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McGILL ADVANCE MANAGEMENT PTY LTD

REMEDIATION ACTION PLAN

4-12 McGILL STREET, LEWISHAM NSW

Report E22830 AB_Rev 0

6 May 2016

REPORT DISTRIBUTION

Remediation Action Plan
4-12 McGill Street, Lewisham NSW

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EXECUTIVE SUMMARY

Mr John Anogianakis of McGill Advance Management Pty Ltd (the client) engaged Environmental Investigations Australia Pty Ltd (EI) to prepare a Remediation Action Plan (RAP)) for the property located at 4-12 McGill Street, Lewisham NSW ('the site'). The primary objective of this RAP is to guide remediation works required, to make the site suitable for the proposed residential land use with minimal soil access. The proposed development involves the demolition of the existing site structures and the construction of two, five- and six-storey residential apartment buildings over a common, one- to two-level stepped basement carpark excavated to a depth of approximately 3-6m BGL.

Previous environmental investigations undertaken for the site comprised a *Preliminary Site Investigation Report* (PSI, 2015), prepared by Douglas Partners Pty Ltd in November 2015 and a *Detailed Site Investigation* Report (DSI, 2016), prepared by Environmental Investigations Australia Pty Ltd in April 2016.
The site was developed in the 1960's for commercial/industrial purposes with various commercial/industrial activities likely being present onsite since. A commercial laundry was present in the northern end of the site (No. 4 McGill Street), whilst an offsite drycleaner was located at the neighbouring property to the north (No. 2 McGill Street). It should be noted that access was not granted at No 4 McGill Street and therefore was not included in the DSI, 2016 report.
The DSI, 2016 report identified a B(α)P TEQ hotspot (13mg/kg) at the south-western corner of the site and the presence of an empty Underground Storage Tank (UST) at the central-east site boundary with the UST's approximate dimensions being defined by a Ground Penetrating Radar (GPR) approximately 1.6 x 2.5m at a depth of 0.8m BGL (top of tank). These areas were deemed to require remedial activities.
Ecological exceedances were also noted for benzo(α)pyrene in the fill layer of borehole location BH2 (2mg/kg at a depth of 0.4-0.5m BGL and 2.6mg/kg at 0.9-1.0m BGL) and BH7 (8.5mg/kg at a depth of 0.0-0.1m BGL and 5.8mg/kg at 0.5-0.7m BGL), as well as TRH fraction F3 in the fill layer of BH7 (340mg/kg at 0.0-0.1m BGL).

The adopted remedial strategy for the impacted soil considered most appropriate for the current scenario is excavate and dispose. Therefore, the following works are required to remediate:

- Furthermore, it was recommended that further soil and groundwater investigation should be undertaken prior to commencing the remedial works in order address the outstanding data gaps. The additional investigation should include another two borehole locations drilled in the northern part of the site (No 4 McGill Street) to complete site characterisation and to assess potential impacts to soil and groundwater from the former offsite drycleaners (adjacent to the north at No 2 McGill Street); installation of three monitoring bores, groundwater sampling and laboratory analysis to assess groundwater underneath the site; and additional soil investigation for any proposed deep soil landscaped areas.
- Further delineation sampling to define the extent of the B(α)P TEQ impacts within the south-western part of the site;
- Removal of the UST present at the central-east site boundary;
- Further characterisation of fill materials in-situ, and classification of the fill materials as well as any excavated waste stockpiles for off-site disposal of this material in accordance with NSW EPA guidelines;
- Classification of any remaining natural soils and/or bedrock to determine their suitability for recycling and reuse as appropriate, for the remainder of excess soils designated for basement excavation;
- Validation of the remedial excavations, involving the collection of soil validation samples and analysis for contaminants of concern. If visible or olfactory signs of contamination are detected,

additional materials will be removed from the impacted zone(s) and validation samples will be collected for analysis. Subject to laboratory results the impacted zone(s) may be further remediated and revalidated, if necessary; and

- Further soil sampling of ecological areas to assess the site specific suitability of these soils for ecological uses.

Following completion of these works a Site Validation Report will be prepared in accordance with the OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites stating that the results of remediation and site validation assessment meet the criteria for the proposed commercial and industrial land uses.

1 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

Mr John Anogianakis of McGill Advance Management Pty Ltd (the client) engaged Environmental Investigations Australia Pty Ltd (EI) to prepare a Remediation Action Plan (RAP) for the property located at 4-12 McGill Street, Lewisham NSW ('the site'). The purpose of this RAP is to guide remediation works required to make the site suitable for the proposed residential land use.

The site is located approximately 6km south-west of the Sydney central business district, as shown in **Figure 1**, situated within the Local Government Area of Marrickville Council. The land parcel covers a total area of approximately 2,660 m^2 as shown in **Figure 2**.

Two previous environmental assessments were conducted at the site, being:

- *Preliminary Site Investigation Report* (PSI), prepared by Douglas Partners Pty Ltd (Douglas Partners). Project No: 85086.1_Rev1, dated November 2015 (PSI, 2015); and
- *Detailed Site Investigation* Report (DSI), prepared by Environmental Investigations Australia Pty Ltd (EI). Reference Report Number E22830 AA_Rev0, dated 26 April 2016 (DSI, 2016).

The previous environmental investigations were completed for site characterisation purposes. Based on the PSI, 2015 historic land use indicated that the site was subject to commercial/industrial activities, including an onsite commercial laundry at the northern portion of the site (No. 4 McGill Street) and an offsite drycleaner at the neighbouring property to the north (No.2 McGill Street) as well as potential filling, especially on the western side of the site near the stormwater canal.

During the DSI, 2016, a B(α)P TEQ hotspot (13mg/kg) was identified at the south-western site corner, at borehole location BH7. Impacted fill soils at this location extended down to at least 0.8m Below Ground Level (BGL), however TC-bit refusal during the intrusive works prevented adequate delineation of this hotspot. The presence of an empty Underground Storage Tank (UST) was located at the central-east site boundary with the UST's approximate dimensions being defined by a Ground Penetrating Radar (GPR) approximately 1.6 x 2.5m at a depth of 0.8m BGL (top of tank). Exceedances of the ecological criteria were also identified for benzo(α)pyrene in the fill layer of borehole location BH2 (2mg/kg at a depth of 0.4-0.5m BGL and 2.6mg/kg at 0.9-1.0m BGL) and BH7 (8.5mg/kg at a depth of 0.0-0.1m BGL and 5.8mg/kg at 0.5-0.7m BGL), as well as TRH fraction F3 in the fill layer of BH7 (340mg/kg at 0.0-0.1m BGL).

This RAP was developed to guide the remediation and validation works for the identified contamination, to aid in the successful redevelopment of the site.

1.2 PROPOSED DEVELOPMENT

Based on the client provided concept plans (Ref. Tony Owens Partners, Project no. 947, dated August 2015), the proposed development involves the demolition of the existing site structures and the construction of two, five- and six-storey residential apartment buildings over a common, one- to two-level stepped basement carpark excavated to a depth of approximately 3-6m BGL. Locally deeper excavations may be required for footings, service trenches and lift overrun pits. A four meter setback from the western boundary was dedicated to comprise a deep soil landscaped area, as depicted on the proposed development plans provided in **Appendix A**.

1.3 REMEDIATION OBJECTIVES

The main objective is to render the soils at the site suitable for the proposed residential land use with minimal access to soils. This RAP will guide site remediation and validation works by:

- Providing the framework of the additional investigation required to be undertaken, as recommended in the DSI, 2016 report in order to close the identified data gaps;
- Providing details on how to carry out remediation works in a safe and environmentally friendly manner, while minimising impacts;
- Providing a sampling and quality plan (SAQP) to be used for site validation, and
- Complying with the DA Conditions.

1.4 SCOPE OF WORKS

The scope of works proposed are:

- Define remediation goals and acceptance criteria;
- Evaluate available remediation options and select of the most appropriate remedial strategy (or combination of) for the site;
- Provide information so that remedial works may be carried out in accordance with relevant approvals, licenses, and legislation (e.g. SEPP 55);
- Provide information to assist the contractor in their preparation of a Work Health and Safety Plan and other site management/planning documents;
- Develop a sampling and quality strategy for soil delineation works, to limit the volume of potentially hazardous soils to be excavated and disposed of, making way for basement construction; and
- Develop a sampling and quality strategy for site validation, to confirm that previously identified contaminated materials have been effectively remediated, to a level suitable for the proposed mixed land use, and in accordance with this RAP.

The scope of works shall achieve the above objectives while keeping the project cost-effective and generally complying with the OEH (2011) guidelines for consultants reporting on contaminated sites.

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 the additional investigations and/or site remedial works. The measures provided in this RAP are brief, and are designed to accompany site specific management plans. These measures do not replace any requirements for the site as a whole, and a complete set of site specific management should be developed, and adhered to.

1.5 REGULATORY FRAMEWORK

The following regulatory framework and guidelines that applies to the preparation of this RAP and implementation of the remedial works include, but are 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;*
- *State Environment Protection Policy 55 – Remediation of Land (SEPP 55) under the Environmental Planning and Assessment Act (1997);*
- *Work Health and Safety Act 2011; and*
- *Work Health and Safety Regulations 2011*.

Guidelines

- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality;
- DECCW (2009) Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (now 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) Technical Note: Investigation of Service Station Sites;
- EPA (2014) Wast Classification Guidelines;
- NEPC (2013) Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater;
- NEPC (2013) Schedule B(2) Guideline on Site Characterisation; and
- OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites.

Many of these documents are also required to be considered during the preparation of any site specific plans and the remediation and validation works.

1.6 DEVIATIONS FROM THIS RAP

While it may be possible to vary the sequence and/or details of the actual site remediation and validation works to meet site constraints, it is strongly recommended that the appointed Environmental Project Manager be involved during this process to ensure that:

- An environmental engineer/scientist is present on the site during critical stages of the site remediation/validation process, so that site works are documented and the required data is collected for environmental reporting purposes; and
- Any deviations from the works specified in this RAP are properly documented, as required under the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*.

Performing remedial works without the presence of a qualified environmental engineer/scientist when necessary may lead to project delays and extra costs due to additional environmental investigation requirements imposed by any independent third party, regulator or auditor (if appointed), to confirm the environmental status of the site. In worst case scenarios, waste materials removed from the site without proper characterisation and/or waste classification assessment, may lead to potential regulatory action and significant penalties, as described under the Waste Regulation 2014, the Protection of the Environment Operations Act 1997 and the Contaminated Land Management Act 1997.

2 SITE DESCRIPTION

2.1 SITE SETTING

The site identification details and associated information are presented in **Table 2-1**, while the site locality is shown in **Figure 1**. For further information regarding site setting, please see the DSI, 2016 report.

Table 2-1 Site Setting

Attribute	Description
Street Address	The site was located at 4-12 McGill Street, Lewisham NSW (Ref. **Figure 1**). It was further identified as Lot 2 in DP 533963, Lot B in DP 161098, Lot E in DP 419611, and Lot F in DP101532.
Location Description	Approx. 6 km southwest of Sydney CBD, a rectangular shaped block bound by several multistorey residential developments to the north, south and east, and a light rail corridor to the west. Northeast corner of site: GDA94-MGA56 Easting: 328369.229, Northing: 6248033.289 (Source: http://maps.six.nsw.gov.au).
Site Area	2.660 m^2 (Ref. Survey Plan by Geomat Engineering Pty Ltd, Dwg no. 14100-01, dated 3/11/2014)
Site Owner	McGill Advance Management Pty Ltd, Kam Shan Josephine Lam and Amen Kwai Ping Lee (Ref. PSI, 2015).
Local Government Authority	Marrickville Council
Parish	Petersham
County	Cumberland
Current Zoning	R4 – High Density Residential (8-12 McGill Street) & B4 – Mixed Use (4 McGill Street) (Ref. Marrickville Local Environment Plan 2011)
Current Land Uses	Northern Lot (No. 4 McGill St.) – Currently display office for adjacent residential development, formerly an “A.N.T” commercial Laundry. North Central Lot (6-8 McGill St.) – “Peckam Binding Company”, a commercial binding/print manufacturer. South Central Lot (10 McGill St.) – “Wholesale Imaging”, a commercial printer. Southern Lot (12 McGill St.) – “TK Pacific marketing”, a commercial storage warehouse for tobacco and baby products.
Site Topography / Drainage	The local topography falls towards the west from an RL of approximately 14.2m AHD at the south-eastern corner to RL of about 11.13m AHD at the north-western corner. The western boundary is excavated for the existing railway corridor at approximately 11.3 to 10.2 m. Consistent with the general slope of the site, stormwater is assumed to flow north and west towards the Hawthorne Canal drainage system

Attribute	Description
Regional Geology	With reference to the 1:100 000 scale Geological Series Sheet 9130 (Sydney) the site was indicated to be on the boundary of man-made fill on Quaternary Holocene aged alluvial to the west of the site and Ashfield Shale of the Wianamatta Group to the east. The alluvial sand deposits typically comprise of silty to peaty quartz sand, silt, and clay, with ferruginous and humic cementation in places. Ashfield Shale comprises of black to dark-grey shale and laminite. Based on the intrusive works undertaken onsite by EI, the site appeared to be underlain by a thin layer of clay (possible Ashfield Shale or Mittagong Formation) in several boreholes overlying Hawkesbury Sandstone.
Depth of Site Filling	Filling during the DSI, 2016 intrusive works was recorded between 0.1 m BGL and 1.1 m BGL, comprising Gravelly Clayey Sand & Silty Gravelly Sand; orange/grey, red/brown - grey, dry-moist, no odour.
Typical Soil Profile	Concrete hardstand over clayey sand and sand fill with some gravel including brick and sandstone, overlying a thin clay layer, thence Sandstone, distinctly to slightly weathered or fresh with depth, medium to coarse grained.
Groundwater	Based on previous information close to the site, the average depth to groundwater is anticipated to be 3 – 4 m BGL. However the onsite installed groundwater monitoring well as part of the DSI, 2016 report was found to be dry down to 4.5 m BGL and no additional monitoring wells were installed thereafter due to access restrictions. The groundwater includes intermittent seepage zones that may be present in the fill layer (estimated to be up to 0.5m thick) and deeper groundwater moving through fractures, joints and bedding planes within the underlying sandstone bedrock. Groundwater flow direction is anticipated to flow in the direction of Hawthorne Canal which flows to Iron Cove and Sydney harbour approximately 2.6 km north of the site.

3 SITE CHARACTERISATION

3.1 PREVIOUS INVESTIGATIONS

In preparing this RAP, EI considered the following documents:

- *Preliminary Site Investigation Report* (PSI), prepared by Douglas Partners Pty Ltd (Douglas Partners). Project No: 85086.1_Rev1, dated November 2015 (PSI, 2015);
- *Geotechnical Assessment Report (GA),* prepared by Environmental Investigations Australia Pty Ltd (EI). Reference Report Number E22830 GA, dated 20 April 2016 (GA, 2016);
- *Detailed Site Investigation* Report (DSI), prepared by Environmental Investigations Australia Pty Ltd (EI). Reference Report Number E22830 AA_Rev0, dated 26 April 2016 (DSI, 2016).

GA, 2016:

The primary objective of the previous geotechnical investigation was to assess site surface and subsurface conditions at one borehole location and to provide geotechnical advice and recommendations.

Auger drilling was undertaken at one location (BH1) by a track-mounted drill rig using solid flight augers, down to a depth of 0.4 m BGL and was then advanced using NMLC diamond coring technique to a termination depth of about 8.1 m BGL.

The primary objective of the previous environmental investigations were to investigate and evaluate the degree of potential site contamination caused by on and off-site sources to soil and groundwater. Pertinent findings of the reports indicated the following:

PSI, 2015:

- The site comprised four allotments, each occupied by one or two storey brick buildings. The site was bound by Inner West Light Rail line to the west.
- The site was developed in the 1960's for commercial/industrial purposes with various commercial/industrial activities likely being present onsite since.
- A commercial laundry was present in the northern end of the site (No. 4 McGill Street), whilst an offsite drycleaner was located at the neighbouring property to the north (No. 2 McGill Street). This was considered to pose a moderate to high risk of contamination in both soil and groundwater at the site.
- The remainder of the site was also considered of moderate risk of contamination from historic and current land use, which included potential filling (especially on the western side of the site, near the stormwater canal) from historic demolition activities and from general commercial/industrial activities.

