

15 – Contamination Report



Pells Sullivan Meynink

Environmental Site Assessment

Waitara Public School
48-58 Myra Street
Wahroonga, NSW

31 August 2017
53033/110766 (Rev A)
JBS&G

Pells Sullivan Meynink
Environmental Site Assessment

Waitara Public School
48-58 Myra Street
Wahroonga, NSW

31 August 2017
53033/110766 (Rev A)
JBS&G

Table of Contents

Executive Summary.....	6
1. Introduction.....	7
1.1 Background.....	7
1.2 Objective	7
1.3 Scope of Works.....	7
2. Site Conditions and Surrounding Environment	8
2.1 Site Identification	8
2.2 Site Description	8
2.3 Surrounding Land-use	8
2.4 Topography	8
2.5 Geology and Soil.....	8
2.6 Acid Sulfate Soils	9
2.7 Hydrology	9
2.8 Hydrogeology	9
2.9 Meteorology.....	9
3. Site History.....	10
3.1 Aerial Photograph.....	10
3.2 Historical Land Titles	10
3.3 EPA Records.....	11
3.4 Council Records	11
3.5 Heritage Register.....	12
3.6 Dangerous Goods Records	12
3.7 Previous Environmental Reports.....	12
3.7.1 Asbestos Register – Waitara Public School (3334)	12
3.8 Integrity Assessment	12
4. Conceptual Site Model (CSM).....	13
4.1 AECs & COPCs	13
4.2 Potentially Impacted Media	13
4.3 Potential Receptors	13
4.4 Potential Exposure Pathways	14
4.5 Potential for Migration.....	14
4.6 Preferential Pathways	14
5. Sampling and Analysis Plan	15
5.1 Data Quality Objectives	15
5.1.1 State the Problem	15
5.1.2 Identify the Decision	15

5.1.3	Identify Inputs to the Decision.....	15
5.1.4	Define the Study Boundaries	15
5.1.5	Develop a Decision Rule.....	15
5.1.6	Specify Limits of Decision Error.....	16
5.1.7	Optimise the Design for Obtaining Data	18
5.2	Investigation Methodology	18
5.2.1	Soil Sampling Methodology	18
5.2.2	Soil Sampling Decontamination	19
5.2.3	Soil Field PID Screening	19
5.2.4	Soil Duplicate Preparation	19
5.3	Laboratory Analysis	19
6.	Assessment Criteria	21
6.1	Regulatory Guidelines	21
6.2	Soil Assessment Criteria	21
7.	Quality Assurance/Quality Control	23
7.1	QA/QC Results	23
7.2	QA/QC Discussion.....	24
7.2.1	Precision.....	24
7.2.2	Accuracy.....	24
7.2.3	Representativeness.....	25
7.2.4	Comparability.....	25
7.2.5	Completeness.....	25
7.2.6	Sensitivity	25
7.3	QA/QC Conclusion	26
8.	Soil Results	27
8.1	Soil Field Observations	27
8.2	Soil Analytical Results	27
8.2.1	Metals	27
8.2.2	PAHs	27
8.2.3	Asbestos.....	27
8.2.4	TRH	27
8.2.5	BTEX	27
8.2.6	OCPs	27
8.2.7	PCBs.....	28
8.2.8	Soil Properties for Site Specific EILs	28
8.3	Preliminary Waste Classification	28
9.	Site Characterisation.....	29

9.1	Are there any unacceptable risks to likely future receptors from impacted soil?	29
9.2	Are there any issues relating to the local area background soil concentrations?	29
9.3	Are there any impacts from chemical mixtures?	29
9.4	Are there any aesthetic concerns?	29
9.5	Is there any evidence of, or potential for, migration of contaminants from the site?	29
9.6	Is a site management strategy required?	30
10.	Conclusions	31
11.	Limitations	32

List of Tables

Table 2.1: Summary Site Details	8
Table 4.1: AECs & COPCs	13
Table 5.1: Summary of Decision Rules	16
Table 5.2: Summary of Quality Assurance / Quality Control Program	17
Table 5.3: Sampling and Analytical Program	20
Table 6.1: Derived EIL urban residential/public open space land use	22
Table 7.1: QA/QC Results Summary	23

List of Figures

Figure 1	Site Location
Figure 2	Site Layout
Figure 3	Sample Locations

Appendices

Appendix A	Summary Tables
Appendix B	Photographic Log
Appendix C	Borelogs
Appendix D	Historical Aerial Photographs
Appendix E	Land Titles
Appendix F	EPA Records
Appendix G	Section 149 (2) and (5) Certificate
Appendix H	Heritage Records
Appendix I	Calibration & Decontamination Records
Appendix J	QA/QC Results

Appendix K	Laboratory Documentation
Appendix L	Proposed Development Plans

Executive Summary

JBS&G Australia Pty Ltd (JBS&G) was engaged by Pells Sullivan Meynink (PSM, the client), to conduct an environmental site assessment (ESA) with limited intrusive investigations of Waitara Public School located at 48-58 Myra Street, Wairoa (the site). The site is legally identified as Lot A DP309739, Lots 11, 12 & 13 DP17375 and Lot 1 DP333142 and has a total site area of approximately 2 hectares (2 ha). The site location and site layout are presented on **Figure 1** and **Figure 2** respectively.

At the time of the investigation, the site was used as a school. It is understood that classrooms are to be constructed within the investigation areas.

The objective of the investigation was to characterise potential contamination within the investigation areas that may pose an unacceptable risk to construction workers during construction or to school users.

The scope of work comprised a desktop review, soil sampling at eight locations, laboratory analysis of samples for contaminants of potential concern (COPC) and preparation of an ESA report. The soil sampling locations were preselected prior to undertaking the ESA in conjunction with geotechnical investigations by the client.

Based on the findings of this assessment and subject to the limitations in **Section 11**, the following conclusions are provided:

- The site is understood to have been used for education use (school) since 1924. Prior to this, the site was used for residential purposes.
- Fill material was encountered at all eight sample locations and generally comprised heterogeneous, damp, soft to very soft brown silty clay or sandy silty clay, with some trace gravel, organic material, glass and plastic inclusions. Fill material was observed at depths ranging from 0.05 m bgs to 0.25 m bgs. Natural high plasticity, homogeneous, damp and stiff orange brown silty clay overlying grey and red mottled silty clay were identified beneath the fill material. Natural clay soils were in turn underlain by dark grey weathered shale.
- Concentrations of COPCs in representative soils were less than the adopted NEPC (2013) site assessment criteria.
- Based on the soil and leachate analytical data, the fill material would preliminary be classified as General Solid Waste in accordance with EPA guidelines.
- No chemical mixtures, aesthetic issues or significant offsite migration risks were identified.
- On this basis, it is considered that there were no contamination risks identified that would need to be managed during construction works. Given the limited extent of investigations, implementation of an appropriate unexpected finds protocol implemented during future development works would enable management of any unidentified contamination if encountered.

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by Pells Sullivan Meynink Pty Ltd (PSM, the client) to conduct an environmental site assessment (ESA) with limited intrusive investigations of Waitara Public School located at 48-58 Myra Street, Wahroonga (the site). The site is legally identified as Lot A DP309739, Lot 11, 12 & 13 DP17375 and Lot 1 DP333142 and has a total site area of approximately 2.0 hectares (2.0 ha). The site location and site layout are presented on **Figure 1** and **Figure 2** respectively.

The site is currently used as a school and it is understood that the investigation was undertaken to assess the contamination status for the development of classroom buildings. The investigation was limited to the locations of the proposed classrooms as provided by the client.

The investigation has been developed in general accordance with NEPC (2013)¹, guidelines made or approved by the NSW Environment Protection Authority (EPA) and relevant Australian Standards.

1.2 Objective

The objectives are to investigate the potential for contamination within the investigation areas that may pose an unacceptable risk to construction workers during construction and or to school users. Where potential risks are identified, recommendations are to be made for further investigation or management.

1.3 Scope of Works

The scope of work for the assessment comprised:

- Desktop review of readily available relevant background and historical information including:
 - Site conditions and environmental setting;
 - s.149 certificate(s) obtained from council;
 - current and historical land title records;
 - historical aerial photographs;
 - heritage records held by the Department of Planning;
 - records of environmental incidents or former environmental licenses as held by the EPA;
- A detailed site inspection in the vicinity of the investigation areas;
- Soil sampling at eight locations;
- Laboratory analysis of representative soil samples; and
- Preparation of this Environmental Site Assessment (ESA) report in general accordance with relevant EPA guidelines.

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

2. Site Conditions and Surrounding Environment

2.1 Site Identification

The location of the site shown on **Figure 1**. The layout of the site and approximate site boundary are shown on **Figure 2**. The site details are summarised in **Table 2.1**.

