental Management Plan (EMP) for the ongoing management of contamination remaining on site. The EMP will require establishment of appropriate public notification under Section 149(2) of the E&PAA 1979 or a covenant registered on the title to land under Section 88B of the Conveyancing Act 1919; and
5. Undertake demolition of the building in accordance with the Hazardous Materials Assessment (Hazmat) previously prepared for the existing buildings.

In the event unexpected conditions are encountered during development work or between sampling locations that may pose a contamination risk, all works should stop and an environmental consultant should be engaged to inspect the site and address the issue.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of the report.

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ABBREVIATIONS

Ambient Background Concentrations	**ABC**
Added Contaminant Limits	**ACL**
Asbestos Containing Material	**ACM**
Australian Drinking Water Guidelines	**ADWG**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Asbestos Health Screening Levels	**ASL**
Acid Sulfate Soil	**ASS**
Above-Ground Storage Tank	**AST**
Below Ground Level	**BGL**
Bureau of Meteorology	**BOM**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene	**BTEXN**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Construction Management Plan	**CMP**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Conceptual Site Model	**CSM**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Assessment Criteria	**EAC**
Ecological Investigation Levels	**EILs**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Excavated Natural Material	**ENM**
Environmental Protection Agency	**EPA**
Environmental Site Assessment	**ESA**
Ecological Screening Level	**ESL**
Fibre Cement Fragments	**FCF**
General Approvals of Immobilisation	**GAI**
General Solid Waste	**GSW**
Health Investigation Level	**HILs**
Hardness Modified Trigger Values	**HMTV**
Health Screening Level	**HSLs**
International Organisation of Standardisation	**ISO**
Lab Control Spike	**LCS**
Light Non-Aqueous Phase Liquid	**LNAPL**
Local Government Authority	**LGA**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**

ABBREVIATIONS

Photo-ionisation Detector	**PID**
Practical Quantitation Limit	**PQL**
Preliminary Site Investigation	**PSI**
Quality Assurance	**QA**
Quality Control	**QC**
Remediation Action Plan	**RAP**
Relative Percentage Difference	**RPD**
Restricted Solid Waste	**RSW**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
Site Audit Statement	**SAS**
Site Audit Report	**SAR**
Specific Contamination Concentration	**SCC**
Standard Penetration Test	**SPT**
Semi-Volatile Organic Compounds	**sVOC**
Standard Sampling Procedure	**SSP**
Standard Water Level	**SWL**
Standard Sampling Procedure	**SSP**
Trip Blank	**TB**
Toxicity Characteristic Leaching Procedure	**TCLP**
Total Recoverable Hydrocarbons	**TRH**
Trip Spike	**TS**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**
Underground Storage Tank	**UST**
Virgin Excavated Natural Material	**VENM**
Volatile Organic Compounds	**VOC**
Work Health and Safety	**WHS**

1 INTRODUCTION

Designinc Sydney Pty Ltd ('the client') commissioned Environmental Investigation Services (EIS)[1] to undertake a Preliminary Environmental Site Assessment (ESA) for the new Ultimo Pyrmont Public School at 189 Jones Street, Ultimo. The site location is shown on Figure 1 and the assessment was confined to the site boundaries as shown on Figure 2.

A geotechnical investigation was undertaken in conjunction with this assessment by JK Geotechnics[2]. The results of the investigation are presented in a separate report (Ref. 30361SBrpt, dated 9 May 2017[3]). This report should be read in conjunction with the JK report.

1.1 Proposed Development Details

From the supplied architectural drawings by DesignInc Sydney Pty Ltd (Project No: S15124, Drawing Nos: DA-2301 to DA-2306, DA-3001, DA-3002, DA-4001 and DA-4002, Revision 1, dated 16/12/16) the existing school will be completely demolished and a new school constructed. The new school will extend to all site boundaries. The new development will step up the hillside and will be formed at three main floor levels of RL4.5m at the western end, RL11.7m within the central portion and RL15.3m at the eastern end. However, a lower parking area is proposed within the north-western corner at RL2.9m. To achieve these levels excavation will be required to maximum depths of approximately 6m at the eastern edge of each step in level. At the western end of each level the proposed level will be up to about 2m higher than the existing surface. At this point it is unknown if fill will be placed in areas where the finished level is above the existing level or a void left below the lowest floor slabs.

1.2 Aim and Objectives

The primary aims of the assessment were to identify any past or present potentially contaminating activities at the site, identify the potential for site contamination, and make a preliminary assessment of the soil contamination conditions. The assessment objectives were to:

- Provide an appraisal of the past site use(s) based on a review of historical information contained in a previous report prepared for the site;
- Assess the current site conditions and use via a site walkover inspection;
- Identify potential contamination sources/areas of environmental concern (AEC) and contaminants of potential concern (CoPC);
- Assess the soil contamination conditions via implementation of a preliminary sampling and analysis program;
- Prepare a conceptual site model (CSM);
- Assess the potential risks posed by contamination to the receptors identified in the CSM (Tier 1 assessment);

[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)
[2] Geotechnical consulting division of J&K
[3] Referred to as JK 2017 Report

- Provide a preliminary waste classification for off-site disposal of soil;
- Assess whether further intrusive investigation and/or remediation is required; and
- Assess whether the site is suitable or can be made suitable for the proposed development (from a contamination viewpoint).

1.3 Scope of Work

The assessment was undertaken generally in accordance with an EIS proposal (Ref: EP44487KH) of 10 March 2017 and written acceptance from the client of 4 April 2017. The scope of work included the following:

- Review of site information, including background and site history information contained in the previous report prepared by NSW Department of Education;
- A walkover site inspection;
- Design and implementation of a sampling, analysis and quality plan (SAQP);
- Interpretation of the analytical results against the adopted site assessment criteria (SAC);
- Assessment of data quality; and
- Preparation of an ESA report presenting the results of the assessment, including a CSM and Tier 1 risk assessment.

The report was prepared with reference to regulations/guidelines outlined in the table below. Individual guidelines are also referenced within the text of the report.

Table 1-1: Guidelines

Guidelines/Regulations/Documents
Contaminated Land Management Act (1997)[4]
State Environmental Planning Policy No.55 – Remediation of Land (1998)[5]
Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)[6]
Guidelines for Consultants Reporting on Contaminated Sites (2011)[7]
Guidelines for the NSW Site Auditor Scheme, 2nd Edition (2006)[8]
National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)[9]

[4] NSW Government Legislation, (1997). *Contaminated Land Management Act 1997.* (referred to as CLM Act 1997)

[5] NSW Government, (1998). *State Environmental Planning Policy No. 55 – Remediation of Land.* (referred to as SEPP55)

[6] Department of Urban Affairs and Planning, and Environment Protection Authority, (1998). *Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land*. (SEPP55 Planning Guidelines)

[7] NSW Office of Environment and Heritage (OEH), (2011). *Guidelines for Consultants Reporting on Contaminated Sites.* (referred to as Reporting Guidelines 2011)

[8] NSW DEC, (2006). *Guidelines for the NSW Site Auditor Scheme, 2nd ed.* (referred to as Site Auditor Guidelines 2006)

[9] National Environment Protection Council, (2013). *National Environmental Protection (Assessment of Site Contamination) Amendment Measure 1999* (as amended 2013). (referred to as NEPM 2013)

2 SITE INFORMATION

2.1 Background

EIS understand that a hazardous materials assessment has previously been prepared for the site, however, we have not undertaken a review of the assessment.