DSI, 2016:

- The site comprised a commercial/industrial property, occupied by a display office for the adjacent development at the northern allotment (No 4 McGill Street), a commercial binding/printing manufacturer at the central-north allotment (No 8 McGill Street), a commercial printing company at the central-south allotment (No 10 McGill Street) and a commercial storage warehouse for tobacco and baby products at the southern allotment (No 12 McGill Street). The property to the northern end (No 4 McGill Street) formerly comprised a commercial laundry.
- The site was bound by an un-occupied dry cleaning business to the north (No 2 McGill Street) (downgradient), a commercial warehouse to the south (No 14 McGill Street), McGill Street followed by construction sites to the east and a light rail corridor running in a NE-SW direction to the west as well as a concrete-lined drainage channel (Hawthorne Canal) running in a NW-SE direction to the south-western corner of the site.
- Local site topography sloped to the west from an RL of approximately 14.2 m AHD at the south-

western corner to RL 11.3 m AHD at the south-western corner.

- The condition of the suspected corrugated fibreboard roofing, likely to contain asbestos material, was not able to be closely examined due to height/access restrictions.
- An Underground Petroleum Storage System (UPSS) was confirmed to exist in the loading bay of the central-north property (No 8 McGill Street). A survey of the UPSS area by a GPR and using an existing dip-stick indicated the presence of a single UST approximately 2.5 x 1.6 m with the top of the tank measured at a depth of 0.8 m BGL.
- Soil sampling and laboratory analysis was conducted at seven borehole locations (BH1-BH7) across accessible areas of the site, down to a maximum depth of 1.5 m BGL. The investigation depth of the boreholes extended down to a maximum depth of 8.05 m BGL. Access was restricted in the northern end of the site (No 4 McGill Street) due to tenancy.
- Groundwater was not assessed onsite, as the installed groundwater monitoring well down to 4.5 m BGL was found dry. No deeper monitoring wells were installed thereafter due to access restrictions.
- Laboratory results of all tested soil samples for selected heavy metals, TRH/BTEX, pesticides and asbestos reported all concentrations to be below the adopted human health based criteria. A single exceedance of the adopted human health criteria was noted for PAH B(α)P TEQ at borehole location BH7 ranging between 8.2-13 mg/kg to a minimum depth of 0.7 m BGL.
- Ecological based exceedances were noted for benzo(α)pyrene in the fill layer at BH2_0.4-0.5 (2 mg/kg), BH2_0.9-1.0 (2.6 mg/kg), BH7_0.0-0.1 (8.5 mg/kg) and BH7_0.5-0.7 (5.8 mg/kg), as well as for TRH fraction F3 in fill layer sample BH7_0.0-0.1 (340 mg/kg).

The DSI, 2016 report recommended that a Remedial Action Plan should be undertaken to outline necessary remediation and validation requirements associated with the decommissioning of the UPSS and any unexpected finds during redevelopment.

Furthermore, it was recommended that further soil and groundwater investigation should be undertaken prior to commencing the remedial works in order address the outstanding data gaps. The additional investigation should include another two borehole locations drilled in the northern part of the site (No 4 McGill Street) to complete site characterisation and to assess potential impacts to soil and groundwater from the former offsite drycleaners (adjacent to the north at No 2 McGill Street); installation of three monitoring bores, groundwater sampling and laboratory analysis to assess groundwater underneath the site; and additional soil investigation for any proposed deep soil landscaped areas.

3.2 CONCEPTUAL SITE MODEL

As part of the DSI, 2016 assessment, a conceptual site model (CSM) was derived for the site, assessing potential linkages between contamination sources, migration pathways and receptors and aid with site characterisation. From the findings of this assessment, the CSM was adapted for the remedial works and is presented in this section.

3.2.1 Site Geology and Subsurface Conditions

The general site geology encountered during the investigation were described as a layer of anthropogenic filling overlying residual soils and sandstone bedrock. The geological information obtained is summarised in **Table 3-1** and borehole logs from these works are presented in **Appendix B**.

Table 3-1 Generalised Subsurface Profile

Layer	Description	Depth to top & bottom of layer (m BGL)
Concrete		0 – 0.1 (max 0.16 at BH1)
Fill	Gravelly Clayey Sand & Silty Gravelly Sand; orange/grey, red/brown - grey, dry-moist, no odour.	0.1 – 0.4 (max 1.1 at BH2)
Residual Soil	CLAY; medium plasticity, orange/brown, very stiff, moist, no odour (possibly residual Ashfield Shale or Mittagong Formation).	0.4 – 0.8 (min 0.1 at BH4 & BH6 max 1.1 – 1.5+ at BH2)
Bedrock	SANDSTONE; weathered Hawkesbury Sandstone, medium grained, pale yellow grey, no odour.	0.25 – 8.05+ (min 0.1 at BH3)

Notes: + Termination depth of borehole.

3.2.2 Contamination Sources Requiring Remediation

Based on the findings of the DSI, 2016 investigation, the resulting sources of contamination that require remediation and/or further investigation are:

- The presence of the UST at the central-east site boundary;
- The B(α)P TEQ hotspot identified at the south-western site corner, in the vicinity of borehole BH7, down to at least 0.8 m BGL;
- Benzo(α)pyrene impacts in exceedance of the ecological criterion in the fill layer of borehole location BH2 (2mg/kg at a depth of 0.4-0.5m BGL and 2.6mg/kg at 0.9-1.0m BGL) and BH7 (8.5mg/kg at a depth of 0.0-0.1m BGL and 5.8mg/kg at 0.5-0.7m BGL) and TRH F3 impacts in fill at BH7 (340mg/kg at 0.0-0.1m BGL);
- Additional soil investigation of the northern end of the site (No 4 McGill Street) to complete site characterisation and to assess potential impacts to soil and groundwater from the former offsite drycleaners (adjacent to the north at No 2 McGill Street);
- Groundwater investigations across the site to assess groundwater conditions underneath the site; and
- Additional soil sampling along the western site boundary where soils are proposed to remain onsite (4m set-back from the site boundary) and comprise deep soil landscaped areas to assess whether soils can be retained onsite for the intended use.

Should additional groundwater or soil impacts be identified, a RAP addendum may need to be issued. Further discussion on the extent of remediation and additional investigatory works is provided in **Section 4**.

3.2.3 Contaminants of Concern

The contaminants of concern at the site are:

- Soil – heavy metals (HMs), TPH, PAH, the monocyclic aromatic hydrocarbon compounds benzene, toluene, ethylbenzene and xylenes (BTEX), organochlorine and organophosphate pesticides (OCP/ OPP), polychlorinated biphenyls (PCB) and asbestos.

- Groundwater – HMs, TPH, BTEX, PAH and volatile organic compounds (VOC), including chlorinated VOC (VOCC) such as tetrachloroethylene (PCE) and trichloroethylene (TCE).

3.2.4 Potential receptors

For the periods during and after remediation works the following human and environmental receptors are considered, with risk ratings as presented in **Table 3-2**:

Table 3-2: Potential Receptors

Receptor	Media/exposure route	Risk
Workers during remediation	Soil / Dermal / Inhalation/Ingestion	Medium - high for fill removal, to be reduced with implementation of dust control and health and safety measures, such as the use of dust masks during fill removal. Odour control should also be implemented should odorous soils be encountered.
Surrounding Residents	Soil / Inhalation	Low (however is dependent on effectiveness of dust control measures)
Residential occupants	Soil / Inhalation	Medium – high should the additional investigation identify the presence of VOCs in soils or groundwater Low – none post remediation
Groundwater	Soil / Contact / Dissolution	Medium - high due to the former presence of the onsite commercial laundry and commercial/industrial activities, as well as offsite drycleaner.
Hawthorne Canal (south-west corner of the site)	Dissolution	Medium - high due to the former presence of the onsite commercial laundry and commercial/industrial activities, as well as offsite drycleaner.
Proposed Landscape Areas	Soil / Contact / Dissolution	Unknown, as inadequate sampling has been conducted within this area of the site, to date.

3.2.5 Data Gaps/Uncertainties

Based on the conceptual site model derived for the site, the following data gaps or uncertainties have been identified:

- Unknown hydrocarbon impacts from the presence of the UST;
- Unknown impacts from the former presence of the onsite commercial laundry and offsite drycleaner, as well as onsite commercial/industrial activities;
- Further characterisation of fill and natural material present across the site, for site characterisation and waste classification purposes; and
- The suitability of fill materials in the proposed retained deep soil zones for landscaping use.

4 REMEDIATION WORKS

4.1 REMEDIATION GOALS

The main objectives of the remediation program are to remediate and/or remove contaminated soils and to ensure that the quality of remaining site soils and groundwater are consistent with the relevant regulatory criteria for residential (with minimal access to soil) and deep soil planting zone along the western boundary.

Further investigations are required to identify potential soil and/or groundwater contamination and possible vapour impact that may require the further assessment of risk particularly on the northern site boundaries of site occupied by the off-site Golden Laundry/Dry Cleaner. Contingency measures designed to address this risk have been provided in this RAP.

4.2 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.

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. Advantages, disadvantages and suitability of available soil remedial technologies are summarised in **Appendix C.**

4.3 ANTICIPATED VOLUME OF EXCAVATED SOIL

As the majority of the site is designated for bulk excavation to make way for basement construction, the remediation option of excavation and disposal is considered the most appropriate for this site. However, should excavation depths differ from that currently proposed, this remedial option should be re-assessed for suitability. The excavation and offsite disposal remedial option should ensure no sources of soil contamination remain for the proposed residential land use. As shown in **Table 4-1**, it is estimated that approximately 128 m^3 of soil is to be excavated for the remedial works, whilst overall 12,062 m^3 of soil is to be excavated for the entire development. Further characterisation of fill and natural material in situ is required to adequately characterise site soils and classify the soils which may increase the volume of soils to be remediated.

Table 4-1 Approximate Excavation Volumes

Area	Approximate Volume	Excavation Area- Approximate Dimensions	
	(m^3)	Area (m^2)	Depth (m)
Impacted fill materials present in the UST area	108	36	3
B(α)P TEQ hotspot at borehole BH7	20 (pending delineation)	25	0.8

Area	Approximate Volume	Excavation Area- Approximate Dimensions	
	(m^3)	Area (m^2)	Depth (m)
Fill soils within deep soil landscaped area (to be confirmed if these soils will be removed)	108	215	~0.5
Fill across basement area excluding soils to be remediated	606	2,444	~0.3
Natural soils across basement area	11,220	2,444* / 1,540^	3 / 3
Total	12,062	-	-

* = Area of basement 1 (upper basement)

^ = Area of basement 2 (lower basement)

4.4 PREFERRED REMEDIATION STRATEGY

Based on the assessment of remedial technologies (**Appendix C)** the preferred remedial strategy for the site is excavation and removal of the impacted soils. A detailed description of required delineation and remedial activities, as well as additional site history requirements are outlined below:

4.4.1 Task 1 – Preliminaries and Site Preparation

SEPP 55 (1998) – *Remediation of Land*, details when a consent is required for remediation works. Under SEPP 55, the remediation work needs to be determine whether it is considered Category 1 work where there is the potential for significant environmental impact and requires development consent or Category 2 works which does not require consent. The determination is outlined in **Table 4-2**.

Table 4-2 Category Determination

Significant Environment Impact	Yes/No	Category
Designated Development or State Significant Development	No	2
Critical or threatened species habitat	No	2
Have significant impact on threatened species, populations, ecological communities or their habitats	No	2
In area identified environmental significance such as scenic areas, wetlands (see list*)	No	2
Comply with a policy made under the contaminated land planning guidelines by the council.	Yes	2
Is work ancillary to designated development	Yes	2

* - Environmental significance list -coastal protection, conservation or heritage conservation, habitat area, habitat protection area, habitat or wildlife corridor, environment protection, escarpment, escarpment protection or escarpment preservation, floodway, littoral rainforest, nature reserve, scenic area or scenic protection, or wetland.
TBD – To be defined

Based on the above assessment the remediation works for the site are considered as Category 2 remediation works, and therefore will not require development consent. Instead, council should be notified 30 days before commencement of the works. The 30-day limit does not prevent council intervention after that time for a breach of the Act or non-compliance with SEPP 55. The notification also serves as the basis for updating council records on properties in its area and must:

- Be in writing;
- Provide contact details for the notice;
- Briefly describe the remediation work;

- Show why the work is considered category 2 remediation work;
- Specify the property description and street address on which the remediation work is to be carried out;
- Provide a location map; and
- Provide estimates for commencement and completion dates of the work.

Provision of this RAP, as well as an indication of commencement and completion dates of the works in writing, is usually sufficient to meet the requirements of this notification.

Development Consent / Development Control Plans (DCPs)

All works should be in accordance with the Marrickville Council DCPs and any development consent issued by Council for the development.

Other Requirements

The appointed site contractor should prepare an appropriate Construction Environmental Management Plan (CEMP), health and safety plans and other plans required by the Council DA and DCPs as detailed in **Section 6**.

4.4.2 Task 2 – Additional Investigation for Site Characterisation

Once site has been demolished and prior to commencement of remedial works, further investigations will required to be undertaken. This should include the following tasks:

- Additional soil investigation is required in the previously inaccessible northern end of the site (No 4 McGill Street) to complete site characterisation and to assess potential impacts to soil and groundwater from the former offsite drycleaners (adjacent to the north at No 2 McGill Street). The proposed sampling locations have been indicated on **Figure 2**;
- Groundwater investigations across the site to assess groundwater conditions underneath the site. Three groundwater monitoring bores should be installed across the site with at least one round of groundwater monitoring and laboratory analysis for the relevant chemicals of concern. The groundwater monitoring well in the proximity of the drycleaner should be cored with the screen interval placed where any major bedding planes or fractures have been identified. Should VOCs be identified during this additional investigation, consideration should be given in the requirement of a vapour assessment;
- Further delineation of the identified B(α)P TEQ hotspot at the south-western site corner, in the vicinity of borehole BH7, as this borehole refused in fill and therefore the extent of the B(α)P TEQ impacted soils was not achieved;
- Should soils within the proposed deep soil landscaped area (4m set-back from the western site boundary) be proposed to be retained onsite, further investigation should be undertaken within this area in order to ascertain whether these soils are suitable for the intended use. Collect one soil sample per 100m^2, targeting any changes in lithology, to at least 2m BGL. Analyse a range of samples considered sufficient to adequately assess the deep soil planting area (minimum of 3 samples), for chemicals of concern (**Section 3.2**). Ensure analysis includes an assessment of physicochemical parameters (pH, clay content and cation exchange capacity). Should any soils sampled be considered unsuitable for the ecological use proposed, the soils should be removed as detailed in **Task 5**, with the excavation to continue until no further impacts are observed. Soils should then be validated as outlined in **Section 7**.

4.4.3 Task 3 – UPSS Removal

The results from the assessment phase (DSI, 2016) indicated the presence of a UST in the loading bay of the central-north property (No 8 McGill Street). A geophysical survey utilising the Ground

Penetrating Radar method indicated that the UST sized approximately 2.5 x 1.6 m and the top of the tank was identified at a depth of 0.8 m BGL.

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

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

- Appropriate decommissioning and removal the USPSS 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. Spoil will be stockpiled on a plastic lined bunded area prior to assessment, classification and off-site disposal. Water that may collect within remedial excavations will require water sampling and testing to enable appropriate disposal and /or recycling

4.4.4 Task 4 – B(α)P TEQ Impacted Fill

The results from the assessment phase indicated that a hotspot of B(α)P TEQ contamination was present in the south-western corner of the site (BH7). Impacted soils were considered to extend down to at least 0.8 m BGL where drilling of the borehole was terminated due to refusal of the hand auger. Delineation depth of the hotspot will be provided once the additional investigation described in **Task 3** has been undertaken.

The fill soils in this area, to at least 0.8m depth (pending confirmation of the additional investigation), will therefore be remediated, utilising the following methodology:

- pending the delineation depth provided by the additional investigation, excavation of the surface fill to expose underlying natural soil. The excavation will centre on location BH7 and will cover a footprint of 5m x 5m. ;
- inspection of the excavation area(s) for visible asbestos and other unexpected finds;
- validation sampling of the base and side walls of the final excavation, to enable PAH analysis. Complete field screening of soil validation samples collected from the base and side walls of the final excavations in accordance with EPA (2014) *Technical Note: Investigation of Service Station Sites,* using a PID along with visual and olfactory observations;

- If laboratory analysis reports exceedance of acceptance criteria then the excavation will be extended and further sampling undertaken at the new extent.

Machinery and / or equipment used for the excavation works should be dedicated to the individual excavation, and should be clean, free of all solid materials. All excavated material is to be stockpiled. The excavated material is to be stockpiled separately from all other excavated materials, on either hardstand, or an impermeable surface (such as a plastic liner). Any soils with heavy staining and/or odour not of a hydrocarbon nature are to be isolated from other excavated materials, for waste classification sampling and testing.

4.4.5 Task 5 – Excavation of Site Wide Fill Materials

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.
- Validation sampling of exposed natural soil surfaces will be required following the removal of the UST and B(α)P TEQ impacted fill soils to confirm the removal of all contamination within the remediated areas. Validation requirements are further discussed in **Section 7**.
- 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.