Table 2.1: Summary Site Details

Site Address	48-58 Myra Street, Wahroonga, NSW
Lot / DP	Lot A DP309739, Lot 11, 12 & 13 DP17375 and Lot 1 DP333142
Local Government Authority	Hornsby Shire Council
Site Area	Approximately 2.0 ha
Approximate Geographical Coordinates (MGA 56)	Easting: 324988 Northing: 6268616
Zoning	R2 – Low Density Residential (Hornsby Local Environmental Plan 2013)
Previous Land-use	School/Education and Residential
Current Land-use	School/Education

2.2 Site Description

A detailed site inspection was undertaken on 14 August 2017 by one of JBS&G's trained and experienced field scientists. A photographic log is presented in **Appendix B**.

The site was bound by Edgeworth David Avenue to the north, Myra Street to the east and by residential properties to the south and west. The site was secured by a 2 m high metal fence. The site was generally flat with a slight south-western slope along the southern and western edges.

Most of the site comprised sealed surfaces. Buildings, concrete paths and asphalt surfaces were present across the majority of the site, while artificial turf playing fields were located in the western portion of the site. Small strips of grassed areas were observed following the boundary fence lines, and exposed soil was noted in garden beds surrounding trees.

No odours, surface soil staining, soil discolouration or asbestos containing material (ACM) was observed on accessible ground surfaces at the time of inspection. No evidence of above/underground storage tanks was observed at the site.

2.3 Surrounding Land-use

The surrounding land-uses of the site are detailed below.

North – Edgeworth David Avenue, then residential.

East – Residential.

South – Residential.

West – Myra Street, then residential.

2.4 Topography

The site is generally flat with a slight gradient to the south east. The site topography appeared to be consistent with the surrounding land indicating that significant earthworks are unlikely to have occurred at the site.

The site has an approximate elevation of 185 m Australian Height Datum (AHD) based on Google Earth.

2.5 Geology and Soil

According to the Sydney 1:100 000 Geological Sheet 9130 (1983), the site is underlain by a Triassic Period geological formation, Ashfield Shale of the Wianamatta group, comprising of black to dark-grey shale and laminite.

Review of eSPADE² indicated that the site soils comprise Glenorie soils, shallow to moderately deep (<100cm) red podzolic soils on crests, moderately deep red and brown podzolic soils on upper slopes and deep yellow podzolic soils and gleyed podzolic soils along drainage lines.

Investigations encountered fill material across the site to a maximum depth of up to 0.25 metres below ground surface (mbgs). Observations of the fill materials are presented in the bore logs included in **Appendix C**.

2.6 Acid Sulfate Soils

A review of the Office of Environment and Heritage (OEH) – Acid Sulfate Soils Risk Map³ indicated that the site is located within an area of “no known occurrence”. Acid sulfate soils (ASS) are unlikely to occur in areas having this classification. This is consistent with the topographical and geological setting of the site.

2.7 Hydrology

The site is partially unsealed and infiltration consistent with the fill material type and underlying natural soils / geology is anticipated across the site. Surface drainage was observed at the site in the sealed areas which would drain any surface water to the local stormwater system.

The nearest flowing water receptor comprises Hornsby Creek approximately 1 km to the north east of the site. This creek flows in a northerly direction before reaching its confluence with Cowan Creek/Hawkesbury River.

2.8 Hydrogeology

One registered groundwater bore (GW107088) was present within 1.5 km of the site on the NSW Office of Water Groundwater Database⁴.

Bore GW107088 was drilled to a total depth of 162 metres below ground surface (mbgs). The standing water level (SWL) was reported at 78.5 mbgs. The geological log for the bore reported clay between the surface and 11 mbgl which was overlying sandstone from 11mbgl to 162mbgl. No other relevant information for the bore was available.

It is anticipated that on a regional scale groundwater would move toward the north-west, generally towards Hornsby Creek then Cowan Creek/Hawkesbury River. The depth of groundwater beneath the site is unknown, however it is considered likely that the depth to groundwater would be greater than 10mbgs.

2.9 Meteorology

Based on data from Pennant Hills (Yarrara Road) weather station⁵ approximately 3.3 kilometres from the site, the mean monthly maximum temperature ranges from 15.8 degrees Celsius to 27.6 degrees Celsius and the mean monthly average rainfall ranges from 56.1 mm to 124.0 mm.

² <http://www.environment.nsw.gov.au/eSpade2Webapp> Department of Environment and Heritage, NSW Government. Accessed 17/08/2017

³ OEH – Acid Sulfate Soils Risk Map <http://data.environment.nsw.gov.au/dataset/acid-sulfate-soils-risk0196c> (accessed 18 August 2017)

⁴ <http://allwaterdata.water.nsw.gov.au/water.stm>. Accessed 18 August 2017.

⁵ <http://www.bom.gov.au/climate/data/index.shtml>. Accessed 18 August 2017.

3. Site History

3.1 Aerial Photograph

Historical aerial photographs are provided in **Appendix D** and discussed below.

1943 – The site appeared to be used for education/school purposes. The site contained three large buildings in the northern, central and eastern portions of the site. Smaller buildings (possibly sheds or small classrooms) were in the central portion of the site. What appear to be zig-zag-shaped trenches were visible in the northern portions of the site. Vegetation could be observed in the southern portion of the site and along the site boundaries. Edgeworth David Avenue and Myra Street had been constructed to the north and west of the site respectively. The surrounding land appeared to be used for residential purposes with the property to the south consisting of bushland.

1951 – The site generally remained unchanged except the previously identified trenches had been filled and vegetation in the south eastern portion of the site had been cleared. The surrounding land use remained generally unchanged except for the bushland to the south west which had been cleared for residential development.

1961 – Additional buildings (likely classrooms) had been constructed in the north western, northern and south eastern portions of the site. No other significant changes were observed to site. The surrounding land remained for residential use with the bushland to the south completely cleared and residential dwellings constructed.

1970 – The site has remained essentially unchanged except for the construction of buildings (likely to be classrooms) along the western boundary and north eastern portion of the site. The surrounding land remained essentially unchanged from the previous 1961 aerial photograph.

1982 – The site appeared generally unchanged from the previous 1970 aerial photograph. The site is sealed with asphalt in the north western and central portions of the site. Due to the quality of the previous aerial photographs, it is unknown if these areas were previously sealed. No changed to the surrounding land use was observed.

1991 – Three of the classroom buildings in the central portion of the site had been demolished and the area remained sealed. An additional large building (classroom) had been constructed in the western portion of the site. No other changes to the site were noted. The surrounding land use remained unchanged from the previous 1982 aerial photograph.

2003 – Three additional interconnected buildings (classrooms) and a structure that appeared to be a demountable building had been constructed in the central portion of the site approximately where the three former buildings existed. No other changes from the previous 1991 aerial photograph were observed. No changed were observed to the surrounding land.

2009 – No significant changes were observed at the site or surrounding land from the previous 2003 aerial photograph.

2017 – A demountable building had been constructed in the central portion of the site. Two demountable had been constructed in the south western portion of the site. Four demountable had been constructed in the south eastern portion of the site. No other changes to the site were noted. The surrounding land remained used for a residential use.

3.2 Historical Land Titles

Historical land title records are summarised in below and full records provided in **Appendix E**.

The registered proprietors for the site were as follows:

- 1894 to 1924 – Caroline Hordern (married woman).

- 1924 to date – His most gracious King George the Fifth now Minister of Education.

3.3 EPA Records

A search of the NSW EPA's public register maintained under the Protection of the Environment Operations Act 1997 (POEO Act) was undertaken for the subject site and surrounding properties. The results of the search are present in **Appendix F**. The search identified that there were no current or former prevention, clean-up or prohibition notices for the site and immediate surrounds.

A search of the EPA's public contamination land register (**Appendix F**) was also undertaken. The search identified that there have been no notices issued under the Contaminated Land Management Act 1997 (CLM Act) for the site.

The site has not been notified to the EPA as containing significant contamination.

3.4 Council Records

A full copy of the Section 149 (2) and (5) planning certificate for Lot A DP309739 is provided in **Appendix G**. A summary of the information with respect to contamination is as follows:

- The site is zoned R2 Low Density Residential under the Hornsby Local Environmental Plan 2013.
- Draft *State Environmental Planning Policy (Educational Establishments and Child Care Facilities)* 2017 applies to the site.
- The land is located in a conservation area.
- There is an item of environmental heritage located on the land.
- Acid sulfate soils are not considered likely at the site that would restrict the development of the land.
- Council's electronic property records did not identify the land to be contaminated, being contaminated, having been remediated or being remediated.
- The land is not affected by flood related development controls.
- The land has not been identified as bush fire prone land.
- The council is not aware of the land as significantly contaminated within the meaning of the *Contaminated Land Management Act 1997*.
- The council is not aware of the land as subject of a management order within the meaning of the *Contaminated Land Management Act 1997*.
- The council is not aware of the land as subject of an approved voluntary management proposal within the meaning of the *Contaminated Land Management Act 1997*.
- The council is not aware of the land as subject to an ongoing maintenance order within the meaning of the *Contaminated Land Management Act 1997*.
- The council is not aware of the land as subject of a site audit statement within the meaning of the *Contaminated Land Management Act 1997*.
- The site is not listed on the loose-fill asbestos insulation public register. The council considered there was potential for loose-fill asbestos insulation to be found on properties not listed on the Asbestos Public Register.