2.1.1 Preliminary Contamination Investigation

A Preliminary Contamination Investigation was undertaken by the Specialist Services Section (NSW Public Works, NSW Water Solutions). The results are contained in the report dated November 2015 (ref: 15-GS94B). The investigation included a review of historical site information and soil sampling from 6 boreholes.

The site has been owned by the Minister for Education and Training since 1989. Between 1921 and 1989, the land was Crown Land. From 1914 to 1921, the Railway Commissioner for NSW owned the land. Between 1867 and 1914, the land was privately owned. The historical information indicated that the development of the present school features, including the majority of the building construction and slope formation occurred in the 1960s. Placement of the imported topsoil in the upper terrace (eastern playing field) area probably occurred around the mid-1980s. Construction for the administration block was underway in 2002, and the building and current carpark at the western end of the school (lower terrace) were completed prior to 2004. The softfall surface on the upper terrace was placed at some time after 2005.

The main source of potential contaminant at the site was considered to be the fill material.

The boreholes typically encountered deep fill material overlying natural soil and/or bedrock. Groundwater was encountered in the three boreholes (B4 to B6) drilled within the lower terrace area. Inflow/ seepages were encountered at depths of 3.2m (B4), 2.85m (B5) and 2.7m (B6). At the completion of drilling the groundwater levels were recorded at depths of 2.9m (B4), 2.5m (B5) and 2.4m (B6), which corresponded to elevations of RL1.0m, RL1.4m and RL1.5m, respectively.

The investigation report referred to a previous assessment from 2001 that included garden bed sampling. These results are considered too old to be reliable, however, EIS note that some elevations of Polycyclic Aromatic Hydrocarbons (PAHs), lead and Total Recoverable Hydrocarbons (TRH) were encountered.

The lead results in the fill in B6 (south-west section of the site) exceeded the Health Investigation Level (HIL-A). Copper and mercury results in the fill in B5 and B6 exceeded the Ecological Assessment Criteria (EAC).

Benzo(a)Pyrene TEQ (B(a)P TEQ) results in the fill in B1 and B2 (North-east section of the site) exceeded the HIL-A criteria. TRH F3 in the B1 and B2 fill samples exceeded the EAC.

The report recommended the following:

- Any material that is to be excavated and disposed of in a NSW OEH (now EPA) licensed landfill should be assessed and classified (with TCLP testing, where appropriate) in accordance with the Waste Classification Guidelines (NSW EPA, November 2014) and relevant legislation.
- Any imported fill material should be validated in accordance with National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM). The fill material should not contain asbestos, and not be acid sulfate soil or saline soil. The imported fill material should be 'virgin excavated natural material' (VENM) or 'excavated natural material' (ENM), as defined in the Waste Classification Guidelines (NSW EPA, 2014) because of their low risk of contamination.
- An Environmental Site Management Plan should be prepared. This Plan should include a contingency plan for the assessment / management of any unexpected contamination during the course of earthworks.

2.2 Site Identification

Table 2-1: Site Identification

Current Site Owner:	Minister for Education and Training
Site Address:	189 Jones Street, Ultimo
Lot & Deposited Plan:	Lot 101 DP 1105527
Current Land Use:	Primary School
Proposed Land Use:	Primary School
Local Government Authority (LGA):	City of Sydney
Current Zoning:	B4 Mixed Use
Site Area (m^2):	5,350
RL (AHD in m) (approx.):	10
Geographical Location (decimal degrees) (approx.):	Latitude: -33.8777 Longitude: 151.1956

2.3 Site Location and Regional Setting

The site is located in a predominantly residential area of Ultimo and is bound by Jones, Quarry and Wattle Streets to the east, north and west, respectively. The site is located approximately 500m to the south-east of Blackwattle Bay.

2.4 Topography

The regional topography generally falls to the west at 5-10° with a north-south orientated ridgeline located to the east of the site. The site itself falls to the west at approximately 5-10° overall, however, several terraces have been cut into the slope to create level areas.

2.5 Site Inspection

A walkover inspection of the site was undertaken by EIS on 12 April 2017. The inspection was limited to accessible areas of the site and immediate surrounds. An internal inspection of buildings was not undertaken.

At the time of the inspection the site was occupied by Ultimo Public School, including various school buildings and playground areas.

A summary of the findings are outlined in the following subsections:

2.5.1 Buildings, Structures and Roads

School buildings were located in the north, west and south sections of the site. The buildings in the north and west were multi-storey classroom buildings. The building in the south section included common rooms and a library. A demountable classroom building was located in the north-west corner of the site.

2.5.2 Boundary Conditions, Soil Stability and Erosion

The school was fully fenced along all boundaries and included retaining walls along the east and south boundaries. The retaining wall along the east boundary was approximately 1.6m high and retained Jones Street above the site. The retaining wall along the south boundary was of variable height and generally followed the existing tiers at the site.

The majority of the site was paved and included an Asphaltic Concrete car park in the west section, a concrete playground in the central section and artificial grass in the east section.

A batter slope was located west of the artificial turf that fell to the west at approximately 30° and included a 1m high retaining wall at the base of the batter. A series of four retaining walls and terraces were located immediately west of the concrete paved playground. The terraces included garden areas.

2.5.3 Visible or Olfactory Indicators of Contamination

No visual or olfactory indicators of contamination were observed at the site.

2.5.4 Presence of Drums/Chemicals, Waste and Fill Material

Deep fill material is likely to be encountered on the high side of retaining walls, batters and terraces at the site.

2.5.5 Drainage and Services

Surface water flows would be expected to flow into the stormwater infrastructure at the site, except for the small landscaped and garden areas at the site, where infiltration is more likely.

2.5.6 Sensitive Environments

Sensitive environments such as wetlands, ponds, creeks or extensive areas of natural vegetation were not identified on site or in the immediate surrounds.

2.5.7 Landscaped Areas and Visible Signs of Plant Stress

A vegetable garden was located in the south-east corner of the site. Garden and landscaped areas were located in the batter slope, terraces and along the east, north and west site boundaries.

2.6 Surrounding Land Use

During the site inspection, EIS observed the following land uses in the immediate surrounds:

- North – A large commercial, warehouse building was located to the north of Quarry Street. Signage indicated the building was occupied by Johnson & Johnson (health care and pharmaceutical products);
- South – high rise residential apartments;
- East – mixed retail and residential area including apartment buildings and street front shops (framing, take-away sushi and computers sales/repairs); and
- West – Parkland and Wentworth Park Greyhound track.

