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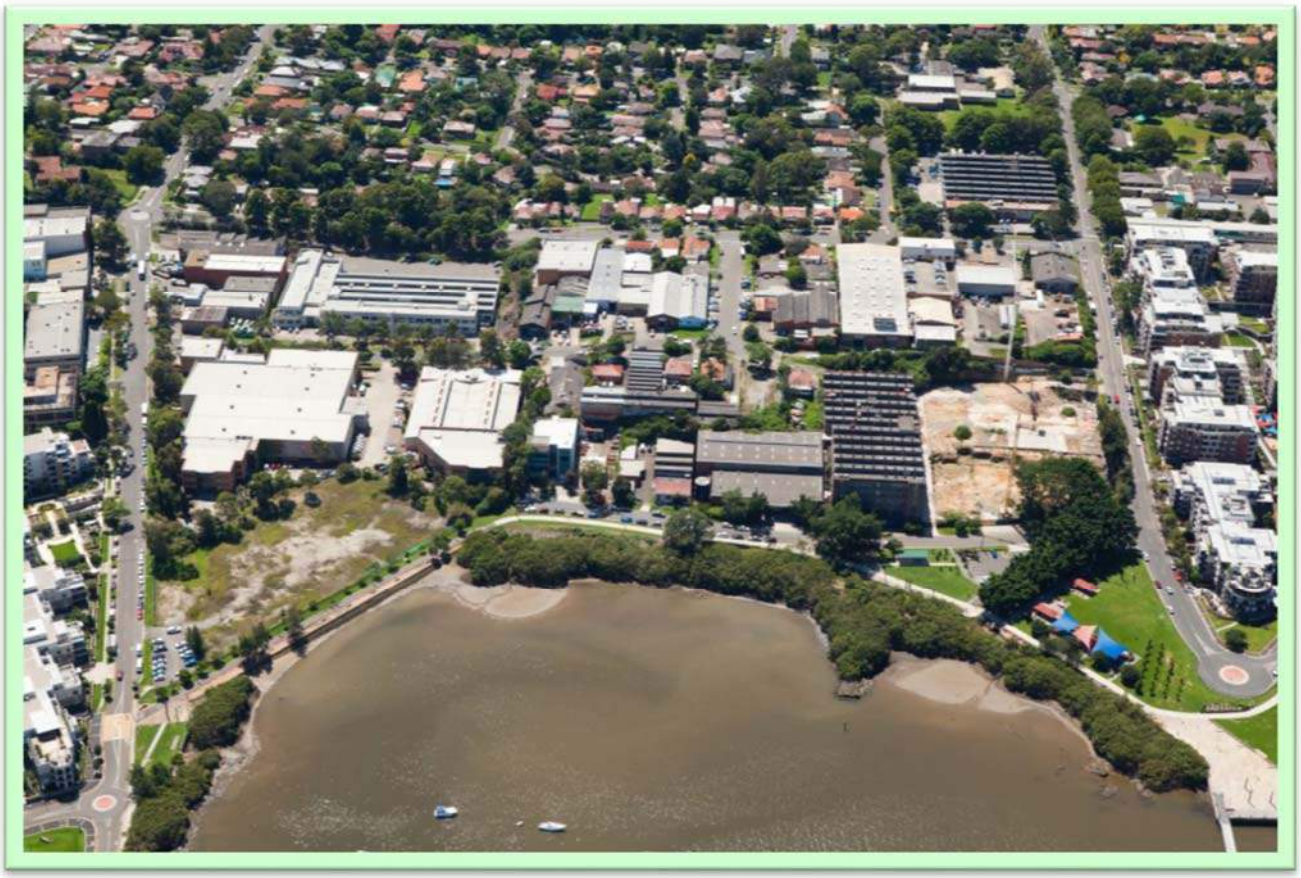
ENVIRONMENTAL SITE ASSESSMENT

STAGES 2 & 3 OF THE SHEPHERDS BAY URBAN RENEWAL PROJECT, MEADOWBANK NSW



Environmental Investigations

Report No. E2008 AA

10 January 2014

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STAGES 2 & 3 OF THE SHEPHERDS BAY URBAN RENEWAL PROJECT,
MEADOWBANK NSW

EI Report No. *E2008 AA*
Date: *10 January 2014*

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1.0 INTRODUCTION

BACKGROUND

The Shepherds Bay Urban Renewal Concept Plan (MP09_0216) was approved in March 2013 and required:

> *Clause 38 Future Development Applications shall include a detailed contamination assessment (involving sampling and testing of soil) including the presence of acid sulphate soils and salinity.*
>
> *Clause 39 A groundwater assessment (involving sampling and testing of groundwater) shall be undertaken across the entire Concept Plan prior to the first Development Application being lodged for Stage 2 or any other stage of the development.*
>
> *Clause 40 Future Development Applications where necessary shall include a targeted groundwater assessment for the specific stage (based on the recommendations of the groundwater assessment undertaken for the entire Concept Plan)*

Environmental Investigations (EI) was engaged by Mr Adam Fahi of Holdmark Pty Ltd to conduct an Environmental Site Assessment (ESA) for site characterisation purposes within stages 2 and 3 of the Shepherds Bay Urban Renewal Development Project (henceforth 'the site'), which encompasses a number of properties, being 9 - 11 Rothesay Avenue, 6 - 18 Nancarrow Avenue and 41 Belmore Street, Meadowbank, NSW (henceforth 'the site'). The groundwater assessment is also being undertaken by EI and is presented in a separate document.

As shown in **Figure 1,** the Shepherds Bay Urban Renewal Project is located approximately 11km north west of Sydney's central business district, with stages two and three of this development comprising Lots 11, 12, 13, 14, 15, 16 and 18 in DP 7130, Lots 1 and 18 in DP1072555, Lot 1 in DP 703858 and Lot 1 in DP 322641, located within the Local Government Area of City of Ryde Council. The site covers a total area of approximately 1.53 hectares (15347m^2), as depicted in the site plan presented as **Figure 2**.

Proposed Development

Stages 2 and 3 of the development has been designated for the construction of two multi storey residential developments with associated basement car parking facilities. The site encompasses eight

separate lots, bound by Nancarrow Avenue, Rothesay Avenue, Nancarrow Lane and 41 – 45 Belmore Street, and site lies across two neighbouring suburbs, being Ryde and Meadowbank.

REGULATORY FRAMEWORK

The following regulatory framework and guidelines were considered during the preparation of this report:

- NEPC (2013) *Schedule B(1)* Guideline on *Investigation Levels for Soil and Groundwater*, National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, National Environment Protection Council, May 2013;
- NEPC (2013) *Schedule B(2) Guideline on Site Characterisation*, National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, National Environment Protection Council, May 2013;
- (ANZECC and NHMRC January, 1992) *Guidelines for the Assessment and Management of Contaminated Sites*, published by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC);
- NSW DEC, 2006 *Guidelines for the NSW Site Auditor Scheme*;
- ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*; and
- NSW EPA (1995) *Sampling Design Guidelines*

2.0 OBJECTIVES AND SCOPE OF WORK

2.1 OBJECTIVES

In accordance with the Concept Approval (Clause 38) the proponent is required to undertake a detailed contamination assessment for any future development applications. The primary objectives of this ESA were therefore to:

- Evaluate the potential for site contamination on the basis of historical land uses, anecdotal and documentary evidence of possible pollutant sources; and
- To investigate the degree of any potential contamination by means of limited intrusive sampling and laboratory analysis, for relevant contaminants.

2.2 SCOPE OF WORKS

In order to achieve the above objective, and in keeping the project cost-effective while meeting the minimum requirements of the EPA/DECC guidelines for consultants reporting on contaminated sites, the scope of works was as follows:

Desktop Study

- A review of relevant topographical, geological, hydrogeological and soil landscape maps for the project area;
- Search of historical aerial photographs archived at NSW Land and Property Information in order to review previous site use and the historical sequence of land development in the neighbouring area;
- A land titles search, also conducted through NSW Land and Property Information for information relating to site ownership;
- Site history survey involving a detailed search of City of Ryde Council records for information relating to operational site history and/or relevant environmental incidents;
- A search through the NSW EPA / OEH Land Information records to confirm that there are no statutory notices current on the site under the *Unhealthy Building Land Act* (1990) or the *Contaminated Land Management Act* (1997);

- A search of the Stored Chemical Information Database (SCID) and microfiche records held by WorkCover NSW relating to possible underground tank approvals and locations; and
- A review of existing underground services on site.

Field Work

- A detailed site walkover inspection;
- Construction of test boreholes at twenty nine preliminary locations (BH1 – BH5, BH201 – BH224) distributed in a triangular grid pattern across accessible areas of the site;
- Multiple level soil sampling down to natural soils;
- Laboratory analysis of selected soil samples for relevant analytical parameters as determined from the site history survey and field observations during the investigation program; and
- Data interpretation and reporting.

EI have also carried out a groundwater assessment for the entire concept area which has been reported separately (EI, 2014 Ref: AC E2008)

3.0 SITE DESCRIPTION

3.1 PROPERTY IDENTIFICATION, LOCATION AND PHYSICAL SETTING

The site identification details and associated information are presented in **Table 3-1** while the site locality is shown in **Figure 1**.

Table 3-1: Site Identification, Location and Zoning

Attribute	Description
Street Address	9 - 11 Rothesay Avenue, 6 - 18 Nancarrow Avenue and 41 Belmore Street, Meadowbank, NSW
Location Description	Approx. 11 km north west of Sydney central business district, a slightly skewed rectangular shaped block, bound by Nancarrow Avenue (north), Stage 1 of the Shepherds Bay Urban Renewal Development Project, followed by Belmore Street (east), Rothesay Avenue (south) and commercial / industrial land use (west).
Site Area/GDA	Stages 2 and 3 of the development combined were approx. 1.53 hectares (15347m^2, from Survey Plan) Southern corner GDA Lat:-33.820732713, Long: 151.095191508
Site Owner	Holdmark Pty Ltd
Lot and Deposited Plan (DP)	Lots 11, 12, 13, 14, 15, 16 and 18 in DP 7130, Lots 1 and 18 in DP1072555, Lot 1 in DP 703858 and Lot 1 in DP 322641
State Survey Marks	Two State Survey Marks (SSM) occur around the sites, being SS122873D in Rothesay Avenue (now destroyed) and SS122864 in Belmore Street. (http://maps.six.nsw.gov.au)
Local Government Authority	City of Ryde Council
Parish	Hunters Hill
County	Cumberland
Current Zoning	*B4 – Mixed Use* (Ryde Draft Local Environment Plan, 2011)

At the time of this assessment, the site was divided into eight separate allotments comprising various commercial properties in the northern portion of the site, residential and vacant land present in the central eastern portion of the site, a large vacant industrial warehouse in the central western portion of the site, and cleared land which has undergone demolition in the southern portion of the site. The demolished building and current industrial warehouse were historically used for manufacturing of

white goods by Hoover. A site plan illustrating the assessment areas are shown in **Figure 2**.

3.2 LOCAL LAND USE

The site is situated within an area of mixed use. Current uses on surrounding land are described in **Table 3-2**.

Table 3-2: Local Land Use

Direction Relative to Site	Land Use Description
North east	Nancarrow Avenue, beyond which was retail and commercial warehouse properties
South east	Preliminary construction of a high density residential development *(Stage 1, Shepherds Bay Urban Renewal Project)* followed by Belmore Street
South west	Rothesay Avenue, beyond which is Parramatta River, with a public reserve (*Anderson Park*) located to the south.
North west	Commercial office building followed by Nancarrow Lane, with commercial properties beyond.

3.3 REGIONAL SETTINGS

The topographical, geological, soil landscape and hydrogeological information for the locality is summarised in **Table 3-3**.

Table 3-3: Topographical, Geological and Hydrogeological Information

Attribute	Description
Topography	The site slopes south toward Paramatta River from a RL of approximately 7m to 12m AHD on Nancarrow Avenue (H Ramsay & Co. Pty Ltd Survey) to approximately 5m to 2m AHD on Rothesay Avenue
Site Drainage	The general slope of the site is in the direction of Parramatta River, with all stormwater present at the site flowing towards this feature via drainage to various stormwater easements and the municipal stormwater system.
Regional Geology	The site is likely underlain by Hawkesbury Sandstone (*Rh)*. Hawkesbury Sandstone is described as medium to coarse-grained quartz sandstone, very minor shale and laminite lenses. *(Ref. 1:100 000 Geological Series Sheet 9130 –Sydney)*
Soil Landscapes	The Soil Conservation Service of NSW *Soil Landscapes of the Sydney 1:100,000 Sheet* (Chapman and Murphy, 1989) indicated that the site overlies an *Erosional Landscape – Glenorie (gn),* which typically includes gently undulating to rolling low hills on

Attribute	Description
	Wianamatta Group shales. However, the site lies within an area of the map that borders a *Disturbed Terrain (xx*) soil landscape, which includes level plain to hummocky terrain extensively disturbed by human activity including complete disturbance, removal or burial of soils. Soils encountered during the investigation works were considered to be consistent with soils described as part of the Disturbed Terrain landscape. The *Disturbed Terrain (xx*) soil landscape land fill includes soil, rock, building and waste materials. Disturbed terrain may be bare or covered with opportunist weeds such as cobblers peg, purple top and ribwort. Most areas are eventually turned to grassland or lawn. Landuse is varied and includes commercial and industrial complexes, sporting and recreational area, quarries and waste disposal sites. Dominant soil materials include of loose black sandy loam, compacted mottled clay, variable transported fill and dark dredged muds and sands. Soils have been disturbed to a depth of at least 0.1m with most of the original soil either removed, buried or greatly disturbed Most disturbed areas are eventually artificially topsoiled and revegetated or covered by buildings, concrete or bitumen. The occurrence and relationship of soil materials is highly variable.
Prospect_Parramatta Acid Sulfate Soil Risk Map *(1:25,000 scale; Murphy, 1997)*	Subject land lies within the map class description of No Known Occurrence. In such cases, acid sulfate soils (ASS) are not known or expected to occur and "land management activities are not likely to be affected by ASS materials" Some ASS is likely to be present along the foreshores of Shepherds Bay but the development does not extend to this area.
City of Ryde Council Acid Sulfate Risk Class Map *(1:1,000 scale; Draft Local Environmental Plan 2011)*	The City of Ryde Council Draft Local Environmental Plan 2011- Acid Sulfate Soils Risk Class Map indicates that the site lies within a Class 5 ASS area. Council consent is therefore required prior to commencing any works within 500m of Class 1, 2, 3 or 4 land, with a ground elevation of below 5m Australian Height Datum (AHD) and where the water table is likely to be lowered below 1m AHD on adjacent Class 1, 2, 3 or 4 land. However, Based on the findings of the subsequent field investigation, the site was underlain by sandstone bedrock and failed to demonstrated field indicators for actual and potential ASSs listed in the ASSMAC (1998) manual (Ref. Table 2.3, Section 2, ASSs Assessment Guidelines). The need for further Acid Sulfate soil management was considered unwarranted and the risks associated with Acid Sulfate soils were considered negligible.
Typical Vadose Zone Soil Types	Weathered sandstone. Some sandy clay near Parramatta River
Depth to Groundwater	Groundwater was encountered between 1.3 to 7.4 m BTOC during the groundwater investigation and generally flows toward Shepherds Bay. The interpretations of groundwater at the site, including groundwater flow direction is discussed within report E2010.AA – to be issued at a later date. This ESA report is to be read in conjunction with the groundwater report for the site.
Groundwater Types	The groundwater includes intermittent seepage zones that may be present in the fill and groundwater within the underlying sandstone bedrock
Nearest Water Body	Parramatta River, via Shepherds Bay is located approximately 40 meters (m) south west of the site, which is considered to be the nearest receiving water body for the site, and is considered to be marine and part of Sydney Harbour.

3.4 GROUNDWATER BORE RECORDS AND LOCAL GROUNDWATER USE

An online search of registered groundwater bores was conducted by EI on the 19th of December 2013 through the NSW Natural Resource Atlas database (*Ref.* http://www.nratlas.nsw.gov.au). There were 10 registered bores within about 1 km of the site. A summary of all registered bores being uncovered is presented in **Table 3-4**. A bore location plan as well as the detailed information regarding the identified bores is attached in **Appendix A**.

Table 3-4. Summary of registered Groundwater Bores within 1 km of the site.

Bore No.	Date Drilled	Drilled Depth (m)	SWL(mBGL)*/ Salinity#	Bore Purpose
				Authorised / Intended
GW104997	20-08-2001	2.40	2.32 / 260	MONITORING BORE
GW104998	20-08-2001	3.10	2.50 / 279	MONITORING BORE
GW104999	20-08-2001	3.60	3.54 / 248	MONITORING BORE
GW112117	13-11-2002	2.50	- / -	MONITORING BORE
GW112118	13-11-2002	4.00	- / -	MONITORING BORE
GW112119	13-11-2002	4.00	- / -	MONITORING BORE
GW112120	13-11-2002	2.50	- / -	MONITORING BORE
GW113341	20-09-2004	15.90	- / -	MONITORING BORE
GW113342	21-09-2004	18.00	- / -	MONITORING BORE
GW113343	21-09-2004	17.10	- / -	MONITORING BORE

Notes
NA = Information not available, * SWL = Standing Water Level, #Salinity Units - not recorded,

All of the located registered bores are indicated to have been authorised for monitoring purposes. The drilled bore depths ranged between 2.40m and 18.00m BGL, with water table (as indicated by recorded standing water levels, SWL) being between 2.32m and 3.54m BGL.

The registered water bores are generally located west and south-east of the main catchment area covered by the Shepherds Bay Concept Plan and are therefore not considered receptors for any potential site contamination identified at the site.

The groundwater is further discussed in the EI Groundwater report, **(EI, 2014 Ref: AC E2008)**.

4.0 PREVIOUS INVESTIGATIONS

Previous environmental investigations conducted with relation to the Shepherds Bay Urban Development as a whole, as well as parts of the allotment located at 41 Belmore Street. These reports have been reported as follows:

- *Environmental Site Screening for Proposed Residential Development at 41-45 Belmore Street, Meadowbank*, Environmental Investigation Services (EIS) Project No. E18629FJ-RPT, September 2004;
- *Preliminary Screening Contamination Assessment*, Douglas Partners (DP) Project No. 71920-1, October 2010; and
- *Stage 2 Environmental Site Assessment*, Environmental Investigations Australia (EI) Project No. E1836.1, 25 June 2013.