3.5 Heritage Register

Results of searches on the NSW⁶ and Australian⁷ heritage registers are provided in **Appendix H**. No records relevant to the site were located on the heritage registers.

3.6 Dangerous Goods Records

A search of the Storage of Hazardous Chemicals database by SafeWork NSW was not undertaken due to time constraints. Given historical use of the site, it is considered unlikely that records and licences for use/storage of dangerous goods (including fuel storage) would be associated with the current site.

3.7 Previous Environmental Reports

3.7.1 Asbestos Register – Waitara Public School (3334)

A review of the Asbestos Register for Waitara Public School identified that presence of asbestos containing materials within the buildings at the site. No information relating to asbestos containing materials in soils were reported within the Asbestos Register.

3.8 Integrity Assessment

The information obtained from the historical sources reviewed has been found to be in general agreement and of a suitable quality. It is therefore considered that the information provided in this historical assessment has an acceptable level of accuracy.

⁶ <http://www.environment.nsw.gov.au/heritageapp/heritagesearch.aspx>. Accessed 13 April 2017.

⁷ <http://www.environment.gov.au/cgi-bin/ahdb/search.pl>. Accessed 13 April 2017.

4. Conceptual Site Model (CSM)

NEPC (2013) identifies a conceptual site model (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 and ambient air);
- Potential receptors; and
- Potential and complete exposure pathways.

The CSM below represents a model of potential contamination that may be present at the site based on the desktop review. The potential contamination issues identified are not necessarily present at the site. The CSM usually informs the design of the intrusive sampling program. The results of the intrusive investigation allow conclusions to be drawn regarding the actual site contamination conditions identified as discussed in **Sections 9 and 10**.

4.1 AECs & COPCs

The identified areas of environmental concern (AECs) and associated contaminants of potential concern (COPCs) for the site are presented in **Table 4.1**.

Table 4.1: AECs & COPCs

AECs	COPCs
Fill of unknown origin across the site	Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylenes (BTEX) and asbestos.

4.2 Potentially Impacted Media

Fill material is considered to be a potentially impacted media based upon:

- Unidentified sources of fill material historically imported to or originating from the site to form existing site levels.

Natural soils beneath the fill materials are not expected to be impacted considering the historical use of the site. There is potential that natural soils could be impacted based on possible leaching of contaminants from the fill materials, however considering the low probability of mobile contaminants within the fill, it is expected that any impact would be limited.

Given the anticipated deep levels of groundwater anticipated to occur beneath the site and the relatively low probability of mobile contaminants in fill material and/or natural soils, it is considered that there is a low probability that groundwater will have been significantly impacted as a result of site conditions.

4.3 Potential Receptors

Potential human and ecological receptors on or near the site include:

- Site occupants (including children) / workers and visitors;
- Construction / maintenance workers, including subsurface excavation/maintenance works; and

- Flora and fauna on the site.

4.4 Potential Exposure Pathways

Based on the COPCs identified in soil, the potential exposure pathways for the site include:

- Oral and dermal pathways from impacted soils.
- Inhalation of airborne contaminants (including airborne asbestos fibres).
- Inhalation of vapours/gases migrating from impacted soils.
- Contaminant uptake via vegetation (flora) or bioaccumulation within fauna.

4.5 Potential for Migration

Contaminants generally migrate from site via a combination of windblown dusts, rainwater infiltration, groundwater migration and surface water runoff. The potential for contaminants to migrate is a combination of:

- The nature of the contaminants (solid/liquid and mobility characteristics);
- The extent of the contaminants (isolated or widespread);
- The location of the contaminants (surface soils or at depth); and
- The site topography, geology, hydrology and hydrogeology.

The potential contaminants of concern identified as part of the site history review and site inspection are in solid (e.g. asbestos, metals), liquid (e.g. TRH/BTEX) or vapour/gaseous (e.g. methane) form. In the event of significant soil and/or groundwater contamination, there is the potential for soil vapour impacts, including off-site migration.

The area of investigation was predominantly sealed with asphalt, concrete, grass or synthetic grass/artificial turf. Due to the majority of the site being sealed, it is considered that the potential migration of dust and soil via windblown migration is considered to be low.

There is the potential for contaminants to migrate down and impact groundwater at the unsealed locations of the site, and to migrate offsite via groundwater. However, this is limited via the clayey nature of the surface fill and low permeability of the underlying clay and shale and inferred depth of groundwater.

Migration of soil via surface water runoff is considered to be limited due to the general sealed nature of the site. In addition, it is expected that the presence of grass in the unsealed areas would limit the migration of any soil via surface water runoff.

4.6 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 gasses.

Man-made preferential pathways are present on the site, generally associated with fill materials present beneath the current ground surface, and at near surface depths over the remainder of the site. Fill materials are anticipated to have a higher permeability than the underlying natural soil and/or bedrock.

5. Sampling and Analysis Plan

5.1 Data Quality Objectives

Data quality objectives (DQOs) were developed for the contamination assessment, as discussed in the following sections.

5.1.1 State the Problem

Additional classroom buildings are to be constructed at the site and an ESA is required to characterise potential contamination at the site to enable appropriate management if required during future development activities.

5.1.2 Identify the Decision

The following specific decisions are required to be made as part of these investigations:

- Are there any unacceptable risks to likely future receptors from impacted soil?
- Are there any issues relating to local area background soil concentrations that exceed the appropriate soil criteria?
- Are there any impacts of chemical mixtures?
- Are there any significant aesthetic concerns from impacted soils present at the site?
- Is there any evidence of, or potential for, migration of contaminants from the site?
- Is a site management strategy required?

5.1.3 Identify Inputs to the Decision

Inputs required to address the decisions will be:

- Potential AECs and COPCs as identified by site history review and detailed site inspection;
- Soil environmental data collected by soil sampling and analysis;
- Soil criteria based on the primary school (low density residential) land use;
- Confirmation that data generated by field measurements and sample analysis are of a sufficient quality to allow reliable comparison to assessment criteria as undertaken by assessment of quality assurance / quality control (QA/QC) as per the data quality indicators established in **Section 5.1.6**.

5.1.4 Define the Study Boundaries

The lateral extent of the study comprised the proposed development area, as presented on **Figure 2** and provided plan in **Appendix L**.

The vertical extent of the study comprised assessment of soils to bedrock which was identified between 0.4 and 1.9 mbgs. The investigation comprised only of soil sampling, with no groundwater monitoring wells or soil vapour ports installed or sampled.

The current study does not include assessment of temporal changes in identified COPCs which was beyond the scope of this investigation. Therefore, results were reflective of conditions at the time of the field assessment.

5.1.5 Develop a Decision Rule

The decision rules adopted to answer the decisions identified in **Section 5.1.2** are summarised in **Table 5.1** below.

Table 5.1: Summary of Decision Rules

Decision Required to be Made	Decision Rule
Are there any unacceptable risks to likely future receptors from impacted soil?	Soil analytical data was compared against appropriate criteria. Statistical analyses of the data in accordance with relevant guidance documents were undertaken, if appropriate, to facilitate the decisions. The following statistical criteria were adopted with respect to soils: Either: the reported concentrations were all below the site criteria; Or: the 95% upper confidence limit (UCL) of the average concentration for each analyte was below the adopted site criterion; no single analyte concentration exceeded 250% of the adopted site criterion; and the standard deviation of the results was less than 50% of the site criterion. If the statistical criteria stated above were satisfied, the decision was No. If the statistical criteria were not satisfied, the decision was Yes.
Are there any issues relating to the local area background soil concentrations that exceed appropriate soil criteria?	Analytical data in natural soil samples were compared to the background levels for urban areas of NSW as described in NEPC 2013. Where concentrations were less than the background levels, the answer to the decision was No. Otherwise the answer to the decision was Yes.
Are there any impacts from chemical mixtures?	Are there more than one group of contaminants present which increase the risk of harm? If there was, the decision was Yes. Otherwise, the decision was No.
Are there any significant aesthetic concerns from impacted soils present at the site?	Were significant odour or other aesthetic issues identified during the soil assessment? If yes, the decision was Yes. Otherwise, the decision was No. It is noted that staining/discolouration was not considered to be an aesthetic issue based on DEC 2006 guidance for commercial/industrial land use.
Is there any evidence of, or potential for, migration of contaminants from the site?	Based on the assessment results including soil and groundwater analytical data, was there any evidence of, or potential for, migration of contaminants from the site? If there was potential for unacceptable contaminant concentrations to migrate, the decision was Yes. Otherwise, the decision was No.
Is a site management strategy required?	Was the answer to any of the decisions Yes? If yes, a site management strategy was required. If no, a site management strategy was not required.