EIS did not observe any land uses in the immediate surrounds that were identified as potential contamination sources for the site.

2.7 Underground Services

The 'Dial Before You Dig' (DBYD) plans were reviewed for the assessment in order to establish whether any major underground services exist at the site or in the immediate vicinity that could act as a preferential pathway for contamination migration. No major services were identified that would be expected to act as preferential pathway for contamination migration.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology

A review of the regional geological map of Sydney (1983[10]) indicates that the site is underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses. An area underlain by man-made fill is located immediately west of the site. This fill typically consists of dredged estuarine sand and mud, demolition rubble, industrial and household waste.

3.2 Acid Sulfate Soil Risk and Planning

The site is not located in an acid sulfate soil (ASS) risk area according to the risk maps prepared by the Department of Land and Water Conservation. An area of disturbed terrain is located immediately west of the site.

3.3 Hydrogeology

A review of groundwater bore records available on the NSW Office of Water[11] (NOW) online database was undertaken on 24 May 2017. The search was limited to registered bores located within a radius of approximately 500m of the site. No registered bores were located within the search area.

The information reviewed for this assessment indicated that the subsurface conditions at the site are likely to consist of residual soils overlying relatively shallow bedrock. The potential for viable groundwater abstraction and use of groundwater under these conditions is considered to be low.

3.4 Receiving Water Bodies

Surface water bodies were not identified in the immediate vicinity of the site. The closest surface water body is Blackwattle Bay located approximately 500m to the north-west of the site. This water body could be a potential receptor, however, due to the distance from the site, the potential for Blackwattle Bay to be a receptor is low.

[10] Department of Mineral Resources, (1983). *1:100,000 Geological Map of Sydney (Series 9130).*

[11] http://www.waterinfo.nsw.gov.au/gw/

4 CONCEPTUAL SITE MODEL

NEPM (2013) defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM for the site is presented in the following sub-sections and is based on the site information (including the site inspection information) and the review of site history information. Reference should also be made to the figures attached in the appendices.

4.1 Potential Contamination Sources/AEC and CoPC

The potential contamination sources/AEC and CoPC are presented in the following table:

Table 4-1: Potential Contamination Sources/AEC and Contaminants of Potential Concern

Source / AEC	CoPC
Fill material - The site appears to have been historically filled to achieve the existing levels. The fill may have been imported from various sources and could be contaminated. Historical information indicated that the majority of the site was filled in the 1960's.	Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), polychlorinated biphenyls (PCBs) and asbestos.
Use of pesticides – Pesticides may have been used beneath the buildings and/or around the site.	Heavy metals, OCPs and OPPs
Hazardous Building Material – Hazardous building materials may be present as a result of former building and demolition activities. These materials may also be present in the existing buildings/ structures on site.	Asbestos, lead and PCBs

4.2 Known Contamination Sources/AEC and CoPC

Heavy Metals, TRH and PAHs were encountered in the fill material during previous investigations. The lead results in the fill in B6 (south-west section of the site) and the Benzo(a)Pyrene TEQ (B(a)P TEQ) results in the fill in B1 and B2 (North-east section of the site) were identified above the HIL-A criteria.

4.3 Mechanism for Contamination, Affected Media, Receptors and Exposure Pathways

The mechanisms for contamination, affected media, receptors and exposure pathways relevant to the potential contamination sources/AEC are outlined in the following CSM table:

Table 4-2: CSM

Potential mechanism for contamination	Potential mechanisms for contamination include: • Fill material – importation of impacted material, 'top-down' impacts (e.g. leaching from surficial material), or sub-surface release (e.g. impacts from buried material); • Use of pesticides – 'top-down' and spills (e.g. during normal use, application and/or improper storage); and • Hazardous building materials – 'top-down' (e.g. demolition resulting in surficial impacts in unpaved areas).
Affected media	Soil/soil vapour and groundwater have been identified as potentially affected media.
Receptor identification	Human receptors include site occupants/users, construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users, groundwater users and recreational water users within Blackwattle Bay. Ecological receptors include terrestrial organisms and plants within unpaved areas (including the proposed landscaped areas), and marine ecology in Blackwattle Bay.
Potential Exposure pathways	Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants) and vapours (volatile TRH, naphthalene and BTEX). The potential for exposure would typically be associated with the construction and excavation works, and use of unpaved areas (i.e. the gardens) and basement (i.e. vapour inhalation or incidental contact with groundwater seepage). Potential exposure pathways for ecological receptors include primary contact and ingestion.
Presence of preferential pathways for contaminant movement	Contaminant migration at the site would potentially be restricted by the various retaining walls and terraces. No preferential pathways have been identified.

4.4 Assessment of Data Gaps

EIS has undertaken a preliminary data gap analysis based on the findings of assessment. The data gaps and our comments are outlined in the following table:

Table 4-3: Data Gap Assessment

Data Gap	EIS Comments
The historical assessment was undertaken as part of previous investigations.	The historical assessment excluded Council and SafeWork NSW records. As the site has likely been a school since the early 1900's, the absence of these records is considered unlikely to alter the outcome of the historical assessment.
Groundwater Sampling	Groundwater sampling and analysis was outside the scope of this assessment. This data gap has been considered Section 10.3 of this report.

5 SAMPLING, ANALYSIS AND QUALITY PLAN

5.1 Data Quality Objectives (DQO)

The NEPM 2013 defines the DQO process as a seven step iterative planning tool used to define the type, quantity and quality of data needed to inform decisions relating to the environmental condition of the site. The DQO process is detailed in the Site Auditor Guidelines 2006 and the USEPA documents Data Quality Objectives Processes for Hazardous Waste Site Investigations (2000) and Guidance on Systematic Planning Using the Data Quality Objectives Process (2006). These seven steps are applicable to this assessment as summarised in the table below:

Table 5-1: DQOs – Seven Steps

Step	Input
State the Problem	The CSM has identified AEC at the site which may pose a risk to the site receptors. An intrusive investigation is required to assess the risk and comment on the suitability of the site for the proposed development or intended landuse. The assessment also aims to meet the requirements of SEPP55 in order to address the council DA process.
Identify the Decisions/ Goal of the Study	The data collection is project specific and has been designed based on the following information: • Review of site information including site history; • AEC, CoPC, receptors, pathways and medium identified in the CSM; • Development of SAC for each media; and • The use of decision statements outlined below: ➢ Do any of the samples contain contaminant concentrations above the SAC? ➢ Was asbestos identified in any of the samples? ➢ Is further investigation required? ➢ Is the site suitable for the proposed use? 1) Statistical analysis will be used to assess the laboratory data against the SAC. The following criteria will be adopted: ➢ The 95% Upper Confidence Limit (UCL) value of the arithmetic mean concentration of each contaminant should be less than the SAC; ➢ The standard deviation (SD) of the results must be less than 50% of the SAC; and ➢ No single value exceeds 250% of the relevant SAC. 2) Statistical calculations will not be undertaken if all results are below the SAC; and 3) Statistical calculations will not be undertaken on the following: ➢ Health Screening Levels (HSLs) – elevated point source contamination associated with petroleum hydrocarbons can pose a vapour risk to receptors.