4.4.6 Task 6 – Materials and Waste Management

All excavated soils shall be managed as described in **Section 6.2.** 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 excavations;
- 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, PAHs, pesticides and asbestos; and
- Preparation of a Waste Classification Certificate detailing the interpreted soil waste classification for each stockpile, to enable appropriate off-site disposal.

The proposed waste classification sampling plan may be varied due to site constraints, however, guidance from the appointed Environmental Project Manager or appointed Environmental Consultant must be sought to ensure that deviations from this RAP are properly documented, as required under the NSW EPA (2014) 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.

Contingency measures to handle and manage the disposal of spoil materials that fail to meet landfill threshold criteria are provided in **Section 6.4**.

4.4.7 Task 7 –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. To deem soils suitable for reuse on the subject site, the following confirmation procedure should be undertaken:

For soils present on the subject site:

- If potential backfill material is present in another area of the site, the identified material is to be visually assessed as to whether the material can be physically isolated from any other potentially contaminated material. Should isolation be feasible, the identified 'clean' materials should be separately stockpiled on a concrete-paved area, or 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.

For soils sourced off-site:

- All imported soils brought to the site should be certified as to the suitability of application for the designated land use criteria; and
- 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.

4.5 REMEDIATION SCHEDULE

An estimated schedule for the remedial works is detailed below in **Table 4-3**. The proposed schedule is based on the remedial works being completed as outlined in this RAP and is dependent on Council approval of any DA and conditions of consent which may apply. The estimated timescale is detailed below.

Table 4-3: Indicative remedial schedule

Timeframe	Action
4 weeks	Council and/or Independent Approval of RAP
TBA	Site Demolition
2 - 4 weeks post demo	Additional Soil Investigation
TBA	Site Excavations and Waste Classification
During Excavation	Validation Sampling
4-6 weeks post sampling	Validation Reporting
2 weeks	Review of Validation Report
2-4 weeks post reporting	Review by independent consultant.

5 REMEDIATION CRITERIA

5.1 SOIL CRITERIA

Proposed development plans indicate that the site is to be used for residential purposes with minimal access to soils, over a one- to two-level stepped basement carpark. The proposed soil criteria (based on NEPM 2013) are:

- *Residential B Health Investigation Levels (HILs) 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 (HSLs) for commercial/industrial settings; and*
- *Ecological Investigation / Screening Levels* (EILs/ESLs) for urban residential (deep soil planting zones) and public open space settings.

The proposed criteria with respect to the potential contaminants in soils are detailed in **Table 5-1.** A brief summary of the criteria applied is presented below. 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.

Table 5-1 Adopted Soil Remediation Criteria

Adopted Guidelines	Rationale
NEPM, 2013 Soil HILs and HSLs	**Soil Health-based Investigation Levels (HILs):** Soil concentrations are to be assessed against the *NEPM 2013* ***HIL-B*** based on the land use scenario setting being residential with minimal access to soils.
	Soil Health-based Screening Levels (HSLs): NEPM 2013 soil HSLs for vapour intrusion to assess for potential human health impacts from residual vapours resulting from petroleum, BTEX, naphthalene and VOC impacted soils. • Soil concentrations to be assessed against NEPM 2013 ***HSL-D*** levels for commercial/industrial land use (per NEPM 2013 Table 1A(3), Schedule B1, where HSL-D can be applied for multistorey residential apartments if the ground floor is commercial or car parking, or if there is basement car parking); and • Soils asbestos results to be compared to NEPM 2013 Soil ***HSL*** thresholds for "all forms of asbestos".
NEPM, 2013 EILs and ESLs	**Ecological Investigation and Screening Levels (EILs & ESLs)** – NEPM 2013 EILs for Naphthalene and ESLs for TPH fractions F1 – F4, BTEX and Benzo(a)pyrene in soil will be used to assess ecological impacts of the tested soils in landscaped garden areas and lawns. EILs and ESLs only apply to the top 2m (the root zone).
Other Soil Criteria for Analytes not addressed under NEPM, 2013	**Regional Screening Levels (RSLs)** – US EPA 2012, Region 9 Screening Levels for residential soil (Summary Table, April 2012). In the absence of NEPM 2013 criteria for VOCs, the USEPA 2012 ***RSLs*** will be applied as interim working level SILs, only.

5.2 GROUNDWATER CRITERIA

Groundwater was not assessed as part of the previous investigations. The additional investigation as proposed in Task 3, will incorporate the groundwater assessment. Should groundwater identified to be impacted, an addendum to this RAP will be required to detail the required remedial process.

6 SITE MANAGEMENT

6.1 RESPONSIBILITIES AND CONTACTS

The overall responsibilities for the various parties involved with the remediation are outlined in **Table 6-1.**

Table 6-1 Site Management Responsibilities

Responsible Party	Details/Contacts	Responsible for:
Principal Project Manager (PPM)	TBA	Overall management of the site remedial activities
Property Owner	McGill Advance Management Pty Ltd	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.
Qualified Independent Consultant	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.

6.2 MATERIALS HANDLING AND MANAGEMENT

Table 6-2 summarises the measures that should be implemented in respect of materials handling during excavation and remediation works at the site.

Table 6-2 Materials Handling and Management Requirements

Item	Description/ Requirements
Earthworks contractors	Excavation of fill materials should be completed by a suitably qualified contractor to ensure: • All site staff are aware of the environmental and health and safety requirements to be adhered to; • There is no discernible release of dust into the atmosphere as a consequence of the works; • There is no discernible release of contaminated soil into any waterway as a consequence of the works; and • There are no pollution incidents, health impacts or complaints.
Stockpiling of materials	All stockpiles will be maintained as follows: • Stockpiles must be located on sealed surfaces such as sealed concrete, asphalt, or high density polyethylene; • Should stockpiles be placed on bare soils, these soils should be placed on yet to be remediated areas. Contaminated materials should only be stockpiled in locations that do not pose any environmental risk (e.g. hardstand areas); • Excavated soils should be stored in an orderly and safe condition (≤2m height); • Stockpiles should be battered with sloped angles to prevent collapse; • Stockpiles should be covered or 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); and • Stockpiles will be strategically located to mitigate environmental impacts while facilitating material handling requirements.

Item	Description/ Requirements
Loading of material	Loading of stockpiles / materials will be as follows: • Transport of contaminated material off the site is to be via a clearly distinguished haul route. • Measures shall be implemented to ensure no contaminated material is spilled onto public roadways or tracked off-site on vehicle wheels. Such measures should include the use of a wheel washing/cleaning facility, placed before the egress point on the site, and should be able to handle all vehicles and plant operating on-site. • Residue from the cleaning facility should be collected, 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 proven otherwise.
Transport of materials	Prior to being assigned to an appropriate waste disposal facility, all waste fill/soils should be classified in accordance with the NSW 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 trucks transporting soils from the site are to be covered with tarpaulins (or equivalent). • All haulage routes for trucks transporting soil, materials, equipment and machinery shall comply with all road traffic rules, minimise noise, vibration and odour to adjacent premises, utilise state roads and minimise use of local road. • All deliveries of soil, materials equipment or machinery should be completed during the approved hours of remediation and exit the site in a forward direction. • 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. • Waste must be transported less than 150 km from the source (POEO, Waste, 2014) and landfills are required to be licensed for the category of waste they are scheduled to receive.
Material tracking	Materials excavated from the site should be tracked from the time of their excavation until their disposal. Tracking of the excavated materials should be completed by recording the following: • Origin of material; • Material type; • Approximate volume; and • Truck registration number. Disposal locations will be determined by the remediation contractor. Disposal location, waste disposal documentation (weighbridge dockets) and the above listed information should be provided to the remediation consultant for reporting purposes. Waste transporters are required to report the movement of more than 100kg of asbestos waste or more than 10 m^2 of asbestos sheeting within NSW. All drivers delivering asbestos to a waste facility are required to scan a QR2id code to confirm the delivery. Any waste facility in NSW which accepts asbestos waste is required to display a *WasteLocate* plate with a unique QR2id code for that facility in a prominent location easily seen and accessed by drivers for scanning in order to complete the delivery. Failure of using the *WasteLocate* will result to heavy penalties.

Item	Description/ Requirements
Material visual inspection prior to validation sampling.	Following the completion of remedial works as specified within this RAP, the following applies: • A suitably qualified environmental scientist should undertake a visual inspection of the work area. If visual observations indicate contamination, the earthworks contractors should rectify any issues arising from the inspection (i.e. further excavation or 'chasing out' until soils show no evidence of contamination based on visual inspection and/or odours); and • Following satisfactory completion of the visual inspection, validation sampling of soils should be completed. Validation sampling is discussed in **Section 8**. Only following satisfactory validation, will remedial works be deemed as completed.

6.3 MANAGEMENT PLANS

All works should be undertaken with due regard to the minimisation of environmental effects and to meet all statutory environmental and safety requirements (**Section 7.6**). An Environmental Management Plan (EMP) should be developed for the site works by the site contractor/builder which should also take into account the Council DA conditions and guidance including but not limited to:

- DA Conditions of Consent;
- Marrickville Council Development Control Plan 2011; and
- Managing Urban Stormwater, Soils and Construction, Volume 1: 4th edition (March 2004) – often referred to as the 'blue book'.

The overall site management related to the remedial works is presented in **Table 6-3**.

Table 6-3 Site Management Measures

Category	Measure
Demolition (including Asbestos Management)	Appropriate measures shall be taken to ensure that demolition works are completed in accordance with WorkCover Standards and Codes of Practice. Any asbestos identified within building materials should be managed in accordance with WorkCover Codes of Practice and Australian Standards, and should be detailed within the EMP.
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: • Diversion and isolation of any 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*.
Soil Management	Appropriate measures shall be taken to ensure soils are excavated using a methodology appropriate to reduce nuisance dust and odours from leaving the boundary, and are disposed of in accordance with the NSW Government *Protection of the Environment Operations (Waste) Regulation* (2014).
Dust and Odour	Control of dust and odour during the course of the remediation works shall be maintained by the contractor to ensure no nuisance dust or odours are received at the site boundary according to requirements of Marrickville Council DCP (2014). This may be implemented through 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;

Category	Measure
	• 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). EI notes the Council Contaminated Land Policy requires that "No odours shall be detected at any boundary of the site during remediation works by a Council officer who is authorized under the POEO Act and who is relying solely on their sense of smell." Should significant odours be detected, and / or unexpected USTs be identified which are found to be odorous, additional control measures for odour control may be required under the Marrickville Council contaminated land policy, being: • Use of appropriate covering techniques such as plastic sheeting to cover excavation faces; • Use of fine mist sprays / hydrocarbon mitigation agent on the impacted areas/materials (Examples of mitigation agents include BioSolve® Pinkwater®, however a similar product may be selected by the contractor); and • Adequate maintenance of equipment and machinery to minimize exhaust emissions. Furthermore, due to the presence of asbestos within fill material, it is advised that all site workers use adequate dust masks during fill excavation, and that machine operators remain within an enclosed, air conditioned cab.
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 as defined within the Marrickville Council DCP (2011).
Hours of Operation	Working hours will be restricted to those specified by Council, which is loosely defined as being 7am to 7pm weekdays and 7am to 5pm Saturdays; no Sunday work permitted. These hours may differ from DA conditions, and DA conditions specified for the site must be adhered to.
Community Engagement	Community engagement should be carried out in accordance with Schedule B (8) of NEPM (2013). Prior to the commencement of any remediation works at the site, every owner and occupier of any land located either wholly or partly within 100 m of the boundary of the premises (including local council and the RMS) should be notified at least 30 days in advance. The notice should include: • indication that demolition and excavation work is to be carried out on the premises; • state the time and date such work is to commence; • indicate that the works are being conducted to minimise any risk of site contamination impacting on off-site receptors; • provide appropriate site signage at an easily readable location on the site fencing, including site contact name and phone number to be contacted should any matter arise; provide the phone number of a person present on the premises whilst remediation works are being undertaken; and • provide contact information and processes required for registering any complaints.
Incident Management and Community Relations	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 should be prepared and various responsibilities assigned.

Category	Measure
	The site health and safety plan and environmental management plan should 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 should be listed in the Health and Safety Plan and posted on-site for easy access.

6.4 CONTINGENCY MANAGEMENT

Contingency plans for anticipated problems that may arise on-site during the course of the site preparation works comprising demolition and remediation are presented below in **Table 6-4**

Table 6-4 Contingency Management

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/treatment option.
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. If excessive organic odours/vapours are being generated, stop works and monitor ambient air across site for organic vapours with a PID and odours at site boundaries. Implement control measures including respirators for on-site workers, use of odour suppressants, wetting down of excavated material. EI notes that no nuisance odours shall be detected at any site boundary as part of the remedial works. Should odour emissions be detected at or beyond the site boundary, it is recommended, as part of the CEMP and community consultation procedure, that the Remediation Contractor and the Principal Project Manager: • Notify the owners and occupiers of premises adjoining and across the road from the site regarding potential odour issues. Notification should be in writing. This is also required by the Council Contaminated Land Policy; • In the notification, as well as on street signage, provide contact details of the site personnel for anyone who may be concerned by odour emission during the remediation; • Temporarily pause site works to allow for excess odour to subside to a level acceptable by off-site receptors, should it be necessary, after implementation of the above-listed control measures; and • Record logs for volatile emissions and odours. Such records should be kept on-site and made available for inspection on request. In regard to off-site impact from petroleum vapour, EI notes that odour is generally detected at concentrations much lower than what will constitute a health-based risk. Measures listed above for odour control (**Table 6-3**) may also be applied for vapour control.
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 EPA *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.

Anticipated Problems	Corrective Actions
Unearthing unexpected materials, fill or waste	Stop activities, contact the site project manager. Follow the unexpected finds protocol as detailed in **Section 6.7** of this RAP. Prepare a management plan if required, to address the issue.
Identification of cultural or building heritage items	Stop work and notify site project manager. Follow the unexpected finds protocol as detailed in **Section 6.7** of this RAP. 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.

6.5 REMEDIAL CONTINGENCIES

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 **Table 6-5** arise.

Table 6-5 Remedial Contingencies

Scenario	Remedial Contingencies/Actions Required
Highly contaminated soils not identified during previous investigation are encountered, particularly at site boundaries.	Follow the unexpected finds protocol as detailed in **Section 6.7** of this RAP. Work to be suspended until the Environmental Project Manager can further assess impacted soils/ materials and associated risks.
Underground tanks are encountered at the site.	Systems to be removed and the excavations appropriately validated and backfilled by experienced contractor. Tank removal works reported by appropriate environmental consultant in accordance with NSW EPA (2014) Technical Note, Investigation of Service Station Sites and Australian Standard AS4976 (2008). Follow the unexpected finds protocol as detailed in **Section 6.7** of this RAP.
Highly impacted sludge's are located.	The leachability of heavy metals and hydrocarbons will need to be assessed before disposal options are considered. Follow the unexpected finds protocol as detailed in **Section 6.7** of this RAP.
Significant asbestos wastes are encountered.	Work to be suspended and asbestos work removed by a suitably qualified contactor, in accordance with WorkCover regulations. Follow the unexpected finds protocol as detailed in **Section 6.7** of this RAP.
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.
Contaminated groundwater (including LNAPL or DNAPL) encountered.	Review of groundwater conditions on site, may require further groundwater investigations / remediation and longer-term management plan. 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

Scenario	Remedial Contingencies/Actions Required
	groundwater permeability barrier or similar or in-situ oxidation or stabilisation.
Groundwater contamination identified on northern boundary from former dry cleaner	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
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.
Changes in proposed basement excavation depth.	Review of the remediation works completed for the site.
Changes in proposed future land uses at the site.	Review of the remediation works completed for the site.

