CORONATION (28 SHEPHERD ST) PTY LTD

REMEDIATION ACTION PLAN
28 SHEPHERD STREET, LIVERPOOL NSW

Report E22480 AA
15 April 2015

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

REPORT DISTRIBUTION

Remediation Action Plan
28 Shepherd Street, Liverpool NSW

EI Report No.: E22480 AA
Date: 15 April 2015

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Revision	Details	Date	Amended By
-	Original	15 April 2015	-

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EXECUTIVE SUMMARY

Coronation (28 Shepherd St) Pty Ltd engaged Environmental Investigations Australia Pty Ltd (EI) to prepare a Remediation Action Plan for the property located at 28 Shepherd Street, Liverpool NSW (herein referred to as 'the site'). This remediation action plan (RAP) was completed as part of a development application process to allow site development for a proposed mixed commercial and residential development. The purpose of this RAP is to establish a sequential process of remediation and validation works for the site, which was designated for residential land use with minimal soil access. Historical uses included commercial / industrial activities such as a wool mill as part of a larger property.

The proposed development will involve demolition of existing buildings and infrastructure and construction of two multi-storey residential apartment buildings over a double level basement car park spanning almost the entire site. Excavation depth will extend down to at least 8.1m BGL with localised deeper excavations for pilling purposes etc.

Site history summarised by EI was sourced from the previous investigations conducted at site which comprised a Preliminary (Stage 1) Investigation of the property at 26-30 Shepherd St, Liverpool, NSW by Analchem Environmental Resources, (AER, 1996); a Detailed Site Investigation of the property at 26-30 Shepherd St, Liverpool, NSW by Analchem Environmental Resources, (AER, 1998); and a Phase 2 Environmental Site Assessment at 28 Shepherd Street, Liverpool NSW by Environmental Strategies, (ES, 2014). The site historically comprised part of a larger property which consisted two lots (Lots 22 and 23 in DP 859055), however the northern lot (Lot 23) was sold sometime between 1998 and 2014. AER, 1996 and AER 1998 reports refer to the site in its prior form being an entity of both lots. Latest investigation (ES, 2014) referred to the site in its current size and identification being Lot 22. The site was used for commercial / industrial purposes as part of a larger property comprising a wool mill factory. Most of the structures were demolished sometime after 1970, with the exception of the steel frame metal clad warehouse at the southern portion of the site. It was also noted that in the early 1980's the site was used to house an aluminium reheat furnace for the reclamation of aluminium scrap with aluminium scrap stored on the adjacent to the north land.

ES, 2014 investigation identified the presence of two underground storage tanks (USTs) of approximately 5,000 litres each. ES, 2014 plan (Figure 2) indicated these USTs were located central-west of the site with a potential underground tank/pit within the north-western portion of the warehouse, a potential former hoist at the south-eastern portion of the warehouse and a potential former hoist outside of the central part of the warehouse. Asbestos impacted fill soils were reported between 0.0 to 1.3m BGL at the northern portion of the site (Area A – see **Figure 2**), whilst a single location (BH15) reported an exceedance (507mg/kg) of the human health criterion for chromium. It was noted that the sampling depth of the chromium concentration in exceedance of the guidelines was not provided. Benzo(α)pyrene and heavy metals copper, lead and zinc were found in exceedance of the adopted ecological criteria in sampling locations BH13, BH15, BH7, TP1, TP5 and TP11 within fill soils between 0.0 to 0.25m BGL. Tested groundwater reported only concentrations of zinc (10 to 14µg/L) exceeding the adopted criterion for fresh water, however these concentrations were considered to be indicative of the background levels of the urban environment in the vicinity of the site.

Taking into consideration the previous investigations and the Liverpool DCP 2008, further investigations were required. The objectives of the RAP were to inform the site remediation and validation assessment process by providing a strategy and work plan outline for:

- Further investigations comprising a hazardous materials survey and location of known and potential UPSSs;
- UPSS removal and remediation of impacted fill/soil materials; and

- Validation of remediated areas to a standard that is acceptable for the intended mixed commercial and residential land uses, with minimal soil access.

Measures are also described in this RAP outlining site work practices required to minimising impacts to human health and the environmental and protecting the safety of site workers and the general public.

1 INTRODUCTION

1.1 BACKGROUND

Mr Jonathon Canavan of Coronation (28 Shepherd St) Pty Ltd (the Client) engaged Environmental Investigations Australia Pty Ltd (EI) to prepare a Remediation Action Plan (RAP) for a property historically used as part of a larger wool mill site at 28 Shepherd Street, Liverpool NSW ('the site').

The site is located approximately 1.5km south-west of the Liverpool central business district (see **Figure 1**) and is situated within the Local Government Area (LGA) of Liverpool City Council. Cadastral information identifies the site as Lot 22 in DP 859055, covering a total area of approximately 5,887 m^2 and is shown in **Figure 2**. The site is largely unpaved and currently occupied by a steel frame metal clad warehouse and a brick storeroom / toilet, used for commercial / industrial purposes, with no basement levels. The south-eastern boundary of the site comprises Georges River. The site was previously assessed to be potentially contaminated from past land-use practices.

The purpose of this RAP is to establish a sequential process for remediation of the site contamination and validation works to mitigate or reduce the risk at the site to enable redevelopment for residential land uses with minimum soil access. This RAP has been prepared in support of a future development application to Liverpool City Council.

1.2 PROPOSED DEVELOPMENT

The proposed site redevelopment involves the construction of two residential apartments building of 7 to 15 storeys, over a double level basement car park spanning almost the entire site, except of a 6m basement set back at the north-eastern portion of the site, as depicted in the proposed development plans (Ref. Woods Bagot, Project no. 120597, Drawing no. A2190, dated 10/04/15). Bulk excavations onsite are anticipated to at least 8.1m BGL (3.710m AHD) with localised deeper excavations for piling reasons.

1.3 PROJECT OBJECTIVES

The main objective of this RAP is to inform the site remediation and validation assessment process by providing a strategy and work plan outline for:

- Identification of the exact location of the underground storage tanks (USTs) by the use of a ground penetrating radar (GPR) and removal of USTs;
- Remediation of impacted fill/soil materials; and
- Validation of remediated areas to a standard that is acceptable for the intended residential land uses.

Measures are also described in this RAP outlining site work practices required to minimising impacts to human health and the environmental and protecting the safety of site workers and the general public.

1.4 SCOPE OF WORKS

In order to achieve the above objectives and to provide sustainable remedial solution while generally complying with the OEH (2011) guidelines for consultants reporting on contaminated sites, the scope of works was as follows:

- Definition of remediation goals and soil and groundwater criteria;
- Evaluation of available remediation options and selection of the most appropriate remedial strategy or combination of strategies;

- Guidance on approvals and licences under current legislation required for remedial works (e.g. SEPP 55);
- Development of a site remediation strategy for the safe removal of underground petroleum storage systems (UPSS) including USTs and other infrastructure;
- Site validation sampling and analysis to confirm that identified contaminated materials have been effectively remediated, with respect to this RAP;
- Provision of a framework to enable contractor preparation of a Work Health and Safety Plan and other site management/planning documents.

The RAP also outlines measures for the excavation, stockpiling, management and disposal of spoil, water and sediment controls, as well as a contingency plan to handle any additional contamination that may be identified during site remedial works.

1.5 REGULATORY FRAMEWORK

The following regulatory framework and guidelines that applies to the preparation of this RAP and implementation of the remedial works includes but not limited to:

Acts, Policy and Regulations

- *Contaminated Land Management Act* (1997);
- *Protection of the Environment Operations (Underground Petroleum Storage Systems)* Regulation 2014
- *Protection of the Environment Operations (Waste)* Regulation 2014, and
- *State Environment Protection Policy 55 – Remediation of Land (SEPP 55)* under the Environmental Planning and Assessment Act (1997).
- *Work Health and Safety Act* 2011
- *Work Health and Safety Regulations* 2011

Guidelines

- ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*;
- DECCW (2014) *Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2014*, (UPSS Guidelines);
- DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination*;
- DEC (2006) *Guidelines for the NSW Site Auditor Scheme* (2nd Edition);
- EPA (1995) *Sampling Design Guidelines*;
- EPA (2014) Waste Classification Guidelines;
- EPA (2014) Technical Note*: Investigation of Service Station Sites*;
- EPA (2010) UPSS Technical Note: Site Validation Reporting;
- NEPC (2013) Schedule B(1) *Guideline on Investigation Levels for Soil and Groundwater*;

- NEPC (2013) Schedule B(2) *Guideline on Site Characterisation*;
- OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*;

2 SITE DESCRIPTION

2.1 PROPERTY IDENTIFICATION AND LOCATION

The site identification details and associated information are presented in **Table 2-1**, while the location of the site in relation to surrounding areas is shown in **Figure 1**.

Table 2-1 Site Identification, Location and Zoning

Attribute	Description
Street Address	28 Shepherd Street, Liverpool NSW
Location Description	The site is located 1.5km south-west of the Liverpool CBD. It is bounded by a commercial properties (north-east and south-west), Georges River (south-east) and commercial building beyond Shepherd Street (north-west). Coordinates (Northwest corner): GDA94-MGA56 Easting: 307996.859, Northing: 6243396.64 (Source: http://maps.six.nsw.gov.au)
Site Area	5,887 m^2 (Ref. Survey Plan, SDG, Ref. 6514, 19/12/2014)
Lot and Deposited Plan (DP)	Lot 22 in DP 859055
State Survey Marks	One Permanent Survey Mark SS78222 is situated outside of the south-western corner of the site, on the pavement of Shepherd Street. (Source: http://maps.six.nsw.gov.au)
Local Government Authority	Liverpool City Council
Parish	All Saints Parish
County	Cumberland
Current Zoning	*R4 – Medium Density Residential* (Ref. Liverpool Local Environment Plan, 2008)

2.2 SURROUNDING LAND USE

The surrounding land and the nearest sensitive receptors are described in **Table 2-2**. The site is generally located in an area of mixed use.

Table 2-2 Local Land Use

Direction	Land Use/Nearest Receptors
North	Commercial properties, followed by medium density residential.
South	Commercial properties, followed by Georges River and more commercial / industrial properties.
East	Georges River, followed by commercial / industrial properties.
West	Commercial properties followed by a railway corridor and low density residential properties.

3 SITE CHARACTERISATION

3.1 DOCUMENTATION

In preparing this RAP, EI has considered the following documents:

- Preliminary (Stage 1) Investigation of the property at 26-30 Shepherd St, Liverpool, NSW - Analchem Environmental Resources, Ref: 96/3758, dated July 1996, (AER, 1996);
- Detailed Site Investigation of the property at 26-30 Shepherd St, Liverpool, NSW - Analchem Environmental Resources, dated February 1998, (AER, 1998); and
- Phase 2 Environmental Site Assessment, 28 Shepherd Street, Liverpool NSW, - Environmental Strategies, dated 10 July 2014, (ES, 2014).

3.2 REGIONAL SETTING

Local topography, geology, soil landscape and hydrogeological information are summarised in **Table 3-1**.

Table 3-1 Topographical, Geological, Soil Landscape and Hydrogeological Information

Attribute	Description	Source
Topography/Drainage	Local ground topography is undulating with the natural ground sloping downwards in a south-easterly direction towards Georges River. RLs at the site range between 12.14 m AHD to 9.98 m AHD. Stormwater is expected to be infiltrated by onsite soils with excess runoff discharged to Georges River which forms the south-east site boundary.	Ref. Survey Plan, SDG, Ref. 6514, 19/12/2014
Regional Geology	The area is underlain by Tertiary fluvial deposits comprising clayey quartzose sand and clay (Ta).	Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR, 1983)
Soil Landscapes	The site overlies the Blacktown (bt) Residual Landscape, which typically includes generally shallow to moderately deep (< 1 m) red and brown podzolic soils on upper slopes.	Soil Conservation Service of NSW Soil Landscapes of the Penrith 1:100,000 Sheet (Chapman and Murphy, 1989)
Acid Sulfate Soil Risk	The site falls within a Class 5 "No Known Occurrence" of Acid Sulfate Soils classification. In accordance with the local environmental plan however, Council consent is required for development works within 500 m of adjacent Class 1, 2, 3 or 4 lands that is below 5 m AHD, and the works are likely to lower the water table to below 1 m AHD on adjacent Class 1, 2, 3 or 4 land.	Liverpool Local Environmental Plan 2008 Acid Sulfate Soils (ASS) Map – Sheet ASS_012
Regional Hydrogeology	Based on ES, 2014 report, standing water level was measured between 5.1 and 7.1 m BGL. Groundwater was encountered between 5.4 to 6.9m BGL, corresponding to the sandy clay / clayey sand horizon. Groundwater flow direction in the vicinity of the site is inferred to be in an easterly direction towards Georges	

Attribute	Description	Source
	River (immediately east / south-east).	
Registered Groundwater Bores	On review of registered groundwater bores during the preparation of this report, six registered groundwater bores were identified within a radius of approximately 500m of the site. From these bores one was located in up hydraulic gradient direction (approximately 200m north-west of the site) and was registered for monitoring purposes (GW113200) and five across Georges River (approximately 430m south-east of the site) from which one was registered for domestic use (GW016829), three for monitoring purposes (GW111872, GW111873 and GW111874) and one for waste disposal purposes (GW016682). EI considered that it is unlikely for the site to influence the registered bores beyond Georges River.	NSW Natural Resource Atlas database (Ref. http://www.nratlas.nsw.gov.au)

3.3 SITE HISTORY OVERVIEW

Site history summarised by EI was sourced from the previous investigations conducted at the site by Analchem Environmental Resources (AER, 1996 and AER, 1998) and Environmental Strategies (ES, 2014).

The site historically comprised part of a larger property which consisted of two lots (Lots 22 and 23 in DP 859055), however the northern lot (Lot 23) was sold sometime between 1998 and 2014. The AER, 1996 and AER 1998 reports consider both lots. The Environmental Strategies (ES, 2014) investigation was carried out on Lot 22 only. The site was used for commercial / industrial purposes as part of a larger property comprising a wool mill factory. Most of the structures were demolished sometime after 1970, with the exception of the steel frame metal clad warehouse at the southern portion of the site. It was also noted that in the early 1980's the site was used to house an aluminium reheat furnace for the reclamation of aluminium scrap with aluminium scrap stored on the adjacent to the north land.

In addition ES, 2014 identified the presence of two underground storage tanks (USTs) of approximately 5,000 litres each. These tanks appeared to be empty, but the former contents are unknown. ES, 2014 plan (Figure 2) indicated these USTs were located central-west of the site (north-east of the north-eastern warehouse corner) with a potential underground tank/pit within the north-western portion of the warehouse, a potential former hoist at the south-eastern portion of the warehouse and a potential former hoist outside of the central part of the warehouse.

3.4 PREVIOUS INVESTIGATIONS

A summary of previous works and key findings is outlined in **Table 3-2**. Where necessary, the findings were reviewed against the NEPM (2013) Residential B Health-based Investigation Levels (HILs) and Commercial/industrial D Health-based Screening Levels (HSLs) soil criteria, and the ANZECC (2000) Groundwater Investigation Levels for Fresh Water groundwater criteria.

Table 3-2 Summary of Previous Investigation Works and Findings

Details	AER Project Tasks and Findings (AER, 1996)

Previous scope	• To describe the site under investigation; • To review the current and previous activities carried out on the site for environmental implications; • To inspect and evaluate the condition of the site; • To provide a preliminary assessment of the risk of contamination of the site; • To comment on the potential off-site migration of contaminants; and • To recommend subsequent action. This investigation refers to 26-30 Shepherd Street includinglot 22 in DP 859055) and northern lot 23 in DP 859055.
Findings	The property was found fully fenced but neglected with extensive weed growth. The site was subject to previous industrial development (woollen mill) and remaining structures were dilapidated showing signs of illegal entry and occupation. Evidence of superficial soil contamination was noted dating back to the early part of the century, with most of the previous development being demolished and demolition spoil contributing to the superficial soil contamination. Geology was noted to comprise a natural horizon, being sandy clays and silty clays over shale (approximately 9.5m BGL), obscured by a layer of sandy topsoil overlying demolition spoil from the previous structures onsite and some ashes which may have resulted from boiler ash disposal onsite during the operation of the Woollen Mill. Potential contaminants were considered to be polycyclic aromatic hydrocarbons (PAHs) which were expected to be present in the top 1m of soil although tested soils demonstrated contamination to be limited within the top 0.5m BGL. These contaminants were considered to be non-volatile and persistent in the environment, therefore exposure pathways were considered to be likely restricted to direct ingestion and dermal contact. It was also considered that the exposure would be minimal and easily managed should the industrial site use continue. Sampled groundwater was found to contain only low levels of heavy metals which were considered consistent with background levels. No details of the sampling locations and methodology were provided within the AER, 1996 report.
Details	**AER Project Tasks and Findings (AER, 1998)**
Previous scope	• To describe the site under investigation; • To review the current and previous activities carried out on the site for environmental implications; • To describe the geology and hydrogeology of the property; • To inspect and evaluate the condition of the site; • To sample site soils to identify and describe the extent of contamination of the site; • To prepare a suitable report characterising the property; and • To provide comment on the suitability of the property for continuing industrial development.

Details	AER Project Tasks and Findings (AER, 1998)
Findings	• There was evidence of contamination of the topsoils from the previous industrial activities which dated back to the early part of the century; • Demolition spoil from the previous buildings was also present in the top soils and was considered likely to have contributed to the contamination in these disturbed soils; • Review of previous site history and the site inspection, indicated potential contaminants to be heavy metals and PAHs which were expected to be restricted to the disturbed layer; • Pesticides were also considered to be potential contaminants; • Soils comprised a sandy topsoil overlying a disturbed layer of sandy clayey soils with demolition spoil (bricks and concrete), followed by natural sandy clays and silty clays over sandy soils followed by shale at an approximate depth of 9.5 m BGL. Ash was found in the south-eastern section of the site. The disturbed layer varied in depth between approximately 200 mm to 1 m BGL; • Twenty-three boreholes were drilled with the use of a hand auger to test soils onsite. Samples were collected from 0-150 mm and 400-600 mm to target the disturbed layer and natural soils respectively; • One previously installed monitoring well was utilised for sampling. Groundwater was reported at 7.7 m BGL in the sandy soils overlain by silty and sandy clays; • Soil testing detected all of the selected analytes in the disturbed layer. These levels were detected below the adopted criteria which related to the future industrial land use. Results also demonstrated that the levels of potential contaminants in the underlying natural soils were consistent with background levels and below the adopted criteria; • Groundwater testing confirmed the results of the previous evaluation (AER, 1996). Low levels of heavy metals copper and lead were detected, which were considered to be consistent with background levels.

Details	ES Project Tasks and Findings (ES, 2014)
Previous scope	Scope of works was divided in two stages in order to meet the projects objectives. The first stage included: • Underground service location utilising a ground penetrating radar (GPR) survey of the site to determine any areas of anomalous filling or potential unknown USTs; • Excavation of 11 test pit locations across the unsealed portions of the site down to 0.5m below the natural soils or at a maximum depth of 3.5m BGL; • Concrete coring of the shed floor to determine what was beneath the slab and drilling of 6 boreholes; • Conversion of 4 soil boreholes into groundwater monitoring wells to a maximum depth of 8m BGL; The second stage included: • Excavation of 23 test pit locations across the unsealed portions of the site in order to assess the presence of asbestos in accordance with methods detailed in the Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (May 2009)

Details	ES Project Tasks and Findings (ES, 2014)
Results	• The address 28 Shepherd Street, Liverpool NSW formerly incorporated both Lot 22 and 23 in DP 859055. Lot 23 was sold prior to this investigation and did not comprise part of the investigation; • The site was proposed to be sold and was assessed for the potential future development of high density residential land use; • Various distinct fill layers were observed onsite from 0.2 to 2.5 m BGL. Reworked brown/grey clay (fill) was present along the southern portion of the site, whilst reworked red clay (fill) was present underlain by brown silty reworked clay (fill) with building rubble including crushed concrete, bricks, steel, fibre cement (asbestos containing) fragments, plastic and ash. An ash only layer was also observed along the eastern boundary adjacent to the river with greatest depth recorded at 2.5m BGL within the centre of the eastern site boundary; • The subsurface geology comprised fill between 0.2m and 2.5m across the site, overlying natural brown/red/grey clay, dry to moist, stiff and slightly plastic to a depth of 1.1 to 4.0m BGL followed by brown/orange sandy clay, fine to coarse grained and moist to wet between 1.1 to 8.6m BGL overlying weathered shale at approximately 8.6m BGL along the western boundary; • Groundwater was encountered during drilling at depths of approximately 5.4 to 6.9m BGL, corresponding to the sandy clay / clayey sand layer, whilst the standing water level was measured between 5.1 and 7.1m BGL; • Groundwater flow direction was inferred to be to the east towards Georges River; • Two underground storage tanks (USTs) of approximately 5,000 litres each were revealed to be present onsite at the central-west portion of the site with a potential underground tank/pit within the north-western portion of the warehouse. These tanks were found to be empty with former contents and use remaining unknown. In addition a potential former hoist was noted at the south-eastern portion of the warehouse and a second potential former hoist outside the central part of the warehouse. There were no hydrocarbon impacts reported from the tested soil and groundwater samples collected down-gradient of the USTs; • The tested soils were reported below the adopted criteria for high density residential land use with minimal soil access with the exception of the following: – Lead was reported in exceedance of the human health criterion (HIL) at TP1 of 1,300mg/kg within the filling material at a depth of 0.1m BGL. A calculation of the 95% upper confidence level within the fill material observed at TP1 was calculated at 598mg/kg which was below the relevant adopted criteria, therefore it was considered to be suitable to remain onsite; – Copper, lead and zinc was reported in exceedance of the adopted ecological criteria (EILs) at isolated locations across the site; – Asbestos analysed soil samples reported concentrations below the NATA accredited reporting limit of 0.01gr/kg and no respirable fibres were detected. However asbestos fines/fibres were detected at 6 test pit locations across the northern portion of the site. Asbestos was also noted to be present sporadically across the site's surface within the top 0.3m BGL of the unsealed northern site section. This was considered to be unsuitable to remain onsite considering the proposed residential with minimal soil access land use. It was noted however that the surface of the site had been emu picked of any visible fragments of potential asbestos containing material. • Tested groundwater reported concentrations of zinc between 10 to 14µg/L which were in exceedance of the adopted groundwater criteria of 8µg/L for freshwater. These concentrations were considered to be indicative of the background concentrations within an urban environment. Furthermore tested groundwater wells at the down gradient boundary indicated that the site was not contributing to a net gain in dissolved metals.

Details	ES Project Tasks and Findings (ES, 2014)
Recommendations	• Data within this investigation suggested that fill material had not impacted the underlying natural soils, therefore soils in the vicinity of the EIL exceedances should be placed under hard standing and not in areas of landscaping or open space. These exceedances were considered unlikely to adversely impact the nearby environmental receptors and may remain onsite; • Preparation of an Environmental Management Plan (EMP) to outline the requirements and obligations required in order to render the site suitable for the intended land use. This should detail the management of the impacted soil during the remedial and/or redevelopment works to ensure that no unacceptable risks to human health or the environment occur. This EMP should also make reference to the relevant portions of the site specific asbestos management plan (AMP); • And asbestos register and management plan (AMP) is prepared and implemented based on the current and proposed development. This plan should detail how the asbestos impact in soil will be appropriately managed at present and future construction, which may include laying of a marker layer above the existing asbestos impact and then placement of 0.5m of clean fill material in areas where asbestos fibres were detected; and • Preparation of a Remedial Action Plan (RAP) to render the site suitable for the proposed development. This should incorporate the removal and appropriate validation of the two USTs and a site specific methodology to either remove or cap the asbestos impacted soils onsite. The selected remedial procedure should complement where practical the final building and site design.