Step	Input
Identify Information Inputs	The following information will be collected: • Soil samples based on subsurface conditions; • The SAC will be designed based on the criteria outlined in NEPM 2013. Other criteria will be used as required and detailed in this report; • The samples will be analysed in accordance with the analytical methods outlined in NEPM 2013; • Field screening information (i.e. PID data, presence of hydrocarbons etc.) will be taken into consideration in selecting the analytical schedule; and • Any additional information that may arise during the field work will also be used as data inputs.
Define the Study Boundary	The sampling will be confined to the site boundaries as shown in Figure 2. Fill has been identified as an AEC. The source of fill has not been established. Fill is considered to be heterogeneous material with PCC occurring in random pockets or layers. The presence of PCC in between sampling points cannot be measured. The areas excluded from the investigation are outlined in the data gaps.
Develop the analytical approach (or decision rule)	The following acceptable limits will be adopted for the data quality assessment: • The following acceptance criteria will be used to assess the RPD results: ➢ results > 10 times the practical quantitation limit (PQL), RPDs < 50% are acceptable; ➢ results between 5 and 10 times PQL, RPDs < 75% are acceptable; ➢ results < 5 times PQL, RPDs < 100% are acceptable; and ➢ An explanation is provided if RPD results are outside the acceptance criteria. • Acceptable concentrations in Trip Spike (TS), Trip Blanks (TB) and Field Rinsate (FR) samples. Non-compliance to be documented in the report; • The following acceptance criteria will be used to assess the primary laboratory QA/QC results. Non-compliance to be documented: ➢ RPDs: - Results that are < 5 times the PQL, any RPD is acceptable; and - Results > 5 times the PQL, RPDs between 0-50% are acceptable; ➢ LCS recovery and matrix spikes: - 70-130% recovery acceptable for metals and inorganics; - 60-140% recovery acceptable for organics; and - 10-140% recovery acceptable for VOCs; ➢ Surrogate spike recovery: - 60-140% recovery acceptable for general organics; and - 10-140% recovery acceptable for VOCs; ➢ Blanks: All less than PQL.
Specify the performance	NEPM 2013 defines decision errors as '*incorrect decisions caused by using data which is not representative of site conditions*'. This can arise from errors during sampling or analytical

Step	Input
or acceptance criteria	testing. A combination of these errors is referred to as '*total study error*'. The study error can be managed through the correct choice of sample design and measurement. Decision errors can be controlled through the use of hypothesis testing. The test can be used to show either that the baseline condition is false or that there is insufficient evidence to indicate that the baseline condition is false. The null hypothesis is an assumption that is assumed to be true in the absence of contrary evidence. In this case, for example, the PCC identified in the PCSM is considered to pose a risk to receptors unless proven not to. The null hypothesis has been adopted for this assessment.
Optimise the design for obtaining data	The most resource-effective design will be used in an optimum manner to achieve the assessment objectives.

5.2 Soil Sampling Plan and Methodology

The soil sampling plan and methodology adopted for this assessment is outlined in the table below:

Table 5-2: Soil Sampling Plan and Methodology

Aspect	Input
Sampling Density	The NSW EPA Contaminated Sites Sampling Design Guidelines (1995[12]) recommend a sampling density for an environmental assessment based on the size of the investigation area. The guideline provides a minimum number of sampling points required for the investigation on a systematic sampling pattern. The guidelines recommend sampling from a minimum of 14 evenly spaced sampling points for this site with an area of approximately 5,350m^2. Samples for this investigation were obtained from 8 sampling points as shown on the attached Figure 2. This density is approximately 57% of the minimum sampling density recommended by the EPA.
Sampling Plan	The sampling locations were placed on a systematic plan with a spacing of up to 32m between sampling locations. A systematic plan was considered suitable to address potential contaminants associated with the fill material.
Exclusion Areas (Data Gaps)	Sampling was not undertaken in inaccessible areas of the site such as beneath existing buildings and in steeper batter or terraced areas. These areas have been excluded from the investigation.

[12] NSW EPA, (1995), *Contaminated Sites Sampling Design Guidelines.* (referred to as EPA Sampling Design Guidelines 1995)

Aspect	Input
Sampling Equipment	Soil samples were obtained on 10-13 April 2017 in accordance with the standard sampling procedure (SSP) attached in the appendices. Sampling locations were set out using a tape measure. In-situ sampling locations were cleared for underground services by an external contractor prior to sampling as outlined in the SSP. The sample locations were drilled using the following equipment as shown on the borehole pit logs attached in the appendices: • Hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.
Sampling Collection and Field QA/QC	Soil samples were collected from the fill and natural profiles based on field observations. The sampling depths are shown on the logs attached in the appendices. Additional samples were obtained when relatively deep fill (>0.5m) was encountered. Samples were also obtained when there was a distinct change in lithology or based on the observations made during the investigation. During sampling, soil at selected depths was split into primary and duplicate samples for field QA/QC analysis. Samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date in accordance with the SSP.
Field PID Screening for VOCs	A portable Photoionisation Detector (PID) was used to screen the samples for the presence of VOCs and to assist with selection of samples for hydrocarbon analysis. The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The portable PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source. The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents. PID field check records are maintained in the job file. PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases.

Aspect	Input
Decontamination and Sample Preservation	The decontamination procedure adopted during sampling is outlined in the SSP. Where applicable, the sampling equipment was decontaminated using a scrubbing brush and potable water and Decon 90 solution (phosphate free detergent) followed by rinsing with potable water. Rinsate samples were obtained during the decontamination process as part of the field QA/QC. Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with the SSP. On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures.

5.3 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 5-3: Analytical Schedule

PCC/CoPC	Fill Samples	Natural Soil Samples
Heavy Metals	28	4
TRH/BTEXN	28	4
PAHs	28	4
OCPs/OPPs	8	-
PCBs	8	-
Asbestos	23	2
pH/CEC/Clay Content (%)	3	-
TCLP Metals	10	-
TCLP PAHs	8	-

5.3.1 Laboratory Analysis

The samples were analysed by the NATA Accredited laboratory/s using the analytical methods detailed in Schedule B(3) of NEPM 2013. Reference should be made to the laboratory reports attached in the appendices for further details.

Table 5-4: Laboratory Details

Samples	Laboratory	Report Reference
All primary samples and field QA/QC samples including (intra-laboratory duplicates, trip blanks, trip spikes and field rinsate samples)	Envirolab Services Pty Ltd NSW, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)	165375, 165375-A and 165375-B
Inter-laboratory duplicates	Envirolab Services Pty Ltd VIC, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)	194747

6 SITE ASSESSMENT CRITERIA (SAC)

The SAC adopted for the assessment is outlined in the table below. The SAC has been derived from the NEPM 2013 and other guidelines as applicable. The guideline values for individual contaminants are presented in the attached report tables.