6.6 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 **Responsibilities and Contacts, Section 6.1**), 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 site officer responsible for implementing health and safety procedures should induct all site personnel so that they are aware of and comply with, the requirements of this document. 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. The following hazards and mitigation measures relevant to the remedial works are presented in **Section 3**, with a brief summary in **Table 6-6.**

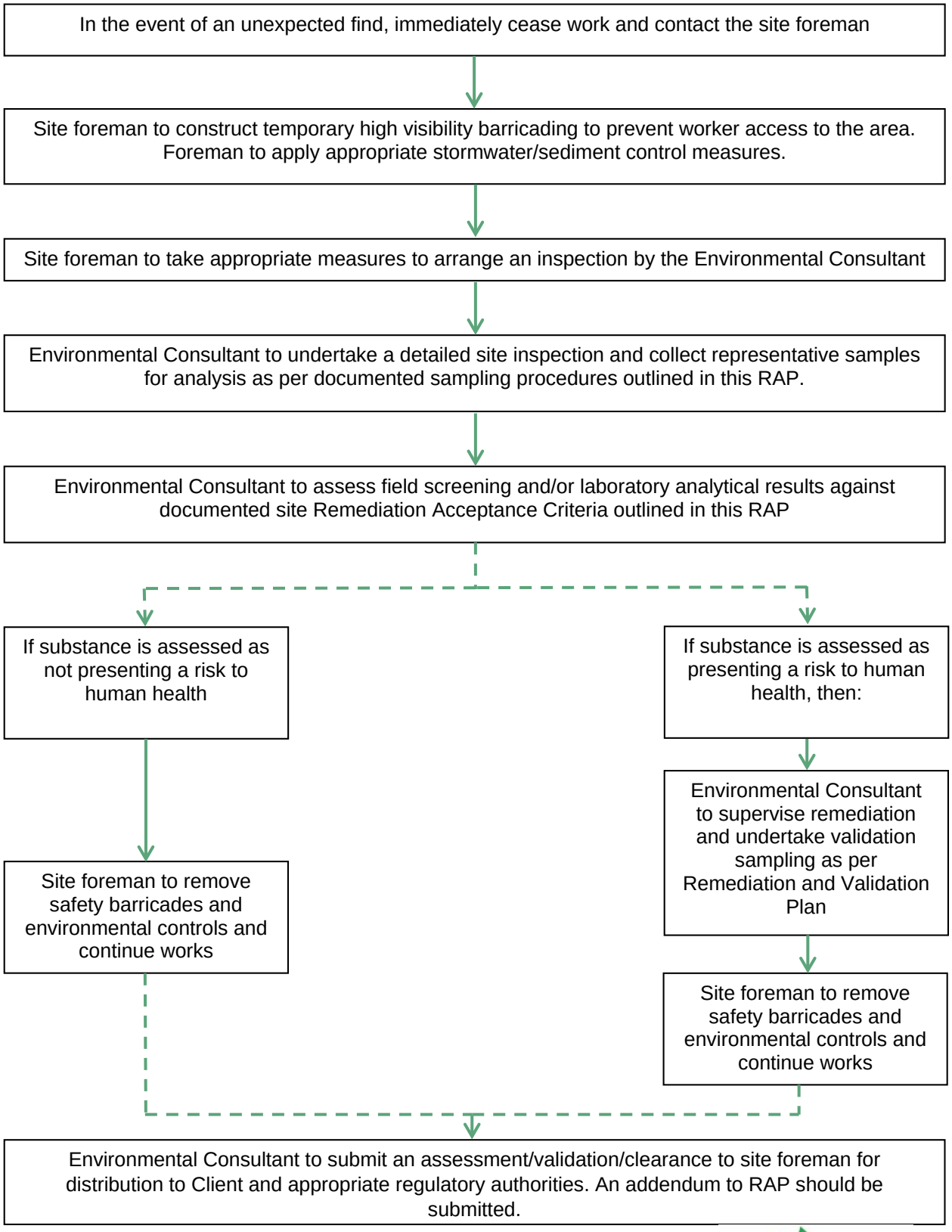
Table 6-6 Remedial Hazards

Anticipated Problems	Corrective Actions
Chemical Hazards	Contaminated sites have chemical compounds substances or materials that may present a risk to human health and the environment. Chemicals of concern and associated risks are as detailed within the Conceptual Site Model, within **Section 3**. The site specific WHS plan should set out controls to mitigate any potential risks.
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.
Personal Protective Equipment 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. Standard PPE with the addition of disposable P2 dust masks as specified for the contractor will be sufficient for the prescribed remedial works.

6.7 UNEXPECTED FINDS PROTOCOL

Should unexpected finds be encountered during site works, the following hierarchical approach should be adopted.

Figure 6-1 Unexpected Finds Protocol



7 VALIDATION SAMPLING AND ANALYSIS QUALITY PLAN

The remediation of the impacted soil areas will be deemed acceptable based on the achievement of the following two validation objectives:

1. ***Remedial Excavations*** – Validation of the remedial excavations will continue to the extent of the impacts as defined by delineation testing, and resulting contaminant concentrations are within the *Remediation Criteria* (**Section 5.1**).

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.

7.1 VALIDATION SOIL SAMPLING METHODOLOGY

The soil sampling and handling of the collected samples is proposed in **Table 7-1**.

Table 7-1 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 Frequency	*Underground Storage Tank & Fuel Infrastructure:* • Min 5 samples from each tank pit as per NSW EPA (2014) including walls and base; • Tank liquids & sludges as per NSW EPA (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 *PAH Remediation Excavation:* • Min 5 samples from the excavated pit including walls and base with one sample per 10 lineal metres along each wall (with a minimum of one sample per excavation wall); *Fill Excavations:* • 1 sample per 50 m^2, across the remainder of the site. *Natural Soil Excavations:* • Grid sampling of the exposed natural soil surfaces across the site. *Stockpiled Materials:* • Sampling of stockpiles at a rate of 1 sample per 25m^3, with a minimum of 3 samples per stockpile. Stockpiles exceeding 200 m^3 but not exceeding 2,000m^3 may be sampled in accordance guidelines prescribed within NEPM (2013) – which allows characterisation according to 95%UCL of the mean concentration of an analyte provided a minimum of 10 representative samples are assessed.
Sampling, handling, transport and tracking	• The use of stainless steel sampling equipment; • All sampling equipment (including hand tools or excavator parts) to be washed in a 3% solution of phosphate free detergent (Decon 90), followed by a rinse with potable water prior to each sample being collected.

Action	Description
	• Direct transfer of the sample into new glass jars or plastic bags is preferred, with each plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory; • Label sample containers with individual and unique identification including Project No., Sample No., Sampling depth, date and time of sampling; • Place sample containers into a chilled, enclosed and secure container for transport to the laboratory; and • Provide 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 the environmental laboratory.
Sample Containers & Holding Times	• Metals - 250g glass jar / refrigeration 4ºC / 6 months (maximum holding period); • TRH/BTEX/VOCs - 250g glass jar / refrigeration 4ºC / 14 days (maximum holding period); • PAH - 250g glass jar / refrigeration 4ºC / 14 days (maximum holding period); and • Asbestos – up to a 10 Litre resealable plastic (polyethylene) bag / no refrigeration / indefinite holding time.
Laboratory Analysis	• Each sample obtained for soil validation purposes will be analysed for the following: – Asbestos analysis using the bulk analysis methodology as described in NEPM (2013); and – TRH, with the addition of PAH and VOCs in hydrocarbon impacted area (AG location AB6) if required. • 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).
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. This will ensure: • 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 (intra-lab) sample and one equipment wash blank sample per sample batch. No QAQC samples will be collected for asbestos sampling.
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

Action	Description
	• 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*.

7.2 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. 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 Qualified Independent Consultant or auditor (if applicable).

8 CONCLUSIONS

Based on the information available, this RAP has been prepared to undertake remediation at the 4-12 McGill Street, Lewisham NSW. It is envisaged that the site will be demolished and remediated in stages which will require the development of appropriate sampling and analysis, hazardous materials, environmental management and demolition plans, so that the site be remediated to make the site suitable for the proposed residential land use with minimal soil access. 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 by the council to allow commencement of the site works (including demolition);
- Selection of a suitably qualified and licensed excavation contractor;
- Preliminaries including approvals;
- Demolition of the site buildings and infrastructure;
- Further soil and groundwater investigation;
- Implementation of the remedial measures identified in the RAP;
- Validation sampling in accordance to the approved RAP; and
- Validation reporting.

In summary, Environmental Investigations considers that the site can be made suitable for the proposed residential land use with minimal access to soils following the implementation of this RAP.

9 STATEMENT OF LIMITATIONS

This report has been prepared for the exclusive use of McGill Advance Management 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 McGill Advance Management Pty Ltd.

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.

REFERENCES

ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, October 2000.

Australian Standard (2005) Table E1 – Minimum sampling points required for site characterisation, in Guide to the investigation and sampling of sites with potentially contaminated soil – Part 1: Non-volatile and semi-volatile compounds, Standards Australia, AS 4482.1-2005, p45.

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DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination, Dept. of Environment and Conservation, New South Wales, DEC 2007/144, June 2007.

Douglas Partners (2015) *Preliminary Site Investigation Report*, Douglas Partners Pty Ltd, Project No: 85086.1_Rev1, dated November 2015

EPA (2014) Waste Classification Guidelines Part 1 – Classifying Waste, Environment Protection Authority of New South Wales, November 2014.

EPA (1995) Sampling Design Guidelines. Environment Protection Authority of New South Wales, Contaminated Sites Unit, EPA

EPA (2014) Technical Note, Investigation of Service Station Sites, Environment Protection Authority of New South Wales, Contaminated Sites Unit, EPA

NEPM (2013) Schedule B1 Guideline on Investigation Levels for Soil and Groundwater, Schedule B2 Guideline on Site Characterisation and Schedule B4 Guideline on site-specific health risk assessments, National Environmental Protection (Assessment of Site Contamination) Measure 1999, National Environmental Protection Council, December 1999, Amendment 2013.

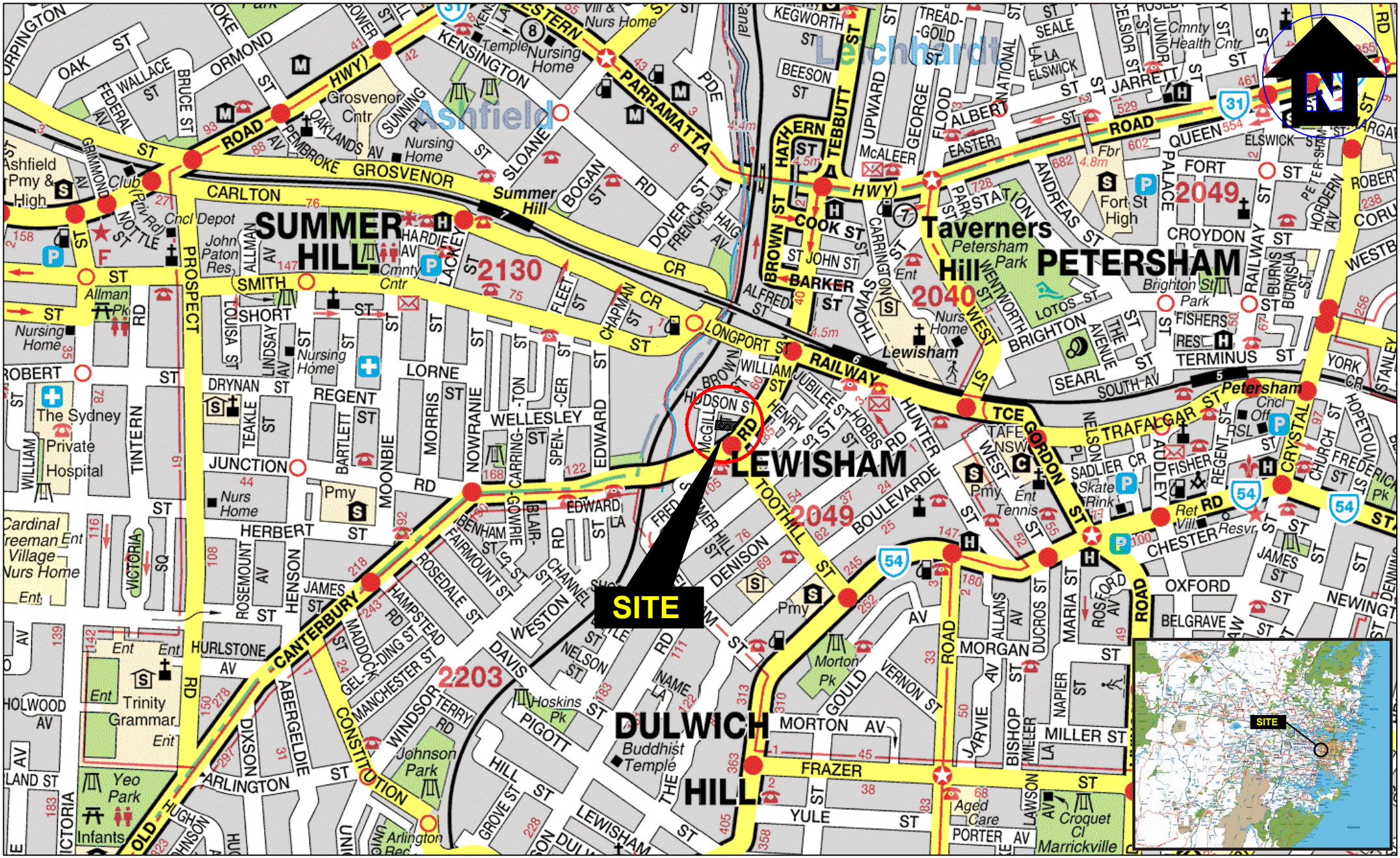
OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites, NSW Office of Environment and Heritage (OEH), OEH 2011/0650, 23 p.

WADOH (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia. Published by the Western Australian Department of Health, May 2009.

ABBREVIATIONS

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
B(a)P	Benzo(a)Pyrene
BGL	Below Ground Level
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
CSM	Conceptual Site Model
CT	Contaminant Thresholds
DECC	Department of Environment and Climate Change, NSW (formerly DEC)
DP	Deposited Plan
DQO	Data Quality Objectives
EPA	Environment Protection Authority
EMP	Environmental Management Plan
ENM	Excavated Natural Material
GIL	Groundwater Investigation Level
GME	Groundwater monitoring event
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
m	Metres
m AHD	Metres relative to Australian Height Datum
m BGL	Metres below ground level
NSW	New South Wales
OEH	Office of Environment and Heritage, NSW (formerly DEC, DECC, DECCW)
PAHs	Polycyclic Aromatic Hydrocarbons
RAP	Remediation Action Plan
SIL	Soil Investigation Level
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable 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
VOCC	Volatile Organic Chlorinated Compounds

FIGURES



Drawn:	V.T.	
Approved:	M.D.	
Date:	29-04-16	
Approx Scale:	N.T.S.	

McGill Advance Management Pty Ltd

Remediation Action Plan

4-12 McGill Street, Lewisham NSW

Site Locality Plan

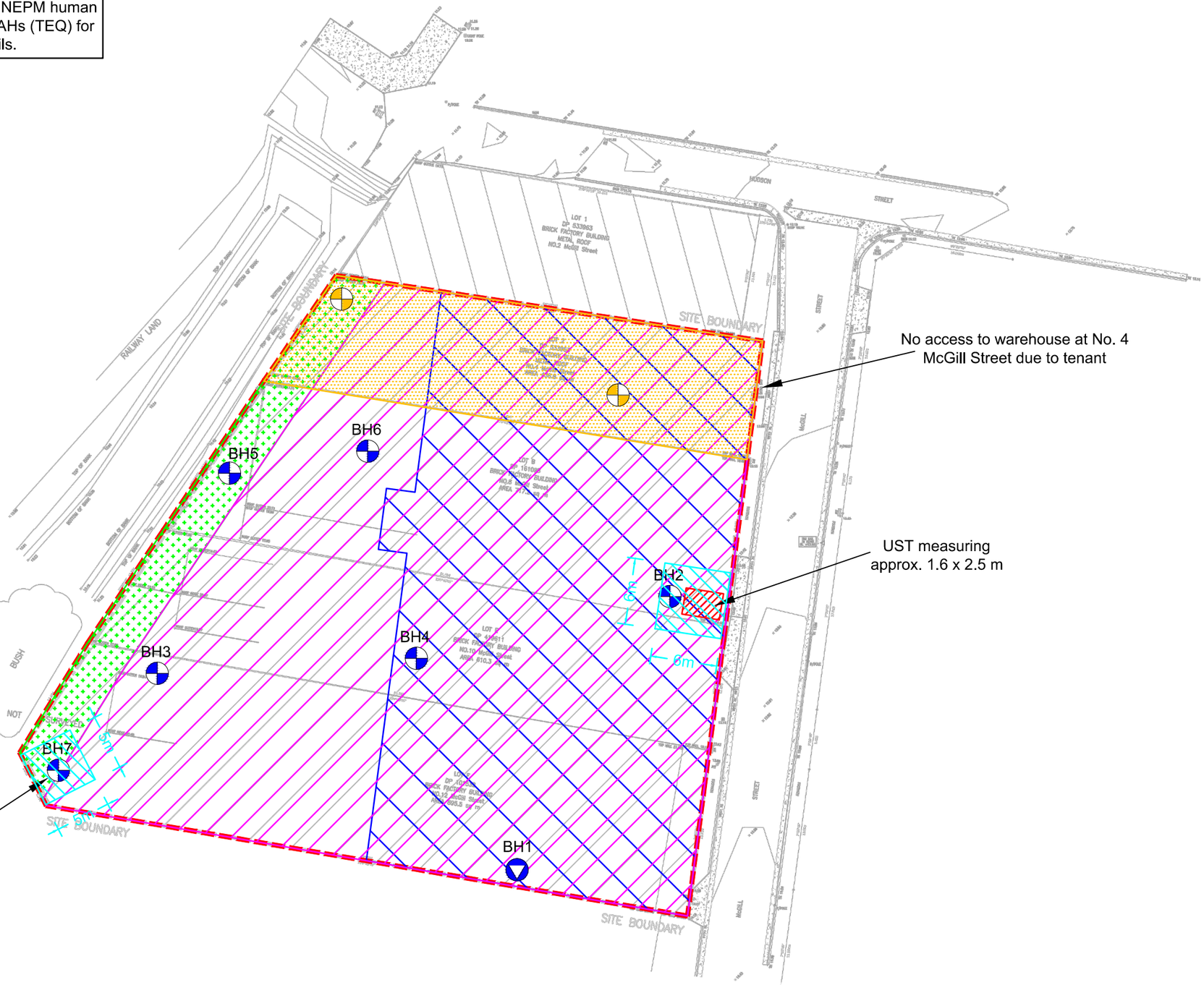
Figure: 1

Project: E22830 AB_Rev0

eiaustralia
Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

KEY

Concentration exceeds adopted 4 mg/kg NEPM human health criteria (HIL B) for Carcinogenic PAHs (TEQ) for residential use with minimal access to soils.