The approximate borehole locations and soil contamination exceedances (against the adopted SILs and GILs) is presented on **Figure 2** and the extracted tables of contaminant concentrations along with extracted figures and part of the reports are provided in **Appendix A**.

3.5 CONCEPTUAL SITE MODEL

In accordance with NEPM (2013) Schedule B2 – Guideline on Site Characterisation and to aid in the assessment of data collection for the site, EI developed a preliminary conceptual site model (CSM) assessing plausible pollutant linkages between potential contamination sources, migration pathways and receptors. The CSM provides a framework for the review of the reliability and useability of the data collected and to identify data gaps in the existing site characterisation.

3.5.1 Subsurface Conditions

The general site geology encountered during the Detailed Site Investigation (DLA, 2015) may be described as a layer of anthropogenic filling overlying residual clays and sandstone. The geological information obtained during the ES investigation is summarised in **Table 3-3** with the borehole logs provided in **Appendix B**.

Table 3-3 Generalised Subsurface Profile

Material	Depth (m BGL)+	General Description
Fill	min 0.2 to 2.5	Reworked CLAY, brown/grey, dry; Reworked CALY, red, dry; Reworked silty CLAY, brown with building rubble including crushed concrete, bricks, steel, asbestos containing fragments, plastic and ash, dry; ASH, with occasional crushed bricks, concrete and steel, dry.
Natural Fluvial Soil	1.1 to 8.6	CLAY, brown/red/grey, dry to moist, stiff and slightly plastic; Sandy CLAY, brown/orange, fine to coarse grained, moist to wet.

Material	Depth (m BGL)+	General Description
Bedrock	From 8.6m	Weathered SHALE.

Notes:

+ Approximate depth shown as metres below ground level (m BGL). Refer to borehole logs in **Appendix B** for specific information at individual test bore locations.

3.5.2 Contamination Sources

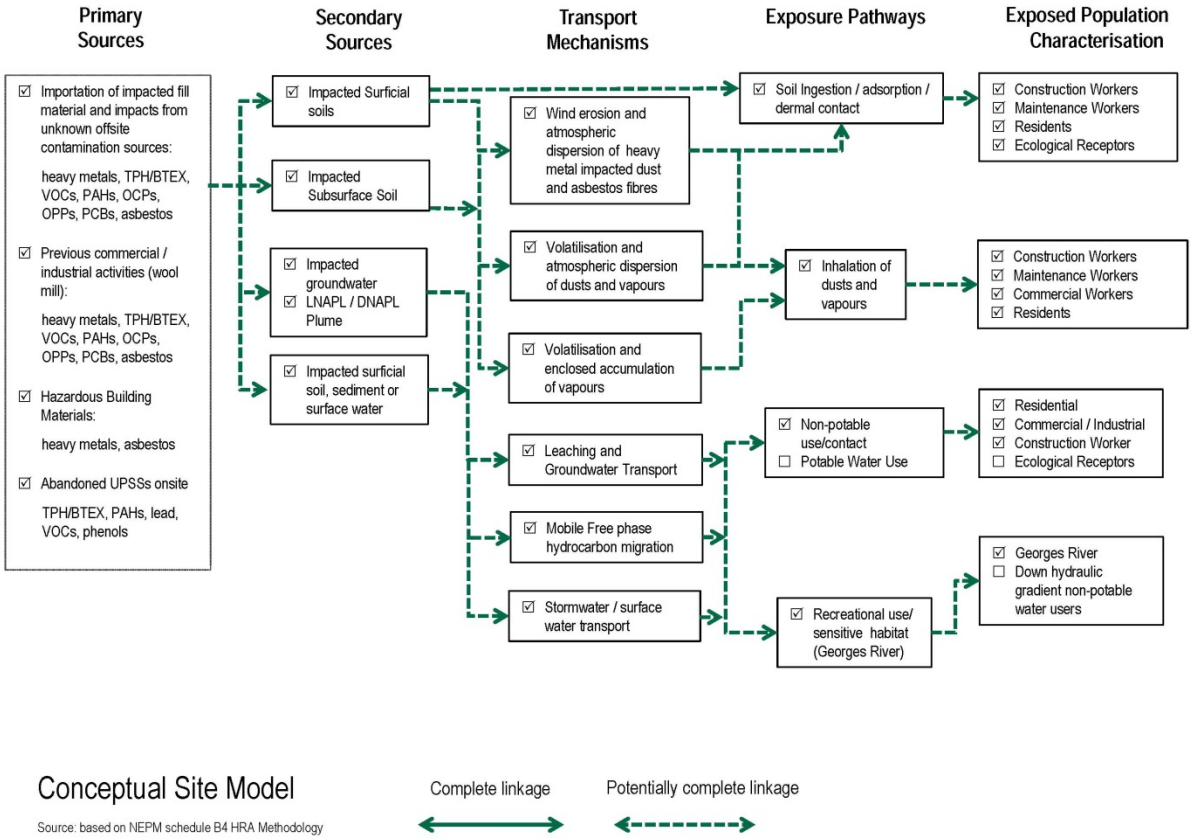
On the basis of site history and review of the detailed assessment (ES, 2014), ES considers potential chemical hazards and onsite contamination sources to be as follows:

- Imported fill soils of unknown origin distributed across the site;
- Leaks and spills associated with the storage of unknown chemicals across the site;
- Possible use of pesticides across the site during its use; and
- Historical commercial / industrial activities on site (wool mill);
- Demolition of previous site buildings;
- Weathering of painted structural surfaces (buildings), historically and currently;
- Hazardous materials, including identified asbestos and potential asbestos-containing materials (ACM) from building products;
- Abandoned underground petroleum storage systems (UPSS) o site;
- Deeper, natural soils containing residual impacts, representing potential secondary sources of contamination;
- Potential presence of light and dense non aqueous phase liquids (LNAPL & DNAPL) that may spilled onto the ground surface during filling and infiltrated the soil profile, or that may have leaked from the UPSS; and
- Impacts from unknown onsite/offsite contamination sources.

3.5.3 Chemicals of Concern

Based on the findings of the site history and contamination appraisal the chemicals of concern at the site are considered to be:

- Soil – heavy metals (HMs), total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), the monocyclic aromatic hydrocarbon compounds benzene, toluene, ethyl benzene and xylenes (BTEX), volatile organic compounds (VOC), organochlorine and organophosphate pesticides (OCP/ OPP), polychlorinated biphenyls (PCB), phenols and asbestos.
- Groundwater – HMs, TPH, BTEX, PAH, VOC including chlorinated VOC (VOCC) such as trichloroethylene (TCE).



Drawing 1 Conceptual Site Model for 28 Shepherd Street, Liverpool NSW

3.6 SUMMARY OF CONTAMINATION REQUIRING REMEDIATION

Based on the previous investigations the primary sources of contamination that require remediation include:

- Remaining in-situ Underground Petroleum Storage Systems;
- Asbestos fibres in fill;
- Copper, lead and zinc within fill soils exceeding the ecological criteria;
- B(α)P within fill soils at two locations exceeding the ecological criteria.

Further discussion on the extent of remediation is provided in **Section 5.4**.

4 REMEDIATION GOALS AND CRITERIA

4.1 REMEDIATION GOALS

The main goal of the remediation program is to remove primary and secondary contamination sources so as to render the site suitable for residential land uses with minimal soil access.

This will require the decommissioning and removal for off-site disposal of underground tanks and associated infrastructure (i.e. filling lines) and to remediate impacted soil and groundwater, where necessary.

4.2 EXTENT OF REMEDIATION REQUIRED

Investigations to date have identified the following areas of the site requiring remediation:

- The removal and appropriate off-site disposal of the two underground tanks and associated facilities after appropriate collection of residual liquids and any contaminated soils and UPSS backfill materials;
- Excavation and waste classification of asbestos containing fill soils;
- The excavation and waste classification of fill/soils prior to off-site disposal as part of the proposed development;
- Classification of soils as Excavated Natural Materials (ENM) or Virgin Excavated Nature Materials (VENM), where appropriate, to enable reuse of suitable materials; and
- Soil validation and groundwater sampling and laboratory testing, following the remediation works at the site to allow the site to be used for residential purposes in accordance with the concept plan approval.

Table 4-1 Approximate Excavation Volumes

Area/Tanks	Approximate Volume	Excavation Area- Approximate Dimensions		
	(m^3)	Length (m)	Width (m)	Depth (m)
Two USTs (5,000L each)	108	6.0	6.0	3.0
Filling points and lines (area subject to further investigation)	-	-	-	-
Site fill soils (approximate based on current data)	10,489	85	71	1.8
Fill under current buildings and paved surfaces onsite (contingency)	(1,886)	73	28	1.1
VENM (estimate)	44,153	85	71	7.5
Total	54,750			

4.3 SOIL REMEDIATION OPTIONS

In considering the remedial options available for the site, the surrounding lands and the geological and hydrogeological limitations, the following issues have been considered:

- Prioritisation of works;
- Ability of remedial method to mitigate contamination with respect to the proposed development and receptors;

- Remedial timetable and cost effectiveness;
- Defensible method to ensure the site is remediated to appropriate levels / validation criteria;
- Monitoring and status of remedial works including risk based performance objectives; and
- Regulatory compliance.

4.4 SOIL CRITERIA

Based on the provided concept plans (Woods Bagot, Project no. 120597), the site has been designated to be redeveloped to a residential land use property with minimal soils access, comprising two multi-storey residential apartment buildings over a double level basement. Soil remediation criteria adopted to be used as clean up levels are based on NEPM (2013):

- *Residential B Health Investigation Levels* for residential settings with minimal opportunities for soil access (including dwellings with fully and permanently paved yard space such as high-rise buildings and apartments);
- *Commercial / Industrial D Health Screening Levels* for commercial / industrial land use, including premises such as shops, offices, factories and industrial sites; and
- *Ecological Investigation Levels and Ecological Screening Levels for Urban residential / public open space [Tables 1B(1) to 1B(6)].*

Commercial / industrial Health Screening Levels (HSLs) have been included within the tables due to the presence of the basements, in accordance with NEPM 2013.

Although deep soil landscape areas are unlikely to be proposed onsite, relevant criteria for the protection of terrestrial ecosystems – urban residential and public open space have been adopted as a more conservative approach. The proposed criteria with respect to the potential contaminants of concern in soils are detailed in **Table 4-2**.

Table 4-2 Soil Remediation Criteria

Chemical	Unit	PQL	HILs/HSLs Residential B	EILs[1] & ESLs[3]	HSLs Commercial/Industrial D
Metals					
Arsenic – As	mg / kg	3	500	100 (EIL)	-
Cadmium - Cd	mg / kg	0.3	150	-	-
Chromium(VI) – Cr(VI)	mg / kg	0.3	500	190 (EIL)	-
Copper – Cu	mg / kg	0.5	30,000	95 (EIL)	-
Lead – Pb	mg / kg	1	1,200	1,100 (EIL)	-
Mercury – Hg (inorganic)	mg / kg	0.01	120	-	-
Nickel – Ni	mg / kg	0.5	1,200	30 (EIL)	-
Zinc – Zn	mg / kg	0.5	60,000	70 (EIL)	-

Chemical	Unit	PQL	HILs/HSLs Residential B	EILs[1] & ESLs[3]	HSLs Commercial/Industrial D
Petroleum Hydrocarbons					
F1*	mg / kg	25	45 (0m - <1m)[2] 70 (1m - <2m) 110 (2m - <4m) 200 (4m+)	180 (ESL)	260 (0m - <1m)1 370 (1m - <2m) 630 (2m - <4m) NL (4m+)
F2**	mg / kg	25	110 (0m - <1m)[2] 240 (1m - <2m) 440 (2m - <4m) NL (4m+)	120 (ESL)	NL
F3 (>C16-C34)	mg / kg	90	2,500	300 (ESL)	-
F4 (>C34-C40)	mg / kg	120	10,000	2,800 (ESL)	-
Polycyclic Aromatic Hydrocarbons					
Naphthalene	mg / kg	0.1	3 (0m - <1m)[2] NL	170 (EIL)	NL
Benzo(α)pyrene	mg / kg	0.1	-	0.7 (ESL)	-
Carcinogenic PAHs (as B(α)P TEQ)***	TEQ	0.2	4	-	-
Total PAHs	mg / kg	0.8	400	-	-
Monocyclic Aromatic Hydrocarbons (BTEX) [4]					
Benzene	mg / kg	0.1	0.5 (0m – 4m+)[2]	50 (ESL)	3 (0m – 4m+)[2]
Toluene	mg / kg	0.1	160 (0m - <1m)[2] 220 (1m - <2m) 310 (2m - <4m) 540 (4m+)	85 (ESL)	NL
Ethylbenzene	mg / kg	0.1	55 (0m - <1m)[2] NL (1m – 4m+)	70	NL
Xylenes (total)	mg / kg	0.3	40 (0m - <1m)[2] 60 (1m - <2m) 95 (2m - <4m) 170 (4m+)	105 (ESL)	230 (0m - <1m)[2] NL (1m – 4m+)
Asbestos HSLs[4]					
Bonded Asbestos	w / w		0.04%	-	-
Friable Asbestos (FA & AF) [6]			0.001%	-	-

Chemical	Unit	PQL	HILs/HSLs Residential B	EILs[1] & ESLs[3]	HSLs Commercial/Industrial D
All forms of Asbestos			No visible in surface soils	-	-

Notes:

Residential B = NEPM 2013, HILs / HSLs Residential with Minimal Access to Soil

Commercial / Industrial D = NEPM 2013, HSLs Commercial / Industrial

* = 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.

*** = Carcinogenic PAHs HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to Benzo(α)pyrene) – ref. footnote (6) of NEPC (2013) *Schedule (B1)* Table 1A(1) for further details.

[1] = Environmental Investigation Levels (EILs) generic values for aged As, fresh DDT and fresh naphthalene in soils irrespective of their physicochemical properties (apply to top 2m of soil), ref. NEPC (2013) *Schedule B1* Table 1B(5).

[2] = Soil Health Screening Levels (HSLs) developed for selected petroleum compounds and fractions, applicable to assessing human health risk via the inhalation and direct contact pathways, ref. NEPC (2013) *Schedule B1* Table 1A(3).

[3] = Ecological Screening Levels (ESLs) developed for selected petroleum hydrocarbon compounds and total recoverable hydrocarbon (TRH) fractions, applicable for assessing risk to terrestrial ecosystems (apply to top 2m of soil), ref. NEPC (2013) *Schedule B1* Table 1B(6).

[4] = Health Screening Levels (HSLs) for asbestos contamination in soil, ref. NEPC (2013) *Schedule B1* Table 7.

Relevant HSLs values will be adopted based on site specific aspects and conditions.

[5] = Health Screening Levels (HSLs) for sand based on the presence of sandy clay (conservative approach) and the assumed maximum depth of basement excavation, ref. NEPC (2013) Schedule B1 Table 1A(3). Relevant HSLs, ESLs and EILs RAC values will be adopted based on site specific aspects and conditions.

[6] = FA – Fibrous Asbestos, AF – Asbestos Fines (Ref. NEPM 2013, Schedule B1, Table 7).

NR = no registered criteria value. NL – Not limiting

Conformance with the criteria will be deemed to have been attained when either all validation samples show contaminant concentrations that are below the specified criteria, or, as a minimum, the 95% upper confidence limit (UCL) mean concentration values of each contaminant in the remediated area (i.e. across the excavated surface), are below the respective remediation criteria.

4.5 WASTE CRITERIA

Prior to being removed from the site, excavated soils must be classified in accordance with the EPA (2014) *Waste Classification Guidelines* (the 'Waste Guidelines'). Under these guidelines, fill/soils may be classified into the following groups: *General Solid Waste, Restricted Solid Waste* or *Hazardous Waste*, subject to laboratory test results for total and leachable contaminant levels, the later involving the *Toxicity Characteristics Leaching Procedure* (TCLP). The total contaminant concentrations and TCLP results for each parameter will then be interpreted against the respective EPA (2014) thresholds (*Ref*. **Table 4-3** and **Table 4-4**), in order to classify the waste. Soils containing asbestos may also be classified as *Special Waste (Asbestos Waste)*, assuming no other contaminant is present at such a level as to render the material *Restricted Solid Waste* or *Hazardous Waste*.

Table 4-3 Waste Classification without Leachate Testing

Contaminant	Maximum Values of *Specific Contaminant Concentration* for Classification without TCLP	
	General Solid Waste CT1 (mg/kg)	Restricted Solid Waste CT2 (mg/kg)
Arsenic	100	400
Benzene	10	40
Benzo(a)pyrene	0.8	3.2
Cadmium	20	80
Chromium (VI)	100	400
Ethylbenzene	600	2,400
Lead	100	400
Mercury	4	16
Nickel	40	160
Toluene	288	1,152
Xylenes (total)	1,000	4,000
TRH C6-C9	650	2,600
TRH C_{10}-C_{36}	10,000	40,000
PAHs (total)	200	800
Xylenes	1,000	4,000

Table 4-4 Waste Classification using TCLP and SCC Values

Contaminant	Maximum Values for *Leachable Concentration* and Specific Contaminant Concentration when used together			
	General Solid Waste		*Restricted Solid Waste*	
	Leachable Concentration	Specific Contaminant Concentration	Leachable Concentration	Specific Contaminant Concentration
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	5.0	500	20	2,000
Benzene	0.5	18	2	72
Benzo(a)pyrene	0.04	10	0.16	23
Cadmium	1.0	100	4	400
Chromium (VI)	5	1,900	20	7,600
Ethylbenzene	30	1,080	120	4,320
Lead	5	1,500	20	6,000
Mercury	0.2	50	0.8	200
Nickel	2	1,050	8	4,200

Contaminant	Maximum Values for *Leachable Concentration* and Specific Contaminant Concentration when used together			
	General Solid Waste		*Restricted Solid Waste*	
	Leachable Concentration	Specific Contaminant Concentration	Leachable Concentration	Specific Contaminant Concentration
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
TRH C_6-C_9	N/A	650	N/A	2,600
TRH C_{10}-C_{36}	N/A	10,000	N/A	40,000
PAHs (total)	N/A	200	N/A	800
Xylenes	50	1,800	200	7,200

Note: N/A = not applicable (assessed using SCC1 and SCC2 values, only)

Should the analytical results exceed the SCC2 and/or TCLP2 thresholds, then the materials will be classified as *Hazardous Waste*. In such cases, material stabilisation treatment with EPA approval may be required for offsite disposal. This approach is discussed in more detail under the contingency plan in **Section 7.3**.

Unexpected material may need to be segregated depending on the source of the waste.

5 REMEDIATION WORKS

5.1 REVIEW OF REMEDIAL TECHNOLOGY

Selection and implementation of any remedial method depends initially on the proposed land use criteria to ensure protection of human health and the environment. Remedial options are then chosen by assessing the feasibility of each option to reach the clean-up goal and evaluating the costs and acceptability of the option. Risk driven remediation can also be considered depending on acceptance of materials being left on site. Remediation should also consider the concepts of ecologically sustainable development (ESD), which attempts to balance acceptable environmental risk/outcomes to the social and economic costs while protecting the biodiversity and heritage.

Readily available remediation techniques were considered for the site, which were then either accepted or rejected based upon their applicability to the contaminants of concern, site setting and cost/technology issues.

Dissolved zinc was reported during the previous investigation (ES, 2014) within groundwater ranging from 10 to 14µg/L. Although these concentrations were in exceedance of the fresh water criterion of 8µg/L, they were considered to be indicative of background concentrations representing the urban environment. Therefore, groundwater was not considered to be in need of remedial procedures. The review of remediation technologies focuses on soil remediation methods at this stage.

Advantages, disadvantages and suitability of available soil remedial technologies are summarised in **Table 5-1**

Table 5-1 Remedial Technology Review – Soils

Remediation methodology	Description	Advantages	Disadvantages	Suitability
No Action	'No Action' can be considered if: • There is no measurable contamination; • Contaminant concentrations are below assessment guidelines; • Contaminants are not mobile; or • Exposure to contaminated soils is unlikely.	No remediation costs Creates minimal disturbance to the site Retains material on-site	Not applicable to the kind of contamination encountered at the site. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	Not suitable – based on the results and recommendations of previous site assessments and that the site soils are to be excavated, the "do nothing" option is not considered to be suitable.
On-site bioremediation	Excavated soils are thoroughly broken down and aerated, mixed with microorganisms and nutrients, stockpiled and aerated in above ground enclosures.	Cost effective if soils are utilised on-site. Lower disposal costs. Limited requirement to import fill material to site. Retains material on-site.	Not suitable for metals contamination or asbestos in soils. Significant area of site required to land farm material. Undefined remediation timeframe. Uncertainty of successful results, particularly for the heavy-end hydrocarbons.	Not suitable – based on the identified asbestos containing soils this method is not suitable.
In-situ treatment	*In-situ* treatment of impacted soils within the smear zone and saturated zone using *in-situ* treatment methods such as SVE, steam stripping, ISCO or injection of oxygen releasing compounds.	Creates minimal disturbance to the site (no excavation). Cost effective for large scale site remediation projects of light to mid-weight petroleum hydrocarbons. Potential to simultaneously remediate dissolved phase hydrocarbons in site groundwater.	Not applicable to the kind of contamination encountered at the site. Expensive establishment costs. Requires detailed design, pilot trials and management.	Not suitable – this method is designed for widespread hydrocarbon impacted soils. Since fill soils were reported to contain asbestos and the present dataset does not provide evidence of widespread hydrocarbon contamination, this is not considered to be an economically viable option. In addition site soils are to be excavated for basement purposes.

Remediation methodology	Description	Advantages	Disadvantages	Suitability
Consolidation and/or capping	Risk minimisation approach where impacted soils are managed on-site by capping the ground surface with a clean, impermeable layer of fill material.	Effectively removes risk to human health by eliminating exposure pathways.	Importance of capping materials. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	Not Suitable – as the proposed development involves a basement spanning the site, with excavation depth extending to an anticipated depth of at least 8.1m BGL.
Excavation and off-site disposal	Excavate impacted materials. Transport directly to a licensed landfill facility. Re-instate site with imported clean fill material.	Fast – impacted material removed immediately, significantly reducing potential for impact to groundwater. No storage or treatment problems. Reduced vapour/odour issues as impacted materials removed from site. Minimal design and management costs.	Transfer of waste to another location (licensed waste facility). High costs associated with the disposal of waste soils and importation of clean backfill. May require some additional testing (including TCLP) to enable waste classification prior to disposal. Not in accordance of the redevelopment vision. Sustainability issues related to disposal to landfill.	Suitable – the site will be excavated down to at least 8.1m BGL for basement purposes; therefore material will require off-site disposal (as per the proposed development).
Natural attenuation	Allowing the contaminants to biodegrade naturally following removal of the contamination source.	No remedial excavation of site. Retains materials on site. Sustainable, cost effective remediation method.	Slow process. Not suitable for asbestos in soils. Potential for contamination to further impact on the groundwater aquifer and nearby environmental receptors. Unlikely to improve the geotechnical characteristics of contaminated fill. Would require Environmental Management Plan and ongoing monitoring.	Not Suitable – as the proposed development involves a basement, with excavation depth extending to an anticipated depth of at least 8.1m BGL. If any organic contamination is detected at the boundary, natural attenuation may be suitable as the hydrocarbons degrade.