The 'residential with accessible soil' guidelines have been adopted for this assessment as these guidelines also include primary schools.

Table 6-1: SAC Adopted for this Investigation

Guideline	Applicability
Health Investigation Levels (HILs) (NEPM 2013)	The HIL-A criteria for 'residential with accessible soil' have been adopted for this assessment.
Health Screening Levels (HSLs) (NEPM 2013)	The HSL-A criteria for 'residential with accessible soil' have been adopted for this assessment.
Ecological Assessment Criteria (EAC) (NEPM 2013)	A preliminary screening of ecological risk has been undertaken based on the limited information available at this stage. The EAC criteria for 'urban residential and public open space (URPOS)' exposure setting have been adopted. The EILs for selected metals and selected samples (those with the highest concentrations of each metal) have been derived as follows: • The ABC values for high traffic (25th percentiles) areas for old suburbs of NSW published in Olszowy et. al. (1995[13]) has been adopted for this assessment; and • Selected fill samples obtained from the surficial profile (<2m) across the site were analysed for pH, CEC and clay content. The average pH, CEC and clay content values were used to calculate the ACL. For samples with concentrations lower than the maximum for each metals, soil parameters: pH; cation exchange capacity (CEC); and clay content have not been analysed for the assessment. On this basis, the EIL and ESL calculations have taken the 'worst case' scenario in order to generate the EAC.
Management Limits for TRH	These guidelines have only been used after considering the relevant HSLs and ESLs for adverse effects of TRH contamination where necessary.

[13] Olszowy, H., Torr, P., and Imray, P., (1995), *Trace Element Concentrations in Soils from Rural and Urban Areas of Australia. Contaminated Sites Monograph Series No. 4*. Department of Human Services and Health, Environment Protection Agency, and South Australian Health Commission.

Guideline	Applicability
Asbestos in Soil	The 'presence/absence' of asbestos in soil has been adopted as the assessment criterion for the Preliminary Site Investigation (PSI).
Waste Classification (WC) Criteria	The criteria outlined in the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014[14]) has been adopted to classify the material for off-site disposal.

[14] NSW EPA, (2014), *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

7 INVESTIGATION RESULTS

7.1 Subsurface Conditions

A summary of the subsurface conditions encountered during the investigation is presented in the table below. Reference should be made to the borehole logs attached in the appendices for further details.

Table 7-1: Summary of Subsurface Conditions

Profile	Description (m in bgl)
Pavement	Asphaltic Concrete (AC), Concrete or synthetic pavement, approximately 10mm to 180mm thick, was encountered at the surface in all boreholes.
Fill	Fill material was encountered beneath the pavement in all boreholes and extended to depths of approximately 1.5m to 8.1m. The fill was typically more shallow (approximately 2m) in the west section of the site. The fill typically comprised silty sand, clayey sand, gravelly sand and sandy gravel. The fill contained inclusions of igneous, ironstone and sandstone gravel, slag, ash and brick fragments. Metal fragments were encountered in the fill in BH6.
Natural Soil	Clayey sand, silty sand, sandy clay natural soils were encountered beneath the fill in BH1 to BH3 and extended to depths of approximately 3.3m to 8.1m. The natural soil was typically grey or brown and contained traces of ironstone gravel in BH2.
Bedrock	Sandstone was encountered beneath the fill or natural soil in all boreholes and extended to the termination of all boreholes at a maximum depth of approximately 13.31m. The sandstone was typically light grey and yellow brown.
Groundwater	Groundwater seepage was encountered in BH1 and BH2 at depths of 2m to 2.2m. Groundwater was encountered at a depth of approximately 7.6m in BH3, which was slightly above the bedrock. The remaining boreholes were dry on completion of augering.

7.2 Field Screening

A summary of the field screening results are presented in the table below.

Table 7-2: Summary of Field Screening

Aspect	Details (m in bgl)
PID Screening of Soil Samples for VOCs	PID soil sample headspace readings are presented in attached report tables and the COC documents attached in the appendices. All results were 0 ppm equivalent isobutylene which indicates a lack of PID detectable VOCs.
Groundwater Depth & Flow	Groundwater seepage was encountered in boreholes BH2 and BH3 during drilling at depths of approximately 2m to 2.2m.

Aspect	Details (m in bgl)
	Groundwater across the majority of the site is expected to be associated with perched water on the surface of the bedrock. Groundwater may be present in the lower (west) section of the site. Groundwater would be expected to flow to the north-west.

7.3 Soil Laboratory Results

The soil laboratory results are compared to the relevant SAC in the attached report tables. A summary of the results assessed against the SAC is presented below.

Table 7-3: Summary of Soil Laboratory Results

Analyte	Results Compared to SAC
Heavy Metals	**HILs:** The lead results in the BH6 (1.5-1.95m) and BH6 (3-3.45m) were 310mg/kg and 400mg/kg, respectively, and exceeded the HIL-A criterion. The remaining heavy metal results were below the HIL-A criteria. **EILs:** The lead results in selected fill samples from BH5, BH6 and BH7 ranged from 110mg/kg to 220mg/kg and exceeded the EIL-UR&POS criteria. The nickel result of 74mg/kg in the BH2 (0.4-0.5m) sample exceeded the EIL-UR&POS criterion. The zinc result of 200mg/kg in the BH6 (3-3.45m) sample exceeded the EIL-UR&POS criterion. It should be noted that for the majority of these exceedances, the pH, CEC and clay content were not analysed. The remaining heavy metal results were below the EIL-UR&POS criteria. **WC:** Several fill samples contained concentrations of lead or nickel above the CT1 criteria. The remaining heavy metal results were less than the CT1 criteria and all results were less than the SCC1 criteria. TCLP leachates were prepared from the samples with elevated lead or nickel results and analysed for lead or nickel as required. The results were less than the TCLP1 criteria.
TRH	**HSLs:** All TRH results were below the HSL-A criteria. **ESLs:** The TRH F3 result of 590mg/kg in the BH6 (0.5-0.95m) sample exceeded the ESL-URPOS criterion. The remaining TRH results were below the ESL-URPOS criteria. **WC:** All TRH results were less than the SCC1 criteria.

Analyte	Results Compared to SAC
BTEXN	**HSLs:** All BTEXN results were below the HSL-A criteria. **ESLs:** All BTEXN results were below the ESL-URPOS criteria. **WC:** All BTEX results were less than the relevant CT1 and SCC1 criteria.
PAHs	**HILs:** The B(a)P TEQ result of 13mg/kg in the BH6 (0.5-0.95m) sample exceeded the HIL-A criterion. The remaining PAHs results were below the HIL-A criteria. **HSLs:** All naphthalene results were below the HSL-A criteria. **ESLs:** All benzo(a)pyrene results were below the ESL-URPOS criteria, **EILs:** All naphthalene results were below the EIL-URPOS criteria. **WC:** The majority of fill samples from BH3, BH5 and BH6 contained concentrations of B(a)P above the CT1 criterion. The remaining PAH results were less than the relevant CT1 criteria and all results were less than the SCC1 criteria. TCLP leachates were prepared from the samples with concentrations of B(a)P above the CT1 criteria, with the exception of the BH6 (1.5-1.95m) sample, and analysed for PAHs. The results were less than the TCLP1 criteria. No TCLP could be prepared from the BH6 (1.5-1.95m) sample as there was insufficient sample remaining after the initial analyses.
OCPs & OPPs	**HILs:** All OCP and OPP results were below the HIL-A criteria. **EILs:** All DDT results were below the EIL-URPOS criteria. **WC:** All OCP and OPP results were less than the relevant CT1 and SCC1 criteria.
PCBs	**HILs:** All PCB results were below the HIL-A criterion.