Sample ID	Carcinogenic PAH as B(a)P TEQ
BH7_0.0-0.1	13 mg/kg
BH7_0.5-0.7	8.2 mg/kg

Map Source: Geomat Engineering Pty Ltd, Drawing No. 14100-01, Dated 12/11/14

LEGEND

- Proposed borehole location
- Approximate borehole location
- Approximate borehole / monitoring well location
- Approx. Underground Storage Tank (UST) location
- Proposed deep soil landscaped area
- Proposed upper basement extent
- Proposed lower basement extent
- Remediation area
- Area not investigated
- Approximate site boundary

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Drawn:	V.T.
Approved:	M.D.
Date:	29-04-16
Approx Scale:	1:400 @ A3 or as shown

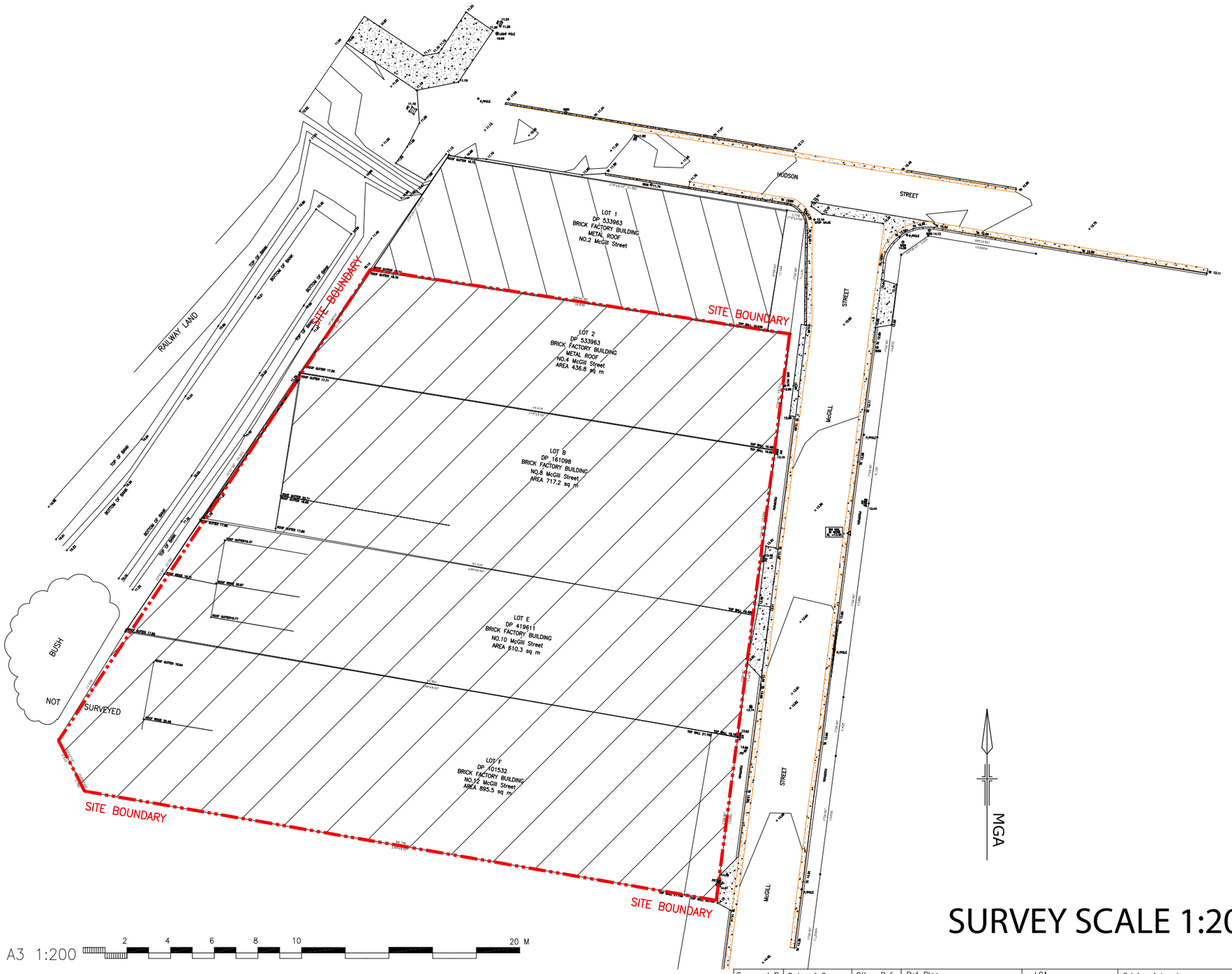
McGill Advance Management Pty Ltd
Remediation Action Plan
4-12 McGill Street, Lewisham, NSW

Remediation Areas Showing Previous & Proposed Sampling Locations

Figure: 2

Project: E22830 AB_Rev0

APPENDIX A
SELECTED PROPOSED DEVELOPMENT PLANS



LEGEND

LINE TYPES

- LIP OF KERB
- TOP OF KERB
- RIDGE
- ROOF
- BUILDING
- SERVICE PIT
- CONCRETE & BITMEN
- METAL FENCE
- TOP OF BANK
- BOTTOM OF BANK

STOP VAVLE · BM · HYDRANT · SIGN · POWER POLE

NOTES

BOUNDARIES HAVE NOT BEEN DEFINED (TITLE DIMENSIONS ONLY) –BOUNDARY DEFINITION IS SUBJECT TO FURTHER SURVEY

TREE SIZES ARE ESTIMATES ONLY

THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF Modern Constrcution Group

RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.

EXCEPT WHERE SHOWN BY DIMENSION LOCATION OF DETAIL WITH RESPECT TO BOUNDARIES IS INDICATIVE ONLY.

ONLY VISIBLE SERVICES HAVE BEEN LOCATED. UNDERGROUND SERVICES HAVE NOT BEEN LOCATED. DIAL BEFORE YOU DIG SERVICES (PH 1100) SHOULD BE USED AND A FULL UTILITY INVESTIGATION, INCLUDING A UTILITY LOCATION SURVEY, SHOULD BE UNDERTAKEN BEFORE CARRYING OUT ANY CONSTRUCTION ACTIVITY IN OR NEAR THE SURVEYED AREA.

CRITICAL SPOT LEVELS SHOULD BE CONFIRMED WITH SURVEYOR.

THIS IS ONLY TO BE USED TO FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS.

CONTOURS SHOWN DEPICT THE THE TOPOGRAPHY. EXCEPT AT SPOT LEVELS SHOWN, THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.

CONTOUR INTERVAL – 0.5 m – SPOT LEVELS SHOULD BE ADOPTED.

POSITION OF RIDGES ARE DIAGRAMMATIC ONLY (NOT TO SCALE).

THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:100

DO NOT SCALE OFF THIS PLAN / FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED READINGS.

ALL DIMENSIONS TO BE CHECKED ON SITE.

IF ACCURATE TRUE NORTH IS REQUIRED A FURTHER SURVEY WOULD BE NECCESSARY.

SURVEY SCALE 1:200

RevNo	Revision note	Date	Drawn	Checked

Geomat Engineering Pty Ltd
Survey Engineering Design & Development
21/141 Allambie Road
Allambie Heights NSW 2100
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Frenchs Forest NSW 2086
EMAIL: geomatsurveys@optusnet.com.au
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PHONE : (02) 9453 0100

Surveyed By	Date of Survey	Other Ref	Ref Plan	LGA	Origin of Levels	Client Job Numb
MF	03/11/2014			Marrickville	SSM50170 RL17.331	
Drawn by	**Checked by**	**Issue date**	**Filename**	**UBD Map Ref**	**Level Datum**	**Grid**	**Scale**
XM	MF	12/11/2014	14100–01DSrevA	254 L/5	AHD	NA	1:100

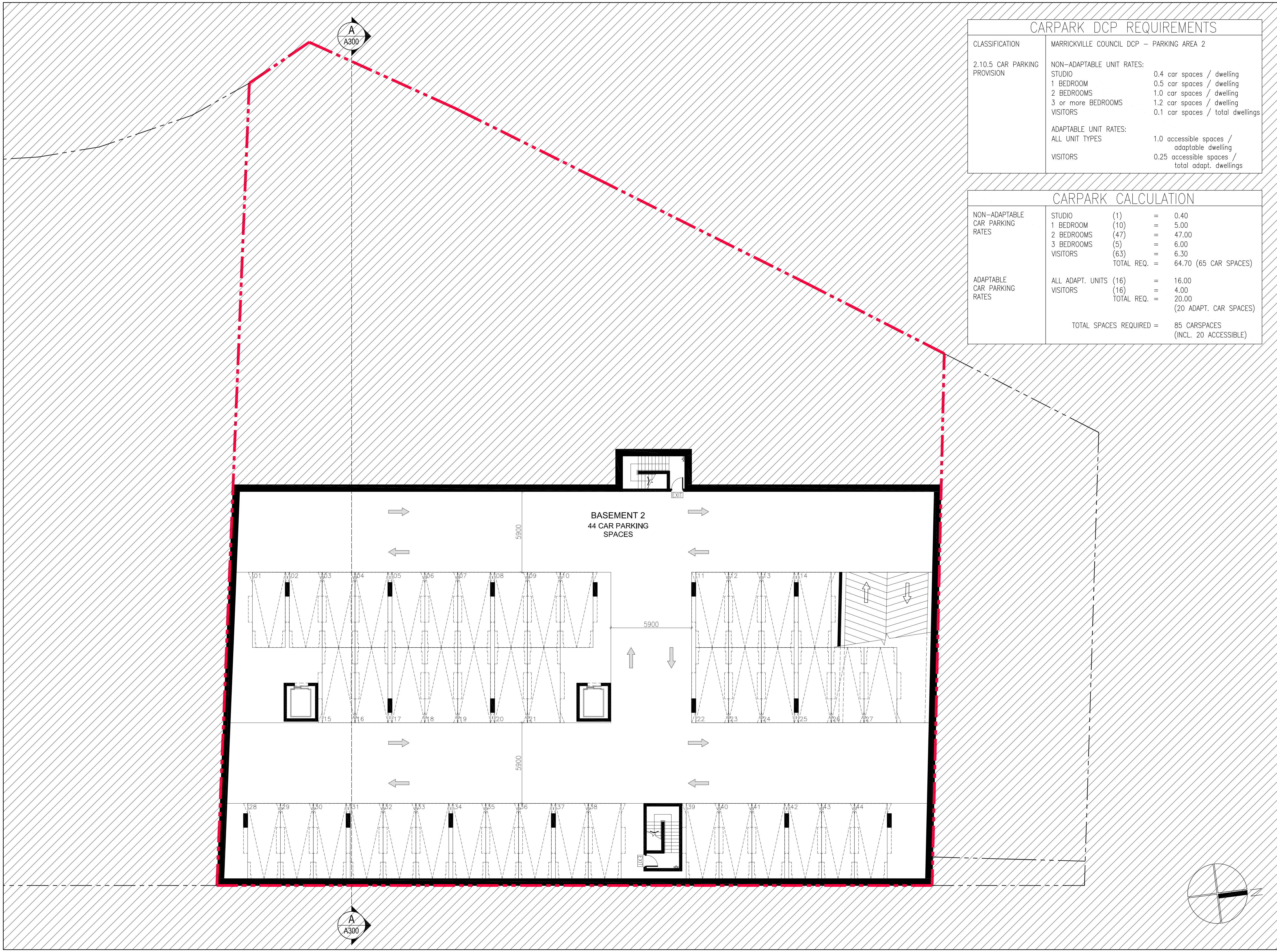
Project:
DETAIL SURVEY
4–12 McGill Street
Lewisham NSW 2049

Client:
Modern Constrcution Group

Drawing Number 14100–01 | Revision A | Sheet 2/2 | Original A1

PROJECT	CLIENT	ADDRESS	TITLE	SCALE	DATE
Lewisham Apartments	McGill Advance Pty ltd	4-12 Mcgill St, Lewisham	Pre-DA	1:200	June 2015

tony owen ptnrs ARCHITECTS INTERIORS PLANNERS



CARPARK DCP REQUIREMENTS

CLASSIFICATION	MARRICKVILLE COUNCIL DCP – PARKING AREA 2	
2.10.5 CAR PARKING PROVISION	NON-ADAPTABLE UNIT RATES:	
	STUDIO	0.4 car spaces / dwelling
	1 BEDROOM	0.5 car spaces / dwelling
	2 BEDROOMS	1.0 car spaces / dwelling
	3 or more BEDROOMS	1.2 car spaces / dwelling
	VISITORS	0.1 car spaces / total dwellings
	ADAPTABLE UNIT RATES:	
	ALL UNIT TYPES	1.0 accessible spaces / adaptable dwelling
	VISITORS	0.25 accessible spaces / total adapt. dwellings

CARPARK CALCULATION

NON-ADAPTABLE CAR PARKING RATES	STUDIO	(1)	=	0.40
	1 BEDROOM	(10)	=	5.00
	2 BEDROOMS	(47)	=	47.00
	3 BEDROOMS	(5)	=	6.00
	VISITORS	(63)	=	6.30
		TOTAL REQ.	=	64.70 (65 CAR SPACES)
ADAPTABLE CAR PARKING RATES	ALL ADAPT. UNITS	(16)	=	16.00
	VISITORS	(16)	=	4.00
		TOTAL REQ.	=	20.00 (20 ADAPT. CAR SPACES)
	TOTAL SPACES REQUIRED =			85 CARSPACES (INCL. 20 ACCESSIBLE)

Rev.	Description	Date
A	xx	xx

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BEFORE CARRYING OUT ANY WORK ENSURE THAT THE DRAWINGS USED CARRY THE LATEST AMENDMENT No.