5.2 PREFERRED REMEDIATION STRATEGY

Based on the assessment of remedial technologies, the potential risks to human health and the environment and considering the cost effectiveness of each remedial technique, the preferred remedial strategy for the site is a staged approach involving:

- Hazardous materials assessment conducted on the remaining commercial buildings prior to any partial demolition;
- Site demolition;
- Removal of sources of contamination by decommissioning and appropriate off-site disposal of site infrastructure, including all underground storage systems;
- Classification and disposal of all wastes (including contaminated soils) by licensed transport to approved/licensed, off site, waste facilities;
- and
- Remediation of the impacted soils (where required) using a combination of the following:
  - Excavation and disposal of impacted soils to a licensed landfill facility; and
  - Excavation and on-site separation of highly impacted soils (where concentrations exceed criteria for classification as restricted solid waste) for additional waste classification prior to disposal.

Material derived from the site, including contaminated soil, rock and fill would be removed by truck to a suitable licenced disposal facility or recycled where classified as virgin excavated natural material (VENM) or excavated natural material (ENM) in accordance with the general waste exemptions (EPA, 2014). The potential environment impacts relating to the demolition, remediation and offsite disposal are discussed further in **Section 5.9**.

As no impacts were identified within the tested groundwater during the previous investigation (ES, 2014) and the identified concentrations of zinc in exceedance of the adopted criterion were considered to represent background concentrations remedial action for groundwater at the site is not proposed at this stage, but may be considered at a later stage if warranted.

Details on the methodology to be employed for the key work tasks are described below. They will not necessarily be conducted in the indicated sequence.

5.3 APPROVALS AND LICENCES

5.3.1 State environmental planning policies

State Environmental Planning Policy No 55 (SEPP 55) – *Remediation of Land* sets the regulatory framework for contaminated land and remediation works in NSW. Remediation work which requires development consent is known as Category 1 work which refers to work:

- Classed as *designated development*;
- Proposed on land identified as critical habitat;
- Where consideration indicates remediation work is likely to have a significant effect on threatened species, populations, ecological communities or their habitats;

- Proposed in an area or zone designated as an area of environmental significance such as scenic areas, wetlands; and
- Requiring consent under another state environmental planning policy or a regional environmental plan.

All other remediation work is classified as Category 2 works, which may be carried out without development consent. EI considers the work to be classified as Category 1 works due to the proximity of the Georges River. The following notifications, licenses and approvals would be required to undertake the site remediation works:

- Council or third party approval of the RAP document and notification for Category 1 remediation works (i.e. 30 days' notice prior to works commencement); and
- Notification of tank disposal under UPSS and WorkCover regulations (once UPSS locations have been established).

5.3.2 Development Control Plans (DCPs)

A planning instrument dealing with the general approach when dealing with the management and remediation of contaminated land has been identified through Liverpool City Council titled Liverpool Development Control Plan 2008, Part1, General Controls for all Development (Liverpool Council DCP, 2008). This document provides provisions for regulating the carrying out of development while protecting human health and the environment and maintaining the development sustainability.

All site works need to be undertaken in accordance with the Liverpool Council DCP, 2008.

5.3.3 Other licences required

Transporters of contaminated waste are required to be licensed to transport contaminated waste to the licensed landfills. Waste must also be transported less than 150 km (POEO Waste, 2014) and landfills are required to be licensed for the category of waste they are scheduled to receive.

Waste receipts and evidence of disposal of classified waste fill/soils at an appropriately-licensed landfill facility should be provided for site validation purposes. NSW EPA requires a cradle to grave approach in the management of waste. Non-compliance with the waste guidelines can result in significant fines in accordance with the NSW Protection of the Environment Operations Act.

5.4 Task 1 – Preliminaries and Site Preparation

At least 30 days prior to the commencement of remediation, notice shall be given to Council. A list of all required work permits will be obtained from Council and arrangements are to be made to obtain the necessary approvals from the relevant regulatory authorities.

The site itself will be prepared in accordance with the requirements of the Environmental Management Plan outlined in **Section 7**. Once cleared, a thorough walkover inspection of the site shall be conducted, to assess for visible evidence indicating the presence of UPSS and/or contamination.

5.5 Task 2 – Further Investigation Works

The following additional works are required in order to properly characterise the environmental status of the site:

- Prior to any demolition, a detailed hazardous materials survey should be undertaken to identify any potential hazardous substances requiring management and to minimise any impact to the site soils;
- In addition the exact location of the USTs, including associated infrastructure (i.e. location of former bowsers and lines traced back to USTs) should be established by the use of a GPR and then removed in accordance with the UPSS 2014 Regulation;

5.6 TASK 3 – UPSS AND UNDERGROUND PITS

The results from the assessment phase (ES, 2014) indicated that two abandoned UPSSs are present on site, with the likelihood of a third UPSS, possibly resulting in petroleum hydrocarbon contamination of nearby fill soils, underlying natural soils and groundwater. A geophysical survey utilising the Ground Penetrating Radar method should be conducted across the site by a suitable, qualified contractor, in order to confirm the exact position of suspected underground tanks and infrastructure, as well as to survey for any additional, unknown (or forgotten) UPSS that may still be present on the site.

Residual liquids may be present within the underground tanks and product lines that remain on the site. Any liquid waste should be classified for disposal purposes as defined in NSW EPA (2014).

The following methodology is proposed for these areas, as well as any other UPSS which may be subsequently encountered during the data-closure investigations and site remediation phase:

- Appropriate decommissioning and removal of the USPSSs and any associated filling points, fuel feed lines and vent pipes (firstly draining where necessary) in accordance with:
  - AS4976 – 2008, Australian Standard for the removal and disposal of underground petroleum storage tanks;
  - POEO (Underground Petroleum Storage System) Regulations (2014); and
  - NSW WorkCover and other requirements under the Work Health and Safety Act and associated regulations.
- Field screening of soil samples collected from the base and side walls of the final excavations in accordance with EPA (2014) Technical Note: Investigation of Service Station Sites, during which, a portable photo-ionisation detector (PID) will be used as a field screening tool to provide indicative (semi-quantitative) data in relation to VOC concentrations in soil headspace samples, together with visual and olfactory observations.
- Validation samples will be collected from excavation surfaces (walls and bases) for laboratory analysis for petroleum hydrocarbons, BTEX, PAHs and heavy metals.

Petroleum hydrocarbon impacted soils are to be stockpiled separately from other site fill/soils, for ex-situ, waste classification assessment. Water that may collect within remedial excavations will require water sampling and testing to enable appropriate disposal and /or recycling.

5.7 TASK 4 – REMOVAL OF ASBESTOS IMPACTED SOILS

Soils at Area A (see **Figure 3**) have been identified to be impacted by asbestos fibres. Laboratory analysis of this filling material has reported asbestos fibres between 0.0m to 1.3m BGL. These soils will need to be classified prior to offsite disposal to an appropriately licensed waste facility. After the waste classification of these soils, their removal should be consistent with the following:

- The WA Department of Health guidance (DoH 2009a), including;

- Removal of soils in-situ and not stockpiled to minimise handling of asbestos impacted soil and the likelihood of dust agitation;
- Air quality monitoring should be undertaken at all phases of excavation until asbestos impacted soils have been removed;
- Soil must be wetted at all stages of excavation to minimise the creation of dust and airborne asbestos fibres.

- Soil must be consistent with the description of soil provided in the Waste Classification Certificate and sent to a licenced disposal facility;
- Managing Asbestos In or On Soil (WorkCover NSW, Ref. WC01253)
- Code of Practice How to Safely Remove Asbestos Safe Work Australia (2011); and
- The development of an asbestos management plan (AMP) to mitigate any potential impact to workers and the surrounding receptors.

5.8 TASK 4 – SITE WIDE FILL LAYERS

The following methodology is proposed for the bulk fill / natural soil excavation, as part of the construction of the basement car parking facilities:

- Excavation of the upper fill and natural residual soil layers to full depth (visually) over the entire site, with regular headspace screening of excavated materials (taken from the excavator bucket) for VOCs using a PID.
- All excavated material is to be stockpiled. Soils with headspace VOC concentrations >10ppm, heavy staining and/or odour are to be stockpiled separately from other excavated materials, for classification sampling and testing.
- Residual soils may be able to be classified as Excavated Natural Material (ENM) or virgin excavated natural materials (VENM) depending on sampling for potential contaminants. Both ENM and VENM can be reused or recycled.
- Excavation depths should be in accordance with DA conditions. If further excavation is required, it should not jeopardise the stability of adjoining properties and structures.

5.9 TASK 5 – MATERIALS AND WASTE MANAGEMENT

Prior to being assigned to an appropriate waste disposal facility, all waste fill/soils will be classified in accordance with the EPA (2014) *Waste Classification Guidelines.* If prior immobilisation treatment of the waste soils is required, disposal consent will be obtained from the NSW EPA prior to spoil transport.

All excavated soils shall be stockpiled separately within the designated excavation area, or transported to a suitable compound (with appropriate waste tracking documentation) for temporary storage, to enable waste classification sampling and testing. All stockpile heights must be limited to a maximum of 2 m. After waste classification, the materials will be transported and disposed to EPA-licensed, waste landfill facilities.

In accordance with the NEPM (2013) guidelines, stockpiled fill/soils will be sampled and laboratory analysed for waste classification purposes in accordance with the following methodology:

- Collection of one sample per 25 m^3 of stockpiled material for the fill/soils produced by the hotspots excavation;
- Collection of one intra-laboratory duplicate for every 10 primary samples collected and one inter-laboratory duplicate for every 20 primary samples collected;
- Collection of one rinsate blank per sampling round;
- Analysis of all samples from impacted areas for heavy metals (including lead), TRHs, BTEX and PAHs; and
- Preparation of a Waste Classification Certificate detailing the interpreted soil waste classification for each stockpile, to enable appropriate off-site disposal.

The proposed sampling plan may be varied due to site constraints; however guidance from the appointed Environmental Project Manager must be sought to ensure that deviations from this RAP are properly documented, as required under the OEH (2011) guidelines. Where anomalies in fill/soil consistency are noted (such as heavy staining, odour and/or presence of waste or oils), additional sampling and analysis may be necessary and guidance in this regard should be sought from the appointed Environmental Project Manager.

On review of the data set from the previous investigations, fill soils in the vicinity of Area A (area impacted by asbestos fibres – see **Figure 3**), would be classified as Special Waste – Asbestos Waste. In the vicinity of BH13, fill waste would be classified as Restricted Waste and Special Waste (Asbestos Waste) due to benzo(α)pyrenen exceeding the disposal guidelines, whilst in the vicinity of BH7, fill soil swould be classified as Restricted Waste due to benzo(α)pyrenen exceeding the disposal guidelines. Fill soils in the vicinity of sampling location BH15 would be classified as Hazardous Waste and Special Waste (Asbestos Waste), due to the concentration of chromium which exceeded the disposal guidelines. However, this preliminary approach of assessing the classification of the waste would vary once more soils would be submitted for analysis and leachability testing. Should tested soils reveal leaching and specific contaminant concentrations fall into a different category then waste would be re-classified.

If the stockpiled materials contain concentrations of contaminants that exceed the disposal guidelines for *Restricted Solid Waste* (i.e. the materials are classed as potentially *Hazardous Waste*), they will be held on-site pending the determination of alternative disposal arrangements and/or on-site treatment (i.e. stabilisation and/or micro-encapsulation). If required, disposal consent will be sought from the EPA NSW prior to spoil transport. Contingency measures to handle and manage the disposal of spoil materials that fail to meet landfill threshold criteria are provided in **Section 7.3**.

In order to enable direct truck loading and offsite disposal, more samples would need to be retrieved in order to classify in-situ, alternatively soils would need to be stockpiled and sampled for waste classification purposes.

Table 5-2 summarises the measures that should be implemented in respect of materials handling during excavation and remediation works at the site.

Table 5-2 Materials handling and management requirements

Item	Description/ Requirements

Item	Description/ Requirements
Potential for asbestos containing materials	All asbestos handling, removal, transport and disposal must be performed in accordance with NSW legislative requirements. The National Occupational Health and Safety Commission Code of Practice for the Safe Removal of Asbestos, 2nd Edition [NOHSC 2002(2005)], April 2005 provides more guidance. During excavation works, any surface asbestos cement fragments encountered should be segregated and placed in 200µm thick polythene bags (1200 mm x 900 mm). Bags are to be sealed and double bagged to reduce the risk of the bags splitting
Suitably qualified contractors	Works must be carried out under the direct supervision of a suitably qualified contractor. Excavation of soils impacted by asbestos shall be undertaken in accordance with the control measures recommended within the RAP and with direction from a consultant qualified in occupational hygiene who has been engaged independently of the removal contractor. Correct implementation of these measures should ensure that; • All site staff are aware of the requirements to be adhered to • There is no discernable release of dust potentially containing asbestos fibres into the atmosphere as a consequence of the works. • There is no discernable release of contaminated soil into any waterway as a consequence of the works. • There are no pollution incidents, health impacts or complaints.
Personal protective equipment	All persons engaged in excavation of soils potentially impacted by asbestos should wear appropriate PPE in accordance with the site safety plan to be prepared by the site principal contractor.
Material tracking	Materials excavated from the site should be tracked in order to provide detailed and accurate information about the location and quantity of all materials both on and offsite from the time of their excavation until their disposal. The location of disposal locations will be determined by the remediation contractor. For any truck leaving the site, the following information would be recorded: • origin of material • material type • approximate volume • truck registration number. Such information should be provided to the remediation consultant for reporting purposes. This information, along with the landfill docket number, will be provided in the validation report.
Stockpiling of materials	All stockpiles will be maintained in an orderly and safe condition (≤2m height). Batters will be formed with sloped angles that are appropriate to prevent collapse or sliding of the stockpiled materials.
Stockpile locations	The location of the stockpiles will be selected to fit with the expected stages of the project. Stockpiles will be located in accordance with the following general requirements: • stockpiles will only be placed at approved locations • stockpiles will be strategically located to mitigate environmental impacts while facilitating material handling requirements • Contaminated materials will only be stockpiled in non-remediated areas of the site or at locations that do not pose any risk of environmental impairment of the stockpile area or surrounding areas (e.g. hardstand areas).

Item	Description/ Requirements
Stockpile area preparation	Stockpiles will only be constructed in areas of the site that have been located and prepared in accordance with the requirements of this RAP. All such preparatory works will be undertaken prior to the placement of material in the stockpile. Stockpiles must be located on sealed surfaces such as sealed concrete, asphalt, high density polyethylene or a mixture of these, to mitigate appropriately potential cross contamination of underlying soil. The stockpile areas are to be securely bundled using silt fencing and hay bales around the perimeter of each stockpile area to prevent surface water / silt laden surface water from entering or leaving the stockpiles. Access routes will be established around the material stockpiles to enable access from adjoining haul roads
Stockpile covering	The stockpiles of contaminated material will have to be covered with a waterproof membrane (type polyethylene sheet) to prevent further increase of moisture due to rainwater infiltration and to reduce wind-blown dust or odour emission at the end of each day. Stockpiles shall be lightly conditioned by sprinkler to prevent dust blow. Should the stockpile remain in-situ for over 24 hours, silt fences or hay bales should be erected around each stockpile to prevent losses from surface erosion (runoff).
Backfilling	Any material imported at the site should be certified VENM or ENM.
Loading of material	Direct loading of contaminated fill / soils to appropriate transport vehicles is preferred, with the transport of contaminated material off the site to be via a clearly distinguished haul route. Removal of waste materials from the site shall only be carried out by a recognised contractor holding the appropriate EPA NSW licenses, consents and approvals. Measures shall be implemented to ensure no contaminated material is spilled onto public roadways or tracked off-site on vehicle wheels. Such measures will include the deployment of a vehicle washing/cleaning facility, which should be placed at a location before the egress point on the site. The facility shall be able to handle all vehicles and plant operating on-site. All trucks transporting soils from the site are to be covered with tarpaulins (or equivalent). Residue from the cleaning facility will be collected periodically and either dewatered on site in a contained bunded area or disposed as a slurry to an approved facility. Such residue will be deemed contaminated unless shown by validation to be below criteria. The proposed waste transport route will be notified to Council and truck dispatch shall be logged and recorded by the contractor for each load leaving the site.
Transport of materials	All haulage routes for trucks transporting soil, materials, equipment and machinery to and from the site shall comply with all road traffic rules, minimise noise, vibration and odour to adjacent premises, utilise state roads and minimise use of local road. Consultation with the local Council would be recommended to facilitate selection of the most suitable transport route. All site vehicles should also conduct deliveries of soil, materials equipment or machinery during the approved hours of remediation; securely cover all loads to prevent any dust or odour emissions during transportation, exit the site in a forward direction and avoid tracking soil or sediment onto the road.

Item	Description/ Requirements
Air monitoring	An occupational hygienist should carry out air monitoring during each shift where excavation and removal of soils potentially impacted by asbestos is occurring. Air monitoring should be undertaken surrounding the work area and transit routes on site. If deemed necessary by the hygienist, personal exposure air monitoring can be undertaken on the workers within the work area. Monitoring should be conducted by an independent hygienist at the perimeter of the area and within excavator cabs (at the discretion of the hygienist).
Material visual inspection prior to validation sampling.	Primarily, following the completion of the remedial excavation works to the depths detailed in the RAP, a suitably qualified environmental scientist should undertake a visual inspection of the work area. If visual observations indicate the presence of contamination, removal contractors should re-enter the work area to rectify any issues arising from the inspection (likely to consist of further excavation or 'chasing out' impacted material until soils are deemed to be clear from evidence of potential contamination based on a visual inspection and odours). Following satisfactory completion of the visual inspection, an independent environmental scientist should carry out validation sampling of soils at the excavation base and walls to be sent for laboratory analysis. Only following satisfactory validation, will removal works be deemed as completed.

5.10 TASK 6 – CERTIFICATION OF IMPORTED BACKFILL MATERIAL

Should soils be required to backfill excavations, the imported filling material is to be certified as meeting the criteria by the supplying contractor. Analytical results presented by the contractor to validate imported filling must be derived using NATA-accredited methods, obtained on representative samples that were collected at an appropriate frequency (e.g. 1 sample per 25m^3). All imported clean fill validation results must be included in the final site validation report.

Should excavated materials be identified to be potentially uncontaminated, or potentially suitable for reuse on the subject site, the following confirmation procedure shall be undertaken:

- The identified material is to be visually assessed to determine whether the material can be physically isolated from other potentially contaminated material;
- Should it be found that isolation on a visual basis is feasible, the identified 'clean' materials shall be separately stockpiled in a demarcated area, which is either concrete-paved, or to be lined with an impermeable membrane;
- Verification sampling and analysis shall be conducted on the isolated material at a nominal minimal frequency of one sample per 25m^3; and
- Subject to analytical results showing TRH and BTEX and/or heavy metal concentrations that are within the criteria, isolated 'clean' materials may then be reused as filling material on-site, along with any additional imported and validated backfill materials.
- NO soil or rock is to be imported onto the site for backfilling purposes, unless the supporting documentation is approved by the appointed Environmental Project Manager.

5.11 REMEDIATION SCHEDULE

An estimated schedule for the remedial works is detailed below in **Table 5-3**. The proposed schedule is based on the remedial works being completed as outlined in this RAP and is dependent on the Council approval of the DA and the condition of consent. The estimated timescale is detailed below.

Table 5-3: Indicative remedial schedule

Timeframe	Action
2 weeks	Council Approval of RAP
2-3 weeks	Additional Investigation
TBA	Site Excavations and Waste Classification
During Excavation	Validation Sampling
4-6 weeks	Validation Reporting
2 weeks	Review of Validation Report
TBA	Development Consent

6 VALIDATION PLAN

6.1 VALIDATION RATIONALE

The remediation of the UST and associated infrastructure will be deemed acceptable based on the achievement of the following two validation objectives:

1. ***Remedial Excavations*** – Validation of all remedial excavation areas where infrastructure or contaminated soils have been removed will involve sampling and analysis to ensure that contaminant concentrations are within the *Site Criteria* (**Section 4**). The sampling frequency will be in accordance with the NEPC (2013) and EPA (2014) sampling design guidelines and all tests shall be performed by NATA-accredited environmental analytical laboratories.

   Each excavation and ground surface sample obtained for soil validation purposes will be analysed for TRHs and BTEX, as well as any other relevant contaminant that may be identified during the waste soil classification process (e.g. heavy metals, VOCs). Testing of imported materials intended for backfilling of excavated areas shall include but not be limited to the minimum suite specified for imported fill under the EPA (2014) Technical Note (e.g. heavy metals, TRHs, BTEX, PAHs, OCPs, PCBs and asbestos).

2. ***Backfill Materials*** – Should backfilling be required, validation of imported fill materials used for the backfilling of remediated areas would be required to verify their suitability for the proposed land use. Sampling shall be conducted at a nominal density of 1 sample per $25m^3$ up to a volume of $200m^3$, with all tests performed by NATA-accredited environmental analytical laboratories.

6.2 SOIL VALIDATION DESIGN

The site conceptual model suggests that the site infrastructure is constructed onto fill soils underlying fluvial soils, followed by shale. Up to date data reveal filling materials to extend to approximately 1.1 to 2.5m. The amount of validation samples required for the UPSS is therefore dependant on the remediation area of the UPSS.

Validation sampling would be undertaken following the removal of identified contaminated material to ensure that the vertical and lateral extent of the contamination has been defined. Should residual contamination be identified, it would be ”chased out” where appropriate until material exceeding the validation criteria has been removed. As part of the contingency process, however, consideration would also need to be given to potential impacts to flora.

The collection of validation samples will be based on:

- visual observations
- screening of material using a photoionisation detector (PID) for the presence of elevated levels of volatile organic compounds (VOCs).

All samples should be sent under appropriate ‘chain of custody’ (CoCs) to NATA accredited laboratories.

Based on the above comments, the following validation sample design is proposed in **Table 6-1** below.

Table 6-1 Validation Sampling Design

Item/Area (source)	Sampling Density	Potential Contaminants
Underneath buildings (and concrete slabs) / Final ground surface	20 m grid (surface and depth)	TPH, BTEX, selected PAHs, heavy metals, selected asbestos & pesticides
Underground storage tanks & fuel infrastructure EPA (2014) Technical Note: Investigation of Service Station Sites.	• Min 5 samples from each tank pit as per NSW EPA (2014) including walls and base • tank liquids & sludges as per NSW DECCW (2014) • selected seepage samples • 1 sample per bowser • addition base and wall samples if greater than 1 tank per pit • 1 sample per 8.5 m run of line trench exposed	TPH, BTEX, selected PAHs, heavy metals
Remediated hotspots (if any identified in subsequent data gap closure works)	Linear – 1 sampling location per 10m length of excavation walls. Vertical –1 sampling location per 0.5m depth of excavation. Base – 1 sample per 100 m^2.	Relevant contaminant(s) of concern
Final ground surface	20 m grid (surface and depth)	TPH, BTEX, selected PAHs, heavy metals, selected asbestos & pesticides
Groundwater	Appropriate wells will be sampled following source removal and near the end of the site preparation works. Selected seepage zones will be sampled if encountered in tank pit excavation.	TPH, BTEX, PAHs, heavy metals, VOCs
Landfarm and Stockpiled Material	Any soil material stockpiled on-site for landfarming or for re-evaluation for waste classification should be sampled at a rate of one per 25 m^3. Landfarmed material suitable for re-use may be tested at a higher frequency depending on the re-use options. Stockpiled crushed concrete will be tested at a rate of one per 25 m^3 for recycling or reuse.	
Imported Fill Material	If material is required to be sourced from off-site to reinstate the sites, it should be certified suitable for the intended use. If the material is not Virgin Natural Excavated Material (VENM) or if no suitable certification can be supplied by the source then the material should be sampled at a rate of one per 100 m^3.	