Analyte	Results Compared to SAC
	<u>WC:</u> All PCB results were less than the SCC1 criterion.
Asbestos	Asbestos was not detected in the samples analysed for the investigation.

8 DATA QUALITY ASSESSMENT

As part of the data quality assessment the following data quality indicators (DQIs) were assessed: precision, accuracy, representativeness, completeness and comparability as outlined in the table below. Reference should be made to the appendices for an explanation of the individual DQI.

Table 8-1: Assessment of DQIs

Completeness

Field Considerations:

- The investigation was designed as a preliminary screening and sampling was confined to accessible areas of the site (see Figure 2);
- Samples were obtained from various depths based on the subsurface conditions encountered at the sampling locations. All samples were recorded on the borehole logs. All sampling points are shown on the attached Figure 2;
- The investigation was undertaken by trained staff in accordance with the SSP; and
- Documentation maintained during the field work is attached in the appendices where applicable.

Laboratory Considerations:

- Selected samples were analysed for a ranged of PCC/CoPC. For the preliminary screening samples were not analysed for VOCs;
- All samples were analysed by NATA registered laboratories in accordance with the analytical methods outlined in NEPM 2013;
- Appropriate analytical methods and PQLs were used by the laboratories;
- Appropriate sample preservation, handling, holding time and COC procedures were adopted for the investigation;
- Samples analysed for TCLP PAHs were outside the 14 days holding time. This is not considered to have an impact on the data set due to the following:
  - ➢ The main contaminant of concern from a health based point of view was benzo[a]pyrene. This PAH has a high molecular weight and low vapour pressure and is very stable; and
  - ➢ The samples have been stored in a refrigerator at the lab.

Comparability

Field Considerations:

- The investigation was undertaken by trained staff in accordance with the SSP;
- The climate conditions encountered during the field work were noted on the site description record maintained in the job file; and
- Consistency was maintained during sampling in accordance with the SSP.

Laboratory Considerations:

- All samples were analysed in accordance with the analytical methods outlined in NEPM 2013;
- Appropriate PQLs were used by the laboratories for all analysis (other than those outlined above);
- All primary, intra-laboratory duplicates and other QA/QC samples were analysed by the same laboratory; and
- The same units were used by the laboratory/s for all of the analysis.

Representativeness

Field Considerations:

- The investigation was designed to obtain appropriate media encountered during the field work as outlined in the SAQP. Dust and/or vapour sampling was outside the scope of this assessment; and
- All media based on the subsurface conditions encountered during the field work was sampled.

Laboratory Considerations:

- All samples were analysed in accordance with the SAQP.

Precision

Field Considerations:

- The investigation was undertaken in accordance with the SSP.

Laboratory Considerations:

- Analysis of field QA/QC samples including inter and intra-laboratory duplicates, trip blanks (TB), field rinsate (FR) and trip spikes (TS) as outlined below;
- The field QA/QC frequency adopted for the investigation is outlined below;
- Calculation of the Relative Percentage Difference (RPD) from the primary and duplicate results (the RPD calculation equation is outlined in the attached appendices);
- Assessment of RPD results against the acceptance criteria outlined in **Section 5.1.**

Intra-laboratory RPD Results:
Soil Samples at a frequency of 3% of the primary samples:

- Dup 2 is a soil duplicate of primary sample BH6 (0.05-0.15m).

The RPD value for mercury was outside the acceptance criteria. Values outside the acceptable limits have been attributed to sample heterogeneity and the difficulties associated with obtaining homogenous duplicate samples of heterogenous matrices.

As both the primary and duplicate sample results were less than the SAC, the exceedances are not considered to have had an adverse impact on the data set as a whole.

Inter-laboratory RPD Results:
Soil Samples at a frequency of 3% of the primary samples:

- Dup 3 is a soil duplicate of primary sample BH2 (1-1.2m)

The inter-laboratory results are presented in the attached report tables. The results indicated that field precision was acceptable.

Trip Spike (TS):
One soil and TS was analysed for BTEX at a frequency of one spike per batch of volatiles. The results are presented in the attached report tables.

The results ranged from 99% to 106% and indicated that field preservation methods were appropriate.

Field Rinsate (FR):
One FR sample obtained from the field equipment decontamination process was analysed for BTEXN. The results are presented in the attached report tables.

All results were below the PQL which indicates that cross-contamination artefacts associated with sampling equipment were not present.

Trip Blank (TB):
One soil TB was analysed for BTEX at a frequency of one blank per batch of volatiles. The results are presented in the attached report tables.

The results were all less than the PQLs.

Accuracy

Field Considerations:
- The investigation was undertaken in accordance with the SSP.

Laboratory Considerations:
- The analytical quality assessment adopted by the laboratories was in accordance with the NATA and NEPM 2013 requirements as outlined in the analytical reports;
- A review of the reports indicates the following comments noted by the laboratories:

Envirolab Report 165375 – The laboratory RPD acceptance criteria was exceeded in one sample for nickel and one sample for mercury. Triplicate results were issued to account for this.

9 WASTE CLASSIFICATION OF SOIL FOR OFF-SITE DISPOSAL

The waste classification of soil for off-site disposal is summarised in the following table:

Table 9-1: Waste Classification

Site Extent / Material Type	Classification	Disposal Option
Fill material including the sandy clay in BH3 logged as 'possibly fill'	General Solid Waste (non-putrescible) (GSW) It is noted that No TCLP PAHs analysis was undertaken on the BH6 (1.5-1.95m) sample. As samples above and below this sample were analysed for TCLP PAHs, this result is not considered to have impacted the reliability of the waste classification.	A NSW EPA landfill licensed to receive the waste stream. The landfill should be contacted to obtain the required approvals prior to commencement of excavation.
Natural clayey sand and silty sand soil in BH1 and BH2 and sandstone bedrock across the site	Virgin excavated natural material (VENM)	VENM is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site as fill material. Alternatively, the natural material can be disposed of as VENM to a facility licensed by the NSW EPA to receive the waste stream.

10 TIER 1 RISK ASSESSMENT AND REVIEW OF PCSM

For a contaminant to represent a risk to a receptor, the following three conditions must be present:

1. Source – The presence of a contaminant;
2. Pathway – A mechanism or action by which a receptor can become exposed to the contaminant; and
3. Receptor – The human or ecological entity which may be adversely impacted following exposure to contamination.