A summary of works and key findings of the above reports by various authors are outlined below within **Table 4-1**, as follows:

Table 4-1: Summary of Works and Key Findings

Assessment Details	Project Tasks and Findings
Environmental Site Screening (EIS, 2004)	
Work Objectives	Assess the soil and groundwater conditions at 41 – 45 Belmore Street, Meadowbank NSW (henceforth 'Belmore St.') in relation to the suitability of the site for the proposed residential land use.
Scope of Works	• Review of a historical site contamination assessment report prepared by EGIS (2000); • Review of regional geology and groundwater conditions, including the location of major underground services in the vicinity of the site; • Design and implementation of a field sampling program, involving soil sampling from test pits BH102 to BH113 and BH203, BH211, BH212 and BH213 for heavy metals, petroleum hydrocarbons (TPH), and polyaromatic hydrocarbons (PAH). In addition, three groundwater samples (BH105, BH106 and BH201) were collected and analysed for TPH, benzene, toluene, ethylbenzene and xylene (BTEX) and pH; • Preparation of a report presenting the results of the assessment of potential soil and groundwater contamination. Field work for the investigation was undertaken on 21, 24, 26 May, 2 June and 2 September, 2004.

Assessment Details	Project Tasks and Findings
Conclusions	Historical information and inspection of the site and surrounding areas indicated that the site has formerly been used for industrial purposes, with the following potential site specific issues identified: • Petroleum hydrocarbon and heavy metal contamination in the vicinity of the landscaped area adjacent to the guard house at the north-east of Belmore St.; • Petroleum hydrocarbon and heavy metal contamination in the vicinity of the courtyard at the central north section of Belmore St.; • Petroleum hydrocarbon and heavy metal contamination in the vicinity of former above ground storage tanks in the subbasement area at the south of Belmore St.; • Potential subsurface contamination associated with the storage of trade waste liquids in a bunded area in the sub-basement level at the south of Belmore St. No specific off-site contamination sources were identified during cursory inspection of the surrounding sites of Belmore St. Elevated concentrations of arsenic and heavy fraction petroleum hydrocarbons were encountered in surficial fill silty sand material (BH212) associated with the landscaped area to the west of the guard house at the north-east of the site. The lateral extent of the fill material at this location was unable to be assessed due to limited access. Elevated concentrations of petroleum hydrocarbons were encountered in residual sandy clay soils overlying shallow sandstone bedrock (BH210) at the north of Belmore St., with the lateral and vertical extent identified and presented in Figure 3 of this report. Groundwater was encountered in three temporary standpipes installed for the project, to a depth of approximately six (6) meters (m). Low levels of toluene and total petroleum hydrocarbons (TPH) $C_6 – C_9$ fraction were encountered one sample, whilst another identified low levels of TPH C_{10} - C_{36} fractions, however were found to be less than the NSW EPA endorsed health based investigation guideline levels for petroleum hydrocarbon contamination. Provided activities are undertaken in accordance with a formal remedial action plan (RAP), the site is considered suitable for residential use.
Recommendations	Based on the investigation conducted, EIS considered that site could be made suitable for the proposed development provided the following recommendations were undertaken: • Remediation of contaminated soils proximal to BH210 (petroleum) and BH112 (arsenic and heavy fraction petroleum hydrocarbons). These sample locations are present within the north east corner of 41 – 45 Belmore Street, directly south east of Nancarrow Avenue; • Further groundwater investigation should be undertaken if disposal of groundwater is necessary during dewatering of the proposed excavations works; and • Survey of the existing structures for hazardous materials prior to demolition. EI notes that the areas identified as requiring remediation from this investigation are not located within the Stage 2 – 3 development area assessed as part of the ESA report.

Assessment Details	Project Tasks and Findings
Preliminary Screening Assessment (DP, 2010)	
Work Objectives	The objectives of the investigation was to provide a broad scale assessment of the site, being all stages of the works, to identify the likely contaminants of concern and whether there are contamination issues that are likely to cause material impact on the proposed redevelopment. The assessment also provides some indication of the additional works that would be required to assess the contamination status of the site, once site access is more readily available.
Scope of Works	• A review of the DP database for jobs conducted within and around the site area to determine the likely site condition; • A review of published geological, soil landscape, acid sulphate soils and salinity mapping; • A review of broad scale history sources including: - Historical aerial photographs; - A search of the Department of Environment, Climate Change and Water (DECCW) register of contaminated sites and licences; - A search for registered groundwater bores using DECCW online search; - A search of the local library for any available local histories (if available). • A site walkover inspection of the sites; • Identification of areas or issues of environmental concern (AECs) and likely issues associated with these AECs; • Preparation of preliminary contamination assessment detailing the results of the assessment and making recommendations for future works.
Conclusions	Based on the limited site history investigation completed by DP, it was considered that there was generally a moderate potential for contamination, although the probability of widespread contamination across the site appeared to be generally limited. Various commercial/industrial site uses over the past 50 or so years including storage of fuel and fuel related products in underground storage tanks, potentially industrial/commercial operations involving the use of chemicals and the use of fuels, solvents and other degreasers at the numerous mechanics, auto shops and smash repairers within the site may also result in soil and/or groundwater contamination. It was considered likely that some potential or actual acid sulphate soil materials are present, particularly in reclaimed areas and the area of the jetty. Overall, it was considered that the contamination issues, if present, would most likely be mainly confirmed to areas close to the original source due to the generally shallow depth of bedrock at the site and can likely be dealt with in a relatively straight forward and staged manner and are unlikely to significantly affect the viability of the redevelopment project.
Recommendations	From a broad scale evaluation standpoint, DP considered that the site can be rendered suitable for the proposed development. Further intrusive and more detailed assessment would be required, preferentially in stages to better define the nature and extent of any contamination issues. Furthermore, it was recommended that a regional groundwater study be conducted as part of the early works to assess the overall groundwater quality and conditions at the site and to assist in determining the overall potential for potential contamination issues within all or part of the site.

Assessment Details	Project Tasks and Findings
Stage 2 Environmental Site Assessment (EI, 2013)	
Work Objectives	The main objective of this ESA was to appraise the degree of site contamination (if any) at 41 – 45 Belmore Street (Belmore St.) and to assess Belmore St.'s suitability for the proposed residential apartment development.
Scope of Works	• A review of the previous Environmental Site Screening conducted by EIS in September 2004; • A detailed site walkover inspection; • A review of underground service plans; • The construction of test boreholes at eighteen (18) locations distributed in a triangular grid pattern across the site with allowance for structural obstacles; • Multiple level soil sampling down to natural soils; • Installation of six (6) groundwater monitoring wells to intercept groundwater; • Laboratory analysis of soil samples and groundwater for relevant analytical parameters as determined from the site history survey and field observations during the investigation program; and • Data interpretation and reporting.
Conclusions	At the time of this investigation Belmore St. was free of statutory notices issued by the NSW EPA/DECCW under Section 58 of the Contaminated Land Management Act 1997. Belmore St. was cleared of all buildings and the majority of concrete including surface fill was removed, the soil profile across the site was characterised as grey/orange-brown weathered sandstone bedrock with some minor surface brown silty sand. A total of eighteen (18) test boreholes and six groundwater bores were drilled across the site targeted at areas of concern and near the previous investigation which identified the following: • Non-detectable or low concentrations of the screened TPH fractions were identified in the tested soil samples; • No detectable benzene toluene, ethyl benzene or xylene (BTEX) concentrations were identified in any of the tested soil samples being below the adopted EPA (1994*) Threshold concentrations for Sensitive Land Use – Soils*; • Non-detectable or trace concentrations of volatile organic compounds (VOCs) or poly-aromatic hydrocarbons (PAHs) were identified in the tested soil samples. However, all results were below the adopted soil investigation limits (SILs); • No detectable asbestos concentrations or traces of respirable fibres were identified in any of the tested soil samples; • No detectable concentration of any of the screened OCP, OPP or PCB compounds were identified in the tested soil samples, with all laboratory quantitation limits being within the corresponding SILs; • No detectable asbestos concentrations or traces of respirable fibres were identified in any of the tested soil samples; • No detectable concentration of any of the screened organochlorine pesticides (OCP), organophosphorus pesticides (OPP) or polychlorinated biphenyl (PCB) compounds were identified in the tested soil samples, with all laboratory quantitation limits being within the corresponding SILs.

Assessment Details	Project Tasks and Findings
	• Trace concentrations of copper and zinc were identified within groundwater which may be attributed to background levels in the urban area. • Low or Non-detectable concentrations of TPH compounds were identified in the tested groundwater samples being below the Groundwater Investigation Limits (GILs). • Low or Non-detectable concentrations of BTEX compounds were identified in the tested groundwater samples being below the GILs. • Low or non-detectable concentrations for the PAH and VOCs were identified in the tested groundwater samples, being below the GILs.
Recommendations	In view of the above findings, it was concluded that the site soils present a low risk to human health, the environment or the aesthetic enjoyment of the land, and is suitable for the proposed residential apartment development. However, site soils requiring excavation are to be classified in accordance with the DECCW (2009) *Waste Classification Guidelines* prior to off-site disposal.

5.0 SITE HISTORY

5.1 SITE LAND TITLES INFORMATION / HISTORIC AERIAL REVIEW

A historical land titles search was conducted through Service First Registration Pty Ltd. Copies of relevant documents resulting from this search are presented in **Appendix B**. A summary of all the previous and current registered proprietors along with information obtained from the available historical aerial photographs which indicates the site's potential land uses are presented in **Tables 5-1** to **5-4.** The historical aerial photographs reviewed as part of this ESA included:

- **1930:** March 1930, Run 4, Map 3424 B/W - Commonwealth Australia Crown
- **1943:** Sydney 1943 Imagery (source : http://maps.six.nsw.gov.au/)
- **1951:** May 1951, Run 10, Map 468 – 92 B/W - Lands Photo
- **1961:** Run 31 Map 1050 B/W, Lands photo, Cumberland 1961 series - Department of Lands NSW 5118
- **1986 :** 03 August 1986, Run 20, Map 115-162 - Department of Lands NSW 3528
- **1999:** 4 May 1999, Run 2, Map 10-29 - Land and Property Information NSW 4702
- **2005:** 10 December 2005, Run 9, Map 246-259 - Department of Lands NSW4937

Table 5-1: Summary of Owners – Lot 1 D.P. 1072555 – 41 Belmore Street, Ryde.

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
As regards the part numbered (1) on the attached cadastre (Appendix			
12.12.1916 (1916 to 1940)	James Perrott (Contractor)	1930 - Vacant Land	Vacant Land
09.09.1940 (1940 to 1942)	Mary Cassandra Perrott (Widow) (Transmission Application not investigated)		Vacant Land
16.11.1942 (1942 to 1945)	Aurora Ceres Minerva Bragato (Married Woman) (Transmission Application not investigated)	1943 - Vacant Land	Vacant Land
08.08.1945 (1945 to 1949)	Norman George Reed (Felt Hatter) Audrey Delia Reed (Married Woman)		Residential
07.02.1949 (1949 to 1963)	Charles Edwin Bird (Laundry Proprietor)	1951 – Revealed to have been developed into a residential property occupied by a two storey structure (gable roof) fronting onto Rothesay Avenue. 1961 – Appeared unchanged from 1951.	Residential/ Commercial
14.12.1963 (1963 to 1973)	William Harry Cole (Laundry Proprietor)		Residential/ Commercial
19.10.1973 (1973 to 2000)	Meadowbank Properties Pty Limited	1986 – Revealed to have been redeveloped becoming part of a larger commercial/industrial premise which incorporates Parts 1, 2 and 3, being overlayed by a warehouse structure and an above storage tank (AST). 1999 - Appeared unchanged from 1986.	Commercial/ Light Industrial

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Light Industrial
Leases: - *28.06.1957 to William Harry Cole, Laundry Proprietor – Expired 06.09.1962*			
As regards the part numbered (2) on the attached cadastre			
16.05.1918 (1918 to 1925)	David More Anderson (Builder)	1930 - Vacant Land	Vacant Land
12.10.1925 (1925 to 1945)	William Russell (Solicitor) (& his deceased estate)	1943 - Vacant Land	Vacant Land
10.07.1945 (1945 to 1951)	Thomas Edward Neal (Toolmaker)		Residential
18.10.1951 (1951 to 1970)	George Edward Thrush (Construction Worker) Lillian Thrush (Married Woman)	1951 – Revealed to have developed into a residential property occupied by a single storey structure (hipped roof) fronting onto Rothesay Avenue. 1961 – Appeared unchanged from 1951.	Residential
23.10.1970 (1970 to 1970)	Progress Development No. 8 Pty Limited		Commercial
23.10.1970 (1970 to 2000)	Meadowbank Properties Pty Limited	1986 – Revealed to have been redeveloped becoming part of a larger commercial/industrial premise which incorporates Parts 1, 2 and 3, being overlayed by a warehouse structure. 1999 - Appeared unchanged from 1986.	Commercial/ Light Industrial
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Light Industrial
As regards the part numbered (3) on the attached cadastre			
16.05.1918 (1918 to 1925)	David More Anderson (Builder)	1930 - Vacant Land	Vacant Land
12.10.1925 (1925 to 1945)	William Russell (Solicitor) (& his deceased estate)	1943 - Vacant Land	Vacant Land
10.07.1945 (1945 to 1950)	Henry Joseph Dicconson (Fitter & Turner)		Residential
19.01.1950 (1950 to 1970)	Arthur Thomas Costello (Stone Mason)	1951 – Revealed to have been developed into a residential property occupied by a single storey structure (hipped roof) fronting onto Rothesay Avenue. 1961 – Appeared unchanged from 1951.	Residential
23.10.1970 (1970 to 1970)	Progress Development No. 8 Pty Limited		Commercial
23.10.1970 (1970 to 2000)	Meadowbank Properties Pty Limited	1986 – Revealed to have been redeveloped becoming part of a larger commercial/industrial premise which incorporates Parts 1, 2 and 3, being overlayed by a warehouse structure. 1999 - Appeared unchanged from 1986.	Commercial/ Light Industrial
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Light Industrial
Leases: - *07.06.1982 to Sydney County Council of substation No. 5400, together with right of way and easement for electricity – expires 31.12.2030*			
As regards the part numbered (4) on the attached cadastre			
21.10.1915 (1915 to 1945)	Bonnie Annie Mary Walker (Married Woman) (& Her Deceased estate)	1930 - Vacant Land 1943 - Vacant Land	Vacant Land
08.02.1945 (1945 to 1945)	Doris May Anderson (Married Woman)		Vacant Land

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
19.10.1945 (1945 to 1959)	Henry Joseph Cook (Saw Doctor)	1951 – Revealed to have been developed into a residential property occupied by a single storey structure (hipped roof) fronting onto Rothesay Avenue.	Residential
04.12.1959 (1959 to 2000)	Hoover Industries Pty Limited Now Meadowbank Properties Pty Limited	1961 – Appeared mostly unchanged from 1951. 1986 – Revealed to have been redeveloped becoming part of a larger commercial/industrial premise which incorporates Parts 4, 5, 7, 8 and extends further east, being overlayed by a composite warehouse structure. 1999 - Appeared unchanged from 1986.	Commercial/ Industrial
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Industrial
Leases: - • *09.04.1969 to Sydney County Council of substation No. 697, together with right of way and easement for electricity – expired 25.06.1996* • *25.06.1966 to Sydney County Council of substation No. 697, together with right of way and easement for electricity – expired 31.12.2009*			
As regards the part numbered (5) on the attached cadastre			
21.10.1915 (1915 to 1925)	Bonnie Annie Mary Walker (Married Woman)		Residential
11.02.1925 (1925 to 1944)	Charles Booth (Orchardist)	1930 - Appeared to be a residential property occupied by a dwelling, accessed from Rothesay Avenue. 1943 – Appeared unchanged from 1930.	Residential
03.08.1944 (1944 to 1944)	Albert Booth (Clerk in Holy Orders) (Transmission Application not investigated)		Residential
03.08.1944 (1944 to 1956)	Ruby May Booth (Widow)	1951 – Appeared unchanged from 1943.	Residential
03.06.1956 (1956 to 2000)	Hoover Industries Pty Limited Now Meadowbank Properties Pty Limited	1961 – Revealed to have been redeveloped becoming part of a larger commercial/industrial premise which incorporates Parts 5, 8 and extends further east, being overlayed by a composite warehouse structure. 1986 – Appeared to have remained mostly unchanged since 1961, with an overall premise being structurally extended also incorporating Parts 4 and 7. 1999 - Appeared unchanged from 1986.	Commercial/ Industrial
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Industrial
Leases: - • *09.04.1969 to Sydney County Council of substation No. 697, together with right of way and easement for electricity – expired 25.06.1996* • *25.06.1966 to Sydney County Council of substation No. 697, together with right of way and easement for electricity – expired 31.12.2009*			
As regards the part numbered (6) on the attached cadastre			
26.11.1917 (1917 to 1928)	David More Anderson, Junior (Farmer)		Residential
09.10.1928 (1928 to 1929)	David More Anderson, Senior (Member of the Legislative Assembly		Residential
10.12.1929 (1929 to 1929)	Archibald Thomas Robens (Driller)		Residential
26.11.1929 (1929 to 1943)	John Charles Maunder (Cabinet Maker)		Residential
As regards the part numbered (7) on the attached cadastre			

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
11.11.1913 (1913 to 1929)	Archibald Thomas Robens (Driller)		Residential
26.11.1929 (1929 to 1943)	John Charles Maunder (Cabinet Maker)	1930 - Appeared to be a residential property occupied by a dwelling, accessed from Nancarrow Avenue.	Residential
Search continued as regards the parts numbered (6) and (7) on the attached cadastre			
25.08.1943 (1943 to 1951)	Edward Christopher Smith (Tramway Employee)	1943 – Appeared unchanged from 1930.	Residential
17.08.1951 (1951 to 1955)	Archibald Maxwell McGeorge (Despatch Clerk)	1951 – Appeared unchanged from 1943.	Residential
30.08.1955 (1955 to 1966)	William Charles Phillip Rotherham (Cabinet Maker) Mary Doris Rotherham (Married Woman)	1961 – Appeared to be mostly unchanged from 1951.	Residential
15.09.1966 (1966 to 1969)	Plico Investments Pty Limited		Residential
26.11.1969 (1969 to 2000)	Meadowbank Properties Pty Limited	1986 – Revealed to have been redeveloped becoming part of a larger commercial/industrial premise which incorporates Parts 4, 5, 7, 8 and extends further east, being overlayed by a composite warehouse structure. 1999 - Appeared unchanged from 1986.	Commercial/ Industrial
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Industrial
As regards the part numbered (8) on the attached cadastre			
19.04.1913 (1913 to 1939)	Michael Nancarrow (Fruit Merchant)	1930 - Vacant Land	Vacant Land
03.03.1939 (1939 to 1945)	Henry Ernest Odell Gee (Gentleman) Margaret Ellen Nanacarrow Gee (Spinster) (Transmission Application not investigated)	1943 - Vacant Land	Vacant Land
29.10.1945 (1945 to 1948)	Stanley Robson (Foreman)		Vacant Land
02.03.1948 (1948 to 1963)	Charles Stanlie Beavis (Tram Conductor)	1951 - Vacant Land	Vacant Land
28.03.1963 (1963 to 2000)	Hoover Industries Pty Limited Now Meadowbank Properties Pty Limited	1961 – Revealed to have been developed becoming part of a larger commercial/industrial premise which incorporates Parts 5, 8 and extends further east, being overlayed by a composite warehouse structure. 1986 – Appeared to have remained mostly unchanged since 1961, with an overall premise being structurally extended also incorporating Parts 4 and 7. 1999 - Appeared unchanged from 1986.	Commercial/ Industrial
06.11.2000 (2000 to 2008)	Sydney Sae Soon Presbyterian Church Inc	2005 - Appeared unchanged from 1999.	Commercial/ Industrial
Search continued as regards the whole of the subject land			
28.07.2008 (2008 to date)	# Bayone Projects Pty Limited	Currently Parts 1, 2 and 3 remain unchanged with Parts 4, 5, 6, 7 and 8 being cleared and	Commercial/ Industrial

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
		levelled with all former structures being now demolished and removed off site.	
# Denotes current registered proprietor **Leases: Nil** **Easements:** 15.09.2004 Easement to Drain Water 2.5 metres wide and variable (D.P. 1072555)			

Table 5-2: Summary of Owners – Lot 1 D.P. 322641 – 6 Nancarrow Avenue, Ryde.