Excavation of contaminated material shall continue until the analytical results indicate compliance with the criteria (i.e. either the concentrations of all contaminants are within the criteria, or the 95% UCL average contaminant concentration for each detected parameter is within the criteria). If results indicate that additional excavation is necessary, the excavation shall be extended until the excavation surface samples indicate that the location is validated as meeting the criteria for each respective contaminant.

6.3 SOIL SAMPLING METHODOLOGY

The soil sampling and handling of the collected samples is proposed in **Table 6-2**.

Table 6-2 Sample Collection and Handling

Action	Description
Sample Collection (soils)	Soil validation sampling will be directly from the exposed surface of excavation, or from the material brought to the surface by the backhoe/excavator bucket. Sampling data shall be recorded to comply with routine chain of custody requirements
Sampling, handling, transport and tracking	• The use of stainless steel sampling equipment; • Washing of all sampling equipment, including hand tools or excavator parts in contact with the sample, in a 3% solution of phosphate free detergent (Decon 90) then rinsing with potable water prior to each sample being collected; transfer of the sample into new glass jars or plastic bags, with each plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory; • Labelling of the sample containers with individual and unique identification including Project No., Sample No., Sampling depth, date and time of sampling; • Placement of the containers into a chilled, enclosed and secure container for transport to the laboratory; and • Use of chain of custody documentation to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to ultimate hand-over to the environmental laboratory.
Sample Containers & Holding Times	• Metals - 250g glass jar / refrigeration 4^{o}C / 6 months (maximum holding period); • TRH/BTEX - 250g glass jar / refrigeration 4^{o}C / 14 days (maximum holding period); • PAH - 250g glass jar / refrigeration 4^{o}C / 14 days (maximum holding period); and • Asbestos - 10 Litre resealable plastic (polyethylene) bag / no refrigeration / indefinite holding time.
Laboratory Analysis	• Each sample obtained for soil validation purposes will be analysed for metals (8), TPHs, BTEX, PAHs, and asbestos as well as any other relevant contaminant that may be identified during the further soil investigation process (i.e. VOCs). Soil leachate testing (ASLP) may also be required to assess potential for mobilisation of any residual fill contaminants. • Testing of imported materials intended for backfilling of excavated areas shall include but not be limited to the minimum suite specified for imported fill under the EPA (2014) guideline (e.g. heavy metals, TPHs, BTEX, PAHs, OCPs, OPPs, PCBs and asbestos).

Action	Description
Field QA/QC	Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy, which will be assessed through the analysis of 10% field duplicate/replicate samples. Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with EI's Standard Operating Procedures Manual, which specifies that: • Standard operating procedures are followed; • Site safety plans are developed prior to works commencement; • Split duplicate field samples are collected and analysed; • Samples are stored under secure, temperature controlled conditions; • Chain of custody documentation is employed for the handling, transport and delivery of samples to the contracted environmental laboratory; and • Contaminated soil, fill or groundwater originating from the site area is disposed in accordance with relevant regulatory guidelines. In total, field QA/QC will include one in 10 samples to be tested as blind field duplicates, one in 20 samples to be tested as inter-laboratory duplicates (ILD), as well as one VOC trip blank sample and one equipment wash blank sample per sample batch.
Laboratory Quality Assurance and Quality Control	The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of: • Reagent blanks; • Spike recoveries; • Laboratory duplicates; • Calibration standards and blanks; • QC statistical data; and • Control standards and recovery plots.
Achievement of Data Quality Objectives	Based on the analysis of quality control samples (i.e. duplicates/replicates and in-house laboratory QA/QC procedures), the following data quality objectives are required to be achieved: • conformance with specified holding times; • accuracy of spiked samples will be in the range of 70-130%; and • field and laboratory duplicates and replicates samples will have a precision average of +/- 30% relative percent difference (RPD). An assessment of the overall data quality should be presented in the final validation report, in accordance with the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.

6.4 DATA QUALITY OBJECTIVES

The scope of remediation works has been devised broadly in accordance with the following Data Quality Objective (DQO) process, as defined in Australian Standard *"Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and semi-volatile compounds"* (AS 4482.1 – 1997). The DQO process for the proposed remediation and site validation program is outlined within **Table 6-3**:

Table 6-3 Data Quality Objective Remediation

Step	Description
State the Problem	The site requires to be rendered suitable for residential (minimum soil access) purposes. The site validation program will therefore need to verify that soil samples collected from the remediated areas meet the adopted remediation criteria for the intended land use, relevant to the respective part of the site being validated.
Identify the Decision	The completeness of the remediation works will therefore be determined by the further assessment and the subsequent validation analyses. Remediation will be deemed to be complete when all validation samples of any remedial work meet the remediation criteria and/or when the remediation goals have been attained (e.g. the contamination risk is reduced to acceptable levels). 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?
Identify Inputs to the Decision	Inputs to the decision will include: • Additional soil and groundwater sampling and analysis • Soil validation sampling of any remedial works; • Systematic soil validation sampling from remediated excavation surfaces; • Sampling from stockpiled material for waste classification; • Laboratory analytical results for tested validation samples; and • Assessment of analytical results in relation to the remediation criteria.
Define the Boundary of the Assessment	Lateral - The boundary of the assessment is defined by the boundary of the subject site. Vertical – The existing ground level to the final excavation depth, approximately 8.1m BGL with localised deeper excavations (i.e. pilling, lift pits). Temporal – the findings of this assessment will hold true for as long as the site use remains passive in nature; that is, for as long as the site is used for residential land use with minimal soil access and there are no activities taking place onsite or on the immediately adjacent properties that may compromise onsite environmental conditions.
Develop a Decision Rule	Laboratory test results will be assessed against the adopted remediation criteria for soils remaining on site, and against SCC/TCLP thresholds for waste classification for soils to be disposed off-site. Should the remediation criteria be exceeded then additional excavations and/or 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 remediation 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. Further decisions are also required following the additional assessment. This may require updating of the RAP to include an acid sulfate soil management plan, a soil gas (soil vapour) and

Step	Description
	groundwater remediation or management.
Specify Acceptable Limits on Decision Errors	The remediation consultant must identify the potential decision errors, evaluate the potential consequences and severity of decision error consequences, define the null hypothesis and specify what level of false positive or false negative decision error will be acceptable for the validation assessment. Details are to be presented in the final validation assessment report. Specific limits for this project are to be in accordance with the appropriate NSW EPA guidance, appropriate indicators of data quality and standard procedures for field sampling and handling. Tolerable limits will be quantified as follows: • Sampling on a 10 m grid will allow detection of a circular hotspot with a diameter of nominally 10 m with 95% certainty. • The acceptance of the site as validated will be based on the probability that the 95% Upper Confidence Limits (UCL) of the data will satisfy the given site criteria. Therefore a limit on the decision error will be 5% that a conclusive statement may be incorrect. Soil and groundwater concentrations for chemicals of concern that are below investigation criteria made or approved by the NSW EPA will be treated as acceptable and indicative of suitability for the proposed land use(s).
Optimise the Design for Obtaining Data	In order to identify the most resource-effective sampling and analysis design for general data that are expected to satisfy the DQOs: • Written instructions will be used to guide field personnel in the required fieldwork activities. • Representative soil samples will be collected from the site and analysed to allow characterisation of soils. A review of the results will be undertaken to determine if additional sampling is warranted. Additional investigations would be considered to be warranted where soil concentrations are found to exceed remediation criteria endorsed by the NSW EPA, relevant to the proposed land use(s). • In order to facilitate the development and prevent unnecessary delays due to rework (in case of failed validation samples) the builder/subcontractor responsible for excavation works will be required to liaise closely with the environmental consultant as to required turnaround time for samples.

6.5 REPORTING

All fieldwork, chemical analysis, discussions, conclusions and recommendations will be documented in a validation report for the site. The validation report will be prepared in general accordance with requirements of the NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* and NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme*. This report shall be submitted to Council at the completion of the remediation works program.

The report shall confirm that the site has been remediated to a suitable standard for the proposed development and occupation and that no related adverse environmental effects have occurred as a result of the temporary works. It shall also include details of the remediation methodology, the total volume and final disposal destinations for all contaminated materials removed from site, and confirm that placed fill meets the adopted remediation criteria.

No building construction other than the necessary demolition and excavation works should commence until the remediation and validation report has been accepted by Council or a third party reviewer.

7 SITE MANAGEMENT

7.1 RESPONSIBILITIES AND CONTACTS

The overall responsibilities for the various parties involved with the remediation are outlined in **Table 7-1.**

Table 7-1 Site Management Responsibilities

Responsible Party	Details/Contacts	Responsible for:
Principal Project Manager (PPM)	Mr Jonathon Canavan Coronation (28 Shepherd St) Pty Ltd 9-25 Commonwealth Street, SYDNEY NSW 2000	Overall management of the site remedial activities
Property Owner	TBA	Management of the site and associated remedial activities, particularly with respect to policy and operational procedures
Environmental Management Coordinator (EMC)	TBA	• ensure that the site remediation works are carried out in an environmentally responsible manner; • liaise between the appointed Environmental Consultant and Council providing regular updates and informing of any problems encountered; • ensure that all environmental protection measures are in place and are functioning correctly during site remediation works; and • report any environmental issues to owner.
Demolition, Earthworks or Remediation Contractor	TBA	• ensure that all operations are carried out as identified in the RAP (demolition and remediation), as directed by the PPM and EMC; • induct all employees, subcontractors and authorised visitors on procedures with respect to site works, WHS and environmental management procedures; • report any environmental issues to EMC; • maintain site induction, site visitor and complaint registers; • fugitive emissions and dust leaving the confines of the site must be suitably controlled and minimised; • water containing any suspended matter or contaminants must not leave the site in a manner which could pollute the environment, and must be minimised and suitably controlled; • vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and • noise and vibration levels at the site boundaries must comply with the legislative requirements.

Responsible Party	Details/Contacts	Responsible for:
Environmental Consultant	TBA	• ensure that all operations are carried out as identified in the RAP (demolition and remediation); • advise should scenario arise deviating from the RAP.
Council	TBA	• Reviewing proposed remediation strategies and ensuring remediation is technically feasible, environmentally justifiable and consistent with relevant legislation and guidelines; • review actions taken demolition, earthworks or remediation contractor; • ensure all works have complied with the RAP and remedial procedures deem the site suitable for the intended land use.

7.2 MANAGEMENT PLANS

All work should be undertaken with due regard to the minimisation of environmental effects and to meet all statutory environmental and safety requirements (**Section 7.4**). An Environmental Management Plan (EMP) should be developed for the site works by the site manager or contractor which should also take into account the Council DA conditions and guidance including but not limited to:

- DA Conditions of Consent;
- Liverpool Development Control Plan 2008 (Part 1).

The overall site management is displayed in **Table 7-2**.

Table 7-2 Site Management Measures

Category	Measure
Site Stormwater Management and Control	Appropriate measures shall be taken to ensure that potentially contaminated water does not leave the site. Such measures should include, but not be limited to: • Construction of stormwater diversion channel and linear drainage sumps with catch pits in the remediation area to divert and isolate stormwater from any contaminated areas; • Provision of sediment traps including geotextiles or hay bales; and • Discharge of any water to drains and water bodies must meet the appropriate effluent discharge consent condition under the *Protection of the Environmental Operations Act*. This will be verified by sampling and analyses undertaken by the contractor. Laboratory analytical reports for tested discharge waters must be maintained on site and made available for inspection by Council's representative or the relevant authority.
Traffic and Load Management	All vehicular traffic shall use only routes approved by the Council to and from the selected landfill. All loads shall be tarpaulin-covered and lightly wetted to ensure that no materials or dust are dropped or deposited outside, or within the site. Each truck prior to exiting the site, shall be inspected prior to despatch and either logged out as clean (wheels and chassis), or hosed down within the wheel wash / wash down bay until designated as 'clean'. All loads will be lightly conditioned and covered before leaving the site. Each load of contaminated spoil leaving the site shall be accounted for, such that its origin, despatch time, cleanliness of the vehicle, route, destination and arrival time are recorded. Appropriate (trip ticket)

Category	Measure
	docket information confirming disposal shall be maintained for inspection.
Excavations	Records of all excavations and stockpile locations shall be maintained. All unsealed contaminated stockpile locations will be re-validated following spoil removal. A site diary or log will also be maintained to record daily progress, abnormal occurrences, incidents, truck movements and load characteristics. All excavation works should be in accordance with Liverpool Council DCPs including but not limited to soil and water management issues.
Dust and Odour	Control of dust and odour during the course of the remediation works shall be maintained by the contractor and may include but not necessarily be limited to: • The use of a water cart, as and when appropriate, to eliminate wind-blown dust; • Use of sprays or sprinklers on stockpiles or loads to lightly condition the material; • Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; • Covering of stockpiles or loads with polythene or geotextile membranes; • Restriction of stockpile heights to 2m above surrounding site level; • Ceasing works during periods of inclement weather such as high winds or heavy rain; and • Regular checking of the fugitive dust and odour issues to ensure compliance with the EMP requirements, undertaking immediate remedial measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent).
Noise and Vibration	Noise and vibration will be restricted to reasonable levels. All plant and machinery used on site will be noise muffled to ensure that noise emissions do not breach statutory levels.
Hours of Operation	Working hours will be restricted to those specified by Council (e.g. 7am to 7pm weekdays and 7am to 5pm Saturdays; no Sunday work shall be permitted).
Incident Management and Community Relations	Site preparation works will include extensive demolition and site preparation including remedial works, which will involve numerous project teams, machinery and vehicles handling on site soils, some of which have been identified as contaminated and/or potentially hazardous (i.e. building waste, asbestos, USTs, contaminated soils, etc.). All demolition works should be in accordance with council and WorkCover requirements. While various environmental management and occupational safety plans will be developed to protect human health and the environment, incidents may occur which pose a risk to the various stakeholders. To mitigate these risks and ensure that a suitable response is carried out quickly, a response plan to any incident that may occur on site will be prepared and various responsibilities assigned. The site health hand safety plan and environmental management plan will document these procedures and responsibilities and incident contact numbers should be maintained in an on-site register. All other relevant emergency contact numbers such as Police, Fire Brigade, and Hospital will be listed in the Health and Safety Plan and posted on-site for easy access. As part of the process to manage incident response, various contingency management issues are documented in the following section.

7.3 REMEDIAL CONTINGENCY MANAGEMENT AND MEASURES

7.3.1 Contingency Management

Corrective actions for the management of anticipated environmental issues that may arise on-site during the course of the site preparation works and remediation are presented below in **Table 7-3**.

Table 7-3 Management of Problems During Site Remediation

Anticipated Problems	Corrective Actions
Chemical / fuel spill	Stop work, notify above site project manager. Use accessible soil or appropriate absorbent material on site to absorb the spill (if practicable). Stockpile the impacted material in a secure location, sample and determine the appropriate disposal option.
Hazardous materials e.g. asbestos and lead paint within current building structure	Work to be suspended and hazardous materials to be removed by a suitably qualified contactor, in accordance with WorkCover regulations
Excessive Dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates.
Excessive Noise	Identify the source, isolate the source if possible, modify the actions of the source or erect temporary noise barriers if required.
Excessive Odours/Vapours	Stage works to minimise odours/vapours. Ensure adequate ventilation whilst working indoors. If excessive organic odours/vapours are being generated, stop works and monitor ambient air across site for organic vapours with a PID (maximum of 10 ppm) and odours at site boundaries. Implement control measures including respirators for on-site workers, use of odour suppressants, wetting down of excavated material.
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible divert surface water away from active work areas or excavations.
Water in excavations	Collect samples and assess against relevant NSW DEC *Waste Classification Guidelines (2014)* assessment criteria, to enable disposal options to be formulated.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair failed control measure.
Unearthing unexpected materials, fill or waste	Stop activities, contact the site project manager. Prepare a management plan to address the issue.
Identification of cultural or building heritage items	Stop work and notify site project manager. Prepare action or conservation plan as required.
Equipment failures	Ensure that spare equipment is on hand at site, or that the failed equipment can be serviced by site personnel or a local contractor.
Complaint Management	Notify Client, Project Managers and Environmental Consultant (if required) following complaint. Report complaint as per management procedures. Implement control measures to address reason of complaint (if possible). Notify complainant of results of remedial actions.

At this stage it is anticipated that the proposed remedial technologies should be effective in dealing with the contamination present, however remedial contingencies may be required should the scenarios detailed in the **Table 7-4** arise. This table also addresses excavated soils which should be stockpiled separately and depending on their waste classification, disposed according to the EPA (2014) *Waste Classification Guidelines*.

Table 7-4 Remedial Contingencies

Scenario	Remedial Contingencies/Actions Required
Highly contaminated soils (odours, colouration and/or oily residues) not identified during previous investigation are encountered, particularly at site boundaries.	Work to be suspended until the Environmental Project Manager can further assess impacted soils/ materials and associated risks. Under no circumstances shall the contractor or any site personnel undertake to move such materials, without prior advice by the appointed environmental specialist.

Scenario	Remedial Contingencies/Actions Required
Additional underground systems are encountered at the site.	Systems to be removed and the excavations appropriately validated and backfilled (if required) by experienced contractor. Tank removal works supervised and reported by appropriate environmental consultant in accordance with UPSS guidelines (DECCW 2014).
Highly impacted sludges are located in "cleaned" UPSSs or during concrete removal works.	The leachability of the lead, other heavy metals and hydrocarbons will need to be assessed before disposal options are considered.
Suspected asbestos containing material is encountered.	Work to be suspended and area quarantined. Area inspected and sampled by qualified Hazmat professionals. Asbestos removed by a suitably qualified contactor, in accordance with WorkCover regulations.
Residual soil impacts remain on-site between site boundary and basement excavation	Review/assess potential vapour hazard If there is a vapour risk additional remedial measures may be required including installation of a vapour barrier or passive or active vapour extraction system.
Waste Classification	Contaminated spoil materials that fail to meet the criteria will be handled as follows: 1. Materials will be carefully excavated and placed in separately demarcated and contained locations and separately stockpiled on the basis of on-site observations and the contaminant exceedances detected. 2. Stockpiles of excavated materials will be appropriately bunded with hay bales/sandbags and if required, covered and/or lined with impermeable plastic sheeting, or alternatively placed in an appropriate container e.g. waste skip, with appropriate cover. 3. Sampling and analysis of segregated stockpiles will be conducted to determine the concentrations of the target contaminant parameters in the excavated materials. 4. Disposal arrangements will be determined based on sampling results as follows: • material that falls below the CT1 thresholds for General Solid Waste as outlined in **Table 4-3** shall be collected and disposed direct to landfill; • material that exceeds the CT1 screening thresholds for and shall be tested for leachability with respect to the elevated contaminants using the TCLP method, and subject to meeting the relevant disposal requirements, will be dispatched off-site for disposal as either General Solid Waste or Restricted Solid Waste; and • those materials that exceed the TCLP2/SCC2 criteria for landfill disposal, as outlined in **Table 4-4**, shall be further segregated into separate stockpiles and await alternate treatment and disposal arrangements. 5. Stockpiled materials that cannot be landfilled directly (i.e. those that are awaiting TCLP results or that fail the combined specific concentration and TCLP testing, or require to be stored pending treatment), will be covered by anchored geotextile to prevent erosion and wind blow of contaminated materials. 6. Approval of the immobilisation method for materials exceeding the leaching guidelines must be obtained from the EPA NSW and disposal consent must be sought from the Hazardous Material Advice Unit prior to the removal of such wastes from the site.
Contaminated groundwater (including LNAPL or DNAPL) encountered.	Review of groundwater conditions on site, may require further groundwater investigations / remediation and longer-term management plan.

Scenario	Remedial Contingencies/Actions Required
	Any dewatering may require approval under the Water Management Act (2000) Remedial measures may include, source removal, natural attenuation, bioremediation, PSH recovery using active pumping (including hydraulic control), installation of a groundwater permeability barrier or similar or in-situ oxidation or stabilisation.
Groundwater contaminant plume is identified and is migrating off-site or there are increases in concentration due to increased infiltration (following demolition).	Review contaminant increase and analytes. Review active remediation alternatives (if necessary). Ensure down-gradient monitoring is undertaken. Carry out fate and transport modelling (if required) and assess the need for further action.
Contamination is identified near heritage items or significant trees (if identified).	Stop work. Review contaminant concentrations and risks to heritage items / flora. Assess human health and environmental risks if contamination remains in place. Review natural attenuation options.
Changes in proposed future land uses at the site.	Review of the remediation works completed for the site.

7.4 WORK HEALTH SAFETY ISSUES

7.4.1 Work Health and Safety Plan

As required by the NSW Work Health and Safety Act 2011 and associated Regulations, a Work Health and Safety (WHS) Plan should be prepared by the Principal Contractor (see **Section 7.1**), to manage the health and safety of site workers and nearby residents and address such issues as site security, exclusion zones, excavation safety, vibration, noise, odour and dust levels. The plan should address the risks during the remediation works and cover site specific requirements associated with the contaminants present within the site soils and groundwater. The use of personal protective equipment (PPE) and environmental management measures (e.g. dust control etc.) should be documented where necessary.

The site officer responsible for implementing health and safety procedures should induct all site personnel so that they understand the Work Health and Safety Plan prior to commencing site works and all site staff should sign a statement to that effect. Contractors employed at the site will be responsible for ensuring that their employees are aware of and comply with, the requirements of this document. All site personnel must also be aware of the relevant emergency contact numbers which should be include in the WHS Plan and provided at the facilities at the site.

It is the contractor's responsibility, with assistance from client/owner(s) of the site to ensure that all other permits, approvals, consents or licences are current.

7.4.2 Chemical Hazards

Contaminated site have chemical compounds substances or materials that may be present a risk to human health and the environment. These include but are not limited heavy metals, TRHs, VOCs (including BTEX), PAHs and asbestos. The possible risks to site personnel associated with contaminated site include:

- Ingestion of contaminated soil or water;
- Dermal contact with contaminated soil or water; and
- Inhalation of dusts (including asbestos), aerosols or vapours containing contaminants.

The site specific WHS plan should set out controls to mitigate any potential risks.

7.4.3 Physical Hazards

The following hazards are associated with conditions that may be created during site works:

- Heat exposure;
- Buried services;
- Noise, vibration and dust;
- Electrical equipment; and
- The operation of heavy plant equipment.

7.5 PERSONAL PROTECTIVE EQUIPMENT (PPE) AND MONITORING.

Personnel should, wherever possible, avoid direct contact with potentially contaminated material. Workers are to ensure that surface waters or groundwater is not ingested or swallowed and that direct skin contact with soil and water is avoided.

- Air monitoring should be carried out during the asbestos fibre impacted soils.

All personnel on site will be required to wear the following protection at all times:

- Steel-capped boots;
- Safety glasses or safety goggles with side shields;
- Hard hat;
- Hearing protection when working in the vicinity of machinery or plant equipment (if noise levels exceed exposure standards) and
- Breathing protection to mitigate any asbestos fibres during fill excavation and removal.