If one of the above components is missing, the potential for adverse risks is relatively low.

The assessment has identified the following contamination issues at the site:

Table 10-1: Tier 1 Risk Assessment and Review of PCSM

Contaminant of Primary Concern (CoPC)	Receptor and Exposure Pathway	Discussion and Risk Rating
Lead and B(a)P TEQ	<u>Human Receptors:</u> Dermal Contact, ingestion and inhalation via dust <u>Environmental Receptors:</u> Direct exposure to plants and animals	The CoPC were above the SAC adopted for this investigation and pose a risk to site receptors. EIS are of the opinion that the risk posed to human receptors is moderate and will require remediation and/or management. If the fill soils containing elevated concentrations of CoPC are removed from the site, the risk will be negligible. Environmental receptors on-site include proposed landscaped areas between buildings. The deep natural soils at the site do not seem to have been impacted by these contaminants. The lead and PAHs in the fill are most likely associated with ash and slag inclusions. These contaminants are likely to be insoluble as they are bound within a siliceous matrix. Consequently the risk posed by these materials to groundwater is considered to be low. As noted above, if the fill containing the elevated concentrations of CoPC are removed from the site, the risk will be negligible.
Lead, Nickel, Zinc and TRH F3	<u>Environmental Receptors:</u> Direct exposure to plants and animals	The CoPC were above the EAC adopted for this investigation and pose a risk to environmental receptors. The concentrations above the EAC were at BH2, BH5 and BH6. BH2 was impacted by nickel only and it was noted that no pH, CEC and clay content analysis was undertaken for the BH2 (0.4-0.5m) sample. Therefore, the result was assessed against the

Contaminant of Primary Concern (CoPC)	Receptor and Exposure Pathway	Discussion and Risk Rating
		most conservative EAC. These analyses were, however, undertaken for the BH2 (1-1.2m) sample, which had a higher nickel concentration than the shallower sample. The higher result was less than the adjusted EIL-URPOS. BH6 (3-3.45m) was impacted by zinc and it was noted that no pH, CEC and clay content analysis was undertaken for this sample. Therefore, the result was assessed against the most conservative EAC. These analyses were, however, undertaken for the BH6 (1.5-1.95m) sample, which had a higher zinc concentration than the deeper sample. The higher result was less than the adjusted EIL-URPOS. It is likely that with analysis for pH, CEC and clay content that the nickel and zinc results would be below the EAC. The lead and TRH results in BH5 and BH6 may pose a risk to ecological receptors if gardens are proposed in these areas and the existing fill remains on site. Environmental receptors on-site include plants in the current/future landscaped areas and small burrowing animals which may frequent the site. These contaminants pose a risk to the environmental receptors and will require remediation/management. . If the fill soils containing elevated concentrations of CoPC are removed from the site, the risk will be negligible.

10.1 Source and Extent of Contamination

10.1.1 Sources

The source of the PAHs and lead including lead in the fill samples is considered to be associated with the ash and slag inclusions encountered in the fill matrix. The natural soil samples analysed below the fill profile were not impacted by the contaminants.

The TRH F3 encountered in the fill in BH6 is considered likely to be associated with elevated PAHs rather than a fuel or other hydrocarbon source.

10.1.2 Known Extent

Based on a review of the field logs and the laboratory data, EIS are of the opinion that the soil contamination is confined to the fill material at the site. The fill ranges in depth from approximately 1.5m in the west section to 8.1m in the east section as shown on the attached Figure 2.

10.1.3 Unknown Extent

Sampling was not undertaken beneath the existing buildings. The extent of contamination beneath the buildings is currently unknown. Due to the heterogeneous nature of the fill material and the 57% sampling density, no distinct hotspots can be identified at the site. Fill material in the vicinity of BH5 (central) and BH6 (north-east) appears to be impacted by the contaminants, however, the previous investigation encountered impacted fill material in the north-east and south-west sections of the site. It is possible that all fill material in the proposed development area could be contaminated and should be treated accordingly.

10.1.4 Hazardous Building Materials in Existing Buildings

There is a possibility of the presence of hazardous building materials in the existing buildings at the site. This is considered to pose a relatively low risk to the receptors provided that the demolition works are undertaken in accordance with the relevant codes and standards.

10.2 Fate and Transport of Contaminants

The potential fate and transport of PCC/CoPC identified at the site is summarised in the following table:

Table 10-2: Fate and Transport of PCC/CoPC

PCC/CoPC	Fate and Transport
Non-volatile contaminants including: metals, heavy fraction PAHs and TRH F3	Non-volatile contaminants are predominantly confined to the soil and groundwater medium. The mobility of these contaminants varies depending on: the nature and type of contaminant present (e.g. leachability, viscosity etc.); soil type/porosity; surface water infiltration; groundwater levels; and the rate of groundwater movement. **Presence of Ash and Slag** Non-volatile contaminants associated with ash and slag waste (some heavy metals, heavy fraction PAHs, and sometimes heavy fraction TPHs) are bound within a relatively insoluble matrix. Slag and ash is usually formed as a by-product of combustion at high temperatures which 'locks in' the contaminants within the matrix. **Site Conditions** The TRH F3 encountered in the fill in BH6 (0.5-0.95m) was typically not present in the deeper fill samples obtained from the same location. Groundwater was typically deeper than the impacted material at the site. Heavy fraction PAH and

PCC/CoPC	Fate and Transport
	TRH F3 are only slightly soluble in water and preferentially bind to soil particles. Consequently the mobility of these contaminants is limited. The potential for surface water infiltration is very limited at the subject site which would reduce the migration potential for certain contaminants. The presence of paved surfaces in the surrounding areas can also limit the migration potential for non-volatile contaminants.

10.3 Data Gaps

The assessment has identified the following data gaps:

- Areas beneath the existing buildings have not been included in the assessment; and
- The horizontal extent of the contamination has not been adequately assessed.

11 CONCLUSION

EIS consider that the report objectives outlined in **Section 1.2** have been addressed.

The decision statements identified for this investigation are outlined below with appropriate responses:

- Do any of the samples contain contaminant concentrations above the SAC?
  - Yes, lead and PAHs were identified above the HILs. These results may present a risk to the site as discussed in Section 10. The risk posed by the fill material at the site will require further assessment.
- Was asbestos identified in any of the samples?
  - No.
- Is further investigation required?
  - Yes, further investigation is considered necessary to better assess the nature and extent of the contamination.
- Is the site suitable for the proposed use?
  - In its current configuration with pavement across much of the site, the risk posed by the contamination to site receptors is very low. However is order to make the site suitable for the proposed new development, the recommendations listed below should be implemented.

Based on the scope of works undertaken, EIS are of the opinion that the CoPC identified at the site may pose a risk to the receptors.