5.1.6 Specify Limits of Decision Error

This step is to establish the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data. Data generated during this project must be appropriate to allow decisions to be made with confidence.

Specific limits with respect to the limits of decision error adopted for this project have been implemented in accordance with the appropriate guidance from NEPC (2013) and appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard JBS&G procedures for field sampling and handling.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined Data Quality Indicators (DQIs).

The pre-determined DQIs established for the project are discussed below in relation to precision, accuracy, representativeness, comparability, completeness and sensitivity (PARCCS parameters), and are shown in Table 5.2.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are 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 represent 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.
- **Sensitivity** - expresses the appropriateness of the chosen field and laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted site assessment criteria.

Table 5.2: Summary of Quality Assurance / Quality Control Program

Data Quality Indicator	Frequency	Data Quality Criteria
Precision		
Blind duplicates (intra laboratory)	1 / 20 samples	<50% RPD ¹
Blind triplicates (inter laboratory)	1 / 20 samples	<50% RPD ¹
Laboratory duplicates	1 / 20 samples	<50% RPD ¹
Accuracy		
Surrogate spikes	All organic samples	70-130%
Laboratory control samples	1 per lab batch	70-130%
Matrix spikes	1 per lab batch	70-130%
Representativeness		
Sampling appropriate for media and analytes	-	-
Samples extracted and analysed within holding times.	-	organics (14 days), inorganics (6 months)
Trip spike	1 per sampling batch	70-130% recovery
Trip blank	1 per sampling batch	<LOR
Rinsate	1 per sampling batch with reusable sampling equipment	<LOR

Data Quality Indicator	Frequency	Data Quality Criteria
Laboratory Blanks	1 per analytical method	<LOR
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		
Sample 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
Sensitivity		
Field and analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	All samples	LOR < adopted site criteria (where possible)

1 Relative percent difference (RPD)

If any of the DQIs are not met, further assessment will be necessary to determine whether the non-conformance will significantly affect the usefulness of the data. Corrective actions may include requesting further information from samplers and/or analytical laboratories, downgrading of the quality of the data or alternatively, re-collection of the data.

A qualitative assessment of compliance with standard procedures and appropriate sample collection methods will be completed during the DQI compliance assessment.

5.1.7 Optimise the Design for Obtaining Data

For a site of approximately 20,000 m² EPA (1995)⁸ recommends a stratified approach to sampling. However, based on the requirement to co-locate contamination samples within geo-technical boreholes and the scope of works provided, a total of eight (8) sample locations were undertaken. The borehole locations were generally within the vicinity of the geotechnical investigation locations provided by the client. No locations were drilled on Lot 11 DP17375. The soil sample locations are presented on **Figure 3**.

5.2 Investigation Methodology

5.2.1 Soil Sampling Methodology

Soil samples were collected during the site investigation works using a solid flight auger. Sample locations were extended until bedrock was reached.

Samples were obtained directly from the auger wearing fresh disposable nitrile gloves for each sample. Disturbance of the soil sample was minimised where possible during sample collection and placement with laboratory supplied sample containers to reduce the potential for release of volatile organic contaminants.

Visual inspection of drilling spoil was undertaken at each location for the presence of discolouration, ACM or other indications of potentially contaminated materials. Where identified, the observations were recorded on field logs, which are presented in **Appendix C**.

⁸ Contaminated Sites: Sampling Design Guidelines, NSW EPA, 1995 (EPA 1995).

During site works, sufficient sample material was collected to allow for field testing and laboratory analyses. Additional samples were collected from any soil horizons which exhibited staining, odours, seepage, discolouration, or other physical evidence of potential contamination.

Soil samples destined for laboratory analysis were immediately transferred to laboratory supplied sample jars and sealed with a Teflon-lined screw closure or placed into asbestos sample bags. The sample containers were then placed in a pre-cooled insulated box for sample preservation prior to and during shipment to the testing laboratory. Preservation of the primary soil and QA/QC samples obtained during this investigation was completed in accordance with recognised protocols (NEPC 2013).

The samples were transported under standard JBS&G chain-of-custody protocols to the National Association of Testing Authority (NATA) registered laboratory, Eurofins | mgt Pty Ltd (Eurofins).

Not all samples collected were analysed. Selected samples were analysed in accordance with the analytical schedule (**Section 5.3**). However, all samples remain at the primary laboratory for a period of two months. This allows for future analysis to be completed in the event that further information is required to characterise site conditions, provided that proposed analytes remain within analytical holding times.

5.2.2 Soil Sampling Decontamination

Prior to the commencement of sampling activities, non-disposable sampling equipment, including sampling trowel/knife were all cleaned with a high-pressure water/detergent spray and brush, rinsed with water and then air dried. The equipment was then inspected to ensure that no soil, oil, debris or other contaminants were apparent on the equipment prior to the commencement of works. Sampling equipment was subsequently decontaminated using the above process between each sampling location. New gloves were used for each sampling event.

5.2.3 Soil Field PID Screening

Samples collected during the JBS&G sampling event were screened on site using a photo-ionisation detector (PID) to assess the potential presence of VOCs including petroleum hydrocarbons. Samples obtained for PID screening were placed in a sealed plastic bag for a period of approximately five minutes to equilibrate, prior to a PID being attached to the bag. Readings were then monitored for a period of approximately one minute or until values stabilise and the stabilised/highest reading were recorded on the borehole logs. PID screening results were recorded on the bore logs included as **Appendix C**. PID calibration records are included in **Appendix I**.

5.2.4 Soil Duplicate Preparation

Field soil duplicate samples were obtained during sampling using the above sampling methods. The collected samples were then divided laterally into two samples and placed in clean glass jars or sample bags as appropriate. Each sample was then labelled with a primary or duplicate sample identification before being placed in the same chilled esky for transport to the laboratory.

5.3 Laboratory Analysis

JBS&G contracted a NATA certified laboratory (Eurofins | mgt) for the required analysis to which the primary and duplicate samples were submitted. Laboratory analysis of samples was conducted as summarised in **Table 5.3**. Duplicate samples were collected at rate of at least 1 per 20 primary samples.

Table 5.3: Sampling and Analytical Program

Sample Media	No. Sample Locations	Analyses (exc. QA/QC)
Soil	8	Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) – 8 samples PAH – 8 samples OCPs/PCBs – 8 samples TRH/BTEX – 8 samples Asbestos – 8 samples (500 mL) CEC, Ph, % clay, TOC – 8 samples TCLP (metals/PAHs) – 8 samples

6. Assessment Criteria

6.1 Regulatory Guidelines

Development of site assessment criteria and the associated scope of investigation was undertaken with consideration to aspects of the following guidelines, as relevant:

- *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)*, National Environment Protection Council (NEPC 2013);
- *Contaminated Sites: Sampling Design Guidelines*, NSW EPA, 1995 (EPA 1995);
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*, NSW OEH, 2011 (OEH 2011);
- *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme*, 2nd Edition, NSW EPA, 2006 (DEC 2006); and
- *CRCCARE Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*, 2011, Friebe and Nadebaum (CRCCARE 2011).

6.2 Soil Assessment Criteria

As per the decision process for assessment of urban development site (DEC 2006), a set of health and ecological assessment thresholds derived from NEPC (2013) or other EPA approved guidelines was used for evaluation of site contamination data collected for this assessment. The site is zoned R2 Low Density Residential and used as a primary school. On this basis, low density residential with gardens and accessible soil land use criteria were adopted as the site assessment criteria. These land use criteria also apply to primary schools. The site assessment criteria are presented on **Table A** and summarised as follows:

- Health based investigation levels (HILs) for residential land use with garden/accessible soils (HIL A);
- Health screening levels (HSLs) for vapour intrusion for low density land use, clay (HSL A);
- HSLs for direct contact for intrusive maintenance worker;
- Management limits for TRH fractions for residential, parkland and public open space, fine soils;
- HSLs for asbestos in soil for residential land use with garden/accessible soils (HSL A);
- Ecological investigation levels (EILs) for urban residential/public open space land use, site specific; and
- Ecological screening levels (ESLs) for urban residential/public open space land use, fine soils.

The results of the asbestos analysis were assessed in general accordance with NEPC (2013) including DOH (2009) guidance.

To derive EILs for the selected inorganics COPCs, consistent with NEPC (2013), the pH, cation exchange capacity (CEC) and percent clay content for surface soils at the site were analysed. The selected pH value, CEC and percent clay was based on the median concentration of the eight samples analysed. Based on the information, the following criteria for copper, nickel, chromium and zinc in **Table 6.1** were derived from the proposed residential land use scenarios using the EIL spreadsheet provided in the NEPC 2013. Additionally, NEPC 2013 provided generic EILs for lead, arsenic, DDT and naphthalene.