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WHERE ANY DISCREPANCY EXISTS BETWEEN FIGURED AND SCALED DIMENSIONS. THE FIGURED DIMENSIONS SHALL PREVAIL

BUILDER TO CHECK ALL SITE DIMENSIONS PRIOR TO FABRICATION OF FITMENTS

TONY OWEN PARTNERS
PRELIMINARY
AUGUST 2015

Consultants

Client

Architects

tony owen ptnrs
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P 612 9698 2900
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Project:
LEWISHAM 3

Project address:
2-12 McGill St, Lewisham

Key plan

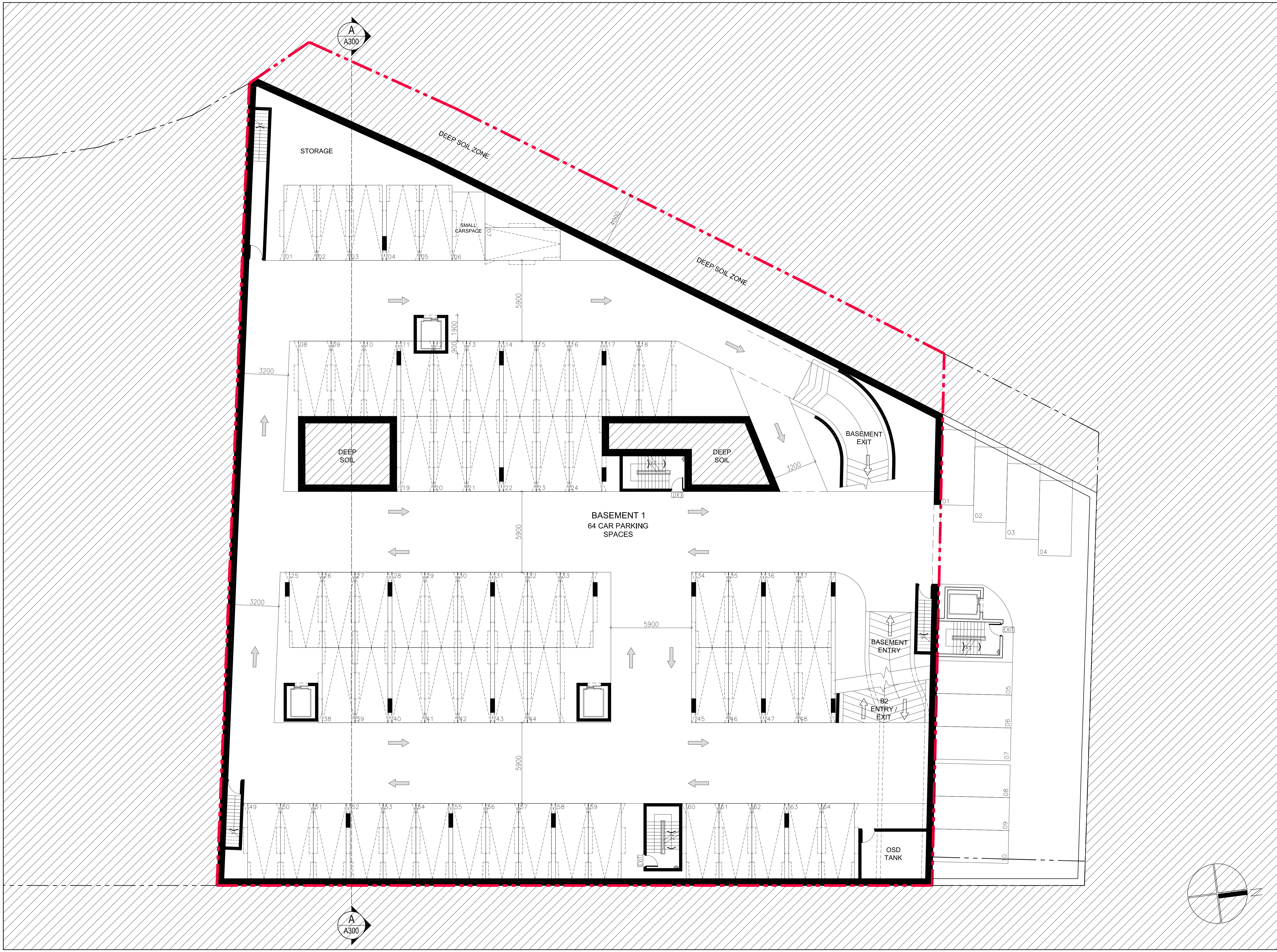
Scale: 1:250 @ A3
Date: AUG 2015

Drawing title:
BASEMENT 2 PLAN

Project no. 947 Dwg #. A090

Drawn: DC

Drawing status:
SKETCH DESIGN



Rev.	Description	Date
A	xx	xx

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WHERE ANY DISCREPANCY EXISTS BETWEEN FIGURED AND SCALED DIMENSIONS. THE FIGURED DIMENSIONS SHALL PREVAIL

BUILDER TO CHECK ALL SITE DIMENSIONS PRIOR TO FABRICATION OF FITMENTS

TONY OWEN PARTNERS
PRELIMINARY
AUGUST 2015

Consultants

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E info@tonyowen.com.au

Project:
LEWISHAM 3

Project address:
2-12 McGill St, Lewisham

Key plan

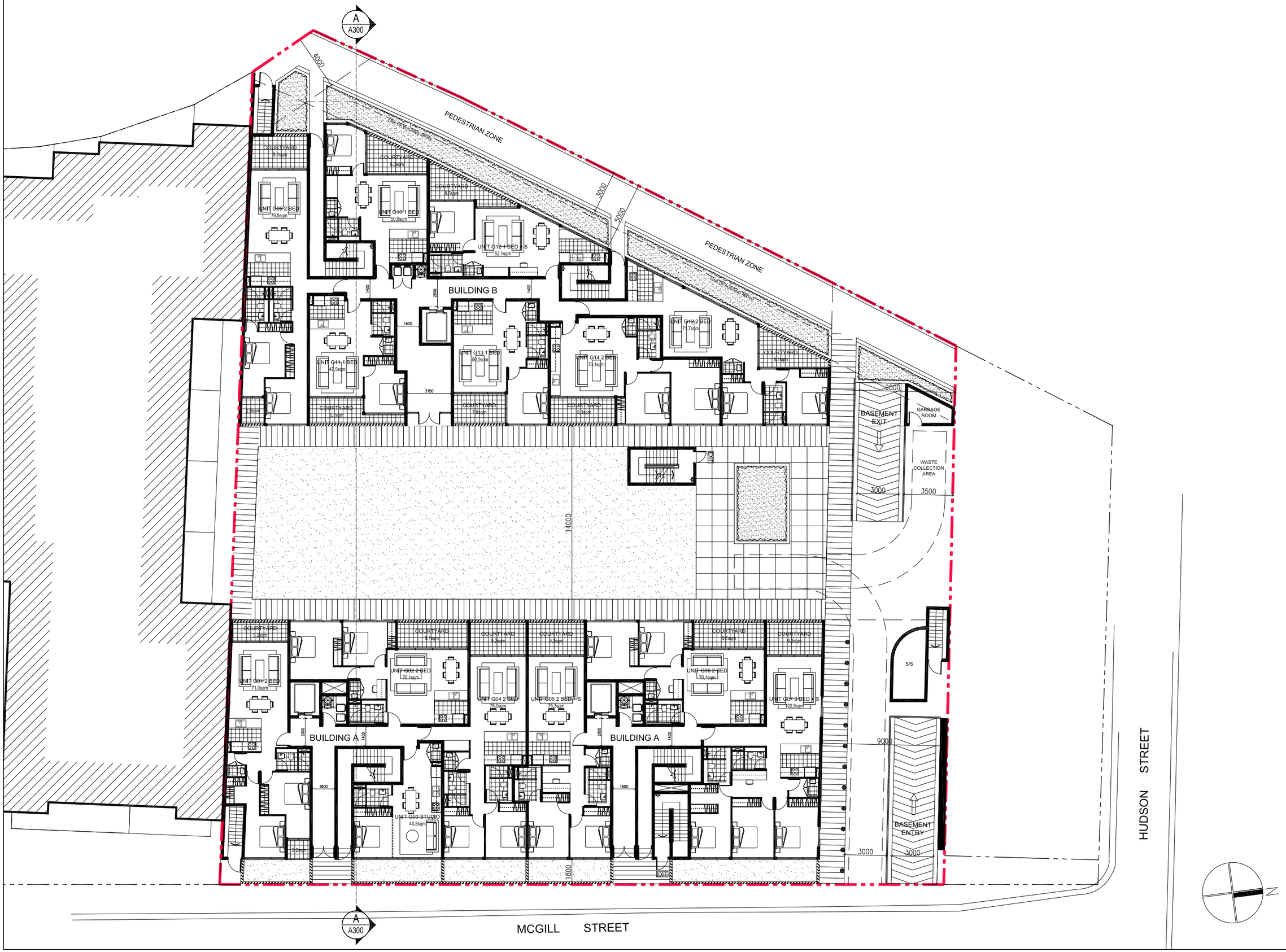
Scale: 1:250 @ A3
Date: AUG 2015

Drawing title:
BASEMENT 1 PLAN

Project no. 947 Dwg #. A091

Drawn: DC

Drawing status:
SKETCH DESIGN



Rev.	Description	Date
A	xx	xx

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BUILDER TO CHECK ALL SITE DIMENSIONS PRIOR TO FABRICATION OF FITMENTS

TONY OWEN PARTNERS

PRELIMINARY

AUGUST 2015

Consultants

Client

Architects

tony owen ptnrs

Project:
LEWISHAM 3

Project address:
2-12 McGill St, Lewisham

Key plan

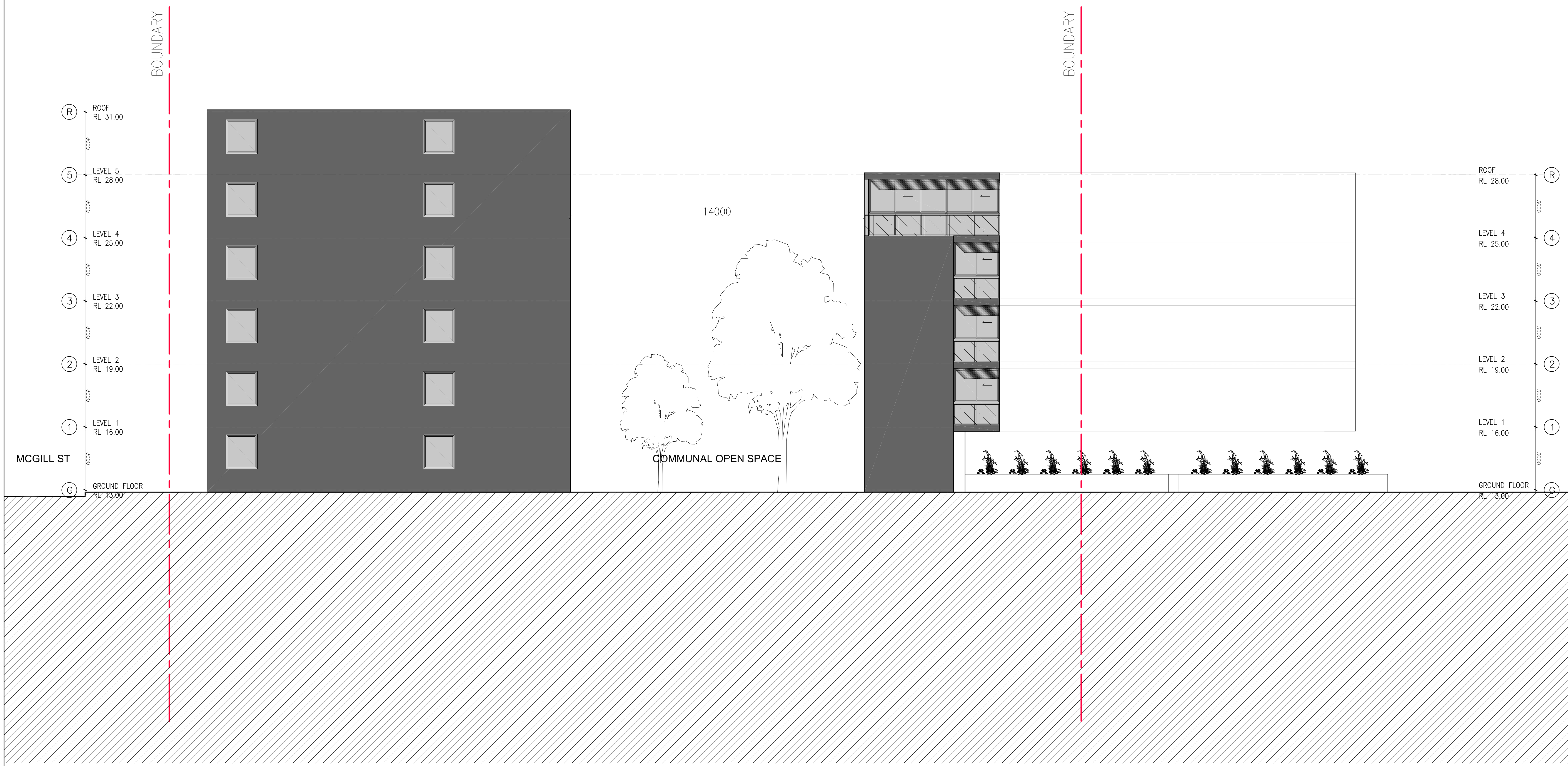
Scale:	Date:
1:250 @ A3	AUG 2015

Drawing title:
GROUND FLOOR PLAN

Project no. 947 | Dwg #. A100

Drawn: DC

Drawing status:
SKETCH DESIGN



NORTH ELEVATION

Rev.	Description	Date
A	xx	xx

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BUILDER TO CHECK ALL SITE DIMENSIONS PRIOR TO FABRICATION OF FITMENTS

TONY OWEN PARTNERS
PRELIMINARY
AUGUST 2015

Consultants

Client

Architects

tony owen ptnrs

Project:
LEWISHAM 3

Project address:
2-12 McGill St, Lewisham

Key plan

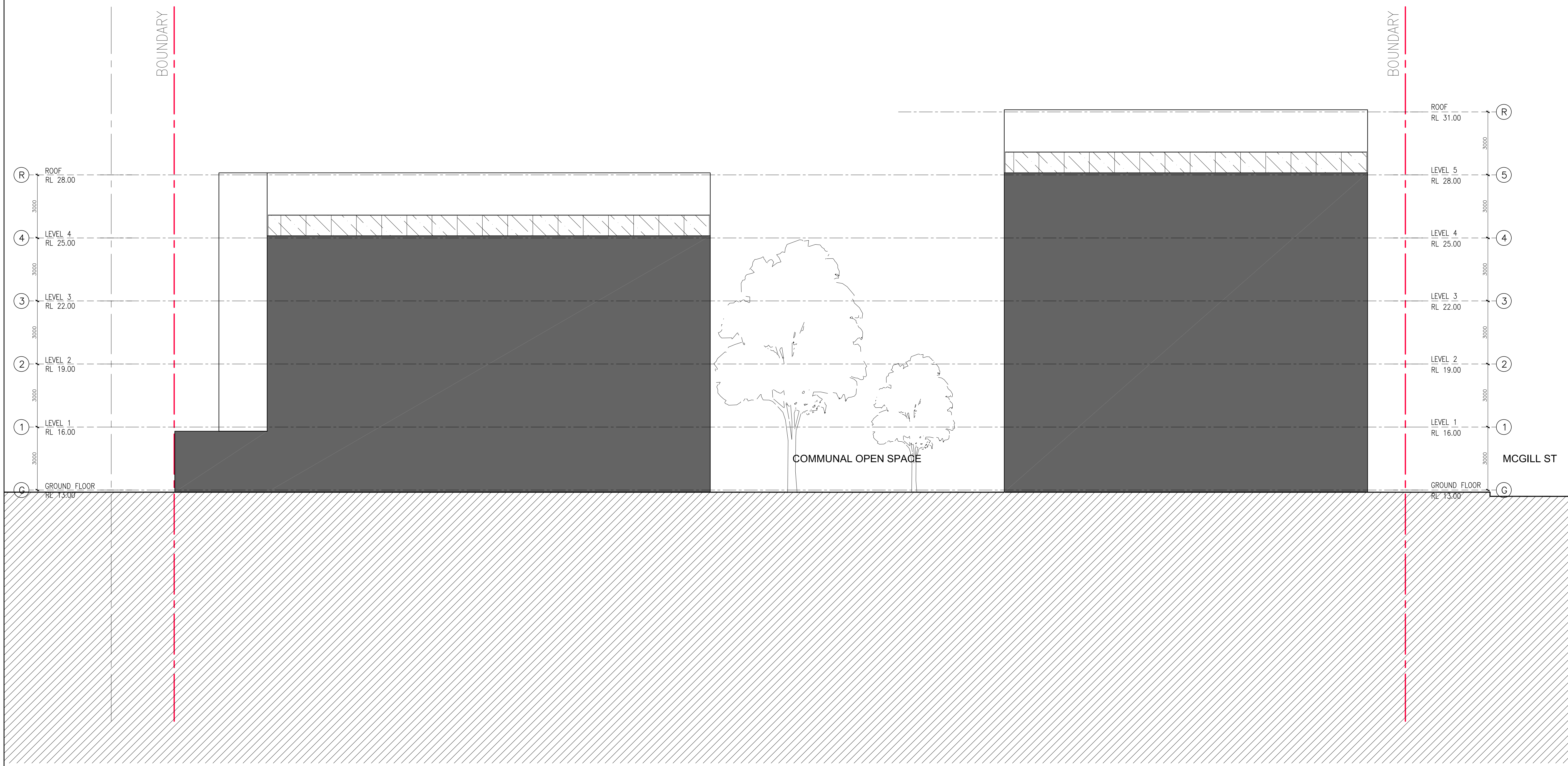
Scale: 1:200 @ A3
Date: AUG 2015

Drawing title:
NORTH ELEVATION

Project no. 947
Dwg #. A204

Drawn: DC

Drawing status:
SKETCH DESIGN



SOUTH ELEVATION

Rev.	Description	Date
A	xx	xx

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BUILDER TO CHECK ALL SITE DIMENSIONS PRIOR TO FABRICATION OF FITMENTS