8 CONCLUSIONS

Based on the information available, this RAP has been prepared to undertake remediation at 28 Shepherd Street, Liverpool NSW. It is envisaged that this site will be demolished, concrete pavements removed and remediated in stages which will require the development of appropriate sampling and analysis, hazardous materials, environmental management and demolition plan in order that the site be remediated to allow residential land use with minimal soil access development. The following stages are therefore considered to achieve the overall objective of the remediation but no remediation schedule has been developed:

- Review and approval of the RAP in accordance to SEPP55 and Council DCP by the council to allow commencement of the site works (including demolition)
- Selection of a suitably qualified and licensed demolition and remediation contractor
- Preparation of appropriate demolition, work health and safety and environmental management plans
- Preliminaries including approvals and community engagement
- Demolition of the site buildings and infrastructure
- UPSS removal
- Further investigation to address remaining data gaps and amendment of RAP if deemed necessary
- Implementation of the remedial measures identified in the RAP
- Validation sampling in accordance to the RAP
- Validation reporting to ensure that the site is considered suitable for the proposed residential development.

In summary, Environmental Investigations considers that the site can be made suitable for the approved development following the implementation of this RAP.

9 STATEMENT OF LIMITATIONS

This report has been prepared for the exclusive use of Coronation (28 Shepherd St) Pty Ltd, who is the only intended beneficiary of our work. The scope of the investigations carried out for the purpose of this report is limited to those agreed with Coronation (28 Shepherd St) Pty Ltd on 27 January 2015.

No other party should rely on the document without the prior written consent of EIA, and EIA undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EIA's approval.

EIA has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the environmental industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions, with specific sampling locations chosen to be as representative as possible under the given circumstances.

EIA's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EIA may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EIA.

EIA's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during remedial activities. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

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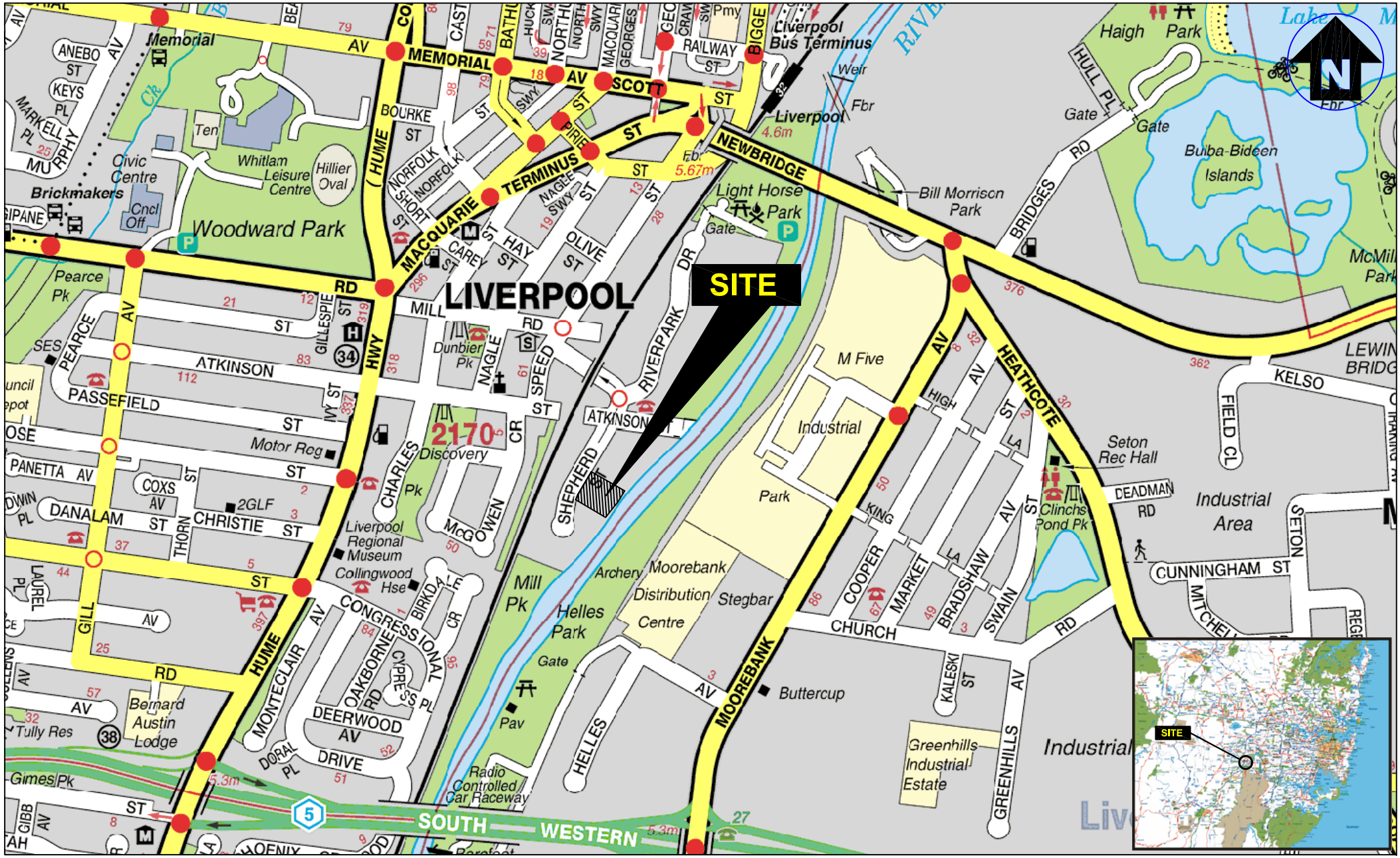
ABBREVIATIONS

AHD	Australian Height Datum (e.g. mAHD)
ASS	Acid sulfate soils
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
CSM	Conceptual Site Model
DECC	Department of Environment and Climate Change, NSW (formerly DEC) Department of Environment and Conservation, NSW
DP	Deposited Plan
DQO	Data Quality Objectives
EPA	Environment Protection Authority
EMP	Environmental Management Plan
ENM	Excavated Natural Material
F1	TPH C6 – C10 less the sum of BTEX concentrations
F2	TPH >C10 – C16 less the concentration of naphthalene
GIL	Groundwater Investigation Level
GME	Groundwater monitoring event
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
km	Kilometres
m	Metres
m BGL	Metres below ground level
µg/L	Micrograms per litre
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage, NSW (formerly DEC, DECC, DECCW)
OPP	Organophosphate Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance / Quality Control
RAP	Remediation Action Plan
SIL	Soil Investigation Level
TBA	To Be Announced
TCLP	Toxicity Characteristics Leaching Procedure
TPHs	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
UPSS	Underground Petroleum Storage System
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VENM	Virgin Excavated Natural Material
VOC	Volatile Organic Compounds

FIGURES



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Date:	10/04/15
Approx Scale:	N.T.S

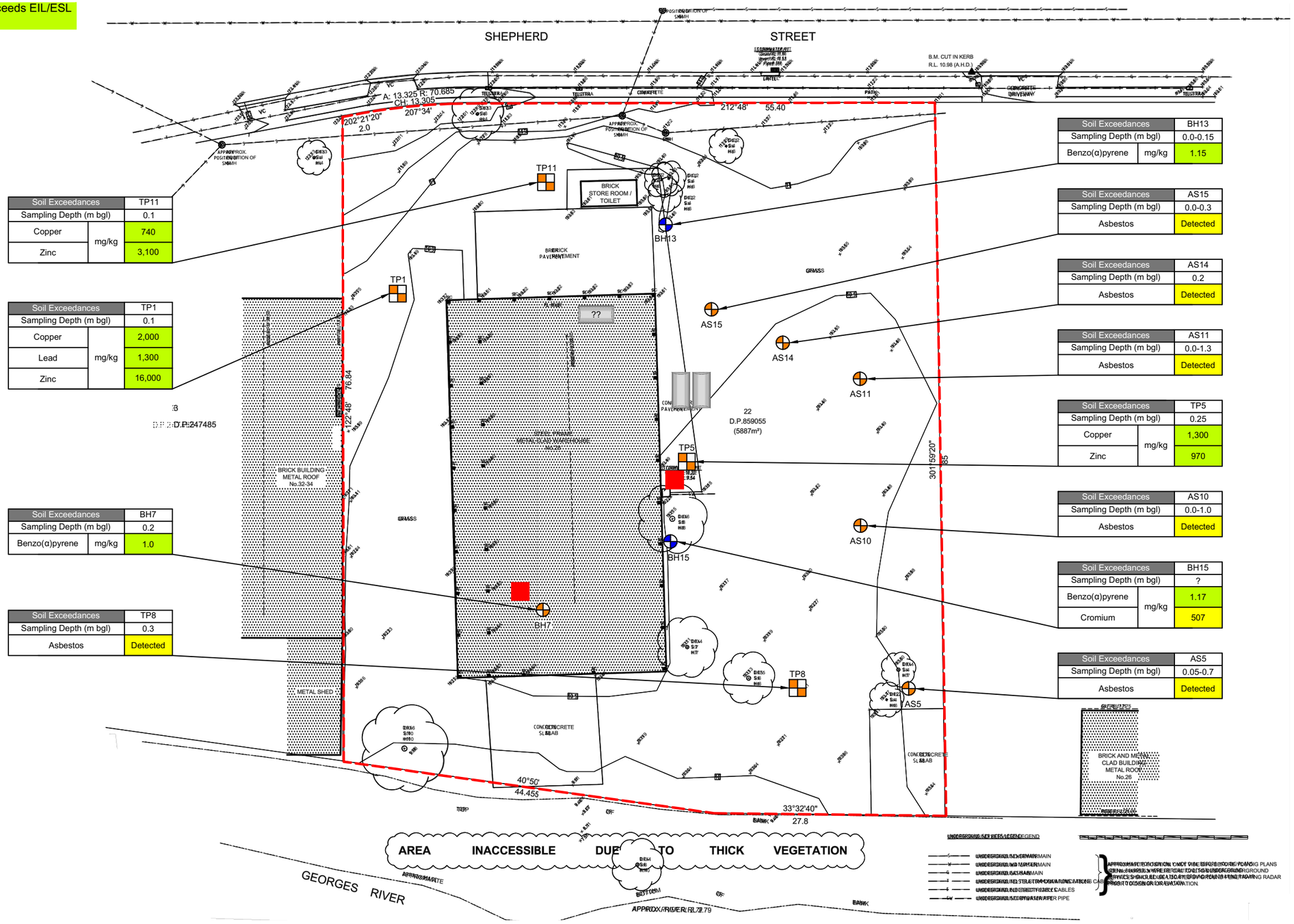
Coronation (28 Shepherd St) Pty Ltd
Remediation Action Plan
28 Shepherd Street, Liverpool, NSW
Site Locality Plan

Figure:
1

Project: E22480 AA

Highlighted yellow = Exceeds HIL/HSL (Human Health Criteria)

Highlighted green = Exceeds EIL/ESL (Ecological Criteria)



Soil Exceedances		TP11
Sampling Depth (m bgl)		0.1
Copper	mg/kg	740
Zinc		3,100

Soil Exceedances		TP1
Sampling Depth (m bgl)		0.1
Copper	mg/kg	2,000
Lead		1,300
Zinc		16,000

Soil Exceedances		BH7
Sampling Depth (m bgl)		0.2
Benzo(α)pyrene	mg/kg	1.0

Soil Exceedances		TP8
Sampling Depth (m bgl)		0.3
Asbestos		Detected

Soil Exceedances		BH13
Sampling Depth (m bgl)		0.0-0.15
Benzo(α)pyrene	mg/kg	1.15

Soil Exceedances		AS15
Sampling Depth (m bgl)		0.0-0.3
Asbestos		Detected

Soil Exceedances		AS14
Sampling Depth (m bgl)		0.2
Asbestos		Detected

Soil Exceedances		AS11
Sampling Depth (m bgl)		0.0-1.3
Asbestos		Detected

Soil Exceedances		TP5
Sampling Depth (m bgl)		0.25
Copper	mg/kg	1,300
Zinc		970

Soil Exceedances		AS10
Sampling Depth (m bgl)		0.0-1.0
Asbestos		Detected

Soil Exceedances		BH15
Sampling Depth (m bgl)		?
Benzo(α)pyrene	mg/kg	1.17
Cromium		507

Soil Exceedances		AS5
Sampling Depth (m bgl)		0.05-0.7
Asbestos		Detected

0 5 10 20 30 50

Approx. Scale (m)

Map Source: SDG, Ref. No. 6514, dated 19/12/14

LEGEND

- Approx. former borehole location (ES, 2014)
- Approx. former test pit location (ES, 2014)
- Approx. former borehole location (AER, 1998)
- Approx. potential former hoist
- Approx. Underground Storage Tank location
- Approximate Site Boundary

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Approx Scale:	1:500 @ A3 or As Shown

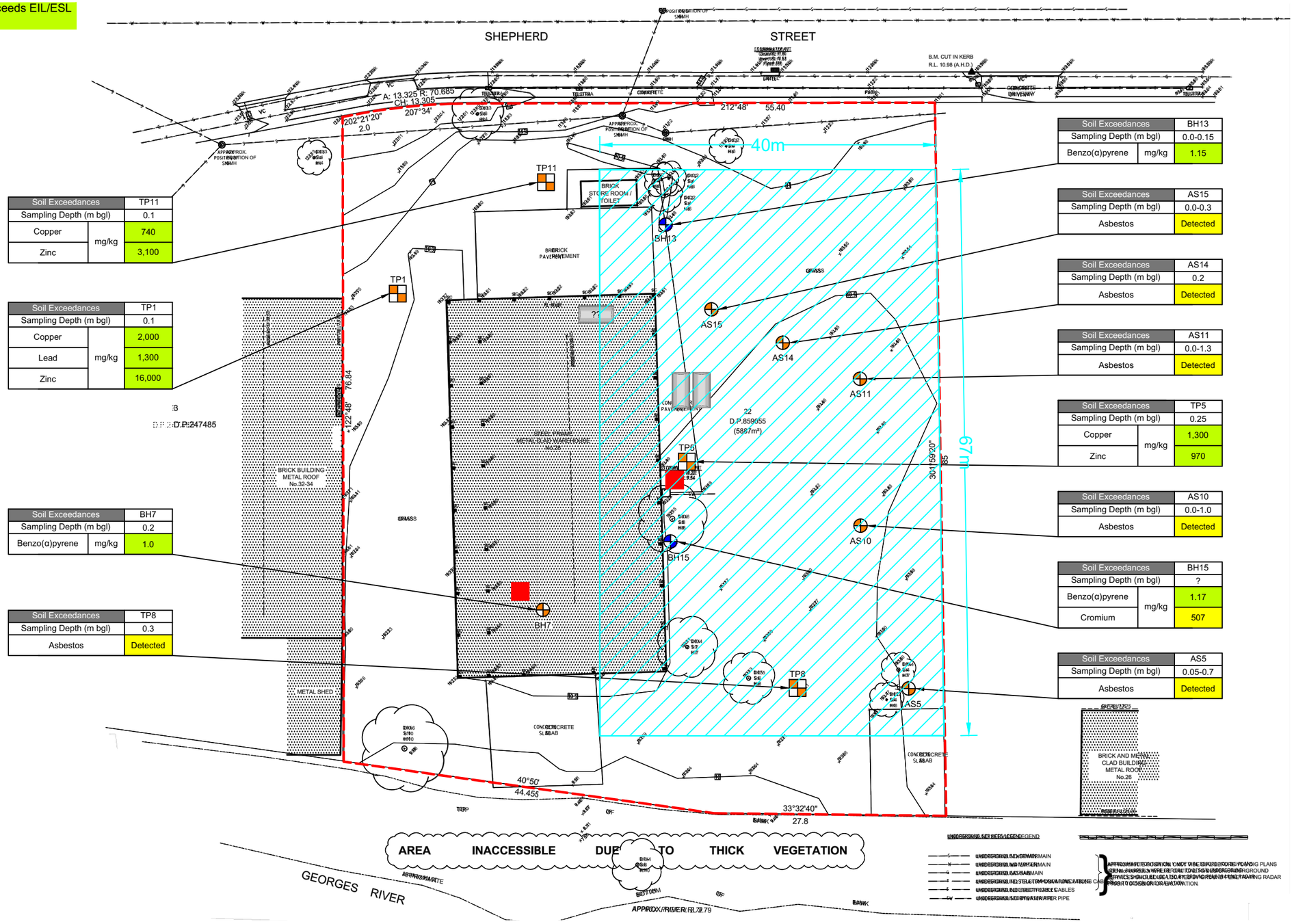
Coronation (Shepherd St) Pty Ltd
Remediation Action Plan
28 Shepherd Street, Liverpool, NSW
Former Sampling Location Plan w/- Soil Exceedances

Figure: 2

Project: E22460 AB

Highlighted yellow = Exceeds HIL/HSL (Human Health Criteria)

Highlighted green = Exceeds EIL/ESL (Ecological Criteria)



Soil Exceedances		TP11
Sampling Depth (m bgl)		0.1
Copper	mg/kg	740
Zinc		3,100

Soil Exceedances		TP1
Sampling Depth (m bgl)		0.1
Copper	mg/kg	2,000
Lead		1,300
Zinc		16,000

Soil Exceedances		BH7
Sampling Depth (m bgl)		0.2
Benzo(α)pyrene	mg/kg	1.0

Soil Exceedances	TP8
Sampling Depth (m bgl)	0.3
Asbestos	Detected

Soil Exceedances		BH13
Sampling Depth (m bgl)		0.0-0.15
Benzo(α)pyrene	mg/kg	1.15

Soil Exceedances	AS15
Sampling Depth (m bgl)	0.0-0.3
Asbestos	Detected

Soil Exceedances	AS14
Sampling Depth (m bgl)	0.2
Asbestos	Detected

Soil Exceedances	AS11
Sampling Depth (m bgl)	0.0-1.3
Asbestos	Detected

Soil Exceedances		TP5
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Sampling Depth (m bgl)	0.0-1.0
Asbestos	Detected

Soil Exceedances		BH15
Sampling Depth (m bgl)		?
Benzo(α)pyrene	mg/kg	1.17
Cromium		507

Soil Exceedances	AS5
Sampling Depth (m bgl)	0.05-0.7
Asbestos	Detected

Map Source: SDG, Ref. No. 6514, dated 19/12/14

LEGEND

- Approx. former borehole location (ES, 2014)
- Approx. former test pit location (ES, 2014)
- Approx. former borehole location (AER, 1998)
- Approximate Site Boundary
- Area A - Asbestos impacted soils between 0.0-1.3m BGL
- Approx. potential former hoist
- Approx. Underground Storage Tank location

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Approx Scale:	1:500 @ A3 or As Shown

Coronation (Shepherd St) Pty Ltd
Remediation Action Plan
28 Shepherd Street, Liverpool, NSW
Remediation Area A

Figure: 3

Project: E22460 AB

APPENDIX A
PREVIOUS INVESTIGATION RESULTS, FIGURES AND REPORT EXTRACTS

5. SITE CHARACTERISATION AND CONCLUSIONS

5.1 POTENTIAL FOR SITE CONTAMINATION

From Site Operations

The site operations in recent years were few and accordingly had introduced no significant potential for contamination of the site. However, the previous metal fabrication and aluminium scrap recovery operations were likely to have resulted in some superficial contamination of the soils with heavy metals.

The previous woollen milling operations and the subsequent demolition of the Mill was likely to have also resulted in contamination of the disturbed soils with heavy metals. In addition, the presence of boiler ashes in this disturbed zone which was thought to have been the result of previous disposal practices dating back to the Woollen Mills, was considered likely to have resulted in minor contamination of the disturbed zone with PAHs.

Both heavy metals and PAHs, the potential contaminants, were considered to be persistent in the environment. The heavy metals would not be expected to be dissolve to any extent in the essentially neutral conditions (soil pH measured at 7.4) and accordingly are unlikely to move into the underlying soils. It was also considered likely that the heavy metals could be sequestered to a limited extent by the clays in the soils and further immobilised.

PAHs have low water solubility (0.0038mg/l for benzo[a]pyrene) and a low vapour pressure ($5\ 10^{-9}$ for benzo[a]pyrene) and are essentially non-volatile. They were also considered unlikely to move through the soil matrix into the underlying soils.

Accordingly, any potential contamination was considered to be restricted to the disturbed zone which extended up to 1 metre below the topsoil.

Industrial land use was considered unlikely to provide extensive exposure to the potential soil contaminants particularly if redevelopment of the site resulted in coverage of the soils with either concrete/ bitumen paving, or lawn/ gardens.

EXECUTIVE SUMMARY

An industrial site, located at 26-30 Shepherd St in Liverpool was subjected to a Detailed Environmental Assessment in accordance with the NSW EPA Guidelines during February and March of 1998. The assessment was conducted in response to a Liverpool City Council request for a "Contamination Audit" prior to redevelopment of the site for industrial purposes. No change in land use is intended.

The Site

The property was fully fenced, but was somewhat neglected with extensive weed growth. The land had been subject to previous industrial development, although most of the original factories had been demolished prior to the 1980s. The remaining structures were dilapidated and the property was generally overgrown with grasses and weeds.

There was evidence of contamination of the topsoils from the previous industrial activities which dated back to the early part of the century. Demolition spoil from the previous buildings was also present in the top soils and was considered likely to have contributed to the contamination in these disturbed soils which extended to depths ranging from 200mm to 1 metre approximately.

Review of the previous history and the site inspection indicated that the potential contaminants were heavy metals and polycyclic aromatic hydrocarbons (PAHs) which were expected to be restricted to the disturbed layer.

It was also considered that contamination with pesticides may have occurred.

Site Work and Results

The site soils were sampled in accordance with NSW EPA Sampling Design Guidelines and the soil samples were evaluated by two NATA certified laboratories. Testing detected all of the selected analytes in the disturbed layer.

The levels detected (table 1) were lower than the assessment criteria selected which related to the future industrial land use (The Health-based Investigation Levels for *commercial/industrial* development - Reference 7).

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Table 1

Soil Contamination Levels

mg/kg

Analyte	Range	Average	95%UCL	"F" Level	ANZECC
Arsenic	n/d-20	5.8	7.2	500	20
Cadmium	n/d-4.0	0.6	0.8	100	3
Chromium	3-507	41.6	**78.6**	500	50
Copper	4-1240	**107**	**159**	5000	60
Lead	6-916	132	181	1500	300
Mercury	n/d-4.3	0.3	0.5	75	1
Zinc	8-6860	**429**	**724**	35000	200
PAHs	n/d-17.9	2.05	3.17	100	20
Benzo(a)pyrene	n/d-1.39	0.17	0.26	5	1
Chlorinated Pesticides	n/d-6.5	0.24	0.51	50	-
Dieldrin	n/d-6.5	**0.23**	**0.5**	50	0.2

n/d - not detected; below test quantitation limits.

"F" Levels refers to the Health-based Investigation Levels for *commercial/industrial* development.

ANZECC refers to the ANZECC Soil Quality Investigation "B" Levels.

The values shown in **bold** relate to the ANZECC Guidelines for the Assessment and Management of Contaminated Sites (Reference 6) and indicate levels in excess of the Soil Quality Investigation "B" Levels although these levels are below the assessment criteria which are more relevant to the proposed land use.

The results also demonstrate that the levels of potential contaminants in the underlying natural soils are consistent with background and less than either of the Investigation Levels cited earlier.

The groundwater was sampled and the results confirmed the results of a previous evaluation (Reference 1). Low levels of copper and lead were detected consistent with background.

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Site Characterisation

The site consisted of disturbed soils overlying the natural virgin soils. The depth of the disturbed soils varied across the property from approximately 200mm to about 1 metre.

The disturbed soils contained anthropogenic contaminants which were present at levels below the Health-based Investigation levels for the proposed industrial land use. However, the underlying virgin soils exhibited contamination levels consistent with natural background.

The contamination levels in the disturbed top soils varied across the property although the individual levels detected and the average and 95% confidence limits were all below the assessment criteria, the Health-based Investigation Levels for *commercial/industrial* development (Reference 7).