Where no criteria are present for a contaminant, the laboratory limit of reporting (LOR) has been used as an initial screening criteria.

Table 6.1: Derived EIL urban residential/public open space land use

pH	CEC (meq/100g)	Clay Content (%)	Cu (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Cr (mg/kg)
6	15	26	190	170	400	400

7. Quality Assurance/Quality Control

7.1 QA/QC Results

The QA/QC results are summarised in **Table 7.1** and discussed in **Section 7.2** below. Relevant QA/QC data is presented in **Appendix J**.

Table 7.1: QA/QC Results Summary

Data Quality Indicator	Results	DQI Met?
Precision		
Blind duplicates (intra laboratory) (soil)	Sampling rate greater than 1 in 20. RPDs = 0-51%	Partial ¹
Blind triplicates (inter laboratory) (soil)	Sampling rate greater than 1 in 20. RPDs = 0-<50%	No ¹
Laboratory duplicates	Sampling rate greater than 1 in 20. RPDs = 0-<50%	Yes
Accuracy		
Surrogate spikes	58-134% Surrogate spikes were completed for all organic samples	Partial ¹
Laboratory control samples	>70-<130% Laboratory control samples completed for each batch	Yes
Matrix spikes	>70-139%. One matrix spike was completed for each batch	Yes
Representativeness		
Sampling appropriate for media and analytes	All sampling was conducted in accordance with JBS&G procedures	Yes
Samples extracted and analysed within holding times.	All samples were extracted and analysed within holding times	Yes
Trip spike	77-128% One per sampling event when sampling for volatile or semi-volatile COPC	Yes
Trip blank	<LOR One per sampling event when sampling for volatile or semi-volatile COPC	Yes
Rinsate blank	No rinsate blank was collected.	No ¹
Laboratory Blanks	<LOR One per laboratory method	Yes
Comparability		
Standard operating procedures for sample collection & handling	Field staff used same standard operating procedures throughout works	Yes
Standard analytical methods used for all analyses	Standard analytical methods were used	Yes
Consistent field conditions, sampling staff and laboratory analysis	Sampling was conducted using standard operating procedures in the same conditions throughout the works. The laboratory remained consistent throughout the investigation.	Yes
Limits of reporting appropriate and consistent	Limits of reporting were consistent and appropriate	Yes
Completeness		

Sample description and COCs completed and appropriate	All borehole logs and COCs were completed appropriately.	Yes
Appropriate documentation	Field documentation was appropriately completed.	Yes
Satisfactory frequency and result for QC samples	All frequency and results for QC were satisfactory	Yes
Data from critical samples is considered valid	Data from critical samples is considered valid.	Yes
Sensitivity		
Field and analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	Appropriate laboratory analysis methods and detection limits were considered to have been achieved to the extent practicable during the field and laboratory phases of this investigation.	Yes

Notes: 1 See discussion of DQI exceedances

7.2 QA/QC Discussion

7.2.1 Precision

Soil Blind Duplicates (intra laboratory)

Duplicate sample analysis was completed at the required frequency. The reported RPDs were generally within the acceptable limits for all COPCs with the exception of chromium (51%) and zinc (51%). The reported RPDs are marginally outside the acceptable range and are considered not to influence the investigation findings due to the low concentrations of the two analytes within the sample.

Soil Blind Triplicates (inter laboratory)

No triplicate samples were analysed as part of the investigation.

Laboratory Duplicates

Laboratory duplicate analysis was completed at the required frequency and the laboratory duplicate RPDs were reported within the acceptable limits for all COPCs.

7.2.2 Accuracy

Surrogate Spikes

The surrogate spikes samples have been reported for analysis of all organic constituents for soils and water. A total of 13 surrogate spike samples reported were >30% variation ranging from 58% to 69% and 132% to 135%. Given that most organic COPCs were reported below the LOR and all volatile COPCs were reported below the site assessment criteria, this is not considered to influence the outcome of the investigation. Furthermore, field screening (PID) and observations (odour, staining and sheen) did not indicate the presence of any volatile contaminants. Additionally, the recovery percentages were generally within the NATA accredited lab method acceptance range for surrogate spike recoveries, which are 50-150%.

Laboratory Control Samples

Laboratory control samples have been reported for analysis of all constituents for the analytical batches. All laboratory control samples were within the 70 to 130% acceptance range.

Matrix Spikes

Matrix spikes have been reported for analysis of all constituents for the analytical batches. All laboratory control samples were within the 70 to 130% acceptance range.

7.2.3 Representativeness

Sampling appropriate for media and analytes

All soil sampling works completed during the investigation were conducted in accordance with JBS&G standard operating procedures. Solid flight augers with 300 mm diameter were advanced for the purposes of visual inspection of fill conditions and the collection of 500mL asbestos soil samples, which is considered appropriate for the assessment of asbestos.

All samples were collected wearing a new pair of disposable nitrile gloves. Where possible, disturbance of the sample was minimised during placement into the laboratory supplied sample container and during shipment.

Given the absence of specific information in relation to the potential for volatile contaminant sources, this sampling method was considered appropriate to achieve investigation objectives.

Samples extracted and analysed within holding times

All analyses have been undertaken within holding times.

Trip spikes

A single trip spike was submitted with the soil samples collected during the assessment. Trip spike recoveries were within the JBS&G acceptable limit of 70-130%, with a reported range of 77% to 128%.

Trip blanks

A single trip blank was submitted with the soil sampling event. There were no reported concentrations of BTEX compounds or naphthalene above the laboratory LOR.

Rinsate Blanks

No rinsate blanks were submitted with the samples collected during the assessment, however, based on the concentration of COPCs within soil samples either at background levels (heavy metals) or below LOR, the lack of rinsate blank is not considered to affect the outcome of the assessment.

Laboratory Blanks

Reported concentrations of all analytes were <LOR in laboratory blank samples.

7.2.4 Comparability

Experienced JBS&G personnel undertook all sampling in accordance with standard JBS&G sampling methods.

All field works and sampling were undertaken by one experienced JBS&G field scientist.

The laboratory LORs are consistent and are considered appropriate.

7.2.5 Completeness

Samples were generally transported under full chain of custody (COC) documentation. The COC documentation was generally completed correctly and the selected analyses were correctly conducted.

All field documentation was completed appropriately and were correct.

The frequency of analysis and result for all QC samples are appropriate.

7.2.6 Sensitivity

The adopted analytical methods generally provided suitable LORs with respect to the adopted site assessment criteria.

7.3 QA/QC Conclusion

The field sampling and handling procedures produced QA/QC results which indicate that the soil data are of an acceptable quality and suitable for use in site characterisation.

The NATA certified laboratory results sheets indicate that the project laboratory was generally achieving levels of performance within its recommended control limits during the period when the samples from this program were analysed.

The non-conformances described in **Section 7.2** are considered to be minor in nature and acceptable given the consistency of the data and results significantly below the adopted site assessment criteria.

On the basis of the results of the field and laboratory QA/QC program, the soil data are of an acceptable quality upon which to draw conclusions regarding the environmental condition of the site.

8. Soil Results

8.1 Soil Field Observations

A total of eight sample locations were advanced. Soil sample locations are presented on **Figure 3** and bore logs are provided in **Appendix C**.

Grass/unsealed ground was encountered at the surface at four sampling locations. Three sampling locations were undertaken beneath asphalt. One soil sampling location was undertaken beneath concrete.

Fill material was encountered at all sample locations and generally comprised brown silty clay or sandy silty clay, heterogeneous, damp, soft to very soft with some trace gravel, organic material, glass and plastic inclusions. Fill material was observed at depths ranging from 0.05 m bgs to 0.25 m bgs.

Natural soils underlying the fill material generally comprised orange brown silty clay overlying grey silty clay containing red mottles, high plasticity, homogeneous, damp and stiff, underlain by dark grey weathered shale. Natural clays were encountered at all locations. No groundwater seepage was observed during augering.

No odours, staining or asbestos containing material (ACM) were observed within the fill material or natural soils at the site.

PID results during field screen for volatile contaminants were 0 ppm, consistent with the lack of observed odours and staining.

8.2 Soil Analytical Results

Summarised soil analytical results are presented in **Table A** and discussed in the following sections. Laboratory documentation is provided in **Appendix K**.

8.2.1 Metals

The concentrations of the heavy metals in the soil samples selected for analysis were all less than the site assessment criteria.

8.2.2 PAHs

The concentrations of PAHs in the soil samples selected for analyses were all less than the site assessment criteria and below the LOR.

8.2.3 Asbestos

The concentration of all forms of asbestos in the soil samples selected for analyses were all less than the site assessment criteria and below the LOR.