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
26.11.1917 (1917 to 1928)	David More Anderson, Junior (Farmer)		Residential
09.10.1928 (1928 to 1947)	David More Anderson, Senior (Member of the Legislative Assembly	1930 - Appeared to be a residential property occupied by a dwelling, accessed from Nancarrow Avenue. 1943 – Appeared unchanged from 1930.	Residential
31.07.1947 (1947 to 1947)	Andrew Archibald Anderson Gordon McPherson Anderson (Water & Sewerage Board Officials) Walter Beames (Bank Manager) (Transmission Application not investigated)		Residential
26.11.1947 (1947 to 1954)	Kenneth McColl Anderson (Real Estate Agent)	1951 – Appeared unchanged from 1943	Residential
26.05.1954 (1954 to 1957)	Norman Eldred Keene (Manager) Dorothy May Keene (Married Woman)		Residential
20.05.1957 (1957 to 1958)	Alick Walter Lennan (Retired Shearer) Elizabeth Lennan (Married Woman)		Residential
10.01.1958 (1958 to 1994)	Keith John Gordon (Oil Blender)	1961 – Appeared unchanged from 1951 1986 – Appeared unchanged from 1961	Residential
28.04.1994 (1994 to 1998)	Ronald Stanley Moran Catherine Matthews		Residential
03.08.1998 (1998 to 2010)	Hilltop Investment Holdings Pty Ltd	1999 – Appeared unchanged from 1986 2005 – Appeared unchanged from 1999	Residential/ Commercial
09.04.2010 (2010 to date)	# Bayone Projects Pty Limited		Residential/ Commercial
# Denotes current registered proprietor **Leases & Easements: -NIL**			

Table 5-3: Summary of Owners – Lots 11 to 16 and 18 in D.P. 322641 – 8 to 18 Nancarrow Avenue and 11 Rothesay Avenue, Ryde.

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
As regards Lot 11 D.P. 7130 – 8 Nancarrow Avenue, Ryde			
26.11.1917 (1917 to 1928)	David More Anderson, Junior (Farmer)		Residential
09.10.1928 (1928 to 1947)	David More Anderson, Senior (Member of the Legislative Assembly)	1930 - Appeared to be occupied by a number of structures and accessed from Nancarrow Avenue overall being most likely residential in nature.	Residential

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
		1943 – Appeared to be occupied by a dwelling and some ancillary shed structures overall being unchanged from the 1930 aerial photograph.	
31.07.1947 (1947 to 1947)	Andrew Archibald Anderson Gordon McPherson Anderson (Water & Sewerage Board Officials) Walter Beames (Bank Manager) (Transmission Application not investigated)		Residential
26.11.1947 (1947 to 1954)	Kenneth McColl Anderson (Real Estate Agent)	1951 – Appeared unchanged from 1943	Residential
26.05.1954 (1954 to 1957)	Norman Eldred Keene (Manager) Dorothy May Keene (Married Woman)		Residential
20.05.1957 (1957 to 1958)	Alick Walter Lennan (Retired Shearer) Elizabeth Lennan (Married Woman)		Residential
10.01.1958 (1958 to 1994)	Keith John Gordon (Oil Blender)	1961 – Appeared unchanged from 1951 1986 – Appeared unchanged from 1961	Residential
28.04.1994 (1994 to 1998)	Ronald Stanley Moran Catherine Matthews		Residential
03.08.1998 (1998 to 2010)	Hilltop Investment Holdings Pty Ltd	1999 – Vacant, cleared block, former structures demolished and removed off site 2005 – Appeared unchanged from 1999	Vacant Land
# Denotes current registered proprietor **Leases & Easements: -NIL**			
As regards Lot 12 D.P. 7130 – 10 Nancarrow Avenue, Ryde			
12.12.1916 (1916 to 1924)	James Perrott (Contractor)		Residential
29.01.1924 (1924 to 1927)	George August Scott (Commercial Traveller)		Residential
14.09.1927 (1927 to 1928)	Percy Goodwin (Jam Manufacturer) Maud Alice Goodwin (Married Woman)		Residential
13.09.1928 (1928 to 1960)	Elizabeth Franklin (Married Woman)	1930 - Appeared to be occupied by a dwelling being accessed from Nancarrow Ave. 1943 – Appeared unchanged from 1930 1951 – Appeared unchanged from 1943	Residential
12.09.1960 (1960 to 2010)	Duncan H. McFarlane Pty Ltd	1961 – Appeared mostly unchanged from the 1951 with an exception of some shed structures being built in the southern part of the property. 1986 – Appeared unchanged from 1961 1999 – Appeared unchanged from 1986 2005 – Appeared unchanged from 1999	Residential/ Commercial
01.06.2010 (2010 to date)	# Bayone Projects Pty Limited		Residential/ Commercial
# Denotes current registered proprietor **Leases & Easements: -NIL**			
As regards Lot 13 D.P. 7130 – 12 to 16 Nancarrow Avenue, Ryde			
18.05.1915 (1915 to 1928)	Frank William Heard (Builder & Contractor)		Residential
01.11.1928 (1928 to 1961)	Margaret McDougall Davey (Married Woman)	1930 - Appeared to be occupied by a dwelling being accessed from Nancarrow Ave. 1943 – Appeared unchanged from 1930 1951 – Appeared unchanged from 1943	Residential
24.08.1961	Joseph Davey (Retired)	1961 – Appeared unchanged from the 1951	Residential

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
(1961 to 1966)	(Section 94 Application not investigated)		
24.03.1966 (1966 to 1967)	Joseph Davey, Junior(Company Representative) (Section 94 Application not investigated)		Residential
01.02.1967 (1967 to 2008)	Kitchen Aid Pty Limited	1986 – Appeared mostly unchanged from 1961 with an exception of a warehouse/shed type structure being built in the southern part of the property which also extends over the Lots 14 and 15. 1999 – Appeared unchanged from 1986 2005 – Appeared unchanged from 1999	Residential/ Commercial
11.09.2008 (2008 to date)	# Bayone Projects Pty Limited		Residential/ Commercial
# Denotes current registered proprietor **Leases & Easements: -NIL**			
As regards Lot 14 D.P. 7130 – 12 to 16 Nancarrow Avenue, Ryde			
19.04.1913 (1913 to 1939)	Michael Nancarrow (Fruit Merchant)	1930 - Vacant Land	Vacant Land
03.03.1939 (1939 to 1939)	Henry Ernest Odell Gee (Gentleman) Margaret Ellen Nancarrow Gee (Spinster) (Transmission Application not investigated)		Vacant Land
21.07.1939 (1939 to 1950)	James Walter Scott (Insurance Inspector)	1943 – Vacant Land	Vacant Land
23.06.1950 (1950 to 1952)	Joan Margaret White (Married Woman)	1951 – Vacant Land	Vacant Land
03.07.1952 (1952 to 1953)	Victor Hingston Moy (Iron Worker)		Vacant Land
24.08.1953 (1953 to 1958)	Clifford Halliday Gittins (Engineer)		Vacant Land
27.02.1958 (1958 to 2008)	Kitchen Aid Fitment Pty Limited (? Now Kitchen Aid Pty Limited)	1961 – Revealed to have been developed into commercial premise occupied by a warehouse structure (flat roof) overlying most of the property area fronting onto Nancarrow Ave. 1986 – Appeared mostly unchanged from 1961 with an exception of an additional warehouse/shed type structure being built in the southern part of the property which also extends over the Lots 13 and 15. 1999 – Appeared unchanged from 1986 2005 – Appeared unchanged from 1999	Commercial
11.09.2008 (2008 to date)	# Bayone Projects Pty Limited		Commercial
# Denotes current registered proprietor ***Easements: -*** • *20.10.1982 Right of Carriageway (D.P. 628202)* **Leases: - NIL**			
As regards Lot 15 D.P. 7130 – 12 to 16 Nancarrow Avenue, Ryde			
19.04.1913 (1913 to 1939)	Michael Nancarrow (Fruit Merchant)	1930 - Vacant Land	Vacant Land
03.03.1939 (1939 to 1939)	Henry Ernest Odell Gee (Gentleman) Margaret Ellen Nancarrow Gee (Spinster) (Transmission Application not investigated)		Vacant Land

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
30.07.1939 (1939 to 1946)	Noel Steinthal (Warehouseman)	1943 – Vacant Land	Vacant Land
11.03.1946 (1946 to 1955)	James Keith Lovell (Civil Servant)	1951 – Revealed to have been developed, being occupied by a dwelling structure and accessed from Nancarrow Ave.	Residential
29.04.1955 (1955 to 1961)	Reginald Phillip Petith (Engineer) Nancy Petith (Married Woman) (or Nancy Pearl Petith)		Residential
07.09.1961 (1961 to 1970)	Nancy Pearl Petith (Widow)	1961 - Appeared mostly unchanged from 1951, apart from a small ancillary shed structure being built next to the dwelling	Residential
11.08.1970 (1970 to 2008)	Kitchen Aid Pty Limited	1986 – Appeared mostly unchanged from 1961 with an exception of a warehouse/shed type structure being built in the southern part of the property which also extends over the Lots 13 and 14. 1999 – Appeared unchanged from 1986 2005 – Appeared unchanged from 1999	Residential/ Commercial
11.09.2008 (2008 to date)	# Bayone Projects Pty Limited		Residential/ Commercial
# Denotes current registered proprietor ***Easements: -*** • *13.11.1969 Easement for Overhang (L 621011)* **Leases: - NIL**			
As regards Lot 16 D.P. 7130 – 18 Nancarrow Avenue, Ryde			
19.04.1913 (1913 to 1927)	Michael Nancarrow (Fruit Merchant)		Vacant Land
08.10.1927 (1927 to 1934)	William Rayward Greene (Builder)	1930 - Vacant Land	Vacant Land
12.02.1934 (1934 to 1946)	Richard Helem Ambler (Labourer)	1943 – Cleared/levelled vacant lot	Unoccupied
15.08.1946 (1946 to 1948)	James Keith McFarlane (Draftsman)		Unoccupied
13.08.1948 (1948 to 1955)	James Keith Lovell (Draftsman)	1951 – Cleared/levelled vacant lot	Unoccupied
29.04.1955 (1955 to 1961)	Estelle Marie Petith(Spinster) Norma Marie Petith (Spinster) Leslie George Petith (Engineer) Reginald Phillip Petith (Engineer)		Commercial
18.10.1961 (1961 to 1969)	Estelle Marie Petith (Spinster) Norma Marie Petith (Spinster) Leslie George Petith (Engineer) Nancy Peare Petith (Widow) (Section 94 Application not investigated)	1961 – Revealed to have been developed into commercial premise occupied by a warehouse structure (gable roof) overlying most of the property area fronting onto Nancarrow Ave.	Commercial
01.10.1969 (1969 to 1981)	Automatic Totalisators Limited		Commercial
23.01.1981 (1981 to 1987)	Maluka Pty Limited	1986 – Appeared unchanged from 1961	Commercial
16.12.1987 (1987 to 2010)	Victor Mocsari Andree Mocsari	1999 – Appeared unchanged from 1986 2005 – Appeared unchanged from 1999	Commercial
15.7.2010 (2010 to date)	# Bayone Projects Pty Limited		Commercial
# Denotes current registered proprietor ***Easements: -*** *07.04.1982 Easement to Drain Water 1 metre wide (S965958)*			

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
Leases: - • *Leases AA 321286 & AE 329925 not investigated* 13.01.2012 to Sorrento Constructions Pty Limited – expired 30.09.2013			
As regards Lot 18 D.P. 7130 – 11 Rothesay Avenue, Ryde			
17.08.1914 (1914 to 1925)	David More Anderson (Estate Agent)		Residential
14.12.1925 (1925 to 1929)	Charles Gardner (Builder)		Residential
22.01.1929 (1929 to 1944)	John William Foster (Public Servant)	1930 - Appeared to be occupied by a single storey dwelling and some ancillary shed structures, being accessed from Rothesay Ave. 1943 – Appeared unchanged from 1930	Residential
07.09.1944 (1944 to 1965)	Henrietta Foster (Widow) (Transmission Application not investigated)	1951 – Appeared unchanged from 1943 1961 – Appeared unchanged from the 1951	Residential
04.06.1965 (1965 to 1967)	Iris Kathleen Bland (Married Woman) Now Iris Kathleen Stedman (Married Woman)		Residential
24.06.1967 (1967 to 1994)	James Richard Dummett (Contractor) Clara Herd Dummett (Married Woman)	1986 – Revealed to have been redeveloped into a commercial premise occupied by a structure with flat roof, being concrete paved throughout, with northern part of the property being used as a storage area	Commercial
24.06.1994 (1994 to 2004)	Clara Herd Dummett (Widow) Andrew James Austin Dummett	1999 – Appeared unchanged from 1986	Commercial
09.02.2004 (2004 to 2011)	Rothesay Avenue Pty Limited	2005 – Appeared unchanged from 1999	Commercial
22.02.2011 (2011 to date)	# 357 HPG Pty Ltd		Commercial
# Denotes current registered proprietor **Leases & Easements: -NIL**			

Table 5-4: Summary of Owners – Lot 1 in D.P. 703858 – 9-11 Rothesay Avenue, Ryde.

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
As regards the part marked (A) on the attached cadastre			
04.08.1915 (1915 to 1925)	David More Anderson (Estate Agent)		Residential
14.12.1925 (1925 to 1925)	Charles Gardner (Builder)		Residential
167.12.1925 (1925 to 1945)	John Dingwall Stephen (Mechanic)	1930 - Appeared to be occupied by a single storey dwelling and some ancillary shed structures, being accessed from Rothesay Ave. 1943 – Appeared unchanged from 1930.	Residential
19.10.1945 (1945 to 1948)	Frank William Gifford (Bridge Operator)		Residential
18.11.1948 (1948 to 1960)	Reginald George Smallwood (Technical Representative)	1951 – Appeared unchanged from 1943	Residential
20.06.1960 (1960 to 1966)	Chafic Saghabi (Labourer) Souraya Saghabi (Married Woman)	1961 – Appeared unchanged from the 1951	Residential
25.11.1966 (1966 to 1966)	Frank Warwick Ireland (Real Estate Agent)		Residential

Date of Acquisition	Registered Proprietor(s) & Occupations where available	Review of Historical Aerial Photographs	Potential Land Uses
25.11.1966 (1966 to 1970)	Kitchen Aid Pty Limited		Commercial
31.07.1970 (1970 to 2003)	H.T Chapman Pty Limited	1986 – Revealed to have been redeveloped into a commercial premise occupied by a structure with flat roof, being concrete paved throughout. 1999 – Appeared mostly unchanged from 1986, with an exception of a structural addition being built adjoining previously identified commercial structure on site, extending over the northern part of the property, which now appears to also include Part B.	Commercial
As regards the part marked (B) on the attached cadastre			
04.08.1915 (1915 to 1925)	David More Anderson (Estate Agent)		Vacant Land
12.10.1925 (1925 to 1946)	William Russell (Solicitor) (& His Deceased Estate)	1930 - Vacant Land 1943 – Vacant Land	Vacant Land
30.08.1946 (1946 to 1947)	Elizabeth Ewart (Married Woman)		Residential
27.03.1947 (1947 to 1949)	Maurice Layton Wood (Clerk) Rose Adele Wood (Married Woman)		Residential
17.01.1949 (1949 to 1961)	Harold Thomas Chapman (Manufacturer)	1951 – Revealed to have been developed into a residential property occupied by a two storey structure (gable roof) fronting onto Rothesay Avenue.	Residential
20.02.1961 (1961 to 2003)	H.T Chapman Pty Limited	1961 – Appeared unchanged from 1951 1986 – Appeared to have a warehouse/workshop type addition being built (flat roof) adjoining previously identified residential structure on site, extending over the northern part of the property, which now appears to also include Part A. 1999 – Appeared unchanged from 1986	Residential/ Commercial
Search continued as regards the whole of Lot 1 D.P. 703858			
06.03.2003 (2003 to 2011)	Kavlyn Pty Ltd	2005 – Appeared unchanged from 1999	Commercial
10.02.2011 (2011 to date)	# 357 HPG Pty Ltd		Commercial
# Denotes current registered proprietor **Leases & Easements: -NIL**			

For the overall site, being Stages 2 and 3 of the development, it was revealed that the site was used for residential and vacant land uses, with predominantly commercial land uses present by the 1960s to 1970s and industrial land uses occurring in the southern portion of the site.