The contaminants identified on-site are all non-volatile and have low water solubility. They are considered unlikely to be leached and may be regarded as persistent in the environment. Accordingly, they are considered unlikely to contaminate either stormwater, or groundwater and the levels detected in the latter support this consideration.

The exposure pathways are ingestion and to a lesser extent inhalation which in the context of industrial land use limits the health risk; the property will be extensively developed and paved and site worker are likely to receive only short term, intermittent exposure to any residual soils.

The property is therefore considered acceptable for continuing industrial land use and suitable for the proposed industrial development.

Recommendations

It is recommended that:

- The redevelopment minimise the exposure to contaminated site soils by extensive coverage of the site soils with buildings and paving.
- Areas where there will be continuing access to site soils, such as gardens, should be covered with certified clean soil and grassed.
- The development should ensure that the disturbed soils should be retained on-site (disturbed soils should not be disposed off-site).

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- During construction/ redevelopment, site worker's exposure to contaminated soils should be minimised by appropriate Health and Safety precautions.
- Prior to construction/ redevelopment, appropriate Environmental precautions should be implemented to control any risk of movement of materials off-site.

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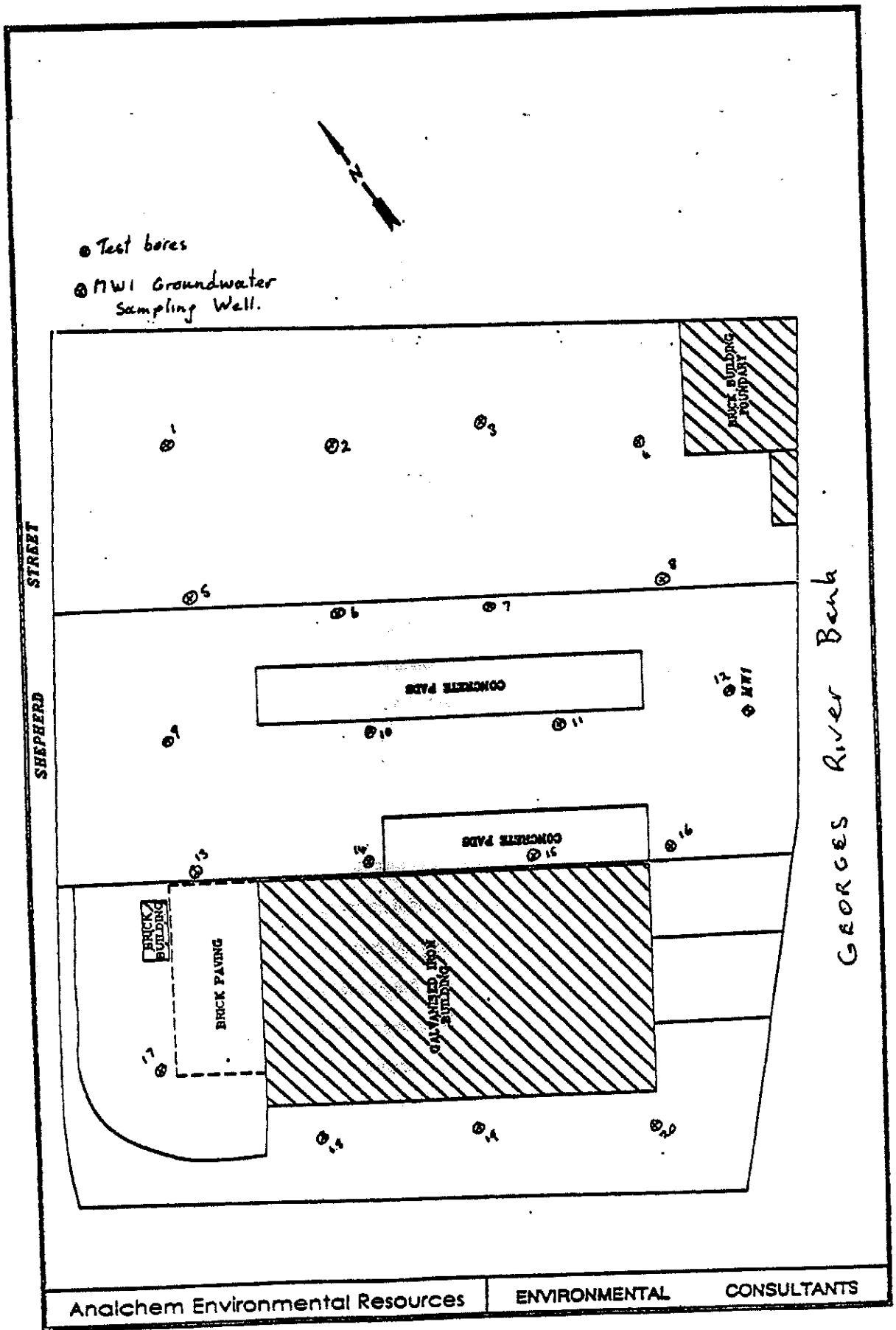
N
Test bores
MW1 Groundwater Sampling Well.
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BRICK BUILDING BOUNDARY
CONCRETE PADS
CONCRETE PADS
BRICK BUILDING
BRICK PAVING
GALVANISED IRON BUILDING
SHEPHERD STREET
GEORGES River Bank
Analchem Environmental Resources
ENVIRONMENTAL
CONSULTANTS

FIGURE 3

Executive Summary

Environmental Strategies Pty Limited (ES) was commissioned by Bob Nash to conduct a Phase 2 Environmental Site Assessment (ESA) 28 Shepherd Street, Liverpool NSW. The objective of the ESA was as to identify issues, concerns or environmental risks and liabilities associated with the current and past use(s) of the site prior to its redevelopment.

The address 28 Shepherd Street Liverpool NSW formerly incorporated both Lot 22 and 23 of DP 859055. Lot 23 was sold prior to, and is not included in the current investigation. The site the subject of the investigation detailed in this report is limited to Lot 22 DP 859055, an area of approximately 5,887m^2 (the Site).

The investigation area is zoned for high density residential development under the Liverpool Local Environmental Plan 2008. The Site is proposed for sale and has been assessed for the potential future redevelopment as high density residential land use.

Based on the field observations and review of analytical data collected during the Environmental Site Assessment the following conclusions have been reached.

The subsurface geology observed across the site during the ESA was as follows:

- Fill was observed to be present between 0.2 to 2.5m across the site. There were a number of distinct fill horizons observed. A reworked brown/grey clay was present along the southern portion of the site. A reworked red clay was present underlain by a brown silty reworked clay with building rubble including, crushed concrete, bricks, steel, fibre cement (asbestos containing) fragments, plastic and ash. An ash only layer was also observed along the eastern boundary adjacent to the river. The depth of the ash only layer was observed to be at its greatest (2.5m bgl) within the centre of the eastern site boundary.
- Natural material comprised a brown/red/grey clay dry to moist, stiff and slightly plastic to a depth of between 1.1 to 4.0 metres below ground level. Underlying the clay was a sandy clay fine to course grained brown/orange in colour and moist to wet between 1.1 to 8.6 metres below ground level. Underlying these natural clays was a weathered shale at approximately 8.6 metres along the western boundary.

Groundwater was encountered in boreholes at depths of approximately 5.4 to 6.9m bgl, corresponding with a sandy clay / clayey sand horizon. The standing water level (SWL) ranged between 5.1 and 7.1m bgl. The inferred direction of flow was east toward the Georges River which is consistent with the sites topography.

The concentrations of contaminants of concern in soil were reported to be below the adopted NEPM (2013) high density residential B land use criteria in all samples with the exception of the following:

- Concentrations of lead at TP1 @ 0.1m (1300 mg/kg) exceeded the HIL B (1200 mg/kg). The 95% upper confidence level however within the fill material observed at TP1 was calculated at 598 mg/kg, this is below the adopted soil criteria for lead and therefore is considered suitable to remain onsite;
- Concentrations of copper, lead and zinc at isolated locations across the site were reported above the adopted ecological investigation levels (EILs).

All samples analysed for asbestos were below the NATA accredited reporting limit of 0.01 g/kg and no respirable fibres were detected in any samples. Asbestos fines/fibres however, were detected at 6 test pitting locations on the northern portion of the site.

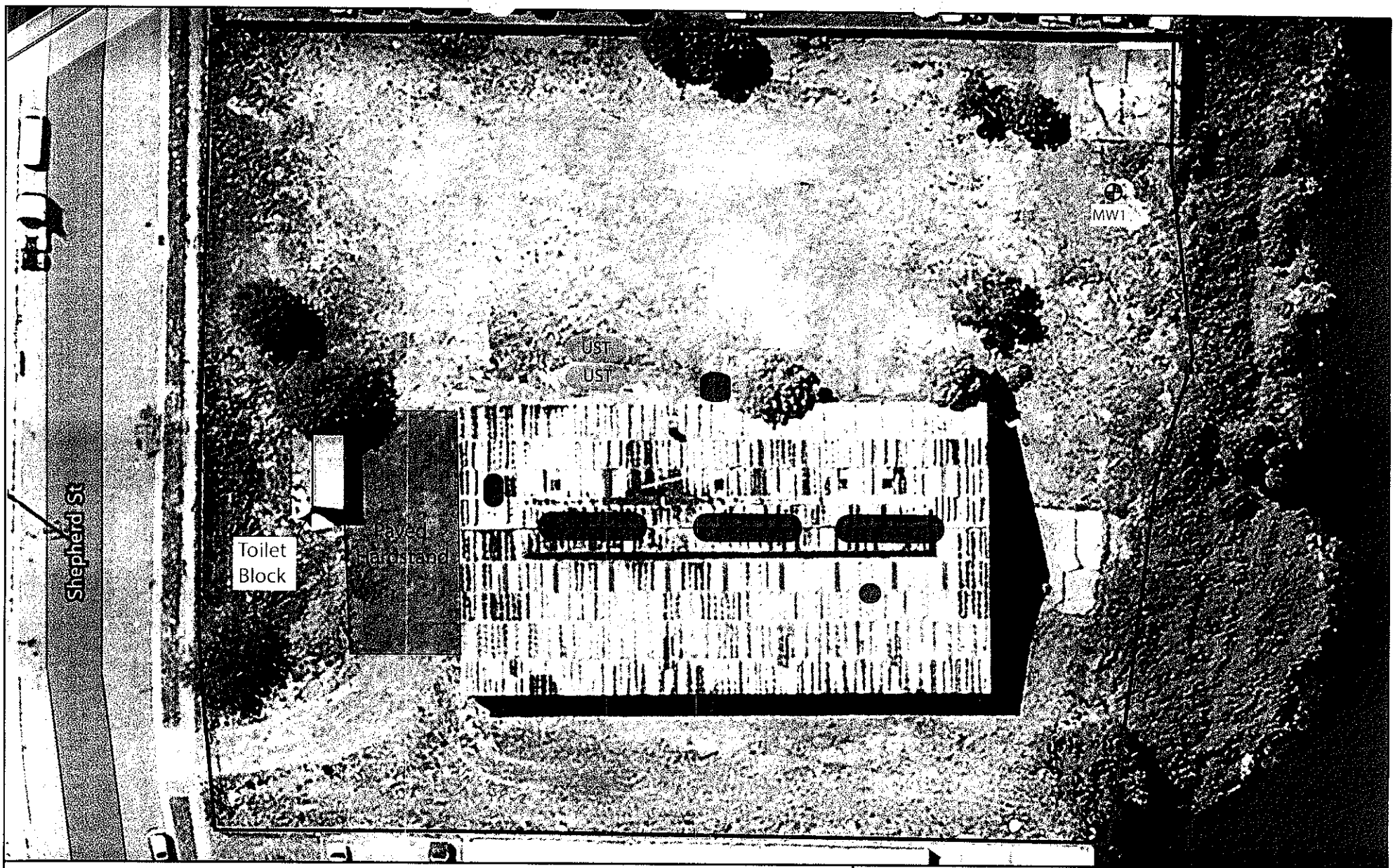
Asbestos was also noted to be present sporadically across the site's surface and within the initial 0.3m of the unsealed portion of the northern section of the site. The presence of this asbestos material within the initial 0.1m of fill is unsuitable for the proposed residential B land use with minimal access to soils. It is noted however that the surface of the site has been reported to have been emu picked of any visible fragments of potential asbestos containing material.

Two underground storage tanks (approximately 5,000 litres each) were uncovered during the works. The tanks appeared to be empty and the former contents and use of each tank is unknown. The soil and groundwater samples collected downgradient from the USTs indicate that there was no hydrocarbon contamination reported above guidelines from this area..

Dissolved zinc was reported at a concentration of between 10 to 14 ug/l which is above the adopted ANZECC (2000) 95% Freshwater Guideline of 8ug/L. These concentrations are considered to be indicative of background concentrations within an urban environment, which is known to have naturally elevated concentrations of copper, nickel and zinc. Furthermore down gradient boundary wells indicate that the site is not contributing to a net gain in dissolved metals.

ES considers that whilst some of the site's soils are currently unsuitable for high density residential use with minimal opportunities for soil access, it can be made suitable by implementing the following:

- The current data suggests that the fill material has not impacted the underlying natural material. Therefore if EIL exceedances are placed under hard standing and not in areas of landscaping or open space these exceedances are unlikely to adversely impact the nearby environmental receptors and may remain onsite. This is consistent with the NEPM (2013) guidelines for high density residential sites;
- Preparation of an Environmental Management Plan (EMP) to outline the requirements and obligations required to render the site suitable for a proposed high density residential development. The EMP should detail how the impacted soil will be managed during remedial and/or redevelopment works to ensure that no unacceptable risks to human health or the environment occur. The EMP should make reference to the relevant portions of the site specific asbestos management plan (AMP);
- An asbestos register and management plan (AMP) is prepared and implemented based on the current and proposed future land use. This plan should detail how the asbestos impact in soil will be appropriately managed at present and following construction. This may include laying of a marker layer above the existing asbestos impact and then placement of 0.5m of clean fill material in areas where asbestos fibres were detected. In areas where no asbestos fibres were detected then there is unlikely to be a requirement to conduct any asbestos remediation works;
- Preparation of a remedial action plan (RAP) to render the site suitable for the proposed land use. The RAP should incorporate the removal and appropriate validation of the two identified Underground Storage Tanks (USTs) and a site specific methodology to either remove or cap the asbestos impacted soils onsite. In regards to remediation of the asbestos in soil the remedial strategy should complement, where practical, the final building and site design.



Key:

- Approximate Site Boundary
- Test Pit 2 October 2013
- Existing well
- Groundwater Well 1 Oct 2013
- Soil Bore 2 Oct 2013
- Steel UST
- Potential Underground Tank/pit
- Potential former hoist

Source: Nearmap August 2013

North

Scale (m) 0 10

Site location: 28 Shepherd Street, Liverpool NSW

Figure 2: Current Site Layout

Job: 13092

Phase 2 Environmental Site Assessment

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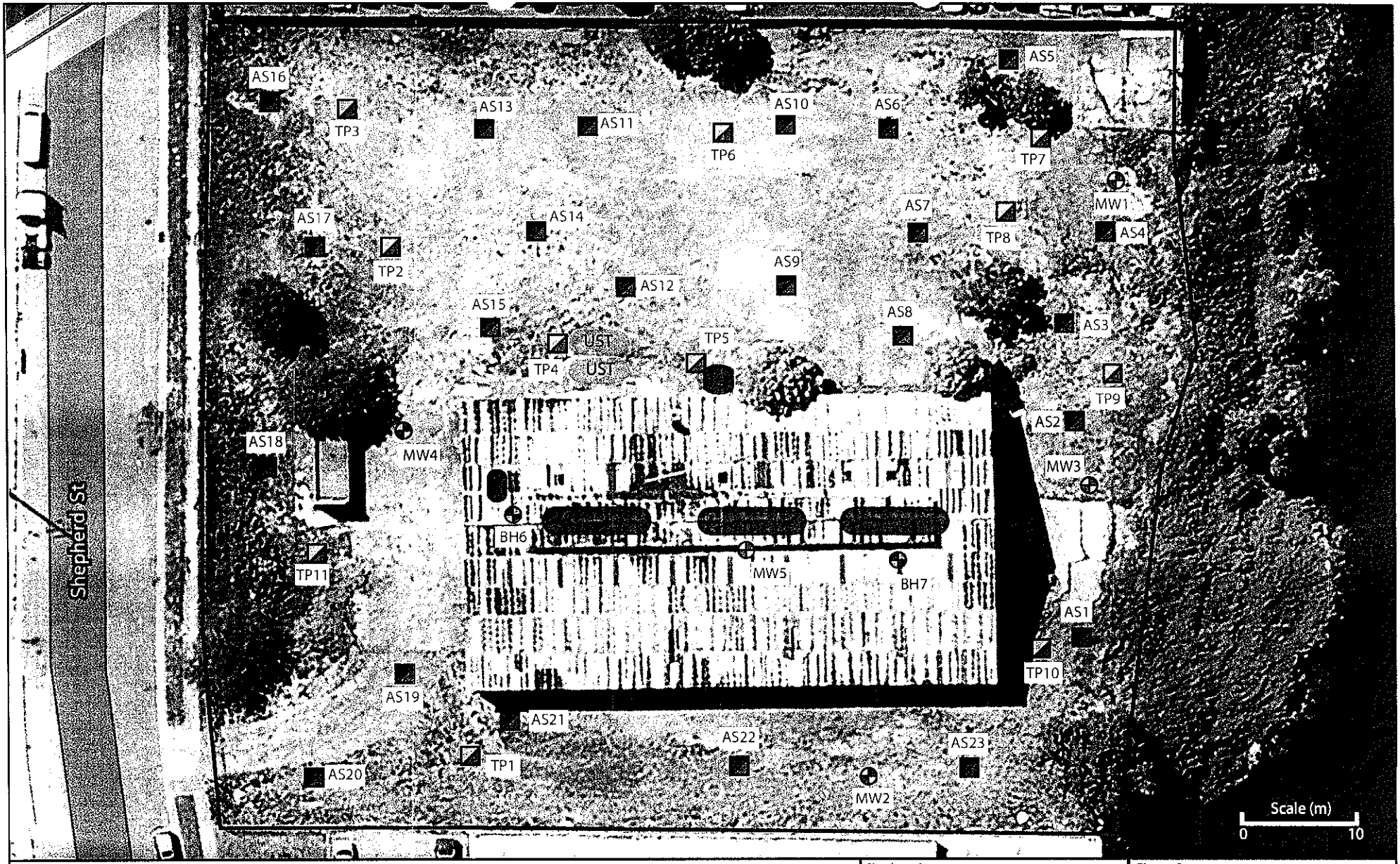


Key:

- Approximate Site Boundary
- Test Pit 2 October 2013
- Existing well
- Groundwater Well 1 Oct 2013
- Soil Bore 2 Oct 2013
- Steel UST
- Potential Underground Tank/pit
- 4 December 2013 Asbestos Testpit
- Asbestos Fines/Fibres Identified in fill

Source: Nearmap August 2013

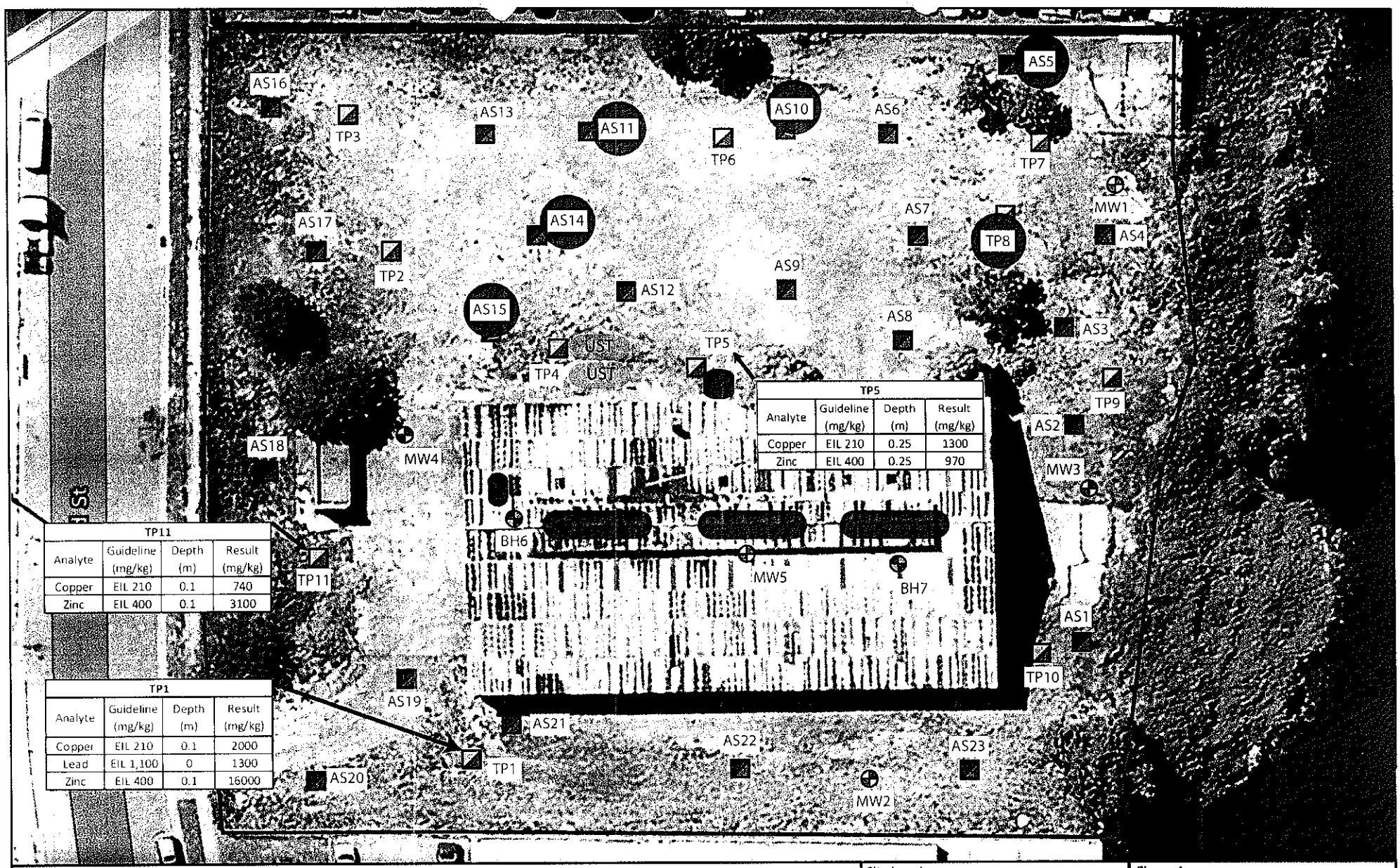
North

Site location: 28 Shepherd Street, Liverpool NSW

Job: 13092
Phase 2 Environmental Site Assessment

Figure 3:
Sample Locations

EnvironmentalStrategies
PROVIDING BENEFITS



Key:

- Approximate Site Boundary
- Test Pit 2 October 2013
- Existing well
- Groundwater Well 1 Oct 2013
- Soil Bore 2 Oct 2013
- Steel UST
- Potential Underground Tank/pit
- 4 December 2013 Asbestos Testpit
- Asbetsos Fines/Fibres Identified in fill

North

Source: Nearmap August 2013

Site location:
28 Shepherd Street, Liverpool NSW

Job: 13092
Phase 2 Environmental Site Assessment

Figure 4:
Soil Exceedances

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8 Observations and Analytical Results

The following section presents an overview of the field observations for soil and groundwater encountered during the ESA. Borehole logs with monitoring well installation details are included in Appendix C and copies of groundwater field sheets are included in Appendix D.