8.2.4 TRH

The concentration of TRH in the soil samples selected for analyses were all less than the site assessment criteria and generally below the LOR.

8.2.5 BTEX

The concentration of BTEX in the soil samples selected for analyses were all less than the site assessment criteria and below the LOR.

8.2.6 OCPs

The concentration of OCPs in the soil samples selected for analyses were all less than the site assessment criteria and generally below the LOR.

8.2.7 PCBs

The concentration of PCBs in the soil samples selected for analyses were all less than the site assessment criteria and below the LOR.

8.2.8 Soil Properties for Site Specific EILs

The reported % clay ranged from 6.3% (BH2) to 40% (BH1 & BH7). The cation exchange capacity ranged from 2.2 meq/100g (BH07) to 27 meq/100g (BH1). pH ranged from 5.0 pH (BH07) to 7.2 pH (BH1). Total organic carbon ranged from 0.4% (BH08) to 9.2% (BH03).

8.3 Preliminary Waste Classification

Toxicity characteristic leaching procedure (TCLP) was undertaken on the soil samples at the site to assess the likely leaching of heavy metal and PAH contaminants within the soils. The results of the TCLP analysis identified that leaching of heavy metals and PAHs within the soil was low as all concentrations were reported below the laboratory limit of reporting (LOR) with the exception if zinc in one sample which was marginally above the laboratory LOR.

The concentrations reported within the soil were below the leachable concentrations and specific contaminant concentration 1 (SSC1) for general solid waste. Based on the results of the soil and TCLP data, the fill material at the site has been preliminary classified as General Solid Waste.

9. Site Characterisation

The following sections provide a summary discussion of the decision outcomes for this assessment.

9.1 Are there any unacceptable risks to likely future receptors from impacted soil?

Boreholes completed at the site in conjunction with the geo-technical investigation works were broadly spread across the site. The boreholes were limited to areas understood to be redeveloped and the locations of the boreholes were pre-selected at geotechnical investigation locations completed by the client. When considering the fill material encountered during the investigation works were generally consistent across the site comprising silty clay or sandy silty clay with a lack of other anthropogenic inclusions (except for traces of plastic), odours, staining and ACM observed, the predetermined sampling locations are considered to be representative of site conditions. Furthermore, the concentrations of COPCs within fill materials analysed at the proposed development locations were reported within background levels (heavy metals) or below the LOR (organic COPCs) in all samples selected for analyses.

Concentrations of COPCs in all soil samples analysed were reported below the site assessment criteria. Based on the soil analytical data, there are no unacceptable risks to future receptors at the proposed development locations sampled.

9.2 Are there any issues relating to the local area background soil concentrations?

Given the nature of the investigation, the soil sampling was targeted towards fill materials, which were considered to represent the greatest potential risk. Heavy metals were reported within background ranges as per Olszowy et al. (1995). In addition, all other COPCs were reported below the LOR. On this basis, there are not considered to be any issues relating to local area background soil concentrations. The physical observations of natural soil/rock conditions is considered sufficient to confirm the absence of conditions of concern for natural materials at the site.

9.3 Are there any impacts from chemical mixtures?

There were no soil conditions identified with significant concentrations of more than one contaminant of concern and therefore no potential chemical mixtures were identified during the investigation that may pose an unacceptable contamination risk at the site with respect to future site users.

9.4 Are there any aesthetic concerns?

Based on the lack of observed odours or staining within site soils, the lack of anthropogenic inclusions and that no ACM was observed within surface soils (or at depth), no unacceptable aesthetic concerns have been identified during this assessment.

9.5 Is there any evidence of, or potential for, migration of contaminants from the site?

The potential for migration of contaminants from the site is considered to be low based upon the absence of identified soil contamination.

No evidence of volatile compounds were identified during the analytical program. As such, it is considered that migration of contamination via migration is negligible.

No groundwater investigation was undertaken at the site. Groundwater was not intercepted during the investigation, and is anticipated to be at depth in bedrock. Considering the concentrations identified within the fill material and the surrounding land uses, it is considered that the risk to groundwater is low and no groundwater assessment would be required.

9.6 Is a site management strategy required?

Based on the scope of works completed, including a desktop review and limited intrusive investigations, and the limitations presented in **Section 11**, there are considered not to be any contamination conditions at the site that represent an unacceptable risk with respect to the proposed development works. On this basis, a contamination management strategy is not required for the site.

An appropriate unexpected find protocol implemented during development works would enable management of any unidentified contamination if encountered.

10. Conclusions

Based on the findings of this assessment and subject to the limitations in **Section 11**, the following conclusions are provided:

- The site is understood to have been used for education use (school) since 1924. Prior to this, the site was used for residential purposes.
- Fill material was encountered at all eight sample locations and generally comprised heterogeneous, damp, soft to very soft brown silty clay or sandy silty clay, with some trace gravel, organic material, glass and plastic inclusions. Fill material was observed at depths ranging from 0.05 m bgs to 0.25 m bgs. Natural high plasticity, homogeneous, damp and stiff orange brown silty clay overlying grey and red mottled silty clay were identified beneath the fill material. Natural clay soils were in turn underlain by dark grey weathered shale.
- Concentrations of COPCs in representative soils were less than the adopted NEPC (2013) site assessment criteria.
- Based on the soil and leachate analytical data, the fill material would preliminary be classified as General Solid Waste in accordance with EPA guidelines.
- No chemical mixtures, aesthetic issues or significant offsite migration risks were identified.
- On this basis, it is considered that there were no contamination risks identified that would need to be managed during construction works. Given the limited extent of investigations, implementation of an appropriate unexpected finds protocol implemented during future development works would enable management of any unidentified contamination if encountered.

11. Limitations

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

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

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

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

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

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

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

Figures

Legend:

 Approximate Site Boundary



Job No: 53033

Client: Pells Sullivan Meynink

Version: R01 Rev A

Date: 31-Aug-2017

Drawn By: BC

Checked By: SB

Scale 1:6,000

0 70 140



metres

Coor. Sys. GDA 1994 MGA Zone 56

**48-58 Myra Street
Wahroonga, NSW**

SITE LOCATION

FIGURE 1





Legend:

 Approximate Site Boundary



Job No: 53033

Client: Pells Sullivan Meynink

Version: R01 Rev A

Date: 31-Aug-2017

Drawn By: BC

Checked By: SB

Scale 1:1,000



0 10 20
metres

Coor. Sys. GDA 1994 MGA Zone 56

48-58 Myra Street
Wahroonga, NSW

SITE LAYOUT

FIGURE 2



Legend:

- Approximate Site Boundary
- Sample Location



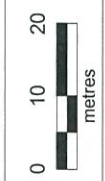
Job No: 53033

Client: Pells Sullivan Meyrick

Version: R01 Rev A Date: 31-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,000



Coor. Sys. GDA 1994 MGA Zone 56

48-58 Myra Street
Wahroonga, NSW

SAMPLE LOCATIONS

FIGURE 3

Appendix A Summary Tables

Table A
Project Number 53033
Project Name Waitara Public School

[illegible]

Some analyses are missing North Combined Compound

Some analyses are reported multiple times, the lowest model for the highest event is used. Some analyses are with no direct measure of OS. Some analyses are missing from this combined component.

438. **PS307** Continued. Some analyses are in progress, multiple tests, the time is insufficient on the highest default is used. Some analyses are missing from this Combined Compound.

439. **PS307** Continued with this Default Multiplier of 0.5. Some analyses are missing from this Combined Compound.

440. **PS307** Continued. Some analyses are missing from this Combined Compound.

441. **PS307** Continued.