EIS consider that the site can be made suitable for the proposed development provided that the following recommendations are implemented to address the data gaps and to better characterise the risks:

1. Undertake a Stage 2 ESA to address the data gaps identified in **Section 10.3;**

2. Prepare a Remediation Action Plan (RAP) to outline remedial measures for the site;

3. In the event active remediation is preferred at the site, prepare a Validation Assessment (VA) report on completion of remediation;

4. In the event management is preferred over active remediation, prepare an Environmental Management Plan (EMP) for the ongoing management of contamination remaining on site. The EMP will require establishment of appropriate public notification under Section 149(2) of the E&PAA 1979 or a covenant registered on the title to land under Section 88B of the Conveyancing Act 1919; and

5. Undertake demolition of the building in accordance with the Hazardous Materials Assessment (Hazmat) previously prepared for the existing buildings.

In the event unexpected conditions are encountered during development work or between sampling locations that may pose a contamination risk, all works should stop and an environmental consultant should be engaged to inspect the site and address the issue.

11.1 Regulatory Requirement

The regulatory requirements applicable for the site are outlined in the following table:

Table 11-1: Regulatory Requirement

Guideline	Applicability
Duty to Report Contamination 2015[15]	At this stage, EIS consider that there is no requirement to notify the NSW EPA of the site contamination. After successful implementation of the RAP, the site contamination is unlikely to meet the Notification Triggers. Please note that in the event the recommendations for remediation/management are not undertaken, there may be justification to notify the EPA. EIS can be contacted for further advice regarding notification.
POEO Act 1997	Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner.
Dewatering Consent	In the event groundwater is intercepted during excavation works, dewatering may be required. Council, NSW Office of Water (NOW) and other relevant approvals (from discharge authorities like Sydney Water etc.) should be obtained prior to the commencement of dewatering.

[15] NSW Department of Environment and Climate Change, (2015), *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.* (referred to as Duty to Report Contamination 2015)

12 LIMITATIONS

The report limitations are outlined below:

- EIS accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the EIS proposal; and terms of contract between EIS and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated in the report;
- EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- EIS accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- EIS have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. EIS should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

LIST OF IN-TEXT TABLES

IMPORTANT INFORMATION ABOUT THIS REPORT

These notes have been prepared by EIS to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the EIS proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

EIS/J&K will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by EIS to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations
Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

REPORT FIGURES

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.5.1557
AERIAL IMAGE ©: 2015 GOOGLE INC.

This plan should be read in conjunction with the EIS report.

Title: **SITE LOCATION PLAN**

Location: ULTIMO PUBLIC SCHOOL
189 JONES STREET, ULTIMO, NSW

Report No: E30361KH

Figure No: 1

ENVIRONMENTAL INVESTIGATION SERVICES

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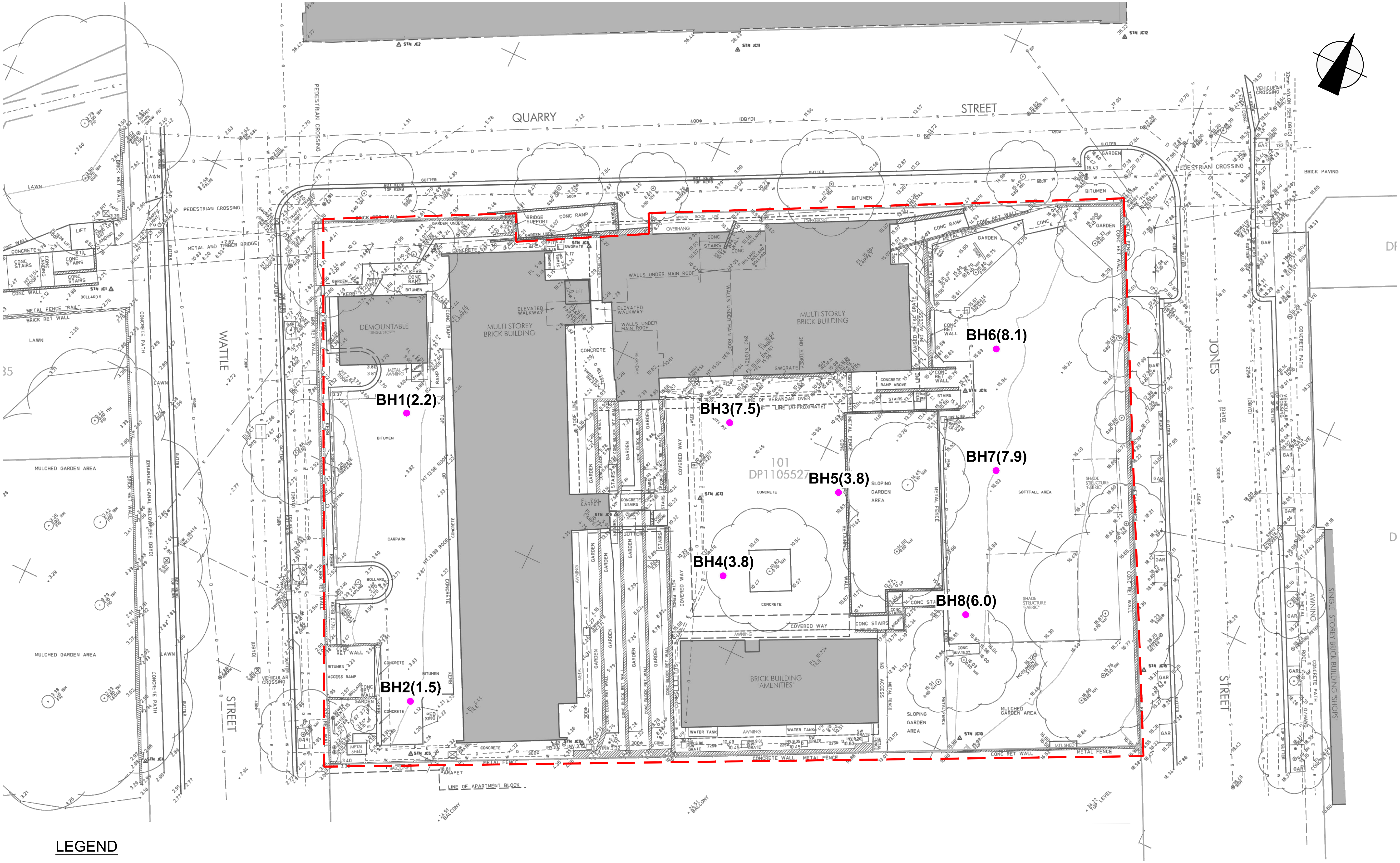

LEGEND

APPROXIMATE SITE BOUNDARY

BH (Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

SCALE 0 4 8 12 16 20 METRES 1:400 @A3

This plan should be read in conjunction with the EIS report.

Title:	SAMPLE LOCATION PLAN
Location:	ULTIMO PUBLIC SCHOOL 189 JONES STREET, ULTIMO, NSW
Report No:	E30361KH
Figure No:	2

ENVIRONMENTAL INVESTIGATION SERVICES

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