5.2 SURROUNDING LANDS HISTORICAL AERIAL PHOTOGRAPHY REVIEW

The site history review included a search of surrounding land uses using historical aerial photographs sourced from NSW Land and Property Information. A summary of the pertinent information identified at surrounding land parcels from the reviewed photographs are presented in **Table 5-5**.

Table 5-5: Summary of Aerial Photograph Review

Aerial Photograph	Surrounding
March 1930 Run 4, Map 3424 B/W Commonwealth Australia Crown	Primarily vacant land with some residential land use identified to the north east, south east and north west of the site with Parramatta River located to the south west of the site.
1943 Sydney 1943 Imagery http://maps.six.nsw.gov.au/	Land remains primarily unchanged from previous aerial with the exception of an increase in residential developments to the north east and the development of a large flat roofed commercial warehouse to the north east of the site which appears commercial in nature.
May 1951 Run 10, Map 468 – 92 B/W Lands Photo	Surrounding land has undergone significant development. Vacant land remains to the north west, with a large industrial property located to the north of the site. Land use to the north east and south east remains primarily residential. Construction of a large industrial type structure appears to be present at the south east boundary of the site, and is inclusive of the south east portion of the Stage 2 – 3 development site. This industrial development is considered to be the construction of the Hoover site, beyond which remains as vacant land. Parramatta river remains to the south west.
1961 Run 31 Map 1050 B/W Lands photo, Cumberland 1961 series NSW 5118	Vacant land remains to the north west, as does the large industrial property located to the north of the site. Land to the north east of the site has been developed for what appears to be commercial use, mixed with residential. Construction of a large industrial warehouse (Hoover) has been completed, with further construction of a large industrial type structure present beyond this hoover industrial warehouse. Parramatta river remains to the south west.

03 August 1986 Run 20, Map 115-162 Department of Lands NSW 3528 Colour imagery 1:16,000 Scale	Surrounding land use appears to have changed significantly, with the demolition of the majority of residential properties, and the construction of multiple commercial / industrial type structures. Land present to the north west remains primarily vacant however has increased in size suggesting that this section of land has been reclaimed. Construction of a large commercial type warehouse structure has occurred, and is located directly at the north, north western boundary of the site . An increase in commercial type warehouses is present to the north east with no residential structures remaining. Land use to the south east remains primarily unchanged from the previous aerial, with Parramatta River present to the south west.
4 May 1999 Run 2, Map 10-29 Land and Property Information NSW 4702 Colour imagery 1:12,000 Scale	Surrounding land use appears remain primarily unchanged from the previous aerial, with the exception of the construction of an industrial type warehouse to the far north of the site.
10 December 2005 Run 9, Map 246-259 Department of Lands NSW4937 Colour imagery 1:25,000 Scale	Surrounding land use remains relatively unchanged from the previous aerial, with the exception of the demolition of commercial / industrial structures that were present to the south east of the site. This area now appears as vacant land.

5.3 WORKCOVER NSW AUTHORITY SEARCH

A search of WorkCover NSW Authority records relating to the site was requested on 11th December, 2013 by EI, on behalf of the client. Correspondence dated 17th December, 2013 from the Dangerous Goods Licensing Section received by EI (Appendix C), confirmed that a search of Stored Chemical Information Database (SCID) and the microfiche records held by WorkCover was conducted and revealed that the following records pertaining to the premises were held, with details as described in **Table 5-6** below.

Table 5-6: Summary of WorkCover Records

Licence Holder / Premises	Type of Infrastructure	Goods Stored	Quantity	Location of storage	Status
H.T. Chapman Pty Ltd 9 Rothesay Avenue, Ryde, NSW 2112	Underground Tank	Flammable Liquids	5,000 Litres	Unknown	Unknown
J.R. Dummett & Co. Pty Ltd 11 Rothesay Avenue, Ryde, NSW 2112	Underground Tank	Petroleum	5,000 Litres	South western boundary of site	In Situ
Ryde Speedy Couriers Pty Ltd 8 Nancarrow Avenue, Ryde NSW 2112	Underground Tank	Inflammable Liquid – Mineral Spirit	21,040 Litres	Central portion of site	Removed
Hoover Australia Pty Ltd. 41 – 45 Belmore Street, Meadowbank NSW 2114	Roofed	Flammable Liquids	20,000 Litres	Paint store area, north eastern boundary of site	Removed
	Roofed	Flammable Liquids	10,000 Litres	Paint store area, north eastern boundary of site	Removed
	Underground Tank	Flammable Liquids	5,000 Litres	South western corner of brick warehouse	Removed
	Flammable Liquid Cupboard	Sodium Nitrate Class 5	250 Litres	Paint store area, north eastern boundary of site	Removed

The WorkCover searches revealed the potential for a single underground storage tank (UST) to remain in situ, present at 11 Rothesay Avenue, Ryde NSW 2112. Further investigation as to the current status of the identified infrastructure confirmed the presence of a UST at 11 Rothesay Avenue. No evidence of an in situ UST was observed at 9 Rothesay Avenue.

5.4 HAZARDOUS CHEMICALS AND REGULATORY COMPLIANCE

On 6th January, 2014, an on-line search of the *Contaminated Land – Record of EPA Notices* was conducted, this being a database that is maintained by the NSW OEH. This search confirmed that the NSW OEH has no involvements or regulations under Section 58 of the *Contaminated Land Management Act 1997* for the NSW property identified as 9 - 11 Rothesay Avenue, 6 - 18 Nancarrow Avenue and 41 Belmore Street, Meadowbank, NSW. Section 58 of the *CLM Act 1997* relates to the investigation, remediation and management of sites where contamination poses a significant risk of harm, and includes Sections 35 and 36 of the *Environmentally Hazardous Chemicals Act 1985*.

5.5 SITE WALKOVER INSPECTION

Mr Earin Short (EI, Environmental Scientist) made the following observations during an inspection of the site between 21st and 28th November, 2013, with a summary of the findings of the report provided in **Table 5-7** below:

- The site comprised of a rectangular shaped suburban block and covered a total area of approximately 15 347m^2, bound by Nancarrow Avenue to the north-east; preliminary construction stages of a high density residential development (*Stage 1, Shepherds Bay Urban Renewal Project*) followed by Belmore Street to the south-east, Rothesay Avenue to the south-west; and Nancarrow Lane to the north-west;

- The site topography was stepped, generally falling towards the south-west with a slope of approximately 1m vertical to 10m horizontal across the site surface; and

- The site encompassed eight separate lots as described in Table 3-1, being the western portion of 41 Belmore Street, 9 - 11 Rothesay Avenue, 11 Rothesay Avenue, 6 Nancarrow Avenue, 8 Nancarrow Avenue, 10 Nancarrow Avenue, 12 - 16 Nancarrow Avenue, and 18 Nancarrow Avenue.

Table 5-7 Summary of buildings and infrastructure

Lot	Buildings	USTs/ASTs	Observations
41 Belmore Street (southern third of site)	Northern portion occupied by high roofed brick factory building with single level concrete floor throughout. Firefighting infrastructure comprising a large volume water storage tank and pump building in western corner. Southern portion undergoing demolition works with concrete slab/rubble and steel reinforcement remaining.	Single removed UST (1000L approximately) stored in south-eastern part of factory building.	Corrugated fibreboard sheet roofing potentially contain asbestos fibre materials. Building in poor to fair condition with general deterioration including paint flaking, concrete floor staining and debris/dust build up. Factory building in use for storage of building materials, heavy machinery and maintenance including engine blocks, earthmoving plant, welding gas bottles, paints and oil/grease drums. Overgrown vegetation in south-western corner.

Lot	Buildings	USTs/ASTs	Observations
9-11 Rothesay Avenue (central western part of site)	Several adjoining brick and metal commercial buildings (including a saw-toothed factory building in north-eastern corner) separated by central bitumen driveway with metal carport at rear.	None indicated.	Corrugated fibreboard sheet roofing in north-eastern saw-toothed factory building potentially containing asbestos fibre materials. Buildings in use by operating businesses including a joinery/carpentry workshop and a second hand clothes store. Buildings in good condition with only minor deterioration or debris/dust. Overgrown weed vegetation along north-eastern boundary slope and established garden in western corner.
11 Rothesay Avenue (western corner of site)	Flat roofed two storey brick office block occupying the central south-western part with concrete driveway/car park facing Rothesay Avenue. Concrete and metal storage shed occupies the northern corner.	Suspected single in-situ UST in southern part of property.	Minor fill/rubble and scrap metal stockpiles in northern yard. Buildings in fair to good condition with only minor deterioration noted.
6 -10 Nancarrow Avenue (north-central part of site)	Two single-storey gable roofed dwellings constructed of brick (at No. 6) and fibreboard (at No. 10) were located on the north-eastern portion of the lot facing Nancarrow Avenue. Large unpainted fibreboard shed was located in southern portion of No. 10.	None indicated.	Corrugated fibreboard sheeting of building potentially contain asbestos fibre materials. External buildings surfaces were in poor to fair condition with deterioration including paint flaking and rust. Property No. 8 (wholly) and backyard of No. 6 (partly) in use for storage of construction/ building materials. Overgrown vegetation along south-western boundaries and established gardens in front and rear yards of No. 6 and No. 10.

Lot	Buildings	USTs/ASTs	Observations
12-16 Nancarrow Avenue (north-west part of the site)	Two single-storey hipped roofed brick dwellings located in the northern and southern boundaries of the lot facing Nancarrow Avenue. Single brick L shaped factory type building with saw-toothed metal roof fronting Nancarrow Avenue located within the central portion of the site. A large unpainted fibreboard roofed two storey brick office block with underground carparking was located along the south-western boundary extending to the central part of the lot. This office was adjoined to the factory building.	None indicated.	Corrugated fibreboard sheeting/roofing potentially contain asbestos fibre materials. Stained ground and dying lawn at front of No. 14. Dust deposits and rubbish including tyres, car parts and wrecked vehicles at No. 16. Buildings surfaces were in poor to fair condition with deterioration including paint flaking and rust. Overgrown weed vegetation along north-western boundary and established garden in the western corner of the property.
18 Nancarrow Avenue (Northern corner of the site)	Single brick/fibreboard warehouse building with gable tile and unpainted fibreboard roof covering the majority of the property.	None indicated.	Front of building occupied by business (Tilers World), rear warehouse for storage of heavy vehicles, plant and equipment. Fibreboard sheeting/roofing potentially contain asbestos fibre materials. External buildings surfaces were in poor to fair condition with deterioration including paint flaking, wall/window damage and rust. Dumped vehicle and general rubbish amongst overgrown weed vegetation along south-western boundary of the property.

6.0 PRELIMINARY CONCEPTUAL SITE MODEL

In accordance with the *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (Ammendment 2013) Schedule B2 – Guideline on Site Characterisation* (NEPM 2013), and to aid in the assessment of data collection for the site, EI has developed a preliminary conceptual site model (CSM) with an assessment of plausible pollutant linkages whereby a source of contamination can migrate along a given pathway and have an effect on a particular receptor. The CSM provides a framework to allow for the review of any information collected to ascertain the reliability and useability of the data collected, and to identify any gaps in field investigations. Each migration and exposure pathway is summarised in **Table 6-1** along with an assessment that provides a qualitative opinion of the potential risk of each complete exposure pathway.

Table 6-1: Preliminary Conceptual Site Model

Site	Subsurface Profile	Potential Sources	Potential Contaminants	Media	Sensitive Receptor	Migration & Exposure Pathways	Potential Risk of Complete Exposure Pathway
Stage 2 South (Majority of Hoover Factory site)	Site excavated into Hawkesbury Sandstone with possible filling on the down gradient slope. Sandstone at shallow depth	Hoover factory manufacturing activities, 1,000 L UST removed from central south western portion of site, asbestos sheeting, filling.	Flammable Liquids, Solvents, Heavy Metals, Asbestos (friable and non-friable), Unknowns from fill materials	Building Fabric Soils/Bedrock Groundwater Air/Soil Vapour LNAPL/DNAPL (if present)	Paramatta River Site Workers during demolition and construction Future site residents	Seepage into the subsurface soils, bedrock and groundwater. Dermal Contact Ingestion Inhalation	M – L (to be further assessed) M – H (should contamination be present) L (post development)
Stage 2 North (Residential property and vacant land, 6 - 8 Nancarrow Ave)	Residual soil overlying Hawkesbury Sandstone. Depth of sandstone < 1 m	Asbestos sheeting, filling, termiticides, lead paint, vehicle storage & minor maintenance, general waste	Pesticides, Heavy Metals (particularly Cu, Pb, Zn), Petroleum Hydrocarbons (inc PAHs), OCPs, Asbestos, Unknown	Building fabric Soils/Bedrock	Site Workers during demolition and remediation. Future site residents	Dermal Contact Ingestion Inhalation	M – H (to be controlled by WHS Plan) L (post development)
Stage 3 South (small north eastern section of Hoover Factory site)	Site excavated into Hawkesbury Sandstone with possible filling on the down gradient slope. Sandstone at shallow depth	Hoover factory manufacturing activities, asbestos sheeting, filling.	Flammable Liquids, Solvents, Heavy Metals, Asbestos (friable and non-friable), Unknowns from fill materials	Building Fabric Soils/Bedrock Groundwater Air/Soil Vapour LNAPL/DNAPL (if present)	Paramatta River Site Workers during demolition and construction Future site residents	Seepage into the subsurface soils, bedrock and groundwater. Dermal Contact Ingestion Inhalation	M – L (to be further assessed) M – L (to be further assessed) L (post development)

Stage 3 West (9 – 11 and 11 Rothesay Avenue)	Site excavated into Hawkesbury Sandstone with filling on the down gradient slope. Sandstone at shallow depth	Commercial activities, suspected in situ UST, asbestos sheeting, filling, termiticides, lead paint, vehicle storage, general waste	Pesticides, Heavy Metals, Petroleum Hydrocarbons (including PAHs), OCPs, Acid Sulfate Soils, Asbestos, Unknown	Building fabric Soils/Bedrock Groundwater Air/Soil Vapour	Paramatta River Site Workers during demolition and construction Future site residents	Seepage into the subsurface soils, bedrock and groundwater. Dermal Contact Ingestion Inhalation	M - L (to be further assessed) M – H (to be controlled by WHS Plan) L (post development)
Stage 3 North (12 – 18 Nancarrow Avenue)	Residual soil overlying Hawkesbury Sandstone. Depth of sandstone < 1.5m	Commercial activities, asbestos sheeting, filling, lead paint, vehicle storage and maintenance, general waste	Pesticides, Heavy Metals, Petroleum Hydrocarbons (including PAHs), OCPs, Acid Sulfate Soils, Asbestos, Unknown	Building fabric Soils/Bedrock Groundwater Air/Soil Vapour	Paramatta River Site Workers during demolition and construction Future site residents	Seepage into the subsurface soils, bedrock and groundwater. Dermal Contact Ingestion Inhalation	M - L (to be further assessed) M – H (to be controlled by WHS Plan) L (post development)
Stage 3 East (Residential property, 10 Nancarrow Avenue)	Residual soil overlying Hawkesbury Sandstone. Depth of sandstone < 1.5 m	Asbestos sheeting, filling, termiticides, lead paint, vehicle storage & minor maintenance, general waste	Pesticides, Heavy Metals (particularly Cu, Pb, Zn), Petroleum Hydrocarbons (inc PAHs), OCPs, Asbestos, Unknown	Building fabric Soils/Bedrock	Site Workers during demolition and remediation. Future site residents	Dermal Contact Ingestion Inhalation	M – H (to be controlled by WHS Plan) L (post development)

7.0 SAMPLING, ANALYTICAL AND QUALITY PLAN (SAQP)

The SAQP plays a crucial role in ensuring that the data collected as part of this, and ongoing environmental works carried out at the site are representative, and provide a robust basis for site assessment decisions. This SAQP includes the following:

- Data quality objectives, including a summary of the objectives of the ESA;
- Investigation methodology including media to be sampled, details of analytes and parameters to be monitored and a description of intended sampling points;
- Sampling methods and procedures;
- Field screening methods;
- Analysis Methods;
- Sample handling, preservation and storage; and
- Analytical QA/QC.

7.1 DATA QUALITY OBJECTIVES (DQO)

The scope of the ESA works has been devised broadly in accordance with the following Data Quality Objective (DQO) process, as defined in NSW Environmental Protection Agency (EPA) *Guidelines for the NSW Site Auditor Scheme (2nd Edition), 2006 (* NSW Auditor Scheme 2006) and the Australian Standard "Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and semi-volatile compounds" (AS 4482.1 – 2005). The DQO process for the ESA is outlined in the following sections.

7.1.1 State the Problem

The site requires to be rendered suitable for medium density residential land use. The ESA will therefore need to verify that the site will be rendered suitable for the intended land use by evaluating the potential for site contamination on the basis of historic land uses, anecdotal and documentary evidence of possible pollutant sources. This shall include an investigation of any potential contamination within soils present at the site by means of limited intrusive sampling and laboratory analysis for relevant contaminants of concern. Currently there is no available data related to the contamination status of the site. A sampling and analysis plan is required in order to assess the sites suitability for the intended medium density residential land use development. This

ESA shall provide a summary of historic land uses and potentially contaminating activities, as well as providing a preliminary assessment of the contamination status of the site.

7.1.2 Identify the Decision

The completeness of the ESA works will therefore be determined by the findings of the report, ensuring that historic land uses and potentially contaminating activities that may have occurred at the site do not currently present a risk of harm to human health or the environment for residential purposes.

The completeness of the ESA will therefore be determined by the identification of potentially contaminating activities which have occurred from historic land uses and likely migration routes, and the interpretation of soil analytical results when compared to the relevant medium density residential site assessment criteria for soils.