8.1 Field Observations - Soil

The geology observed across the site during the ESA was as follows:

- Fill was observed to be present between 0.2 to 2.5m across the site. There were a number of distinct fill horizons observed. A reworked brown/grey clay was present along the southern portion of the site. A reworked red clay underlain by a brown silty reworked clay with building rubble including, crushed concrete, bricks, steel, fibre cement (asbestos containing) fragments, plastic and ash. An ash only layer was also observed along the eastern boundary adjacent to the river. The depth of the ash only layer was observed to be at its greatest within the centre of the eastern site boundary.
- Natural material comprised a brown/red/grey clay dry to moist, stiff and slightly plastic to a depth of between 1.1 to 4.0 metres below ground level. Underlying the clay was a sandy clay fine to course grained brown/orange in colour and moist to wet between 1.1 to 8.6 metres below ground level. Underlying the soils was a weathered shale at approximately 8.6 metres along the western boundary.

PID measurements ranged between 0.1 and 0.3. PID measurements are provided on the borelogs presented in Appendix C.

8.2 Field Observations - Groundwater

During sampling the groundwater was observed to be odourless, clear to slightly cloudy, and colourless, yellowish brown or brown. No odours or sheens were observed in any of the purged water. The groundwater field parameters for the site are summarised in Table 8.2:

Table 8.2 Groundwater Field Parameters

Monitoring Well ID	Date	Temp (°C)	pH (pH units)	Dissolved Oxygen (ppm)	Redox / ORP (mV)	Conductivity (us/cm)
MW1	18/10/2013	18.2	6.12	0.39	256	1390
MW2	18/10/2013	18.6	5.96	2.16	346	339
MW3	18/10/2013	21.1	6.28	1.45	309	998
MW4	18/10/2013	19	6.06	0.94	331	1018
MW5	18/10/2013	17.7	6.05	0.54	340	992
Maximum	-	21.1	6.28	2.16	346	1390
Minimum	-	17.7	5.96	0.39	256	339

**ORP field results converted to Standard Hydrogen electrode (SHE) readings by adding 199mV*

Table 8.2 indicates the following groundwater conditions:

- The temperature of the groundwater ranged between 17.7 and 21.1°C;
- pH ranged between 5.96 and 6.28 pH units indicating slightly acidic groundwater conditions;

- Dissolved oxygen in the groundwater ranged from 0.39 and 2.16 ppm indicating aerobic conditions;
- ORP (oxidation reduction potential) levels measured from 256 to 346mV, which indicates oxidising conditions;
- Conductivity levels were between 339 and 1390 uS/cm, which indicates freshwater groundwater conditions across the site.

8.3 Soil Analytical Results

Soil analytical results were compared against the Soil Assessment Criteria (SAC). Result summary tables are included in Appendix F and copies of laboratory certificates are included as Appendix E.

8.3.1 Heavy Metals

Concentrations of heavy metals in all soil samples submitted for analysis were reported below the adopted with the exception of sample TP1 @ 0.1m for which the Lead concentration (1300 mg/kg) exceeded the HIL B (1200 mg/kg). The 95% upper confidence level for lead within the fill material observed at TP1 was calculated at 598 mg/kg, well below the HIL B criteria. The following samples also exceeded the site specific EILs:

- Concentrations of copper at TP1 @ 0.1m (2,000mg/kg), TP5 @ 0.25m (1,300mg/kg) and TP11 @ 0.1m (740 mg/kg) were above the adopted EIL of 210 mg/kg;
- Concentrations of lead at TP1 @ 0.1m (1,300mg/kg), were above the adopted EIL of 1,100 mg/kg; and
- Concentrations of zinc at TP1 @ 0.1m (16,000mg/kg), TP5 @ 0.25m (970mg/kg) and TP11 @ 0.1m (3,100 mg/kg) were above the adopted EIL of 400 mg/kg;

It is noted that at all locations that exceeded the EIL criteria deeper soil samples were below the adopted criteria.

8.3.2 PAHs and Phenols

Concentrations of PAHs and phenols in all soil samples submitted for analysis were reported below the adopted SAC with the exception of benzo(a)pyrene at BH7 @ 0.2 m (1 mg/kg) that exceeded the adopted EIL of 0.7 mg/kg.

8.3.3 BTEX, TPH and VOCs

Concentrations of BTEX, TPH (C_6-C_{36}) in all soil samples submitted for analysis were reported below the SAC.

8.3.4 OCP/OPP

Concentrations of OCPs/OPPs in all soil samples submitted for analysis were reported either below the SAC.

8.3.5 Asbestos ID in Soil

Thirty-eight soil samples were submitted for Asbestos ID in Soil analysis the following samples detected asbestos fines/fibres, albeit all below the laboratory reporting limit:

- Chrysotile, amosite and crocidolite asbestos was detected in test pit sample TP8 at 0.3m.

- Chrysotile, amosite and crocidolite asbestos was detected in fill material from test pits AS5 and AS14, all detections were below the limit of reporting.
- Chrysotile asbestos was detected in fill material from test pit soil samples AS10, AS11.
- Chrysotile asbestos was also detected in fill samples from AS10 and AS11. This was reported in a matted material, below the limit of reporting.
- Chrysotile asbestos was also detected in fill sample AS15 as loose fibre bundles below the limit of reporting.

No respirable fibres were detected in any soil sample submitted for asbestos analysis.

Fibre cement fragments were observed across the site surface north of the shed and also within the fill material of two test pits AS5 and AS14. The total concentration of asbestos in soil was calculated at each location as follows (bulk density of 1.6 kg/L, 20% asbestos content, 10 L sample):

- AS5 the total weight of FC fragments weighed 0.152 kg, this equates to a concentration in soil of 0.0019 % w/w; and
- AS14 the total weight of FC fragments weighed 0.026 kg, this equates to a concentration in soil of 0.000325 % w/w.

Concentrations of bonded asbestos fibre cement was below the adopted SAC of 0.04%. It is noted however that fibre cement sheeting was observed within the initial 0.3m of the ground surface and on the ground surface which is unacceptable for the proposed Residential land use.

It is noted that since the investigation it has been reported that the site surface has been emu picked of all visible asbestos which was removed offsite.

8.4 Materials Analytical Results

8.4.1 Asbestos ID in Material

Three materials samples from test pits were submitted for Asbestos ID in Material analysis.

Chrysotile, amosite and crocidolite asbestos were detected in two material collection from test pit samples TP2 @ 0.27m and TP8 @ 0.2m.

No asbestos was detected in the material sample collected from test pit TP2 @0.27m.

8.5 Groundwater Results

Groundwater analytical results were compared against the Groundwater Assessment Criteria (GAC). Result summary tables are included in Appendix F and copies of laboratory certificates are included as Appendix E.

8.5.1 Heavy Metals

Concentrations of heavy metals in all groundwater samples submitted for analysis were reported below the adopted GAC, with the exception of dissolved zinc which reported a concentration of between 10 ug/L and 13 ug/L in all groundwater wells. This exceeded the ANZECC (2000) 95% Freshwater criteria of 8 ug/L.

8.5.2 PAHs, BTEX, Naphthalene, TPH, Fluoride and VOCs

The concentrations of PAHs, BTEX, Naphthalene, TRH (C_6-C_{40}), Fluoride and VOCs were reported below the adopted GAC or laboratory limit of reporting in all of the groundwater samples submitted for analysis.

APPENDIX B
PREVIOUS BORELOGS

TEST BORE REPORT

CLIENT : Bob Nash
PROJECT : Shepherd St
LOCATION: Liverpool

DATE : 11.2.98.
PROJECT NO. :
SURFACE LEVEL:

BORE NO. 1
SHEET 1 OF 1

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
650	Disturbed clayey soil with Building Rubble	45 - 60	
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash
DATE : 11.2.98.
BORE NO. 2

PROJECT : Shepherd St
PROJECT NO. :
SHEET 1 OF 1

LOCATION: Liverpool
SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
400	Disturbed clayey soil with Building Rubble		
600	Brown clay	45 - 60	

TEST BORE RECORD

BORE NO. 3

SHEET 1 OF 1

CLIENT : Bob Nash

PROJECT : Shepherd St

LOCATION: Liverpool

DATE : 11.2.98.

PROJECT NO. :

SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
550	Disturbed clayey soil with Building Rubble	45 - 60	
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash
PROJECT : Shepherd St
LOCATION: Liverpool

DATE : 11.2.98.
PROJECT NO. :
SURFACE LEVEL:

BORE NO. 4
SHEET 1 OF 1

Depth	Description of Strata	Sampling cm	Sampling Type
150	Disturbed Sandy Soil with Building Rubble	0-15	
750	Silty sand	45-60	
850	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash
DATE : 12.2.98..
BORE NO. 5
PROJECT : Shepherd St
PROJECT NO. :
SHEET / OF /
LOCATION: Liverpool
SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
550	Disturbed clayey soil with Building Rubble	45 - 60	
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash DATE : 12.2.98. BORE NO. 6

PROJECT : Shepherd St PROJECT NO. : SHEET 1 OF 1

LOCATION: Liverpool SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
550	Disturbed clayey soil with Building Rubble	45 - 60	
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash
PROJECT : Shepherd St
LOCATION: Liverpool

DATE : 12.2.98.
PROJECT NO. :
SURFACE LEVEL:

BORE NO. 7
SHEET 1 OF 1

Depth	Description of Strata	Sampling cm	Sampling Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
550	Disturbed clayey soil with Building Rubble	45 - 60	
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash
PROJECT : Shepherd St
LOCATION: Liverpool

DATE : 11.2.98.
PROJECT NO. :
SURFACE LEVEL:

BORE NO. 8
SHEET / OF /

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0 - 15	
550	Disturbed clayey soil with Building Rubble	45 - 60	
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash **DATE** : 13.2.98. **BORE NO.** 9

PROJECT : Shepherd St **PROJECT NO.** : **SHEET** 1 **OF** 1

LOCATION: Liverpool **SURFACE LEVEL**:

Depth	Description of Strata	Sampling	
		cm	Type
	Disturbed Sandy Soil with Building Rubble	0 - 15	
300			
	Disturbed clayey soil with Building Rubble	45 - 60	
600			

TEST BORE RECORD

BORE NO. 10
SHEET 1 OF 1

CLIENT : Bob Nash
PROJECT : Shepherd St
LOCATION: Liverpool

DATE : 13.2.98.
PROJECT NO. :
SURFACE LEVEL:

Depth	Description of Strata	Sampling cm	Sampling Type
550	Disturbed clayey soil with Building Rubble	0 - 15 45 - 60	

BORE NO. 11

SHEET 1 OF 1

CLIENT : Bob Nash

PROJECT : Shepherd St

LOCATION: Liverpool

DATE : 13.2.98.

PROJECT NO. :

SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
550	Disturbed clayey soil with Building Rubble	0 - 15	
		45 - 60	

TEST BORE REPORT

BORE NO. 12

SHEET 1 OF 1

CLIENT : Bob Nash

PROJECT : Shepherd St

LOCATION: Liverpool

DATE : 12.2.98.

PROJECT NO. :

SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble		
800	Soil and ashes		

TEST BORE REPORT

CLIENT : Bob Nash
DATE : 13.2.98.
BORE NO. 13
PROJECT : Shepherd St
PROJECT NO. :
SHEET 1 OF 1
LOCATION: Liverpool
SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
550	Disturbed clayey soil with Building Rubble	0 - 15 45 - 60	

TEST BORE REPORT

CLIENT : Bob Nash DATE : 16.2.98. BORE NO. 14

PROJECT : Shepherd St PROJECT NO. : SHEET 1 OF 1

LOCATION: Liverpool SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
	Disturbed clayey soil with Building Rubble Ashes		
500			
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash
DATE : 16.2.98.
BORE NO. 15
PROJECT : Shepherd St
PROJECT NO. :
SHEET 1 OF 1
LOCATION: Liverpool
SURFACE LEVEL:

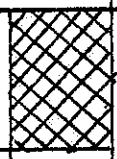
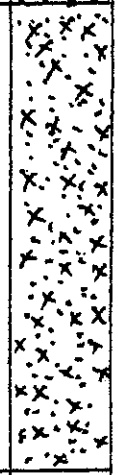
Depth	Description of Strata	Sampling	
		cm	Type
	Disturbed clayey soil with Building Rubble Ashes		
500			
600	Brown clay		

TEST BORE REPORT

CLIENT : Bob Nash DATE : 12.2.98. BORE NO. 16

PROJECT : Shepherd St PROJECT NO. : SHEET 1 OF 1

LOCATION: Liverpool SURFACE LEVEL:

Depth	Description of Strata		Sampling	
			cm	Type
200	Disturbed Sandy Soil with Building Rubble			
800	Soil and ashes			

TEST BORE REPORT

CLIENT : Bob Nash
DATE : 13.2.98.
BORE NO. 17

PROJECT : Shepherd St
PROJECT NO. :
SHEET 1 OF 1

LOCATION: Liverpool
SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
	Brown silty sand	0 - 15	
300			
	Brown clay	45 - 60	
600			

TEST BORE REPORT

CLIENT : Bob Nash DATE : 16.2.98. BORE NO. 18

PROJECT : Shepherd St PROJECT NO. : SHEET 1 OF 1

LOCATION: Liverpool SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
150	Disturbed Sandy Soil with Building Rubble	0-15	
300	Soil and ashes		
600	Brown clay	45-60	

TEST BORE REPORT

CLIENT : Bob Nash DATE : 16.2.98. BORE NO. 19

PROJECT : Shepherd St PROJECT NO. : SHEET 1 OF 1

LOCATION: Liverpool SURFACE LEVEL:

Depth	Description of Strata	Sampling cm	Sampling Type
150	Disturbed Sandy Soil with Building Rubble	0-15	
300	Soil and ashes		
600	Brown clay	45-60	

TEST BORE REPORT

CLIENT : Bob Nash
DATE : 16.2.98.
BORE NO. 20
PROJECT : Shepherd St
PROJECT NO. :
SHEET / OF /
LOCATION: Liverpool
SURFACE LEVEL:

Depth	Description of Strata	Sampling	
		cm	Type
200	Disturbed Sandy Soil with Building Rubble	0-15	
400	Ashes		
660	Brown clay	45-60	

Test Pit Log

EnvironmentalStrategies
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Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**AS1**
Project Number:	**13092**
Hole Depth:	**0.80 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 0.4 0.6 0.70				Fill	**FILL** - ASH with Sandy Silty CLAY.	dry	
		0.80			CL	Nat.	**CLAY** - brown, soft to medium stiff, cohesive.	dry	
		1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4					**End of Hole at 0.80 m**		

Additional Comments

Strike Groundwater Level Static Groundwater Level

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

ES LOG LT LIVERPOOL 13092.GPJ ES.GDT 5/2/14 2:36:00 PM

Test Pit Log

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2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
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Hole ID.	**AS2**
Project Number:	**13092**
Hole Depth:	**1.45 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.10				Fill	**FILL** - Silty CLAY, brown mottling.	dry	
		0.2					**FILL** - ASH, grey white, with vitrifications >100mm.	dry	
		0.4							
		0.6							
		0.8							
		1.0							
		1.2							
		1.30							
		1.4			CL	Natural	**CLAY** - brown, soft to medium stiff, cohesive, slight plasticity.	dry	
		1.45					**End of Hole at 1.45 m**		
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

ES LOG LT LIVERPOOL 13092.GPJ ES.GDT 5/2/14 2:36:01 PM

Test Pit Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	AS3
Project Number:	13092
Hole Depth:	1.20 m
Sheet:	1 of 1

Project Name:	Asbestos Investigation Liverpool	Date Started:	2/10/2013
Location / Site:	28 Shepherd Street, Liverpool	Date Completed:	2/10/2013
Client:	NSW Bob Nash	Ground Level :	
Drilling Company:	Ken Coles Excavations Pty Ltd	Top of Casing :	
Drill Method:	Excavation	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.15				Fill	**FILL** - ASH mixed with brown grey CLAY.	dry	
		0.2					**FILL** - ASH, with metal (stainless stell shards approximately 20 to 40mmm).	dry	
		0.4							
		0.6							
		0.8							
		1.00							
		1.20			CL	Natural	**CLAY** - brown, medium stiff, slightly cohesive.	dry	
		1.4					**End of Hole at 1.20 m**		
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

ES LOG LT LIVERPOOL 13092.GPJ ES.GDT 5/2/14 2:38:02 PM

Test Pit Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**AS4**
Project Number:	**13092**
Hole Depth:	**1.65 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2				Fill	**FILL** - CLAY, non cohesive, slightly silty, rootlets.	dry	
		0.35							
		0.4					**FILL** - ASH, with some crushed brick.	dry	
		0.6							
		0.8							
		1.0							
		1.18							
		1.4			CL	Natural	**CLAY** - brown / red mottled, stiff to medium stiff, cohesive, slight plasticity.	dry	
		1.6							
		1.65							
		1.8					**End of Hole at 1.65 m**		
		2.0							
		2.2							
		2.4							

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

ES LOG LT LIVERPOOL 13092.GPJ ES.GDT 5/2/14 2:36:02 PM

Test Pit Log

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Hole ID.	**AS5**
Project Number:	**13092**
Hole Depth:	**0.90 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Samples / Tests DUP TRIP	Observations / Comments
Excavation		0.2 0.4 0.6 0.70				Fill	**FILL** - Sandy CLAY, brown, with concrete, crushed brick, plastic, metal, asbestos.	dry	AS5_0.05-0.7	Dup1	Asbestos present. Weight 0.152kg.
		0.8 0.90			CL	Natural	**CLAY** - brown, medium stiff.	dry			
		1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4					**End of Hole at 0.90 m**				

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	AS6
Project Number:	13092
Hole Depth:	2.00 m
Sheet:	1 of 1

Project Name:	Asbestos Investigation Liverpool
Location / Site:	28 Shepherd Street, Liverpool
Client:	NSW Bob Nash
Drilling Company:	Ken Coles Excavations Pty Ltd
Drill Method:	Excavation

Date Started:	2/10/2013
Date Completed:	2/10/2013
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.2 0.4 0.60			Fill	Fill	**FILL** - CLAY, brown, with building rubble, bricks, crushed concrete, plastic (melted), glass, tree roots, fibro.	dry		Fibro in cuttings.
		0.8 1.0 1.2 1.4 1.50			Fill	Fill	FILL - ASH with Reworked CLAY, with steel, plastic.	dry	AS6_0.3-1.0	
		1.6 1.8 2.00			CL	Natural	**CLAY** - brown / orange mottled.	dry		
		2.2 2.4					**End of Hole at 2.00 m**			

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au
Logged By: David Jackson
Checked By:
Date: 2/10/2013
Date:

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Hole ID.	**AS7**
Project Number:	**13092**
Hole Depth:	**2.00 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.15				Fill	**FILL** - Silty CLAY, brown, with crushed rock.	dry		
		0.2					**FILL** - ASH with Reworked CLAY, with crushed bricks, crushed rock.	dry	AS7_0.1-1.0	
		0.4								
		0.6								
		0.8								
		1.0								
		1.2								Brick footing / wall encoutered at 1.2m.
		1.4								
		1.60								
		1.8			CL	Natural	**CLAY** - brown, cohesive.	moist		
		2.00								
							End of Hole at 2.00 m			
		2.2								
		2.4								

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

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PROVIDING BENEFITS

Hole ID.	**AS8**
Project Number:	**13092**
Hole Depth:	**1.34 m**
Sheet:	**1 of 1**

Project Name: **Asbestos Investigation Liverpool**
Location / Site: **28 Shepherd Street, Liverpool**
Client: **NSW Bob Nash**
Drilling Company: **Ken Coles Excavations Pty Ltd**
Drill Method: **Excavation**

Date Started: **2/10/2013**
Date Completed: **2/10/2013**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.10				Fill	**FILL** - Silty CLAY, brown, non cohesive.	dry		
		0.2					**FILL** - BUILDING RUBBLE, with some ash, crushed rock, brick, reworked clay.	dry	AS8_0.1-1.1	
		0.4								
		0.6								
		0.8								
		1.0								
		1.10								
		1.2			CL	Natural	**CLAY** - brown / red, cohesive, slight plasticity.	dry to moist		
		1.34								
		1.4					**End of Hole at 1.34 m**			
		1.6								
		1.8								
		2.0								
		2.2								
		2.4								

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

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Hole ID.	**AS9**
Project Number:	**13092**
Hole Depth:	**0.90 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**	Date Started:	**2/10/2013**
Location / Site:	**28 Shepherd Street, Liverpool**	Date Completed:	**2/10/2013**
Client:	**NSW Bob Nash**	Ground Level :	
Drilling Company:	**Ken Coles Excavations Pty Ltd**	Top of Casing :	
Drill Method:	**Excavation**	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 0.24				Fill	**FILL** - Reworked CLAY, orange.	dry	
		0.4					**FILL** - ASH. With reclaimed alluminium bars below 0.5m.	dry	Refusal on buried concrete slab at 0.5m on first attempt. Brick footing at 0.5m on second attempt.
		0.6 0.70							
		0.8 0.90			CL	Natural	**CLAY** - red, stiff, cohesive, slight plasticity.	dry to moist	
		1.0					**End of Hole at 0.90 m**		
		1.2							
		1.4							
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**AS10**
Project Number:	**13092**
Hole Depth:	**1.10 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.2 0.4 0.50				Fill	**FILL** - Reworked CLAY, brown, with building rubble, crushed brick, cloth, metla, plastic, crushed concrete.	dry	AS10_0.0-1.0	
		0.6 0.8 1.00					**FILL** - BUILDING RUBBLE, with ash and reworked clay.	dry		
		1.10			CL	Nat.	**CLAY** - brown, soft to medium stiff, cohesive.	dry		
		1.2 1.4 1.6 1.8 2.0 2.2 2.4					**End of Hole at 1.10 m**			

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	**AS11**
Project Number:	**13092**
Hole Depth:	**1.45 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.30				Fill	**FILL** - BUILDING RUBBLE / Reworked CLAY, with bricks, crushed concrete, steel wire, large steel plate (tailgate ot door). Steel plates at 1.0m, brick footing encountered.	dry	
		1.4, 1.45			CL	Natural	**CLAY** - brown, stiff, cohesive.	dry to moist	
		1.6, 1.8, 2.0, 2.2, 2.4					**End of Hole at 1.45 m**		

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	AS12
Project Number:	13092
Hole Depth:	1.40 m
Sheet:	1 of 1

Project Name:	Asbestos Investigation Liverpool	Date Started:	2/10/2013
Location / Site:	28 Shepherd Street, Liverpool	Date Completed:	2/10/2013
Client:	NSW Bob Nash	Ground Level :	
Drilling Company:	Ken Coles Excavations Pty Ltd	Top of Casing :	
Drill Method:	Excavation	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2				Fill	FILL - Reworked CLAY, with building rubble, crushed sandstone, concrete footings.	dry	
		0.30							
		0.4					FILL - ASH, with crushed bricks, concrete, steel.	dry	
		0.6							
		0.8							
		1.0							
		1.2							
		1.30			CL	Nat.	CLAY - red / orange, stiff, cohesive, no plasticity.	dry	
		1.40					End of Hole at 1.40 m		
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

Test pit moved twice and refused on buried concrete slab at 1.0m in both instances.
Third attempt natural ground encountered.