Appendix B Photographic Log

PHOTOGRAPH 1: LOCATION OF BH01 IN THE CENTRAL NORTHERN PORTION OF THE SITE, FACING NORTH. PICTURED IS AN EXAMPLE OF TYPICAL ASPHALT SEALED SURFACES



PHOTOGRAPH 2: LOCATION OF BH02 IN THE SOUTH EASTERN CORNER OF THE SITE, FACING WEST. PICTURED IS AN EXAMPLE OF GRASSED AND ARTIFICIAL TURF SURFACES



PHOTOGRAPH 3: LOCATION OF BH05 IN THE NORTH WESTERN CORNER OF THE SITE, FACING EAST. PICTURED IS AN EXAMPLE OF CONCRETE AND RUBBER SEALED SURFACES



PHOTOGRAPH 4: LOCATION OF BH08 IN THE CENTRAL WESTERN PORTION OF THE SITE, FACING SOUTH WEST. PICTURED IS AN EXAMPLE OF SEALED CONCRETE AND EXPOSED SOIL SURFACES



Job No: 53033

Client: PSM

Version: R01 Rev A

Date: 29/08/17

Drawn By: SG

Checked By: SB

Not to Scale

Coord. Sys n/a

Waitara Public School

48-58 Myra Street,
Wahroonga, NSW

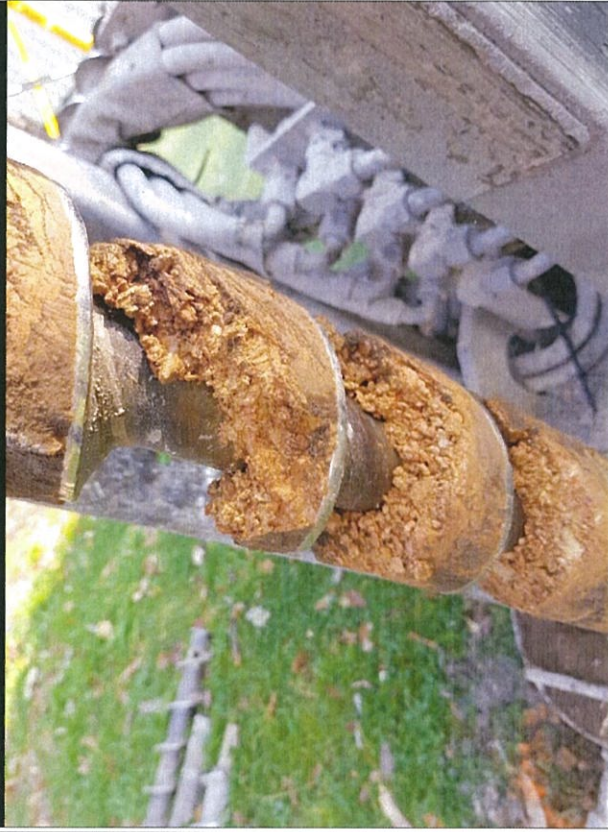
PHOTOGRAPH 5: TYPICAL FILL MATERIAL ENCOUNTERED AT THE SITE DURING INTRUSIVE SAMPLING



PHOTOGRAPH 6: TYPICAL FILL MATERIAL ENCOUNTERED AT THE SITE DURING INTRUSIVE SAMPLING



PHOTOGRAPH 7: TYPICAL NATURAL MATERIAL ENCOUNTERED DURING INTRUSIVE SAMPLING



PHOTOGRAPH 8: TYPICAL NATURAL MATERIAL ENCOUNTERED DURING INTRUSIVE SAMPLING



Job No: 53033

Client: PSM

Version: R01 Rev A

Date: 29/08/17

Drawn By: SG

Checked By: SB

Not to Scale

Coord. Sys n/a

Waitara Public School

48-58 Myra Street,
Wahroonga, NSW

APPENDIX B

Appendix C Borelogs

**BH01**

Project Number: 53033

Client: Pells Sullivan Meynink

Project Name: Waitara Public School

Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017

Logged By: S.Gray

Contractor: BG Drilling

Total Hole Depth (mbgs): 4

Bore Diameter (mm): 90

Easting (GDA 94):

Northings (GDA 94):

Zone/Area:

Reference Level:

Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	Fill - ASPHALT		
	0.10			Fill	Fill - Silty CLAY - Brown, heterogeneous, medium plasticity, damp, soft	BH01 0.1-0.2 PID = 0 ppm	No ACM, no odours, no staining
	0.20			CH-MH	Silty CLAY - Grey, homogeneous, high plasticity, damp, stiff, becomes darker grey with depth	BH01 0.2-0.3 PID = 0 ppm	No ACM, no odours, no staining
	0.5						
	1.0					BH01 0.9-1.0 PID = 0 ppm	No ACM, no odours, no staining
	1.5						
	2.0						
	2.5						
	3.0						
	3.5						
	3.90			SHALE	SHALE - Dark grey		
	4.00				Borehole BH01 terminated at 4m		

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 8/30/17



BH02

Project Number: 53033

Client: Pells Sullivan Meynink

Project Name: Waitara Public School

Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017

Logged By: S.Gray

Contractor: BG Drilling

Total Hole Depth (mbgs): 3.6

Bore Diameter (mm): 90

Eastings (GDA 94):

Northings (GDA 94):

Zone/Area:

Reference Level:

Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	Fill - Sandy Silty CLAY - Brown, heterogeneous, non-plastic, damp, soft	BH02 0.0-0.1 PID = 0 ppm	No ACM, no odours, no staining. QA/QC20170814-01
	0.20			CH-MH	Silty CLAY - Orange with red and grey mottles, homogeneous, high plasticity, damp, stiff, colour becomes lighter with depth	BH02 0.2-0.3 PID = 0 ppm	No ACM, no odours, no staining
	0.70			MH-CH	Clayey SILT - Grey with red mottles, high plasticity, damp, stiff		
	3.60				Borehole BH02 terminated at 3.6m		



BH03

Project Number: 53033

Client: Pells Sullivan Meynink

Project Name: Waitara Public School

Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017

Logged By: S.Gray

Contractor: BG Drilling

Total Hole Depth (mbgs): 3.8

Bore Diameter (mm): 90

Eastings (GDA 94):

Northings (GDA 94):

Zone/Area:

Reference Level:

Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	Fill - Sandy Silty CLAY - Brown, heterogeneous, low plasticity, dry, soft, with inclusions of a high concentration of organic matter and traces of plastic	BH03 0.0-0.1 PID = 0 ppm	No ACM, no odours, no staining
	0.25			CL-ML	Silty CLAY - Orange-brown with red and grey mottles, homogeneous, damp, stiff, becomes lighter with depth	BH03 0.3-0.4 PID = 0 ppm	No ACM, no odours, no staining
	1.00			ML-CL	Clayey SILT - Grey-brown, homogeneous, dry, firm		
	3.80				Borehole BH03 terminated at 3.8m		

BOREHOLE_JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 8/30/17



BH04

Project Number: 53033
 Client: Pells Sullivan Meynink
 Project Name: Waitara Public School
 Site Address: 48-58 Myra Street, Wairoa NSW

Date: 14/08/2017
 Logged By: S.Gray
 Contractor: BG Drilling
 Total Hole Depth (mbgs): 3.5
 Bore Diameter (mm): 90

Eastings (GDA 94):
 Northings (GDA 94):
 Zone/Area:
 Reference Level:
 Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger	0.05			Fill	Fill - ASPHALT		
				Fill	Fill - Silty CLAY - Brown, heterogeneous, non-plastic, dry, very soft with traces of gravel	BH04 0.1-0.2 PID = 0 ppm	No ACM, no odours, no staining
	0.20			CL-ML	Silty CLAY - Orange-brown with red and grey mottles, homogeneous, dry, stiff	BH04 0.3-0.4 PID = 0 ppm	No ACM, no odours, no staining
	0.80			ML-CL	Clayey SILT - Grey with red mottles, homogeneous, low plasticity, damp, firm	BH04 0.8-0.9 PID = 0 ppm	No ACM, no odours, no staining
	3.50				Borehole BH04 terminated at 3.5m		



BH05

Project Number: 53033

Client: Pells Sullivan Meynink

Project Name: Waitara Public School

Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017

Logged By: S.Gray

Contractor: BG Drilling

Total Hole Depth (mbgs): 2.8

Bore Diameter (mm): 90

Eastings (GDA 94):

Northings (GDA 94):

Zone/Area:

Reference Level:

Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	Fill - Silty CLAY - Brown, heterogeneous, non-plastic, dry, soft, with trace inclusions of plastic and sand	BH05 0.0-0.1 PID = 0 ppm	No ACM, no odours, no staining
	0.20			CL-ML	Silty CLAY - Orange with red and grey mottles, homogeneous, low-plasticity, damp, stiff	BH05 0.2-0.3 PID = 0 ppm	No ACM, no odours, no staining
	0.50			CL-ML	Silty CLAY - Grey with red mottles, homogeneous, low plasticity, damp, stiff		
	1.0					BH05 0.8-0.9 PID = 0 ppm	No ACM, no odours, no staining
	2.00			ML-CL	Clayey SILT - Grey with red mottle, low plasticity, damp, firm		
	2.80				Borehole BH05 terminated at 2.8m		

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 8/30/17



BH06

Project Number: 53033
Client: Pells Sullivan Meynink
Project Name: Waitara Public School
Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017
Logged By: S.Gray
Contractor: BG Drilling
Total Hole Depth (mbgs): 2.9
Bore Diameter (mm): 90

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger	0.05			Fill	Fill - Silty CLAY - Brown, heterogeneous, non-plastic, dry, soft, with trace inclusions of plastic	BH06 0.0-0.1 PID = 0 ppm	No ACM, no odours, no staining
	0.10			CL-ML	Fill - Silty CLAY - Grey with red mottles, heterogeneous, low plasticity, damp, very stiff Silty CLAY - Grey, heterogeneous, low plasticity, dry, very stiff	BH06 0.2-0.3 PID = 0 ppm	No ACM, no odours, no staining
	0.5						
	1.0						
	1.5						
	2.0						
	2.5						
	3.0	2.90			Borehole BH06 terminated at 2.9m		
	3.5						
	4.0						