The required decisions are therefore related to answering the following two questions:

- *Is the soil and groundwater quality suitable for the proposed land use; and*
- *Will site soils and groundwater require further remediation and/or special management before the site can be used for residential purposes?*

7.1.3 Identify Inputs to the Decision

Inputs to the decision will include:

- The collection of soil samples from various depths until natural soils are encountered;
- Vertical and lateral delineation of any identified soil hotspots;
- Field screening of VOCs using PID, with the highest PID reading and/or any visual observations of potential contamination being the defining factor for the selection of samples for analysis;
- laboratory analysis of selected soil samples for relevant analytical parameters as defined from the site history and field observations; and
- assessment of analytical results in relation to the adopted health based and environmental screening levels, being the HILB , HSLs and EIL/ESLs of the NEPM 2013;

7.1.4 Define the Boundary of the Assessment

The spacial boundaries of the site were limited to:

- **Lateral** - the geographical boundary of the assessment was defined by the site boundary, as illustrated in **Figure 2**.
- **Vertical** - from the existing ground level to the low permeability barrier / top of subsurface clay or bedrock layer, which prevents deeper, vertical contaminant migration; and
- **Temporal** - perspective, it was considered that the findings of this assessment will hold true for as long as the proposed site land use remains passive in nature; that is, for as long as the site is used for its proposed purpose and that there are no activities taking place on-site or on the immediately adjacent properties that may compromise the current environmental conditions on site.

7.1.5 Develop a Decision Rule

Laboratory test results will be assessed against the adopted criteria for soils. Should the adopted criteria be exceeded then additional investigations will be required to delineate vertical and lateral extent of contamination. Laboratory test results will be accepted if:

- all contracted laboratories are accredited by NATA for the analyses undertaken;
- all detection limits fall below the adopted criteria;
- analyte concentrations in rinsate (i.e. blank) samples do not vary significantly from concentrations in the distilled water used for equipment rinsing;
- RPDs for duplicate samples are within accepted limits; and
- Laboratory QA/QC protocols and results comply with NEPM requirements.

The data acceptance criteria for Field Quality Control and Laboratory Quality Control samples tested for the identified chemicals of concern are detailed in **Appendix D, Table QC5.**

7.1.6 Specify Acceptable Limits on Decision Errors

Determination of possible concentration ranges:

As there were no previous field investigations conducted on the site, mean concentrations for the identified contaminants of concern (COC) could not be estimated.

Identifying the Decision Errors:

Considering that future site redevelopment will involve a residential development, EI has determined that the two decision errors for each respective COC are:

a) deciding that site soils exceed the SILs when they truly do not; and

b) deciding that site soils are within the SILs when they truly are not.

Evaluating the potential consequences of each decision error:

The consequences of deciding that the soils exceed the SILs when they truly do not, will be that additional soil investigations will need to be carried out and/or remediation of affected site soils, which will add cost and time delays to the project.

The consequences of deciding that the soils do not exceed the SILs when they truly do, will be that contaminated soils will be left unmanaged, on the site and potentially endanger human health or pose ongoing risks to the environment. In addition, the future owners of the site may be liable for future damages and environmental cleanup costs.

Evaluating Severity of Decision Error Consequences:

EI concluded that the consequences of deciding that the soils do not exceed the SILs when they truly do, would be more severe near the action level since the risk of jeopardising human health and the environment outweigh the consequences of having to pay more for further investigation and/or remediation of affected soils.

Definition of the Null Hypothesis:

For soils remaining on the site and for each respective COC, the baseline condition or null hypothesis (H_o) is "the soils exceed the SILs". The alternative hypothesis (H_a) is "the soils are within the SILs".

The *false positive* decision error occurs when the null hypothesis is rejected when it is true. For soils to remain on the site, the *false positive* decision error occurs when the decision maker decides the soil is within the SILs for the respective COC when it truly exceeds the SILs.

The *false negative* decision error occurs when the null hypothesis is not rejected when it is false. For soils remaining on the site, the *false negative* decision error occurs when the decision maker decides the soil exceeds the SILs for the respective COC when it truly is within the SILs.

Decision Error Limits:

Errors that increase the probability of not carrying out additional soil investigations and/or remediation of affected soils when that action is truly required (i.e. false positive decision errors) will be considered acceptable 10% of the time for each respective COC. Errors that increase the

probability of carrying out additional soil investigations and/or remediation of affected soils when that action is not required (i.e. false negative decision errors) will be considered acceptable 10% of the time for each respective COC.

7.1.7 Optimise the Design for Obtaining Data

Soil sampling procedures that would be implemented to optimise data collection for achieving the DQOs included the following:

- sampling from a systematic, triangular sampling grid; and
- stratified sampling from selected depth intervals to characterise fill soils, separately to natural soils.

7.2 DATA QUALITY INDICATORS

To ensure the data collected as part of the ESA was of quality, the following data quality assurance procedures were adopted, as presented in **Table 7-1** below. An assessment of the data quality indicators (DQI) relating to both field and laboratory procedures shall be carried out, with the details of the assessment presented in **Table 7-2** below.

Table 7-1 Data Quality Assurance Procedures

Item	Objectives
Environmental Consultant	The Environmental Consultant should maintain Quality Assurance Systems certified to AS/NZS ISO 9001:2000. Work would be undertaken by appropriately qualified and experienced personnel.
Sample handling and Storage	Work should be undertaken general in accordance with field procedures based on industry accepted standard practice and in accordance with: ▪ Australian Standard AS4482.1 (2005) Guide to the investigation and sampling of sites with potentially contaminated soil – Part 1: Non-volatile and semi-volatile compounds; ▪ Australian / New Zealand Standard AS/NZS 5667.11 (1998) Guidance on sampling of groundwater; ▪ NSW EPA (March 2004) Approved Methods for the sampling and analysis of water pollutants in New South Wales; and ▪ National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, National Environment Protection Council, May 2013.
Transport	Samples would be stored in an ice brick-cooled esky and transported to the laboratory. To ensure the integrity of the samples from collection to receipt by the analytical laboratory, samples will be sent to the laboratories under "chain of custody" (CoC) describing sample preservation and transport duration. One trip blank per sample batch sent to laboratory. Results for trip blanks should all be non-detected.
Volatile losses	One spiked sample should be analysed per batch for soils and groundwater. Volatile losses should be less than 10 percent in the trip spike.

Item	Objectives
QA samples	Field and laboratory QA samples will be analysed as follows: ▪ intra-laboratory duplicate samples at a rate of 1 in 10 primary samples ▪ inter-laboratory duplicate samples at a rate of 1 in 20 primary samples. Field and Laboratory acceptable limits are between 30–50% RPD as stated by AS 4482.1–2005. Non-compliance is to be documented in the report and sample to be re-analysed or higher level to be conservatively adopted.
Laboratory analyses	The selected laboratories would comply with the respective ISO 9001 quality assurance programs, be NATA registered for the analysis to be undertaken and perform their own internal QA/QC programs, and would use appropriate detection limits for the analyses to be undertaken.
Laboratory Quality Control – Duplicates, spikes, blanks and surrogates – Acceptable Limits	Primary laboratory QA/QC acceptance limits are expected to be as follows: ▪ surrogates: 70% to 130% recovery ▪ matrix Spikes: 70% to 130% recovery for organics or 80%-120% recovery for inorganics ▪ control Samples: 70% to 130% recovery for soil or 80% to 120% recovery for waters ▪ duplicate Samples: <4PQL - +/- 2PQL, 4-10PQL – 0.-25 or 50%RPD, >10PQL – 0-10 or 30%RPD ▪ method Blanks: zero to <PQL.

Table 7-2 Data Quality Indicators (NSW DEC, 2005)

QA/QC Measures	Data Quality Indicators
Precision - A quantitative measure of the variability (or reproducibility) of data	Performance of blind field duplicate sample sets, through calculation of relative percentage differences (RPD); and The RPDs will be assessed as acceptable if less than 30%. RPDs that exceed this range may be considered where: Results are less than 10 times the limits of reporting (LOR); Results are less than 20 times the LOR and the RPD is less than 50%; or Heterogeneous materials or volatile compounds are encountered.
Accuracy - A quantitative measure of the closeness of reported data to the "true" value	Method blanks, which are analysed for the analytes targeted in the primary samples; Matrix spike and matrix spike duplicate sample sets; and Laboratory control samples.
Representativeness - The confidence (expressed qualitatively) that data are representative of each medium present on Site	To ensure the data produced by the laboratory is representative of conditions encountered in the field, the following steps are taken by the laboratory: Blank samples will be run in parallel with field samples to confirm there are no unacceptable instances of laboratory artefacts; Review of relative percentage differences (RPD) values for field and laboratory duplicates to provide an indication that the samples are generally homogeneous, with no unacceptable instances of significant sample matrix heterogeneities; and The appropriateness of collection methodologies, handling, storage and preservation techniques will be assessed to ensure/confirm there was minimal opportunity for sample interference or degradation (i.e. volatile loss during transport due to incorrect preservation / transport methods).
Completeness - A measure of the amount of useable data from a data collection activity	In validating the degree of completeness of the analytical data sets acquired during the program the following is considered: Whether standard operating procedures (SOPs) for sampling protocols have been adhered to; and Copies of all COC documentation are reviewed and presented. It can therefore be considered whether the proportion of "useable data" generated in the data collection activities is sufficient for the purposes of the land use assessment.

QA/QC Measures	Data Quality Indicators
Comparability - The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.	Given that a reported data set can comprise several data sets from separate sampling episodes, issues of comparability between data sets are reduced through adherence to Standard Operating Procedures (SOPs) and regulator-endorsed or published guidelines and standards on each data gathering activity. In addition the data will be collected by experienced samplers and NATA-accredited laboratory methodologies will be employed in all laboratory testing programs.

8.0 ASSESSMENT METHODOLOGY

8.1 FIELDWORK SUMMARY

The work objectives and scope of works for the soil investigation are summarised in **Table 7-1**.

Table 8-1: Sampling Methodology

Activity/Item	Details
Fieldwork Date	15th, 20th – 22nd, 26th and 28th of November, 2013 (Soil investigation works).
Investigation Method	Boreholes with drilled with a geoprobe drill rig, be small enough to drill within the buildings, and fitted with push tube capabilities.
Rationale	In order to comply with the minimum sampling density requirements recommended under the EPA (1995) *Sampling Design Guidelines* for a site area of 1.53 hectares (15347m^2) (being Stages 2 and 3 of the development) as well as the EPA (1994) *Minimum Soil Sampling Protocol* for imported fill soils, approximately 25 - 30 test locations would be required. Twenty nine (29) separate test boreholes (BH1 – BH5 and BH201 – BH224) were selected using a mixed judgemental / systematic, triangular sampling pattern, with allowance for structural obstacles (e.g. building walls, underground and overhanging services and other physical obstructions in use by existing operating businesses).
Bores Drilled and Target Depth	At this stage it is anticipated that sampling would be continued down to 'clean' natural soils, or 0.5 m beyond the extent of observed contamination, whichever is greater. As Hawkesbury sandstone of high strength may be present at surface, the drillings may cease due to drill auger refusal, which would be considered appropriate for the purposes of this investigation.
Soil Logging	Stratigraphy and any other relevant information during drilling and the installation of the monitoring wells (if any) will be recorded by appropriately qualified personnel. Soil classifications and descriptions were based on Unified Soil Classification System (USCS) and Australian Standard (AS) 4482.1-1997. Geological bore logs are presented in **Appendix E.**
Sample collection	At the following depths: ▪ the surface (0.0-0.2 m) ▪ 0.3-0.6 m ▪ 1.0 metre and at 1.0 metre interval to the base of the borehole ▪ where any changes in lithology (i.e. 'clean'natural soils are encountered), evidence of contamination occurs or elevated photo-ionisation detector (PID) readings area noted. Samples will be collected from the auger / trowel and the sampling equipment will be cleaned with suitable phosphate free detergent and rinsed with distilled water between sampling episodes.
Field screening	All drain outlets in soil samples collected during the works will be screened with a Photo Ionisation Detector (PID), to assess if volatile contaminants are present.

Activity/Item	Details
Laboratory analyses	Based on the available PID results and field observations, selected soil samples will be analysed in the laboratory. At this stage, it is anticipated that selected primary samples will be analysed for a range of potential contaminants of concern including: ▪ Metals allowance 2 samples/hole ▪ Total Petroleum Hydrocarbons (TPH) 1.5 samples/hole ▪ Benzene/Toluene/Ethyl benzene/Xylene (BTEX) 1.5 sample/hole ▪ Polycyclic Aromatic Hydrocarbons (PAH) 1.5 sample/hole ▪ Organo Chlorine Pesticides (OCP) allowance 1 sample/hole ▪ Asbestos allowance 1 sample/hole In addition to these primary samples, QAQC samples would be analysed as per **Section 9** of this report. The remaining soil samples collected will be kept on hold should further laboratory analysis be required.
Soil Sampling	Soil samples were collected using a hand trowel and placed into clean, laboratory-supplied acid washed, solvent rinsed glass jars using dedicated nitrile gloves.
Decontamination Procedures	The drilling rods were decontaminated between sampling locations with potable water. Stainless steel trowel used was decontaminated using Decon 90, followed by a rinse with potable water, and a final rinse with laboratory prepared volatile rinsate water.
Sample Preservation	Samples were stored in a refrigerated (ice-brick filled) chest, whilst on-site and in transit to the laboratory. All samples were submitted and analysed within the required holding period.
Sampling locations reinstatement after sampling	Soil cuttings were used as backfill for drilled boreholes as the site was in the process of excavation or soon to be excavated. Sampling locations would be reinstated to pre-investigation conditions and be sufficiently compacted to ensure this condition is maintained. Any excess spoil that cannot be returned to the borehole will be stored in drums at the site and removed from site and lawfully disposed of by a licensed contractor following appropriate waste classification.
Quality Control & Laboratory Analysis	A number of soil samples were submitted for analysis by SGS Laboratories (SGS). QA/QC testing comprised intra-laboratory duplicates ('field duplicates') tested by SGS and inter-laboratory field duplicate tested by Envirolab Services (Envirolab). Selected samples were submitted for analysis of previously-identified PCOC.

9.0 DATA QUALITY ASSESSMENT

9.1 QUALITY ASSURANCE PROGRAMME

In order to satisfy the objectives of the environmental site assessment (ESA) works, Environmental Investigations (EI) implemented a quality assurance programme, including:

- The use of appropriately qualified / trained Environmental professional staff with over ten years of continuous relevant experience in the assessment and management of contaminated sites, to carry out the environmental site assessment investigation works;
- Calibration of equipment prior to application on site and recording the results of the calibration in appropriate site documentation.
- Appropriate storage (esky and ice bricks) and handling of quality control (QC) samples received from the laboratories for use on site, prior to and during ESA investigation works;
- Undertaking appropriate equipment decontamination and use of a new pair of nitrile gloves by site personnel prior to the collection of each soil sample directly from the push tube liner or drill rig auger;
- Use of a cooler with ice to store collected samples prior to and during transport to the laboratories;
- The collection and analysis of field quality control samples during the ESA investigation works;
- The use of chain of custody (CoC) procedures to ensure the traceability of sample transport and handling; and
- The use of laboratories accredited by the National Association of Testing Authorities (NATA) for the analysis of soil samples collected during the monitoring well installation works.

9.2 ADOPTED ASSESSMENT CRITERIA

The Soil Investigation Levels (SILs) that would be used as the action levels for the assessment are summarised in **Table 9-1**. Analytical methods have been selected to be relevant for the selected SILs with respect to contaminant detection limits and these are presented in detail in **Appendix D, Table QC3**.

The Soil Investigation Levels (SILs) that would be used as the action levels for the assessment were the:

- NEPM (2013) – *Health-Based Investigation Levels for residential with minimal opportunities for soil access; which includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments (HIL-B)*;
- NEPM (2013) – *Soil Health Screening Levels (HSLs) for vapour intrusion* (for TPHs F1 and F2, BTEX and Naphthalene);
- NEPM (2013) – *Ecological Screening Levels (ESLs) for TPH fractions F1 – F4, BTEX and Benzo(α)pyrene in soil*;
- NEPM (2013) – *Management Limits for TPH fractions F1 – F4*; and
- NEPM (2013) - *Health Screening Levels for asbestos contamination in soil (Asbestos HSLs).*

Table 9-1: Summary of Site Assessment Criteria for Soil Investigation Levels (SILs)

Parameter	Unit	PQL	SILs
Metals			
Arsenic - As	mg / kg	3	500[1]
Cadmium - Cd	mg / kg	0.3	150
Chromium(VI) – Cr(VI)	mg / kg	0.3	500
Copper - Cu	mg / kg	0.5	30,000
Lead - Pb	mg / kg	1	1,200[2]
Mercury - Hg	mg / kg	0.01	120[3]
Nickel - Ni	mg / kg	0.5	1,200
Zinc - Zn	mg / kg	0.5	60,000
Petroleum Hydrocarbons#			
F1*	mg / kg	25	210[6]
F2**	mg / kg	25	160[6]
F3 ($>C_{16}$-C_{34})	mg / kg	90	3500[7]
F4 ($>C_{34}$-C_{40})	mg / kg	120	10,000[7]
Monocyclic Aromatic Hydrocarbons (BTEX)			
Benzene	mg / kg	0.1	50
Toluene	mg / kg	0.1	85
Ethylbenzene	mg / kg	0.1	70
Xylenes (total)	mg / kg	0.3	105
Polycyclic Aromatic Hydrocarbons (PAHs)			
Naphthalene	mg / kg	0.1	4[6]
Benzo(α)pyrene	mg / kg	0.1	0.7
Carcinogenic PAHs [4]	TEQ	0.2	4
Total PAHs [5]	mg / kg	0.8	400[5]
Organochlorine Pesticides (OCPs)			
DDT + DDD + DDE	mg / kg	0.1	600
Aldrin + Dieldrin	mg / kg	0.1	10
Chlordane	mg / kg	0.1	90
Endosulfan	mg / kg	0.1	400
Endrin	mg / kg	0.1	20
Heptachlor	mg / kg	0.1	10
HCB	mg / kg	0.1	15
Methoxychlor	mg / kg	0.1	500
Mirex	mg / kg	0.1	20
Toxaphene	mg / kg	0.1	30
Organophosphorus Pesticides (OPPs)			
Chloropyrifos	mg / kg	0.2	340
Other			
Total PCBs	mg / kg	1	1
Asbestos	w / w	0.001	<0.001

Notes: All values are in mg\kg unless otherwise noted.