TONY OWEN PARTNERS
PRELIMINARY
AUGUST 2015

Consultants

Client

Architects

tony owen ptnrs

Project:
LEWISHAM 3

Project address:
2-12 McGill St, Lewisham

Key plan

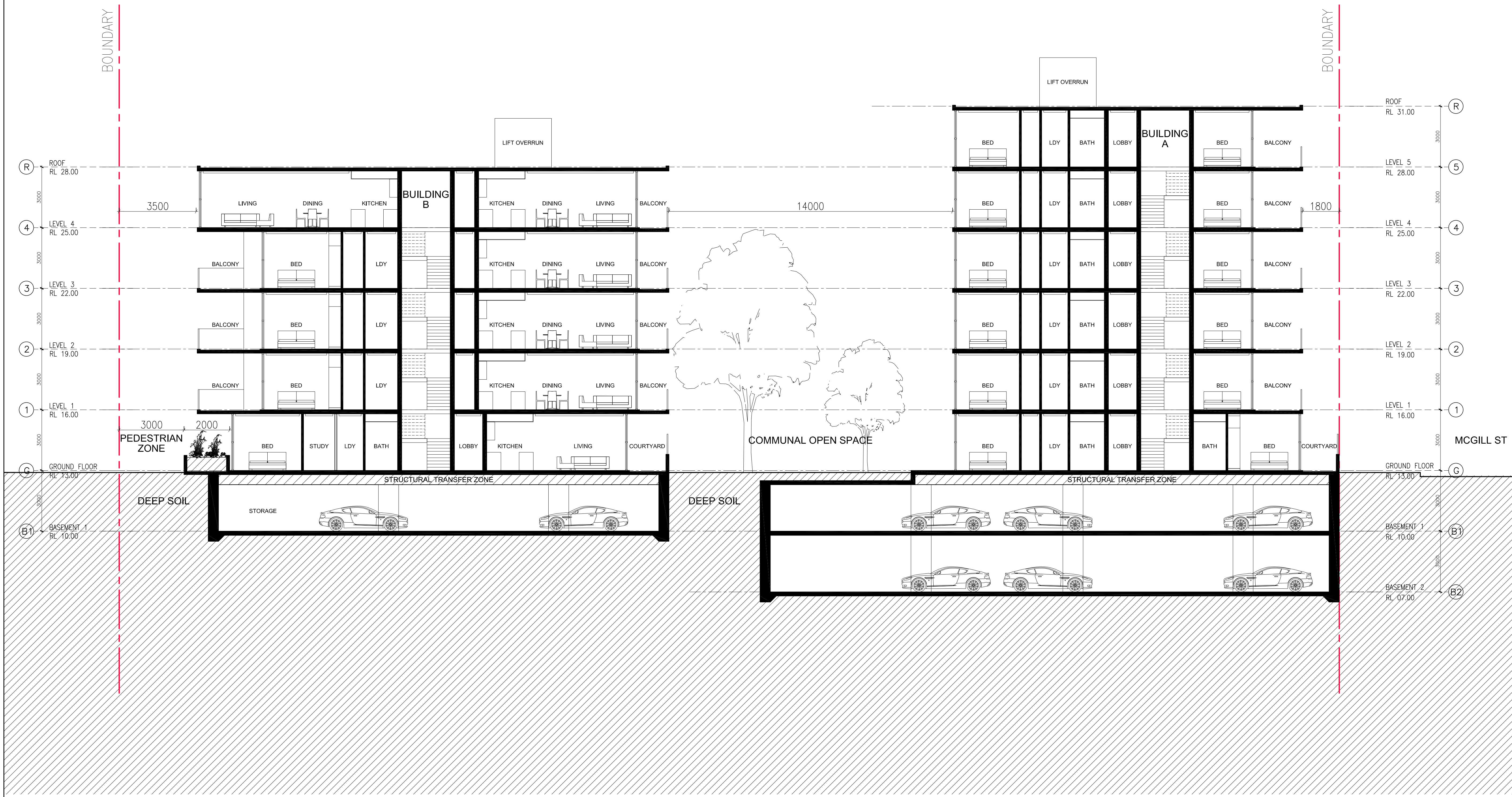
Scale: 1:200 @ A3
Date: AUG 2015

Drawing title:
SOUTH ELEVATION

Project no. 947 Dwg #. A205

Drawn: DC

Drawing status:
SKETCH DESIGN



SECTION A

Rev.	Description	Date
A	xx	xx

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TONY OWEN PARTNERS
PRELIMINARY
AUGUST 2015

Consultants

Client

Architects

Project:
LEWISHAM 3

Project address:
2-12 McGill St, Lewisham

Key plan

Scale: 1:200 @ A3
Date: AUG 2015

Drawing title:
SECTION A

Project no. 947 Dwg #. A300

Drawn: DC

Drawing status:
SKETCH DESIGN

APPENDIX B
BOREHOLE LOGS

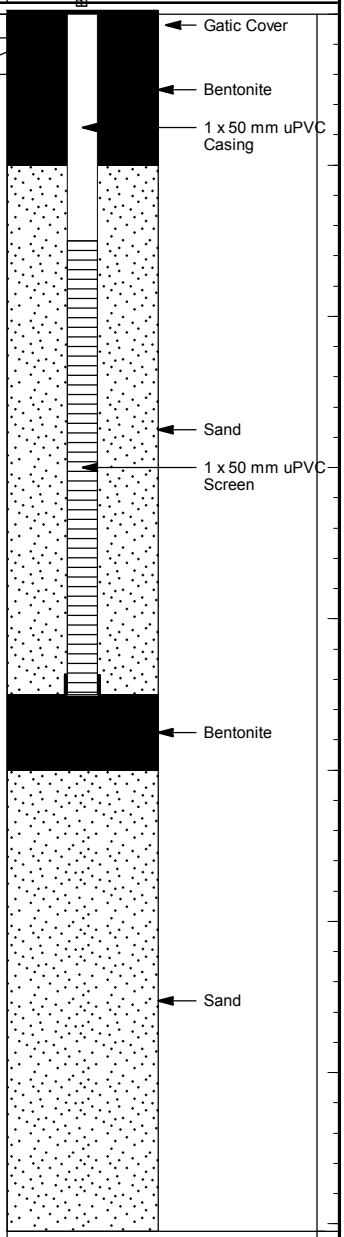
BOREHOLE: BH1

eiaustralia
Contamination | Remediation | Geotechnical

Project	Proposed Residential Development	East	328335.3 m		
Location	4-12 McGill Street, Lewisham NSW	North	6247987.6 m MGA94 Zone 56	Sheet	1 OF 1
Position	Refer to Figure 2	Surface RL	12.50 m AHD	Date Started	6/4/16
Job No.	E22830	Contractor	BG Drilling Pty Ltd	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Dando Dual Mast	Logged JZ	Date: 20/4/16
		Inclination	-90°	Checked JC	Date: 20/4/16

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY
AD/T	-	GWNE	0	0.16				-	CONCRETE: 160mm thick.	-	-
					BH1_0.16-0.25 ES			-	FILL: Sandy CLAY; low plasticity, fine to coarse grained sand, with fine to coarse igneous gravel, dark brown/grey.	M>PL	-
				0.40	0.16-0.25 m			-	SANDSTONE; fine to medium grained, pale brown/pale grey, distinctly weathered, medium strength.	-	-
				12.10	BH1_0.25-0.40 DS			-	SANDSTONE; medium grained, bedding dipping 0-10 degrees, <1-2mm thick, pale brown to pale grey/dark brown.		
					0.25-0.40 m						
					BH1_0.25-0.40 ES						
					0.25-0.40 m						
					C 0.40-1.93 m						
			1		0.40 m						
					1.40 m						
			2		C 1.93-3.52 m						
					2.40 m						
			3		3.00 m						
				3.52							
				8.98	3.50 m			-	SANDSTONE; medium grained, bedding dipping 0-10 degrees, 2-3mm thick, pale grey with dark grey laminations.		
					C 3.52-4.87 m						
NMLC		50-60% RETURN	4		4.50 m						
					C 4.87-6.46 m						
			5		5.50 m						
			6		C 6.46-8.05 m						
					6.50 m						
			7		7.50 m						
			8	8.05	8.00 m				Hole Terminated at 8.05 m Borehole Converted into Monitoring Well.		
			9								
			10								

PIEZOMETER DETAILS
ID Static Water Level
BH1M



This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH2

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development			Sheet	1 OF 1
Location	4-12 McGill Street, Lewisham NSW	East	328357.8 m	Date Started	6/4/16
Position	Refer to Figure 2	North	6248011.6 m MGA94 Zone 56	Date Completed	6/4/16
Job No.	E22830	Contractor	NA	Logged ES	Date: 6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Hand Auger	Checked EG	Date: 26/4/16
		Inclination	-90°		

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
	-		0	0.10				-	CONCRETE: 100mm thick.	-	-	CONCRETE HARDSTAND
	-			0.40	BH2_0.1-0.2 ES 0.10-0.20 m 0.20 m PID = 8 ppm			-	FILL: Gravelly Clayey SAND; fine to coarse grained sand, orange/brown to red/brown, no odour.	M	-	FILL
HA	-	GWNE			BH2_0.4-0.5 ES 0.40-0.50 m 0.50 m PID = 50 ppm				from 0.4m, orange grey with hydrocarbon staining and hydrocarbon odour.	M	-	
	-		1	1.10	BH2_0.9-1.0 ES 0.90-1.00 m 1.00 m PID = 106 ppm			CI-CH	CLAY; medium to high plasticity, orange/brown, no odour.	M	VSt	NATURAL
				1.50	BH2_1.3-1.5 ES 1.30-1.50 m 1.50 m PID = 1.2 ppm				Hole Terminated at 1.50 m			
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH3

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development				
Location	4-12 McGill Street, Lewisham NSW	East	328317.5 m	Sheet	1 OF 1
Position	Refer to Figure 2	North	6248003.1 m MGA94 Zone 56	Date Started	6/4/16
Job No.	E22830	Contractor	NA	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Hand Auger	Logged ES	Date: 6/4/16
		Inclination	-90°	Checked EG	Date: 26/4/16

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	-	GWNE	0	~~0.10~~				-	CONCRETE: 100mm thick.	-	-	CONCRETE HARDSTAND
	-			~~0.20~~	BH3_0.1-0.2 ES 0.10-0.20 m			-	SANDSTONE: fine to medium grained, pale brown/pale grey, weathered, no odour.	-	-	BEDROCK
									Hole Terminated at 0.20 m Refusal at 0.2 m			
			1									
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH4

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development				
Location	4-12 McGill Street, Lewisham NSW	East	328340.2 m	Sheet	1 OF 1
Position	Refer to Figure 2	North	6248004.9 m MGA94 Zone 56	Date Started	6/4/16
Job No.	E22830	Contractor	NA	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Hand Auger	Logged ES	Date: 6/4/16
		Inclination	-90°	Checked EG	Date: 26/4/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	-	GWNE	0	0.10	BH4_0.0-0.1 ES 0.00-0.10 m			-	FILL: Gravelly Clayey SAND; fine to coarse grained sand, orange/brown to red/brown, minor charcoal, no odour.	D	-	FILL
	-			0.50	BH4_0.3-0.4 ES 0.30-0.40 m			CI-CH	CLAY; medium to high plasticity, orange/brown, no odour.	M	VSt	NATURAL
									Hole Terminated at 0.50 m			
			1									
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH5

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development				
Location	4-12 McGill Street, Lewisham NSW	East	328321.5 m	Sheet	1 OF 1
Position	Refer to Figure 2	North	6248021.1 m MGA94 Zone 56	Date Started	6/4/16
Job No.	E22830	Contractor	NA	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Hand Auger	Logged ES	Date: 6/4/16
		Inclination	-90°	Checked EG	Date: 26/4/16

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
	-		0	0.10				-	CONCRETE: 100mm thick.	-	-	CONCRETE HARDSTAND
HA	-	GWNE		0.40	BH5_0.1-0.2 QD1/QT1 0.10-0.20 m			-	FILL: Gravelly Clayey SAND; fine to coarse grained sand, orange/brown to red/brown, no odour.	D	-	FILL
	-			1.00	BH5_0.7-0.8 ES 0.70-0.80 m			-	SANDSTONE: fine to medium grained, pale brown/pale grey, weathered, no odour.	-	-	BEDROCK
			1						Hole Terminated at 1.00 m			
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH6

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development				
Location	4-12 McGill Street, Lewisham NSW	East	328336.8 m	Sheet	1 OF 1
Position	Refer to Figure 2	North	6248023.8 m MGA94 Zone 56	Date Started	6/4/16
Job No.	E22830	Contractor	NA	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Hand Auger	Logged ES	Date: 6/4/16
		Inclination	-90°	Checked EG	Date: 26/4/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	-	GWNE	0	0.10	BH6_0.0-0.1 ES 0.00-0.10 m			-	FILL: Gravelly Clayey SAND; fine to coarse grained sand, orange/brown to red/brown, no odour.	D	-	FILL
	-							CI-CH	CLAY; medium to high plasticity, orange/brown, no odour.	M	-	NATURAL
				0.50	BH6_0.4-0.5 ES 0.40-0.50 m				Hole Terminated at 0.50 m Refusal at 0.8 m			
			1									
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH7

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development			Sheet	1 OF 1
Location	4-12 McGill Street, Lewisham NSW	East	328307.4 m	Date Started	6/4/16
Position	Refer to Figure 2	North	6247995.9 m MGA94 Zone 56	Date Completed	6/4/16
Job No.	E22830	Contractor	NA	Logged ES	Date: 6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Hand Auger	Checked EG	Date: 26/4/16
		Inclination	-90°		

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	-	GWNE	0	0.30	BH7_0.0-0.1 ES 0.00-0.10 m			S-F	FILL: Silty Gravelly SAND; fine to course grained, brown to dark brown, some organic matter, no odour.	D	-	FILL
	-			0.80	BH7_0.5-0.7 ES 0.50-0.70 m			G-M	FILL: Silty Sandy GRAVEL; red/brown to grey, no odour.	D	-	
			1						Hole Terminated at 0.80 m			
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH1

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Contamination | Remediation | Geotechnical

Project	Proposed Residential Development	East	328335.3 m		
Location	4-12 McGill Street, Lewisham NSW	North	6247987.6 m MGA94 Zone 56	Sheet	1 OF 2
Position	Refer to Figure 2	Surface RL	≈12.50 m AHD	Date Started	6/4/16
Job No.	E22830	Contractor	BG Drilling Pty Ltd	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Dando Dual Mast	Logged JZ	Date: 6/4/16
		Inclination	-90°	Checked JC	Date: 20/4/16

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	-	GWNE	0	0.16				-	CONCRETE: 160mm thick.	-	-	CONCRETE HARDSTAND
					BH1_0.16-0.25 ES 0.16-0.25 m			-	FILL: Sandy CLAY; low plasticity, fine to coarse grained sand, with fine to coarse igneous gravel, dark brown/grey.	M>PL	-	FILL
				0.40	BH1_0.25-0.40 DS 0.25-0.40 m			-	SANDSTONE; fine to medium grained, pale brown/pale grey, distinctly weathered, medium strength.	-	-	BEDROCK
					BH1_0.25-0.40 ES 0.25-0.40 m				Continued as Cored Borehole			
			1									
			2									
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

BOREHOLE: BH1

Project	Proposed Residential Development	East	328335.3 m		
Location	4-12 McGill Street, Lewisham NSW	North	6247987.6 m MGA94 Zone 56	Sheet	2 OF 2
Position	Refer to Figure 2	Surface RL	≈12.50 m AHD	Date Started	6/4/16
Job No.	E22830	Contractor	BG Drilling Pty Ltd	Date Completed	6/4/16
Client	McGill Advance Management Pty Ltd	Drill Rig	Dando Dual Mast	Logged JZ	Date: 6/4/16
		Inclination	-90°	Checked JC	Date: 20/4/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH 10)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC	50-60% RETURN			0	*0.40*		Continuation from non-cored borehole				
		100	70 (76)	1	12.10		SANDSTONE; medium grained, bedding dipping 0-10 degrees, <1-2mm thick, pale brown to pale grey/dark brown.	SW		0.46: BP 10° PR RF CN 0.49: BP 10° PR RF CN 0.52-0.54: JT 15° UN RF CN 0.59: JT 0 - 10° UN RF CN 0.72: BP 10° PR RF CN 0.96: BP 10° PR RF CN 1.05: HB 1.25-1.30: JT 50° PR RF CN 1.47: JT 0 - 5° UN RF CN	
		100	86 (87)	2				DW		1.85: BP 10° PR RF CN 1.90: BP 10° PR RF CN 1.96: BP 5° PR RF CN 2.05: BP 0° UN RF CN 2.25: BP 10° PR RF CN 2.33: BP 0° PR RF CN	
				3	*3.52*			SW		3.20: BP 10° PR RF CN 3.24: BP 10° PR RF CN	
		100	100 (93)	4	8.98		SANDSTONE; medium grained, bedding dipping 0-10 degrees, 2-3mm thick, pale grey with dark grey laminations.	FR		3.66: BP 0° PR RF VNR 3.89: BP 10° PR RF CN 4.05: BP 10° PR RF CN 4.57: BP 10° PR RF CN 4.75: BP 10° PR RF CN	
		100	79 (82)	5						5.41: BP 10° PR RF CN 5.57: BP 0° UN RF CN 5.73: BP 10° PR RF CN	
		100	87 (83)	6						6.02: BP 10° PR RF CN 6.04: BP 10° PR RF CN 6.07: BP 10° PR RF CN 6.08: JT 80° PR RF CN 6.20: BP 10° PR RF CN 6.22: BP 10° PR RF CN 6.38: BP 10° PR RF CN 6.40: BP 10° PR RF CN 6.41: BP 10° PR RF CN 6.46: DB 6.57: BP 10° PR RF CN 6.59: BP 10° PR RF CN 6.65: BP PR RF CN 6.80: HB 7.05: BP 10° PR RF CN 7.11: JT 0 - 10° ST RF CN 7.36: BP 10° PR RF CN 7.38: BP 10° PR RF CN	
				7							
				8	*8.05*						
				9	4.45		Hole Terminated at 8.05 m Borehole Converted into Monitoring Well.			7.56: BP 10° PR RF CN 7.95: HB 8.01: HB	
				10							