BH07

Project Number: 53033

Client: Pells Sullivan Meynink

Project Name: Waitara Public School

Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017

Logged By: S.Gray

Contractor: BG Drilling

Total Hole Depth (mbgs): 3

Bore Diameter (mm): 90

Eastings (GDA 94):

Northings (GDA 94):

Zone/Area:

Reference Level:

Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger		0.05		Fill	Fill - ASPHALT		
				Fill	Fill - Silty CLAY - Brown, heterogeneous, non-plastic, dry, soft	BH07 0.1-0.2 PID = 0 ppm	No ACM, no odours, no staining
		0.15		CH-MH	Silty CLAY - Orange-brown with red and grey mottles, homogeneous, high plasticity, damp, stiff	BH07 0.2-0.3 PID = 0 ppm	No ACM, no odours, no staining
		0.30		CL-ML	Silty CLAY - Grey with red mottles, homogeneous, low plasticity, damp, stiff	BH07 0.4-0.5 PID = 0 ppm	No ACM, no odours, no staining
	0.5 1.0 1.5 2.0 2.5 3.0						
	3.00				Borehole BH07 terminated at 3m		
	3.5 4.0						

**BH08**

Project Number: 53033

Client: Pells Sullivan Meynink

Project Name: Waitara Public School

Site Address: 48-58 Myra Street, Wahroonga NSW

Date: 14/08/2017

Logged By: S.Gray

Contractor: BG Drilling

Total Hole Depth (mbgs): 2.6

Bore Diameter (mm): 90

Eastings (GDA 94):

Northings (GDA 94):

Zone/Area:

Reference Level:

Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	Fill - CONCRETE		
	0.10			Fill	Fill - Sandy Silty CLAY - Brown, heterogeneous, non-plastic, wet, with inclusions of gravels and plastic	BH08 0.1-0.2 PID = 0 ppm	No ACM, no odours, no staining
	0.20			CL-ML	Silty CLAY - Orange-brown with red and grey mottles, homogeneous, low plasticity, damp, firm		
	0.40			CL-ML	Silty CLAY - Grey with red and orange mottles, homogeneous, low plasticity, firm	BH08 0.3-0.4 PID = 0 ppm	No ACM, no odours, no staining
	0.5						
	1.0						
	1.5						
	2.0						
	2.5						
	2.60				Borehole BH08 terminated at 2.6m		
	3.0						
	3.5						
	4.0						

Appendix D Historical Aerial Photographs

Legend:

Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500

0 10 20
metres

Coor. Sys. GDA 1994 MGA Zone 56

48-58 Myra Street
Wahroonga, NSW

HISTORICAL AERIAL
PHOTOGRAPH 1943

FIGURE 1943



Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500 

0 10 20

metres

Coor. Sys. GDA 1994 MGA Zone 56

**48-58 Myra Street
Wahroonga, NSW**

**HISTORICAL AERIAL
PHOTOGRAPH 1951**

FIGURE 1951



Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500



0 10 20



metres

Coor. Sys. GDA 1994 MGA Zone 56

48-58 Myra Street
Wahroonga, NSW

HISTORICAL AERIAL
PHOTOGRAPH 1961

FIGURE 1961



Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500 

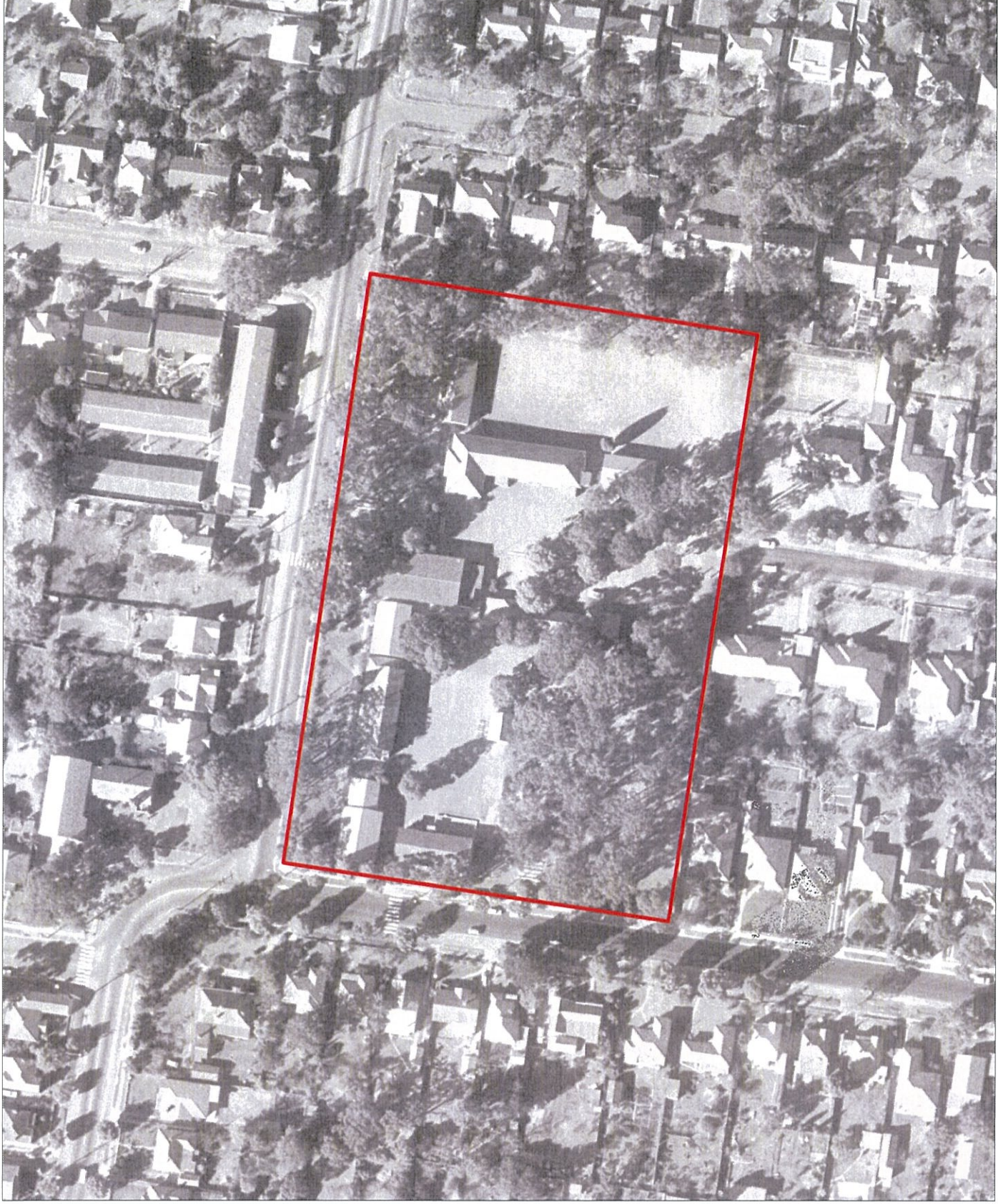
0 10 20
metres

Coor. Sys. GDA 1994 MGA Zone 56

**48-58 Myra Street
Wahroonga, NSW**

**HISTORICAL AERIAL
PHOTOGRAPH 1970**

FIGURE 1970



Legend:

Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500



0 10 20



metres

Coor. Sys. GDA 1994 MGA Zone 56

48-58 Myra Street
Wahroonga, NSW

HISTORICAL AERIAL
PHOTOGRAPH 1982

FIGURE 1982



Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials

Date: 30-Aug-2017

Drawn By: BC

Checked By: SB

Scale 1:1,500



0 10 20



metres

Coor. Sys. GDA 1994 MGA Zone 56

**48-58 Myra Street
Wahroonga, NSW**

**HISTORICAL AERIAL
PHOTOGRAPH 1991**

FIGURE 1991



Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500 

0 10 20

metres

Coor. Sys. GDA 1994 MGA Zone 56

**48-58 Myra Street
Wahroonga, NSW**

**HISTORICAL AERIAL
PHOTOGRAPH 2003**

FIGURE 2003





Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB

Scale 1:1,500 

0 10 20
metres

Coor. Sys. GDA 1994 MGA Zone 56

**48-50 Myra Street
Wahroonga, NSW**

**HISTORICAL AERIAL
PHOTOGRAPH 2009**

FIGURE 2009



Legend:

 Approximate Investigation Area (A
DP309739)



Job No: 53033

Client: Pells Sullivan Meynink

Version: Aerials Date: 30-Aug-2017

Drawn By: BC Checked By: SB



Scale 1:1,500



Coor. Sys. GDA 1994 MGA Zone 56

**48-58 Myra Street
Wahroonga, NSW**

**AERIAL
PHOTOGRAPH 2017**

FIGURE 2017