SIL are NEPM (2013) **HIL B** – *Residential with minimal opportunities for soil access; which includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments* unless indicated otherwise

- Petroleum Hydrocarbon Contamination will be assessed according to the methodology described in NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013* Guidelines i.e. NEPM (2013), and presented as a flowchart in Figure 1 of its *Schedule (B1).*

* = To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

** = To obtain F2 subtract Naphthalene from the $>C_{10}$-C_{16} fraction.

[1] - Arsenic SIL assumes 70% oral bioavailability. Site specific bioavailability may be important and should be considered where appropriate (refer schedule B7)
[2] - Lead SIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL B where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate (refer schedule B7)
[3] - Elemental Mercury: SIL does not address elemental mercury. A Site specific assessment should be considered if elemental mercury is present.
[4] - SIL is based on the 8 carcinogenic PAHs and their TEFs (potency related to B(a)P adopted by CCME 2008 (*Ref.* Schedule B7 of NEPM 2013)
[5] - Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (World Health Organisation 1998). The application of the total PAH SIL should consider the presence of carcinogenic PAHs and Napthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ SIL. Napthalene reported in the total PAH should meet the relevant SIL.
[6] – Value obtained from NEPM 2013 Table 1A(3)Soil HSLs for vapour intrusion, 0 to <1m in silt, considered to be the most conservative of silt and clays
[7] – Value obtained from NEPM 2013Table 1 B(7) Management Limits for TPH fractions F1 – F4 in soil for fine grained soil texture

9.3 QUALITY CONTROL PROGRAM

For the purpose of assessing the quality of data presented in this ESA, EI collected field QC samples for analysis. The primary laboratory, SGS Australia Pty Ltd (SGS) and secondary laboratory, Envirolab Services Pty Ltd (Envirolab) also prepared and analysed QC samples. Details of the field and laboratory QC samples are provided in **Table 9-4,** with the allowable acceptance ranges for the data presented in **Table 9-2** below.

Table 9-2: Sampling Methodology

Data Quality Objective	Data Quality Indicator	Acceptable Range
Accuracy	Field – Trip spike (laboratory prepared) Laboratory – Laboratory control spike and matrix spike	70 – 130 % recovery Prescribed by the laboratories
Precision	Field – Blind replicate and spilt duplicate Laboratory – Laboratory duplicate and matrix spike duplicate	< 30 % relative percentage difference (RPD [%]) Prescribed by the laboratories
Representativeness	Field – Trip blank (laboratory prepared) Laboratory – Method blank	< laboratory limit of reporting (LOR) Prescribed by the laboratories
Completeness	Completion (%)	-

Calculation of Relative Percentage Difference (RPD)

The RPD values were calculated using the following equation:

$$RPD = \frac{([C_O - C_R] \times 100)}{\frac{(C_O + C_R)}{2}}$$

C_O = Concentration obtained from the primary sample.
C_R = Concentration obtained from the blind replicate or split sample.

Calculation of Spike Recovery

The trip spike sample recovery values were calculated using the following equation:

$$\frac{X}{T} \times 100\ \%$$

X = Observed value of measurement.
T = True value.

9.2.1 Field QA/QC Data Evaluation

The field quality assurance/quality control (QA/QC) samples collected during the ESA works were as follows:

- Blind field duplicate;
- Inter laboratory duplicate;
- Trip blank;
- Trip spike; and
- Rinsate Blank.

The results of the QA/QC samples including the calculated RPD values are presented in **Table 9-2.**

Blind Field Duplicate

One (1) blind field duplicate (BFD) sample, being sample B1, was collected from the primary sample BH208-1. The preparation of the BFD sample involved the collection of a bulk quantity of soil from the same sampling point without mixing, before dividing the material into identical sampling vessels. The duplicate sample was then presented blind to the primary laboratory (SGS) to avoid any potential analytical bias. The BFD was analysed for TPH, BTEX and selected heavy metals with the RPD values calculated found to be within the Data Acceptance Criteria (**Ref.**

Appendix D, Table QC5), indicating that the samples collected were representative of the soils present at the respective sampling locations.

Inter Laboratory Duplicate

One (1) inter laboratory duplicate (ILD) sample, being sample I1, was collected from the primary sample BH208-1. The preparation of sample I1 was identical to the BFD sample as described above, and analysed for TPH, BTEX and selected heavy metals. The RPD values calculated for the ILD sample were found to be within the Data Acceptance Criteria (**Ref. Appendix D, Table QC5**), with the exception of the following:

- Nickel (RPD 70.27%); and
- Zinc (RPD 78.48%).

The minor RPD exceedences identified within the indicating that the RPDs for the samples were found to be higher than the expected range for homogenous soils. The variance in RPD can be explained as the soil samples were not perfectly homogenous, being consistent with field observations and as described in the borehole logs (*Ref.* **Appendix E**). Further to this, soil samples were placed directly into jars so as to reduce the loss of volatiles within the sample. Therefore, EI concluded that that the samples collected were representative of the soils present at the respective sampling locations.

Trip Blank

One (1) trip blank (TB) sample, prepared by the primary laboratory, was analysed for BTEX by the primary laboratory. The soil TB sample results were reported below the laboratory LOR, indicating that ideal sample transport and handling conditions were achieved.

Trip Spike

One (1) trip spike (TS) sample was submitted to the primary laboratory for BTEX, as prescribed by the primary laboratory. The soil TS recovery percentages (%) were found to be within the Data Acceptance Criteria (**Ref. Appendix D, Table QC5**), indicating that ideal sample transport and handling conditions were achieved.

Rinsate Blank

One (1) rinsate blank (RB) sample was submitted to the primary laboratory for TPH, BTEX and selected heavy metals. The RB sample results were reported below the laboratory LOR, with the exception of the following:

- Copper (52 µg/L)
- Zinc (11 µg/L)

EI notes that these concentrations reported within the RB sample when simply converted to mg/kg (assuming 1L of the mixture weighs 1kg), the exceeding values reported are less than background concentrations. Further testing of the rinsate water alone revealed quality issues within the laboratory supplied rinsate waters, which had been contaminated with trace amounts of metals, which were used during the ESA sampling event. However, as the analytes which have reported exceeding RB concentrations are not considered to be of an issue at the site, it was therefore concluded that decontamination procedures performed during the field works had been effective.

Assessment of Field QA/QC Data

All soil samples were classified in the field with respect to soil/fill characteristics and any observable signs of contamination based on visual and odour assessment. A Field Contamination Ranking (FCR) System was applied to each lithological soil sample, and FCR values were recorded on test bore logs.

The FCR system was assigned to samples on the following basis:

0 - for samples that did not display any visual signs of contamination or detectable odours;
1 - for samples that displayed slight visual signs of contamination and/or detectable odours;
2 - for samples that displayed obvious signs of contamination and/or detectable odours; and
3 - for samples that display significant signs of contamination and/or detectable odours.

All samples, including field QC samples, were transported to the primary and secondary laboratories under strict Chain-of-Custody conditions and appropriate copies of relevant documentation were included in the respective reports.

The overall completeness of documentation produced under the field program of the subject assessment was considered to be adequate for the purposes of drawing valid conclusions regarding the environmental condition of the site.

Based on the results of the field QA/QC data, EI considered the field QA/QC programme carried out during the ESA works to be appropriate and the results to be acceptable.

9.2.2 Laboratory QA/QC Data Evaluation

Details of the laboratory QA/QC data is provided in the *Laboratory Analytical Reports* (**Appendix G***)*. As part of their NATA accreditation, the primary and secondary laboratories carried out a comprehensive QA/QC assessment.

The soil samples submitted to the primary and secondary laboratories were allocated a batch number by as follows:

- SGS – ES122980;
- SGS – ES122980A; and
- Envirolab – 101722.

EI note that soil samples were analysed within the holding times prescribed by the laboratories.

The laboratory QA/QC samples collected during the ESA works were as follows:

- Laboratory duplicate (DUP);
- Method blank (MB);
- Laboratory control spike (LCS);
- Matrix spike (MS); and
- Matrix spike duplicate (MSD).

No QC outliers were reported by the primary or secondary laboratories.

9.2.3 Assessment of Laboratory QA/QC Data

The laboratories used for this assessment used certified methods pursuant with their respective NATA accreditations. All laboratory duplicates (DUP), method blanks (MB), laboratory control

spikes (LCS), matrix spikes (MS) and matrix spike duplicates (MSD) were compliant with internal laboratory recovery limits with the exception of instances as detailed within the table below.

Table 9-3 Laboratory QA/QC Outliers

Laboratory and Laboratory report number	Laboratory QC Analyte (Laboratory Sample ID and/or Client Sample ID)	Data (%)	Comment by Laboratory
SGS (Primary Laboratory) SE122980 SGS (Primary Laboratory) SE122980	Copper SE122980.001	69%	DUP RPD % is outside the acceptable limit
	Copper SE122980.014	37%	DUP RPD % is outside the acceptable limit
	Nickel SE122980.014	54%	DUP RPD % is outside the acceptable limit
	Zinc SE122980.014	34%	DUP RPD % is outside the acceptable limit
	Arsenic SE122980.022	66%	DUP RPD % is outside the acceptable limit
	Chromium SE122980.022	37%	DUP RPD % is outside the acceptable limit
	Lead SE122980.010	23%	DUP RPD % is outside the acceptable limit
	Zinc SE122980.010	47%	DUP RPD % is outside the acceptable limit
	Nickel SE122980.010	64%	DUP RPD % is outside the acceptable limit
SGS (Primary Laboratory) SE122980A	Zinc - SE122980A.13	38%	MS Recovery % is outside the acceptable limit (70 – 130%)

Due to the rigorous NATA accreditation process and the laboratory QC sample results reviewed, EI considered that the results were within acceptable control limits specified by SGS and Envirolab, in accordance with their NATA accreditation. Therefore the integrity of the analytical data was considered to be suitable for use.

9.3 OVERALL DATA ASSESSMENT

The QA/QC assessment of the field and laboratory data indicated that for the purpose of the ESA works, the results of the field and laboratory QA/QC programme were considered acceptable for use as outlined in the data assessment below.

9.3.1 Accuracy

The spike recovery results for the field (laboratory prepared) spike samples were within the acceptable range, therefore EI considered that the accuracy of the overall field QA/QC data assessed during the ESA works was kept.

The remaining spike recovery results for the laboratory spike samples were within the acceptable range.

9.3.2 Precision

The RPD calculations for the field and laboratory duplicate samples were within the acceptable range.

9.3.3 Representativeness

The results of the field (laboratory prepared) and laboratory blank samples were within the acceptable range, with the exception of copper and zinc identified within the rinsate blank sample, which was found to be due to incorrect rinsate waters supplied by the laboratory.

9.3.4 Completeness

EI has assessed that 100 % of the analytical results were considered valid to be used for the ESA works.

Table 9-4: Summary of laboratory results for BFD sample B1 and ILD sample I1, field QC soil duplicates of BH208-1, with calculated relative percentage differences (% RPD)

Sample identification	Description	TRH				BTEX				Heavy Metals							
		F1*	F2**	F3 (>C_{16} - C_{34})	F4 (>C_{34} - C_{40})	Benzene	Toluene	Ethylbenzene	Xylene (total)	Arsenic	Cadmium	Chromium (Total)	Copper	Lead	Mercury	Nickel	Zinc
Intra-laboratory Duplicate																	
BH208-1	Stg 2-3	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	6	0.6	16	48	50	0.03	25	550
B1	Replicate of 208 - 1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	6	0.4	12	35	44	0.03	16	380
RPD		***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***40.00***	***28.57***	***31.33***	***12.77***	***0.00***	***43.90***	***36.56***
Inter-laboratory Duplicate																	
BH208-1	Stg 2-3	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	6	0.6	16	48	50	0.03	25	550
I1	Replicate of 208 - 1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	6	0.5	15	33	47	<0.1	12	240
RPD		***0.00***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***0.00***	***18.18***	***6.45***	***37.04***	***6.19***	***50.00***	***70.27***	***78.48***
Trip Blank																	
TB	De-ionised water					<0.5	<0.5	<0.5	<1.5	NR	NR	NR	NR	NR	NR	NR	NR
Trip Spike																	
TS	De-ionised water	NR	NR	NR	NR	98%	98%	101%	88%[1]	NR	NR	NR	NR	NR	NR	NR	NR
Rinsate Blanks																	
RB	De-ionised water	<50	<60	<500	<500	<0.5	<0.5	<0.5	<1.5	<1	<0.1	<1	**52**	<1	<0.0001	<1	**11**

Note: all soil analysis is reported in mg/kg and waters are reported in µg/L.

10.0 RESULTS AND DISCUSSION

10.1 SOIL SAMPLING AND FIELD OBSERVATIONS

Soil samples were obtained from the test bores BH1 to BH5, and BH201 to BH 224 at various depths ranging between 0.0m to 1.1 m BGL. All examined soils were evaluated on a qualitative basis for odour and visual signs of contamination (e.g. hydrocarbon odours, oil staining, petrochemical filming, asbestos fragments, ash, charcoal, etc.) if any, and on the basis of the field-work findings, the following observations were noted.

- No visual and olfactory evidence of hydrocarbon impacts were noted at any of the borehole locations investigated during this assessment;
- PID VOC concentrations were detected from soil samples collected from boreholes BH1 – BH5, ranging from 7.5 – 1250 parts per million (ppm). Analysis of soil samples with the highest PID readings at each soil sampling location was completed by the laboratory.
- No fibrous board, ash, charcoal or slag was observed in any of the examined fill soils; and
- Two soil test borehole locations were located within the road reserve along Nancarrow Avenue, due to access issues on the site. However, regeneration of the road reserve area is included within the proposed development, therefore these sample test borehole locations are considered to be representative of the development site.

Borehole logs were prepared for all test holes and included sample descriptions and are presented in Appendix E.

10.2 SUB-SURFACE CONDITIONS

On the basis of observations made during the drilling investigation, a summary of site sub-surface conditions is presented in **Table 10-1**.

Table 10-1 General site geology

Depth Interval (m BGL)	General Description
0.0 - 0.5 (Max 1.0 at BH201)	CONCRETE identified at BH1, BH2, BH201 – BH204, BH209, BH217 – BH221 and BH224
0.0 – 0.1	ASPHALT identified at BH207 an BH210
0.0 – 0.5	FILL brown – dark brown sandy gravelly topsoil with organics (rootlets), fine – medium grained. Identified at BH3, BH4, BH206 – BH208, BH211 – BH216 and BH223
0.0 – 0.5 (Max 0.7 at BH202)	FILL Grey/brown silty gravel (road base) identified at boreholes BH202, BH205, BH207, BH209 and BH210
0.2 – 0.3	FILL boulders and brick rubble identified at BH217 – 220 which was unable to be sampled
0.2 – 0.8	CLAYEY SAND brown/light brown, fine – medium grained
0.3 – 0.9 (Max. 1.4m at BH209)	SANDY CLAY brown/orange, low to moderate plasticity, fine to medium grained sands
0.15 - 1.2	SANDSTONE orange / brown with some red mottling, extremely to distinctly weathered (Hawkesbury Sandstone)

10.3 LABORATORY RESULTS

Laboratory analytical results for the representative discrete soil samples are summarised in **Tables 10-2 to 10-5** and presented in detail in copies of the laboratory analytical reports in **Appendix G**. Tables 10-1 to 10-5 also include the adopted soil criteria. EI notes that the sampling event for the Stage 2 – 3 ESA works was carried out in conjunction with the sampling works for the Stage 4 – 5 ESA works. As such, the lab reports as presented in **Appendix G** contain sample results for all soil samples collected for stages 2 – 5 of the Shepherds Bay Urban Renewal Project. The Stage 2 – 3 ESA report discusses the soil sample results applicable to stages 2 – 3 only, with the results of stages 4 – 5 to be discussed in a separate ESA report for Stages 4 – 5 of the development.

Heavy Metals

Results of soil samples collected from soil test boreholes BH1 to BH5, and BH201 – BH224 reported concentrations of the screened heavy metals to be below the adopted human health based SILs, with the exception of BH4-1, which reported concentrations of lead exceeding the human health based SIL (2,000 mg/kg). The BH4-1 sample was collected from within the front yard of 10 Nancarrow Avenue.

Results of the soil samples collected from the soil test boreholes BH1 – BH5 and BH201 – BH224 as stated above reported concentrations of the screened heavy metals to be below the adopted ecological SILs with the exception of the following:

- BH3-1 reported concentrations of zinc (6,500mg/kg) which exceeded the ecological based SIL. The concentration reported was greater than 2.5 times the adopted SIL therefore is indicative of an ecological based hotspot at this location;
- BH4-1 reported concentrations of copper (260 mg/kg) lead (2,000 mg/kg) and zinc (570mg/kg) which exceeded the ecological based SIL;
- BH202-1 reported concentrations of nickel (78mg/kg) which exceeded the ecological based SIL;
- BH207-1 reported concentrations of nickel (98 mg/kg) which exceeded the ecological based SIL;
- BH208-1 reported concentrations of zinc (550mg/kg) which exceeded the ecological based SIL;
- BH214-1 reported concentrations of copper (120 mg/kg) which exceeded the ecological based SIL;

TPHs and BTEX

Results of soil samples collected from BH1 to BH5, and BH201 – BH224 reported concentrations of screened fractions to be below the adopted SILs, with the exception of the following:

- BH203-1 reported concentrations of TPH F2 (C_{10}-C_{16} less naphthalene) fraction (170mg/kg) which exceeded ecological based SIL for coarse grained soils;
- BH205-1 reported concentrations of TPH F2 (C_{10}-C_{16} less naphthalene) fraction (390mg/kg) which exceeded the human health based SIL, and concentrations of TPH F3 (>C_{16}-C_{34}) fraction (490mg/kg) which exceeded the ecological based SIL for coarse grained soils; and
- BH223-1 reported concentrations of TPH F1 (C_6-C_{10} less BTEX) fraction (620mg/kg) and the TPH F2 fraction (9,500 mg/kg) which exceeded the human health based SILs. This sample also reported concentrations of the TPH F3 fraction.

No detectable BTEX concentrations were identified in any of the tested samples.

PAHs

Results of soil samples collected from BH1 to BH5, and BH201 – BH224 reported concentrations of the screened PAH compounds to be either non-detectable or trace concentrations, being within the adopted SILs.

Asbestos

No detectable asbestos concentrations or traces of respirable fibres were identified in the tested soil samples.

Other Organics

Non-detectable concentrations of the screened OCP, OPP or PCB compounds were identified in samples, with all laboratory quantitation limits being within the corresponding SILs.