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: David Jackson	Date: 2/10/2013
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	**AS13**
Project Number:	**13092**
Hole Depth:	**0.90 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 0.4 0.6 0.65				Fill	**FILL** - Reworked CLAY, red, stiff, slightly cohesive, with building rubble, bricks, concrete, steel.	dry	
		0.8 0.90			CL	Natural	**CLAY** - brown, stiff, cohesive, slight plasticity.	dry	
		1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4					**End of Hole at 0.90 m**		

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

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Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

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Hole ID.	**AS14**
Project Number:	**13092**
Hole Depth:	**0.85 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Observations / Comments
Excavation		0.2, 0.4, 0.6, 0.8, 0.85				Fill	**FILL** - Reworked CLAY, brown, with building rubble.	ACM at 0.2m, 0.026kg.
		1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.2, 2.4					**End of Hole at 0.85 m**	

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**AS15**
Project Number:	**13092**
Hole Depth:	**0.70 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2				Fill	**FILL** - CLAY, brown, cohesive, some bricks, ash.	dry	
		0.30							
		0.4			CL	Natural	**CLAY** - red / orange, stiff, cohesive.	dry to moist	
		0.6							
		0.70							
		0.8					**End of Hole at 0.70 m**		
		1.0							
		1.2							
		1.4							
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	**AS16**
Project Number:	**13092**
Hole Depth:	**1.65 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 0.4 0.60				Fill	**FILL** - CLAY, brown, slightly cohesive, with some bricks, crushed concrete.	moist	
		0.8 1.0 1.2 1.4 1.50				Fill	**FILL** - Reworked CLAY, red / yellow / white mottled, stiff, slightly cohesive.	dry	
		1.6 1.65			CL	Natural	**CLAY** - red, stiff, cohesive, no plasticity.	dry	
		1.8 2.0 2.2 2.4					**End of Hole at 1.65 m**		

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**AS17**
Project Number:	**13092**
Hole Depth:	**1.40 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.15				Fill	**FILL** - Sandy CLAY, with blue metal.	dry	
		0.2					**FILL** - Reworked CLAY, with crushed brick, concrete, plastic, steel.	dry	
		0.4							
		0.6							
		0.8							
		1.0							
		1.2							
		1.35							
		1.40			CL	Nat	**CLAY** - red mottled yellow, stiff, no plasticity.	dry	
							End of Hole at 1.40 m		
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

Strike Groundwater Level Static Groundwater Level

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson**
Checked By:

Date: **2/10/2013**
Date:

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Hole ID.	**AS18**
Project Number:	**13092**
Hole Depth:	**1.00 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 / 0.30				Fill	**FILL** - Sandy CLAY, brown black, non cohesive.	dry	
		0.40				Fill	**FILL** - ASH.	dry	
		0.6 / 0.80				Fill	**FILL** - Reworked CLAY, brown, soft, with crushed sandstone, bricks.	dry	
		1.00			CL	Natural	**CLAY** - brown, medium stiff, cohesive.	dry	
		1.2 / 1.4 / 1.8 / 1.8 / 2.0 / 2.2 / 2.4					**End of Hole at 1.00 m**		

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Test Pit Log

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Hole ID.	**AS19**
Project Number:	**13092**
Hole Depth:	**0.55 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.15				Fill	**FILL** - CLAY, red, non cohesive, with bricks, steel.	dry	
		0.2			CL	Natural	**CLAY** - grey brown, stiff, cohesive.	moist to dry	
		0.55					**End of Hole at 0.55 m**		

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

Strike Groundwater Level Static Groundwater Level

REUMAD

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

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Test Pit Log

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Hole ID.	**AS20**
Project Number:	**13092**
Hole Depth:	**1.40 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2				Fill	**FILL** - Reworked CLAY, with some plastic and steel.	dry	
		0.35							
		0.4			CL	Natural	**CLAY** - red mottled brown, stiff, slightly cohesive, with some blue metal.	dry	
		0.6							
		0.8							
		1.0							
		1.2							
		1.40							
		1.6					**End of Hole at 1.40 m**		
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**AS21**
Project Number:	**13092**
Hole Depth:	**0.70 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.10				Fill	**FILL** - Reworked CLAY, brown grey, soft.	dry	
		0.2			CL	Natural	**CLAY** - brown / grey / red, soft to medium stiff, cohesive.	moist to dry	
		0.4							
		0.6							
		0.70					**End of Hole at 0.70 m**		
		0.8							
		1.0							
		1.2							
		1.4							
		1.6							
		1.8							
		2.0							
		2.2							
		2.4							

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

▽ Strike Groundwater Level ▼ Static Groundwater Level

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Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

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Hole ID.	**AS22**
Project Number:	**13092**
Hole Depth:	**0.70 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 0.30				Fill	**FILL** - Reworked CLAY, brown, non cohesive, with blue metals gravel (40 to 60mm).	dry	
		0.4 0.6 0.70			CL	Natural	**CLAY** - red, slightly cohesive, no plasticity.	dry	
		0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4					**End of Hole at 0.70 m**		

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**AS23**
Project Number:	**13092**
Hole Depth:	**1.50 m**
Sheet:	**1 of 1**

Project Name:	**Asbestos Investigation Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Observations / Comments
Excavation		0.2 0.30				Fill	**FILL** - CLAY, red / brown, non cohesive.	dry	
		0.4 0.6 0.8 1.0 1.05				Fill	**FILL** - ASH.		Brick footings at 0.5m. Concrete slab sections at 0.9m.
		1.2 1.4 1.50			SC	Natural	**Clayey SAND** - brown / grey, soft, cohesive.	moist to wet	
		1.6 1.8 2.0 2.2 2.4					**End of Hole at 1.50 m**		

Additional Comments

Refusal on concrete slab at 0.85m. Moved test pit three times and still refusal.

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**TP1**
Project Number:	**13083**
Hole Depth:	**0.50 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.10			CL	Natural	**Silty Sandy CLAY** - red / brown, some organic matter.	dry	TP1_0.1	
		0.2			CL		**CLAY** - laminated dark grey and dark orange, hard, low plasticity.	dry	TP1_0.2	
		0.4							TP1_0.4	
		0.50					**End of Hole at 0.50 m**			
		0.6								
		0.8								
		1.0								
		1.2								
		1.4								
		1.6								
		1.8								
		2.0								

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Test Pit Log

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Hole ID.	**TP2**
Project Number:	**13083**
Hole Depth:	**0.65 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.2 / 0.25				Fill	**FILL** - Silty CLAY, grey.	dry	TP2_0.2	With concrete, metal, tile.
		0.4 / 0.6 / 0.65			CL	Natural	**Silty CLAY** - medium brown, no plasticity.	dry	TP2_0.5	
		0.8 / 1.0 / 1.2 / 1.4 / 1.6 / 1.8 / 2.0					**End of Hole at 0.65 m**			

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	TP3
Project Number:	13083
Hole Depth:	0.70 m
Sheet:	1 of 1

Project Name:	Phase II ESA - Liverpool	Date Started:	2/10/2013
Location / Site:	28 Shepherd Street, Liverpool	Date Completed:	2/10/2013
Client:	NSW Bob Nash	Ground Level :	
Drilling Company:	Ken Coles Excavations Pty Ltd	Top of Casing :	
Drill Method:	Excavation	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.20				Fill	**FILL** - Silty Sandy FILL, light brown, with irregular sized pebbles.	dry	TP3_0.2	With metal.
		0.40				Fill	**FILL** - ASH / CONCRETE.	dry	TP3_0.4	with glass fragments throughout, layer of grey ash material, brick fragments, orange layer 3mm thick. Fibro noted at 0.27m, 50mm layer.
		0.6			CL	Natural	**Heavy Silty CLAY** - red.	dry	TP3_0.7	
		0.70					**End of Hole at 0.70 m**			
		0.8								
		1.0								
		1.2								
		1.4								
		1.6								
		1.8								
		2.0								

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Test Pit Log

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Hole ID.	**TP4**
Project Number:	**13083**
Hole Depth:	**0.76 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
Excavation		0.2				Fill	**FILL** - Silty CLAY, rootlets.	dry	0.1	TP4_0.3	With concrete, metal, buried concrete, terracotta, brick (building rubble). Sandstone footing or block at 200mm.
		0.30					**FILL** - ASH.	dry			
		0.4									
		0.6									
		0.76					**End of Hole at 0.76 m** Terminated on large concrete slab.				
		0.8									
		1.0									
		1.2									
		1.4									
		1.6									
		1.8									
		2.0									

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**TP4A**
Project Number:	**13083**
Hole Depth:	**1.20 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**	Date Started:	**2/10/2013**
Location / Site:	**28 Shepherd Street, Liverpool**	Date Completed:	**2/10/2013**
Client:	**NSW Bob Nash**	Ground Level :	
Drilling Company:	**Ken Coles Excavations Pty Ltd**	Top of Casing :	
Drill Method:	**Excavation**	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.2 0.30				Fill	**FILL** - Silty CLAY, rootlets.	dry		With concrete, metal, buried concrete, terracotta, brick (building rubble).
		0.4 0.6 0.8 1.0 1.10					**FILL** - Tank Backfill SAND.	moist to wet	TP4A_0.8	Tank wall observed in test pit, at least 1.0m deep. Water observed in tank backfill sands.
		1.20			CL	Nat.	**Slightly Silty CLAY** - mottled brown / red, cohesive, slight plasticity, petrified organic matter.		TP4A_1.2	
		1.4 1.6 1.8 2.0					**End of Hole at 1.20 m**			

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**TP5**
Project Number:	**13083**
Hole Depth:	**1.50 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
Excavation		0.2				Fill	**FILL** - Silty CLAY, ASH, CONCRETE.		1.0	TP5_0.3	
		0.50					**FILL** - ASH.		0.1	TP5_0.6	
		0.60					**FILL** - CLAY mixed with ASH.		0.1		
		0.80									
		1.0			CL	Natural	**CLAY** - mottled grey orange, medium plasticity, organic matter.	moist			
		1.2									
		1.4									
		1.50							0.2	TP5_1.5	
		1.6					**End of Hole at 1.50 m**				
		1.8									
		2.0									

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White		Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au		Checked By:	Date:

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Hole ID.	**TP6**
Project Number:	**13083**
Hole Depth:	**1.30 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
Excavation		0.2				Fill	**FILL** - CLAY mixed with Oversized CONCRETE, BRICKS, STEEL.		1.2	TP6_0.4	
		0.4									
		0.6									
		0.80					**FILL** - CLAY mixed with ASH, brown, with oversized building rubble.	dry	0.1	TP6_0.8	More ash disseminated at 0.8m.
		1.0									
		1.10									
		1.2			CL	Natural	**Silty CLAY** - brown, stiff, slightly cohesive, no plasticity.	dry	0.2	TP6_1.3	
		1.30									
		1.4					**End of Hole at 1.30 m**				
		1.6									
		1.8									
		2.0									

Additional Comments

Landfill type odour.

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**

Checked By: Date:

Test Pit Log

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Hole ID.	**TP7**
Project Number:	**13083**
Hole Depth:	**1.30 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
Excavation		0.2				Fill	**FILL** - Silty CLAY, brown, non cohesive, with plastic, concrete, bricks.	dry	0.2	TP7_0.2	Fibro observed.
		0.30									
		0.4				Fill	**FILL** - ASH mixed with CLAY.		0.1	TP7_0.5	
		0.6									
		0.80									
		1.0			CL	Natural	**CLAY** - red / brown, firm, medium plasticity.	moist	0.2	TP7_1.0	
		1.2									
		1.30									
		1.4					**End of Hole at 1.30 m**				
		1.6									
		1.8									
		2.0									

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

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Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **2/10/2013**
Checked By: Date:

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Hole ID.	**TP8**
Project Number:	**13083**
Hole Depth:	**1.30 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.2 0.4 0.6 0.80				Fill	**FILL** - Silty CLAY, brown, non cohesive, with building rubble, glass, brick, crushed rock, metal, tiles.	dry	TP8_0.2 TP8_0.3	Asbestos fibro fragments noticed throughout the fill.
		1.00					**FILL** - ASH, black, with charcoal.		TP8_0.8	
		1.2 1.30			CL	Natural	**CLAY** - brown, firm, cohesive.	dry	TP8_1.1	
		1.4 1.6 1.8 2.0					**End of Hole at 1.30 m**			

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

ES LOG LT LIVERPOOL 13083.GPJ ES.GDT 5/2/14 2:32:32 PM

Test Pit Log

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www.environmentalstrategies.com.au

Hole ID.	**TP9**
Project Number:	**13083**
Hole Depth:	**2.70 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street, Liverpool**
Client:	**NSW Bob Nash**
Drilling Company:	**Ken Coles Excavations Pty Ltd**
Drill Method:	**Excavation**

Date Started:	**2/10/2013**
Date Completed:	**2/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
Excavation		0.10				Fill	**FILL** - Silty CLAY, with bricks.		TP9_0.1	
		0.2					**FILL** - ASH, fine to coarse grained, with 200mm charcoal.			Potential smolder pit.
		0.4								
		0.6								
		0.8								
		1.0								
		1.2								
		1.4								
		1.6								
		1.8								
		2.0								
		2.2								
		2.4								
		2.50							TP9_2.5	
		2.6			CL	Nat.	Silty CLAY, brown, soft, slightly cohesive.	dry		
		2.70								
		2.8					**End of Hole at 2.70 m**			
		3.0								

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	**TP10**
Project Number:	**13083**
Hole Depth:	**1.20 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**	Date Started:	**2/10/2013**
Location / Site:	**28 Shepherd Street, Liverpool**	Date Completed:	**2/10/2013**
Client:	**NSW Bob Nash**	Ground Level :	
Drilling Company:	**Ken Coles Excavations Pty Ltd**	Top of Casing :	
Drill Method:	**Excavation**	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
Excavation		0.2				Fill	**FILL** - Silty CLAY, brown, non cohesive.		0.1	TP10_0.2	
		0.30					**FILL** - ASH, with some basalt boulders to 200mm.		0.1	TP10_0.4	
		0.4									
		0.6									
		0.8									
		1.00			CL	Natural	**Silty CLAY** - brown / red, firm, slightly cohesive, slight plasticity, potential organic material.	moist	0.0	TP10_1.1	
		1.20					**End of Hole at 1.20 m** Galvanised pipe noted.				
		1.4									
		1.6									
		1.8									
		2.0									

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Test Pit Log

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Hole ID.	**TP11**
Project Number:	**13083**
Hole Depth:	**0.60 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**	Date Started:	**2/10/2013**
Location / Site:	**28 Shepherd Street, Liverpool**	Date Completed:	**2/10/2013**
Client:	**NSW Bob Nash**	Ground Level :	
Drilling Company:	**Ken Coles Excavations Pty Ltd**	Top of Casing :	
Drill Method:	**Excavation**	Easting:	
		Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Samples / Tests DUP TRIP	Observations / Comments
Excavation		0.10				Fill	**FILL** - Sandy Organic Topsoil, light brown.				
		0.2			CL	Natural	**Heavy CLAY** - grey / orange, hard, organic matter.	dry to damp	TP11_0.1		
		0.4									
		0.60							TP11_0.6	Dup2 Trip2	
		0.8					**End of Hole at 0.60 m**				
		1.0									
		1.2									
		1.4									
		1.6									
		1.8									
		2.0									

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **Daniel K.**	Date: **2/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Monitoring Well Log

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Hole ID.	**BH2/MW**
Project Number:	**13083**
Hole Depth:	**8.00 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street,**
Client:	**Liverpool NSW Bob Nash**
Drilling Company:	**Terratest Pty Ltd**
Drill Method:	**Solid Stem Auger**

Date Started:	**1/10/2013**
Date Completed:	**1/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments	Well Details	Well Construction
Solid Stem Auger	7m	0.40				Fill	**FILL** - Reworked CLAY, brown, with rootlets.	dry		BH2_0.2		Gatic	
		0.5								BH2_0.4			
		0.90					**FILL** - Reworked CLAY, with ash and charcoal.	dry				Backfill	
		1.0			CL		**CLAY** - brown, cohesive, slight plasticity.	moist	0.1	BH2_1.0			
		1.10					**Silty CLAY** - grey, soft, with 3 to 5mm angular gravel, petrified organic matted.	moist	0.1	BH2_1.5			
		1.5											
		2.0			CL		Becoming stiffer and more laminated with depth.						
		2.5							0.1	BH2_2.5			
		3.00										Bentonite	
		3.5			CL		**Silty CLAY** - red, soft.	moist					
		3.80							0.2	BH2_3.5			
		4.0				Natural	**Sandy CLAY** - red, stiff.	moist					
		4.5							0.6	BH2_4.5		4.40	
		5.0										4.80	
		5.5								BH2_5.5		Screen	
		6.0			CL		Becoming more moist with depth.					Gravel Pack	
		6.5								BH2_6.5			
		7.0						wet					
		7.5										7.90	
		8.00					**End of Hole at 8.00 m**						Collapse

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **1/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	**BH3/MW3**
Project Number:	**13083**
Hole Depth:	**8.00 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street,**
Client:	**Liverpool NSW Bob Nash**
Drilling Company:	**Terratest Pty Ltd**
Drill Method:	**Solid Stem Auger**

Date Started:	**1/10/2013**
Date Completed:	**1/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments	Well Details	Well Construction
Solid Stem Auger	6.8m	0.20				Fill	**FILL** - Reworked CLAY, brown, with rootlets.	dry	0.1	BH3_0.2		Gatic	
		0.5					**FILL** - ASH with some brown CLAY.	dry	0.2	BH3_0.5		Backfill	
		0.90											
		1.0											
		1.10					**FILL** - CLAY, brown, soft, cohesive, slight plasticity.	moist	0.3	BH3_1.0			
		1.5					**FILL** - ASH / CHARCOAL with some Clay.	moist					
		2.0							0.2	BH3_2.0			
		2.5											
		2.60											
		3.0			CL		**CLAY** - brown, medium stiff.	moist	0.1	BH3_3.0		Bentonite	
		3.5											
		4.0					Becoming more moist with depth.		0.3	BH3_4.0			
		4.5										4.80	
		5.00										4.90	
		5.5				Natural	**Sandy Silty CLAY** - brown, soft, non cohesive, no plasticity.	moist				Screen	
		6.0											
		6.5			CL							Gravel Pack	
		7.0						wet			Collapsed to 7.1m, redrilled to 8.0m, collapsed to 7.85m.		
		7.5										7.85	
		8.00					**End of Hole at 8.00 m**					Collapse	

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **1/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Hole ID.	**BH4/MW4**
Project Number:	**13083**
Hole Depth:	**7.00 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street,**
Client:	**Liverpool NSW Bob Nash**
Drilling Company:	**Terratest Pty Ltd**
Drill Method:	**Solid Stem Auger**

Date Started:	**1/10/2013**
Date Completed:	**1/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments	Well Details	Well Construction
Solid Stem Auger	6.4m ▽	0.10				FILL	**BRICK PAVERS.**						Gatic
		0.5			CL	Natural	**CLAY** - red to orange brown, very stiff, cohesive, no plasticity, minor laminations.	slightly moist	0.4	BH4_0.4			Backfill
		1.0							0.1	BH4_1.0			
		1.5					Becoming more stiff and laminated with depth.						
		2.0							0.2	BH4_2.0			Bentonite
		2.5											
		2.60											
		3.0			CL		**Sandy Silty CLAY** - brown, slightly cohesive, no plasticity.	dry to moist	0.3	BH4_3.0			
		3.5					Becoming more stiff and consolidated with depth.					3.50	
		4.0								BH4_4.0		4.00	Gravel Pack
		4.20											
		4.5					**SAND** - orange yellow, fine grained, with some minor clay component.	dry to moist					
		5.0						moist		BH4_5.0			
		5.5			SP			becom. wet					Screen
		6.0								BH4_6.0			
		6.5											
		7.00								BH4_7.0			
							End of Hole at 7.00 m				SPT at 7.0m showed Shale Bedrock at 7.2m.		
		7.5											
		8.0											

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **1/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Monitoring Well Log

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Hole ID.	**BH5/MW**
Project Number:	**13083**
Hole Depth:	**9.00 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street,**
Client:	**Liverpool NSW Bob Nash**
Drilling Company:	**Terratest Pty Ltd**
Drill Method:	**Solid Stem Auger**

Date Started:	**1/10/2013**
Date Completed:	**1/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments	Well Details	Well Construction
CC		0.17				Fill	**CONCRETE.**						Backfill Gatic
		0.5					FILL - ASH & CHARCOAL mixed with CLAY, black.	damp		BH5_0.4-0.5			
		0.60											
		1.0			SC		**Clayey SAND** - orange brown, soft, non cohesive, fine grained.	dry		BH5_1.0			
		1.5					Becoming moist with depth.						
		1.60											
		2.0			CL		**CLAY** - brown orange, medium stiff, cohesive.	moist		BH5_2.0			Bentonite
		2.5											
		3.00											
		3.5			CL	Natural	**Sandy CLAY** - soft, slightly cohesive, fine grained.	moist	0.1	BH5_3.0			
		4.0							0.4	BH5_4.0		4.00	
		4.5										4.50	Gravel Pack
		5.0							0.5	BH5_5.0			
		5.5											
		6.0							0.2	BH5_6.0			
Solid Stem Auger	6.5m	6.5						very moist					
								wet					Screen
		7.0							0.1	BH5_7.0			
		7.5											
		8.0											
		8.5											
		8.60					**Weathered SHALE.**						
		9.00					**End of Hole at 9.00 m**						

Additional Comments

▽ Strike Groundwater Level ▼ Static Groundwater Level

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Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **David Jackson** Date: **1/10/2013**
Checked By: Date:

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Borehole Log

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Hole ID.	**BH6**
Project Number:	**13083**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street,**
Client:	**Liverpool NSW Bob Nash**
Drilling Company:	**Terratest Pty Ltd**
Drill Method:	**Solid Stem Auger**

Date Started:	**1/10/2013**
Date Completed:	**1/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC		0.17				Fill	**CONCRETE.**				
		0.5					**FILL** - Reworked CLAY, brown, soft, cohesive, with some ash and charcoal.	moist	0.1	BH6_0.5	
		0.60					**CLAY** - brown, stiff, cohesive, slightly laminated.	dry			
		1.0							0.1	BH6_1.0	
		1.5									
		2.0					Becoming stiffer with depth.		0.3	BH6_2.0	
		2.5									
		3.0							0.2	BH6_3.0	
		3.5									
Solid Stem Auger		4.00			CL	Natural			0.2	BH6_4.0	
		4.5					**End of Hole at 4.00 m**				
		5.0									

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **1/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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Borehole Log

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Hole ID.	**BH7**
Project Number:	**13083**
Hole Depth:	**1.20 m**
Sheet:	**1 of 1**

Project Name:	**Phase II ESA - Liverpool**
Location / Site:	**28 Shepherd Street,**
Client:	**Liverpool NSW Bob Nash**
Drilling Company:	**Terratest Pty Ltd**
Drill Method:	**Solid Stem Auger**

Date Started:	**1/10/2013**
Date Completed:	**1/10/2013**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests ID No.	Observations / Comments
CC							**CONCRETE.**			
Solid Stem Auger		0.17				Fill	**FILL** - Silty CLAY, brown, with crushed rock and brick.	dry	BH7_0.2	
		0.2 / 0.40					**FILL** - ASH.	dry	BH7_0.5	
		0.6 / 0.8 / 1.00								
		1.20			CL	Natural	**Sandy CLAY** - red / brown / grey, stiff, cohesive, no plasticity.	dry to moist	BH7_1.1	
		1.4 / 1.6 / 1.8 / 2.0					**End of Hole at 1.20 m**			

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White	Logged By: **David Jackson**	Date: **1/10/2013**
Contact: laurie.white@reumad.com.au	Checked By:	Date:

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