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH1

Project:	Proposed Residential Development	East:	328335.3m	Depth Range:	0.4m to 8.05 m
Location:	4-12 McGill Street, Lewisham, NSW	North:	6247987.6 m MGA94 Zone 56	Contractor:	BG Drilling Pty Ltd
Position:	Refer to Figure 2	Surface RL:	≈12.50 m AHD	Drill Rig:	Dando Dual Mast
Job No. :	E22830	Inclination:	-90°	LOGGED: JZ	DATE: 6/4/16
Client:	McGill Advance Management Pty Ltd	Box:	1 of 1	CHECKED: JC	DATE: 20/4/16
		Hole Depth:	8.05m		

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Contamination | Remediation | Geotechnical

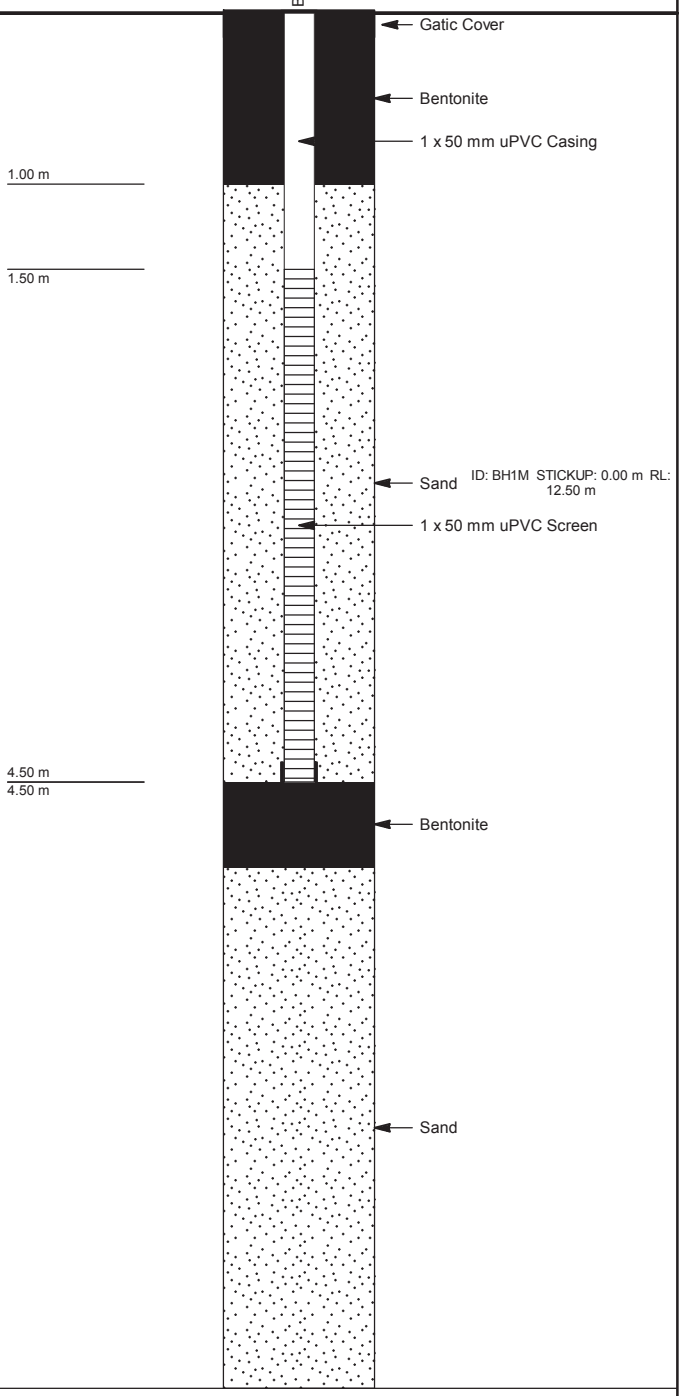
Hole ID
BH1

CLIENT	: McGill Advance Management Pty Ltd	POSITION	: Refer to Figure 2	SHEET	: 1 OF 1
CONTRACTOR	: BG Drilling Pty Ltd	EASTING	: 328335.3 m	LOGGED BY	: JZ
PROJECT	: Proposed Residential Development	NORTHING	: 6247987.6 m	DRILL DATE	: 06/04/2016
LOCATION	: 4-12 McGill Street, Lewisham NSW	COORD. SYS.	: MGA94 Zone 56		
PROJECT No.	: E22830	GROUND RL	: 12.50 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T DT	GWNE				CONCRETE: 160mm thick.
					FILL: Sandy CLAY; low plasticity, fine to coarse grained sand, with fine to coarse igneous gravel, dark brown/grey.
			12		SANDSTONE; fine to medium grained, pale brown/pale grey, distinctly weathered, medium strength.
		1			SANDSTONE; medium grained, bedding dipping 0-10 degrees, <1-2mm thick, pale brown to pale grey/dark brown.
			11		
		2			
			10		
		3			
			9		
NMLC	50-60% RETURN	4			SANDSTONE; medium grained, bedding dipping 0-10 degrees, 2-3mm thick, pale grey with dark grey laminations.
			8		
		5			
			7		
		6			
			6		
		7			
			5		
		8			
			4		Hole Terminated at 8.05 m Borehole Converted into Monitoring Well.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH1M	Standpipe	0.00 m 12.50 m	4.50 m 8.00 m	06/04/2016	



CHECKED BY : JC
CHECKED DATE : 20/04/2016

REMARK
Borehole Converted into Monitoring Well.

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT LOGS

DRILLING/EXCAVATION METHOD

HA	Hand Auger	**RD**	Rotary blade or drag bit	**NQ**	Diamond Core - 47 mm
DTC	Diatube Coring	**RT**	Rotary Tricone bit	**NMLC**	Diamond Core - 52 mm
NDD	Non-destructive digging	**RAB**	Rotary Air Blast	**HQ**	Diamond Core - 63 mm
AS*	Auger Screwing	**RC**	Reverse Circulation	**HMLC**	Diamond Core - 63 mm
AD*	Auger Drilling	**PT**	Push Tube	**BH**	Tractor Mounted Backhoe
***V**	V-Bit	**CT**	Cable Tool Rig	**EX**	Tracked Hydraulic Excavator
***T**	TC-Bit, e.g. AD/T	**JET**	Jetting	**EE**	Existing Excavation
ADH	Hollow Auger	**WB**	Washbore or Bailer	**HAND**	Excavated by Hand Methods

PENETRATION RESISTANCE

L	**Low Resistance**	Rapid penetration/ excavation possible with little effort from equipment used.
M	**Medium Resistance**	Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used.
H	**High Resistance**	Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used.
R	**Refusal/Practical Refusal**	No further progress possible without risk of damage or unacceptable wear to equipment used.

These assessments are subjective and are dependent on many factors, including equipment power and weight, condition of excavation or drilling tools and experience of the operator.

WATER

Water level at date shown

Partial water loss

Water inflow

Complete Water Loss

GWNE	GROUNDWATER NOT OBSERVED - Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit.
GWNO	GROUNDWATER NOT ENCOUNTERED - Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18 seating	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
Sampling	
DS	Disturbed Sample
BDS	Bulk disturbed Sample
GS	Gas Sample
WS	Water Sample
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
Testing	
FP	Field Permeability test over section noted
FVS	Field Vane Shear test expressed as uncorrected shear strength (sv= peak value, sr= residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket Penetrometer test expressed as instrument reading in kPa
WPT	Water Pressure tests
DCP	Dynamic Cone Penetrometer test
CPT	Static Cone Penetration test
CPTu	Static Cone Penetration test with pore pressure (u) measurement

ROCK CORE RECOVERY

TCR=Total Core Recovery

$$= \frac{Length\ of\ core\ recovered}{Length\ of\ core\ run} \times 100$$

SCR=Solid Core Recovery (%)

$$= \frac{\sum Length\ of\ cylindrical\ core\ recovered}{Length\ of\ core\ run} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum Axial\ lengths\ of\ core > 100mm}{Length\ of\ core\ run} \times 100$$

MATERIAL BOUNDARIES

———— = Inferred Boundary

– – – – – – – – – = Probable Boundary

– ? – ? – ? – ? – ? – = Possible Boundary

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

	FILL		ORGANIC SOILS (OL, OH or Pt)		CLAY (CL, CI or CH)
	COUBLES or BOULDERS		SILT (ML or MH)		SAND (SP or SW)
	GRAVEL (GP or GW)	Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay			

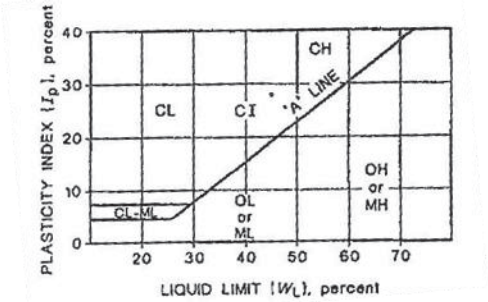
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/tactile methods.

PARTICLE SIZE CHARACTERISTICS

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6 to 20 mm
	Fine	2 to 6 mm
SAND	Coarse	0.6 to 2 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2mm
SILT		0.002 to 0.075 mm
CLAY		<0.002 mm

PLASTICITY PROPERTIES



USCS SYMBOLS

Major Divisions		Symbol	Description
COARSE GRAINED SOILS More than 50% by dry mass less than 63mm is greater than 0.075mm	More than 50% of coarse grains are >2.mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines.
		GM	Silty gravel, gravel-sand-silt mixtures.
		GC	Clayey gravel, gravel-sand-clay mixtures.
	More than 50% of coarse grains are <2 mm	SW	Well graded sand and gravelly sand, little or no fines.
		SP	Poorly graded sand and gravelly sand, little or no fines.
		SM	Silty sand, sand-silt mixtures.
		SC	Clayey sand, sandy-clay mixtures.
FINE GRAINED SOILS More than 50% by dry mass less than 63mm is less than 0.075mm	Liquid Limit less < 50%	ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
		OL	Organic silts and organic silty clays of low plasticity.
	Liquid Limit > than 50%	MH	Inorganic silts of high plasticity.
		CH	Inorganic clays of high plasticity.
		OH	Organic clays of medium to high plasticity.
		PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

Moisture content of cohesive soils may also be described in relation to plastic limit (WP) or liquid limit (WL) [» much greater than, > greater than, < less than, « much less than].

CONSISTENCY

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0. to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

DENSITY

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	< 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Density	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.
SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

MINOR COMPONENTS

Term	Assessment Guide	Proportion by Mass
Trace	Presence just detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: ≤ 5% Fine grained soil: ≤15%
Some	Presence easily detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: 5 - 12% Fine grained soil: 15 - 30%

TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

STRENGTH

Symbol	Term	Point Load Index, $Is_{(50)}$ (MPa) #	Field Guide
EL	Extremely Low	< 0.03	Easily remoulded by hand to a material with soil properties.
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

 # Rock Strength Test Results

▼ Point Load Strength Index, $Is_{(50)}$, Axial test (MPa)

● Point Load Strength Index, $Is_{(50)}$, Diametral test (MPa)

Relationship between rock strength test result ($Is_{(50)}$) and unconfined compressive strength (UCS) will vary with rock type and strength, and should be determined on a site-specific basis. UCS is typically 10 to 30 x $Is_{(50)}$, but can be as low as 5 MPa.

ROCK MATERIAL WEATHERING

Symbol		Term	Field Guide
RS		Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
EW		Extremely Weathered	Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water.
DW	HW	Distinctly Weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. In some environments it is convenient to subdivide into Highly Weathered and Moderately Weathered, with the degree of alteration typically less for MW.
	MW		
SW		Slightly Weathered	Rock slightly discoloured but shows little or no change of strength relative to fresh rock.
FR		Fresh	Rock shows no sign of decomposition or staining.

ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

ROCK MATERIAL DESCRIPTION

Layering	
Term	**Description**
Massive	No layering apparent
Poorly Developed	Layering just visible; little effect on properties
Well Developed	Layering (bedding, foliation, cleavage) distinct; rock breaks more easily parallel to layering

Structure	
Term	**Spacing (mm)**
Thinly laminated	<6
Laminated	6 – 20
Very thinly bedded	20 – 60
Thinly bedded	60 – 200
Medium bedded	200 – 600
Thickly bedded	600 – 2,000
Very thickly bedded	> 2,000

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

Defect Type	Abbr.	Description
Joint	JT	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement.
Bedding Parting	BP	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Foliation	FL	Repetitive planar structure parallel to the shear direction or perpendicular to the direction of higher pressure, especially in metamorphic rock, e.g. Schistosity (SH) and Gneissosity.
Contact	CO	The surface between two types or ages of rock.
Cleavage	CL	Cleavage planes appear as parallel, closely spaced and planar surfaces resulting from mechanical fracturing of rock through deformation or metamorphism, independent of bedding.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed Seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Decomposed Seam/ Zone	DS/DZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Schistocity	SH	The foliation in schist or other coarse grained crystalline rock due to the parallel arrangement of platy or prismatic mineral grains, such as mica.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	Pl	Consistent orientation	Polished	Pol	Shiny smooth surface
Curved	Cu	Gradual change in orientation	Slickensided	SL	Grooved or striated surface, usually polished
Undulating	Un	Wavy surface	Smooth	S	Smooth to touch. Few or no surface irregularities
Stepped	St	One or more well defined steps	Rough	RF	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper
Irregular	Ir	Many sharp changes in orientation	Very Rough	VR	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper

Orientation: **Vertical Boreholes –** The dip (inclination from horizontal) of the defect.
Inclined Boreholes – The inclination is measured as the acute angle to the core axis.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

Coating	Abbr.	Description
Clean	CN	No visible coating or infilling
Stain	SN	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)
Veneer	VNR	A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy

DEFECT APERTURE

Aperture	Abbr.	Description
Closed	CL	Closed.
Open	O	Without any infill material.
Infilled	-	Soil or rock i.e. clay, talc, pyrite, quartz, etc.

APPENDIX C
REVIEW OF REMEDIAL TECHNOLOGIES

Table C 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	Contamination would remain in situ, and would pose limitations on land use options. Requires an Environmental Management Plan (EMP) and ongoing monitoring.	Based on the results and recommendations of previous site assessments, 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.	Significant area of site required to land farm material. Undefined remediation timeframe. Potential for odour problems. Uncertainty of successful results, particularly for the heavy-end hydrocarbons. Not suitable for metals impacts.	Possibly suitable – should unexpected contaminated materials be encountered during UPSS excavation and remediation. This may be more cost effective than off-site disposal; however this will be dependent on the volume of impacted material. Furthermore, this would delay the development phase.
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. Potential for odour problems. Requires detailed design, pilot trials and management.	Not suitable –Since the present dataset does not provide evidence of widespread contamination of a volatile nature.

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.	Suitable – as the proposed development involves "capping" the entire site to allow for the ground-floor residential area, it is an economically viable option. However this option would likely require an ongoing EMP for the site, which may not be favoured by the client.
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 –This will remove all contamination sources, eliminating all risks posed by soil exceedances identified. As bulk excavation is required across the majority of the site, this option could coincide with onsite basement excavation.
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. 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 – although natural attenuation (depending on the levels and distribution of PAH impacts) may be possible, this would be time consuming and considering that the majority of the site will be excavated for the basement car park this is not considered a suitable method.