Table 10-2: Summary of Laboratory Analysis for Heavy Metals in Soils

Sample ID	Arsenic	Cadmium	Chromium*	Copper	Lead	Mercury	Nickel	Zinc
BH1-1	<3	<0.3	4.1	2.0	4	<0.01	1.7	7.3
BH2-1	<3	0.9	10	9.9	41	0.04	2.6	53
BH3-1	4	0.8	17	37	230	0.03	19	**6,500**
BH3-2	25	<0.3	9.7	8.5	27	0.02	21	370
BH4-1	4	1.5	42	**260**	**2,000**	0.04	25	**570**
BH5-1	3	2.8	12	30	160	0.06	7.1	110
BH201-1	<3	<0.3	11	10	6	<0.01	13	19
BH202-1	<3	<0.3	11	47	5	<0.01	**78**	44
BH203-1	<3	<0.3	44	14	5	<0.01	20	21
BH204-1	<3	<0.3	7.7	5.3	14	<0.01	4.3	17
BH205-1	<3	<0.3	8.6	3.1	7	0.02	1.1	6.7
BH206-1	<3	<0.3	8.5	11	53	0.22	3.5	73
BH207-1	<3	<0.3	100	29	7	<0.01	**98**	66
BH208-1	6	0.6	16	48	50	0.03	25	**550**
BH209-1	4	<0.3	18	<0.5	6	<0.01	0.6	2.0
BH210-1	<3	1.9	29	21	20	<0.01	36	32
BH211-1	10	0.6	34	64	80	0.04	30	210
BH212-1	<3	<0.3	10	14	59	0.08	7.8	55
BH213-1	6	0.4	9.7	50	320	0.05	3.6	170
BH214-1	<3	0.6	11	**120**	600	0.05	6.8	250
BH215-1	10	1.6	73	22	310	0.03	10	78
BH216-1	7	2.8	57	60	370	0.11	16	180
BH217-1	<3	<0.3	7.4	1.2	5	<0.01	<0.5	5.8
BH218-1	<3	<0.3	7.5	1.6	6	<0.01	0.5	10
BH219-1	<3	<0.3	8.9	3.1	9	<0.01	1.0	9.8
BH220-1	<3	<0.3	8.1	2.2	9	<0.01	0.6	7.0
BH221-1	<3	<0.3	4.9	2.5	6	0.02	4.1	8.6
BH222-1	<3	<0.3	5.1	7.7	17	0.01	1.7	37
BH223-1	5	0.8	25	45	270	0.04	26	290
BH224-1	<3	<0.3	7.6	3.0	7	<0.01	**54**	62
SILs								
HIL B	**500**	**150**	**500[3]**	**30,000**	**1,200**	**120**	**1,200**	**60,000**
EILs	**100[1]**	**NR**	**213***	**96.6**	**1,100[2]**	**NR**	**37.6**	**380**

Notes: All results are in units of mg/kg, unless otherwise noted

All SILs are sourced from *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, Schedule (B1)* - Guideline on Investigation Levels for Soil and Groundwater, (NEPM 2013), unless otherwise indicated

HIL B – NEPM (2013) Health Investigation Levels (HILs) for Soil Contaminants – Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high rise buildings and apartments, Table 1A(1)

EIls - NEPM (2013) Soil-specific added contaminant limits for aged zinc (Table 1B[1]), copper (Table 1B[2]), chromium III and nickel (Table 1B[3]), unless otherwise indicated. Values are derived by calculating the sum off the respective added contaminant limit to values reported for sample BH208-2, considered to be representative of the natural residual soils at the site

NR = No Recommended criteria are currently available for the indicated parameter(s)

***** As clay content was not analysed within the data set, the most conservative value was applied, being 1%

[1] Referenced value is sourced from NEPM (2013) Generic Ecological Investigation Levels (EILs) for aged As, fresh DDT and fresh naphthalene in soils irrespective of their physiochemical properties – Table 1B(5)

[2] Referenced value is sourced from NEPM (2013) Generic added contaminant limits for lead in soils irrespective of their physiochemical properties, Table 1B(4)

[3] NEPM 2013 thresholds are for Chromium VI. It is assumed all detected Chromium is Chromium (III), as Chromium (VI) would be too unstable to exist under normal circumstances.

Highlighted bold values indicate exceedences of the adopted human health based SILs

Bolded values indicate analyte concentration exceeding the adopted ecological SILs

Table 10-3: Summary of Laboratory Analysis for TPH and BTEX in Soils

Sample ID	Sample Depth (m)	Total Petroleum Hydrocarbons (mg/kg)				Benzene (mg/kg)	Toluene (mg/kg)	Ethyl benzene (mg/kg)	Total Xylenes (mg/kg)
		F1[1]	F2[2]	F3 [3]	F4 [4]				
BH1-1	0.15-0.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH2-1	0.15-0.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH3-1	0.1-0.2	<25	58	720	<120	<0.1	<0.1	<0.1	<0.3
BH3-2	0.5-0.6	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH4-1	0.1-0.2	<25	<25	91	<120	<0.1	<0.1	<0.1	<0.3
BH5-1	0.1-0.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH201-1	1.0 – 1.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH202-1	0.4 – 0.5	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH203-1	0.3 – 0.4	<25	**170**	<90	<120	<0.1	<0.1	<0.1	<0.3
BH203-2	0.4 – 0.5	<25	<25	<90	<120	<0.1	NA	NA	NA
BH204-1	0.5 – 0.6	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH205-1	0.0 – 0.1	<25	**390**	**490**	<120	<0.1	<0.1	<0.1	<0.3
BH205-2	0.4 – 0.5	<25	<25	<90	<120	<0.1	NA	NA	NA
BH206-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH207-1	0.1 – 0.2	<25	<25	94	<120	<0.1	<0.1	<0.1	<0.3
BH208-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH209-1	0.2 – 0.3	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH210-1	0.1 – 0.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH211-1	0.1 – 0.2	<25	<25	130	<120	<0.1	<0.1	<0.1	<0.3
BH212-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH213-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH214-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH215-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH216-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH217-1	0. 3 – 0.4	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH218-1	0. 3 – 0.4	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH219-1	0. 3 – 0.4	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH220-1	0. 3 – 0.4	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH221-1	0.1 – 0.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH222-1	0.0 – 0.1	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
BH223-1	0.0 – 0.1	**620**	**9500**	**10000**	<120	<0.1	<0.1	<0.1	<0.3
BH223-2	0.5 – 0.6	NA	100	140	<120	NA	NA	NA	NA
BH224-1	0.1 – 0.2	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3
SILs									
HSL A & B (Sand)	**0 m to <1 m**	**45**	**110**	**NR**	**NR**	**0.5**	**160**	**55**	**40**
	1 m to <2 m	**70**	**240**	**NR**	**NR**	**0.5**	**220**	**NL**	**60**
HSL A & B (Clay)	**0 m to <1 m**	**50**	**280**	**NR**	**NR**	**0.7**	**480**	**NL**	**110**
	1 m to <2 m	**90**	**NL**	**NR**	**NR**	**1**	**NL**	**NL**	**310**
ESLs	**Coarse grained**	**180[1]**	**120[1]**	**300**	**2,800**	**50**	**85**	**70**	**105**
	Fine grained			**1,300**	**5,600**	**65**	**105**	**125**	**45**
Management Limits	**Coarse grained**	**700**	**1,000**	**2,500**	**10,000**	**NR**	**NR**	**NR**	**NR**
	Fine grained	**800**		**3,500**		**NR**	**NR**	**NR**	**NR**

Notes: All results are in units of mg/kg, unless otherwise noted

All SILs are sourced from *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, Schedule (B1)* - Guideline on Investigation Levels for Soil and Groundwater, (NEPM 2013), unless otherwise indicated

HSL A&B – NEPM (2013) Soil Health Screening Levels (HSLs) for vapour intrusion – low to high density residential, Table 1A(3)

ESLs - NEPM (2013) Ecological Screening Levels (ESLs) for TPH fractions F1 – F4, BTEX and Benzo(a)pyrene in soils– urban residential and public open space, Table 1B(6)

Management Limits – NEPM (2013) Management Limits for TPH fractions F1 – F4 in soil, Table 1B(7)

NL = 'not limiting' – HSL exceeds soil saturation concentration for the analyte group and soil vapour source concentration cannot exceed maximum allowable vapour risk

NR = No Recommended criteria are currently available for the indicated parameter(s)

* = To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction

** = To obtain F2 subtract Naphthalene from the >C_{10}-C_{16} fraction

1 = ESLs are of low reliability except where indicated by [1] which indicates that the ESL is of moderate reliability

Highlighted bold values indicate exceedences of the adopted human health based SILs

Bolded values indicate analyte concentration exceeding the adopted ecological SILs / Management Limits

Table 10-4: Summary of Laboratory Analysis for Polycyclic Aromatic Hydrocarbons in Soils

Sample Identification	Polycyclic Aromatic Hydrocarbons (mg/kg)			
	Carcinogenic PAHs (as Benzo[a]pyrene TEQ) [4]	Benzo(a)pyrene	Total PAHs	Naphthalene
BH1-1	<0.2	<0.1	<0.8	<0.1
BH2-1	<0.2	<0.1	<0.8	<0.1
BH3-1	<0.2	<0.1	0.8	<0.1
BH3-2	<0.2	<0.1	<0.8	<0.1
BH4-1	0.2	0.1	2.8	<0.1
BH5-1	0.7	0.5	4.8	<0.1
BH201-1	<0.2	<0.1	<0.8	<0.1
BH202-1	<0.2	<0.1	<0.8	<0.1
BH203-1	<0.2	<0.1	<0.8	<0.1
BH204-1	<0.2	<0.1	<0.8	<0.1
BH205-1	<0.2	<0.1	1.0	<0.1
BH205-2	NA	<0.1	NA	<0.1
BH206-1	0.2	0.1	1.5	<0.1
BH207-1	<0.2	<0.1	0.8	0.1
BH208-1	<0.2	<0.1	<0.8	<0.1
BH209-1	<0.2	<0.1	<0.8	<0.1
BH210-1	<0.2	<0.1	<0.8	<0.1
BH211-1	0.3	0.2	2.2	<0.1
BH212-1	0.3	0.2	2.2	<0.1
BH213-1	<0.2	<0.1	<0.8	<0.1
BH214-1	0.6	0.5	3.5	<0.1
BH215-1	<0.2	<0.1	<0.8	<0.1
BH216-1	<0.2	<0.1	<0.8	<0.1
BH217-1	<0.2	<0.1	<0.8	<0.1
BH218-1	<0.2	<0.1	<0.8	<0.1
BH219-1	<0.2	<0.1	<0.8	<0.1
BH220-1	<0.2	<0.1	<0.8	<0.1
BH221-1	<0.2	<0.1	<0.8	<0.1
BH222-1	<0.2	<0.1	<0.8	<0.1
BH223-1	<1	<0.5	6.8	<0.5
BH223-2	NA	<0.1	NA	<0.1
BH224-1	<0.2	<0.1	<0.8	<0.1
SILs				
HIL B	**4**	**NR**	**300**	**3 / 5 [1]**
EIL/ESLs	**NR**	**0.7[3]**	**NR**	**170[2]**

Notes: All results are in units of mg/kg, unless otherwise noted
All SILs are sourced from *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, Schedule (B1)* - Guideline on Investigation Levels for Soil and Groundwater, (NEPM 2013), unless otherwise indicated

HIL B – NEPM (2013) Health Investigation Levels (HILs) for Soil Contaminants – Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high rise buildings and apartments, Table 1A(1)

1 Referenced value is sourced from NEPM (2013) Soil Health Screening Levels (HSLs) for vapour intrusion – low to high density residential, Table 1A(3) for *Sand* (3 mg/kg *)* and *Clay* (5 mg/kg) soils

2 Referenced value is sourced from NEPM (2013) Generic Ecological Investigation Levels (EILs) for aged As, fresh DDT and fresh naphthalene in soils irrespective of their physiochemical properties – Table 1B(5)

3 Referenced value is sourced from NEPM (2013) Ecological Screening Levels (ESLs) for TPH fractions F1 – F4, BTEX and benzo(a)pyrene in soil – Table 1B(6)

4 Carcinogenic PAHs: SIL is based on the 8 carcinogenic PAHs and their TEFs (potency related to B(a)P) adopted by CCME 2008 (Refer schedule B7). TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, and summarising the products.

NR = No Recommended criteria are currently available for the indicated parameter(s)
Highlighted bold values indicate exceedences of the adopted human health based SILs
Bolded values indicate analyte concentration exceeding the adopted ecological SILs

Table 10-5: Summary of Laboratory Analysis for Asbestos in Soils

Sample Identification	Asbestos (% w/w)
BH1-1	No Asbestos Detected
BH2-1	No Asbestos Detected
BH3-1	No Asbestos Detected
BH3-2	No Asbestos Detected
BH4-1	No Asbestos Detected
BH5-1	No Asbestos Detected
BH201-1	No Asbestos Detected
BH202-1	No Asbestos Detected
BH203-1	No Asbestos Detected
BH204-1	No Asbestos Detected
BH205-1	No Asbestos Detected
BH206-1	No Asbestos Detected
BH207-1	No Asbestos Detected
BH208-1	No Asbestos Detected
BH209-1	No Asbestos Detected
BH210-1	No Asbestos Detected
BH211-1	No Asbestos Detected
BH212-1	No Asbestos Detected
BH213-1	No Asbestos Detected
BH214-1	No Asbestos Detected
BH215-1	No Asbestos Detected
BH216-1	No Asbestos Detected
BH217-1	No Asbestos Detected
BH218-1	No Asbestos Detected
BH219-1	No Asbestos Detected
BH220-1	No Asbestos Detected
BH221-1	No Asbestos Detected
BH222-1	No Asbestos Detected
BH223-1	No Asbestos Detected
BH224-1	No Asbestos Detected
SILs	0.04%

All SILs are sourced from *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, Schedule (B1)* - Guideline on Investigation Levels for Soil and Groundwater, (NEPM 2013), Table 7 – *Health screening levels for asbestos contamination in soil* unless otherwise indicated
Highlighted Bold values indicate analyte concentration exceeding the adopted SIL

Table 10-6: Summary of Laboratory Analysis for OCPs, PCBs and OPPs in Soils

Sample ID	OCPs								Total OPPs (mg/kg)	Total PCBs (mg/kg)
	aldrin (mg/kg)	dieldrin (mg/kg)	endrin (mg/kg)	chlor-dane (mg/kg)	hepta-chlor (mg/kg)	DDT (mg/kg)	DDD (mg/kg)	DDE (mg/kg)		
BH1-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH2-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH3-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH3-2	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH4-1	<0.1	<0.2	<0.2	0.6	<0.1	<0.2	<0.2	<0.2	ND	ND
BH5-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH201-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH202-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH203-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH204-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH205-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH206-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH207-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH208-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH209-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH210-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH211-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH212-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH213-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH214-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH215-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH216-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH217-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH218-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH219-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH220-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH221-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH222-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH223-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
BH224-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	ND	ND
SILs										
HIL B	**Total 10**		**20**	**90**	**10**	**Total 600**			**NR**	**50**

Notes: All results are in units of mg/kg, unless otherwise noted
All SILs are sourced from *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013, Schedule (B1)* - Guideline on Investigation Levels for Soil and Groundwater, (NEPM 2013), unless otherwise indicated
HIL B – NEPM (2013) Health Investigation Levels (HILs) for Soil Contaminants – Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high rise buildings and apartments, Table 1A(1)
NR = No Recommended criteria are currently available for the indicated parameter(s)
Highlighted bold values indicate exceedences of the adopted human health based SILs

10.4 DISCUSSION OF RESULTS

PID Results

The majority of samples analysed with corresponding elevated PID readings did not report any concentrations of TPH VOC compounds present within the sample, with the exception of BH3-1, which recorded the highest detected PID reading of 1250 parts per million (ppm). Due to the absence of laboratory derived VOC concentrations within the analysed samples, EI considers that the remaining soil samples which indicated elevated PID concentrations is likely to be due to either moisture present within the sample, or due to heat generated during drilling.

Ambient Background Concentration (ABC)

Soil sample BH208-2 taken at a depth of 1m was considered to be the most representative of natural soils sampled at the site. Due to the common occurrence of fill materials overlying natural sandstone, it was difficult to obtain a representative background soil sample from subsurface layers, therefore a greater depth, being 1 meter BGL was used. Due to the depth at which this sample was obtained being inconsistent with accessible soils for ecological considerations, the values derived using the ABC methodology will be of a conservative nature. Furthermore, As CEC measured within the background sample was reported as 4.2 $cmol_c/kg$, 5 $cmol_c/kg$ EIL values were applied being the lowest available CEC value within the guidance.

Heavy Metals

Sample BH3-1 was found to exceed the ecological criteria for zinc, and was collected within a sandy gravelly topsoil, from within the nature strip in front of 18 Nancarrow Avenue. It should be noted that this value does not represent a human health risk at these concentrations.

Sample BH4-1 was found to exceed criteria for both human health and ecological criteria, and removal of these soils should be considered. However, this sample was collected from an area considered to be within the Stage 3 residential building footprint, which is intended to contain a basement level car park. Due to the construction of the basement, it is considered that these soils will be removed, and will not be present at the end use of the site.

BH202-1 and BH214-1 were found to exceed the ecological criteria for nickel and copper, respectively. These samples were collected from locations considered to be within the Stage 2 residential building footprint, which is intended to contain a basement level car park. Due to the construction of the basement, it is considered that these soils will be removed, and will not be present at the end use of the site.

BH207-1 and BH208-1 were found to exceed the ecological criteria for nickel and zinc, respectively. These samples were collected from locations considered to be within the Stage 3 residential building footprint, which is intended to contain a basement level car park. Due to the construction of the basement, it is considered that these soils will be removed, and will not be present at the end use of the site.

TPHs and BTEX

Sample BH203-1 was also collected from the same silty gravel road base identified at sample BH205-1, located within the south western portion of 41 Belmore Street. This location is considered to be within the Stage 2 residential building footprint, which is intended to contain a basement level car park. Due to the construction of the basement, it is considered that these soils will be removed, and will not be present at the end use of the site, therefore the ecological protection of these adopted SILs will not be realised for the end use of this site.

Sample BH205-1 was found to exceed the SILs for TPH F2 fraction, as well as concentrations of the TPH F3 fraction exceeding the ecological based SILs also reported within this sample. The sample was collected from a silty gravel road base fill material, a material known to contain TPH and PAH fractions. Soil sample BH205-2 collected from distinctly weathered natural sandstone soils below the road base material, being soil sample BH205-2 indicated that the TPH F2 fraction impacts are restricted to the road base fill material. Furthermore, sample BH205-1 located within the rear yard of 11 Rothesay Avenue is designated for open space, therefore EI considers that this road base fill material will be removed, and shall not pose a risk to ecological or human health based receiving environments for the end use of the site.

Sample BH223-1 was found to exceed the human health based SILs for TPH F1 and F2 fractions, as well as the ecological based SILs for TPH F3 adopted for this assessment. This sample was collected from within silty sand fill located in the nature strip along Nancarrow Avenue, in front of 12 – 16 Nancarrow Avenue. EI understands that an upgrade of the Nancarrow Avenue road, and associated nature strip is designated for redevelopment, therefore it is considered that this fill layer will be removed from the site, and shll not pose a risk to the end users of the site. Furthermore, sample BH223-2 collected from natural sandy clay materials at a greater depth, from the same borehole was found to contain minor concentrations of TPH fractions, within the adopted SILs.

Minor TPH (F2 and F3) fractions were detected in soil borehole sample BH205-1, with minor TPH (F2) fractions detected in soil samples BH203-1 with soil logs for these boreholes indicating the presence of road base. Therefore, it is considered that these minor concentrations of TPH (>C_{16} – C_{34}) fractions are indicative of TPH present in road base fill, which is expected to be removed from the site during the development, therefore shall not pose a risk to the end users of the site

11.0 CONCLUSIONS

The property located at 9 - 11 Rothesay Avenue, 6 - 18 Nancarrow Avenue and 41 Belmore Street, Meadowbank, NSW was the subject of an Environmental Site Assessment in order to assess the potential for on-site contamination associated with the identified current and former land uses. Based on the findings of this Environmental Site Assessment, it was concluded that:

- Site observations during the assessment revealed the site to be comprised of an irregular rectangular shaped block, covering a total area of approximately 15347m^2. The site was bound by Nancarrow Avenue to the north-east beyond which were retail and commercial warehouse properties; preliminary construction stages of a high density residential development to the south-east (*Stage 1, Shepherds Bay Urban Renewal Project*) ; Rothesay Avenue to the south-west beyond which was a public reserve (*Anderson Park*) bordering Shepherds Bay/Parramatta River, a commercial office (*BIC Services Pty Ltd*) immediately to the west, and Nancarrow Lane to the north-west beyond which was a commercial office property (JTec Pty Ltd).
- The site was free of statutory notices issued by the NSW EPA/DECC;
- WorkCover search revealed the presence of a single UST remaining in situ, located within the north western portion of the site (11 Nancarrow Avenue);
- Soil sampling and analysis were conducted at twenty nine (29) targeted test bore locations (BH1-BH5, BH201 – BH224) down to a maximum depth of 1.4m BGL. Sampling regime was considered to be appropriate for preliminary investigation purposes, and was mixed judgemental / systematic, triangular sampling pattern, with allowance for structural obstacles (e.g. building walls, underground and overhanging services and other physical obstructions in use by existing operating businesses);
- The sub-surface layers comprised of fill materials of various constituents, comprising dark brown to brown clayey sands and brown orange sandy clays, underlain by Hawkesbury Sandstone.;
- Groundwater was encountered at depths ranging from 1.3 to 7.4 meters below top of casing, with a groundwater assessment report to be completed by EI for groundwater pertaining to the Shepherds Bay Urban Renewal Project as a whole;
- Results of soil samples collected from soil test boreholes BH1 to BH5, and BH201 – BH224 reported concentrations of the screened heavy metals to be below the adopted human health

based SILs, with the exception of BH4-1, located within the front yard of 10 Nancarrow Avenue, which reported concentrations of lead exceeding the human health based SIL (2,000 mg/kg);

- Sample BH3-1, collected from within a sandy gravelly topsoil from the nature strip in front of 18 Nancarrow Avenue was found to exceed the ecological criteria for zinc.;
- BH202-1 and BH214-1 collected from locations considered to be within the Stage 2 residential building footprint were found to exceed the ecological criteria for nickel and copper, respectively;
- BH207-1 and BH208-1 collected from locations considered to be within the Stage 3 residential building footprint were found to exceed the ecological criteria for nickel and zinc, respectively;
- As the soils associated with samples BH202-1, BH214-1, BH207-1 and BH208-1 are located within the proposed building footprint for the stage 2 and 3 development EI considers that these soils will be removed, therefore the application of the ecological criteria will not be realised at these sample locations;
- BH203-1 reported concentrations of TPH F2 (C_{10}-C_{16} less naphthalene) fraction (170mg/kg) which exceeded ecological based SIL for coarse grained soils. Soil test borehole BH203 was located within the rear yard of 11 Rothesay Avenue, with the sample collected from a silty gravel road base fill material, a material known to contain TPH and PAH fractions which are considered to be immobile and of low risk. Vertical delineation of these impacts was achieved at this sample location;
- Sample BH205-1 was found to exceed the SILs for TPH F2 fraction (390mg/kg), as well as concentrations of the TPH F3 fraction exceeding the ecological based SILs also reported within this sample. The sample was collected from a silty gravel road base fill material, a material known to contain TPH and PAH fractions. Soil sample BH205-2 collected from distinctly weathered natural sandstone soils below the road base material, being soil sample BH205-2 indicated that the TPH F2 fraction impacts are restricted to the road base fill material. Furthermore, sample BH205-1 located within the rear yard of 11 Rothesay Avenue is designated for open space, therefore EI considers that this road base fill material will be removed, and shall not pose a risk to ecological or human health based receiving environments for the end use of the site.
- Sample BH223-1 was found to exceed the human health based SILs for TPH F1 and F2 fractions, as well as the ecological based SILs for TPH F3 adopted for this assessment. This sample was collected from within silty sand fill located in the nature strip along Nancarrow Avenue, in front

of 12 – 16 Nancarrow Avenue. EI understands that an upgrade of the Nancarrow Avenue road, and associated nature strip is designated for redevelopment, therefore it is considered that this fill layer will be removed from the site, and shall not pose a risk to the end users of the site. Furthermore, sample BH223-2 collected from natural sandy clay materials at a greater depth, from the same borehole was found to contain minor concentrations of TPH fractions, within the adopted SILs.

Overall, widespread contamination was not identified from the findings of this this ESA. A lead hotspot was identified within the central north eastern portion of the site (in front of 10 Nancarrow Avenue) as well as the presence of an in situ underground storage tank (UST) within the north-west portion of the site (11 Rothesay Avenue) which require removal.

12.0 RECOMMENDATIONS

It is assumed that during the proposed construction of a basement level car park as part of the development, all fill and residual soil materials will be removed from the site, therefore in view of the above findings, and in accordance with NEPM 2013 guidelines, it is considered that the site shall be suitable for the proposed residential development on completion of the following recommendations:

1. Preparation and implementation of a Remediation Action Plan to outline the removal of the lead hotspot identified, as well as the known USTs and any unexpected finds.
2. Classification and off-site disposal of contaminated soils in accordance the DECCW (2009) *Waste Classification Guidelines*.
3. Validate that the excavated areas are left free of contamination by comparing analytical results for excavation surfaces and any backfill material, against the respective DECC/EPA thresholds.
4. Preparation of a final site validation report by a qualified environmental consultant, certifying site suitability for the proposed development.

The ecological exceedence identified at sample BH3-1 located in the nature strip reserve in front of 18 Nancarrow Avenue is considered to be indicative of an ecological hotspot at this location. These soils are considered to be unsuitable within areas of open space or areas considered to be ecologically significant.

For future off-site disposal of site soils, waste classification testing is recommended to enable appropriate soil disposal in accordance with the DECCW (2009) *Waste Classification Guidelines*.

It should be noted that prior arrangements with the destination site and/or relevant authorities should be obtained prior to the disposal of any material.

Any soils to be imported onto the site for the purpose of back-filling excavated areas will be Virgin Excavated Natural Materials (VENM) and will also require validation testing in accordance with the relevant EPA / DECC regulatory guidelines to confirm soil suitability for the proposed land use.

13.0 STATEMENT OF LIMITATIONS

The findings presented in this report are the result of discrete and specific sampling methodologies used in accordance with best industry practices and standards. Due to the site-specific nature of soil sampling from point locations, it is considered likely that all variations in subsurface conditions across a site cannot be fully defined, no matter how comprehensive the field investigation program.

While normal assessments of data reliability have been made, EI assumes no responsibility or liability for errors in any data obtained from previous assessments conducted on site, regulatory agencies (e.g. Council, EPA, etc.), statements from sources outside of EI, or developments resulting from situations outside the scope of works of this project.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to EI's investigations and assessment.

EI's assessment is necessarily based upon the result of the site investigation and the restricted program of surface and subsurface sampling, screening and chemical testing which was set out in the proposal. Neither EI, nor any other reputable consultant, can provide unqualified warranties nor does EI assume any liability for site conditions not observed or accessible during the time of the investigations.

This report was prepared for the above named client and no responsibility is accepted for use of any part of this report in any other context or for any other purpose or by other third parties. This report does not purport to provide legal advice.

This report and associated documents remain the property of EI subject to payment of all fees due for this assessment. The report shall not be reproduced except in full and with prior written permission by EI.

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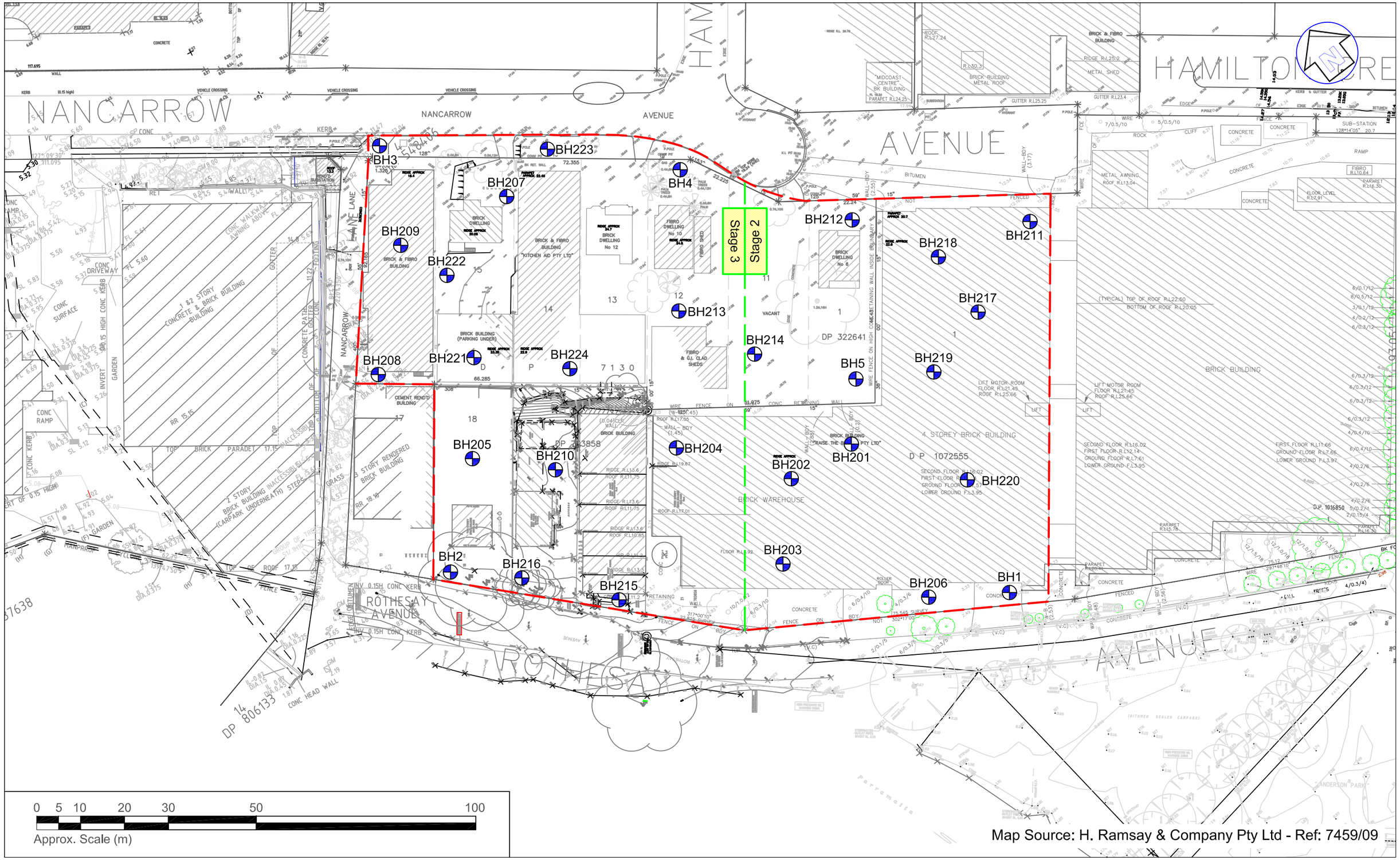
ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
AHD	Australian Height Datum
AST	Aboveground Storage Tank
ANZECC	Australian and New Zealand Environment Conservation Council
B(a)P	Benzo(a)Pyrene
BGL	Below Ground Level
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
COC	Chemical of Concern
DEC	Department of Environment and Conservation, NSW
DECC	Department of Environment and Climate Change, NSW (formerly DEC)
DECCW	Department of Environment, Climate Change and Water, NSW (formerly DECC)
DP	Deposited Plan
DQO	Data Quality Objective
EI	Environmental Investigations
EIL	Ecological Investigation Level
EPA NSW	Environment Protection Authority, New South Wales
ESA	Environmental Site Assessment
GC-ECD	Gas Chromatograph-Electron Capture Detector
GC-FID	Gas Chromatograph-Flame Ionisation Detector
GC-MS	Gas Chromatograph-Mass Spectrometer
HIL	Health Based Investigation Level
ICP-AES	Inductively Couple Plasma – Atomic Emission Spectra
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
NHMRC	National Health and Medical Research Council
OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage, NSW (formerly DECCW)
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photoionisation Detector
PQL	Practical Quantitation Limit
P&T	Purge & Trap
QC	Quality Control
RAC	Remediation Acceptance Criteria
RAP	Remediation Action Plan
RPD	Relative Percentage Difference
SILs	Soil Investigation Levels
SWL	Standing Water Test
TP	Test Pit
TPHs	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
UCL	Upper Confidence Limit

FIGURES



LEGEND

- Borehole location
- Assessment stage boundary
- Approx. site boundary

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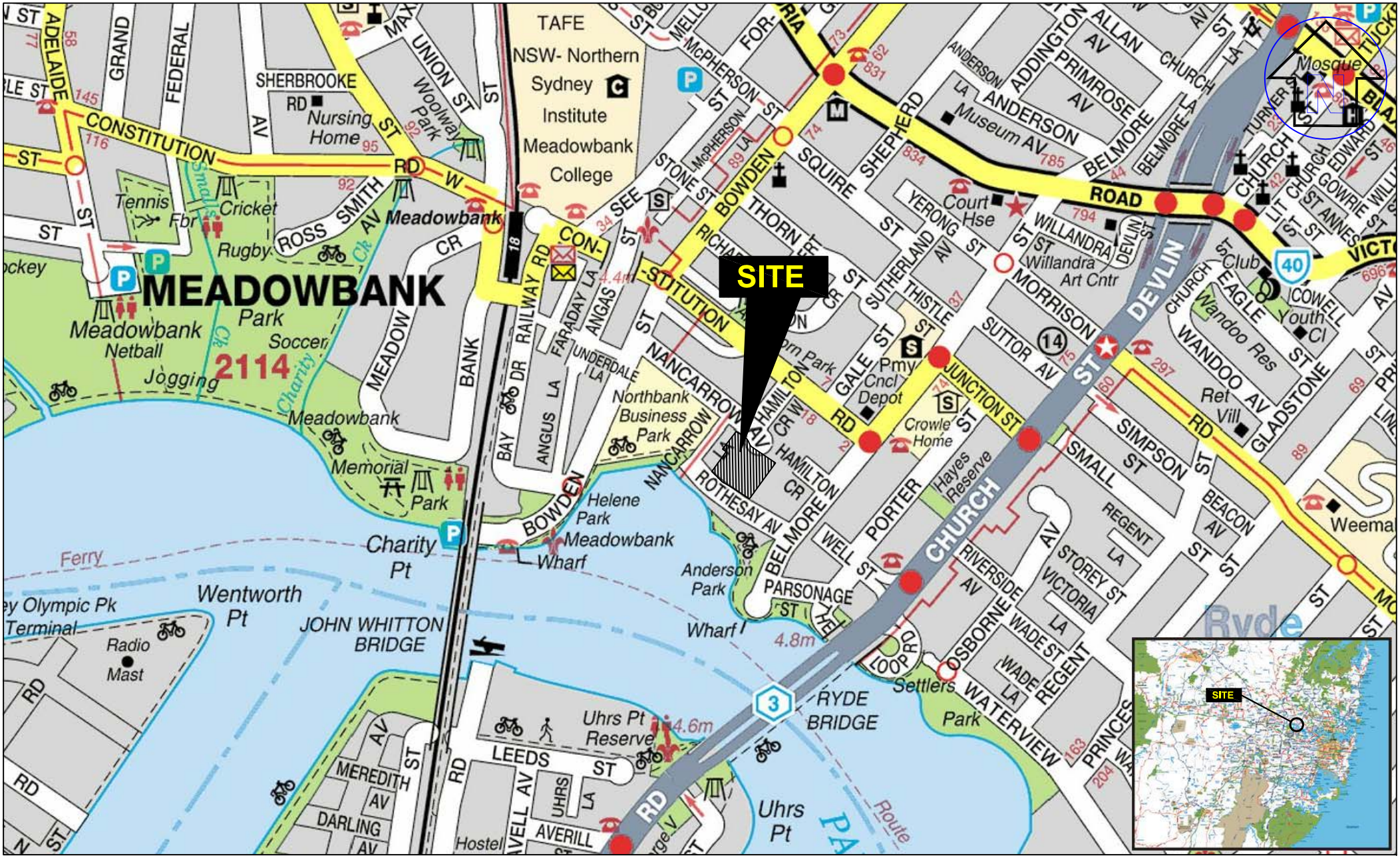
Approx Scale:	1:800 @ A3

Holdmark Pty Ltd
Environmental Site Assessment
Stages 2-3
Shepherds Bay Urban Renewal,
Meadowbank, NSW
Sampling Location Plan

Figure: 2

Project: E2008 AA



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Holdmark Pty Ltd
Environmental Site Assessment
Stages 2-3
Shepherds Bay Urban Renewal, Meadowbank NSW
Locality Plan

Figure: 1

Project: E2008 AA